

Black mildews (Meliolaceae) on plantation crops

V. B. HOSAGOUDAR AND T. K. ABRAHAM

Division of Microbiology, Tropical Botanic Garden and Research Institute, Palode 695562
Thiruvananthapuram, Kerala

This paper deals with the importance and morphology of the black mildews found on plantation crops in India. 19 taxa of Meliolaceae belonging to 5 fungal genera had infected 7 host genera. Generic key is provided and all the 19 fungal taxa are enumerated.

Key words: *Amazonia*, *Appendiculella*, *Armatella*, *Asteridiella*, *Meliola*, plantation crops

INTRODUCTION

Plantation crops are grown in all parts of India, especially in the hilly tracts of Western Ghats in peninsular India and also in north east Himalayan region. These are the main sources of export to earn foreign exchange. They include fruits, seed and other plant parts used as spices. Most of these plantation crops are subjected to several fungal diseases. One among them is the black mildews which is the least studied group. Black mildews also attack the wild genetic resources of the present cultivated plantation crops which are the main source for crop improvement. The black mildews found on a few plantation crops, and on their wild genetic resources are enumerated and discussed.

MORPHOLOGY AND TAXONOMY

"Black mildews" in the present sense belonging to the family Meliolaceae of the order Meliolales. These are ecto and endophytic, apparently produce black colonies. Mycelium appressoriolate and appressoria produce haustorium in the host cells. Phialides on the mycelium produce phialoconidia and their function is unknown. Simple, branched or dentate setae are produced on the mycelium or on perithecia. Perithecia may be globose or flattened globose, bearing appendages or bearing projected perithecial wall cells. Asci 2-4-spored, evanescent. Ascospores brown and 1-4-septate.

Taxonomically, more than 2200 taxa belonging to 10 genera of the family Meliolaceae are known in the

world (Hansford, 1961; Hosagoudar, 1996; Hosagoudar *et al.*, 1996; Mibey and Hawksworth, 1997).

Key to the genera of black mildews known on plantation crops

1. Perithecia flattened globose with radiating cells
..... *Amazonia*
1. Perithecia globose 2
2. Ascospores uniseptate *Armatella*
2. Ascospores 3-4 septate 3
3. Perithecia bearing appendages *Appendiculella*
3. Perithecia devoid of appendages 4
4. Mycelial setae present *Meliola*
4. Mycelial setae absent *Asteridiella*

Enumeration of the species

Amazonia cinnamomi Hosag,
Nova Hedwigia 47: 535, 1988; Meliolales of India, P
68, 1996.

Colonies epiphyllous, dense, crustose, up to 2 mm in diameter, confluent. Hyphae straight to substraight, branching opposite at wide angles, loosely to closely reticulate and almost solid in the centre, cells 15-19 x 6-9.5 µm. Appressoria opposite, few solitary, crowded, antrorse, mostly straight, 18-22 µm long; stalk cells cuneate, 4-6 µm long; head cells ovate, versiform, entire, 12-15.5 x 9-12.5 µm. Phialides mixed with appressoria, opposite to alternate, ampulliform, 21-25 x 9-12.5 µm. Perithecia flattened - globose, up to 162 µm in diameter; ascospores ellipsoidal, 4-septate, constricted, 40 - 44 x 15-19 µm.

This species is known on *Cinnamomum riparium* Gamble from Kerala. Both the host and the fungus are endemic to Western Ghats of peninsular India (Hosagoudar, 1998).

Appendiculëlla calostroma (Desm.) Hohnel
in Sitzb. K. Akad. Wissen. Wien, Math. Naturw. Kl. 138: 556, 1919; Kapoor, Indian Phytopathol 20:151, 1967; Kar & Maity, Norw.J.Bot. 19:248, 1972.

