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# **e - Book**

## **A Manual on Orchid Education**

**Conceptualized and developed by  
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**Produced by**

D R Singh, Director

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## PREFACE

Orchid is a unique crop to grow artificially. Domesticating this crop requires controlled conditions; potting these plants also requires unique potting materials, as the root of this crop requires high aeration and optimum moisture for proper growth. Potting method of these plants also vary from orchid to orchid. Seed germination of orchids are very rare in nature, thus it requires unique practices to propagate. Also it requires expert management of light, temperature, humidity, nutrients throughout its life cycle. The management of above mentioned factors even varies from season to season. In spite of above mentioned difficulties; orchid account a large share of global trade, estimated around 10% of international fresh and cut flower trade, because, global demand for these flowers are very high for its beauty, utility, colour, texture, fragrance, long vase life etc.

Cultivating orchid requires high expertise, understanding and unique procedures of managing different factors. In this e-book we are providing basic information regarding success full growing of orchids. The e-book covers botanical description, cultivation procedures, post-harvest management, value addition and marketing. It also includes management of light, temperature, humidity, water, nutrient, insect, pest, diseases for orchids. It also provides information about orchid specific cultivation practices, their management and marketing. Thus, this e-book provides an education from propagating orchids to successful growing of it, their post-harvest management and marketing.

I hope this e-book will be a valuable and handy source of manual for amateur and professional orchid growers, orchid farmers, orchid entrepreneurs, business men, students and exporters.

Authors

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## 1. Introduction

The Orchidaceae are one of the largest families in the plant kingdom, consisting of about 28,000 currently accepted species, some 800 subspecies distributed in about 763 genera. At recent count around 110000 registered hybrids of orchids are there. Most species occur in the subtropical and tropical regions of Asia, South and Central America, but this diverse and adaptable family of flowering plants is found all around the globe except for the Polar Regions and extreme arid deserts. Along with the Asteraceae, they are one of the two largest families of flowering plants, they are a diverse and widespread family of flowering plants, often colourful and fragrant and, the family encompasses about 6–11% of all seed plants. The largest genera are *Bulbophyllum* (2,000 species), *Epidendrum* (1,500 species), *Dendrobium* (1,400 species) and *Pleurothallis* (1,000 species). It also includes *Vanilla*—the genus of the vanilla plant, the type genus *Orchis*, and many commonly cultivated plants such as *Phalaenopsis* and *Cattleya*. In addition to their geographical and taxonomic diversity, orchids are also widely used and traded 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 (De, 2015; FloraHolland, 2015), orchids are also harvested, grown and traded for a variety of purposes, including as ornamental plants, medicinal products and food.

## 2. How to distinguish orchids from other plants

2.1. You need to distinguish your orchids from other flowering plants when you want to grow it personally. Three elements are there that can distinguish orchids from other flowering plants-

**Pollen:** Pollens are formed into masses (generally two masses), called “pollinarium”, plural “pollina”

**Column:** In case of flowers other than orchids stamens and pistils are present in the flower separately but for orchids Stamens and pistils are joined together in a structure called the column.

**Seeds and capsule:** Orchid seeds are very small present in a very large quantity in a single capsule (may be up to 3 million in a capsule), Seeds are having no endosperms also do not contain any organized embryo.

Beside this orchid leaves are generally thick and leathery and orchid root is generally thicker than those of a normal conventional plant and may even appear as individual strands having a thick spongy outer layer or grey, white protective tissue (velamen).

## 2.2. Common structure of orchid flowers

Orchid flowers are zygomorphic or bilaterally symmetrical. Dividing each flower on vertical plane only will produce two identical halves. While other flowers produce two mirror images when divided on any plane. Flowers have three sepals and three petals and a reproductive structure called “column”, sepals and petals are arranged in a pinwheel or whorl shape.

### 2.2.1. Sepals and Petals:

Orchid flowers consists of two rings, one outer ring made up of sepals and one inner rings made up of petals. Sepals and petals are generally equal in size and having similar colour and texture make them difficult to distinguish. In some species uppermost (dorsal) sepal may be slightly larger than lower ones. Sepals are generally less flamboyant than petals.

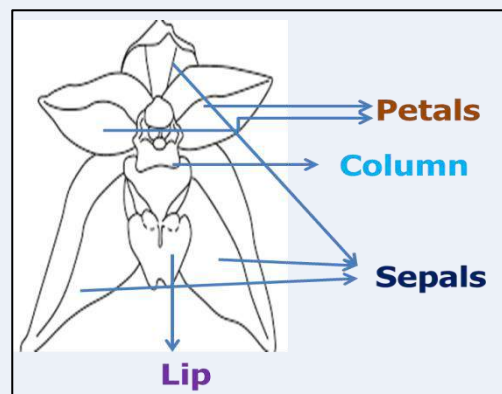


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### 2.2.2. The Lip:

The lip (labellum) is a modified petal and can be distinguished from the other petals and from the sepals by its large size and its often irregular shape. As other two petals of an orchid flower generally look like the sepals, the labellum stands out as distinct. It can vary in shape, form, and colour. Can resemble a trumpet; it can be fringed, curved, elongated or even pouch-like. Sometimes it can even be stripes, or speckled, or very bright or subdued in colour. Often it is found that the lip of the orchid flower is the largest, most ornate feature on the plant few are totally opposite. In orchids, the labellum is the modified median petal that sits opposite from the fertile anther and usually highly modified from the other perianth segments, thus it acts as a landing pad for prospective

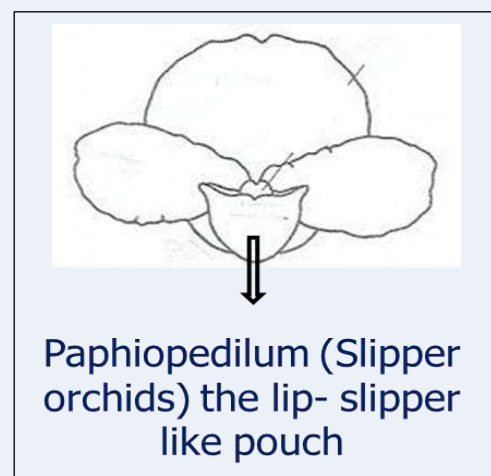


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pollinators like bees, luring them to the flower with extravagant shapes and colouring like in *Paphiopedilum* (Slipper orchids) the lip forms a slipper like pouch that trap the insect until pollination is complete.

### 2.2.3. The Column:

The column, or technically the gynostemium, is a reproductive structure. It is derived from the fusion of both male and female parts (stamens and pistil) into a single organ. This means that the style and stigma of the pistil, with the filaments and anthers of the stamen, are all united. It is quite unique, male and female organs being fused into a tubular, waxy structure at the center of the flower, while conventional type of flower has separate male (the stamen with the pollen) and female reproductive organs (the pistil with the stigma). At the top of the column, the pollen grains form golden yellow waxy masses called pollinia (no varies from 2-8). Pollinia are contained in the anther cap. The number of pollinia varies from orchid species to



orchid species and represents the male reproductive organ. The stigma is immediately below the tip, on the underside of the column, which is quite sticky and thus adapted for pollination purposes. The stigma represents the female part of the flower.

### 2.2.4. Roots

Orchid root is generally thicker than those of a normal conventional plant and may even appear as individual strands. The roots have a fragile inner core, protected by a thick spongy layer or grey, white protective tissue, the velamen; it is essentially air-pockets of dead cells that provide the roots with high absorbency. The outer layer of the roots is often covered with fine hair-like projections that resemble the roots of conventional plants. Throughout an orchids life new roots are produced as old one dies. Underground roots of terrestrial orchids usually perform the usual conventional root functions. Aerial roots are usually on the epiphytic orchids, normally thick and strong with super absorption capabilities. The roots attach the orchids to either host trees or rocks. Aerial roots usually have green tips that



contain chlorophyll (especially the leafless orchid species such as the *Chilochistra parishii*) that is required to absorb energy from the sun.

#### **2.2.5. Leaves**

Orchid leaves are generally thick and leathery. They are just as varied as the flowers. It can be broad, thin, succulent, cylindrical, tiny and even as huge as more than a meter. Most of the orchid leaves occur in shades of green, blue and grey. There is however, a group of orchids that have leaves that are shades of grey, green, red, brown, silver, bronze and even in copper tones – the so-called jewel orchids. Orchid leaves can grow in various ways: fan shape, at intervals ranging from a few to several centimetres in between. Whichever way it grows, it reflects the adaptations of the orchid to its environmental conditions, for example some Vanda orchid species grow in shaded areas and thus their leaves are broad, flat or pinnate for maximum exposure to sunlight. The other example is the Brassavola species which grow naturally in tropical regions in harsh sunlight. Their leaves are fleshy and pencil shaped to as to expose the minimal surface area of the plant and retain moisture.

### 3. Growth habits of orchids

Generally orchids have two distinct growth habits, one sympodial growth habit and another monopodial growth habit.

#### 3.1.Sympodial growth habit:

These orchids have a rhizome (main stem) at the base (usually horizontal, at least when they are grown in pots), with a series of growths developing upward from it. Branches grow laterally from this stem, there it produce flower. After flower dies, main stem produce new lead next to the previous one. Most of them produce pseudobulbs (thick bulb like stem), there they store moisture and nutrients. Some species like Coelogynae or Bulbophyllum produce pseudo bulb at an interval of 3-4 cm where as in other species they appear in bunches (like cymbidium). After developing a new growth the existing pseudobulbs nearly deplete, generally goes dormant to back bulb, as new growth will exploit energy stored in the back bulb, the back bulb shrivels and die.

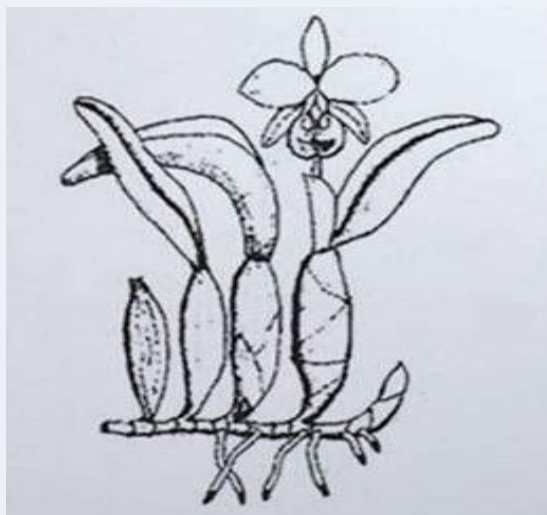


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#### 3.2.Monopodial growth:

In contrast to horizontally growing sympodial orchids, monopodial orchids grow vertically. These types of orchids have a single main stem that produces a series of leaves; leaves grow alternately on either side of the stem. Leaves may be narrow or broad widely spaced compact or broad. Roots and flower stems emerge alternately along the main stem at the nodes above leaf. The stem may occasionally branch. New shoots can grow from the end bud of an old shoot. They don't have pseudobulbs; leaves are succulent where they store moisture and nutrients, like Vanda.



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## 4. Natural habitats of orchids

Orchids having unique way of growing in nature, basically they are divided into four groups on the basis of their habitat

- 4.1.**Epiphytes:** This type of orchid grows on the host trees, supported by the trunk. Adhere to the host tree with very strong roots, take moisture and nourishment from organic debris from crevices of the bark, air movement is the key requirement of them. Their strong roots absorb moisture and nutrients from the air. They are not parasite, but take advantage of aerial microclimate, like- *Dendrobium*, *Cattleya*, *Phalaenopsis* etc.
- 4.2.**Lithophytes:** This type of orchid grows on rock, with very limited food resources and strained light they could thrive, it should be kept in open and airy condition, and it grows amongst pebbles. Generally found in tropical region. Their strong roots absorb moisture and nutrients from the air, with additional supplies found in rock crevices where moss and organic debris accumulates. They often have fleshy succulent leaves or pseudobulbs which store moisture and allow the plant to tolerate prolonged dry spells, like- *Dendrobium kingianum*, *Dendrobium speciosum*, *Bifrenaria*, *Maxillarias* etc.
- 4.3.**Semi terrestrial:** This type of orchid grows on ground, on decomposing plant materials not quite soil, they can grow both above plant and on soil, like-*Cymbidiums*.
- 4.4.**Terrestrial:** They grow in the grounds, can adapt to damp forest floors and boggy ravines to sandy dunes and semi-arid deserts, The roots of these orchids produce tubers that may lie just below the soil surface or deep underground, they store nutrients and moisture and provide reserve during dry spells, like- *Phaius tankervilleae*, *Arundina graminifolia* etc.

