

PHELLINUS PACHYPHLOEUS AND ITS RELATED SPECIES IN INDIA

J. R. SHARMA

Botanical Survey of India, Dehra Dun

ABSTRACT

The pachyphloeus group is represented by *Phellinus lamaensis* (Murr.) Pat., *P. pachyphloeus* (Pat.) Pat., *P. noxius* (Corner) Cunn., *P. conchatus* (Pers.: Fr.) Quel., *P. contiguus* (Pers.: Fr.) Pat., *P. ferruginosus* (Schard.: Fr.) Pat., *P. portoricensis* (Overh.) O. Fidalgo, *P. melanodermus* (Pat.) O. Fidalgo and *P. hoehnelii* (Bres.) Ryv. in order of their frequency of occurrence in India. *P. melanodermus* and *P. portoricensis* are new records for India. Both these species grow parasitically on specific hosts and cause white pocket rots.

INTRODUCTION

Phellinus pachyphloeus and its related species form a well marked group in the genus *Phellinus* Quel., of the family Hymenochaetaceae (Fidalgo 1968, Corner 1932). All the species of this group have in common the presence of tramal setae or setal hyphae in the context and dissepiments and hyaline to rusty brown spores. It has about 22 species all over the world (Larsen 1990).

Besides *P. pachyphloeus*, the other species of this group occurring in India are *P. conchatus*, *P. contiguus*, *P. ferruginosus*, *P. hoehnelii*, *P. lamaensis*, *P. melanodermus*, *P. noxius* and *P. portoricensis*, *P. melanodermus* known only from South-east Asia (Patouillard 1897, Lloyd 1922, 1924 and Petch 1925) and *P. portoricensis* known earlier from American tropics only (Overholts 1926, Lowe 1957) are reported as new records from India. These two species so far not known to occur on any specific host (Fidalgo 1968) have been found growing as parasites on the species of *Shorea*, *Casuarina* and *Schleichera* causing white pocket rots.

The present study is based on the survey and collections of pachyphloeus group made by the author during past 12 years. Besides fresh collections, also examined were the specimens at CAL, BSIDD, DD, HClO, PAN & CALI. Collections made by the author are deposited in the

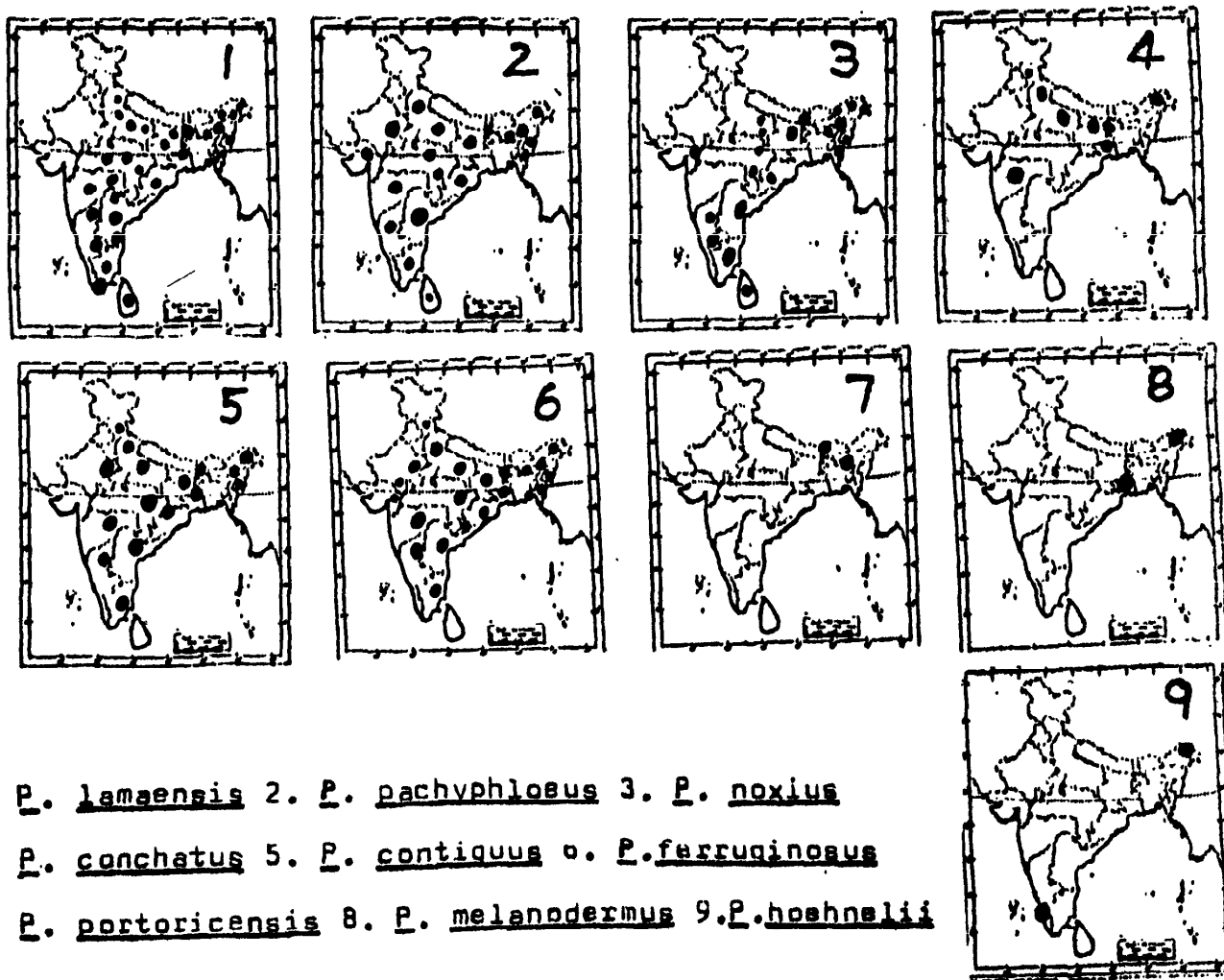
Cryptogamic section, Central National Herbarium (CAL); Department of Botany, University of Oslo (O), Norway and Department de Biologicas, Universidad de Boenos Aires (BAFC) Argentina, under the author's name

Free hand sectioned and squashed mounts of tissues in 2% KOH with 1% aqueous phloxine, Melzer's reagent and lactophenol-cotton blue were examined for microscopic details following Ryvarden and Johansen (1980). Wider distribution (Fig.1) and host ranges in India have been determined for all the species. The location of each collection studied is indicated by standard herbarium designation before the collection number. In case of a large number of collections for any species, only the representative collections from different areas were cited. As the period of collections for specimens of this group is restricted to Aug.- Oct., so the date of collections have not been specifically mentioned.