Colonies amphigenous, mostly epiphyllous, dense, crustose, up to 2 mm in diameter. Hyphae mostly straight, branching mostly opposite at wide angles, spreading, 24-28 µm long; stalk cells cylindrical to cuneate, 9-12.5 µm long; head cells globose, irregularly sublobate, 12-15.5 x 18-25 µm. Phialides mixed with hyphopodia, opposite to alternate, conoid to ampulliform, 18-25 x 9-12.5 µm. Perithecia mostly grouped at the centre of the colony, up to 300 µm in diameter, perithecial appendages many, cylindrical to conoid, twisted rounded at the apex, 49-95 x 18-25 µm; ascospores ellipsoidal, mostly curved, 3-septate, 40-43.5 x 15-18 µm.

This species is known on *Rubus* spp. from Karnataka, Sikkim, Uttar Pradesh and West Bengal in India. It appears to be circumglobal (Hansford, 1961; Hosagoudar, 1996).

Armatella balakrishnanii Hosag.,
J. Econ. Tax. Bot. 15: 196, 1991.

Colonies hypophyllous, thin, spreading, up to 8 mm in diameter. Hyphae smooth walled, crooked, branching alternate to irregular at acute angles, closely reticulate, cells 9-25 x 4.5-6.5 µm. Appressoria alternate, antrorse to reflexed, 15.5 - 115 µm long; stalk cells aseptate to several septate, straight to tortuous, 3-102.5 µm long; head cells globose, narrowly ovate, angular, entire, 9-12.5 x 10-12 µm. Perithecia scattered, globose, verrucose, up to 115 µm in diameter; ascospores ellipsoidal, mostly aseptate but few ascospores septate, cells unequal, 43.5-49.5 x 18.5-21.5 µm.

This species is known on *Cinnamomum malabattrum* from Kerala. Both the host and the fungus are endemic to Western Ghats of peninsular India (Hosagoudar, 1991).

Armatella cinnamomi Hansf. & Thirum.,
Farlowia 3: 286, 1948; Hosagoudar, J.Econ. Tax. Bot. 15:197, 1991.

Colonies hypophyllous, thin, confluent. Hyphae smooth

walled, undulate to crooked, branching irregular at acute angles, loosely reticulate, cells 20-30 x 4-5 µm. Appressoria alternate, unilateral, straight to curved, spreading, 10-20 µm long; stalk cells mostly cylindrical, 2-5 µm long; head cells globose, cylindrical, narrowly ovate, occasionally subglobose, 6-15 x 5-10 µm. Perithecia scattered, verrucose, up to 140 µm in diameter, perithecial wall cells conoid, projecting; ascospores oblong with rounded ends, pale brown, 1-septate constricted at the septum, 20-22 x 9-11 µm, upper cell slightly larger.

This species is known on *Cinnamomum zeylancium* from Karnataka and is known only from the type description (Hansford and Thirumalachar, 1948).

Armetella cinnamomicola Hansf.
Reinwardtia 3:87, 1954; Hosag & Goos, Mycotaxon 36: 237, 1989; Hosag., J. Econ. Tax. Bot. 15: 197, 1991.

Colonies amphigenous, thin to subdense, up to 4 mm in diameter, confluent. Hyphae straight to substraight, crenulated, branching alternate to irregular at acute angles, loosely reticulate, cells 15-40 x 6.5-9 µm. Appressoria alternate, antrorse to spreading, straight to curved, 16-23 µm long; stalk cells cylindrical to cuneate, 4-6 µm long; head cells ovate, broadly conoid, rarely globose, 13-20 x 8-13 µm, outer wall crenulated. Perithecia seated on tortuous exappressoriolate mycelium, scattered, globose, up to 215 µm in diameter; ascospores initially hyaline, continuous, oblong with rounded ends, dumbbell shaped, matured spores 1-septate with mostly equal cells, cinnamon brown to dark brown, 23 - 30 x 10-13 µm, germinating cell enlarged to form appressoria and the other one emptied and collapsed.

