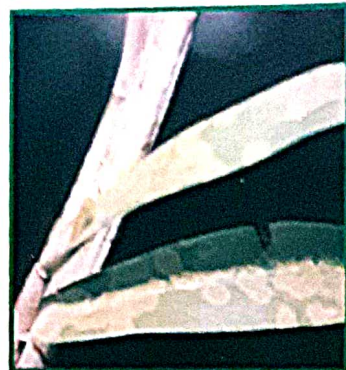
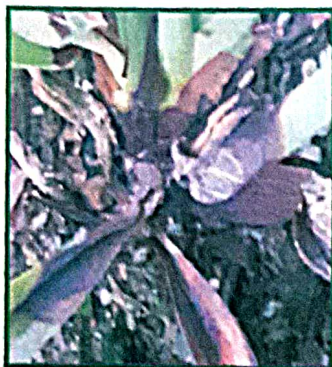
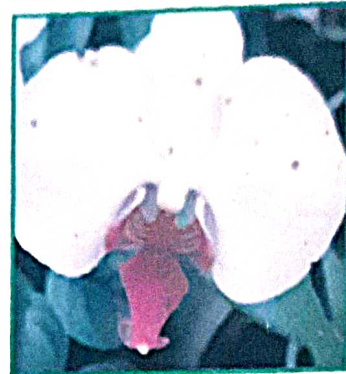
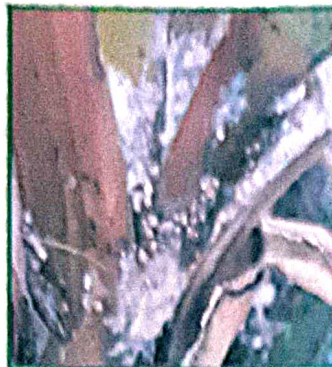


Orchid Diseases And Their Management

T. K. Bag



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Technical Bulletin

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And Their Management

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Front Cover page

Row 1: Black rot on *Dendrobium nobile*, *Sclerotium* wilt on *Cymbidium pendulum*, Rust on *Phaius*.

Row 2: Black rot on *Cymbidium*, *Sclerotinia* rot on *Goodyera*
Botrytis petal spotting on *Phalaenopsis*.

Row 3: CymMV infected *Cymbidium*, *Sclerotium* wilt on *Paphiopedilum hirsutissimum* and ORSV infected *Dendrobium*.

Back cover: Black rot on *Cymbidium*

Printed
June, 2006

Published by Dr. V. Nagaraju, Director, National Research Centre for Orchids, Pakyong-737106, Sikkim and Printed at Royal Offset Printers, A-89/1, Naraina Industrial Area, Phase-I, New Delhi-110028.

Foreword

Orchids are considered as one of the top ten cut flowers due to their ornamental value. Nowadays orchids have received enough attention for their conservation, multiplication development and commercialization. Since orchids were never grown as a commercial crops like other horticultural and agricultural crops in India, there is no systematic research works on the disease problems, their distribution, nature of damage, the causal organism(s) involved, their mode of transmission and epidemiology. Besides, orchids are adapted to withstand a variety of environmental stress but under highly adverse growing condition their natural defense mechanism generally gets weakened and therefore like any other group of cultivated plants, orchids are also prone to infect by number of diseases. Hence, the present technical bulletin is formulated with a view to disseminate an effective documentation of fungal diseases infecting orchids, their transmission, epidemiology and management approaches.

The author has taken an intensive survey work on orchid diseases in the orchid growing areas, mainly in the NEH regions including Darjeeling. Among the documented orchid diseases, major diseases are black rot, anthracnose, orchid wilt, Botrytis petal blight, Cymbidium Mosaic virus and Odontoglossum Ring spot virus. Diagnosis and management of all major important diseases have been covered in this bulletin based on available information and own research output.

It gives me immense pleasure to bring out this bulletin on Orchid diseases and their management where the survey and research work of Dr. T. K. Bag has been compiled in a comprehensive manner. I am sure that the bulletin will be useful to orchid growers, extension personnel, students and researchers to identify the diseases and manage them efficiently and effectively leading to the increase in contribution of orchids in floriculture trade in India.

