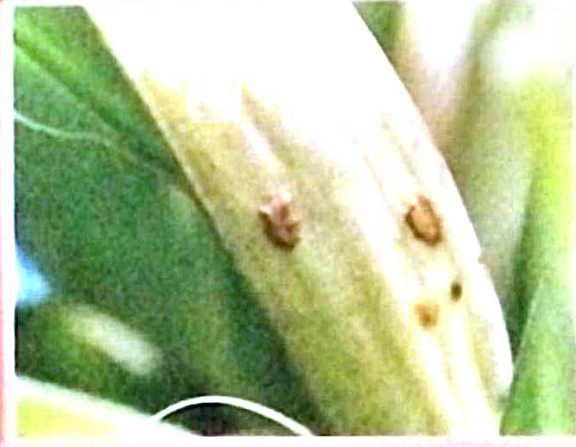




Production Technology of Aromatic *Acampe* & *Bulbophyllum* Species



**D. Barman, A. Mandal Khan
Raj Kumar and R.P. Medhi**



राष्ट्रीय आर्किड्स अनुसंधान केन्द्र

(भारतीय कृषि अनुसंधान परिषद्)

पाक्योड - ७३७१०६, सिक्किम, भारत

National Research Centre for Orchids

(Indian Council of Agricultural Research)

Pakyong - 737 106, Sikkim, India



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Cover Photographs

Front: (1st Row – L-R): *Acampe papillosa* and *Bulbophyllum leopardinum*

(2nd Row – L-R): *Bulbophyllum odoratissimum* and Scale insects

Back: Brief introduction & objective of NAIP

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Foreword

Orchids are known for their beautiful flower and their ability to travel long distances made them one of the top ten cut flower in international market.

Since time immemorial, floral fragrance has had a prominent influence on societal customs and much value has been placed on fragrant flowers and fragrances derived from them. As technology has advanced, people have been able to analyze the chemical compositions of different flower's scents and use them in consumer products, from perfumes to detergents and cleaning products to aromatherapy items.

The business of orchid trading is soaring up day by day. The trading is searching new avenue for the product and by-product. In search of by-product or value addition many orchids are used in fragrance and flavor industry and in medicines. Most of us are not familiar and unaware about the scent or aroma of orchids. In developed country, orchid scents are being used for various purposes. Floral scent present is due to some volatile essential oils which are highly concentrated substances extracted from various floral parts. There are so many *Acampe* and *Bulbophyllum* species in our India, of which some are scented. Most of the scented or fragrant species of *Acampe* and *Bulbophyllum* are rare, threatened and endangered in nature. Understanding the basic of the plant, climate factor and method of cultivation will help the conservation of these species.

This technical bulletin is largely based on the identification, climate factor and production technology of *Acampe rigida*, *Acampe papillosa*, *Bulbophyllum leopardinum*, *Bulbophyllum leptanthum* and *Bulbophyllum odoratissimum*. The authors have put their best effort to make the bulletin explanatory and handy. It has been scripted in such a way that it can be easily understandable to all.

It gives an immense pleasure to bring out this bulletin on "Production Technology of Aromatic *Acampe* and *Bulbophyllum* Species". I hope this bulletin will be useful to the orchid growers, scientists and students as well as entrepreneurs' interests in growing fragrant orchids.

February, 2014
NRC for Orchids,
Pakyong, Sikkim



Dr. R.P. Medhi
Director

Preface

Orchids with sweet fragrance are a pleasure in addition to the exotic appearance. Floral scent is used by the plants for its survival mechanism and pollination mechanism. Nowadays, fragrance in orchids is achieving new importance as this characteristic adds to the aesthetic appeal of the flower spikes besides determining the consumer choice as well as market price.

Fragrance of flowers results from the biosynthesis and emission of low molecular weight compounds. These compounds have a high vapour pressure sufficient to be released and dispersed into the air under room temperature conditions. Most of the volatile compounds are products of three main biosynthetic pathways: terpenoids, fatty acid derivatives and phenyl propanoids.

Fragrance of orchid is due to the presence of volatile aromatic oils produced in minute quantities on floral parts from sepals, petals, calluses, basal spurs to petioles. The oily fragrant substances change into vapour form enabling the flowers to smell. Only some of the odoriferous compounds released by a flower are detectable by human sense of smell but not all. The emission of scent depends on the temperature and light condition of the area where it is grown. Orchids emit scent at morning, late noon and evening or night. Both quantity and quality of the released scent often shows a close correlation with time of the day, flower age and weather conditions. Essential oils of orchids may be extracted by hydro-distillation,

steam distillation, extraction with low boiling solvents and with liquefied gases.

I sincerely thank Dr.R.P.Medhi, Director, NRC for Orchids for his encouragement and support for writing this bulletin. I profusely thank Prof. S. N. Puri, V-C and Mission Leader (NAIP); Dr. P. K. Srivastava, Dean and Principle Investigator; Dr. S. N. Yadav, Associate Professor and Co PI, CAUPHT, Ranipool; Dr. Rajendra Gupta, Chairman, CIC(NAIP) for their continuous encouragement to bring publication of these unexploited crops. My sincere thanks are also for the Scientists, RAs and SRFs who help in writing the bulletin and farm workers who nurtured these orchids as their baby.