This species is known on *Cinnamomum malabattrum* from Kerala and was described by Hansford (1954) from Java on *Cinnamomum iners*. Later, Hosagoudar and Goos (1989) and Hosagoudar (1991) reported it from Kerala and Tamil Nadu, respectively. Export of this spice to other countries might have made this fungus to disseminate.

Armatella indica Hosag.
J. Econ. Tax. Bot 15:199, 1991.

Colonies hypophyllous, carbonaceous black, dense, velvety, up to 5 mm in diameter. Hyphae smooth walled, crooked, branching alternate to irregular at acute angles, closely reticulate, cells 12.5-31 x 6-9.5 µm. Appressoria alternate, about 5% opposite, antrorse to spreading, 15.5 - 21.5 µm long; stalk cells single celled, cylindrical

to cuneate, 6-9.5 μm long; head cells ovate, globose, angular, rarely lobate, 9-12.5 x 12.5-15.5 μm . Perithecia scattered, verrucose, up to 310 μm in diameter; ascospores initially aseptate, white, one septate at maturity, brown, 46.5-52.5 x 18.5-21.5 μm .

This species is known on *Cinnamomum malabattrum* from Kerala. Both the host and the fungus are endemic to the area (Hosagoudar, 1991).

Asteridiella pygei Hansf. var. *microspora* Hosag., Meliolales of India, P. 100, 1996.

Colonies epiphyllous, dense, scattered, up to 2 mm in diameter. Hyphae substraight to crooked, branching irregular at acute angles, loosely reticulate, cells 27-40 x 5-7 μm . Appressoria alternate, antrorse, subantrorse, spreading, straight to recurved, 18-31 μm long; head cells ovate, globose, entire, angular to irregularly sublobate to lobate, 12-18 x 12-15.5 μm . Phialides mixed with appressoria, scattered, ampulliform, 15-18.5 x 6-9.5 μm . Perithecia immature. Ascospores curved, ellipsoidal, 3-septate, slightly constricted at the septa, 37-41 x 11-13 μm .

This species is known on *Rubus* sp. from Sikkim (Hosagoudar, 1996).

Meliola anacardii Zimm.

Centralbl. f. Bakt. Abt. 28: 151, 1902; Hansf., Sydowia Beih. 2: 462, 1961; Hosag., Raghu & Pillai, Nova Hedwigia 58: 536, 1994.

Colonies epiphyllous, dense, velvety, up to 3 mm in diameter, confluent. Hyphae straight to substraight, branching alternate to opposite at acute to subacute angles, loosely reticulate cells 21-30 x 5-7 μm . Appressoria alternate, antrorse to subantrorse, mostly straight, 15-18.5 μm long; stalk cells cuneate, 3-6.5 μm long; head cells ovate, attenuated at the apex, entire, 12-15.5 x 6-8 μm . Phialides mixed with appressoria, alternate to opposite, ampulliform, neck elongated, 24-28 x 9-12.5 μm . Mycelial setae scattered, simple, straight, acute, obtuse to dentate at the tip, up to 450 μm long. Perithecia scattered, verrucose, up to 140 μm in diameter, ascospores broadly ovoid to obovoid, 4-septate, slightly constricted, 43-46.5 x 20-22 μm .

This species is known on *Anacardium occidentale* from Kerala (Hosagoudar *et al.*, 1994)

Meliola artocarpi Yates

Pilippine J. Sci. 12: 362, 1917; Hansf., Sydowia Beih. 2: 1961; Hosag., Kaveriappa, Raghu & Goos,

Mycotaxon 51: 111, 1994.

