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THIELAVIOPSIS BASICOLA: A POTENTIAL THREAT TO AGRICULTURE AND FORESTRY IN PAKISTAN

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Abstract

Thielaviopsis basicola, the cause of black root rot disease in various plants of economic importance is for the first time reported from the roots of cowpea (*Vigna unguiculata* L. (Walp.), from Karachi, Pakistan.

Introduction

During the course of studies on Fungal Flora of Pakistan collected in December 2006, a fungus was isolated from rotted root of cowpea (*Vigna unguiculata*) from Karachi, Pakistan. The fungus was identified as *Thielaviopsis basicola* after reference to Ellis (1971, 1976), Carmichael *et al*., (1980), Nag Raj & Kendrick (1975), Punja & Sun (1999), Paulin Mahady & Harrington (2002). World maps of plant diseases No. 218 prepared by CABI (Anon., 2006) indicate that *Thielaviopsis basicola,* the cause of black root rot disease of tobacco and many other plants was also found from Pakistan. A survey of literature, for Fungal Flora of Pakistan, revealed it has not been included in any compilation of lists of fungi from Pakistan (Ghaffar & Kafi, 1968; Ghaffar *et al,* 1971; Ghaffar & Abbas, 1972; Kamal & Mughal, 1968; Mirza & Qureshi, 1978; Ahmad *et al*., 1997). One wonders why such a common plant pathogen was not included in any of these lists. It appear that none of these compilers have seen world map of plant diseases No. 218.

T. basicola grows well on Czapek Dox agar medium at pH 8-9.5 and >20^{o}C. (Yarhood, 1981). It is a cosmopolitan species with wide host range and reported from Africa, American continents, Asia, Australia and Europe (Agrios, 1997, Ellis, 1971, 1976; Nag Raj & Kendrick, 1975; Lambe & Ritchie, 1986; Allen, 1990; Punja *et al*., 1992; Punja & Sun, 1999; Daughtrey *et al.,* 1995; Abawi & Hansa, 2005; Garibaldi *et al*., 2005; Geldehuis *et al*., 2006; Noshad *et al.,* 2006) causing black root rot disease and damping off of seedling in more than 150 species belonging to 33 plant families especially Solanaceae, Cucurbitaceae and Leguminosae.

Microscopic studies

***Thielaviopsis basicola* (Berk. & Br.) Ferr**
Fig. 1A

Colonies effuse, initially white and later become grey. Mycelium well developed, branched, smooth, septate, hyaline. It has dimorphic reproductive organs.

1. Phialocoidia: Conidiophore simple, septate, unbranched, hyaline subtended by subcylindrical conidiogenous cells 80 µm long, 5-8 µm thick at broader part, tapering towards apex, 3-4 µm. Conidia hyaline, cylindrical, apex and base truncate thin-walled, 7-15 x 2.5-3 µm formed enterogenously and stationarily (Sensu, Hennbert & Sutton, 1994).

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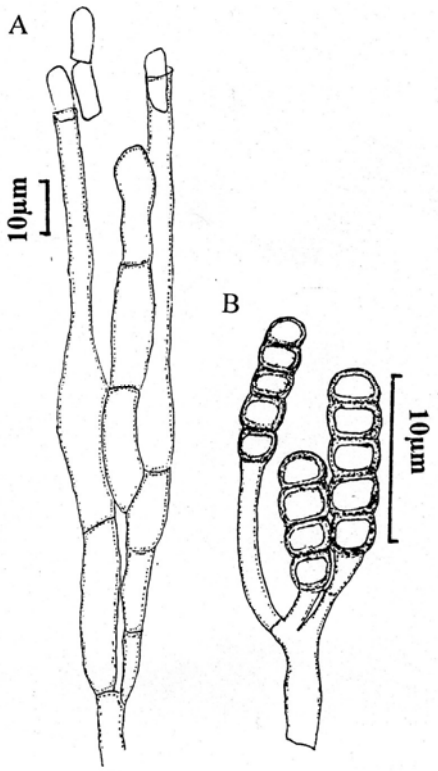

Fig. 1. *Thielaviopsis basicola* A. Phaloconidia, conidiophore and conidiogenous cells, B. Aleuroconidia, conidiophore and conidiogenous cells.