June 10, 2006
NRC for Orchids, Pakyong, Sikkim

(V. Nagaraju)
Director

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1. Introduction

The Sikkim Himalayas comprising the hills of Sikkim and Darjeeling harbors about 525 species of orchids belonging to 137 genera. History of orchid collection in this Himalayan belt and their cultivation can be traced back to 1843. Several species of native orchids and introduced hybrids are being cultivated in this region by hobby growers as well as private nurserymen under protected conditions. Although, orchid culture is more than 100 years old in this tiny Himalayan belt, the disease scenario on this beautiful flowering crop is not very much clear. Therefore, an attempt was made to document the status of orchid diseases in the Sikkim Himalayas. In the initial stage, major orchid growing belts were surveyed extensively. Survey programme was made and at least four surveys were done in each year in the identified nurseries and disease samples were collected. The diseases were identified on the basis of laboratory tests. Seasonal incidence of the diseases was recorded and on the basis of the frequencies, major diseases were identified in this region. These diseases were studied for symptoms, causal agents, host range, spread of the disease and suggested management approaches.

2. Orchid diseases and their seasonal incidence in the Sikkim Himalayas

Disease	Pathogen	Plant parts infected	Time of occurrence
Black Rot	<i>Phytophthora</i> sp. and <i>Pythium</i> sp.	Leaves, pseudobulbs, new shoots	May-August
Anthraxnose	<i>Colletotrichum</i> <i>gloeosporioides</i>	Leaves, stems	April-October
Orchid Wilt	<i>Sclerotium rolfsii</i>	Pseudobulbs, crown, stem and roots	June-August
Rust	<i>Uredo</i> sp.	Leaf, inflorescence, aerial portion of pseudobulbs and stems	Throughout the year

Wet Blight	<i>Botrytis cinerea</i>	Flower spikes and flower petal, aerial portion of pseudobulbs and leaf	February-June
Web Blight of <i>Pleione humilis</i>	<i>Rhizoctonia solani</i>	Leaf and stem	June-July
Leaf Blight of <i>Thunia bensoni</i>	<i>Rhizoctonia solani</i>	Leaf and stem	June-July
Blight of <i>Bulleyia yunnanensis</i>	<i>Fusarium oxysporum</i>	New shoot and inflorescence	April-September
Cymbidium Mosaic	<i>Cymbidium mosaic virus</i>	Newly emerged and old leaves	Throughout the year
Odontoglossum Ring spot	Odontoglossum Ring spot Virus	Leaves	Throughout the year

3. MAJOR FUNGAL DISEASES

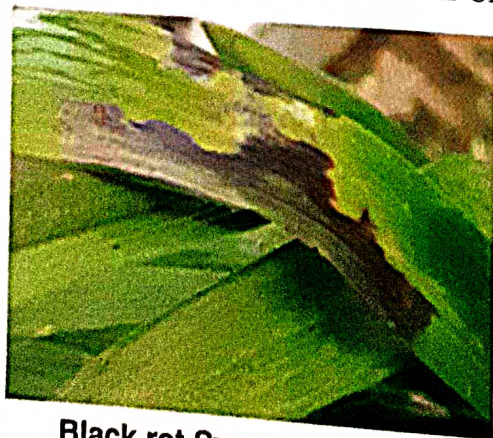
3.1 Black Rot, Crown Rot or Heart Rot

Causal Pathogens

Pythium ultimum, *Pythium splendens*, *Phytophthora palmivora* and *Phytophthora parasitica*.

Symptoms

Black rot is the most destructive disease of orchids. The disease appears as water soaked small brown patches appear on the aerial



Black rot Symptom on leaf



New shoot rot form of Black rot in *Cymbidium*

parts of plants. Discoloured / black necrotic lesions may develop on pseudobulbs and roots which may later spread upward resulting in complete defoliation of the plant. The disease later migrates to the other potted *Cymbidium* hybrids kept within the vicinity of the (about 1-2 m distance) disease beds. New shoots also show the black rot symptoms, which starts from the junction attached with the mother plants/pseudobulbs. Several *Cymbidium* hybrids in pots were also infected with black rot causing initial water soaked small leaf spot, which later transformed into blight covering larger leaf area. Leaf black rot symptom might be initiated by secondary air borne inoculums as the symptoms appeared on leaves at random but new shoot rot infection may be initiated by soil borne primary inoculums and progress slowly as compare to the leaf infection. These pathogens also cause damping off seedlings.