Drawings were made with the help of Camera lucida. Colours are from Kelly and Judd (1955).

KEY TO THE SPECIES OF PACHYPHLOEUS GROUP IN INDIA

- | | |
|---|----------------------------|
| 1. Hymenial setae present | ... 2 |
| 1. Hymenial setae absent | ... 9 |
| 2. Fruiting body resupinate | ... 3 |
| 2. Fruiting body effused-reflexed to pileate | ... 5 |
| 3. Contextual setal hyphae present; tramal setae absent; spores broadly ellipsoid | ... <i>P. ferruginosus</i> |



1. *P. lamaensis* 2. *P. pachyphloeus* 3. *P. noxius*
 4. *P. conchatus* 5. *P. contiguus* or *P. ferruginosus*
 7. *P. portoricensis* 8. *P. melanodermus* 9. *P. hoehneltii*

Fig. 1 : Distribution of *P. pachyphloeus* and its related species in India.

- | | |
|--|---|
| 4. Pores 2-4 per mm; spores oblong ellipsoid, 5-7 × 3-3.5 μm; tramal setae up to 150 μm long; hymenial setae not misshapen. ... <i>P. contiguus</i> | 7. Tramal setae present; contextual setal hyphae absent; spores 5-6.5 μm in diam; in tropical to temperate forests ... <i>P. conchatus</i> |
| 4. Pores 5-6 per mm; spores globose to sub-globose, 5-6.5 μm in diam; tramal setae up to 50 μm long; hymenial setae misshapen at the tops or sides ... <i>P. conchatus</i> | 7. Tramal setae absent; contextual setal hyphae present; spores 4- 5 μm in diam.; in tropical forests ... 8 |
| 3. Contextual setal hyphae absent; tramal setae present; spores not broadly ellipsoid ... 4 | 8. Fruiting body effused-reflexed to applanate; setal hyphae with obtuse ends, up to 7 μm wide and not much different from skeletal hyphae ... <i>P. lamaensis</i> |
| 5. Pilear surface persistent - velutinate; context duplex with intermittent dark layer; spores pale brown to rusty brown ... <i>P. portoricensis</i> | 8. Fruiting body ungulate to rarely applanate; setal hyphae with acute ends, up to 20 μm wide, much darker and thicker than the skeletal hyphae ... <i>P. pachyphloeus</i> |
| 5. Pilear surface velutinate when young, glabrous with age; context homogeneous without an intermittent black layer; spores hyaline to pale yellow ... 6 | 6. Pores 7-10 per mm; context and tubes concolorous; spores up to 6.5 μm in diam ... 7 |
| 6. Pores 3-4 per mm; context and tubes much different in colour; spores 6-8.5 μm in diam ... <i>P. hoehneltii</i> | 9. Fruiting body effused-reflexed to sub-applanate; setal hyphae with obtuse ends, running all along the dissepiments and frequently projecting into the lumen of tubes <i>P. noxius</i> |

9. Fruiting body ungulate; setal hyphae with acute ends, running parallel in the middle of the dissepiments and rarely projecting into the lumen of the tubes ... *P. melanodermus*

Phellinus conchatus (Pers. : Fr.) Quel. Ench. Fung. p. 173, 1886. *Boletus conchatus* Pers., Obs. Mycol. 1: 24, 1976; *Polyporus conchatus* Pers.; Fr., Syst. Mycol. 1: 376, 1821. (Fig. 2, i & j).

Type locality : Europe.

Fruitbody perennial, sessile, effused-reflexed to resupinate, solitary to often imbricate, semicircular; connate to convex, single; pileus up to 6 cm broad, 4 cm wide and 1 cm thick at base, woody hard, upper surface cinnamon brown, tomentose, with age becoming greyish brown to black, glabrous with a distinct thick crust in narrow, sharp, sulcate zones, finely cracked radially, covered with moss at base; margin rounded, wide to narrow, yellowish brown; pore surface yellowish to cinnamon brown; pores 5-6 per mm; tubes sepia brown, indistinctly stratified, paler than the pore surface; context concolourous with the tubes, up to 5 mm thick; hyphae dimitic; generative hyphae thin walled, hyaline septate, 1.5-2 μ m wide; skeletal hyphae 2-3 μ m wide, unbranched, thick walled; hymenial setae abundant, 30-60 $\times$ 5.12 μ m, subulate to ventricose, dark reddish brown, misshapen with irregular tops or sides; basidia 8-15 $\times$ 4-7 μ m, clavate; tramal setae present, up to 50 μ m long and 3-6 μ m wide, straight; spores globose to subglobose, 5-6.5 $\times$ 4-5.5 μ m, hyaline to pale brown, uniguttulate, IKI.

Specimens examined : CAL 706, on a stump of *Mangifera indica* L., Howrah, West Bengal; CAL 61776, on a rotting stump of *Toona ciliata* Roem., Namdapha Biosphere Reserve, Tirup, Arunachal Pradesh; HCIO 2376, on a dead standing tree of *Quercus incana* Roxb., Nainital, Uttar Pradesh; HCIO 4236, on dead wood of *Mallotus philippinensis* (Lam.) Muell.-Arg. Bombay, Maharashtra; BSIDD 348, on dead branch of a living tree of *Pyrus pashia* (Buch.-Ham.) D. Don, Gangi, Tehri, Uttar Pradesh; BSIDD 509, on dead branch of a living tree of *Salix*, Jalori pass, Kulu,

Himachal Pradesh; BSIDD 513, on a dead branch of *Viburnum*, Mondal, Chamoli, Uttar Pradesh.

Distribution : India (Uttar Pradesh, West Bengal, Maharashtra, Himachal Pradesh, Arunachal Pradesh), Eastern United States; Poland; North Africa; Australia; New Zealand and North America.

Hosts : Frequently on the dead branches of *Salix* ad *Pyrus pashia*; less common on the dead woods of *Mangifera indica*; *Cotoneaster bacillaris* Wall.; Lind.; *Mallotus philippinensis* (Lamk.) Muell.-Arg.; *Quercus incana* & *Q. semicarpifolia* Sm.; *Rhus parviflora* Roxb. & *R. punjabensis* J.L. Stew: Brand.; *Lyonia ovalifolia* (Wall.) Drude; *Toona ciliata* Roem., and rarely on the species of *Viburnum*, *Populus* and *Betula*.