Another type of asexual spores are also produced by this fungus. These spores are variously described by different authors, Barron (1968) considered them as Aleurioconidia, Ellis (1971) as Arthroconidia and Hughes (1953) as chlamydospores.

***Thielaviopsis basicola* (Berk. & Br.) Ferr**
Fig. 1B

2. Aleurioconida: Conidiophores unbranched, straight, hyaline, smooth, septate, 30 x 6-8 µm, uppermost cell functioning as conidiogenous cell and forming Aleurioconidia. Aleurioconidia unicellular, thick walled, brown in chain of 4-6, remain intact for a long time and resemble as multiseptate conidia, terminal conidium thick walled, brown, apex obtuse, base truncate, while rest of the conidia are more longer than wider, thick walled, brown, apex and base truncate. 7-10 x10-15µm.

Taxonomy and nomenclature

Thielaviopsis was erected by Went (1893), based on a single species (*Thielaviopsis ethacetica*) from java on sugarcane. *Sporoschisma paradoxum* was already described by

de Seynes (1886). Saccardo (1892) considered that the fungus belongs to *Chalara*, therefore, made a combination *Chalara paradoxa* (de Seynes) Sacc. Hohnel (1904) also reported a fungus from endosperm of *Cocos nucifera*, identical to *Sporoschisma paradoxum* de Seynes. He considered it to be the same as *Thielaviopsis ethacetica* Went, which was also confirmed by Went, since epithet *paradoxa* had priority over *ethacetica*, hence Hohnel (1904), proposed the combination *Thielaviopsis paradoxa* (de Seynes) Hohnel.

Berkeley & Broome (1850) reported *Torula basicola* Berk. & Br., from *Pisum* sp., and *Nemophila auriculata.* Ferraris (1910) transferred *Torula basicola* to *Thielaviopsis* forming the combination *Thielaviopsis basicola* (Berk. & Br.) Ferr., and listed it as an anamorph of *Thielavia basicola*. McCormick (1925) showed that there is no telo-anamorph connection between *Thielavia basicola* and *Thielaviopsis basicola.*

Hughes (1953) was of the opinion that name of pleomorphic genera should be based on most frequent, common, conspicuous and identifiable characters. Hennbert (1968), Nag Raj & Kendrick (1975) also support Hughes (1953). Barron (1968) was of the opinion that distinction among *Chalara, Chalariopsis* and *Thielaviopsis* is arbitrary. Hence he placed *Thielaviopsis* and *Chalariopsis* under synonymy of *Chalara*. Nag Raj & Kendrick (1975) in the monograph of *Chalara* and allied genera placed *Torula* (Pers.) Link subg. *Chalara* Corda, *Torula* (Pers.) Link sect. *Chalara* (Corda) Corda, *Cylindrocephalum* Bon., *Thielaviopsis* Went, *Stilbochalara* Ferd. & Winge, *Chalariopsis* Peyr, *Excioconidium* Plunkett and *Hughesiella* Bat. & Vital in its synonymy.

Thielaviopsis Went, *Chalara* (Corda) Rabenh., *Chaetochalara* Sutton & Pirozynski, *Hughesiella* Batista & Vital and *Trichocladium* Harz closely resemble each other. *Chalara* and *Chaetochalara* have monomorphic anamorph, with enterogenous and stationarily proliferating conidia (sensu Hennbert & Sutton, 1994), while *Trichocladium* has monomorphic, hologenous, stationary, solitary, 1- several transversly septate, brown and thick-walled conidia. *Chalara* differs from *Chaetochalara* in absence of setae. *Thielaviopsis, Chalaropsis* and *Hughesiella* have dimorphic anamorphs. *Chalaropsis* and *Hughesiella* resemble each other in having single apical or lateral holoblastic conidium, with the difference that conidia of *Hughesiella* have a longitudinal subhyaline band which is absent in *Chalariopsis.* Furthermore they also differ from each other in the enterogenous and stationary perforated conidia which are coloured in *Hughesiella* and hyaline in *Chalariopsis* whereas, *Thielaviopsis* differ from *Chalariopsis* and *Hughesiella* in having arthroconidia formed in a chain of 4-8 conidia which remain attached to each other, looking like a multiseptate conidium.