Colonies epiphyllous, subdense to dense, velvety, up to 5 mm in diameter, rarely confluent. Hyphae straight to substraight, branching mostly irregular at acute angles, closely reticulate, cells 20-30 x 6-9.5 μm . Appressoria alternate, antrorse to subantrorse, straight to curved, 24-42 μm long; stalk cells cylindrical to cuneate, 8-13 μm long; head cell ovate, globose, entire to angulose, 16-27 x 12-20 μm . Phialides mixed with appressoria, alternate to opposite, ampulliform, 18-25 x 9-12.5 μm . Mycelial setae numerous, simple, arcuate to uncinata, obtuse at the tip, up to 500 μm long. Perithecia closely scattered, up to 195 μm in diameter; ascospores oblong, 4-septate, constricted at the septa, 48-56 x 18-26 μm .

This species is known on *Artocarpus heterophyllus* from Karnataka and Tamil Nadu (Hosagoudar and Goos, 1991; Hosagoudar *et al.*, 1994)

Meliola artocarpi Yates var. *indica* Hosag.,

Pillai & Raghu in Hosag., Meliolales of India, P. 134, 1996.

Colonies epiphyllous, dense, velvety, up to 2 mm in diameter, rarely confluent. Hyphae straight to sub straight, branching opposite to irregular at acute angles, closely reticulate, cells 15-25 x 9-12.5 μm . Apical portion of the hyphae profusely and closely branched and resemble like netted fingers but devoid of phialides and appressoria but are borne just below the profusely branched apical portion of the hyphae. Appressoria alternate, closely antrorse, 31-41 μm long; stalk cells cuneate, 15-18.5 μm long; head cells ovate, globose, entire, angular to slightly lobate, 18-22 x 18-21 μm . Phialides borne on a separate mycelial branch, alternate, conoid to ampulliform, 21-25 x 9-12.5 μm . Mycelial setae densely scattered, simple, acute, oblong at the apex, few mycelial setae straight and acute at the tip, up to 390 μm long. Perithecia scattered, verrucose, up to 150 μm in diameter; ascospores obovoidal, 4-septate, slightly constricted at the septa, 49-53 x 15-18.5 μm .

This taxon is known on *Artocarpus gomezianus* subsp. *zeylanicus* from Karnataka (Hosagoudar, 1996).

Meliola butleri Sydow

Ann Mycol. 9: 379, 1911; Hansf., Sydowia Beih. 2: 382, 1961; Srinivasulu, Nova Hedwigia Beih. 47: 423, 1974; Hosag., J. Econ. Tax. Bot. 9: 375, 1987.

Colonies amphigenous, mostly epiphyllous, subcrustose,

dense, up to 4 mm in diameter. Hyphae straight to undulate, branching opposite to irregular at wide angles, closely reticulate, cells 12-24 x 6-8 μm . Appressoria alternate to opposite, antrorse, curved, 16-24 μm long; stalk cells cylindrical to cuneate, 4-6 μm long; head cells ovate, clavate, cylindrical, often curved, entire, 12-16 x 8-10 μm . Phialides mixed with appressoria, opposite to alternate, ampulliform, 16-20 x 6-8 μm . Mycelial setae scattered, straight, acute to dentate, up to 650 μm long. Perithecia closely scattered, verrucose, up to 220 μm in diameter, ascospores oblong to subellipsoid, 4-septate, constricted, 32-44 x 14-18 μm .

This species is known on *Citrus* spp. from Andaman and Nicobar Islands, Sikkim, Tamil Nadu and W. Bengal. This species appears to have wide host range (Hosagoudar, 1996).

Meliola citricola Sydow

Ann Mycol. 15: 183, 1917; Hansf., Sydowia Beih. 2: 246, 1961; Kar & Maity, Norw. J. Bot. 19: 246, 1972; Hosag. & Goos, Mycotaxon 37: 326, 1990; 42: 133, 1991.