Rot : White.

Phellinus contiguus (Pers. : Fr.) Pat. Essai Taxon. Hymeno., p. 97, 1900. *Boletus contiguus* Pers., Synop. Meth. Fung., p. 544, 1801; *Polyporus contiguus* Pers. : Fr., Syst. Mycol. 1: 378, 1821.

Type locality : (?) France (BPI).

Fruitbody perennial, resupinate, up to 15 cm long, 5 cm wide and 5-1 cm thick, smooth and even or nodulose, spongy when fresh, hard and brittle on drying; pore surface greyish brown to umber brown; pores angular, 2-4 per mm, sinuate to irregular on oblique surfaces; tubes indistinctly stratified, up to 10 mm deep, greyish-white from inside; context up to 1 mm thick; hyphae dimitic; generative hyphae thin walled, hyaline, 2-3 μ m wide; skeletal hyphae yellowish to rusty brown, straight, thick-walled, 2-3 μ m wide; tramal setae acute, tapering from the base, slightly swollen towards the tip, thick-walled, more easily seen near the margin of fresh specimens, up to 150 μ m long and 5-10 μ m wide; hymenial setae abundant, subulate, thick walled, 40-70 $\times$ 5-7 μ m; basidia 10-18 $\times$ 5-7 μ m, ovate; spores 5-6.5 (7) $\times$ 3-3.5 μ m, hyaline, oblong ellipsoid to cylindrical, thin-walled, IKI.

Specimens examined : CAL 53707, on dead wood, Deban, Tirup, Arunachal Pradesh; CAL

59201, base of hardwood stump, Pasighat, Arunachal Pradesh; CAL 58728, on a dead gymnospermous log, Shimla, Himachal Pradesh; CAL 78359, on a dead hardwood log, Howrah, West Bengal; PAN 6175, on *Quercus incana*, Bhadarwah, J & K; PAN 6123, on *Q. incana*, Dalhousie, H.P.; PAN 6124, on stumps of *Q. incana*, Dalhousie, H.P.; BSIDD 17 on a rotting stump, Dehra Dun, U.P.; BSIDD 517, on rotting log, Rishikesh, U.P.; HCIO 619, on dead wood, Dehra Dun, U.P.

Distribution : India (Throughout the tropical and temperate forests); USA; Warmer and Tropical Parts of Europe; Ceylon; Australia; New Zealand; Jamaica; Cuba; Brazil; Paraguay; Algeria and Singapore.

Hosts : Dead wood of Angiosperms, very rarely on coniferous wood.

Rot : White fibrous.

Phellinus ferruginosus (Schr.: Fr.) Pat. Essai Taxon. Hymeno., p. 97, 1900. *Boletus ferruginosus* Schrad., Spic. Fl. Germ., p. 172, 1794; *Polyporus ferruginosus* Schrad.: Fr., Syst. Mycol. 1: 378, 1821.

Type locality : Germany.

Fruitbody annual to rarely biennial, resupinate, not easily separable, sometimes nodulose at the upper margin, up to 4 cm long, 1-1.5 cm wide and .2-4 cm thick, spongy, flexible; margin floccose, setulose under a lens, reddish brown on drying; pore surface ferruginous to dull brown, slightly undulating; pores 5-6 per mm, round and entire, split on oblique substrates; tubes concolorous with pore surface, 1-2 mm thick in each layer; context rusty brown, corky to cottony, 1-3 mm thick; hyphae dimitic; generative hyphae thick walled, rusty brown, 2.5-5 μ m wide; setal hyphae present in the lower context and dissepiments not protruding into the tubes, ends pointed, easily observed in the floccose margin of fresh specimens; spores broadly ellipsoid, 4-6 $\times$ 3-3.5 μ m, thin walled, IKI-.

Specimens examined : CAL 60690, on a rotting Bamboo stem, Howrah, West Bengal; CAL

60561, on rotting Bamboo stumps, Miao, Tirup, Arunachal Pradesh; CAL 61287, on a rotting hardwood stump, Shella, Meghalaya; BSIDD 31, base of a rotting stump of *Cedrus*, Shimla, H.P.; BSIDD 11, bark of a living *Pinus* tree, Tura peak, Meghalaya; DD 259, base of a rotting *Shorea* stump, Dehra Dun, Uttar Pradesh.

Hosts : On dead wood of conifers (*Pinus*, *Cedrus*) and Angiosperms (*Alnus*, *Shorea*, *Prunus* and Bamboos).

Distribution : India (Throughout the tropical and sub-tropical forests); North America; East Africa; Scandinavia and Europe.

Rot : White laminated rot.

P. hoehnelii (Bres.) Ryv. In Ryv. et Johan., Pre. Polyp. Flora of East Africa, p. 173. 1980. *Fomes hoehnelii* Bres., Ann. Mycol. 10 : 499, 1912.

Type locality : Buitenzorg, Java, Indonesia (FH).

Fruitbody perennial, pileate, subapplanate, sessile, irregular, woody hard on drying; pilear surface glabrous, encrusted, dark brown to black, rugulose; margin obtuse, thick, entire; pore surface cinnamon brown; pores 3-4 per mm; tubes up to 1 cm deep, dark brown, delimited on upper surface by a black, up to 0.3 mm thick crust; hyphae dimitic; generative hyphae simple septate, 2-5 μ m wide, hyaline; skeletal hyphae 2-6 μ m wide, dark brown, thick walled; setal hyphae present in context and dissepiments, frequent, ferruginous, thick walled to solid, up to 400 μ m long, 5-10 μ m wide, more or less straight, projecting obliquely into the hymenium and the tubes, tips acute; hymenial setae 18-27 $\times$ 6-9 μ m, ventricose, dark brown, projecting 5-15 μ m beyond the hymenium, mostly present near the base of tubes; basidia 9-18 $\times$ 5-8 μ m, clavate; spores 7-8.5 (9) $\times$ 6-7.5 μ m, subglobose, slightly thick walled; hyaline to pale yellow, non-amyloid.

Specimens examined : CAL 68910, on a living tree of *Terminalia*, Namdapha Biosphere Reserve, Tirup, Arunachal Pradesh; CALI 269, on a living tree of *Terminalia* in an evergreen forest, Kerala;

CALI 219, on a living *Terminalia* in an evergreen forest, Kerala; HCIO 37790, on a living tree of *Terminalia*, Kerala.