Distribution

In Sikkim, the disease has been recorded in Rumtek, Ranipool, Namli, Pakyong, Namchepong and Namchi, and in West Bengal, it has been reported from Lava, Kalimpong, Kurseong, Sukia Pokhari, Mirik, Darjeeling, Takdah orchid sanctuary and Nagri Tea estate.

Occurrence

The disease starts to appear from last week of May /first week of June and continued to occur upto September under Darjeeling and Sikkim condition.

Orchid Hosts

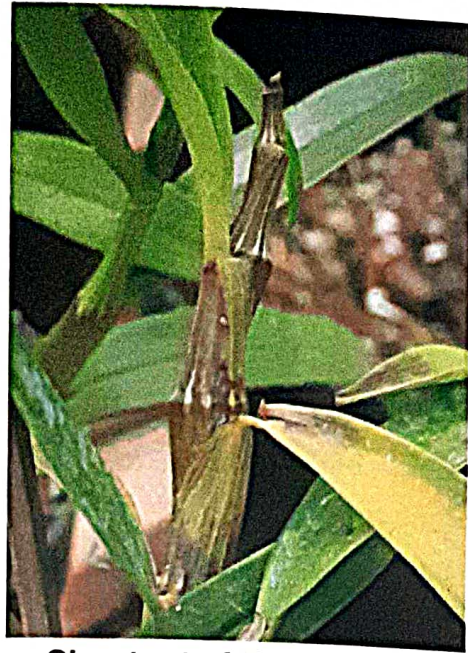
Cattleya, *Coelogyne*, *Phalaenopsis*, *Dendrobium*, *Vanda*, *Cymbidium*, *Epidendrum*, *Oncidium*, *Paphiopedilum*

etc. *Cymbidium* hybrid: *Cym. Takarjuki*, *Cym. Red Star*, *Cym. Rievaulx 'Cooksbridge'*, *Cym. Soul hunt*, *Cym. Tahiti*, *Cym. Showgirl Marion Miller*, *Cym. Hawtescens*, *Cym. Arabian Nights 'Glacier'*, *Cym. Princess Elizabeth 'Linda'*, *Cym. Whitish miniature*, *Cym. Velvet*



New shoot rot on potted *Cym. Bertha Peter short*

Green, Cym. Khyber Pass 'Rowe's Red' X Red Star, Cym. Mayfair 'Stonehurst', Cym. Amesbury 'Frank Slattery', Cym. Goldengirl, Cym. Oklahama tetraploid, Cym. Sarah Jean, Cym. San Francisco 'Del Rio', Cym. Ann Green, Cym. High lander 'Cooksbridge', Cym. Yankalila, Cym. Soul Hunt 3, Cym. Luana "Imperial", Cym. Brass Bottom, Cym. Pesibi Rose Queen, Cym. Bertha 'Petershort', Cym. Agnes Norton "Shoe off".



Shoot rot of *Dendrobium nobile* by *Phytophthora*

Spread

The disease spread through contaminated potting media or water splash from adjacent infected plants or even through irrigation water.

Epidemiology

Plants grown in soil are more infected than raised bed. Soil bed over saturated with >90% water holding capacity favours the disease.



Black rot on leaf of soil grown *Cymbidium*

Rotting occurs mostly on the Cymbidium plants grown in clayey soil beds, which are practically observed lower in elevation and easily get moistened with excessive water by rain or overhead irrigation. Besides, Rainwater was continuously dropping on the plants making the plant surface wet for longer period.

Temperature prevailed comparatively in the higher range of 24-30°C and relative humidity of 80-95% and continuous rainfall coupled with mist like foggy weather.

Management approaches

Avoid using unsterilised potting media and pots. Separate infected plants and destroy infected parts to check further spread of the disease. A good aeration in the nursery is essential. Reduce watering when disease is expected to occur (June-September). Use of rain shelters at nursery during rainy season is essential. Place orchid plants on benches at 90-120 cm off the ground to avoid splash contamination. In terrestrial orchids provide drainage. For effective control, Matco MZ or metalaxyl @ 1g/l or mancozeb @ 2 g/l can be used as spray or soil drenching. Application of contact fungicide e.g. Captan, thiram or mancozeb alternately with a systemic base fungicide metalaxyl is recommended.



