

Dendrocalamus strictus, only two to three concentric rings develop around the central spot. In *Pseudoxytenanthera ritcheyi* and *Thyrsostachys* sp., after the development of one or two rings around the central spot, under very humid conditions, the outer ring, coloured deep magenta to dark brown, spreads to the entire leaf lamina.

CAUSAL ORGANISM

Dactylaria bambusina Mohan. (Mohan 1994a, b; 1995d).

ETIOLOGY

The causal fungus enters the host tissue through stomata. Proliferation of fungal hyphae in the mesophyll causes necrosis of the tissues. Warm-humid environmental conditions favour the development and spread of infection. Conidiophores develop from the necrotic tissues, and the conidia produced abundantly serve as the secondary source of inoculum.

CONTROL

Since the disease is not a serious one, control measures are seldom required.

■3 Colletotrichum Leaf Spot

The disease has been reported in different species of bamboos in Malaysia (Azmy and Maziah 1990) and India (Mohan 1990, 1994b). In Malaysia, the disease has been recorded on *Gigantochloa ligulata* Gamble, *Bambusa vulgaris*, *B. vulgaris* var. *striata*, *Dendrocalamus asper* (Schultes) Baker ex Heyne, *D. giganteus* Wallich ex Munro, *D. pendulus* Ridley, *Gigantochloa levis* (Blanco) Merr., *G. latifolia* Ridley,



G. rostrata Wong and *G. scortechinii* Gamble. In India, the leaf spot has been recorded on *Arundinaria* sp., *Bambusa bambos*, *Dendrocalamus strictus*, *Ochlandra travancorica*, *O. ebracteata* and *O. scriptoria*.



Fig. 80: Leaf spot in *D. strictus* caused by *Colletotrichum gloeosporioides*



Fig. 81: Leaf spot in *B. bambos* caused by *Colletotrichum gloeosporioides*

SYMPTOMS

Water-soaked, small, greyish brown spots occur on juvenile as well as on mature leaves. These spots spread and coalesce to form large, dark brown to purple, linear to irregular areas, which often cover the entire leaf lamina. Infected foliage become pale yellowish green and leathery. Infected leaves also show symptoms of chlorosis, which later turns necrotic during advanced stages (Figs. 80, 81). The necrotic area often becomes thin and detaches very easily, and shot-holes are formed. Infection also spreads to branches and minor branches, causing discolouration and necrosis. Severe infection results in premature defoliation.

CAUSAL ORGANISMS

Colletotrichum gloeosporioides (Penz.) Penz. & Sacc., anamorph of *Glomerella cingulata* (Stonem.) Spauld & Schrenk. (Azmy and Maziah 1990; Mohanan 1990, 1994a,b) and *Colletotrichum* sp. (Azmy and Maziah 1990).

ETIOLOGY

During the wet months of the year,



the conidia of the fungus are dispersed by wind or rain splash. Infection starts when conidia develop appressoria and infection hyphae penetrate the host tissues. Moderate temperatures (25-28°C), high humidity and free water on the host surface are the optimum conditions for the development and spread of the disease. Fungal conidia, as well as ascospores produced in the affected necrotic tissues under high humid conditions, serve as sources of secondary infection.

CONTROL

Plant sanitation, such as regular cleaning of bamboo clumps, has been suggested to reduce the incidence of infection. Fungicides — Thiram (0.2% a.i.), Benlate (0.05% a.i.) or Captan (0.1% a.i.) — are recommended as foliar spray in severely infected young bamboo clumps.

14 *Ascochyta* Leaf Spot

The disease has been reported in bamboo plantations and natural stands in India, Japan and the Philippines. The disease has been recorded on *Schizostachyum lumampao* (Blanco) Merr. in the Philippines (Dayan 1988). In India, the leaf spot has been reported on *Bambusa multiplex* in Maharashtra State (Rao 1962), on *Bambusa* sp. in Karnataka State (Rangaswami et al. 1970), in *Drepanostachyum falcatum* (Nees) Keng f., and on *B. bambos*, *Dendrocalamus strictus* and *Thyrsostachys* sp. in Kerala State (Mohanan 1990, 1994a,b; Balakrishnan et al. 1990).