## **5. Propagation procedures**

Orchid seeds lack of endosperm, which provide energy for seed germination in natural condition. Orchid seeds need fungal association to germinate in natural condition. Initially the fungus will invade the seed as a parasite in search of food source. But before it become destructive, the embryo inhibits the activity of the potentially destructive invader, the fungus provide the embryo with the nutrients for germination. Thus a symbiotic relation establish between orchid and mycorrhizae that continues for the life of the plant. Thus for the production of orchid seedlings you can't do seed sowing directly. You have to follow specific mechanised methods. Or the seedlings will be produced from different plant parts.

### **5.1. Sexual propagation (Propagation from seed):**

All the operations for this method must be conducted in a sterile environment (in laminar flow hood)

1. The encapsulated seeds are in a sterile environment as long as the seed pod is closed. It will eventually crack open at a certain time, in which case the tiny seeds will have to be decontaminated before sowing them. So collect the mature seed pod before it starts to open so that seeds need not to decontaminate.
2. Externally disinfect them using  $\text{HgCl}_2$  solution followed by washing in distilled water, then cut open with a disinfected tool (scalpel).
3. Sow the seed masses into a flask which contains a nutrient solution (the flask and its contents should be previously sterilized in an autoclave).
4. The nutrients solutions contain minerals, sugars, sometimes banana extracts or coconut milk, Agar (a substance like gelatin for solidification of the media)
5. Seal and label the flask and place it in a growth chamber / room where light is relatively limited and temperatures are relatively constant. After several weeks to several months the tiny seeds will germinate. Then they will be transferred to the pots.

### **5.2. Tissue culture**

All the operations for this method must be conducted in a sterile environment (in laminar flow hood)

1. Plant tissue from a new growth is used in this method. Excise (cut) the tissue, removed its outer layers till the active center of developing cells (the meristem); is reached
2. Then cut this tiny mass of cells (less than 1 mm in diameter) into 20 or so parts
3. Immerse them into a flask with growing liquid solution without agar,. This media for this solution is usually called “multiplication” formula.
4. Place the flasks or tubes on an agitator (an apparatus than either slowly rotates or tilts to left and right. The constant movement of the agitator allows the lumps of cells to develop and increase in mass but prevents them from forming roots or leaves.
5. Then the developed lumps are replated into flasks as is done for germinated seeds. From there on the process is the same as for seeds as stated above.

### **5.3. Stem propagation**

All the operations for this method must be conducted in a sterile environment

1. In this method flower stem is used for propagation, take a flower stem with just the first flower open or with up to half the flowers open, flower buds nearer the base of the flower stem open first, below them there will be a number of undeveloped buds, refer to as “nodes”.
2. Remove the flower stem from the plant and externally decontaminate it. Cut the stem at about 1 inch above and below the node, then deep it in decontamination solution for 15 to 20 minutes
3. Remove the protective sheath over the nodes, and remove about 1/8 of an inch further from both ends of the stem
4. Insert it in the sterilized media solution in a tube or jar or flask.
5. After successful operation we may get up to 4 plantlets per node, conduct all these operations in a sterile environment.

### **5.4. Internode propagation:**

This technique is similar to the stem propagation but instead of using a flower stem as the start-up point we use a growth. It is often used with Dendrobiums.

1. Remove a growth from the plant and cut it in between nodes.
2. Dip the edges in a fungicide (RIDOX, PHENTOM, COMPASS, etc.) and then either insert or lay on sphagnum moss, water it at a regular interval to keep it moist.

After successful operation we may get one plantlet per node. The technique does not require any sophisticated equipment, is inexpensive and can be done practically by anyone. These plants are entitled to be recognized by the same variety name as the original plant from which the growth was removed.

### **5.5. Divisions & back bulbs:**

Some orchids grow by developing new growth from the base of the plants, like-Cymbidium. After several years they may have 5, 6, 10 or more growths. By subdividing such plants we can get two or three plants out of the original one. If we remove the older growth or old pseudobulbs of these plants and sow them separately they will generate new growths. Plants resulting from divisions and backbulbs are also entitled to be recognized by the same variety name as the original. The resulting plants will be identical to the plant we divided or from which we removed the pseudobulb(s).

1. Remove fully mature but no shrivelled back bulb (provided that sufficient no of bulbs should be there with the original plant for nourishing the plant with moisture and nutrients)
2. Plant the removed back bulb in sand/or coco peat.
3. Water it at a regular interval to keep it moist.
4. After two months or more new growths will come out of it.

### **5.6. Use of keikis:**

Some orchids, mostly Dendrobiums, are famous for producing keikis. Keikis is the Hawaiian word for “babies”. Occasionally Phalaenopsis will also produce keikis. Some species do it because it is programmed into their genes, others do it when they are exposed to high temperatures while they are developing a flower stem. Keikis will develop leaves first, and then roots. When roots are about an inch in length we can remove the keikis from the mother plant and plant it in its own container. Keikis will be identical to the plant they were removed from and are also entitled to be recognized by the same variety name, if any, as the plant from which they originated.

### **5.7. Top cuts:**

Some plants, mostly vandaceous orchids, tend to grow very tall. Heights of 4, 5 or 6 feet or more, make them difficult to handle. These also tend to develop new roots along their stem, in between leaves. These can be divided by cutting off the top portion of the plant,

this top portion should have at least 2 pairs of roots attached to it. The remaining (bottom) part of the plant will often respond to this attack by sending out new shoots from its base. Top cuts are the same as the plant they were removed from and are also entitled to be recognized by the same variety name, if any, as the plant from which they originated.

## 6. Potting of orchids

Potting comprises of two parts

1. Unpotting the plant from the old container and grooming the plant,
2. Re-potting the plant and staking it if necessary.

### 6.1. Unpotting the plant from the old container and repotting

1. Water the plant first as it makes it easier to remove the old potting material.
2. Retrieve the plant from the pot and remove all the old potting material.
3. Trim dead roots with sterilized shears or scissors.
4. Repot the plant. Potting procedures are discussed latter.

**6.2. The most common containers / supports for growing orchids are given in the table below**

<b>Pots</b>	<b>Plastic pots</b>
	<b>Clay pots</b>
	<b>Orchid clay pots</b>
<b>Baskets</b>	<b>Vanda baskets</b>
	<b>Wire baskets</b>
<b>Supports</b>	<b>Cork slabs</b>
	<b>Tree fern plaques</b>
	<b>Pieces of driftwood</b>



### **6.2.1. Plastic pots**

There are several benefits of using plastic pots. They are less expensive, lighter weight, easier to store. They hold water for a longer period than other pots, mineral salts (from water and fertilizer) will not adhere to them, and roots don't get attached to them. Clear plastic pots enable roots to photosynthesize. Only drawback, of plastic pot is that some plants (like Dendrobiums) might get top heavy in them. Plastic pots should have a fair number of drainage holes (4 to 8 holes on 3" to 4" pots, 8 to 12 holes on 5" to 6" pots).

### **6.2.2. Clay pots**

The advantage of using clay pots is the stability, light weight and their porosity which allows good aeration to the orchid roots. A possible disadvantage is that orchid roots tend to attach themselves to the pot.

### **6.2.3. Clay orchid pots**

They are like clay pots but have holes or slits on their sides, allow more air circulation than regular clay pots.

### **6.2.4. Vanda baskets**

Mostly used for Vanda and vandaceous orchids, most Vanda baskets are made of cedar or teak wood. Plastic Vanda baskets are available. 4" and 8" size are made of sturdy plastic that should last long.

### **6.2.5. Cork slabs**

They are used for mounting orchids. Pieces of cork range can be as small as 2" by 3" or as large as 12" by 24". It gives a much more natural and interesting look.

### **6.2.6. Tree fern plaques**

They are flat, and come in different sizes (4" by 4", 4" by 6", 8" by 8" etc.), like cork, they are also used to mount orchids. They are easier to cut than cork slabs. They should not be too dense to adsorb water.

### **6.2.7. Driftwood**

An alternative for cork, can make some very intriguing and interesting "compositions".

### **6.3. List of potting material for orchids**

**6.3.1.** Before knowing the potting materials you need to know the works performed by the potting materials.

- a. It holds the plant in place
- b. Holds enough moisture for a particular orchid
- c. Provide favourable environment for better roots growth (aeration), most potting materials for orchids do not provide any nutrients, nutrients added in the water in the form of fertilizers are main source of mineral nutrition for the plant.

**6.3.2.** Several things could be used for potting orchids. Some of their names are given below-

1. Tree bark,
2. Sphagnum moss,
3. Tree fern,
4. Coconut chunks,
5. Coconut fibre,
6. Lava rock,
7. Charcoal,
8. Pieces of cork,
9. Peat moss,
10. Rock wool,
11. Brick pieces
12. Leaf mould etc.

ICAR-NRCO recommend brick piece/Stone, Leaf mould, Coconut husk and semi rotten logs in the ratio of 1:1:1:1 for proper aeration, moisture retention and root proliferation and support to the plant as a general recommendation, repotting will be done on every two years.

### **6.4. Potting monopodial orchids**

1. Place the roots in the pot. The plastic pot size should be just large enough to accommodate the roots. To use a clay pot, use a one size larger pot than the plastic pot, a little more to use clay orchid pot.
2. Center the plant and hold it so that the junction of roots and lower leaves flush on the top of the plastic pot.

3. For best results potting media will be well moist (but not dripping wet)
4. When done the base of the plant should be just a little higher so that leaves do not touch the potting media and the top of the roots are just a little bit exposed.
5. Trim yellow, shrivelled leaves and parts of leaves with spots.
6. If necessary stake the plants so that it does not wobble.
7. After two or three months just pull out the stakes without disturbing the plant.

### **6.5. Potting sympodial orchids**

On some sympodial orchids such as *Cymbidiums*, *Jumeleas*, *Paphiopedilum*, *Phragmipedium* etc. the new growths will be very close to the base of the old growth(s), forming sort of a circle around the older growths. The potting procedure for these type of young plants is similar to monopodial orchids, but for many sympodial orchids, such as *Cattleyas*, *Dendrobiums*, *Oncidiums*, etc. the new growths develop along a rhizome and usually tend to grow in the opposite direction of the old growths. The procedure for potting these is the same as for monopodial orchids except that instead of centring the plant places it close to one edge of the pot, leaving room on the opposite side of the pot for the new growths.

### **6.6. Care after repotting of orchids**

Repotting is similarly shocking to plants as major surgery is to humans. So for a few weeks after repotting a plant it is required to nurture it a bit.

1. Spray (mist) their leaves lightly twice a day for two weeks for healthy plants, up to four weeks for weak and ailing plants. Spray early in the day and again not later than mid-day. Do not water after 12 noon in the winter.
2. Addition of 2 or 3 drops of superthrive and 2 or 3 drops of a rooting solution to misting water will be very beneficial. If you do not have rooting solution add a pinch of phosphorus reach fertilizer to the misting water.
3. Place the newly repotted plants at less light than what they usually get for 3-4 weeks. The lower light levels will reduce the stress caused by the repotting shock and will help the plants recover better and faster.
4. Water lightly (just enough to get the potting material moist, for one week), don't add enough water to run through the drainage holes, After one week water thoroughly once a week, Use the rooting solution instead of fertilizer for the first 3 or 4 watering after repotting.
5. Don't fertilize the plant just after repotting.

## **7. Light requirement for growing orchids**

7.1. Watch the foliage of your plants, they will provide you the information regarding light, whether the available light is sufficient for the plant or not or if it is too high?

1. If the leaves of your orchids stay green, crisp and firm, then the light is probably right.
2. If the foliage is dark green, then the light is too low
3. If the foliage shows purplish coloration, then the light is probably too high.