Completely rotten *Cymbidium* plant

3.2 Anthracnose

Causal pathogen

Colletotrichum gloeosporioides and *Colletotrichum orchidacearum*

Symptoms

Leaves are mostly infected even though the disease can occur on any of the aerial parts. Initiation symptoms appear as small oblong



Anthracnose on *Dendrobium nobile*

to circular, oval, sunken and reddish brown to dark brown or gray coloured spots. On the spots black, raised dots are found with target board appearance. Die back of leaves are also observed if the leaf tip is attacked.

Orchid Hosts

Species and hybrids of *Phalaenopsis*, *Dendrobium*, *Coelogyne*, *Cymbidium*, *Eria*, *Oncidium*, *Aerides*, *Otochilus*, *Paphiopedilum*, *Cattleya*, *Zeuxine*, *Calanthe*, *Liparis* and *Bulbophyllum*.

Spread

Through air borne spores and splash rain.

Epidemiology

Damaged plants or weak plants suffering from poor growing or nutritional status are often infected. Excessive fertilizer with nitrogen also makes the plants susceptible to the disease. The disease appears in epidemic form at rainy season.

Management approaches

Avoidance of plants to over exposing to direct sunlight as sun burn may also predispose plants to infection. Maintenance of proper growing condition with adequate nutrition is advisable. Eradication of all diseased organs or plant parts by burning is recommended before spraying with fungicides. In case of higher incidence of the disease, spraying of captain @ 2g/ liter or Thiophanate methyl @ 1 g/ liter at 15 days intervals may be effective to control the disease.

3.3 Orchid Wilt

Causal pathogen *Sclerotium rolfsii*

Symptoms

The disease appears as rapid collapse and rotting of roots and stems/pseudobulbs. The affected plants turn yellow and rot and eventually become brown and dry. Leaf base turn yellow and defoliated. Presence of mycelial webs with fan shaped growth on the infected surface is sign of the disease. The formation of numerous small, brown coloured,



Wilt on *Phaius tankervilleae*

mustard shaped sclerotia which later turns into black coloured sclerotia on the affected tissue is a diagnostic characteristic of the disease.

Orchid Hosts

Eria coronaria, *Eria spicata*,
Paphiopedilum venustum,
Paphiopedilum hirsutissimum,



Wilt on *Paphiopedilum hirsutissimum*



Wilt on *Vanda stangeana*



Wilt on *Cymbidium pendulum*

Phaius flavus, *Phaius tankervilleae*,
Dendrobium chrysotoxum, *Tainia minor*,
Pleione praecox, *Bulbophyllum sp.*,
Tainia latifolia, *Lycaste crueata*,
Calanthe masuca, *Robiquetia spathulata*,
Vanda coerulea, *Vanda stangeana*,
Luisia sp., *Acampe papillosa* and several
Cymbidium hybrids and species. Some of the
Cymbidium hybrid which are infected are :
 Bertha 'Petershort', Yankalila, Madrid 'Forest King',
 Show girl 'Cooksbridge' X Cold Stream, Coral Sea,
 Evening Star 'Pastel Princess', Susan Hughes 'R.D. Hughes'
 and Sayonara Blazing Gold.

Spread

The pathogen spread through infested compost or leaf mould. The disease also spread through old contaminated plant roots and pots.

Epidemiology

The disease usually occurs during

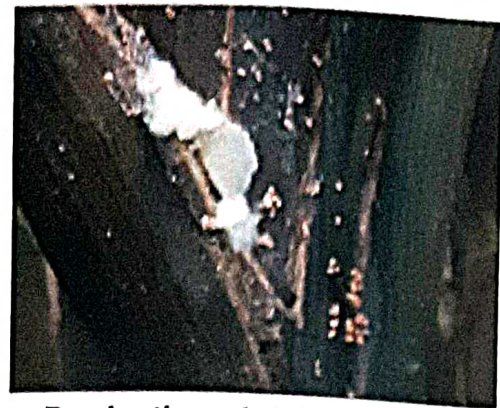


Complete death of wilt infected *Cymbidium pendulum* after 1 month

June-August when the temperature reaches over 30°C and relative humidity of 65-78%.