This bulletin covers botanical descriptions, growing environment, package of growing practices, important diseases and insect pests and their control measures of aromatic *Acampe rigida*, *Acampe papillosa*, *Bulbophyllum leopardinum*, *Bulbophyllum leptanthum* and *Bulbophyllum odoratissimum*. I hope it will be helpful for the orchid growers in cultivating aromatic orchids scientifically and can increase their production qualitatively and quantitatively.



(D.Barman)
Pr. Scientist (Hort.) &CCPI (NAIP)

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Acampe rigida Hunt.

Introduction

Acampe rigida is commonly called the 'Rigid Air-Blossom' orchid describing its small stiff blooms. This epiphytic orchid is found to grow on tree trunks or large branches and also as lithophytes on the summit of limestone hills on exposed positions.



Acampe rigida

Habitat and Distribution

The species is widespread throughout the tropics, including Asia and Africa. In Asia distribution extended from north-west



Acampe rigida growing on rocks

Himalayan region to north-east India, Sri Lanka, Burma, Thailand, Malaya, Cambodia, Laos, Vietnam and China. In Africa the species is found from Transvaal to Kenya, on the islands of Mombasa, Madagascar and Comore Island. In Sikkim it is found in Khamdong, Singtam, Tarku, Kewzing and Phurchachu areas.

The species can grow from 300m to 1200m altitude. In India (Sikkim) and Bhutan, these plants are found in tropical valley at about 1200m above the sea level, whereas, in Sri Lanka, they are found in the tropical wet evergreen forests at 300-910m elevation. In Thailand, plants grow naturally in northern and western mountains at 460-600m elevation as well as in the Thai Peninsula and on Langkawi Island and in Vietnam, it is distributed near Cao Bang and Ha Giang from 300-800m above mean sea level.

Description of the plants

Habitat: *Acampe rigida* is epiphytic in nature and rarely lithophyte.

Plant: It is a robust, monopodial orchid and grows about 60cm tall and densely leafy.

Stem: The stem is long; very stout, branched, covered with fibrous remnants of leaves sheaths. Long stout aerial roots shoot off from the lateral sides of leaf base.

Leaves: The leaves are oblong, thick, coriaceous with board unequally bi-lobed, channeled apex. The remnants of fibrous leaves sheath cover the stem.

Inflorescence: Inflorescence is a sub-corymbose raceme arising from the opposite side of the leaf.

Flowers: The fragrant, long lasting flowers are fleshy, about 2 cm across, yellowish-green in colour with reddish-purple short horizontal stripes and opens partly.

Sepals: Sepals are sub-equal, elliptic-oblong, sub-acute, lemon-yellow with transverse reddish-purple strips. The tip of

the dorsal sepal is obtuse with little notch and arch over the column. The lateral sepals are acute.

Petals: The petals are oblong-ob lanceolate, narrower than the sepals. They are marked with reddish-purple transverse strips on lemon yellow base.

Lip: The three lobed lips are white, dotted sparsely with reddish purple spots. A short conical spur is present at the base. The lateral lobes are erect, narrow and hairy inside while the apical lobe is ovate, very fleshy, slightly recurved.

Column: The column is minute, with two short horns and a very short foot.

Ovary: The pedicellate ovary is thick, slightly boarder at the base and faintly grooved.

Anther: Anther is conical with two chambers.

Pollinia: 4 in number, the inner two are smaller.

Fruit: 8-10cm long and grooved.

Flowering time: *Acampe rigida* flowers during May – June.

Acampe papillosa Lindl.

Introduction

Acampe papillosa is also known as 'Small Warty Acampe'. It is a vandaceous epiphyte, native to the eastern Himalayas. The species has compact and clumping growth habit with stout, erect to curved stem and curved leaves that grow in the fall each year. The small flowers are yellow with reddish–orange marking, strongly fragrant, long lasting and are held close to the leaf axial in a short inflorescence.



Acampe papillosa

Habitat and Distribution

The species is found in Asia and distributed in India, Bangladesh, Nepal, Sri Lanka and Myanmar. In India it is found in North West Himalayas, Sikkim and West Bengal. The plant occurs mainly in the deciduous and semi deciduous lowland forest at elevation of 600- 1600meters. It is distributed in Singtam, Rangpo, Rorathang, Rothak, Nayabazar, Bazek,

Jorathang, Chibirey-Tar, Kitam and meli areas of Sikkim.



Acampe papillosa

Description of the plants

Habitat: *Acampe papillosa* is epiphytic in nature.

Plant: The plant is around 50-90cm tall.

Stem: The long stem grow pendulous from the tree branch and recurve afterwards to produce an erect growing apex. The stem remains enveloped in the overlapping tubular remnants of leaf sheaths. Stoloniferous roots protrude from the stem nodes.

Leaves: The leaves are oblong, rounded and obliquely notched at apex, thick and coriaceous.

