

# Some Hitherto Undescribed *Cercospora* Species from India

H. D. Bhartiya\*<sup>1</sup>

<sup>1</sup> Mycopathology Lab, Department of Botany, Bipin Bihari P. G. College, Jhansi - 284 001, Uttar Pradesh, India

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## Abstract

Three novel species of hyphomycete genus *Cercospora*, viz., *C. holopteleae-integrifoliae*, *C. naraingarhensis* and *C. pithocoelobiicola* occurring on the *Holoptelea integrifolia* (Ulmaceae), *Lagerstroemia speciosa* (Lathyraceae) and *Pithocoelobium dulci* (Mimosaceae) are described, illustrated and compared with its allied taxa. Amongst three species, two former were collected from Gorakhpur and rest one from Kathmandu Valley Nepal respectively. These specimens have been collected during the periodic survey of fungi in the years 2021-2022. Research into the genus *Cercospora* on these hosts has historically been under presented in term of species diversity due to dependence differentiation on morphological characteristics, symptomology and host associations. Therefore, the objective of this study was to identify the predominant species of *Cercospora* associated with the late cycle disease complex in aforesaid hosts. This morphological and taxonomical study proof the pathogenicity of *Cercospora* species. However, further molecular studies are required to identify and establish novel *Cercospora* species.

**Key words:** Taxonomy, Foliicolous, Hyphomycetes, *Cercospora*, Cercosporoid, Dematiaceae

*Cercospora* Fres. is distinguished from other Dematiaceous Hyphomycetous fungi by mononematous, stromatic, coloured and cicatrized conidiophores as well as hyaline and phragmosporic conidia with rim like thickening on conidial base representing the hilum. The present communication describes three new species of, viz. *C. holopteleae-integrifoliae*, *C. naraingarhensis* and *C. pithocoelobiicola*, occurring on living leaves of *Holoptelea integrifolia*, *Lagerstroemia speciosa* and *Pithocoelobium dulci*, respectively.

During periodic survey of foliicolous Hyphomycetes during recent years (2021-2022) made from plants of crops field Gorakhpur, U.P. India and Gendakot Kathmandu Valley, Nepal. *Cercospora* Fres. is distinguished from other Dematiaceous Hyphomycetous fungi by mononematous, stromatic, coloured and cicatrized conidiophores as well as hyaline and phragmosporic conidia with rim like thickening on conidial base representing the hilum. Most of the *Cercospora* like fungi have been reported from tropical Deighton [1-4], Ellis [5-6], Index Fungorum [7], Braun *et al.* [8-10] and subtropical region [11]. A large number of such forms have also been described by Indian Mycologists; Bilgrami *et al.* [12], Vasudeva [13], Sarbhoy *et al.* [14], Subramanian [15-16], Kamal [17].

The objective of the present study was to identify the predominant species of *Cercospora* genus causing symptoms in Indian fields by using infected leaf samples over three seasons from two different countries. These morphological analyses were conducted to test the hypothesis that not only *C. holopteleae-integrifoliae*, *C. naraingarhensis* and *C. pithocoelobiicola* but also other species infect these host fields in India and Nepal. In addition, identification and characterization of predominant pathogen is fundamental for

the development of efficient central strategies, as the presence of *Cercospora* spp. together with the late cycle disease complex has led to increasing productivity losses in recent years.

## MATERIALS AND METHODS

Fungi were collected from Terai region of Gorakhpur in India and Narain ghat of Nepal. The infected living leaves having distinct symptoms were collected, dried and pressed to make herbarium specimens. A part of this was deposited in the Herbarium Cryptogamiae Indiae Orientalis, Indian Agricultural Research Institute, New Delhi and corresponding isotypes were retained in the laboratory for further references. The fungi were observed under microscope after free hand transverse and longitudinal sections of infested parts and mount in cotton blue lacto phenol. Morpho- taxonomic study of the associated fungi was done through routine methods of Camera Lucida drawings. The species determination was made often comprising with the help of most recent literature and expertise of the resident Mycologists.

## RESULTS AND DISCUSSION

*Cercospora holopteleae- integrifoliae* HD Bhartiya sp. nov.