Management approaches

Removal of the disease plants. Repotting of the plant using sterilized potting mixture after fungicidal treatment is recommended. Contaminated pots, potting mix and the wooden branches should be sterilized with 2% formalin. Keep the surrounding free from other host plants.



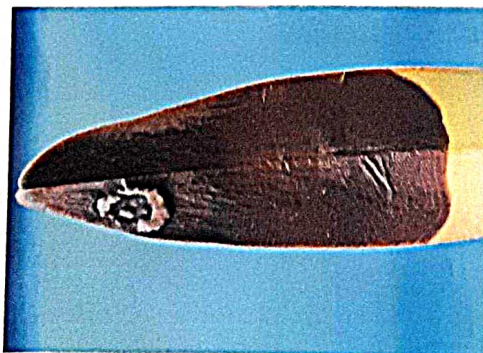
Production of Sclerotial and Basidia stage on *Cymbidium elegans*

3.4 Blossom blight/ petal Blight

Causal pathogen *Botrytis cinerea*



Petal blight on the flower of *Phalaenopsis*



Botrytis blight on leaf of *Cattleya*

Symptoms

It is the most common disease of orchid flowers. The disease first appears as numerous small dark spots on petals, especially on older flowers. Sometimes shot hole effect is found on infected flower petals. *Botrytis* petal blight is common in *Cymbidium*, *Phalaenopsis*, *Aerides*, *Calanthe triplicata* and *Cattleya*.

In case of petal blight on *Calanthe triplicata*, the fungus causes drying of flowers with visible gray coloured fungal growth over the infected flowers. Besides, top leaf blight is another type of

damage caused by *Botrytis cinerea* when new young leaf starts to emerge. Sometimes, leaf sheath and soft rot of young pseudobulbs and blighting of leaf sheath are also recorded.

Orchid Hosts

Cattleya, *Phalaenopsis*, *Cymbidium*, *Aerides*, *Eria javanica*, *Phalaenopsis* sp. and *Cattleya*

Spread

Disseminated by wind and air borne spores on rain splashes.

Epidemiology

Botrytis cinerea is active in a wide range of temperature. However, optimum temperature range is 21-25 °C. The fungus is particularly very troublesome under conditions of moderate temperature and high relative humidity (92-93%). Free moisture is an essential component for germination of spores and growth within plant tissues and spread of the disease is faster in young, tender and succulent plant parts. However, dry weather restricts growth of the fungus. On orchids the disease usually occurs under Sikkim conditions during February – May when temperature is favourable and the humidity is high.



***Botrytis* blight of young leaf on *Tania* sp.**

Management approaches

Botrytis multiplies very fast producing several cycles of asexual spores that are migrated by air currents. As spores may originate in decaying vegetative tissues and old flowers, removal or destruction of spore regenerating sources is an important part. Orchid growers should give great attention to avoid condensation or deposition of water on plant parts. Avoid overhead watering during blooming. Wider plant spacing, ensure proper ventilation to minimize disease incidence.

Many chemicals are effective against grey mould. Spraying with Bavistin @ 1g/l or Indofil M 45 @ 2g/l or Topsin M @ 2g/l or Benlate @ 1g/l at 7 -10 day interval are effective against petal blight of orchids.

4. MINOR FUNGAL DISEASES

4.1 Rust

Causal pathogen *Uredo* sp.

Symptom

The young leaves showed prominent yellow flecks, usually on the lower surface of leaves and later on upper leaf surface. The



Rust on *Calanthe trulliformis*

older spots became dark with large target board effect of numerous ruptured small pustules. Several pustules coalesced and produced larger pustules on leaves. Only uredial stage of the fungus was recorded on the orchids but no telial stage was known and the fungus was characterized as *Uredo* sp.

Orchid hosts

Phaius tankervilliae, *Phaius flavus*, *Calanthe trulliformis*, *Calanthe plantaginea*, *Calanthe discolor* and *Calanthe biloba*.