Inflorescence: The inflorescence is a short sub-umbellate, simple or paniced raceme, densely packed with many tinyflowers. It emerges opposite to leaves. In the simple receme inflorescence, the peduncle is slightly zig-zag and enveloped in 2 to 3 thick, over lapping, stem clasping sheaths whereas, in branched panicle raceme, the main peduncle is sub-umbellate, with 3 to 4, radiating pedicellate flower.

Flower: The flowers are small, long lasting and emit sweet fragrance. They are dark yellow in colour with brown spots on petals and sepals.

Sepals: The sepals are sub-equal, ob-ovate–oblong to elliptic-oblong, pale green - marked with horizontal brown streaks on the lower side and blotched with brown at the apical end. The dorsal sepal is smaller and slightly concave at tip while the lateral pair is spreading.

Petals: The petals are smaller than the sepals, narrowly elliptic, pale green in colour with horizontal brown streaks and brown blotches at the tip.

Lip: The lip is tri-lobbed, elliptic–oblong, white marked with purple horizontal bars. The conical spur lies parallel to the pedicel.

Column: The glabrous column is quadrate with two minute triangular wings at the apical portion and base and bordered with reddish brown.

Anther: Anthers are pale yellow and broadly conical with two pollina.

Ovary: The pedicellate ovary 5 to 8mm long ribbed, pale green and glabrous.

Flowering: The blooming season of the *Acampe papillosa* is June to December.



Plant of *A. papillosa*

Environment

Temperature: Temperature is a very crucial factor in determining the optimal growth and flowering of orchids. Quality flowers are produced only when the plants are exposed to optimum temperature for metabolic activities. Natural species of orchids require a temperature regime under cultivation that is more or less similar to their places or origin or natural habitats. Small and young orchids will prefer about 5°C more temperature than mature plants. If the plants are going through a cooler temperature range than the optimum, then keeping the plant on drier side will help. Reversely, if the plants are going through hotter temperature range than the optimum, keeping humidity level high can avoid injury. The temperature should not below 13-15°C in winter and not below 21°C in summer.

Light: *Acampe* prefer high intensity of light. It prefers light intensity of 2000-4000 foot candle light for proper growth and flowering. A site receiving bright sunlight in morning and less light at afternoon should be selected. If grown in green house, 25-50% shade net is required during noon for the period of April to June. During rainy and winter season shade net is not necessary.

Humidity: During the growing season, it prefers high humidity and plenty of water. *Acampe* require 60 to 80% humidity during entire growth period. The humidity can be raised by damping the foot path in winter or dry month.

Aeration: Being an epiphytic orchid the plants like free air

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Aeration: Being an epiphytic orchid the plants like free air

circulation. Free circulation of air reduce the disease intensity of plants.

Production techniques

Culture: *Acampe rigida* and *Acampe papillosa* are epiphytic orchids belonging to the tropical and sub-tropical zone, so, are best grown in hanging pots or baskets or mounted on cork or tree fern slabs. The potting media can be prepared by mixing 2 parts bricks, 1 part charcoal and 1 part coconut husk chunks. The plants can also be grown on stone wall crevices in open sunlight. These orchids require high humidity, adequate light, good ventilation and abundant water.

Feeding: In wild, these epiphytic species depend on minerals arising from the break down of tree bark, droppings of birds and decomposing materials in very low amounts that have dissolved in rain water for their nutrition. Accordingly, in the controlled condition external fertilization is required in minute doses. The main elements supplied through fertilizers are nitrogen (N), phosphorous (P) and potassium (K) in different composition ratio depending on the plant growth stage. During vegetative growth a combination of N:P:K at 20:20:20 is applied at 0.2% dilution whereas during reproductive stage a weaker solution of N:P:K at 10:20:30 ratio is to be applied at 0.1% dilution. Fertilizers should be applied weekly as a foliar spray. Calcium, Magnesium and other micronutrients are also applied during productive stage @ 0.1% at monthly interval.

Potting and repotting: The *Acampe* is a monopodial orchid and like most of the monopodials is like to get straggly as they grow upward. So, repotting is required to provide proper pot size to the pot-bound orchids as well as to replace the decomposed and exhausted media with new one. Potting also provides the best opportunity to check the health of the plant. The potting and repotting should be done during active growth phase. For potting the combination of coconut husk, charcoal, brick chips is used. The first step of repotting is to cut off the spent inflorescences and damaged and dead roots. Then cut the stem just below the node producing new and active roots. Remove the old and shriveled section. Dab the cut stem with a fungicide paste to avoid infection. Now, select a right size pot or basket, which is not too large for the plant but provides adequate space for several years of growth. To pot an *Acampe*, a rigid bamboo stake is required to be fixed in the center of the pot or basket. This helps to reposition the plants root mass closer to the center. After fixing the stake at center of the pot the plant is fastened to the stake securely with a tie in upright position. Potting media of coconut husk, charcoal or shredded bark and brick pieces are to be added to fill the pot. Care should be taken to place the roots over the media. Avoid any large unfilled cavities while potting.