SYMPTOMS

Minute, spindle-shaped, yellowish brown to brown, water-soaked spots appear on the upper surface of the leaf. Both juvenile and mature leaves are found affected by the disease. The spots enlarge to 3-5 mm with





Fig. 82: Leaf spot in *D. strictus* caused by *Ascochyta dendrocalami*

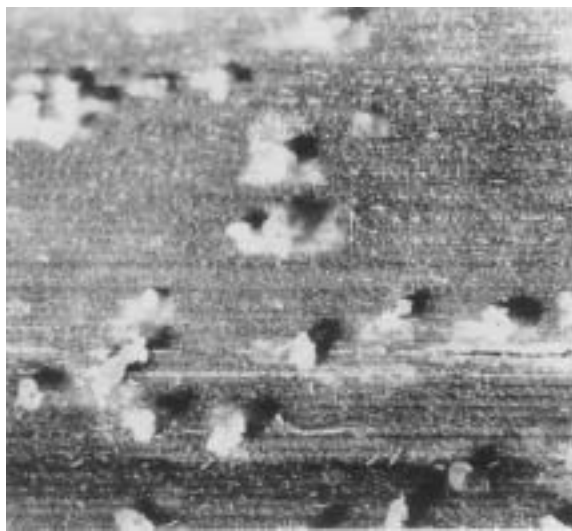


Fig. 83: Magnified view of pycnidia of *Ascochyta dendrocalami*

greyish white centres. During December-January, dark brown to black pycnidia develop over the necrotic spots, from which a pinkish white spore mass oozes out under high humidity (Figs. 82-84). In severe infection, the leaf margins become necrotic, extending towards the centre. Such leaves are gradually blighted and fall off.

CAUSAL ORGANISMS

Ascochyta arundinariae F. Tassi; *A. bambusinae* Rao (Rao 1962; Zhu 1989); *A. phaseolorum* Sacc. (Rangaswami et al. 1970; Balakrishnan et al. 1990); *A. dendrocalami* Mohan. (Mohan 1994b; 1995d); *Ascochyta* sp. (Dayan 1988).

ETIOLOGY

The fungi enter the host tissue through stomata, and the hyphae proliferate in the mesophyll. Pycnidia develop in the necrotic tissues and under high humidity, the conidial mass oozes out. Wind-dispersed conidia serve as the source of secondary infection and spread of the disease.

CONTROL

Since the disease is not economically very important, control measures are not required.





Fig. 84: Conidia of *Ascochyta dendrocalami* (640x)

15 Tar Spot

Tar spot disease has been reported in different species of bamboos in India, Japan and the Philippines. In the Philippines, disease has been recorded on *Bambusa blumeana*, *B. vulgaris* and *Bambusa* sp. (Dayan 1988). Tar spot has been recorded on *Phyllostachys* sp. in Japan (Spaulding 1961; Zhu 1989). In India, tar spot disease has been recorded on *Arundinaria* sp., *Bambusa bambos* and *Dendrocalamus strictus* in Maharashtra State (Parndekar 1964;

Ananthanarayanan 1964; Awati and Kulkarni 1972), on *B. bambos* in Tamil Nadu State (Rangaswami et al. 1970), on *Bambusa* sp., *B. bambos*, *B. vulgaris*, *D. strictus*, *Pseudoxytenanthera ritcheyi*, *Thyrsostachys* sp., *Ochlandra travancorica* and *O. scriptoria* in Kerala State (Sydow and Butler 1911; Butler and Bisby 1960; Mohanan 1990, 1994a,b) and on *Arundinaria* sp. in Assam State (Uppal et al. 1955).

SYMPTOMS

Small, pale to dark yellowish brown lesions appear on the abaxial surface of the leaf. The lesions increase in

size, spread and develop into oval or circular spots with dark brown centres and pale yellow margins. Usually, four to six small spots (each 3-6 mm) appear on the leaf lamina and the leaf sheath. Ascocarps develop as dark brown to black raised structures in the necrotic spots (Figs. 85, 86).



Fig. 85: Tar spots in *B. bambos* due to *Phyllachora* sp.

CAUSAL ORGANISMS

A total of ten *Phyllachoraital* species



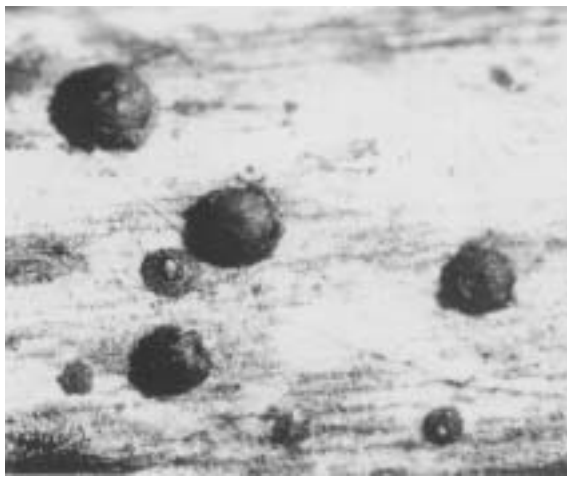


Fig. 86: Ascocarps of *Phyllachora longinaviculata* on *B. bambos*

have been recorded as associated with the disease. These include:

Phyllachora bambusae Syd. & Butler on *Bambusa bambos* (Sydow and Butler 1911; Parndekar 1964; Awati and Kulkarni 1972);

P. dendrocalami Awati and Kulk. on *Dendrocalamus strictus* (Awati and Kulkarni 1972);

P. graminis (Pers.) Fuck. on *Arundinaria* sp. (Ananathanarayanan 1964);

P. longinaviculata Parbery on *B. bambos*, *D. strictus* and

Pseudoxytenanthera ritcheyi (Mohan 1990, 1994a,b);

P. shiraiana Sydow on *B. bambos*, *B. vulgaris*, *D. strictus*, *Ochlandra travancorica*, *O. scriptoria*, *P. ritcheyi* and *Thyrsostachys* sp. (Mohan 1994a,b), on *Arundinaria* sp. and *Bambusa* sp. (Uppal et al. 1955), and on *B. blumeana*, *B. vulgaris* and *Bambusa* sp. in the Philippines (Dayan 1988);

P. ischaemi Syd. on *B. bambos* (Mohan 1994a,b);

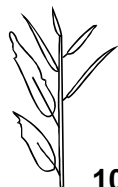
P. malabarensis Syd. et Butler on *Bambusa* sp. (Sydow 1932; Butler and Bisby 1960); and

Phyllachora sp. on *Bambusa* sp. and *B. bambos* (Butler and Bisby 1960; Rangaswami et al. 1970).

Four species of ***Phyllachora***—*P. chimonobambusae* Hino et Katumoto, *P. shiraiana*, *P. graminis* and *P. phyllostachydis* Hara — have been recorded in different species of bamboos from Japan (Zhu 1989).

ETIOLOGY

Airborne spores of the fungus germinate on the leaf surface and the infection hyphae penetrate through stomata. Mycelial ramification occurs in the mesophyll within 24 hours. Lesions develop 7-9 days



after infection and black raised structures form in the necrotic infected tissues.

CONTROL

As the tar spot disease is not an important one, control measures are seldom warranted.

16 Petrakomyces Leaf Spot

This leaf spot disease has been reported in bamboo natural stands and plantations in India. The disease has been recorded on *Bambusa* sp. in Karnataka and Tamil Nadu State (Subramanian and Ramakrishnan 1953; Rangaswami et al. 1970) and on *Bambusa bambos*, *Dendrocalamus strictus*, *Arundinaria* sp., *Thyrsostachys* sp., *Ochlandra scriptoria* and *O. ebracteata* in Kerala State, India (Mohanan 1990, 1994a,b).

SYMPTOMS

Water-soaked, brown, pin head lesions appear on foliage, especially the lower parts of new culms. These lesions enlarge to 3-5 mm, oval to elliptical, dark violet spots with pale yellow haloes. Later, the spots appear as raised black structures bearing pycnidia of the causal fungus (Figs. 87, 88).



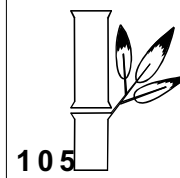
Fig. 87: Leaf spot in *Thyrsostachys* sp. caused by *Petrakomyces bambusae*

CAUSAL ORGANISMS

Petrakomyces indicus Subram. & Ramakr. (Subramaniam and Ramakrishnan 1953; Mohanan 1990, 1994a,b) and *P. bambusae* Mohan. (Fig. 89) (Mohanan 1994a, b; 1995d).

ETIOLOGY

The fungus enters the host tissue through stomata and the hyphae proliferate in the mesophyll. Pycnidia develop in the affected areas and the conidia are extruded from them under warm-humid conditions.