### Taxonomy

*Maculae* amphigenae, 0.5-16 mm latae, orbiculares vel suborbiculares, discretae, superne olivaceis vel atro grisae, inferne olivaceo brunneae, *Coloniae* amphiphyllae, eflusae. *Mycelinum* internum, exhyphis ramosis, septatis, subhyalinis vel olivaceis. *Stromata* eumorpha, immersa, subepidermibus posita, compacta, olivacea vel olivaceo brunnea, 16.5-32 µm diam. *Conidiophora* singularia vel fasciculo (2-8) emergentia,

\*Correspondence to: H. D. Bhartiya, E-mail: hdbhartiya@gmail.com; Tel: +91 9415639976

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macronematosa, mononematosa, 1-4 geniculata, leniter curvata, cylindrica, olivacea vel pallide olivacea, 50-140 × 3.5-6 µm diam, *Cellulae conidiogenae* conidiophores incorporatae, terminales vel intercalares, sympodiales, geniculatae, cicatricibus incrassatae, apicem versus. *Conidia* solitaria, sicca, hyaline, nonramosa, 3-12 transversely septata, erecta, suberecta, leniter curvata, apicem versus subacuta vel obtusa, cylindrica, 40.5-190×2-3 µm diam.

In foliis vivis *Holopteleae integrifoliae* Planch (Ulmaceae) HD Bhartiya, 2022, Botanical Garden, Gorakhpur (U.P.) India; GPU Herb. No. 5080 isotypus, HCIO 41952 holotypus.

*Infection spots* amphigenous, circular to subcircular, discrete, olivaceous to dark grayish, 0.5-16 µm in diam. *Mycelium* internal, branched, septate, subhyaline to olivaceous

brown. *Colonies amphiphyllous*, effuse. *Stromata* well developed, immersed, subepidermal, compact, olivaceous to olivaceous brown, 16.5-32 µm in diam. *Conidiophores* singly or in groups of 2-7, macronematous, mononematous, unbranched, 1-5 septate, straight to substraight, 1-3 geniculate, cylindrical, olivaceous to pale olivaceous, 50-142×3.5 µm. *Conidiogenous* cells integrated, terminal to intercalary, sympodial, geniculate, scar thickened, apex rounded, *Conidia* solitary, dry, hyaline, unbranched, 3-12 transversely septate, erect to suberect or slightly curved, apex subacute to obtuse, cylindrical, 40.5-190 × 2-3µm.

On living leaves of *Holoptelea integrifolia* Planch (Ulmaceae), HD Bhartiya March 2022 Botanical Garden, Gorakhpur (U.P.) India, GPU Herb. No. 5080 isotype, HCIO 41952 holotype [18-20].

Table 1 Comparative analysis of *Cercospora* spp: reported on the host genus *Holoptelea*

<i>Cercospora</i> species	Leaf spots	Stromata	Conidiophores	Conidia
<i>C. holopteleae</i> Chiddarwar (1960)	Amphigenous, pale brown, rounded to ovoid distinct brown border, 1-9 mm in diam.	Well-developed compact, brown, 21-40a in diam.	Arising singly septate subtruncate at apex, scar distinct. 213.545 µm	Subhyaline. Rarely cylindrical, straight 10 curved, 2-8 septate. obconic to obtuse at tip 23-45×3.5+4.5µm
<i>C. holopteleae integrifoliae</i> sp. nov.	Amphigenous, olivaceous brown circular, discrete. effuse, 0.5-16 µm.in diam.	Well developed compact, olivaceous brown, 16-32 µm in diam.	Arising singly or in groups of 2-7, 2-6septate olivaceous, 1-3 geniculate, 50-142.5× 3.5-5 µm.	Hyaline.3-21 transversely septate cylindrical, subacute to obtuse at the tip. 40-190×2-4µm.