Spread

Air borne spores

Epidemiology

The fungus prefers shady place with mild to moderate temperature of 13-24.7 °C and relative humidity of 30-73%. The disease occurs during February to April.



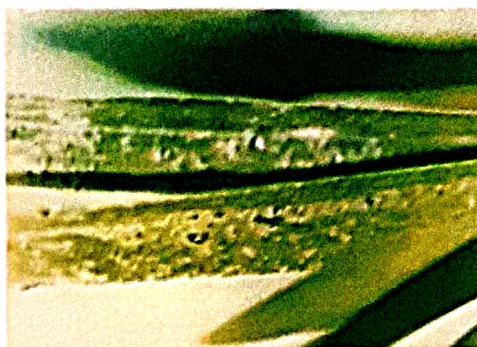
Rust on *Phaius tankervilliae*

Management approaches

Removal and destruction of infected leaves or if whole plant is heavily infected, spraying with Zineb or Captan @ 2g/ litre.

4. 2 Necrotic leaf spot

This disease is recorded in *Cymbidium* spp. causing numerous necrotic leaf spot with yellow halo. The fungus associated with this disease isolated and identified as *Fusarium* sp.



Necrotic leaf spot on *Cymbidium*

4. 3 Inflorescence blight of *Dendrobium moschatum*



Inflorescence Blight of *Dendrobium moschatum*

The disease causes inflorescence blight including individual floret. Individual floret do not open. Tip of the inflorescence later turns black. Rachis and infected individual floret covers with light brown fungal mass. Infected floret drops off before opening.

Orchid host *Dendrobium moschatum*

Causal fungus *Fusarium* sp.

4.4 Inflorescence rot of *Phaius tankervilliae*

Base of the individual floret rots and turns black. Individual florets topple down and hang down. Infected individual floret partially open. Light brown fungal spore and mass are also visible.

Orchid host *Phaius tankervilliae*

Causal fungus *Fusarium* sp.



Inflorescence Rot of *phaius tankervilliae*

4.5 Inflorescence blight and shoot rot of *Bulleyia yunnanensis*

New shoots show rotting and blighting at the collar region. Inflorescence starts rotting from base and progress upward covering whole inflorescence. Flowers do not open at all. Whole inflorescence is covered with powdery mass of fungus.



Inflorescence blight of *Bulleyia yunnanensis*

Causal fungus *Fusarium* sp.

4.6 Leaf spot

Causal pathogen *Haplosporella cymbideii*

Symptoms

The symptoms appear as buff coloured areas with dark mousy grey margins. The spots are initially separate but later merged to form elongated to irregular areas with smooth margins.

Management approaches

Removal of infected leaves, ensure proper ventilation and aeration.

4.7 *Cercospora* leaf spot

Causal pathogen *Cercospora* sp.

Symptom

Symptom appears as small yellow spots on the under surface of leaf. The infected tissues become necrotic, dark brown or black and sunken.

Management approaches

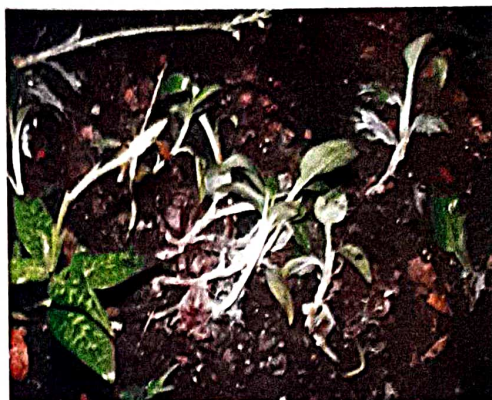
Need good sanitation. Removal of diseased leaves and plants. Spraying with Bavistin @ 0.1% at periodical interval is advisable.

4.8 Sclerotinia Rot of Jewel orchids

Causal fungus: *Sclerotinia sclerotiorum*

Symptoms

Sclerotinia Rot of Jewel orchids, *Goodyera schlechtendaliana* and *Anoectochilus lanceolatus* is recorded for the first time in the orchidarium of National Research Centre for Orchids (ICAR), Darjeeling Campus, Darjeeling (2200 M MSL), India. Plants are chlorotic, wilted and collapsed. There is a soft watery rot at the basal portion, which gradually rot



Sclerotinia rot of Goodyera

the whole plants. Sometimes, several plants are infected at a time and all the plants fall down showing damping off symptoms. White mycelium gradually covers the collapsed plants. Black small sclerotia are formed on the rotted stem tissues. The rot caused death of 5% and 2% of *Goodyera schlechtendaliana* and *Anoectochilus lanceolatus* plants in the bed respectively.