Colonies amphigenous, caulicolous, mostly hypophyllous, dense, velvety, up to 4 mm in diameter, confluent. Hyphae substraight to undulate, branching opposite to irregular at wide to acute angles, closely reticulate, cells 14-24 x 6-10 μm . Appressoria alternate, about 15% opposite, antrorse, spreading, straight to curved, 18-24 μm long; stalk cells cylindrical to cuneate, 6-10 μm long; head cells cylindrical, ovate, entire, straight to curved, 12-16 x 8-14 μm . Phialides mixed with appressoria, opposite to alternate, ampulliform, 16-22 x 6-8 μm . Mycelial setae scattered, simple, obtuse to variously dentate at the tip, up to 576 μm long. Perithecia scattered, verrucose, up to 225 μm in diameter; ascospores ellipsoidal, 4-septate, constricted, 32-42 x 14-20 μm .

This species is known on *Citrus aurantium* from Kerala, Maharashtra, Tamil Nadu and W. Bengal (Hosagoudar, 1996).

Meliola integrifolia C.R. Patil ex V. B. Hosagoudar, Meliolales of India. P.222, 1996

Colonies hypophyllous, dense, velvety, up to 5 mm in diameter. Hyphae crooked, branching opposite to irregular at acute to wide angles, closely reticulate, form solid mycelial mat, cells 13-22 x 6-8 μm . Appressoria opposite (60%), alternate and rarely

solitary, antrorse to subantrorse, 12-18.5 μm long; stalk cells cylindrical to cuneate, 3-6.5 μm long; head cells ovate, globose, entire, 9-13 x 9-12 μm . Phialides mixed with appressoria, scattered, ampulliform, 15-22 x 9-10 μm . Mycelial setae densely scattered, simple, straight, curved, uncinata, acute, obtuse to dentate, up to 300 μm long. Perithecia closely grouped, verrucose up to 140 μm in diameter; ascospores oblong to obovoidal, 4-septate, constricted at the septa, 43-46.5 x 18-20 μm .

This species is known on *Artocarpus heterophyllus* from (= *A. integrifolia* auct. Non L. f.) from Maharashtra (Hosagoudar, 1996).

Meliola Kaveriappai Hosag., Pillai & Raghu in Hosag., Meliolales of India P. 232, 1996

Colonies hypophyllous, very thin, spreading, up to 10 mm in diameter. Hyphae strongly appressed to the host surface, crooked, branching alternate to irregular at acute angles, closely reticulate, cells 30-50 x 6-8 μm . Appressoria alternate, straight to variously curved, antrorse to recurved 24-28 μm long; stalk cells cylindrical to cuneate, 6-9.5 μm long; head cells ovate, globose, straight to curved entire angular to slightly lobate 15-18.5 x 12-15.5 μm . Phialides mixed with appressoria, alternate, opposite, ampulliform, 21-25 x 6-8 μm . Mycelial setae scattered, simple, straight to rarely flexuous at the base, acute to obtuse at the apex, up to 715 μm long. Perithecia scattered, up to 125 μm in diameter; ascospores obovoidal, 4-septate, slightly constricted at the septa 51-54 x 24-25 μm .

This species is known on *Cinnamomum* sp. from Karnataka (Hosagoudar, 1996).

Meliola mangiferae Earle

Bull. New York Bot. Gard. 3:307, 1905; Hansf., Sydowia Beih 2: 464, 1961; Hosag & Goos, Mycotaxon 37: 240, 1990; Hosag., Crypt. Bot. 2/3: 186, 1991; Hosag. & Ansari, J. Andaman Sci. Assoc. 7: 89, 1991.

Colonies hypophyllous, thin, velvety, up to 4 mm in diameter. Hyphae substraight to crooked, branching opposite to irregular at wide angles, loosely reticulate cells 27-40 x 5-6.5 μm . Appressoria alternate, mostly unilateral and variously curved, 24-31 μm long; stalk cells cylindrical to cuneate, 3-6.5 μm long; head cells ovate, versiform, attenuated and rounded at the apex, entire, predominantly curved, 21-25 x 9-12.5 μm . Phialides mixed with appressoria, alternate to opposite, elongated, 21-28 x 8-9.5 μm . Mycelial setae scattered, simple, straight, acute, obtuse to 2-3 dentate at the tip,

up to 860 μm long. Perithecia scattered, verrucose, up to 175 μm , surface cells conoid and projecting; ascospores obovoidal to ellipsoidal, middle cell slightly larger, 49-56 x 18-22 μm .