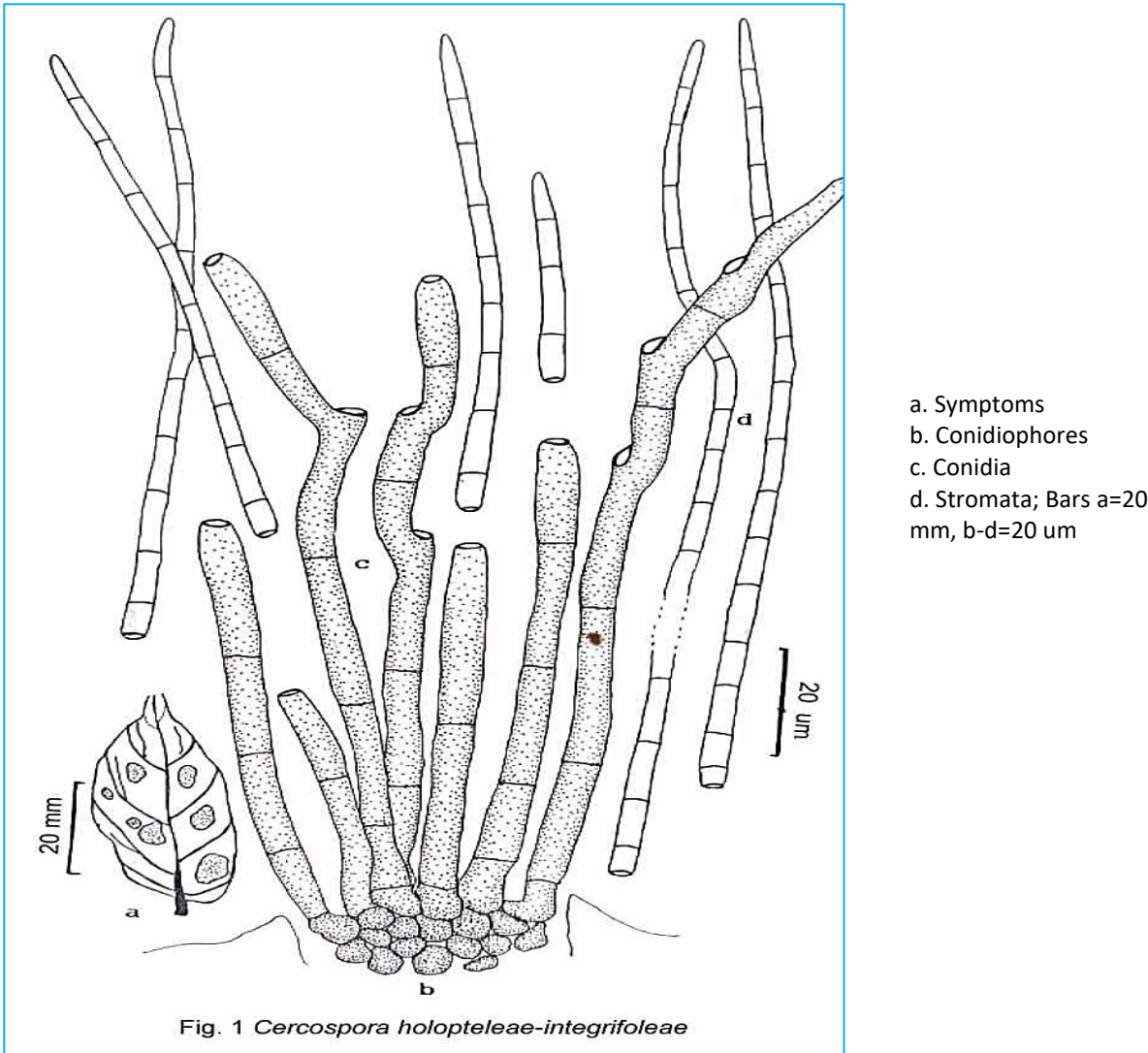


Fig 1 *Cercospora holopteleae-integrifoliae* sp. nov.

A comparison shows that the present collection is significantly different from *C. holopteleae* producing much larger conidiophores and conidia, in addition, the color of conidia is also different in two species. Description and illustration of the present collection as a new species is, therefore, considered worthwhile.

*Cercospora naraingarhensis*. HD Bhartiya sp. nov.

#### Taxonomy

Maculae amphigenae, 0.5-2 µm. latae, orbiculares vel suborbiculares, necroticae, superne albo griseae, ad inferne olivaceo brunnae. *Coloniae* amphiphyllae, effusae. *Mycelium* internum, ex hyphis ramosis, septatis, subhyalinis vel pallide olivaceis. *Stromata* eumorpha, immersa, compacta, subepidermalia, olivaceo brunnea vel brunnea, 16.5-30 µm diam. *Conidiophora* 2- 6 in fasciculo ex emergentia, macronematosa, mononematosa, 3-8 septata, nonramosa, 1- 5 geniculata, recta vel subrecta, leniter curvata, cylindrica, pallide olivacea vel olivaceo brunnea, 45.5-129 × 2.5-5 µm. *Cellulae conidiogenae* in conidiophoris incorporatae, sympodiales, terminales vel intercalares, geniculatae, cicatricibus incrassatae. *Conidia* solitaria, sicca, recta vel subrecta,

nonramosa, 4-15 transverse septata, apicem versus subacuta vel obtusa, cylindrica, 31-125.5×1.5-2.5 µm.