Sometimes if the light is too high the leaves tips will dry up.

Most orchids will not tolerate direct sunlight, except maybe for an hour or two after sunrise and an hour or two before sunset. You have to provide some shade, at least for the brightest part of the day. Surrounding trees or tall buildings may provide enough shade. You should remember, there is a substantial reduction in the light from summer to winter. Provide more light and less shade at winter (from mid of October to mid of February) to compensate for this natural reduction of light. Although the plants will adapt to changing environments, they will adapt better, with less stress if you gradually ease into the new conditions (such as summering them in bright outdoors light). Your orchids will adapt to the environment, to some degree. Orchids will tolerate higher levels of light of their range provided the plant receives more water (more frequent watering), more fertilizer and, if possible, better air movement to keep their leaves a little cooler. More frequent watering mean maybe you will water your orchid on every five days or so instead of every seven days. This does not mean you should subject your plants to excessive light. If your orchids get too much light but not enough water and fertilizer, they will be stressed. Stressed plants have less defences against pests and diseases, they will be easily attacked by the insects and pests.

### **7.2. Signs of stress**

Plants will show several symptoms when they are stressed, like-Shrivelling pseudobulbs and / or leaves, drying buds, prematurely wilting flowers. Note that this kind of stress can also result from improper potting, decaying potting material and insufficient watering.

## 8. Temperature for growing orchids

**8.1.** Orchids are classified into three basic groups, on the basis of their temperature requirement. Their classifications and favourable temperature are given in the table below-

Orchid groups	Day time (temperature ° C)		Night Time (temperature ° C)	
	Winter	Summer	Winter	Summer
Warm growing orchids	20	30	15	25
Intermediate temperature growing orchids	18	27	13	21
Cool growing orchids	15	25	10	18

You can make your orchid to adapt and acclimate to grow pretty well a few degrees outside of these ranges. Some of the examples of orchids of each group are provided below-

### 8.2. Examples of warm climate orchids:

1. Phalaenopsis (provide with 60% shade cloth)
2. Phragmipedium (Provide 50% shade cloth)
3. Cattleya (Provide 40% shade cloth)
4. Catasetum (Provide 50% shade cloth)
5. Vanda and Ascocenda (Provide 20-30% shade cloth)
6. Angraecum and Aerangis (Provide 20-30% shade cloth)
7. Calanthe (Provide 40% shade cloth)

### 8.3. Examples of intermediate climate orchids:

1. Oncidium (Provide 20-30% shade cloth)
2. Warm tolerant Cymbidium (Provide 30-40% shade cloth)
3. Miltonia and Miltoniopsis (Provide 30% shade cloth)
4. Paphiopedilum (Provide 50% shade cloth)
5. Lycaste and Anguloa (Provide 50% shade cloth)
6. Bulbophyllum (Provide 50% shade cloth)

#### **8.4. Examples of Cool climate orchids:**

1. Cymbidium (Provide 30-40% shading)
2. Odontoglossum alliance (Provide 60-70% shade cloth)
3. Disa uniflora (Provide 50-70% shade cloth)
4. Pelione (Provide 50-60% shade cloth)
5. Zygopatalum (Provide 40% shade cloth)
6. Dendrobium (30% shading)
7. Masdevallia (provide 70% shading)
8. Coelogyne (provide 50% shading)

Shed cloths of green colour are generally preferred.

## **9. Humidity for growing orchids**

Most of the orchids require 60 % to 80 % humidity. These humidity levels are necessary for the plants to perform at their best, flowering and longevity of the flowers. Although these levels may appear high, they are in fact well within the comfort zone for people which are 40 % to 70 % of relative humidity. In the summer time the natural humidity is usually sufficient to meet the needs of your plants, except on bright, sunny, dry days. Air conditioning in the summer and artificial heat in the winter, especially from forced air heating and electrical baseboard heating, will dry the air well below the need of your orchids. Plants placed in the path of air conditioning or in the path of forced air heating or next to a radiator or next to a heat source such as a refrigerator can get quickly desiccated, loose their buds and even their leaves in just a few days. Consider investing few rupees in a hygrometer to help you evaluate humidity of the air of your poly house.

### **9.1. Procedures to increase humidity around your orchids**

If the humidity levels are consistently too low, consider buying a humidifier to increase the humidity level. Another way of increasing humidity is by setting your plants on trays filled with pebbles or gravel and with water, but plants should not be in contact with the water. The trays must be wide enough so that the leaves of your plants are over the tray (from where the humidity will raise). A tray for a single plant will not be of much help as the little humidity rising from it will disperse very fast. You should have a dozen or more plants grouped together, they will create a micro climate with higher levels of humidity. The humidifier is the better solution. But mist should not blow directly on your plants as this will eventually wet them and promote bacteria and fungus growth that may kill your plants.

## 10. Common method of fertilizing orchids

Here we will discuss about common method of fertilizing orchids. In a 30-10-10 fertilizer formulation there are 30 % Nitrogen 10 % Phosphorous and 10 % Potassium of the total content. Nitrogen derived from urea is not readily available to orchid plants, so urea should not be used as a N source to orchids. Also organic fertilizers are not well suited for orchids. In the beginning use more frequently the high nitrogen, application of silicon to orchids improves heat & drought tolerance. Orchid requires higher amount of Ca and Mg as compared to common plants. For young plants N application is high, for intermediate growth stages N, P, K applied at a balanced and equal rate, before flowering the rate of P and k need to be increased as compared to the N.

1. For young plants (1<sup>st</sup> year) apply 30:10:10 @ 0.05%; take 0.5 g fertilizer having N:P:K composition as 30:10:10 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days.
2. For intermediate growth stage (2<sup>nd</sup> year ) apply 20:20:20 @ 0.05%; take 0.5 g fertilizer having N:P:K composition as 20:20:20 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm at 60 days interval. For this, dissolve 0.5g calcium nitrate, 0.5g magnesium sulphate, 1g iron sulphate, 50mg boric acid, and 50 mg zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 60 days.
3. At late growth stages (3rd year on word) apply nutrients as 2<sup>nd</sup> year until flower initiates. After flower initiation N, P, K will be applied as 15:25:25@ 0.1%; for this take 1g of fertilizer having N:P:K composition as 15:25:25 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days.



## **11.Method of watering your orchids**

The quality of your water is extremely important for good culture; rain water is acceptable for watering orchids. Well water or underground water is acceptable if its content of total dissolved Solids (TDS) is below 120 ppm. Hard water (water with mineral contents TDS above 120 PPM) will create hard deposits on the leaves of plants. This may clog the pores on the leaves of plants. If your water is hard it may be beneficial to periodically (once to twice a year) clean the leaves with distilled water. The best water is water processed through a reverse osmosis system which will remove most of the minerals from the water.

### **11.1. Some general rules for watering potted orchids**

1. While watering you should be careful, you should look after the matter that, the potting material should never be soggy. Water potted plants sufficiently to prevent them from becoming bone dry.
2. In general water once a week, but be aware that small pots (5" or less) need more frequent watering than large pots (6" or more).
3. Different potting materials and different size potting materials will dry at different rates. Clay pots will evaporate more water than plastic pots when other factors are equal, Clay pots will dry faster than plastic pots. Clay orchid pots, because of their openings, will dry out faster than regular clay pots.
4. Finally temperatures, light air conditioning and heating will affect how fast the potting material dries out. Be ready to adjust your watering habits as the season changes.
5. By a thumb rule method you can adjust the time of watering. By inserting your finger an inch or two in the potting media you can feel the moisture condition of it, it should be moist not soggy, if not moist water it to moisten it, and if it is soggy; let it dry.
6. During watering, some water may get in between leaves or new growth. If this water stays there overnight, it may promote the growth of bacteria and fungi that may harm or kill your orchids or the new growth. To reduce this risks you should adopt sound watering practices, like-
  - Water only on sunny days. If the weather is cool, cloudy or rainy, wait for a day or two before watering.

- Water early in the day. This will allow any water that got in between leaves or new growth to evaporate before nightfall. Stop watering at 2 PM in the summer, at 12 noon in the winter and at 1 PM in the spring
  - Water your plants with room temperature or lukewarm water as a difference of 10 degrees or more between the temperature of the water and the room temperature may cause injuries to the plants
7. Water from the top till the water runs freely through the drainage holes. or immerse the plant in water up to 1/2" or so below the rim and let it absorb water for 10 minutes or so.
  8. Wipe out any water that splashed on the leaves or in between the leaves. Using a straw is a convenient way of focusing the flow of air to blow out water from in between leaves.

## 12. Pests of orchids

As prevention is the best way of defence so check your plants periodically for pest and diseases.

Pests	Description	Where to find	Remedy
Scale insects (for orchids)  Soft scale  Armored scale  (Hard scale)	reptilian scales or fish scales (1–2 mm), They secrete a waxy coating for defence, resemble h scales, Hard scale looks like tiny turtles	Soft scale in dried sheaths at the base of pseudobulbs of Cattleyas or similar plants, Hard scale will usually be under the leaves of Phalaenopsis or Cattleyas, sometimes hiding in the pot	Remove as many as you can see, then treat with an insecticide
Mealybugs	They are white and look sort of cottony, may be 1/4" in size	They can be on or under the leaves, on flower stems, on buds, behind flowers, in the pot	
Aphids	most persistent, reproduce on a short, 3 day cycle, small sap-sucking insects, varies in colour, can fly	New growth, new leaves, on flower stems and flower buds	In warm sunny weather take the plant outside and use a garden hose to shake them off the plant. Then treat with an insecticide
Fungus gnats	Look like small black flies	hiding in the pot, attracted by potting material that stays damp, by decaying plant material (dead roots, leaves), may attack roots, especially those of Cymbidiums	You have to treat them by immersing the pot in an insecticide solution

Spider mite	Very small and cannot be seen individually without a magnifying lens.	Under the leaves tiny silvery pits where they have sucked the plant juices. Place a white paper towel under the leaf and rub the leaf to make them fall on the paper towel	Maintain proper humidity, treat them with an insecticide/miticide. immerse the pot in an insecticide / miticide solution
Thrips	Minute (most are 1 mm long or less), slender insects with fringed wings	Deformed or spotted flowers. They are difficult to eradicate because they tend to lodge in the flower buds and under sheaths where they are protected from insecticide sprays	Remove and destroy Deformed or spotted flowers
Slugs	Slugs are well known to us, emerge at night	May be anywhere	Very effective and safe product called sluggo, available either in granular or liquid form

### 12.1. Treating insects with an insecticide

1. While using commercially available pesticides please always follow the directions on the label, should make sure to apply all required precautions against poisoning yourself and others around you.
2. You should not use more than the recommended doses of the pesticide
3. You can prepare a safe, effective insecticidal soap by mixing one teaspoon of a mild liquid dishwashing detergent to a litre of lukewarm water
4. Many insecticides kill only the adult insects, not necessarily the eggs or the larvae (immature insects). Insects develop resistance to insecticides. That means some of them are not affected by the insecticide and these will reproduce. Treating these with the same insecticide will not kill them. To avoid resistance you should rotate insecticides, that is you make the first application with one insecticide, the second

application with another and the third one either with the first insecticide or with a third one.

5. Rotating is not necessary with the insecticidal soap you prepare, because this insecticidal soap works by suffocating the insects. You need to apply it frequently so that insects coming out of eggs are also controlled.
6. If the infestation is not excessive, spray thoroughly on the new growths, leaves (both sides), flower stem, back of buds and flowers with the insecticidal solution. If the infestation is widespread dip the whole plant for 15 minutes or so in the insecticide solution
7. For the treatment to be effective you have to treat the plants (spraying or immersing) at least three times, at an intervals of one week (at an intervals of 3 - 4 days for aphids), make more than one application because the insecticide will kill the adults and a few days later the eggs will hatch and the cycle will restart, unless you treat again to kill them too.

There are lots of insecticides available on market here I am providing common name of some of them, like- Chlorpyrifos-methyl, Imidacloprid, Acetamiprid, Dinotefuran, Thiamethoxam, Malathion, Pirimicarb, Carbosulfan, Lambda-cyhalothrin, Es-fenvalerate, Pymetrozine and Diafenthiuron.