This species is known on wild and cultivated Mango plants from the mainland as well as from Andaman Islands (Hosagoudar, 1996).

***Meliola rubiella* Hansf.**

Sydowia Beih. 1: 115, 1957; Sydowia Beih. 2:240, 1961; Kapoor, Indian Phytopathol. 20: 158, 1967.

Colonies mostly epiphyllous, thin up to 3 mm in diameter. Hyphae substraight to undulate, branching opposite at wide angles, loosely reticulate, cells 20-28 x 4-6 μm . Appressoria alternate, more or less antrorse, 12-16 μm long; stalk cells cylindrical to cuneate, 4-5 μm long; head cells ovate to subglobose, mostly entire, rarely slightly angulose, 12-14 x 10-12 μm . Phialides mixed with appressoria, opposite to alternate ampulliform, 13-18 x 4-6 μm . Mycelial setae mostly grouped around perithecia, straight, simple, acute to obtuse up to 350 μm long. Perithecia scattered, verrucose, up to 200 μm in diameter, ascospores oblong 4-septate, constricted, 32-36 x 10-12 μm .

This species is known on *Rubus* spp. from Sikkim (Hosagoudar, 1996).

***Meliola stenospora* Wint.**

Hedwigia 25: 97, 1886; Hansf., Sydowia Beih. 2: 75, 1961; Hosag & Raghu, New Botanist 20:72, 1993.

Colonies amphigenous, mostly hypophyllous, thin spreading, up to 5 mm in diameter. Hyphae straight to flexuous, branching opposite to irregular at acute to wide angles, loosely to closely reticulate, cells 18-25 x 6-9.5 μm . Appressoria alternate antrorse to spreading, 15-25 μm long; stalk cells cylindrical to cuneate, 6-9.5 μm long; head cells ovate to globose, angular to very slightly lobate, 9-16 x 9-15 μm . Phialides borne on a separate mycelial branch, alternate to opposite, ampulliform, 15-18.5 x 6-9.5 μm . Mycelial setae scattered to grouped around perithecia, simple, straight, acute to obtuse at the tip, up to 530 μm long. Perithecia scattered, verrucose, up to 150 μm in diameter; ascospores oblong, 4-septate, constricted at the septa, 40-46.5 x 12-18.5 μm .

This species is known on *Piper* spp. from Karnataka and Maharashtra (Hosagoudar, 1996).

***Meliola stenospora* Wint. var. *major* Hansf.**

Sydowia 16: 303, 1963; Patil & Pawar, Indian Phytopathol. 39:306, 1986.

Meliola stenospora Wint. var. *major* Hansf. Sydowia Beih 2:75, 1961.

Colonies mostly epiphyllous, subdense, thinly velvety, up to 3 mm in diameter, confluent. Hyphae substraight to slightly undulate, branching opposite to irregular at wide angles, closely reticulate cells 20-25 x 8-10 μm . Appressoria alternate about 1% opposite, spreading to antrorse, straight to curved, 17-23 μm long; stalk cells cuneate to cylindrical 3-9 μm long; head cells subglobose with crenate to lobate margin, 11-15 x 12-20 μm . Phialides borne on a separate mycelial branch, opposite to alternate, ampulliform, 17-20 x 7-9 μm . Mycelial setae mostly grouped around perithecia, straight, simple, acute, up to 1000 μm . Perithecia loosely grouped, verrucose up to 170 μm in diameter; ascospores oblong, 4-septate, slightly constricted, 37-43 x 11-15 μm .