Ferraris (1910), in transferring the epithet *basicola* to *Thielaviopsis* as *T. basicola*, unwittingly made the two binomials obligate synonyms, despite providing a comprehensive description to include the state. Taking into account the concept of Nag Raj & Kendrick (1975) that the enterogenous and stationary conidial state (Hennbert & Sutton, 1994) provides the generic name for the fungus in *Chalara* and since the epithet *basicola* is not available, therefore they treated this taxon as an unnamed species of *Chalara*. Nag Raj & Kendrick (1975) proposed a new name *Chalara elegans* Nag Raj & Kendrick for *Thielaviopsis basicola.*

Carmichael *et al*., (1980) considered *Thielaviopsis* as a good genus for having dark, thick walled conidia borne in short chains. They excluded species *Theilaviopsis basicola* from the genus *Theilaviopsis* and made a new combination *Trichocladium basicola* Carmichael.

Paulin-Mahady & Harrington (2002) on the basis of parsimony analysis of sequences of the internally transcribed spacer region of the nuclear rDNA and partial sequences of the large subunit (LSU) placed four anamorphic *Chalara* species as a monophyletic group within the teleomorph genus *Ceratocystis*. These include *Chalara ovoidea*, *Ch. Thielaviodes*, *Ch. Populi*, and *Ch. elegans* (synanamorph: *Thielaviopsis basicola*) form aleurioconidia typical of the anamorphic genus *Thielaviopsis*, to which the species were transferred. Three of these species *(T. ovoidea, T. thielavioides* and *T. populi)* were morphologically somewhat similar to each other but were shown to be distinct by rDNA sequences.

Paulin & Harrington (2000) on the basis of rDNA sequences found that some *Chalara* spp., including its types, *Ch. fusidiorides* (Corda) Rebent have Leotialian affinities whereas, *Ch. ovoidea*, *Ch. thielaviodes*, *Ch. populi* and *Ch. elegans* (=*Thielaviopsis basicola*) have *Ceratocystis* affinities. Thus Paulin-Mahady & Harrington (2002) transferred this latter group to the anamorphic genus *Thielaviopsis*.

Paulin-Madhay & Harrington (2002) did not agree with Nag Raj & Kendrick (1975) in placing *Thielaviopsis, Chalaropsis* and *Hughesiella* in synonymy of *Chalara.* On basis of the rDNA (LSU) studies carried out by Paulin-Madhay & Harrington (2002), they considered *Chalara* as distinct genus from *Thielaviopsis* and they amended generic description of the genus *Thielaviopsis*, further they placed *Chalaropsis* and *Hughesiella* under synonomy of *Thielaviopsis.* Therefore, the position of *Thielaviopsis basicola* (Berk. & Br.) Ferr., remained unchanged, as confirmed by rDNA studies of Paulin-Mahady & Harrington (2002).

Current nomenclatural position

Thielaviopsis basicola (Berk. & Broome) Ferraris, *Fl. Ital. Crypt.*, Fungi 1: 233 (1912).

≡*Torula basicola* Berk. & Broome, *Ann. Mag. nat. Hist., Ser*. 2 5: 461 (1850).
=*Trichocladium basicola* (Berk. & Broome) J.W. Carmich., in Carmichael, Kendrick, Conners & Sigler, *Genera of Hyphomycetes*, 185 (1980).
=*Chalara elegans* Nag Raj & W.B. Kendr., *Monograph of Chalara and Allied Genera*, 167 (1975).

Thielaviopsis basicola has been reported widely from all over the world and is a serious pathogen of a wide range of plant species. Tobacco, cotton, pulses, citrus plants are its common hosts and these are cash crops of Pakistan. This is the first report of this fungus from Pakistan and needs further extensive studies to control its further spread exponentially after its endemic establishment.

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