The species is very close to *P. pachyphloeus* but the size of spores and pores separate it from this and all other species of the group. The setae, reported to be absent by Humphrey & Leus (1932) are, frequently present in the Indian collections specially near the tube bases. Llyod (1920) wrongly reported spores to be 11-12 μm diam.

Distribution : India (Kerala & Arunachal Pradesh); Philippines and Indonesia.

Hosts : Parasitic on *Terminalia*.

Rot : White.

Phellinus lamaensis (Murr.) Pat. Bull. Mus. His. Nat. (Paris) 29 : 336. 1923.
Pyropolyporus lamaensis Murr., Bull. Torrey Bot. Club 34 (9): 479, 1907.

Type locality : Lamao river, Luzon, Philippine Islands (NY).

Fruitbody perennial, applanate, solitary to imbricate, dimidiate to lobate, sessile, woody hard, light in weight on drying; pileus up to 10 cm long, 4-12 cm wide and .5-1 cm thick; surface dark brown to reddish black, covered with a depressed tomentum but soon glabrous with a thick crust, strongly and concentrically sulcate in narrow to wider zones; margin paler in colour, entire or lobed, obtuse; pore surface dark reddish to deep brown; pores round, 8-10 per mm, usually darker than the context; tubes layered, up to 1 cm deep, separated by a thin white context; context woody, paler than the tubes, semiglossy, dissepiments entire and acute; hyphae dimitic; generative hyphae septate, hyaline to pale yellow, thin walled, 3-5 μm wide; skeletal hyphae abundant and dominating, golden to rusty brown, thick walled, 2-4 μm wide; setal hyphae present, golden to rusty brown, thick walled, 4-8 μm wide with obtuse ends, partly running parallel to the tube walls and partly projecting into the hymenium, not easily distinguished from the skeletal hyphae; hymenial setae abundant, acuminate to ventricose with acute tips, dark reddish brown, 15-45 $\times$ 4-9 μm ; basidia

8-12.5 $\times$ 4-6.5 μm , hyaline, 4-sterigmate; spores subglobose to broadly ellipsoid, smooth, thin walled, hyaline, 3.5-4.5 μm in diam.

Specimens examined : CAL 2429, on a living Sal tree, Darjeeling, W.B.; CAL 4541, on dead wood, Coimbatore, Tamil Nadu; CAL 4282, on living tree of *Hopea parviflora* Bedd., Coimbatore, T.N.; CAL 2430, on dead wood, Sunderbans, W.B.; CAL 5677, on *Camelliathea* Link., Darrang, Assam; CAL 214, on dead *Schima wallichii* Choisy; CAL 60833, base of a rotting stump, Siang, Arunachal Pradesh; CAL 60799, on a burnt hardwood stump, Tirup, Arunachal Pradesh; CAL 60199, on living *Shorea* tree base, Shella, Meghalaya; BSIDD 15, base of rotting stump of hardwood, Dehra Dun, U.P.; HCIO 5425, on living *Shorea robusta* Gaertn. f. tree, Buxa Division, W. B.; DD 5513, on decaying stump of *Shorea robusta*, Jalpaiguri, West Bengal.

Distribution : India (More frequent in Assam, W.B., and Arunachal Pradesh; also reported from Karnataka, Malabar hills, Tamil Nadu, Uttar Pradesh, Bihar, A. & N. Islands); China; Burma; Malaya; Vietnam; Samatra; Java; Philippines; Japan; New Guinea; New Caledonia; Kenya; Eritrea; Tanganyika; Sierra; Ghana; Ivory Coasts; Cameroon; Belgian Congo; Puerto Rico; Cuba; Guatemala, Brazil; East Indies and Australia.

Hosts : Parasitic on *Terminalia paniculata* Roth.; *T. tomentosa* Wight & Arn.; *Dipterocarpus turbinatus* Gaertn.f.; *Hopea parviflora*; *Shorea robusta*; *Havea brasiliensis* (HBK) Muell.-Arg.; *Erythrina* sp.; *Macaranga denticulata* Muell.-Arg. in DC; *Garcinia mangostana* L.; *Mesua ferrea* L.; *Cinnamomum camphora* L.; *Aleurites fordii* Hamsl.; *Albizia stipulata* Boiv.; *Casia* sp.; *Dalbergia* sp.; *Poinciana regia* Boj.:Hook.; *Eriodendron anfractuosum* DC; *Artocarpus indica*; *Grevillea robusta* A. Cunn. in R. Br.; *Cinchona* sp.; *Coffea arabica* L.; *Sterculia alata* Roxb.; *Camellia sinensis* (L.) Kuntze; *Camellia thea*; *Schima wallichii*; *Rhizophoraceae* and also common on dead hardwoods; never found on conifers.