Orchid hosts *Goodyera schlechtendaliana* and *Anoectochilus lanceolatus*

5. BACTERIAL DISEASES

5.1 Bacterial Soft Rot

Causal pathogen: *Erwinia carotovora* pv. *Carotovora* and *Erwinia chrysanthemi*

Symptoms

The disease appears as deep grayish green lesions on leaves. It causes leaf spot; leaf soft rot and finally stem rot with foul / fishy smell. Progressive rot of pseudobulbs and bulbs leads to soft, shriveled and burnt like appearance to them.

Hosts *Phalaenopsis*, *Paphiopedilum* and *Cymbidium*

Spread spread through rain splash / irrigation water.

Management approaches

It is suggested to use of disease free planting materials. Diseased

plants should be removed and sanitation should be carefully maintained. Sterilized potting mixture should be used. Treat plant materials with streptomycin or oxytetracycline solution before planting in sterilized potting mixture.

5.2 Bacterial Brown Rot

Causal pathogen: *Pseudomonas cattleyae*

Symptoms: Small soft, water soaked sunken spots on leaves that later become black / brown.

Host: *Cattleya*, *Phalaenopsis*, *Paphiopedilum* and *Dendrobium*

Spread Rain splash or overhead irrigation water.

Management approaches

It is advised to reduce prolonged wetness by increasing air circulation and the water retention capability of the growing medium. The infected leaves may be cut off to check further spread of the disease. Overhead irrigation should be avoided. The infected plants should be drenched or sprayed with 8 hydroxyquinoline at a dilution of 1: 2000 in water.

6. VIRAL DISEASES

Orchids are infected by a large number of plant viruses. So far, 30 different plant viruses are known to infect orchid species throughout the world. Among them, Cymbidium mosaic virus (CymMV) and Odontoglossum ring spot virus (ORSV) are the most important because of their high incidence and causing heavy losses to the orchids.

6.1 Cymbidium Mosaic Virus

Causal virus : Cymbidium Mosaic Virus

Symptoms

Symptoms vary from host to host. In *Cymbidium*, mild chlorotic mosaic or blotches occur on newly emerged leaves about 18-25 days after infection, which later turn black and necrotic. Leaves having severe necrotic areas drop prematurely in *Phalaenopsis*. CymMV



**Systemically infected
Cymbidium plant with
CymMV**

retarded plant growth and if severe infection occurred, flowers become malformed and root decayed. On *Oncidium* cv. "Golden shower" symptoms appear as sunken brown or black spots on the ventral surface of the leaves. The spots sometimes appear in concentric rings with few spots breaking through to the dorsal leaf surface. On *Epidendrum*, the infection leads to stunting and formation of brown or black oval spots on ventral surface.

Spread

CymMV is a mechanically transmitted virus. The virus is readily transmitted through knives or implements used during cutting, separation of bulbs and harvesting of flowers. Reusing pots or plant tags without a thorough scrubbing and subsequent sterilizing is another way to transmit virus. Virus may be transmitted by plant leaves rubbing together, or even just touching, on the bench and during transport to meetings or show/exhibition. Till now no vector is known to transmit the virus from one plant to another.



CymMV on leaf of Cymbidium

6.2 Odontoglossum Ring spot Virus

Causal virus : Odontoglossum Ring Spot Virus

Symptoms

ORSV symptoms are characterized by one or more concentric necrotic rings of green to black tissues on leaves. On *Cymbidium*, it cause diamond mottle and in *Cattleya* it appears as mild flower coloured breaking and flower necrosis. Leaves may develop black flecks and streaks. Sometimes OSRV in combination with CymMV

cause blossom brown, necrotic streak and blossom necrosis.