## **12.2. Cautions**

1. Immerse plants in a solution only on sunny days; if the weather is cool, cloudy or rainy, you'll be much better off waiting a day or two before treating your plant(s).
2. Do it early in the day. , this will allow any water that got in between leaves or new growth to evaporate before nightfall.
3. Prepare the solution with room temperature or lukewarm water.

## **13. Diseases of orchids**

### **13.1. Viruses**

1. Occasionally you may come across a plant that has a virus. This may manifest itself by concentric or elongated black or brown or discoloured circles on the leaves or black streaks on flowers and leaves
2. These will be repeated on all leaves / flowers. New leaves / flowers will appear free of it at first, but as they age the virus will manifest itself.
3. Unfortunately there is nothing you can do but discard the plant. Remove the plant or infected plant part and burn it or destroy it.

### **13.2. Bacterial and fungal diseases**

1. These will appear if water stays in between leaves or if the potting material stays soggy, especially when the night temperatures are cooler (winter, spring).
2. You can treat these with fungicides (RIDOX, PHENTOM, COMPASS, etc.), but the best way is to avoid these problems by practicing proper cultural practices.

## **14.Cultural problems which are common to most of the orchids**

### **14.1. Leaves**

1. Leaves are dark green, look very healthy, but plant does not bloom: Probably due to insufficient light, decrease shade and increase the light level.
2. Leaves are not as lustrous, eventually they shrivel: Plant is not absorbing enough water: Check the root system. If roots are abundant, healthy, firm and white, then the plant is being under watered. If the root system is not healthy repot the plant as soon as possible.
3. Yellowing of leaves (chlorosis): May be due to excessive light and/or deficiency of nitrogen and /or sulphur, provide shade, apply nutrient.
4. Clear or watery spots on leaves: usually result from fungal/bacterial infection. Repot the plant, treat the plant with a fungicide (RIDOX, PHENTOM, COMPASS, etc.), keep it relatively dry for a few weeks.
5. Discoloured area on top of curled leaves on leaf area exposed to light: most probably due to sunburn or excessive light for this type of orchid. Provide with sufficient shade.

### **14.2. Leaves or new growth**

1. Soft, rapid growth: may be due to excessive nitrogen, adjust and reduce the application rate of N.
2. New growths are smaller, not as plump than previous ones, are stunted, do not grow upright: the plant is under stress, either because of weakened root system or insufficient light or too extreme temperatures, deficiency in nitrogen, or a combination of these. Check light, temperature levels & fertilizer dosage. Repot if needed. Provide with sufficient shade and increase humidity of the house.
3. No or limited new growth: may result from nitrogen and/or phosphorous deficiency, or damage / rotting of growth or setback if the plant was divided and left with only one growth. Apply N and P fertilizer.

### **14.3. Buds, flowers & flower spikes**

1. Buds yellow and drop: Reasons may be extreme temperatures, extreme or insufficient light, too dry air, inadequate watering, micronutrients deficiency or weak root system. Adjust temperature and light at optimum level, and follow proper fertilizer management practice as specified earlier. If root system got too weak due to decaying potting materials then repot the plant as soon as possible.

2. Flowers do not open up fully: may be due to genetics, or by too low temperatures, or may be due to too low humidity or thrip damage. Adjust the humidity and temperature. If it is thrip damage, treat the plant with an insecticide.

#### **14.4. Buds, flowers & flower spikes**

1. Flowers are too small, colours are not as strong as before: most probably due to insufficient light, and or too extreme temperatures. Adjust the light and temperature.
2. Flowers fade too fast: may be caused by too high or too low temperatures, exposure to direct sunlight, too low humidity, micronutrients deficiency, inadequate watering or poor condition of the root system. Adjust temperature and light at optimum level, and follow proper fertilizer management practice as specified earlier. If root system got too weak due to decaying potting materials then repot the plant as soon as possible.
3. Too few flowers: May be due to weak plant, too low light, phosphorous deficiency. Adjust the light and follow proper fertilizer application procedure.
4. Brown streaks or mosaic patterns on flowers: may be due to a virus
5. Poor display of flowers: When buds start to form on the flower spikes, be careful not to change the orientation of the flower spike so as to get the best possible display of flowers.

#### **14.5. Roots**

1. Roots are black or brown: may be damaged or have rotted (root rot fungus). Cut damaged & rotten roots. If rotted, treat with a fungicide, repot the plant, keep a little drier
2. Chewed or missing tips: chewed by pests (millipedes, sowbugs, snails or slugs), use an insecticide .
3. Dead tips: may be caused by salt built-up due to too hard water or excess fertilizer or not leaching medium regularly. Leach the medium, use good quality water, maintain proper fertilizer dose.
4. Deformed: may be due to chlorine deficiency.
5. Stunted roots: probably because of micronutrients deficiency.



## **15. Orchid specific cultivation practice**

### **15.1. Cymbidium**

Cymbidium flowers are long lasting, at least 6 weeks when cut and up to ten weeks on the plant. It flowers at late summer to spring.

**15.1.1. Temperature:** Cymbidiums are cool grower; most favourable temperature for it is 10-30°C (50-85°F). It can adapt a few degrees out of this range. When temperature is higher, it got stressed, and flower will not last less long as compared to cool climate condition.

**15.1.2. Light:** It should be provided with good light, but direct sunlight should be avoided. A shade net of 30-40% should be provided to the house.

**15.1.3. Water and Humidity:** During flowering the plants must be watered regularly to the point of being damp. They should not be saturated and also there should not be any standing water. During active growth stage humidity requirement is 70-80% whereas during winter it is 40-50%.

#### **15.1.4. Fertilization:**

1. For young plants (1<sup>st</sup> year) apply 30:10:10 @ 0.05%; take 0.5 g fertilizer having N:P:K composition as 30:10:10 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days.
2. For intermediate growth stage (2<sup>nd</sup> year ) apply 20:20:20 @ 0.05%; take 0.5 g fertilizer having N:P:K composition as 20:20:20 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm at 60 days interval. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 60 days.
3. At late growth stages (3<sup>rd</sup> year on word) apply nutrients as 2<sup>nd</sup> year until flower initiates. The difference is that at 3<sup>rd</sup> year from February to May 30:10:10 NPK will be applied at a rate of 1g litre<sup>-1</sup> at an interval of 15 days., and from June to August 20:20:20 NPK will be applied @ 1g litre<sup>-1</sup> at an interval of 15 days., After flower initiation (August to January) N, P, K will be applied as 15:25:25@ 0.1%; for this

take 1g of fertilizer having N:P:K composition as 15:25:25 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days.

#### **15.1.5. Pest and disease:**

Cymbidiums are mostly attacked by red spider mite and scale insects. Also cymbidium mosaic virus attacks them. Proper cultural practices should be followed to avoid and prevent the virus attack; if it is attacked already the plant and plant part must be destroyed to avoid the spread of the viruses to the other plants. Scale insects should be removed using a soft brush, insecticidal soap and water without damaging the leaf. You can also use 50:50 solution of water: denatured alcohol. Take cotton swab, deep it in water alcohol solution and clean the leaves, for very severe infestation required to apply a systemic insecticide (acephate, imidacloprid, dinotefuran etc.) several times. Red spider mite can be prevented by regular misting on the top and underside of the leaf. Clean the leaves with insecticidal soap and water to kill the adult mites. Repeat the cleaning procedure thrice at 10 days interval to control any egg hatched new mite. Also miticide (Permethrin, dicofol etc.) could be used. While using commercial chemical insecticide strictly follow the instruction given on the container regarding precaution and dose of application. For diseases and their control see at the table given at section 16.

#### **15.1.6. Potting and repotting:**

Potting procedures and materials could be used for potting are discussed earlier. Do repotting at spring time, after flowering at an interval of two years are recommended.

## **15.2. Dendrobium**

**15.2.1. Temperature:** Various species of dendrobium falls in all the three temperature classes of orchid cultivation; examples of cool growing Dendrobiums are *Dendrobium wattii*, *Dendrobium wangliangii*, *Dendrobium vonroemeri*, *Dendrobium vexillarius*, *Dendrobium vannouhuysii*, *Dendrobium sutepense*, *Dendrobium sulphureum*, *Dendrobium subclausum*, *Dendrobium stellar*, *Dendrobium sinominutiflorum*, *Dendrobium sculptum*, *Dendrobium rupestre*, *Dendrobium putnamii*, *Dendrobium piranha*, *Dendrobium otaguroanum*, *Dendrobium cuthbertsonii*, optimum temperature for them is 10-24°C. They can tolerate as low as 8°C temperature. Medium temperature growing Dendrobium is *Dendrobium kingianum*, *Dendrobium nobile*, *Dendrobium crassifolium*, *Dendrobium crassicaule*, *Dendrobium amethystoglossum*, *Dendrobium gnomus*, *Dendrobium harveyanum*, *Dendrobium loddigesii*, *Dendrobium longicornu* etc. optimum temperature for them is 14-26°C. warmer growing species of Dendrobium are *Dendrobium phalaenopsis*, *Dendrobium speciosum*, *Dendrobium spectabile*, *Dendrobium tangerinum*, *Dendrobium taurinum*, *Dendrobium transparens*, *Dendrobium truncatum*, *Dendrobium unicum* etc. and optimum temperature for them is 16-30°C.

**15.2.2. Light:** It should be provided with bright light, but direct sunlight should be avoided. A shade net of 30% should be provided to the house.

**15.2.3. Water and Humidity:** Humidity requirement of the crop is very high, optimum range of humidity is 60-80%, It can be watered once in a week, although it varies from season to season and climatic conditions.

### **15.2.4. Fertilization:**

1. For young plants (1<sup>st</sup> year) apply 20:10:10 @ 0.1%; take 1 g fertilizer having N:P:K composition as 20:10:10 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm at 60 days interval. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 60 days.
2. For intermediate growth stage (2<sup>nd</sup> year on word at the month of February to May) apply 10:20:20 @ 0.2%; take 2g fertilizer having N:P:K composition as 10:20:20 and dissolve it in one litre water, then spray it on the plant and potting materials at an

interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm at 60 days interval. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.

3. At late growth stages (2<sup>nd</sup> year on word at the month of June to September) 20:10:10 NPK will be applied at a rate of 1g litre<sup>-1</sup> at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm at 60 days interval. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.
4. At late growth stages (2<sup>nd</sup> year on word at the month of October to January) 20:20:20 NPK will be applied @ 2g litre<sup>-1</sup> at an interval of 30 days.

**15.2.5. Pest and disease:** Shoot borer and aphid generally attack dendrobiums. If shoot borer attacks cut and remove the plant parts and destroy the insect. For diseases and their control see at the table given at section 16.

**15.2.6. Potting and repotting:**

Potting procedures and materials could be used for potting are discussed earlier. Generally repotting will be done immediately after flowering is over at an interval of two years.

### **15.3. Phalaenopsis**

**15.3.1. Temperature:** It is a warm growing orchid (Tropical). Optimum temperature range for this orchid ranges from 15-30°C.

**15.3.2. Light:** It should be provided with bright light, but direct sunlight should be avoided. A shade net of 60% should be provided to the house.

**15.3.3. Water and Humidity:** The plants must be watered regularly to the point of being damp. Allow the potting media almost dry before watering. Humidity requirement is very high. If the humidity is high the plant can survive even without watering.

#### **15.3.4. Fertilization:**

1. For young plants (1<sup>st</sup> year) apply 30:10:10 @ 0.05%; take 0.5 g fertilizer having N:P:K composition as 30:10:10 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm at 60 days interval. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 60 days.
2. For intermediate growth stage (2<sup>nd</sup> year on word at the month of February to May) apply 10:20:20 @ 0.1% + calcium nitrate @0.05% + Magnesium sulphate @ 0.1%; take 1g fertilizer having N:P:K composition as 10:20:20, 0.5 g calcium nitrate and 1 g Magnesium sulphate in one litre water, then spray it on the plant and potting materials at an interval of 30 days. Also apply Iron sulphate @ 50 ppm, Boric acid @ 50ppm, Zinc sulphate @ 50 ppm at 60 days interval. For this, dissolve 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.
3. At late growth stages (2<sup>nd</sup> year on word at the month of June to September) apply 30:10:10 NPK will be applied at a rate of 1g litre<sup>-1</sup> at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm at 60 days interval. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.
4. At late growth stages (2<sup>nd</sup> year on word at the month of October to January) 20:20:20 NPK will be applied @ 1g litre<sup>-1</sup> at an interval of 30 days.