In foliis vivis *Lagerstroemiae speciosae* Pers. (Lythraceae), HD Bhartiya, Feb, 2021. Gendakot, Naraingarh Valley (Nepal), GPU Herb. No. 5080 isotypus, HCIO 41997 holotypus.

Infection spots amphigenous, 0.5-2 mm in diam, circular to subcircular, greyish white on upper surface, olivaceous brown on lower surface. *Colonies* amphiphyllous, effuse. *Mycelium* of thyphae internal, branched, septate, subhyaline to light olivaceous. *Stromata* well developed, immersed, compact, subepidermal, olivaceous brown, 16.5-30 µm diam. *Conidiophores* arising singly or in groups of 2-6, macronematous, mononematous, 2-6 septate, unbranched, 1-5 geniculate, straight to substraight, slightly curved, cylindrical, light to olivaceous brown, 45.5-129×2.5-5 µm diam. *Conidiogenous cells* integrated, sympodial, terminal to intercalary, geniculate, scar thickened, tip obconic and swollen. *Conidia* solitary, dry straight, to sub straight, unbranched, 4-15 transversely septate, apex subacute to obtuse, cylindrical, 31-125.5×1.5-2.5 µm. On living leaves of *Lagerstroemia speciosa* Pers. (Lythraceae), HD Bhartiya, Feb, 2022 Gendakot, Naraingarh Valley (Nepal); GPU Herb. No. 5080 isotype, HCIO 41997 holotype [21-22].

