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NATURAL INFECTION OF *TETRANYCHUS EVANSI* [*ACARINA : TETRANYCHIDAE*] BY A *TRIPLOSPORIUM* SP [ZYGOMYCETES : ENTOMOPHTHORALES] IN NORTHEASTERN BRAZIL

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Infections of *Tetranychus evansi* BAKER & PRITCHARD by *Triplosporium* sp. were observed on tomatoes from April through June of 1979 in Petrolina (Pernambuco), Brazil. Apparently, the pathogenic effect of the fungus together with the direct effect of the rain are important factors in reducing mite populations. The morphological characteristics of this species are described and compared with those of other mite-infecting *Triplosporium* spp. The taxonomic status of this fungus on the specific and generic levels is discussed.

Tetranychus evansi BAKER & PRITCHARD (1960) was first described from specimens collected on tomato in Mauritius in 1955. It is also known today from Texas and California in the U.S.A. and from São Paulo, Rio de Janeiro, Bahia, Pernambuco, and Paraíba in Brazil. Apparently, solanaceous plants are the preferred host for this mite wherever it occurs. In irrigated areas of northeastern Brazil, *T. evansi* is a major pest of processing tomatoes, and frequently causes severe losses (SILVA, 1954 ; RAMALHO & FLECHTMANN, 1979 ; MORAES & FLECHTMANN, 1981). Affected plants may turn yellowish and often die prematurely.

It has been observed in Petrolina (Pernambuco) that although *T. evansi* may be found on solanaceous plants throughout the year, its population levels drop considerably during and soon after the rainy season.

RESULTS

FIELD OBSERVATIONS

In 1979, periodic surveys in this region of *T. evansi* on experimental plots of tomatoes showed the presence of a fungus belonging in the Entomophthorales (Zygomycetes) affecting all stages of the mite. Although no counts were made, it seems that the highest infection levels of the fungus occurred from April through June, corresponding approximately with the end of the rainy season. During this period, either hyphal bodies (fig. 1) or reproductive structures (figs. 2-5) of the fungus were evident on most of the dead mites.

It appears that the pathogenic effect of the fungus together with the direct effect of the rain play an important role in reducing mite populations. It seems that fungicide applications to tomato plants should be made only when and where truly necessary, in order to avoid disturbing the natural control of *T. evansi* in the field exerted by this fungus.