**15.3.5. Pest and disease:** Phalaenopsis mainly infested by mealy bug and scale insects.

These insects should be removed using a soft brush, insecticidal soap and water without damaging the leaf. You can also use 50:50 solution of water: denatured alcohol. Take cotton swab, deep it in water alcohol solution and clean the leaves, for very severe infestation required to apply a systemic insecticide (acephate, imidacloprid, dinotefuran etc.) several times. For diseases and their control see at the table given at section 16.

**15.3.6. Potting and repotting:**

Potting procedures and materials could be used for potting are discussed earlier. Generally repotting will be done immediately after flowering is over at an interval of two years.

#### **15.4. Paphiopedilum** (slipper orchid)

**15.4.1. Temperature:** It is an intermediate climate orchid (Tropical). Optimum temperature range for this orchid ranges from 14-28°C, can grow in subtropical as well as tropical regions.

**15.4.2. Light:** It should be provided with dappled light, but direct sunlight should be avoided. A shade net of 50% should be provided to the house.

**15.4.3. Water and Humidity:** The plants must be watered regularly. There should not be any standing water in the pot. Humidity requirement is very high.

#### **15.4.4. Fertilization:**

1. For young plants (1<sup>st</sup> year) apply 20:10:10 @ 0.05%; take 0.5 g fertilizer having N:P:K composition as 30:10:10 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 30 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm at 60 days interval. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 60 days.
2. For intermediate growth stage (2<sup>nd</sup> year on word at the month of May to October) apply 20:10:10 @ 0.1% + calcium nitrate @0.05% + Magnesium sulphate @ 0.1% + Iron sulphate @ 50 ppm + Boric acid @ 50ppm + Zinc sulphate @ 50 ppm. For this, dissolve 1 g fertilizer having N:P:K composition as 20:10:10, 0.5g calcium nitrate, 0.5g Magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.
3. At late growth stages (2<sup>nd</sup> year on word at the month of November to April) 10:20:20 NPK will be applied @ 1g litre<sup>-1</sup> at an interval of 30 days.

**15.4.5. Pest and disease:** There many pests that attack the orchid, mainly infested by mealy bug and woolly aphid. These insects should be removed using a soft brush, insecticidal soap and water without damaging the leaf. Diazinon can be used for mealy bug and acephate (Orthene) can be used to control woolly aphids. Neem oil can also be used for them @5 ml liter<sup>-1</sup>. For diseases and their control see at the table given at section 16.

**15.4.6. Potting and repotting:** Potting procedures and materials could be used for potting are discussed earlier. It is vital to use a potting mixture that will not hold

too much moisture. Generally repotting will be done immediately after flowering is over at an interval of two years.



### **15.5. Cattleya:**

**15.5.1. Temperature:** It is a warm climate orchid (Tropical). Optimum temperature range for this orchid ranges from 14-28°C, can grow in subtropical as well as tropical regions.

**15.5.2. Light:** It should be provided with shaded light, no direct sunlight should be given. A shade net of 40% should be provided to the house.

**15.5.3. Water and Humidity:** Water only if substrate/potting media is dry. It can be done once a week, but it all depends on the environmental conditions and the season. Humidity must be between 40-70% with good ventilation; however plants must not be exposed to air currents.

### **15.5.4. Fertilization:**

1. For young plants (1<sup>st</sup> and 2<sup>nd</sup> year) apply 30:10:10 @ 0.05%; take 0.5 g fertilizer having N:P:K composition as 30:10:10 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.
2. For intermediate growth stage (3<sup>rd</sup> year on word at the month of February to May) apply 10:20:20 @ 0.1% + calcium nitrate @0.05% + Magnesium sulphate @ 0.1% + Iron sulphate @ 50 ppm + Boric acid @ 50ppm + Zinc sulphate @ 50 ppm. For this, dissolve 1 g fertilizer having N:P:K composition as 20:10:10, 0.5g calcium nitrate, 0.5g Magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.
3. At late growth stages (3<sup>rd</sup> year on word at the month of June to September) apply 30:10:10 @ 0.05%; take 0.5 g fertilizer having N:P:K composition as 30:10:10 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.

4. At late growth stages (3<sup>rd</sup> year onwards at the month of October to January) 20:20:20 NPK will be applied @ 1g litre<sup>-1</sup> at an interval of 30 days.

**15.5.5. Pest and disease:** Ants love the sugary substances produced by newly emerging flowers, ants are also the carrier of scale insects. Regularly remove old bracts and sheaths and groom. These insects should be removed using a soft brush, insecticidal soap and water without damaging the leaf. You can also use 50:50 solution of water: denatured alcohol. Take cotton swab, dip it in water alcohol solution and clean the leaves, for very severe infestation by scale insects required to apply a systemic insecticide (acephate, imidacloprid, dinotefuran etc.) several times. For diseases and their control see at the table given at section 16.

#### **15.5.6. Potting and repotting:**

Potting procedures and materials could be used for potting are discussed earlier. It is vital to use a potting mixture that will not hold too much moisture. Young plant requires repotting annually. After flowering starts generally repotting will be done immediately after flowering is over at an interval of two years.

## **15.6. Oncidium:**

**15.6.1. Temperature:** It is an intermediate climate orchid . Optimum temperature range for this orchid ranges from 14-28°C.

**15.6.2. Light:** It should be provided with bright light, but direct sunlight should be avoided. A shade net of 30-50% should be provided to the house.

**15.6.3. Water and Humidity:** Water only if substrate/potting media is dry. It can be done once a week, but it all depends on the environmental conditions and the season. Humidity must be between 60-80% with good ventilation; however plants must not be exposed to air currents.

### **15.6.4. Fertilization:**

1. For young plants (1<sup>st</sup> year) apply 20:10:10 @ 0.05%; take 0.5 g fertilizer having N:P:K composition as 20:10:10 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 30 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 60 days.
2. For intermediate growth stage (2<sup>nd</sup> year on word at the month of February to May) apply 10:20:20 @ 0.1%; take 1g fertilizer having N:P:K composition as 10:20:20 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 30 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm at 60 days interval. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.
3. At late growth stages (2<sup>nd</sup> year on word at the month of June to September) 20:10:10 NPK will be applied at a rate of 1g litre<sup>-1</sup> at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm at 60 days interval. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.
4. At late growth stages (2<sup>nd</sup> year on word at the month of October to January) 20:20:20 NPK will be applied @ 2g litre<sup>-1</sup> at an interval of 30 days.

**15.6.5. Pest and disease:** Not many pests attack it, but during flowering at flower stem aphids attack. If you have a large aphid invasion, dust plants with flour. It constipates the pests. Neem oil, insecticidal soaps, and horticultural oils are effective against aphids. You can often get rid of aphids by wiping or spraying the leaves of the plant with a mild solution of water and a few drops of dish soap. For diseases and their control see at the table given at section 16.

**15.6.6. Potting and repotting:**

Potting procedures and materials could be used for potting are discussed earlier. Potting media that holds moisture rather than water is beneficial for this orchid, so add some compost in the potting media mixture. Generally repotting will be done immediately after flowering is over at an interval of two years.

## **15.7. Vanda**

### **15.7.1. Temperature:**

It is a warm climate orchid (Tropical). Optimum temperature range for this orchid ranges from 15-32°C, can grow in subtropical as well as tropical regions. It can tolerate as low as 10°C.

**15.7.2. Light:** It should be provided with very bright light, no direct sunlight should be given. A shade net of 20-30% should be provided to the house.

**15.7.3. Water and Humidity:** This orchid must have high humidity and warmth. It must be supplied with frequent watering. When winter temperature drops they will perish if they are exposed to frost and cold for long periods.

### **15.7.4. Fertilization:**

1. For young plants (1<sup>st</sup> and 2<sup>nd</sup> year) apply 30:10:10 @ 0.2%; take 2 g fertilizer having N:P:K composition as 30:10:10 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.
2. For intermediate growth stage (3<sup>rd</sup> year on word at the month of February to May) apply 10:20:20 @ 0.2% + calcium nitrate @0.05% + Magnesium sulphate @ 0.1% + Iron sulphate @ 50 ppm + Boric acid @ 50ppm + Zinc sulphate @ 50 ppm. For this, dissolve 2 g fertilizer having N:P:K composition as 20:10:10, 0.5g calcium nitrate, 0.5g Magnesium sulphate, 0.25g iron sulphate, 0.28g boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.
3. At late growth stages (3<sup>rd</sup> year on word at the month of June to September) apply 30:10:10 @ 0.2%; take 2 g fertilizer having N:P:K composition as 30:10:10 and dissolve it in one litre water, then spray it on the plant and potting materials at an interval of 15 days. Also apply calcium nitrate @0.05%, Magnesium sulphate @ 0.1% , Iron sulphate @ 50 ppm , Boric acid @ 50ppm, Zinc sulphate @50 ppm. For this, dissolve 0.5g calcium nitrate, 1g magnesium sulphate, 0.25g iron sulphate, 0.28g

boric acid, and 0.22g zinc sulphate, in one litre water and spray it on the plant and potting materials at an interval of 30 days.

4. At late growth stages (3<sup>rd</sup> year onwards at the month of October to January) 20:20:20 NPK will be applied @ 2g litre<sup>-1</sup> at an interval of 30 days.

**15.7.5. Pest and disease:** Vanda mainly infested by scale insects. These insects should be removed using a soft brush, insecticidal soap and water without damaging the leaf. You can also use 50:50 solution of water: denatured alcohol. Take cotton swab, dip it in water alcohol solution and clean the leaves, for very severe infestation required to apply a systemic insecticide (acephate, imidacloprid, dinotefuran etc.) several times. Chemicals are least recommended for this orchid. For diseases and their control see at the table given at section 16.

**15.7.6. Potting and repotting:**

Potting procedures and materials could be used for potting are discussed earlier. Generally repotting will be done immediately after flowering is over, at an interval of two years.

## **16.Organic cultivation of orchids**

Temperature, light, shading, humidity, pots, propagation methods will be similar with general common methods orchid cultivation as discussed earlier in this book. The differences will be there in nutrient management, water, and weed and pest management. We will discuss it here.

### **16.1. Growing media:**

Growing media should be prepared from leaf mould, coconut husk, and semi rotten logs and bricks bits taking it at a ratio of 1:1:1:1. The pH of the media should be slightly acidic, ranging from 5.5 to 6.5 and electrical conductivity (EC) of the media will be below 1.05 dS m<sup>-1</sup>. Most of the diseases come from the potting media only, so it is a good practice to sterilize the media before its use as a potting media. For organic cultivation mainly heating treatment is used, different potting media heated at different temperature. Bricks and stone piece can be heated up to 100-105°C but organic matters used for potting like leaf mould, logs etc. they will be heated at a temperature below 65°C. Few potting materials such as coconut husk require overnight soaking so that undesirable chemicals could be leached out. In case of chemical treatments, potting materials will be cut into small pieces and mixed thoroughly, and then soak it by spraying a solution containing formaldehyde 20 ml litre<sup>-1</sup>. Keep the formaldehyde solution soaked materials covered under polythene sheet in bright sunshine for 72 hours. After opening dry it for few hours in to evaporate obnoxious gasses. This chemical treatment is not given to the media required for organically growing orchids. For them only heat treatment and leaching treatment is applicable. Potting and repotting will be same as discussed earlier.

### **16.2. Organic nutrient management:**

Application of nutrients to the plants through supplying it from organic sources is continuing science time immemorial. As it buffers media pH and temperature. Provide favourable moisture retention and good air circulation, improves biological activity provide dissolve organic carbon, macro and micro nutrients slowly, thus it can help for healthy growing of the plants. Some organic nutrient sources such as mustard cake, neem cake can act against disease and pest resistant.