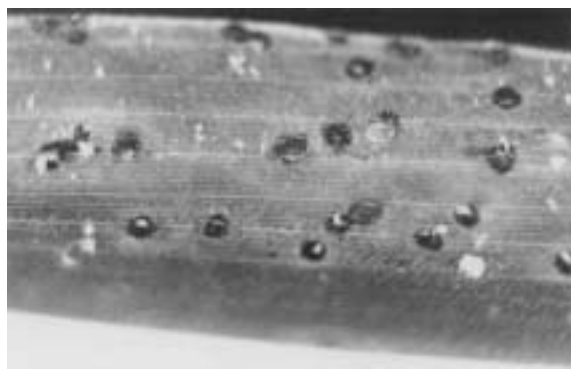


Fig. 88: A magnified view of pycnidia of *Petrakomyces bambusae*

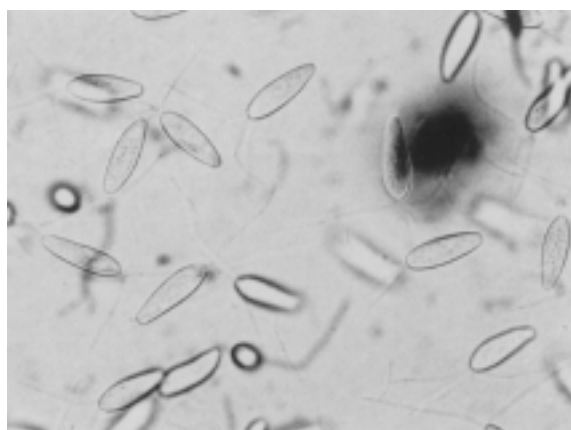


Fig. 89: Conidia of *Petrakomyces bambusae*

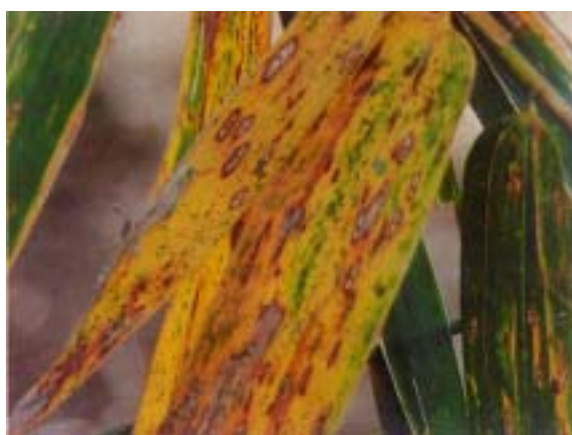


Fig. 90: Phoma leaf spot on *B. bambos*

Conidia, dispersed by wind and rain splash, serve as the source of secondary infection.

CONTROL

As the leaf spot is not an important one, control measures are not required.

17 Phoma Leaf Spot

Phoma leaf spot has been reported on *Bambusa bambos* and *Dendrocalamus strictus* in natural stands and plantations in Kerala State, India (Mohan 1990, 1994a,b), and in *Phyllostachys bambusoides* Munro and *Phyllostachys* sp. stands in Japan (Zhu 1989).

SYMPTOMS

Brown, pin-head lesions occur on the upper surfaces of leaves. Both juvenile and mature leaves are affected. Leaf spots develop during August-September; the spots become spindle-shaped. They later coalesce to form large irregular spots with greyish white centres and dark brown margins (Figs. 90, 91).

CAUSAL ORGANISMS

Phoma sorghina (Sacc.) Boerma, Dorenbosch & Van Kesteran; *P. herbarum* Westend.; *P. dendrocalami* Mohan. (Mohan 1994 a,b, 1995d); *P. arundinacea* Sacc.; *P. pelliculosa* Berk. et Br. (Zhu 1989).



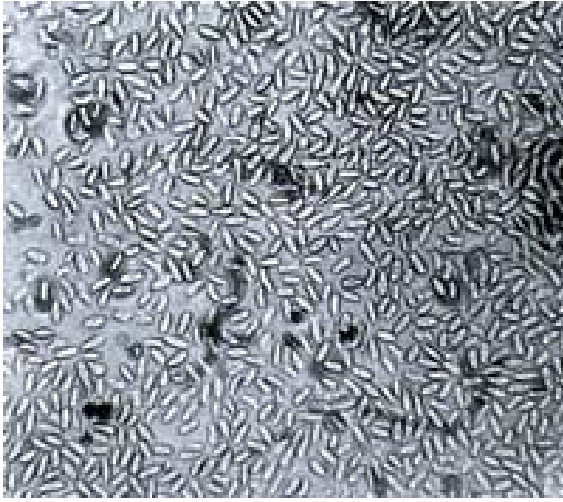


Fig. 91: Conidia of *Phoma dendrocalami*

ETIOLOGY

The fungus enters the leaf tissue through stomata or by direct penetration, and the mycelium ramifies in the mesophyll. Pycnidia of the causal fungus are formed in the necrotic lesions during November-December as erupting structures. Under high humidity, a cream to pink coloured, gelatinous spore mass is extruded in cirri from the pycnidia.

CONTROL

Since the leaf spot disease is of minor importance, control measures are not required.

18 Phomopsis Leaf Spot

The disease has been reported on *Bambusa bambos*, *Dendrocalamus strictus* and *Thyrsostachys* sp. in Kerala State, India (Mohan 1990, 1994a,b).