Potting and repotting

Irrigation: The plants should be irrigated thoroughly when the media has dried up. This can be judged by putting a finger inside the media. If it feels moist watering should not be done. However, the plants might be sprinkled with water on hot summer time to maintain humidity and temperature.

Pest and Disease management

Pests

Yellow aphid

This species of aphid is pale green colour during nymph stage and greenish yellow to yellow colour in adult stage, oval shaped and minute size about 2 to 3mm in length. Blackish two cornicles are present on the tip of abdomen. Adults are winged or wingless. Wingless form has brownish patch on the top of the abdomen.



Yellow aphid

Nature of damage

Both the nymphs and adult suck the cell sap usually from flower spikes, flower buds and flowers. Small, irregular shaped spots appear on the petals and sepals due to loss of cell sap. They also excrete honeydew on which sooty mould develop that affect the photosynthesis. High humidity and cloudy weather fasten the population build up. The affected plants retard growth and ultimately deteriorate the quality of flowers. They are also

believed to transmit some viral diseases from infested to healthy plants.

Management

As soon as the pest appears on the new spikes or flower buds before opening the flowers, initially spray the plants with tobacco leaf extract (10ml/l) or Neem oil 0.03 EC (Azadirachtin) 5ml/l of water to reduce the aphid population. In case of reappearance the plants should be treated with insecticides like Endosulfan 35EC or Malathion 50EC or Acephate 75SP at 0.5% or Imidacloprid 17.8SL (Confidor) at 0.003% at 10 to 15 days interval.

Shoot borer

Shoot borer is also a serious pest of many species of orchids. Adults are small moth, black in colour with white spots on the wings, about 8 to 10mm in length across the wings. Caterpillars are small in size with tiny black head and yellow to creamy in colour.



Shoot borer

Nature of damage

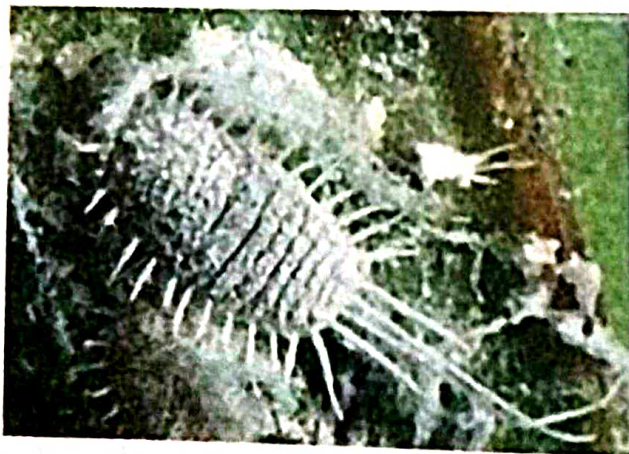
Young larvae bore downward into the shoots, make tunnel and feed therein leaving excreta at opening of hole. Shoot growth is checked and dead shoots or yellow shoot flag produced. As a result, plant growth is checked and flower production gets affected.

Management

The pests can be suppressed by cutting and destroying the infected branches on which dead shoots are produced. Spray the plants with Achook 1500ppm 5ml/l of water or Eco neem plus 3000ppm 3ml/l or Malathion 50EC or Endosulfan 35EC @ 0.05% and if required, repeat the spray at 10 days interval to control the insect.

Mealy bug

Mealy bugs cause damage to orchids in open nursery or under controlled conditions. Adults are soft, filamentous, pink or yellow coloured. The body is covered with white powdery wax like cottony growth in irregular shape. It has piercing and sucking type of mouthparts with long antennae.



Mealey bug

Nature of damage

Both young ones and adult suck the cell sap from the leaves and petioles or any jointed portion of plants as a result plants become weakened. They also secrete honeydew that attracts ants. In case of severe infestation sooty mould develop on infected plant parts. The infested plant looks wilted resulting

poor quality of flowers production.

Management

Remove and destroy infested plant part. Maintain proper distance within the plants to reduce the pest infestation. Spray insecticides like Malathion 50EC or Endosulfan 35EC at 0.05% or imidacloprid 17.8 SL (confidor) @ 0.003% to curtail the mealybug population. Generally two sprays are required with any one of the above mentioned insecticides at 10 to 15 days intervals.

Disease

Leaf spot

Symptoms of leaf spot start usually on the under surface of leaf as small yellow spots. Soon the infected tissues become necrotic, dark brown or black and sometime sunken.



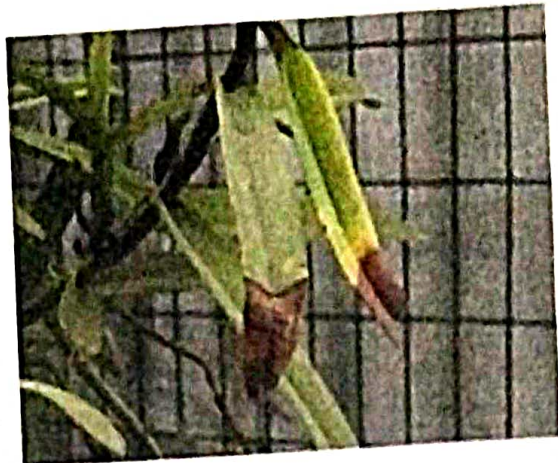
Leaf spot

Management

Provide good sanitation to prevent the occurrence and spread of the disease. Spray Bavistin @ 0.1% at periodical interval to control.