Poultry manure generally has N, P and K content 2-4.5%, 4.5-6% and 1.2-4% respectively, also contains almost all the micronutrients. Add this poultry manure @ 10 g pot<sup>-1</sup> in a10-12

cm pot during potting of orchids. Drench the potting media with vermiwash weekly. Add 50 ml of vermiwash in one litre of water and use to drench your orchid weakly.

You can prepare organic manure by mixing 8kg mustard oil cake and 0.5 kg dried fish along with 4 kg bone meal, then decomposing or composting it for 21 days. It will contain nearly 3.5% N, 2.1% P, 2.7% K, 4.5% Ca and 1.6% Mg. Apply 5 g of this manure at an interval of 6 months. Drench the potting media with vermiwash weekly. Add 50 ml of vermiwash in one litre of water and use to drench your orchid weakly.

### 16.3. Weed management:

Weed competes with the orchids for moisture nutrient and free space. So removal of weeds is necessary. You should not apply any chemical to eradicate weeds in the organic method of orchid cultivation. Weeds in the orchid pots can be easily managed manually by picking through hand and single tooth fork.

### 16.4. Organic management of orchid's insect pest and diseases:

Sl. No.	Name	Symptoms	Management
Disease			
1.	Black rot  Name of causal organism and susceptible orchids are given at section 22.	Water soaked lesions on the aerial part of the plant, subsequently it become black. The necrotic lesions develop on pseudobulbs and roots which latter spread upward, cause complete defoliation of the plant	Immediate removal of the disease plant from the house and manually cutting of the infected leaf portion with sterilized scissors. Repotting of the plant. Proper moisture aeration and plant spacing should be maintained, contaminated pot and potting media should not be used. Infected plant should be removed from rest of the population and will be treated with biological agents alike <i>Bacillus subtilis</i> or <i>Trichoderma viride/harzianum</i> or <i>Burkholderia cepacia</i> @ 2g pot <sup>-1</sup> at monthly interval.
2.	Anthraxnose of Orchid  Name of	Initially small, oblong to circular, oval, sunken and reddish brown to dark brown and grey coloured spots	Immediate removal of the disease plant from the house and manually cutting of the infected leaf portion with sterilized scissors. Repotting of the plant. Sterilize potting



	causal organism and susceptible orchids are given at section 22.	appear at the tip or middle of the leaf lamina which gradually enlarges and covers large area of the leaf surface	mixture. Don't over exposure your orchids to direct sunlight. Maintenance of adequate growing condition and proper nutrition should be done. Infected plant should be removed from rest of the population and will be treated with biological agents alike <i>Trichoderma viride/harzianum</i> @ 2g pot <sup>-1</sup> at monthly interval.
3.	Blossom, petal or leaf blight  Name of causal organism and susceptible orchids are given at section 22.	Water soaked lesions and dense grey mold growing on infected tissues. First appear as numerous small dark spots on petals, especially on older flowers. Sometimes shot hole effect is found in infected flower petals.	Avoid deposition and condensation of water on orchid. Wide plant spacing to ensure ventilation. Immediate removal and destruction of the disease plant part and flower. Infected plant should be removed from rest of the population and will be treated with biological agents alike <i>Candida oliophila</i> I-182 or <i>Trichoderma harzianum</i> or <i>Streptomyces griseoviridis</i> @ 2g pot <sup>-1</sup> at monthly interval.
4.	Orchid wilt  Name of causal organism and susceptible orchids are given at section 22.	Rotting of roots and stems/pseudobulbs, the effected plants turn yellow and rot and eventually become brown and dry. Leaf base turns yellow and defoliate. Presence of mycelial webs with fan shaped growth on the infected surface is the sign of disease.	Immediate removal of the disease plant from the house. Repotting of the plant with sterilize potting mixture. Apply of <i>Coniothyrium minitans</i> or <i>Trichoderma harzianum</i> @ 2g pot <sup>-1</sup> at monthly interval. Organic Bordex mixture @ 2g pot <sup>-1</sup> can also be applied to control this disease during rainy season.
5.	Pseudo bulb rot or root rot	Pseudobulbs and bulbs become dark brown to black in colour and rot also	Ensure proper aeration, moisture, air circulation and provide sufficient sunlight, avoid excess watering and

	Generally observed in cymbidium caused by Pythium and Fusarium	spread to leaves, entire Pseudobulb tissue got rotten in severe case, chlorosis on leaf bases and root rot also observed	ensure proper drainage. Use sterilize potting mixture for potting. Apply biological agents like <i>Bacillus subtilis</i> MB 1600 or <i>Trichoderma viride/harzianum</i> or <i>Burkholderia cepacia</i> @ 2g pot <sup>-1</sup> at monthly interval.
6.	Bacterial soft rot of cymbidium caused by <i>Erwinia carotovora</i>	Deep greyish green lesions on leaves, cause leaf spot, leaf soft rot and finally stem rot with foul fishy smell, progressive rot of pseudobulbs and bulbs leads to soft, shrivelled and burnt like appearance to them.	Use disease free planning materials, destroy diseased plants and maintain proper sanitation, use sterilised potting mixture, spray <i>Pseudomonas</i> fluorescence @ 0.5 ml litre <sup>-1</sup> .
Insects			
7.	Red spider mite	Feed on under surface of the leaves, yellowing of leaves, silvery marks on both the surface of the leaves which turn to brown or black latter, in case of severe infestation plants get covered with webbing, stunting, defoliation of the plant, under developed bud and abortion of flowers are observed.	Proper sanitation and cultural practices, removal of infected plant part, insects can be removed using a soft brush, insecticidal soap and water without damaging the leaf, In case of severe infestation immediately spray the plant with plain water; twice a day. Spray Artemisia or tobacco leaves extract (1:10 extract: water) reduce the population. Spray neem oil 0.03 EC (Azadirachtin) 5ml litre <sup>-1</sup> or <i>Verticillium lecanii</i> @ 0.5 ml litre <sup>-1</sup> or <i>Paecilomyces fumososeus</i> @ 0.5 ml litre <sup>-1</sup> at weekly interval, will reduce the mite population.

8.	Scale insects	Loss of vigour and deformation of infested plants. Yellow leaves, leaf drop and stunted new growth, sticky honey dew secretion observed.	Cleanliness and regular care is necessary, Prompt pruning and burning of infested plant part will reduce further spread. Isolate the infested plant. Scale insects should be removed using a soft brush, insecticidal soap and water without damaging the leaf. You can also use 70% Isopropyl alcohol or sprit. Take cotton swab, deep it in alcohol and clean the leaves. If root is infested with scale insects repot the plant with sterilized potting media, spray neem oil 0.03EC (Azadieachtin) @5ml litre <sup>-1</sup> to roots, or drench roots with <i>Metarrhizium anisopliae</i> @ 0.5 ml litre <sup>-1</sup> at 15 days interval.
9.	Black Aphid	Mainly attack flowers, small irregular shaped spots appear on the petals and sepals, affected plants become retarded, aphids also excrete honeydew on which sooty mould develop.	Spray Artemisia or Tobacco or Datura leaves extract (1:10 extract: water). You can also spray the plants with tobacco leaf extract @ 10 ml litre <sup>-1</sup> , or neem oil 0.03 EC @ 5 ml litre <sup>-1</sup> or Servo Agrospray @ 6 ml litre <sup>-1</sup> of water. Application of <i>Bauveria bassiana</i> @ 0.5 ml litre <sup>-1</sup> at weekly interval effectively controls aphids.
10.	Thrips	Suck sap from the tender portion of the plants. Leaves become curled, wrinkled and discoloured, malformation of leaves, buds and flowers. Plants become stunted, finally it may dry up also.	Remove infected plant part or plant and destroy them. Spray Artemisia or Tobacco or Datura leaves extract (1:10 extract: water). Application of neem oil 0.03 EC @ 5 ml litre <sup>-1</sup> or <i>Bauveria bassiana</i> @ 0.5 ml litre <sup>-1</sup> at weekly interval effectively controls the pest.

11.	Mealy bug	Suck cell sap from leaf and petioles, plants become weakened, also excrete honeydew that attracts ants, in case of severe infestation sooty mould develop.	Remove infected plant part or plant and destroy them. Maintain proper spacing.
12.	Black weevil	Newly born larva feed on young leaves, exudates come out from the puncture on which <i>Fusarium</i> fungus develop. Larva enters into the shoots then feed on pseudobulbs results in rotting of pseudobulbs. Arrest further growth of the plant.	Collection and destruction of adult weevil and infected plant part is a common cultural practice to control it. Spraying of neem oil 0.03 EC @ 5 ml litre <sup>-1</sup> or Pongamia oil @1.5 ml litre <sup>-1</sup> effectively controls further spread of weevil.
13.	Grass hopper	Mostly cause damage during rainy season. Feed on young leaves, unopened flower buds and flowers by cutting them in irregular sheps.	Remove weeds from surrounding areas. Manually collect nymphs and adults by hand or insect collecting nets and kill them by putting in Kerosene .
14.	Nematode	Necrosis and swelling on roots, root system become fluffy, leaves show bending, twisting and unusual enlargement.	Use nematode free planting materials, application of <i>Verticillium lecanii</i> @ 0.5 ml litre <sup>-1</sup> can control nematode. Use tissue cultured propagated materials followed by planting in sterilised potting media. Treat the propagating material with hot water. Incorporate mustard oil cake and neem oil cake in the potting media.

Above mentioned practices for organic cultivation of orchids are most suitable for growing cymbidium, but they could be used for cultivation of other orchids also.

## 17. Orchid based farming system a technological option to double farm income

In the poly houses orchids are generally grown at 0.9-1.2 m height, on an artificial structure (i.e. table, benches) to avoid soil based disease and to avail proper aeration and air circulation. Thus a large portion nutrient solution added to the orchid pots are generally leached out of the pot down. A lot of area of the playhouse remains unutilised. That unutilised area and leached out nutrient solution and water can be utilized efficiently.

1. Prepare a soil bed similar in size of the artificial structure on which orchid pots are kept.
2. Height of soil in the bed must be above 5 cm, it is better to have soil bed having a height of 10-15 cm.
3. Grow vegetables in that soil bed.
4. Nutrients and water added to orchids will be leached down to the bed below.
5. You should be care full that the vegetables grown in the bed should not be tall enough





to reach the orchid pots.

6. You can grow dwarf chilli, cauliflower, spinach etc.
7. For growing off season crop you need controlled condition, in a poly house it is well controlled condition, you can grow off season crops there too, thus you can have a good income from it.
8. You should be careful that your additional vegetables should not attract too many insect pests that could damage your orchids.



*Source of all the images in this section is annual report (2018-19) of ICAR-NRCO*

## 18. Vertical Farming of Orchids

You can go for vertical farming of commercial orchids. That will let you utilize your valuable place more efficiently for more production as well as more income. Here we are giving some pictorial examples of vertical farming in ICAR-NRCO:



**Figure: Vertical farming of orchids.**

*Source of all the images in this section is annual report (2018-19) of ICAR-NRCO*



## **19. Post-harvest technologies of orchids**

### **19.1. Grading and packaging of Cymbidium orchids:**

**19.1.1. Grading:** The parameters taken into account for grading cymbidium orchids are as follows

- i. Stage of maturity
- ii. Appearance
- iii. Colour and size of the bud
- iv. Blemishes or injuries due to disease
- v. Infestations caused by insect and pests
- vi. Strength
- vii. Straightness and
- viii. Length of the flower stem

Cymbidium cut flowers divided into two types i) Cymbidium Standard and ii) Cymbidium miniature, Cymbidium Standard are graded into two grades, like- AAA and AA. AAA grade cymbidium standard will have strong straight stem of 1.25 m length along with 12-15 flowers on it and AA grade cymbidium standard will have flower stems of uniform length of 90 cm length along with 8 flowers on it, there will be no marks on the flowers. Cymbidium miniature has four grades, they are XL, L, M and S, and they will have perfect flowers but bent crooked spikes. XL grade cymbidium miniature flower stem will be of 65+ cm length along with 15 flowers. L grade cymbidium miniature flower stem will be of 55-64 cm length along with 12-14 flowers. M grade cymbidium miniature flower stem will be of 40-54 cm length along with 8-11 flowers, and S grade cymbidium miniature flower stem will be of 30-39 cm length along with at least 5 flowers.