SYMPTOMS

Minute, greyish brown, water-soaked lesions occur on mature leaves and later spreads to form circular to

irregular spots with dark brown wavy margins. In *D. strictus*, the spots enlarge to form larger spots of 5-8 mm diameter with 2-3 dark brown concentric rings (Fig. 92).

CAUSAL ORGANISM

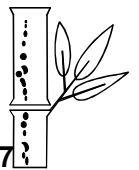
Phomopsis bambusae Mohan. (Mohan 1994a,b; 1995d).

ETIOLOGY

The spores of the fungus, dispersed through air currents or rain splash,



Fig. 92: Leaf spot in *B. bambos* caused by *Phomopsis bambusae*



germinate on the leaf surface and the infection hyphae penetrate through stomata. The hyphae proliferate in the mesophyll and parenchyma tissues. Pycnidia develop in the necrotic tissues during November-December and the conidia oozes out in yellowish cirri, which serve as the source of secondary infection.

CONTROL

As the leaf spot disease is not important, control measures are not required.

■9 Stagonospora Leaf Spot

The leaf spot has been reported on *Bambusa bambos* and *Dendrocalamus strictus* in Kerala, India (Mohanani 1994a,b), and in *Phyllostachys* sp. in Japan (Zhu 1989). The disease has been observed only on mature leaves.

SYMPTOMS

Dark brown, irregular lesions, each 3-5 mm in diameter, appear on mature leaves, and later enlarge and become brownish black necrotic spots. The spots usually develop along the leaf margins.

CAUSAL ORGANISMS

Stagonospora bambusae Mohan. (Mohanani 1994 a,b, 1995e); and *S. phyllostachydis* Hara and *S. septorioides* Hara (Zhu 1989).

ETIOLOGY

The fungus enters the host tissue through stomata as well as by direct penetration through the epidermis. Warm-humid environmental conditions favour infection.

CONTROL

The disease is of minor significance and control is not required.



10 Septoria Leaf Spot

Septoria leaf spot has been reported on *Thyrsostachys* sp. in Kerala, India (Mohan 1994a,b), and in *Bambusa* sp. in Japan (Zhu 1989). In India, the infection was observed on mature leaves of *Thyrsostachys* sp. during December-January.

SYMPTOMS

Greyish brown to dark brown lesions, each 2-4 mm in diameter, occur on the upper surfaces of mature leaves. Pale to dark brown pycnidia develop in the centre of the lesions. Usually, leaf spots caused by *Phomopsis* sp., *Petrakomyces* sp. and *Septoria* sp. were observed intermixed on the same leaf.

CAUSAL ORGANISMS

Septoria thyrsostachydis Mohan. and *S. bambusae* Broom. (Mohan 1994a,b, 1995d; Zhu 1989)

ETIOLOGY

The fungus enters the host tissue through stomata. Warm-humid atmospheric conditions favour infection.

CONTROL

Leaf spot disease is not a serious one and control measures are not required.

11 Chaetospermum Leaf Spot

The disease has been reported on *Bambusa bambos* in Kerala, India (Mohan 1994a,b). It was observed during August-September, usually on mature leaves of the lower culm branches.

SYMPTOMS

The disease occurs as numerous minute, pale yellow



lesions, arranged linearly on the upper surfaces of mature leaves. Usually, development of a large number of such lesions on the leaf impart a yellowish colour to the affected foliage.

CAUSAL ORGANISM

Chaetospermum carneum Tassi (Mohanani 1994a,b).

ETIOLOGY

Fungus enters the host tissue through stomata. High humid atmospheric conditions favour the infection. Free water on the leaf surface helps in rapid spread of the lesions. Yellowish brown minute pycnidia develop in the necrotic areas during October.

CONTROL

This leaf infection is of minor importance and control measures are not needed.

12 Curvularia Leaf Spot

The leaf spot has been reported on *Arundinaria* sp., *Bambusa bambos*, *Thyrsostachys* sp., *Ochlandra travancorica*, *O. scriptoria* and *O. ebracteata* in Kerala, India (Balakrishnan et al. 1990; Mohanani 1990, 1994a,b). The leaf spot has been observed only on the juvenile foliage of new culms.

SYMPTOMS

Greyish black, irregular lesions appear on the juvenile, expanding foliage, especially on those in the lower branches of new culms. Later, the lesions enlarge and cover the entire leaf lamina and become necrotic. The causal fungi sporulate profusely on the affected tissues.

CAUSAL ORGANISMS

Curvularia lunata (Wakker) Boedijn anamorph of *Cochliobolus lunatus* Nelson & Haasis (Mohanani