Anthracnose

Initial symptoms appear as the small oblong to circular oval, sunken and reddish brown to dark brown or gray coloured spots. On the spots black, raised dots are found like target board appearances. The disease also infects floral spikes and leaf sheaths.



Anthracnose

Management

Avoid over exposing of plant to direct sunlight and irrigation through misting. Spray Captain @ 2g/l or Carbandazim (Bavistin) @ 1g/l at 15 days intervals.

Leaf tip die back

Leaf tip turn brown at the apex and proceeding towards the base.



Leaf tip die back

Management

Remove dead tips. Spray Bavistin or Dithane Z-78 or Indofil @1g/l at 15 days interval effectively to control the disease.

Bulbophyllum leopardinum Lindl.

Introduction

Bulbophyllum leopardinum belongs to family Orchidaceae is a plant widely distributed in China, Nepal, Sikkim, Bhutan, India, Burma, Thailand, Laos and Vietnam and used in folk medicine to treat tuberculosis, chronic inflammation and fracture. *Bulbophyllum leopardinum* is a cool to warm growing plant, bear very nice fragrance flowers.



Bulbophyllum leopardinum

Distribution

Plant is found in evergreen lowland forest in Himalayas, India, Nepal, Bhutan, Sikkim, Myanmar, Thailand, Laos, Vietnam and China at an elevation of 800 to 2500 meters. In Sikkim it is available in Chungthang, Shipgyear, Dzongu, Mangshla, Phodong, Dickchu, Pangthang, Bhusuk, Pakyong, Temi, Damthang, Ravongla, Ralong, Gyalzing, Yaksom and Uttery.

Description of Plant

Habitat: This orchid is epiphytic or lithophytic.

Pseudobulb: Pseudo-bulb is compressed, borne obliquely on stout very short rhizome.

Leaf: The leaves are terminal, elliptic-oblong, obtuse and

tapering.

Inflorescence: Inflorescence is raceme from the basal of pseudo bulb.

Peduncle: Peduncle is glabrous and terete.

Rachis: It is small in size.

Ovary: The ovary is pedicellate, ribbed and glabrous.

Flora bract: Ovate acute.

Flowers: Flowers are pale yellow scattered with scarlet spots.

Sepal: Sepals are sub equal thick translucent, pale yellow scarlet spots, keeled; the dorsal sepal ovate sub acute, concave, arched over column; lateral pair oblong, ovate, slightly twisted, tip sub acute and thickened.

Petals: Petals are oblong-ovate, acute translucent yellow with scarlet spot.

Lip: Lip is fleshy, ovate, lanceolate, obtuse, entire, pale white suffused with scarlet red de- curved from below the middle; the base with small toothed auricle near the attachment to the much curved foot of the column; the upper surface concave and with an elongated nectar secreting grooved expanding it at base into a triangular.

Column: Column is triangular wing, side lobe acute, thick, yellow, no rostellum.

Anther: Anther is conical shape.

Pollinia: There are four pollinia of which inner two reduced.

Flowering: The flowering time is July – August.

Bulbophyllum leptanthum Hook.

Introduction

Bulbophyllum leptanthum belongs to family Orchidaceae is a plant widely distributed in China, Nepal, Sikkim, Bhutan, India, Burma, Thailand, Laos and Vietnam and used in folk medicine to treat tuberculosis, chronic inflammation and fracture. It bears very nice fragrance. It is a miniature species which grows in full shade and high humidity with good air movement. The inflorescence appears from late spring through to late summer and up to 15 flowers are clustered at the end of the inflorescence.



Bulbophyllum leptanthom

Distribution

Plant is found in evergreen lowland forest in Himalayas, India, Nepal, Bhutan, Myanmar, Thailand, Loas, Vietnam and China at elevation of 800 to 2500 meters. In Sikkim it is available in Teesta Valley.

Description of the Plant

Habitat: The plant is epiphytic or lithophytic.

Pseudo bulb: Pseudo bulb is cylindrical, glabrous, without ridges erect with short carious sheath at base and branched rhizome.

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Description of the Plant

Habitat: The plant is epiphytic or lithophytic.

Pseudo bulb: Pseudo bulb is cylindrical, glabrous, without ridges erect with short carious sheath at base and branched rhizome.

Leaf: Leaf is narrowly oblong obtuse notched slightly narrowed towards the sessile base.

Inflorescence: Inflorescence is long, erect and slender and arises either from the base of the pseudo bulb or from any points on the rhizome.

Peduncle: Peduncle is long, erect, terete and glabrous.

Flowers: Flowers are three to four in number in an umbel and yellowish green colour.

Ovary: Ovary is pedicellate, long, shallow ribbed and glabrous.

Floral bracts: Floral bract is long, lanceolate and acuminate.

Sepals: Sepals are sub-equal, lanceolate, caudate-acuminate and glabrous.