### **19.1.2. Packaging:**

1. Basal end of cymbidium cut flower can be inserted in a tube containing water or water with preservatives or can be wrapped with wet cotton swab, then they could covered with plastic and tied with rubber band to keep it in place. You can use 2% sucrose or 2% sucrose+100 ppm  $\text{Al}_2(\text{SO}_4)_3$  or 2% sucrose+100 ppm  $\text{Ca}(\text{NO}_3)_2$ , or 2% sucrose+200 ppm 8-HQS or 2% sucrose+100 ppm salicylic acid as preservatives.
2. You can group 5-20 flower stems together, and tie them loosely with a rubber band.
3. Wrap individual flower bunches with suitable packing materials like cellophane paper, Kraft paper, newspaper, tissue paper, or corrugated card board sheet.

4. After wrapping place them in the package.
5. For local market you can hold the bunches in a bucket containing preservative solution or water
6. For long distance transport and storage you should pack the flower bunches in dry card board box. The box should be large enough to comfortably fit the flower bunches. The length of the box will be about twice of the width and the width will be about twice of the height. The ideal boxes are telescope style boxes made of CFB.
7. Place the bunches or individual spikes in the box inside the packaging box in alternate fashion.
8. Keep ethylene scrubber with  $\text{KMnO}_4$  or purafil in the boxes to increase the keeping quality of the flowers.
9. Cymbidium single flowers can be packed and made attractive for sell. Single flower backed with fern leaves or any other attractive leaves and base wrapped with wet cotton swab preservative solution can be packed in three sided box with a display window.

## **19.2. Grading and packaging of Dendrobium orchids:**

**19.2.1. Grading:** Export quality orchids are graded to maintain the quality. They are graded on the basis of length, colour, flower size, number of flowers on the spike, arrangement of the flowers etc. Dendrobiums are graded in four standard grades, like- XL, L, M and S. XL graded dendrobium spikes will be of at least 50 cm length along with >10 flowers per spike. L graded dendrobium spikes will be of 45-50 cm length along with 8-10 flowers per spike. M graded dendrobium spikes will be of 40-45 cm length along with 6-8 flowers per spike and S graded dendrobium spikes will be of 30-40 cm length along with 4-5 flowers per spike.

### **19.2.2. Packaging:**

1. Put base of each spike in a tube containing water or preservative solution or wrap the base with wet cotton swab. To use cotton swab, dip the cotton swab in water or preservative solution and wrap it at the base of the flower spike then cover it with a polythene sheet tied by a rubber band.
2. Put flower spikes of Dendrobium along with preservatives in polythene sleeves of standard thickness.
3. You should keep a bunch of around five spikes of same grade and variety in a box.
4. Provide a cushioning material in the back side of the sleeve to avoid damage during transportation.

5. Tie the base of the spike with the base of the carton with an adhesive tape to prevent the movement of the flower spikes inside the box during transportation.
6. Size of the carton varies according to the size of the spike; the carton used for packaging will be large enough to comfortably place the flower spike in it. The carton should be provided with sufficient no of holes or vent for proper aeration.

### 19.3. Cut flower Storage

Orchid cut flowers can be stored in cold storage. Reduced temperature reduces the metabolic activity of flower tissues, also decreases respiration, transpiration and ethylene action and retards fungal and bacterial activities. In general tropical orchids are stored at 7-10°C and temperate orchids are stored at 5°C. To prevent moisture loss and wilting of the cut flower 90-95% relative humidity should be maintained in the store. Two types of cold storage are there, they are wet storage and dry storage. In case of wet storage flowers are kept in the storage with their base dipped in water or preservative solution for a short time, whereas dry storage method is used for long term. In dry storage method after harvesting the fresh flowers in the morning they are graded and sealed in plastic bags or boxes so that loss of moisture can be prevented. *Oncidium*, *Phalaenopsis*, *Odontoglossum*, *Cattleya* can be stored for two weeks by following wet method of storage at 7-10°C temperature. *Dendrobium* can be stored for 10-14 days by following wet method of storage at 5-7°C temperature and *Cymbidium* can be stored for two weeks by following dry method of storage at 1-4°C temperature.

### 19.4. Orchids flower drying:

Orchid flowers can be dried for their long term preservation, after drying they remain still attractive.

1. *Dendrobium moschatum*, *Vanda teres*, *Arundina graminifolia*, Den. 'Madam Pink', Den. 'Abraham', Den. 'Lervia', Phal. 'Detroit', Phal. 'Casa Blanca' and *Oncidium* 'Sweet Sugar' can be dried at 50°C by embedding in borax in a hot air oven.



Figure: *Dendrobium williamsonii* (dried)

2. *Epidendrum* spp., *Cattleya bowringiana* and *Cattleya* hybrids, *Phal.* 'Ox Plum Rose x Black Jack' and *Den.* 'Big White', *Vanda coerulea* can be dried at 60°C by embedding in borax in a hot air oven.
3. *Coelogyne flaccida*, *Coelogyne cristata*, *Dendrobium nobile*, *Dendrobium williamsonii*, *Dendrobium aphyllum*, *Den.* 'Erika', *Den.* 'Big White 4N', *Den.* 'Bangkok Blue', *Phal.* 'Nagasaki' and *Cym.* 'Sungold' can be dried at 55°C by embedding in borax in a hot air oven.
4. *Dendrobium*, *Phalaenopsis*, *Cattleya*, *Cymbidium*, *Aranda*, *Mokara* hybrids can be dried by embedding them in perlite, Perlite + borax and Perlite + Silica gel under room condition (24-25°C).
5. *Cattleya* 'Guanmian City', *Dendrobium* 'Lervia', *Phalaenopsis* 'Vienna', *Vanda tessellata*, *Oncidium* 'Taka Yellow', *Phalaenopsis* 'Taida S.Red' can be dried at 50°C by embedding in sand in a hot air oven.
6. After drying they can be packed in packed in three sided box with a display window and used for decorating purpose.



Figure: *Vanda coerulea* (dried)



Figure: *Coelogyne flaccida* (dried)



Figure: *Dendrobium nobile* (dried)



Figure: *Den. Madam Pink* (dried)



Figure: *Oncidium Taka Yellow* (dried)

Source of all the images in the section (18.4) is annual report (2018-19) of ICAR-NRCO



### 19.5. Preparations from cymbidium dried leaves: Waste to Wealth

You can use waste dry leave of Cymbidium after flowering; dead leaves should be collected and dried, it can be utilized for making the baskets, those buckets can be utilized for keeping of different commodities in the houses and for decorative purposes. We are going to give some pictorial example below-



**Figure: Baskets prepared from cymbidium dried leaves**

*Source of all the images in the section (18.5) is annual report (2018-19) of ICAR-NRCO*

## **20. Unique use of single orchid flowers**

### **20.1. Single flower package:**

Two type of package are there i. Top facing clear boxes, and ii. Front facing clear boxes. Top facing clear boxes are ideal for low coffee tables as the boxes allow viewing of the flowers from above, and front facing clear boxes are good for placing on higher shelves or table for display. Both the packaging comprises two parts, i. base portion to accommodate the flower pedicel with water tube or wet cotton swab and also hold the flower in position in the package, so it is made of thick paper or card board and ii. The display unit, made of clear transparent material, that allow display of the flower side by side create a modified atmosphere within the package to longer the shelf life of the flower. Boxes will large enough to fit the flower and associative materials well; on the other hand it should not be too large to allow the flower move within the box. Flower should be harvested after 3-4 days of full opening at morning time, with sterilized cutting tools. The harvested flower should not have any mechanical or insect pest damage. Contrasting colour combination will make the package more attractive, like dark marron flower in yellow or white background.

### **20.2. Floral ornaments:**

As orchid flowers are large blooms with extraordinary colour combination and marking, it can be used for floral ornament preparation. It can also be used for preparing bridal bouquets and indoor decorations.



**Figure: Orchid bridal bouquet (source internet)**

### **20.3. Wreath:**

Wreath is an arrangement of flowers and leaves in a circular shape, used as a decoration or as a sign of respect and remembrance for a person who has died. They are also used during Christmas for decorating the front doors. Cymbidium and any other orchid flower can be used to prepare that ring like structure. The ring like



**Figure: Orchid wreath (Source internet)**

structure is made from wire frame or grasses. Then it is covered with foliage, then flower are attached on the structure.

#### **20.4. Boutonniere:**

A boutonniere is a floral decoration, typically a single flower or bud, worn on the lapel of a tuxedo or suit jacket. A wire base is required to insert through the pedicle at the base of the flower to fit it on place, along with flowers other decorative like attractive leaves can be used to prepare it.



Figure: Orchid boutonniere (source internet)

#### **20.5. Bouquet:**

As orchid flowers are of extraordinary colour combination and marking, they can be used for preparing flower Bouquet. Bouquets maybe of various type like-Japanese style, English or western style etc.



Figure: Orchid bouquet (source internet)

## **21. Orchids preparations**

Orchid is one of the main ingredients for various products like-

### **A. Edible products:**

- i. Spice e.g. Vanillin
- ii. Herbal tea
- iii. Vegetable
- iv. Pickles
- v. Ice cream

### **B. Ornamental products**

- i. Orchidscaping
- ii. Cut flowers
- iii. Dried flower craft

### **C. Medicinal products**

- i. Skin care products
- ii. Hair cosmetics
- iii. Nutraceuticals
- iv. Herbal drugs

### **D. Fragrant products**

- i. Perfumery
- ii. Essential oils

### **E. Other uses**

- i. Floral ornaments
- ii. Religious uses
- iii. Potpourri
- iv. Designer candles

### **21.1. Orchid ice cream:**

This is made with salep, mastic, milk and sugar and then rubbed either by mixer or hand. It is chewy and resistant to melting.

### **21.2. Salep:**

Salep is a Turkish word refers to the tubers of terrestrial orchids. It is flour, made from grinding dried tubers of *Orchis mascula*, *Orchis militaris* and related species of orchids.



1. Tubers are collected at close of the summer when the seed vessels are fully formed. Because at this time tubers are full and fleshy also contain largest amount of starchy matters.
2. After collecting tubers they are immersed in boiling milk or water. This process destroys their vitality and removes the bitterness of their fresh state.
3. The outer skins are then rubbed off and tubers are dried by exposing it in the sun or drying it in oven with a bread making temperature for near about 10 minutes. After removing from the oven the will be changed to transparent from milky but the bulk will not be reduced.
4. They are then dried and hardened in fresh air for few days, after hardening they become ready for use or store for as long as time required.
5. Then the dried salep is generally ground to powder before use. Powders are yellowish in colour. These powders are used to produce beverages, desserts. Salep of Indian market known as Salib misri, derived from certain species of *Eulophia*, *Orchis* and *Satyrium*.  
1:10 salep: water homogeneous mixture could be used for treatment to irritation in gastrointestinal track. It is also used for infants suffering from diarrhoea and bilious fever.

### **21.3. Vanilla:**

The pods of the climbing orchid *Vanilla planifolia* is used for the commercial production of the vanilla flavour, it is prepared by curing process. Vanilla is used in ice-creams, dairy products, biscuits, cakes, beverages, perfumery and cosmetics as flavouring agent. Vanilla capsules improves food intake, reduces nausea and menstrual discharge.

### **21.4. Chikanda:**

Tubers of orchid genera *Disa*, *Habenaria* and *Satyrium* are the main ingredients of chikanda, a popular sausage, a brown jelly. Orchid tubers are pounded to remove skins, after that dried and grinded to produce flour, that is yellowish in colour. To enhance the test the flour is mixed with water, soda and salt, and peanut flour is also added to adjust the thickness.