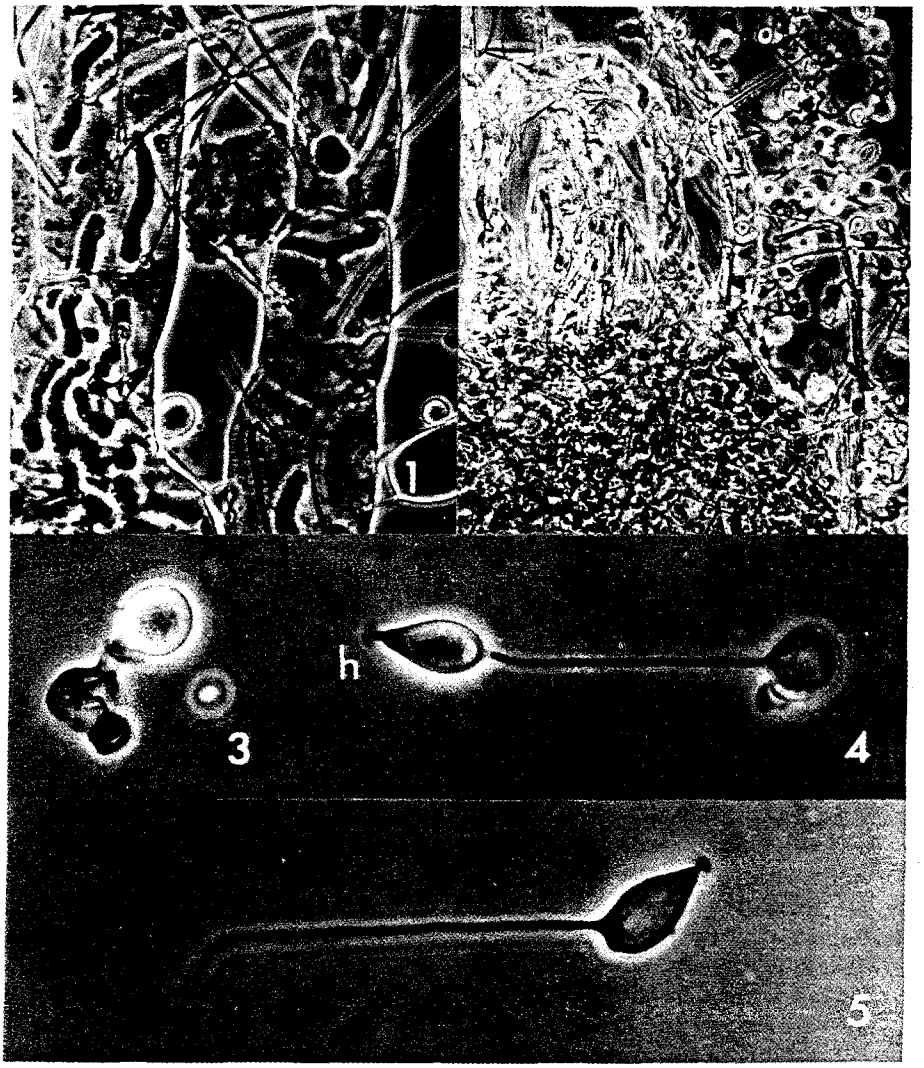

FIG. 1-5. *Triplosporium* sp — 1. Hyphal bodies, × 375 ; 2. Primary conidia and capilliconidia, × 100 ; 3. Forcibly discharged secondary conidium produced on primary conidium, × 1 300 ; 4. Capilliconidium produced on primary conidium ; note haptor (h) at distal end of spore, × 1 300 ; 5. Capillary conidiophore produced on capilliconidium, × 1 300.

CARACTERIZATION OF THE FUNGUS

The fungus has short, generally unbranched hyphal bodies, 24-48 × 3.5-6 μm (fig. 1). Primary conidia are globose with a short, rounded or truncate papilla. Conidia mounted in lactophenol/aniline blue are 12.4-17.7 × 9.4-14.2 μm (averaging 14.9 ×

12.0 μm, n = 75). Primary conidia may occasionally produce a morphologically similar secondary conidium (fig. 3), but the great majority form capillary conidiophores and capilliconidia (anadhesive conidia) (figs. 2, 4). Capilliconidia may form tertiary capilliconidia (fig. 5). Capillary conidiophores are 32-72 μm long (averaging 48 μm, n = 50), and 1-2 μm thick, tapering gradually towards the tip ; the last 5-10 μm are usually bent about 45° off axis. Capilliconidia have a broadly rounded base which tapers conically to a short, narrow isthmus bearing a haptor with a disc-like base and a mucoid drop by means of which the conidia adhere to whatever they contact. Capilliconidia have a slightly grey color in transmitted light ; their surfaces are finely wrinkled in a pattern that can be interpreted as either striate or reticulate. The dimensions of capilliconidia are 15.3-20.1 × 7.1-13.0 μm (averaging 18.2 × 9.6 μm, n = 50), with a length/breadth ratio of 1.86 ± 0.34. The length of capilliconidia was measured to the proximal end of the isthmus, and breadth was taken at the widest point. No cystidia or rhizoids were formed on the affected mites, nor were any resting spores evident.

DISCUSSION

Relatively few entomophthoralean fungi attack mites. *Empusa acaricida* PETCH (1940) and *E. acaridis* PETCH (1944) are inadequately described, and the application of these names will be doubtful until PETCH's collections can be re-examined. However, the conidia of the Brazilian fungus differ substantially from both *E. acaricida* (9-12 × 5-7 μm) and *E. acaridis* (16-22 × 11-13 μm). A *Conidiobolus* sp. (possibly *C. brefeldianus*) has been reported by BATKO (1965, 1974) ; however, the rod-like hyphal bodies and morphologies of both primary and secondary conidia of the Brazilian fungus do not correspond to those of the *Conidiobolus* species.