Petals: Petals are elliptic, ovate and acute.

Lip: Lip is long, ovate –oblong, obtuse, decurved from the thickened stipitate and slightly grooved base and the margin is pale yellow.

Column: Column is short, stout and glabrous, with small triangle apical process, with narrow wing pale yellow blotches of orange and tapering to apex.

Anther: Anther is fleshy convex belt in the middle, its lip truncate.

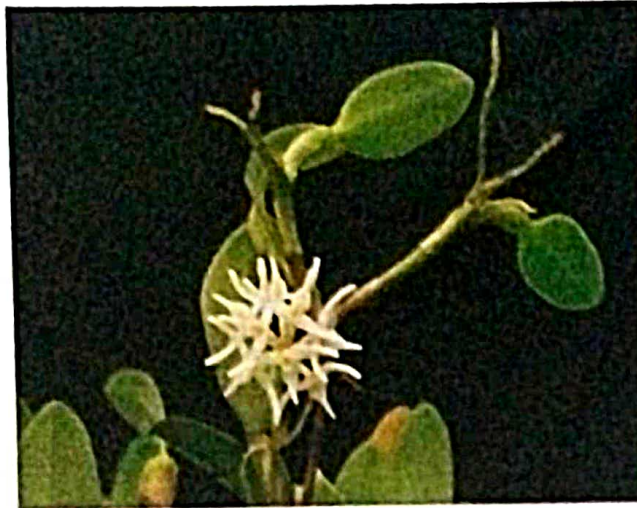
Pollinia: Pollinia are narrow, oval unequal and its broader end is diverging.

Flowering: The flowering time of this species is July.

Bulbophyllum Odoratissimum Lindl.

Introduction

Bulbophyllum odoratissimum is a sweet scented species found in South East Asia. In nature it is found in semi shade condition in the tree or in big stone covered with moss. The inflorescence arises from the base of bulb and bear 4-5 flower in an umbel. The flowering occurs during May to August.



Bulbophyllum odoratissimum

Distribution

Plant is found in evergreen forest in North East Himalayas of India, Nepal, Myanmar, Thailand, Vietnam and China at an elevation of 800 to 1000 meters. In Sikkim it is distributed in Dzongu and Rathangchu area.

Description of the Plant

Habitat: It is epiphytic or lithophytic orchid.

Pseudobulb: The pseudobulb is cylindrical, erect, pale yellow, glabrous obscurely ribbed.

Leaf: The leaf is erect, oblong, tip obtuse and notched.

Inflorescence: The inflorescence is long, erect, arise from the pseudobulb, ovate, oblong, acute to acuminate, many-nerved, pale white open mouth, and stem clasping.

- Rachis:** The rachis is terete, glabrous and curved.
- Ovary:** The ovary is pedicellate, pale and glabrous.
- Floral bracts:** Floral bracts are translucent, pale, lanceolate, acute, and glabrous and persistent.
- Flower:** The flower is pedicellate form globular head, fragrant, white with orange yellow lip and glabrous.
- Sepals:** Sepals are spreading, white to pale- yellow, anterior margin enrolled to form cylindric tip tinged with deep yellow.
- Petals:** Petals are acute, translucent white.
- Lip:** Lip is oblong – ovate, subacute, slightly curved, orange yellow, glandularly hairy, raised lamellae starting from the base till near the apex, in between the lamellae lies in the narrow channel which widens up at the tips, margin of the narrow horizontal flap of the lip also with white glandular-hairs.
- Column:** The column is white and glabrous.
- Anther:** The anther is ovate and papillose.
- Pollinia:** Pollinia are long very unequal, inner one smaller, orange yellow.
- Flowering:** The flowering time of this species is May to August.

Environment

Temperature: The majority of *Bulbophyllums* are comfortable in a temperature range of 7° C to 35° C. Some of the higher elevation *Bulbophyllums*, such as those from the Himalayas and New Guinea mountains prefer cool temperatures for part of the year and can be a little difficult in warmer areas. Temperature ranges vary somewhat with species, but many can cope with freezes. Summer days average 18° C - 19° C, and nights average 13- 14° C, with diurnal range of 4- 5° C. Plant adapt to warmer afternoon temperatures if humidity is kept, high if air movement is strong, and if the plant are able to cool down in the evening. In green house, the temperature can be control to some extend by opening the side vent.

Light: Preferred light conditions are bright shade. If adjusted slowly, full morning sun up to noon is enjoyed by most *Bulbophyllums*. The light can be controlled by providing shade net insight the house. Depending on the situation, 50-75% shade net can be provided during hot summer month. In winter shading net is not require for *Bulbophyllums*.

Humidity: The single dominant factor which affects the cultivation of *Bulbophyllums* is humidity which should be high as 50%- 75 %. It varies species to species depending upon habit of growth, light, temperature and ecotype. Provision of misting units or foggers or even humidifiers will ensure adequate humidity. Relatively high levels of humidity are needed, (about 50-75%) so moist air is essential. The humidity can be maintained in green house by sprinkling water in the footpath and floor or by running mist.