### **21.5. Chinaka:**

It is delicious along with medicinal values, also act as source of energy. Orchid species used to produce it is *Satyrium cursonii*, *Disa englerian*, *Disa robusta*, *Disa zombica*, *Habenaria*

*clavate*, *Satyrium ambylosaccos* etc. The tubers are pounded and used for cooking along with locally produced baking powder called “Chidulo”, In case of non-availability of chidulo sodium bicarbonate can also be used. In a few minutes a cake mixture is produced, that is put in a container and cooled for solidification. Finally the cake is cut into small pieces and cooked with ground nut or tomato sauces.

#### **21.6. Olatshe:**

It is a part of the local diet of Bhutan people. Orchid species preferred for this dish is *Cymbidium hookerianum*. Flowers (open or not) are removed from the flower stalk and washed and boiled in water until flowers become soft. Flowers make it bitter, additional spices are added to remove the bitterness. Then the water is removed and mixture of spices and melted cheese and salt are added and cooked for five minutes. The dish becomes ready. Olatshe can be served with rice, noodle etc.

#### **21.7. Olachoto:**

*Cymbidium* flower is used to prepare this Bhutan delicacy. Flowers are cut into pieces and boiled and cooked along with meat, chilli, cheese or it can also be stir-fried.

#### **21.8. Dendrobium as an edible orchid:**

*Dendrobium* flowers are dipped in butter and deep fried and to be used as food. *Dendrobium* flowers are also used in desserts and cakes. *Dendrobium chrysotoxum* flowers and *Dendrobium catherinatum* cane are dried and consumed as tea. *Dendrobium longicornu* flowers are used for pickled preparation.

#### **21.9. Phytochemicals from orchids**

Flavonoid derived from *Anoectochilus roxburghii*, bibenzyle derivatives from *Dendrobium amoneum*, Ephemeranthone and Erianthridin derived from *Ephemerantha lonchophylla* having antioxidant activity. Flavonoid and Lusianthrin derived from *Cypripedium macranthos* have anti-fungal activities. Flavonoid derived from *Spiranthes australis* and Plicatol B derived from *Bulbophyllum kwangtungense* have anti tumor activity. Like these there are many beneficial phytochemicals those could be derived from orchids. Detailed discussion about them is out of the scope of this book.

### 21.10. Orchid product used as nutraceuticals or herbal drugs

There are many Orchid based product used as nutraceuticals or herbal drugs, few of them are presented here

#### 21.10.1. Chyawanprash



Source of photographs: Internet

Chyawanprash is a polyherbal formulation prepared from more than 50 herbal plants, out of them for are orchids namely *Risbhaka* (*Malaxis accumulata*), *Jivak* (*Malaxis mucifera*), *Vridhhi* (*Hebernaria edgeworthii*) and *Riddhi* (*Hebernaria intermedia*).

#### 21.10.2. Dynamic formulas Formula-1:

This is prepared from *Cymbidium goeringii*, extract from whole plant is used for preparing this product. This is used as a dietary supplement.

Source of photograph: Internet



#### 21.10.3. Shi hu ye guang wan:

Shi hu ye guang wan is prepared from the stem of *Dendrobium chrysotoxum*. It is used as a herbal supplement for cataracts, conjunctivitis, hypertension and glaucoma.

Source of photograph: Internet



#### 21.10.4. Kunbao wan:

Kunbao wan is prepared from *Dendrobium nobile* orchid. For this purpose whole plant extract is used. It is used for Menopausal syndrome, nourishing liver and kidney function, calm and soothe the nerves, insomnia and joint pain treatment.

Source of photograph: Internet



#### 21.10.5. Tian Ma Shou Wu Pian:

Tian Ma Shou Wu Pian is prepared from *Gastrodia elata* orchid. Rhizom tuber of this orchid is used for this preparation. It is used as a herbal supplement capsule.

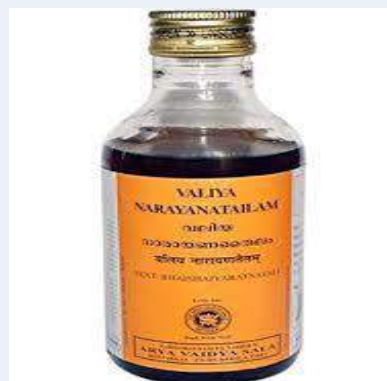
Source of photograph: Internet



#### 21.10.6. Valiya Narayana thaliam:

Valiya Narayana thaliam is prepared from *Malaxis acuminata* orchid. Pseudobulbs and roots of this orchid are used for this preparation. It is used for rheumetoid arthritis, body pain, inflammations etc treatment.

Source of photograph: Internet



## 21.11. Use of orchids in cosmetics:

Orchids are having properties of moisturizing and antioxidant activity, that's why they are being used in several cosmetics. We are going to discuss here about few of them.

### 21.11.1. Herborist T' ai Chai weisse maske:

It is prepared from the root extract of *Bletilla striata*. It is used as cleansing face mask and moisturiser.

Source of photograph: Internet



### 21.11.2. Lierac paris Premium Creme:

Lierac paris Premium Creme is prepared from the flower and leaf extract of *Cynoches cooperi*. It is used as antioxidant and emollient component of cosmetic products.

Source of photograph: Internet



### 21.11.3. Innisfree Orchid day cream:

Innisfree Orchid day cream is prepared from *Cymbidium kanran* orchid. It is prepared from whole plant extract. It is used as antioxidant, astringent, emollient and skin conditioning component of cosmetic products.

Source of photograph: Internet



#### 21.11.4. Misa geumsul skin toner:

Misa geumsul skin toner is prepared from the whole plant extract of *Dendrobium nobile*. It is used as skin conditioning components of cosmetic products.

Source of photograph: Internet



#### 21.11.5. BIOXIDEA MIRACLE 48™ Excellence Diamond:

BIOXIDEA MIRACLE 48™ Excellence Diamond is prepared from callus culture extract of *Neofinetia falcata* orchid. It is used as skin conditioning component of cosmetic products.

Source of photograph: Internet



#### 21.11.6. Herbal essence hello hydration Moisturising Shampoo:

Herbal essence hello hydration Moisturising Shampoo is prepared from root, flower or whole plant extract of *Orchis mascula* orchid. It is used as hair and skin conditioning component of cosmetic products.

Source of photograph: Internet



#### 21.11.7. Organic orchid and jojoba hair conditioner:

Organic orchid and jojoba hair conditioner is prepared from flower extract of *Phalaenopsis amabilis* orchid. It is used as hair and skin conditioning component of cosmetic products.

Source of photograph: Internet





#### 21.11.8. Manhattan surprise waterproof mascara:

Manhattan surprise waterproof mascara is prepared from flower extract of *Phalaenopsis lobbii* orchid. It is used as bleaching component of cosmetic products.

Source of photograph: Internet



#### 21.11.9. Red cattleya perfume:

Red cattleya perfume is prepared from floral extract of red cattleya orchid. It is used as scent.

Source of photograph: Internet



#### 21.11.10. Javanica perfume:

Javanica perfume is prepared from floral extract of *Phalaenopsis javanica* orchid. It is used as scent.

Source of photograph: Internet



## 22. Protection measures

Sl No .	Name of the disease and causal agent	Hosts	Symptoms	Management
Fungal diseases				
1.	<p>Anthracnose of Orchid</p> <p>Caused by <i>Colletotrichum gloeosporioides</i></p>	Dendrobium, Cymbidium etc.	Initially small, oblong to circular, oval, sunken and reddish brown to dark brown and grey coloured spots appear at the tip or middle of the leaf lamina which gradually enlarges and covers large area of the leaf surface	Immediate removal of the disease plant from the poly house and manually cutting of the infected leaf portion with sterilized scissors. Repotting of the plant. Sterilize potting mixture, wooden benches, pots with 2% formalin. Don't expose your plant to direct sunlight. You can spray Blitox @ 2.5-3g litre <sup>-1</sup> at 10 days interval or spray Carbendazim + mancozeb @ 1g litre <sup>-1</sup> of water at 7 days interval
2.	<p>Black rot or crown rot</p> <p>Caused by <i>Phytophthora palmivora</i> and <i>parasitica</i></p>	Dendrobium, Cymbidium, Cattleya, Oncidium, Phalaenopsis, Paphiopedilum, Vanda etc.	Water soaked lesions on the aerial part of the plant, subsequently it become black. The necrotic lesions develop on pseudobulbs and roots which latter spread upward, cause complete defoliation of the plant	Immediate removal of the disease plant from the poly house and manually cutting of the infected leaf portion with sterilized scissors. Repotting of the plant. Sterilize potting mixture, wooden benches, and pots with 2% formalin. A good aeration in the nursey is essential. Keep the orchid plants on benches, 90-120 cm above the ground level to avoid the water splash. For effective control apply mactox MZ or metalaxyl @ 1g litre <sup>-1</sup> or



				mancozeb @ 2g litre <sup>-1</sup> , captan, thiram could also be applied
3.	Blossom, petal or leaf blight  Caused by <i>Botrytis cinerea</i>	Cymbidium, Cattleya, Phalaenopsis, Phaius etc.	Water soaked lesions and dense grey mold growing on infected tissues. First appear as numerous small dark spots on petals, especially on older flowers. Sometimes shot hole effect is found in infected flower petals.	Avoid deposition and condensation of water on orchid. Wide plant spacing to ensure ventilation. Many chemicals are effective like-spray Bavastin @ 1 g litre <sup>-1</sup> or indofil M 45 @ 2 g litre <sup>-1</sup> or topson M @ 2 g litre <sup>-1</sup> or benalate @ 1 g litre <sup>-1</sup> at 7-10 days interval
4.	Orchid wilt  Caused by <i>Sclerotium rolfsii</i>	Dendrobium, Cymbidium, Paphiopedilum, Vanda etc.	Rotting of roots and stems/pseudobulbs, the effected plants turn yellow and rot and eventually become brown and dry. Leaf base turns yellow and defoliate. Presence of mycelial webs with fan shaped growth on the infected surface is the sign of disease.	Immediate removal of the disease plant from the poly house and repotting of the plant. Sterilize potting mixture, wooden benches, and pots with 2% formalin.
5.	Rust  <i>Uredo sp.</i>	Phaius, Calanthe etc.	Yellow flecks usually on the lower surface of	Immediate removal of the disease plant or plant part from the poly house, spraying with Zineb @ 2g

			leaves and later on upper leaf surface. The older spots became dark with large target board effect of numerous ruptured small pustules.	litre <sup>-1</sup> .
Bacterial diseases of orchids				
6.	Bacterial brown rot  Caused by <i>Pseudomonas cattleya</i>	Dendrobium, Cymbidium, Cattleya, Phalaenopsis, Paphiopedilum	Small, soft, water soaked sunken spots are found on leaves, that become black and brown latter. The disease advance rapidly and results immediate death of plant.	Reduce prolonged wetness and increase air circulation. Separate the infected plants from others to prevent the spreading of the disease. Overhead irrigation should be avoided, cut of the infected leaves. Copper based fungicides like Blitox @ 2g litre <sup>-1</sup> can be used. Infected plants should be drenched or sprayed with 8-hydroxyquinoline at a dilution of 1:2000 in water.
Nematode disease of orchids				
7.	Root necrosis of Cymbidium  Caused by <i>Helicotylenchus microcephalus</i>	Cymbidium	Develop severe necrosis swelling and fluffy root system. The leaves of effected plants also exhibit typical bending twisting and abnormal growth.	You should have nematode free planting materials, tissue cultured plants are the best options. Follow proper cultural practices. Hot water treatment o the propagative materials. Incorporate mustard oil cake, neem oil cake in the planting media. For heavy infestation use Carbofuran 3G
Viral disease of orchid				
8.	Cymbidium	Cymbidium	Symptoms like	Separate the plant or plant part

	mosaic virus (CymMV)	Can also infect any other orchids	mosaic, necrosis, chlorotic flecks, water soaked lesions and flower necrosis on different orchid hosts.	and destroy it.
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### **Author's acknowledgement**

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### **Sources of information:**

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2. Technical bulletins of ICAR- NRC for Orchids
3. A practical guide to care and cultivation of orchids, a book written by Michael Tibbs
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