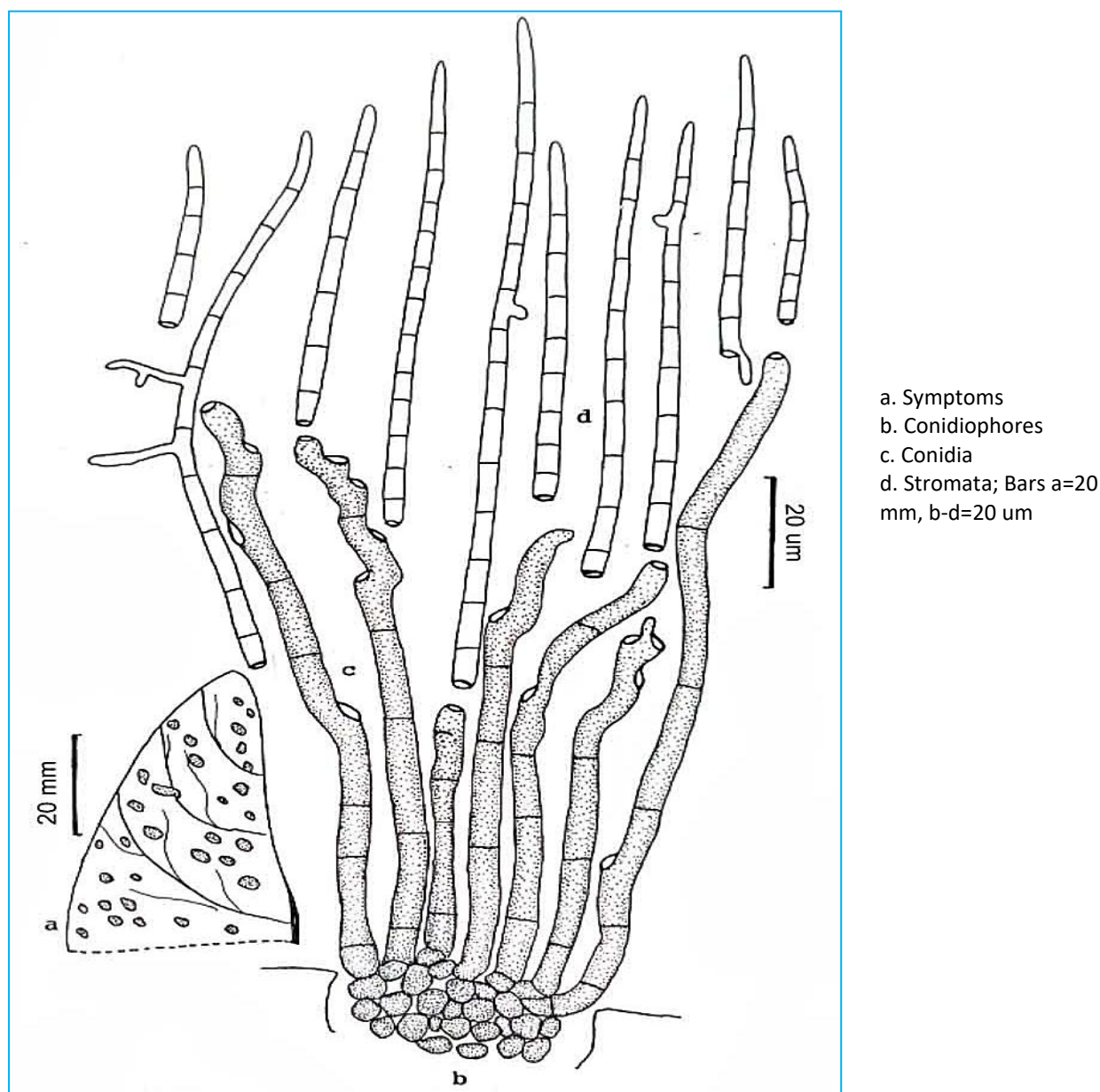


Fig 2 *Cercospora naraingarhensis* sp. nov.



Through comparative analysis shows that *Cercospora lagerstroemiae* H. and P. Sydow (1914) on *Lagerstroemia spectosa*, *Cercospora lagerstroemiue subcostata* Sawada [11] on *Lagerstroemia subcostata* var, *hirtella* have been reduced to synonymy with *Cercospora thracearum* Heald and Wolf (1911) on *Lagerstroemia indica* has been recombined as *Pseudocercospora lythracearum* (Heald and Wolf) Liu and

Guo (Guo and Liu 1992). However, *Cercospora lythracearum* var. *macrospora* Chhidarwar (1960) on *Lagerstroecnia lanceolata* has been invalid due to publication without latin diagnosis. Thus, *Cercospora jugdalspurensis* Rajak and Gautam (1978); on *Lagerstroemia parviflora* is the only species representing true *Cercospora*. This is compared with present collection.

Table 2 Comparative analysis of *Cercospora* spp. reported on the host genous *Lagerstroemia*.

<i>Cercospora</i> species	Leaf spots	Stromata	Conidiophores	Conidia
<i>C. jagdalspurensis</i> Rajak & Gautam (1978)	Amphigenous, irregular olivaceous brown	None	Fasciculate, multiseptate, unbranched scars distinct, 44-94 × 4.5µm	Straight or curved, 3-30 septate, base truncate, apex acute, 48-315×4-6µm
<i>C. naraingarhensis</i> sp.nov.	Amphigenous, 0.5-2mm in diam circular to subcircular, greyish white to olivaceous brown	Well developed, olivaceous brown, 16.5-30µm diam	Single or fasciculate (2-6), 3-8 septate, unbranched, 45.5-128×2.5-5µm	4-15 septate, unbranched, subacute to obtuse, cylindrical, 31-125.5×1.5-2.5µm