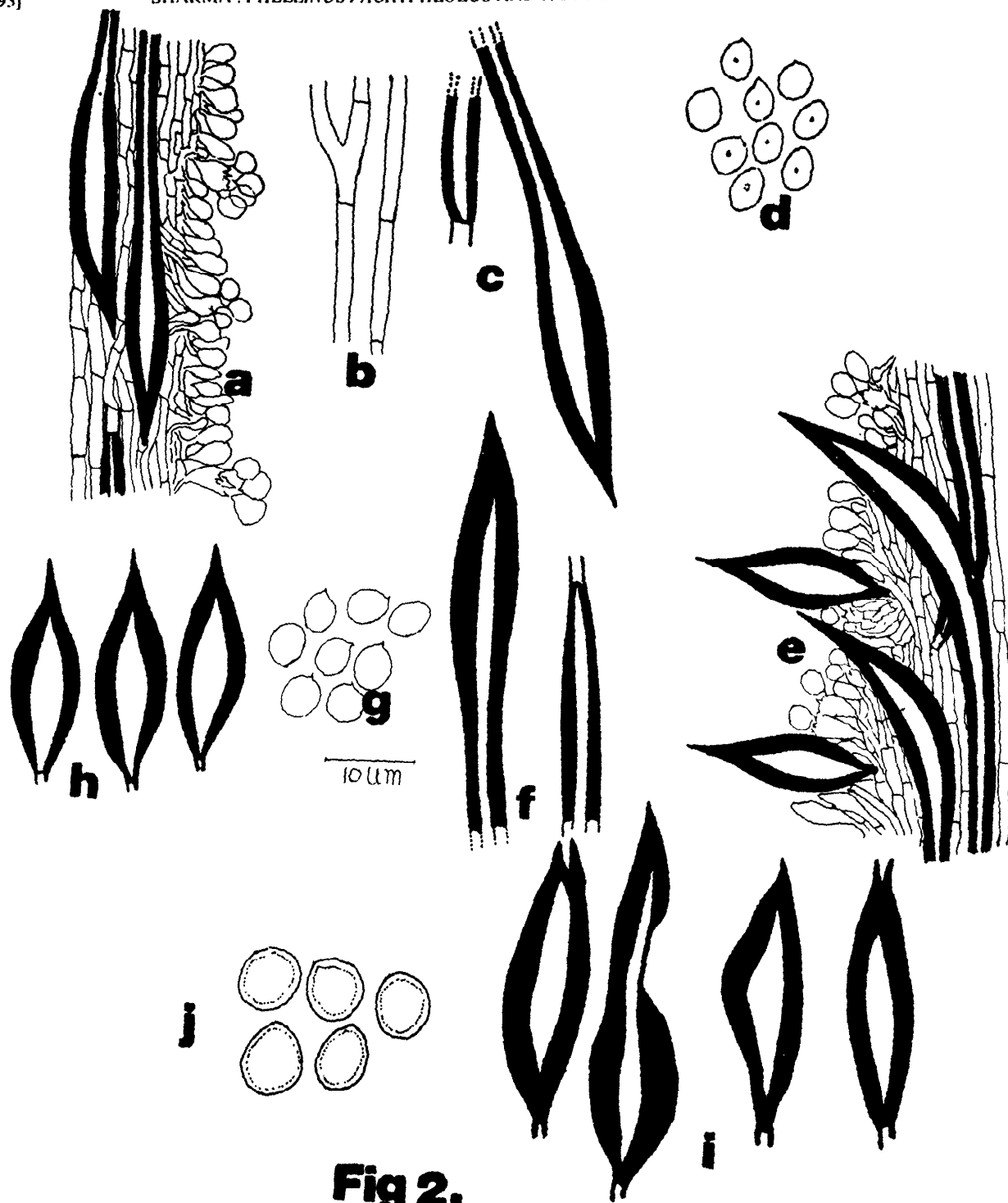


Fig 2.

Fig. 2 : *Phellinus melanodermus* (J 58906) a. section through tube; b. generative hyphae; c. setal hyphae; d. basidiospores; *P. portoricensis* (J 60105) e. section through tube; f. setal hyphae; g. basidiospores; h. hymenial setae; *P. conchatus* (J 348); i. misshapen hymenial setae; j. basidiospores.

Rot : White rot, Honey-comb rot of *Camellia sinensis*.

P. melanodermus (Pat.) O. Fidalgo Mem. New York Bot. Gard. 17 (2), 135 : 1968. *Xanthochrous melanodermus* Pat., Ann. Jard. Bot. Buitenzorg, Supp. 1: 113, 1897. (Fig.2, a-d).

Type locality : Tjibodas, Java, Indonesia (FH).

Fruitbody perennial, sessile ungulate, 12-20 cm long, 8-10 cm broad and up to 15 cm thick, woody hard when dry, heavy; pileus glabrous with a distinct horny crust, excessively cracked, distantly sulcate, dark grey to dull black; margin round, entire, finely velutinate, yellowish brown; pore surface light yellowish brown to light brown becoming darker with age, with drops of honey like exudation when actively growing; pores minute, 7-9 per mm, round; tubes distinctly layered, up to 2 mm deep in each layer; context up to 10 mm thick; homogeneous, chestnut brown, delimited on upper surface by a distinct black crust; hyphae dimitic; generative hyphae hyaline to pale yellow, 2-4 μ m wide, branched, septate; skeletal hyphae dominating, pale rusty brown 2.5-5 μ m wide, thick walled; setal hyphae common in context and dissepiments, dark reddish brown with distinct acute tips, rarely branched, thick walled to solid, 8-14 μ m wide, up to 300 μ m long in context, usually running parallel in the middle portion of the dissepiments and rarely curving and projecting into the lumen of the tubes; hymenial setae absent; basidia hyaline, clavate, 4 sterigmate; spores subglobose, hyaline to pale yellow, 4-5 $\times$ 3.5-4.5 μ m, nonamyloid.

Specimens examined : JRS 58906, (CAL,O) on the living trunk of *Schleichera oleosa* Oken. Indian Botanic Garden, Howrah, W.B., 16. X. 1984; JRS 58956 (CAL) on the living trunk of *Schleichera oleosa* Namdapha Biosphere Reserve, Tirup, Arunachal Pradesh, 29. IX. 1985; JRS 60613 (CAL), on the living trunk of *Casuarina equisetifolia* L. Namdapha Biosphere Reserve, Tirup, Arunachal Pradesh, 10.X. 1987.

In the field, *P. melanodermus* can be confused with *P. pachyphloeus* as both these species have

crusted ungulate fruitbodies. But the basidiocarps of the former are heavier in weight, grey to dull black and have excessively cracked pilear surface while in the latter the fruitbodies are lighter in weight, light to dark brown and have slightly cracked pilear surface. Microscopically absence of hymenial setae differentiates *P. melanodermus* from *P. pachyphloeus*, *P. lamaensis* and *P. portoricensis*, *P. noxius* differs from this species in having setal hyphae with obtuse ends running all along the dissepiments and frequently projecting into the lumen of the tubes.

Distribution : India (Arunachal Pradesh, W.B.); Java; Philippines; Ceylon and Brazil.

Hosts : Parasitic on *Schleichera oleosa* and *Casuarina equisetifolia*; not found on dead woods.

Rot : White pocket rot.

Phellinus noxius (Corner) Cunn. New Zeal. Dept. Sci. Ind. Res. Bull. 164: 221, 1965. *Fomes noxius* Corner, Gard. Bull. Straits, Sett. 5: 324, 1932.

Type locality : Botanic Garden, Singapore, Malayan federation (BPI).