This species is known on *Piper nigrum* from Maharashtra and Tamil Nadu (Hosagoudar, 1996).

***Meliola thitei* Hosag.**

Meliolales of India, P. 328, 1996.

Meliola piperis Thite & Patil, Geophytology 13: 124, 1983 (non Earle, 1901).

Colonies amphigenous, mostly epiphyllous, dense, confluent and cover an entire leaf surface. Hyphae straight to flexuous, branching mostly opposite at acute to wide angles, loosely reticulate, cells 18-25 x 6-8 μm . Appressoria alternate, antrorse, straight, 18-25 μm long; stalk cells cylindrical to cuneate, 3-9.5 μm long; head cells ovate, clavate, versiform, entire, 12-15.5 x 9-12.5 μm . Phialides numerous, mixed with appressoria, alternate to opposite, conoid to ampulliform, 12-18 x 9-11 μm . Mycelial setae thinly scattered, straight, simple, rarely curved, up to 315 μm long. Perithecia scattered, immature; ascospore oblong to cylindrical, straight to slightly curved, 4-septate, slightly constricted at the septa, 30-34.5 x 12-15.5 μm .

This species is known on *Piper nigrum* from Maharashtra (Hosagoudar, 1996).

DISCUSSION AND CONCLUSION

Black mildews are mostly ectoparasites and do not cause destructible pathogenic effect on the host plants. However, the black colonies of these fungi increase the temperature in the infected parts and cause

physiological imbalance. They decrease photosynthetic efficiency of the plants by inhibiting chlorophyll mechanism; affect the hormonal and phenolic compound level and in short, affect the efficiency of the plant and lead to decrease in yield.

Much is to be learnt about black mildews. Hence a thorough and systematic survey of these fungi on plantation crops in India is urgently needed. A crop loss assesment of individual plant is a supplementary.

ACKNOWLEDGEMENT

We are thankful to "Forest Department", Government of Kerala for the financial assistance and to Dr. P. Pushpangadan, Director, TBGRI, Palode for encouragement.

REFERENCES

- Hansford, C.G. (1954) Meliolales from Indonesia. *Reinwardtia* **3**: 75-112.
 Hansford, C.G. (1961). The Meliolineae. A Monograph. *Sydowia Beith* **2**:1-806
 Hansford, C.G. and Thirumalachar, M.J. (1948) Fungi of South

- India *Farlowia* **3**:285-314
 Hosagoudar, V. B. (1988) Meliolaceae of South India - V *Nova Hedwigia* **47**: 535-542
 Hosagoudar, V. B. (1991) The genus *Armatella* (P. Henn) Theiss & Sydow (Meliolaceae) in India *J.Econ.Tax.Bot* **15**: 195-202
 Hosagoudar, V. B. (1991) Meliolaceae of South India - VIII *Crypt. Bot.* **2/3** 183-187
 Hosagoudar, V. B. (1996) *Meliolales of India* Botanical Survey of India, Calcutta, pp. 363.
 Hosagoudar, V. B. and Goos, R. D. (1989). Meliolaceous fungi from the state of Kerala, India - I *Mycotaxon* **36**: 221-247
 Hosagoudar, V. B. and Goos, R. D (1991) Meliolaceae of South India - X *Mycotaxon* **42**: 125-147
 Hosagoudar, V. B., Raghu, P.A. and Pillai, C.M. (1994) Meliolaceae of southern India - XIV *Nova Hedwigia* **58**: 529-543
 Hosagoudar, V. B., Abraham, T.K. and Pushpangadan, P. (1997) The Meliolineae. A supplement. Tropical Botanic Garden and Research Institute, Palode, Thiruvananthapuram, P.201
 Mibey, R.K. and Hawksworth, D.L. (1997) Meliolaceae and Asterinaceae of the Shimba Hills, Kenya. *Mycol. Pap* **174**: 1-108

(Accepted for publication December 20 1999)