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Aeration: Like other epiphytic orchids it prefers gentle aeration. In green house provision of air circulation fan is required. Good air circulation helps to prevent botrytis or bacterial/fungal infection.

Cultivation techniques

Potting mix: Potting mix combination of coconut husk chunks, brick chips, rotten log and bark and sphagnum moss is best suited for growing of *Bulbophyllums*. Plant grows well on the tree block or in shallow pan or basket that allow their creeping growth. They prefer to remain undisturbed as long as possible. They can be mounted on wooden block with moss.

Potting and repotting: The potting and repotting of *Bulbophyllums* should be done during active growth phase or after flowering particularly during spring season. For potting the combination of coconut husk, charcoal, brick chips is used. The first step of repotting is to cut off the death spike, damaged and dead roots and diseased leaves. Then cut the stem just below the node producing new and active roots. The cut stem required to treat with a fungicide solution (1.5g/l) to avoid infection. Now, select a right size pot or basket,



Bulbophyllum leopardinum in pot

which is not too large for the plant but provides adequate space for several years of growth. After potting or repotting, plants need to keep in shady place at least for 15 days, during which no fertilizer or water is applied to encourage rooting of plants. If necessary, a rigid bamboo stake is required to be fixed in the centre of the pot or basket. This helps to reposition the plants root mass closer to the centre. After fixing the stake at centre of the pot the plant is fastened to the stake securely with a tie in upright position. Care should be taken to place the roots over the media. Avoid any large unfilled cavities while potting. The plants can be tied in wooden block or tree fern block with moss.

Watering: Green house plants require normal watering. The growing media should be completely saturated and excess water runs out of the bottom of the pot. Should not water just a little bit; this allows minerals salts to build up in the media. The key to normal watering during the growing season, may dictate that water more frequently. Also, some plants that require normal watering during the growing season, many require less during the winter months when they are dormant. Cultivated plants should be watered heavily while actively growing, but the medium must not be allowed to become stale or soggy. Water should be reduced after new growth mature in autumn. Water requirement greatly varies among species. Plant should be kept moist until bulbs are fully grown. Most orchids are damaged by overwater rather than watering. Excess watering causes root rot and many other diseases. Most orchids prefer water of pH 5.0- 6.5. Watering with lower or higher pH with high levels of dissolved minerals can hamper nutrient uptake. Frequent watering is essential under high sunlight and high

temperature conditions. Watering should be practiced either in the morning or in afternoon time. Potting material like coconut husk, tree fern etc having more moisture retention capacity needs less water and less frequently and vice versa.

Feeding: In wild, these epiphytic species of *Bulbophyllums* received minerals arising from the breakdown of tree bark, droppings of birds and decomposing materials in very low amounts that have dissolved in rain water for their nutrition. Accordingly, in the controlled condition external fertilization is required in minute doses. The main elements supplied through fertilizers are nitrogen (N), phosphorous (P) and potassium (K) in different composition ratio depending on the plant growth stage. During vegetative growth a combination of N: P: K at 20:10:10 is applied at 0.2% dilution whereas during reproductive stage a weaker solution of N: P: K at 10:20:30 ratio is to be applied at 0.1% dilution. Fertilizers should be applied weekly as a foliar spray. Calcium, Magnesium and other micronutrients are also applied during productive stage @ 0.1% at monthly interval.

Propagation: *Bulbophyllums* being sympodial orchid can be propagated by division of plants. Each division is planted in pot with suitable potting mixture or can be mounted in basket or wooden block.

Care after flowering

The flowers of *Bulbophyllum* are delicate so utmost care should be taken while watering or spraying of pesticides.

Pests and Diseases management

Pests

Scale :

Scale are sticky to elongated pear shaped, small sized, brown to dark brown coloured, flat bodied and without any permanent body organs like wings, legs or eyed. It looks dried rather than plump like dead ones.



Scale insects

Nature of damage

Scale insect sucks the juice from leaves, petiole, pseudo bulbs, flowers and cause loss of vigor and deformation of infested plants. Heavy scale infestations reduce overall plant health and cause yellow leaves, leaf drop and stunted new growth. The quality of flower produced from infested plants deteriorated which affect the market value.

Management

Cleanliness and regular care is necessary. Prompt isolation of infested plants from other to prevent the scales from moving one plant to another. Scales can be removed by rubbing the scurf encrustation with tooth brush or cotton swab dipped in 70% Isopropyl alcohol or methylated spirit. If scale infestation found

on root, repotting should be done to eradicate harboring eggs and crawlers and after gentle cleaning, roots should be sprayed with insecticides. Spraying of Malathion 0.05% or Monocrotophos 0.05% or Acephate 0.05% or Neem oil 3ml/l would help to reduce scales infestation.

Mealy Bug :

Adult are soft, filamentous pink or yellow coloured and body is covered with white powdery wax like cottony growth in irregular shape. It has piercing and sucking type of mouthparts with long antennae.



Melay bug

Nature of damage

Mealy bug damage Bulbophyllum orchids in open nursery or under controlled conditions. Both young and adult suck the cell sap from the leaves and petiole or any jointed portion of plants as a result plants become weakened. In case of severe infestation sooty mould develops on infected plant parts. The attacked plant looks like wilted plant resulting poor quality of flowers production.