Fruitbody perennial, solitary to imbricate, effused-reflexed to pileate, sessile, woody hard, light in weight when dry; pileus up to 10 cm long, 5-6 cm broad and 3-4 cm thick near the base, surface reddish brown to reddish black, glabrous with a resinous hard crust; azonate to sometimes faintly and irregularly zonate, frequently nodulose at the centre; margin obtuse, entire, yellowish brown to pale ochraceous when fresh; pore surface greyish or pale brownish when young, reddish brown with age; pores small, 6-8 per mm, subcircular to subangular, dissepiments moderately thick walled, entire; tubes distinctly layered, 1-3 mm deep in each layer; context 1-2 cm thick at base, zoned, pale to golden brown; hyphae dimitic; generative hyphae septate, hyaline to pale yellow, 2-3.5 μ m wide; skeletal hyphae thick walled, dominating, rusty brown, 5-6.5 μ m wide; setal hyphae present, 7-16 μ m wide, up to 150 μ m long, rare in context, abundant in dissepiments, frequently projecting into the lumen of tubes, dark

reddish brown; hymenial setae absent; basidia hyaline, 4-sterigmate, $6-9.5 \times 3-4.5 \mu\text{m}$; spores hyaline, subglobose to broadly ellipsoid, smooth, thin walled, $3.5-4.5 (5) \times 3-3.5 \mu\text{m}$, not seen in dried herbarium specimens.

Specimens examined : CAL 60241, on a dead hardwood log, Shella, Khasi hills, Meghalaya; CAL 60145, base of a living tree of *Coffea arabica*, Deban, Tirup, Arunachal Pradesh; CAL 60940, base of a *Shorea* tree, Tura range, Meghalaya; CAL 60943, on roots of *Thea* sp. Dibrugarh, Assam; CAL 60778, on a dead hardwood stump. East Siang, Arunachal Pradesh.

Distribution : India (Sikkim, Arunachal Pradesh, Assam, West Bengal, Tamil Nadu, Karnataka, A & N Islands); Java; Philippines; New Guinea; Fiji; Nigeria; Gold Coast; Congo; Puerto Rico; Brazil; Cuba; East & West Indies; Australia; Samoa; New Guinea; Ceylon; Malayan Federation; Sumatra; Krakatau; Melanesia; Ghana; France and Costa Rica.

Hosts : Parasitic on *Acacia* sp., *Poinciana* sp., *Cinchona* sp., *Coffea arabica* L., *Camellia sinensis* and also common on many dead angiospermous woods; never collected on Conifers.

Rot : White.

Phellinus pachyphloeus (Pat.) Pat. Essai Taxon. Hymenop. 97. 1900. *Polyporus pachyphloeus* Pat., Journ. Bot. (Paris) 3 (15): 257. 1889.

Fruitbody perennial, solitary, woody hard, light in weight on drying, ungulate to applanate, broadly attached, sessile; pileus up to 60 cm wide, 80 cm broad and 10-20 cm thick near the base, surface velvety to tomentose, yellowish to greyish brown, watery when young, soon glabrous with a thick hard crust, dark brown to greyish black, sulcate to rugulose in wide concentric zones, irregularly cracking on drying; margin obtuse, entire, persistently velutinate; pore surface cinnamon to greyish brown, pores small, invisible to the naked eyes, 8-10 per mm, dissepiments fairly thick; tubes distinctly to indistinctly stratified; context medium to light yellowish brown, with white mycelial strands, woody, up to 8 cm thick; hyphae dimitic; generative hyphae septate, hyaline to pale

yellow, thin walled, 2-4 μm wide; skeletal hyphae thick walled, yellowish to golden brown. 3-5 μm wide; setal hyphae present, dark brown up to 30 μm wide, tips pointed, thick walled to solid, frequently projecting into the lumen of the tubes; hymenial setae present, projecting above the hymenium, thick walled, dark brown, subclavate, 4-sterigmate, hyaline, $6-9.5 \times 3.5-5 \mu\text{m}$; spores subglobose to globose, thin walled, hyaline to pale yellow, $4.5 (5) \times 4-4.5 \mu\text{m}$, nonamyloid, not seen in dried herbarium specimens.

Specimens examined : CAL 60605, on a dead tree trunk of *Ficus* Guwhati, Assam; CAL 61225, on a dead tree trunk of *Cassia* sp., Balpagram National Park, Meghalaya; CAL 31227, on a dead standing tree of *Bruguiera* sp., Sunderbans; CAL 62377, on dead wood, Andaman; CAL 61723, on living *Rhizophora* sp., Sunderbans, W.B.; DD 239, on a living *Ficus* tree, Rishikesh, Dehra Dun, U.P.; DD 287, on living Mango tree, Dehra Dun, U.P.; DD 4720, on a living tree of *Terminalia*, Jalpaiguri, W.B., BSIDD 4672, on dead wood of Mango, Dehra Dun, U.P.; BSIDD 61872, on a standing dead tree of *Ficus*, Pasighat, East Siang, A.P.

Distribution : India (Common in all over the plains of India and A. & N. Islands); Cameroon; Nigeria; Senegal; Sierra Leone; Madagascar; Mauritius; Vietnam; Tonkin; Cambodia; Malayan Federation; East Pakistan; Java; Krakatau; New Guinea; Philippines; Australia; New Zealand; Melanesia; Fiji; West Indies; Tahiti; Surinam; Cuba; Southern and Central America.

Hosts : Parasitic on *Ficus* sp., *Anogeissus latifolia* Wall.; *Mangifera indica* L.; *Terminalia myriocarpa* Heurck & Mulf.-Arg.; *T. tomentosa*; *Odina woder* Roxb.; *Cassia* sp.; *Acer oblongum* (Wall.) DC; *Shorea* sp.; *Albizia* sp.; *Bruguiera* sp.; *Rhizophora* sp.; and also common on dead angiosperms; not found on conifers.

Rot : White stringy.

Phellinus portoricensis (Overh.) O. Fidalgo Mem. New York Bot. Gard. 17 (2): 111, 1968. *Fomes portoricensis* Overh. In Seaver

& Chard., Sci. Surv. Puerto Rico & Virgin Is. 8: 158, 1926. (Fig. 2.e-h).

Type locality : Rio Piedras, Puerto Rico (NY).

Fruitbody perennial, sessile, applanate to rarely effused-reflexed, up to 5 cm long, 4 cm broad and 1-1.5 cm thick at base; pileus dark reddish brown to black specially in parts where the tomentum is lost; persistently velutinate in narrow concentric sulcate zones; margin entire, obtuse, sterile, yellowish brown; pore surface yellowish to deep brown; tubes brown, layer distinct with brown context in between, 1-3 mm deep; pores minute, round to angular, 7-8 per mm; context duplex, lower part up to 3 mm thick, fibrous, yellowish brown, limited upwards by a black line over which lies 0.5 mm thick, soft layer of looser reddish brown tomentum, in old and weathered fruitbodies, the upper loose layer is removed and the black zone forms the crusty upper surface; hyphal system dimitic; generative hyphae septate, hyaline to pale yellow, 2-3.5 μ m wide; skeletal hyphae thick walled, pale rusty brown, 3-5 μ m wide; setal hyphae present both in context and dissepiments, 8-16 μ m broad, dark ferruginous, unbranched with straight acute tips, frequently projecting into the lumen of the tubes; hymenial setae abundant, ventricose to subulate with straight and acute tips, dark ferruginous, solid with narrow lumen, 25-42 $\times$ 6-7.5 μ m; cystidia absent; basidia hyaline, clavate, 4-sterigmate; spores abundant, subglobose to broadly ellipsoid, thin walled, pale yellow to rusty brown, 3.5-5 $\times$ 3-4 μ m, non-amyloid.