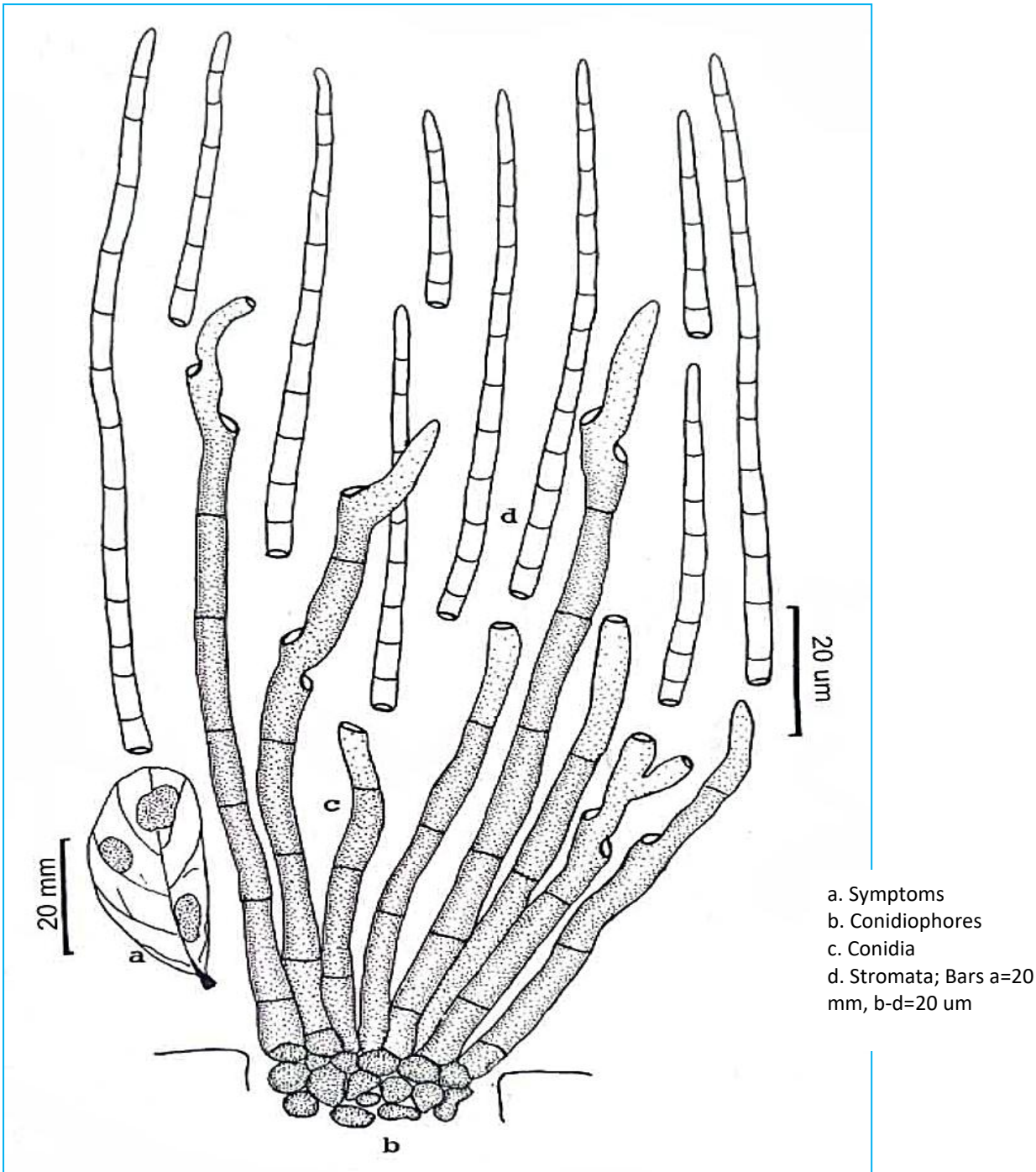


Fig 3 *Cercospora naraingarhensis* sp. nov.

The comparison shows that the fungus in question is distinct in having amphigenous circular leaf spots, well developed stromata, longer conidiophores as well as more septate and shorter conidia. It has been therefore, described and illustrated here as a new species.

*Cercospora pithecolobiicola*, HD Bhartiya sp.nov.

#### Taxonomy

*Maculae* amphigenae, 0.5- 10 µm latae, orbicul Coloniae amphiphyllae, effusae. Mycelium internum, exhyphis ramosis, septatis, subhyalinis vel olivaceis. *Stromata* eumorpha, pallide olivacea vel olivaceo brunnea, 13-27 m. diam. *Conidiophorain* in singularia vel in fasciculo (2-10) emergentia, macronematosa, mononematosa, nonramosa, 3-6 septata, recta vel subrecta, 2-5 geniculata, leniter flexuosa, cylindrica, pallide olivacea vel pallide brunnea, 45-150.5×2-3µm. *Cellulae conidiogenae* in conidiophoris incorporatae, trminales vel intercalares, sympodiales, geniculatae, incrassatae. *Conidia* solitaria, sicca, recta, leniter curvata, nonramosa, 3-13 transversely septata, apicem versus subacuta vel obtus, cylindrica, 24-108×2-3µm.