Management

The cultural methods are removal and destruction of infested

plant parts and proper distance within the plants to reduce the pest infestation. The chemical control is to spraying of insecticides like Malathion 50EC or Endosulfan 35 EC at 0.05% or Imidacloprid 17.8 SL (confidor) @ 0.003% to curtail the mealy bug population. Generally two sprays are required with any one of the above mentioned insecticides at 10- 15 days intervals. Organic insecticide Neem or Pongamia oil 3ml/l is also effective to control the pest.

Aphids: These aphids are pale green, yellow and black colour in adult stage. They are oval shaped and minute size about 2 to 3mm in length. Adults are winged or wingless. Wingless form has brownish patch on the top of the abdomen.



Aphids

Nature of damage

Both the nymphs and adult suck the cell sap usually from floral parts. Small, irregular shaped spots appear on the petals and sepals due to loss of cell sap. They also excrete honeydew on which sooty mould develop that affect the photosynthesis. The affected plants retard growth and ultimately deteriorate the quality of flowers. They are also believed to transmit some viral diseases from infested to healthy plants.

Management

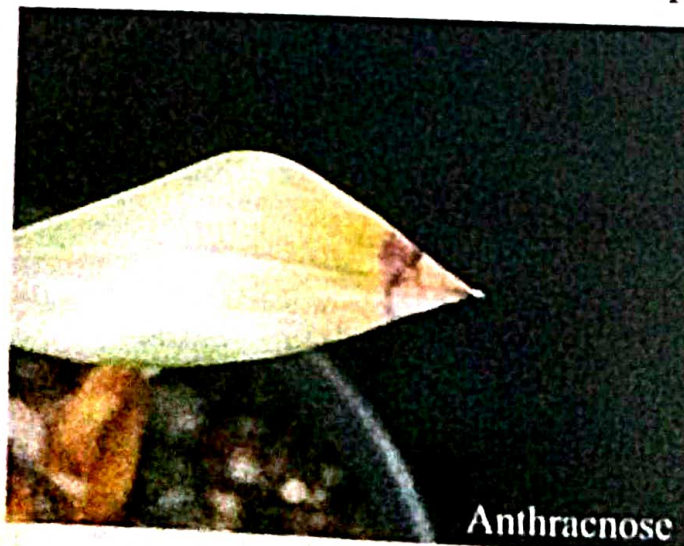
Initially spray with tobacco leaf extract (10ml/l) or Neem oil 0.03 EC (Azadirachtin) 5ml/l reduces the aphid population. Plants should be treated with insecticides like Endosulfan 35EC or Malathion 50EC or Acephate 75SP at 0.5% or Imidacloprid 17.8SL (Confidor) at 0.003% at 10 to 15 days interval if appearance again.

Diseases

Anthracnose

Symptoms

Initial symptoms appear as the small oblong to circular oval, sunken and reddish brown to dark brown or gray coloured spots. On the spots black, raised dots are found like target board appearances. The disease also infects floral spikes and leaf sheaths.



Anthracnose

Control measures

Maintenance of proper growing condition with adequate

nutrition should be done. Avoid over exposing of plant to direct sunlight. Spraying of Carbandazim (Bavistin) or Fixil @ 1g/liter in case of incidence of the disease at 15 days intervals or application of *Trichoderma viridae* 2g/pot may be effective to control the disease.

Bulb/ Pseudobulb rot

Symptoms

The pseudo bulbs/ bulbs of infected plants become dark brown to black in colour and the rot also extends up to the leaves. In the later stage of infection, the entire pseudobulb tissues get rotten. Root rot has also occurred in severe infestation.



Pseudobulb rot

Control measures

Proper aeration, avoid excessive watering and maintenance of proper drainage are the basic cultural operation to avoid diseases. Application of organic Bordeaux mixture 2g/pot during rainy season are effective to control the disease. Spraying with Fixil @ 1g/l or Bavistin 2g/l at 7 days intervals is effective against the disease.



Welcome to NAIP

The National Agricultural Innovative Project (NAIP) is to facilitate accelerated and sustainable transformation of Indian agriculture in support of poverty alleviation and income generation by collaborative development and application of agricultural innovation by the public research organizations in partnership with the farmer's groups, the private sector, the civil society organizations and other stakeholders.

Objectives

- Facilitation of methods of propagation and mass multiplication of quality planting materials of targeted aromatic plants (input supply).
- Refinement of cultivation practices of targeted aromatic crops under Sikkim conditions (Production).
- Exploration and fine-tuning of plant/location (altitude) specific post harvest management, value addition and residue utilization technologies of targeted plants to extend shelf life, retain quality and develop novel products etc. (post harvest management, processing and value addition).
- Conduct market research and create database for market intelligence and GI status to enable higher economic returns to concerned stake holders across the supply chain (marketing).
- Capacity building of primary and secondary stake holders through knowledge sharing, dissemination and demonstration, training and entrepreneurship development/promotion. (Collective action and use of ICTs).