Specimens examined : JRS 60105 (CAL, O) on a living tree trunk of *Shorea robusta*, Nokrek Biosphere Reserve, Garo hills, Meghalaya, Aug. 15, 1986; JRS 60975 (CAL) on a living tree trunk of *Shorea robusta* Baghmara, Garo hills, Meghalaya, Sept. 30, 1987; JRS 61052 (CAL), base of living tree of *Schima wallichii*, Rumtek, Sikkim, Sept. 19, 1987.

Persistently velutinate pilear surface, duplex context and pale to rusty brown spores separate this species from all other species of this group.

Distribution : India (Meghalaya, Sikkim); Mexico; Puerto Rico; Costa Rica; Cuba; Panama & Java.

Hosts : Parasitic on *Schima wallichii* and *Shorea robusta*; not found on dead woods.

Rot : White pocket rot.

FREQUENCY OF OCCURRENCE

Based on the experience in the field and the material seen in the herbaria, the species of this group fall into four categories:

i : *P. lamaensis* and *P. pachyphloeus* are the most common and frequently distributed species because they grow on a variety of living and dead hosts in the tropical forests (Bagchee & Singh 1960; Bagchee 1952, 53, 54; Bose 1924, 37; Tunstall 1930, 40; Khan 1952; Prasad 1950; Padwick 1939; Singh *et al.* 1961 and Banerjee 1947). *P. pachyphloeus* has a preference for living and dead wood of *Ficus* especially *F. bengalensis* L. (One specimen at CAL collected by the author from Assam weighs ca 60 kg and measures 70 cm $\times$ 50 cm $\times$ 30 cm) probably due to the softness of the wood. *P. lamaensis*, saprophytically prefers the undersides of the dead hardwood trunks lying in wetter and shady places in thick forests.

ii : *P. noxius* though is a serious parasite on tea, coffee and cinchona in the North-east and South India (Psaltze 1935; Satyanarayan 1973; Venkataraman 1960; Singh 1966; Ramanathan *et al.* 1951) yet it is more frequently met on dead hardwoods in the opener places in the tropical forests of North-east and A. & N. Islands.

iii : *P. conchatus* (Banerjee 1947, Bose 1934, Bhargava and Sehgal 1954); *P. contiguus* (Thind and Rattan 1971, Bakshi *et al.* 1955) and *P. ferruginosus* (Bakshi 1958, Rattan 1977, Sharma 1985) grow as saprophytes from tropical to temperate zones. The basidiocarps are resupinate in *P. contiguus* and *P. ferruginosus* while in *P. conchatus* basidiocarps are usually pileate, black, crusty in the plains and resupinate to effused-reflexed in the higher altitudes. It has a preference for dead woods of Mango, *Salix* and *Pyrus*.

iv : *P. portoricensis*, *P. melanodermus* and *P. hoehnelii* (Ganesh and Leelavathy 1986) are quite rare (even in their areas of distribution) because

they grow only as parasites on a restricted number of hosts in the tropical forests. Based on the frequency that these species have been collected in the field during the past many years and the number of collections present in the Indian herbaria, a frequency curve can be drawn for this group (Fig.3).

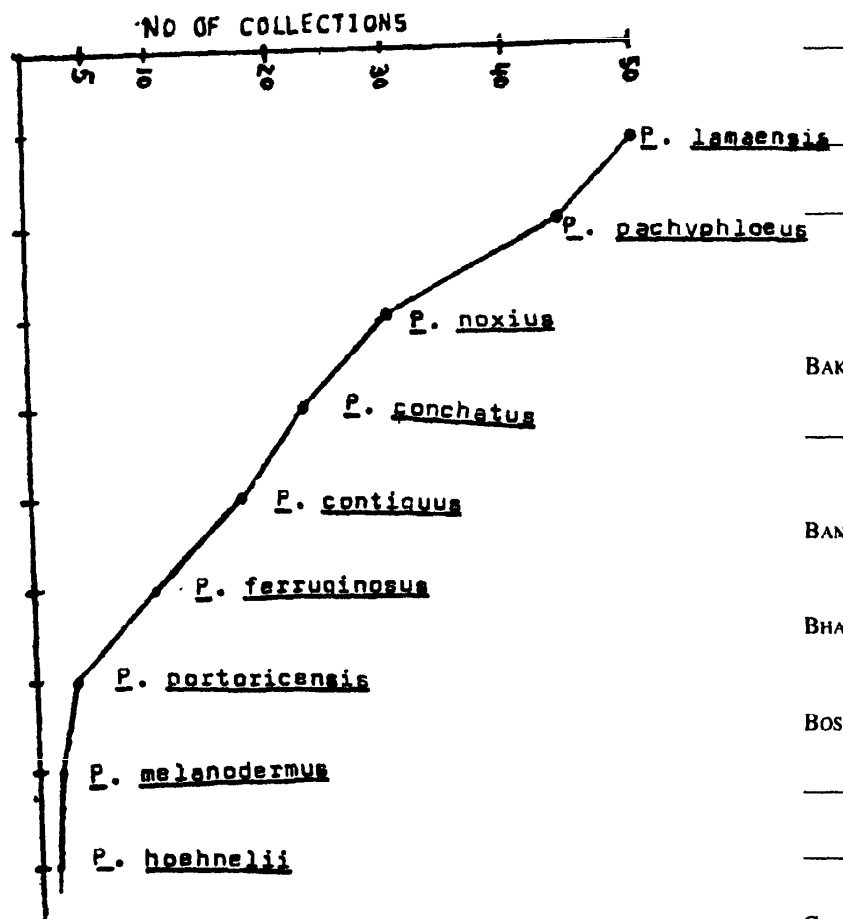


Fig. 3: Relative frequency of occurrence of *Pachyphloeus* group in India.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Botanical Survey of India for providing the facilities. Thanks are also due to Prof. L. Ryvarden, Botanical Institute, Oslo University, Norway; Prof. J. E. Wright, Departamento de Ciencias Biologicas, Universidad de Buenos Aires, Argentina and M.J. Larsen, USDA, Forest Service, Madison for their

opinions on some specimens. I am also thankful to the staff of the herbaria DD, PAN, and HCIO for helping in various ways.