In foliis vivis *Pithecolobi dulci* (Roxb.) Benth. (Mimosaceae) HD Bhartiya, Nov. 2022, Lethifarm, Nichlaul,

Mahrajganj (U. P.) India, GPU Herb, No. 5033 isotypus, HClO 41950 holotypus.

*Infection spots* amphigenous, 0.5- 10mm in diam., circular to subcircular, greyish brown. *Colonies* amphiphyllous, effuse. *Mycelium* of hyphae internal, branched, septate, subhyaline to olivaceous. *Stromata* well developed compact, light olivaceous to olivaceous brown, 13-27µm. *Conidiophores* arising singly or in groups of 2- 10, macronematous, unbranched, 3-13 septate, straight to sub straight, slightly flexuous, cylindrical, pale olivaceous to light brown, 45.0-151µ-2-2 µm [24].

*Conidiogenous cells* integrated, terminal to intercalary, sympodial, geniculate, scar thickened. *Conidia*, solitary, dry, straight, slightly curved, unbranched, 3-13 transversely septate apex subacute to obtuse, cylindrical, 24-108 × 2-3 µm.

On living leaves of *Pithecolobium dulci* (Roxb.) Benth. (Mimosaceae) HD Bhartiya, Nov. 2022 Lethifarm, Nichlaul, Mahrajganj (U.P.) India; GPU Hesb. No. 5033 isotype, HClO 41950 holotype [25].

It is evident from the literature that only one species viz., *C. mimosae* Agarwal and Sharma (1973) was described earlier on the same host genus. However, *C. pithecolobii* Sawada (1942) is probably a synonym of *C.spilosticta* (H. Sydow) Deighton (1976).

Table 3 Comparative analysis of *Cercospora* spp. reported on the host genus *Pithecolobium*

<i>Cercospora</i> species	Stromata	Conidiophores	Conidia
<i>C. mimosae</i> Agarwal & Sharma (1973)	Well-developed dark brown to black 72µm in diam	Fasciculate, olivaceous brown, septate, paler in colour at the tip, 10-12.5×3.5-5µm	3-6 septate, sub hyaline to pale olivaceous, tip obtuse, cylindrical, 32-68×2-4.5µm
<i>C. pithecolobiicola</i> sp.nov.	Well-developed light olivaceous to olivaceous brown, 12.5-27µm in diam	Fasciculate, pale olivaceous to light brown, 3-8 septate, 2-5 geniculate, uniform in colour at the tip, 45-145.5×2-3µm	3-13 septate, hyaline, tip subacute to obtuse, 24.5-109×2-2.5µm

The present collection is different in having well developed stromata, longer geniculate conidiophores as well as longer and unbranched conidia. Therefore, fungus in question merits description and illustration as a new species.

## CONCLUSION

The present study has led to the identification and taxonomic description of three novel species within the genus *Cercospora*, namely *Cercospora holopteleae-integrifoliae* sp. nov., *Cercospora naraingarhensis* sp. nov., and *Cercospora pithecolobiicola* sp. nov. Each of these newly described species is distinguished from previously reported *Cercospora* species on their respective host genera based on distinct morphological characteristics, including conidial size, shape, septation, conidiophore structure, and stromatal development. Comparative analysis with related *Cercospora* species demonstrates significant taxonomic differences. *Cercospora holopteleae-integrifoliae* sp. nov. is notably distinct from *C. holopteleae* Chiddarwar (1960) in terms of conidial size, stromatal structure, and conidiophore morphology. Similarly, *Cercospora naraingarhensis* sp. nov. is differentiated from *Cercospora jagdalpurensis* by its amphigenous leaf spots, well-developed stromata, and conidia with a higher septation count. *Cercospora pithecolobiicola* sp. nov. stands apart from *C.*

*mimosae* Agarwal & Sharma (1973) due to its larger, more geniculate conidiophores and longer, unbranched conidia. These findings contribute to the expanding taxonomy of *Cercospora* species and highlight the diversity of fungal pathogens associated with different host plants. The descriptions and illustrations provided in this study offer a valuable reference for future mycological and phytopathological research. Further molecular and phylogenetic studies are recommended to validate these taxonomic placements and explore their evolutionary relationships within *Cercospora* and related genera. This research underscores the importance of continued fungal biodiversity studies, particularly in lesser-explored regions, to enhance our understanding of plant pathogenic fungi and their ecological significance.

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