Spread Same as CymMV

Management of virus

Diseases

The key to prevent virus transmission from one plant to another is to sterilize any tools used before starting on the next plant. Garden tools can be sterilized in two ways.



ORSV on *Dendrobium*

Traditionally, heat treatment is the safest and most effective method of sterilizing tools. Reusable blades or knives should be heated in an oven at 149 °C for an hour. The most stable orchid virus ORSV can be inactivated by heating the blade of the cutting tools at 96-100 °C for few minutes. Just running the flame along the edge isn't adequate; the whole surface needs to get up to 205 °C or higher, even to the point where it begins to glow.

The tools can also be chemically sterilized by dipping them in alcohol before they are flamed. Liquid virus inactivating solutions are available in the market and can also be used to disinfect tools. 2% Clorox can be used to inactivate CymMV in cutting tools but not ORSV. A mixture of 2% sodium hydroxide and 2% formaldehyde has been recommended for treating cutting tools. 2% solution of Sodium hydroxide can effectively reduce ORSV infectivity by 86-96%. Trisodium phosphate (TSP) is another good virus inactivator because it produces a high pH in water solution.

When reporting, trimming leaves, or cleaning plants for show, wear disposable latex gloves, and discard them when work is over with that plant. The gloves keep your hands clean and protected from any potential disease are left on the glove and so it doesn't affect the next plant. If you don't wear gloves, wash your hands thoroughly with soap and water after each plant. Use a brush to remove dirt from around and under the fingernails and don't skimp on the soap - soap can destroy virus as well.

If metal stakes are used to tie up spikes, sterilize them after each use. Virus can be transmitted very well by reuse of stakes. Don't reuse bamboo stakes at all. Pores in the bamboo stakes can readily absorb loose virus particles, and the root damage resulting from staking guarantees contamination when used in a virus infected plant.

Crowding plants may also encourage the spread of virus. Not only insects can move easily from one plant to another in a crowded situation, but also water can easily splash from one plant to another, and the leaves moving in the wind and touching or rubbing against each other may result in the transfer of virus. Strict pest control, careful watering and vigilance will help to keep the incidence of viral infection to a minimum.

Disinfection of benches on which diseased plants were maintaining previously, is recommended for reuse. Spraying of 10% solution of Clorox or Trisodium phosphate are advisable on the bench surfaces. ORSV is stable and persists in plant debris for years; removal of all debris and roots from bench surface is essential prior to chemical treatment.

Sanitation through proper sterilization of pots is also essential, as orchid viruses are known to be transmitted from contaminated surface of pots. *Cattleya* seedlings planted in sphagnum from pots previously growing CymMV and ORSV infected plants has become infected. Potting substrate should not be reused.

Meristem culture with chemotherapy is a new technique to produce virus free plant in large scale. Thin section culture with chemotherapy i.e. addition of virazole @ 25 ppm on solid culture media produce 95% virus free plantlets. Besides, Virus free plantlet could be obtained from thin section culture of infected plantlet and PLBs with virazole treatment (Ribavirin).

7. GENERAL AWARENESS FOR DISEASE MANAGEMENT

Primary requirement for a disease to occur, the pathogen must be present in the infectious stage and, off course, must come in contact with the host plants. The environmental conditions certainly are

congenial for the infectious agent and the plant may be susceptible. Growers can do a number of things to break that cycle. Firstly they can minimize the amount of pathogen in the environment by keeping the growing space clean and free of old diseased leaves and plant material. They can keep infected plants out of the growing area and isolate new or diseased plants. They can alter the environmental conditions to discourage the growth of the pathogens. Lastly they can choose the resistant plants to disease and can grow plants that are strong and able to resist infection to some degree. In short, good culture plus good sanitation can prevent the majority of plant diseases.

8. KEY POINTS TO BE REMEMBERED TO REDUCE THE RISK OF ANY INFECTION

- Avoid to damage the plants either the leaves or roots.
- Avoid working with plants that are wet.
- Never allow water to drip from one plant to another.
- Maintain excellent air movement.
- Control insects that may transmit disease.
- Keep the growing area clean and free from plant debris.
- Keep the plant themselves clean and strip off old leaves and sheaths.
- Isolate diseased plants.
- Quarantine new plants.
- Always sterilize tools after each use.



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