REFERENCES

- BAGCHEE, K.D. A review of work on India tree diseases and decay of timber and methods of control. *Indian For.* 78 (11): 540-546. 1952.
- The fungal diseases of Sal (*Shorea robusta* Gaertn.) *Indian Forest Rec.* II. 1(2): 11-23. 1953.
- The fungal diseases of Sal (*Shorea robusta*) *Ibid.* 1(18): 97-184. 1954.
- AND B. SINGH. List of common names of fungi attacking Indian forest trees, timber, herbaceous and shrubby undergrowth and list of culture of forest fungi. *Ibid.* 1 (10) : 199-348. 1960.
- BAKSHI, B.K. New records of Hymenomycetes in India. *Indian Phytopath.* 11: 88. 1958.
- Y.N. PURI AND B. SINGH Two decay fungi on conifers in Himalayas. *Ind. J. Mycol. Res.* 1: 75-79. 1955.
- BANERJEE, S.N. Fungus flora of Calcutta and Suburbs-I. *Bull. Bot.Soc. Bengal* 1 : 37-54. 1947.
- BHARGAVA, K.S. AND A.C. SEHGAL. Additions to fungi of Nainital-I. Wood-rotting fungi. *Proc. 41st. Ind. Sci. Cong.* Part IV, 25. 1954.
- BOSE, S.R. Les Polyporacees du Bengale. *Rev. Path. Veg. Ent. Agr.* 11 (2): 132-149. 1924.
- Polyporaceae of Bengal-X. *J. Dept.Sci. Calcutta Univ.* 11: 1-18. 1934.
- Polyporaceae from Lokra hills (Assam). *Ann. Mycol.* 35 (2): 119- 137. 1937.
- CORNER, E.J.H. The identification of Brown-root fungus. *Gard. Bull. Straits Sett.* 5 (12): 316-350. 1932.
- FIDALGO, O. *Phellinus pachyphloeus* and its allies. *Mem. N.Y. Bot. Gard.* 17 (2): 109-147. 1968.
- GANESH, P.N. AND K.M. LEELAVATHY. New records of *Phellinus* from India. *Curr.Sci.* 55 (15) : 727-728. 1986.
- HUMPHREY, C.J. AND S. LEUS. Studies and illustrations in the family Polyporaceae-II, *Philip. Jour. Sci.* 47 (4): 535-556. 1932.
- KHAN, A.H. The wood-rotting fungi from Pakistan and their control. *Pakistan Journ. Sci.* 4: 65-85. 1952.
- KELLY, K.L. AND B.D. JUDD ISCC-NBS methods of designating colours and dictionary of colour names. *Washington, Nat.B. Stand. Cir. No.* 553. 1955.

- LARSEN, M.J. AND L.A. COBB-POULLE. *Phellinus* (Hymenochaetaceae) A survey of the world taxa. *Fungiflora*, 206 p. 1990.
- LLOYD, C.G. Mycological writings 6 (Mycol. Notes 64): 985-1029. 1920.
- LLOYD, C.G. Mycological writings 7 (Mycol. Notes 67): 1137-1168. 1922.
- , Mycological writings 7 (Mycol. Notes 72): 1269-1300. 1924.
- LOWE, J.L. Polyporaceae of North America. The genus *Fomes*. *N.Y. State Univ. Coll. For Tech. Bull.* 80 : 1-97. 1957.
- OVERHOLTS, L.O. Eubasidiomycetes. In Seaver, R.J. and C.E. Chardon, *Mycology. N.Y. Acad. Sci. Sci. Surv. P.R. & Virg. Isl.* 8 (1): 1-208. 1926.
- PADWICK, F. India & Burma, new plant diseases recorded in 1938. *Intern. Bull. Plant Prot.* 13 (11): 256-258. 1939.
- PATOUILLARD, N. Enumeration des Champignon récoltes a Java Par M. Massart. *Ann. Jard. Bot. Buitenzorg Suppl.* 1: 107-128. 1897.
- PETCH, T. Additions to Ceylong fungi-III. *Ann. Roy. Bot. Gard. Paradeniya* 9: 313-328. 1925.
- PRASAD, J. *Aleurites fordii* Harmsl. *Indian For. Rec.* II 8(1): 1-33. 1950.
- PSALTZE, A. Van de Landbouwwereenigingen. De Stand Van Pnze Kennis omtrent Wortel-Schimmels bij *Havea*, *Bergcultures* 9 (37): 850-859. 1935.
- RAMANATHAN, V., D.V. Ball, AND K.M. THOMAS. A Review of the past experimental work on Coffee in South India with suggestions for the future. 56 p. 1951.
- RATTAN, S.S. The resupinate Aphyllophorales of North Western Himalayas. *Bibl. Mycol.* 60: p. 429. 1977.
- RYVARDEN, L. AND I. JOHANSEN. A Preliminary Polypore flora of East Africa. *Fungiflora*. 636 p. 1980.
- SATYANARAYAN, G. Notes on root diseases of tea in Assam and their proposed control by soil fumigation, Two leaf and a bud. 20: 20-23. 1973.
- SHARMA, J.R. Studies on Polyporaceae of Himachal Pradesh. *J. Econ. Tax. Bot.* 7: 95-101. 1985.
- SINGH, B. Timber decay due to five species of *Fomes* as new records in India. *Indian For.* 92: 653-655. 1966.
- SINGH, S., S. SINGH, AND B.K. BAKSHI Fungus flora of South Andamans. *Ibid.* 87 (4): 248-250. 1961.
- THIND, K.S. AND S.S. RATTAN The Polyporaceae of India-VII. *Indian Phytopath.* 24: 290-294. 1971.
- TUNSTALL A.C. Vegetable parasites of the tea plant, *Quart. Journ. Indian Tea Assoc.* 1: 28-36. 1930.
- Notes on root diseases of tea in North East India. *Indian Tea Assoc. Mem.* 8: 7-12. 1940.
- VEKANTARAMAN, C.S. Tea Plant and control of rot diseases-I, in situ action of soil fungicides on *Fomes noxius*, *Rusellina acruata* and *Ustulina zonata*. *Rep. Tea. Sci. Dept. Un. Pl. Ass. S. India*: 66-67. 1960.