The remaining three entomophthoralean species attacking mites are all assignable to the genus *Triplosporium* (THAXTER) BATKO *nomen genericum conservandum propositum* (HUMBER *et al.*, 1981) (= *Neozygites* WITLACZIL, see REMAUDIÈRE & KELLER, 1980). These species are *T. floridanum* (WEISER & MUMA) WEISER, *T. tetranychi* WEISER, and *Entomophthora adjarica* TSINTSADZE & VARTAPETOV. Even though some taxonomically important characters were not seen in the available preparations of the fungus from *T. evansi,* the round conidia with truncate papillae together with greyish capilliconidia confirm the identity of this fungus as a species of *Triplosporium.*

The Brazilian fungus bears similarities to each of the 3 *Triplosporium* species : The primary conidia most closely match the measurements of *E. adjarica* conidia (12-17 × 9.4-14.2 μm ; TSINTSADZE & VARTAPETOV, 1976). Dimensions of hyphal bodies, capilliconidia, and capillary conidiophores as well as the striate/reticulate surface of the capilliconidia of the Brazilian fungus resemble *T. floridanum* (WEISER & MUMA, 1966 ; RAMASESHIAH, 1971 ; KENNETH *et al.*, 1972 ; NEMOTO & AOKI, 1975 ; CARNER, 1976 ; NEMOTO *et al.*, 1979). The apical isthmus and disc-like haptor of the capilliconidia most resemble those for *T. tetranychi,* but CARNER (1976) illustrated similar structures for the fungus he considered to be close to *T. floridanum.* As in *T. tetranychi* (WEISER, 1968), the primary conidia of the Brazilian fungus remain inflated after producing capillaries and capilliconidia although there are deep furrows in the half of the spore subtending the capillary (fig. 4) ; the empty primary conidia of fungi allied to *T. floridanum* appear to collapse (CARNER, 1976 ; NEMOTO *et al.*, 1979).

A close comparison of these 3 species of *Triplosporium* species indicates considerable overlapping of taxonomically significant characters such as spore dimensions. The numerous studies of fungi identified at least provisionally as *T. floridanum* suggest that the full range of morphological variation is not understood for this species ; both *T. tetranychi* and *E. adjarica* are each known only from single collections.

Although the fungus considered here seems to fall closer to *T. floridanum* than to *T. tetranychi* or *E. adjarica,* it seems unwise to offer any tentative specific identification until all 3 species of *Triplosporium* from spider mites can be characterized more accurately and until the taxonomic significance of characteristics such as surface decorations or the exact morphologies of the haptors on capilliconidia can be evaluated properly.

REMAUDIÈRE & KELLER (1980) have noted that, according to the rules of botanical nomenclaure, *Triplosporium* (THAXTER) BATKO (1964) must be replaced by *Neozygites* WITLACZIL (1885), an older name based on the same type species, *Empusa fresenii* NOWAKOWSKI. However, because much published literature now incorporates the name *Triplosporium* and very few paper have noted the synonymy of *E. fresenii* and *Neozygites aphidis,* we believe this change would be disruptive. Much needless confusion would be avoided if the 1981 Botanical Congress (in Sydney, Australia) adopts the formal proposal (HUMBER *et al.,* 1981) to conserve *Triplosporium* against *Neozygites.* Until such time as final action is taken on this proposal, we recommend using the name *Triplosporium* (THAXTER) BAKTO *nomen genericum conservandum propositum* rather than *Neozygites* WITLACZIL *nomen genericum rejiciendum propositum.*

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RÉSUMÉ

Infection naturelle de *Tetranychus evansi* [*Acarina : Tetranychidae*]
par *Triplosporium* sp. [Zygomycètes : Entomophthorales] dans le Nord-Est brésilien.

Dans les conditions de Petrolina (Pernambouc), Brésil, on a observé sur des plants de tomate, chez *Tetranychus evansi* BAKER & PRITCHARD un taux élevé d'infection causée par un *Triplosporium* sp. Ces observations correspondent à la période Avril-Juin 1979. Elles permettent de conclure que selon toute vraisemblance, l'action pathogène du champignon et l'effet direct de la pluie jouent un rôle important dans la diminution des populations d'acariens. Les caractères morphologiques de cette espèce sont décrits et comparés avec ceux des autres espèces de *Triplosporium* qui affectent les acariens. La position spécifique et générique de ce champignon est discutée.

REFERENCES

BAKER, E. W. & PRITCHARD, A. E. — 1960. The tetranychoid mites of Africa. — *Hilgardia,* 29, 540-543.

BATKO, A. — 1964. On the new genera : *Zoophthora* gen. nov., *Triplosporium* (THAXTER) gen. nov., and *Entomophaga* gen. nov. [Phycomycetes : *Entomophthoraceae*]. — *Bull. Acad. Polon. Sci. (Sér. Sci. Biol.),* 12, 323-326.

— 1965. Studies of entomophthoraceous fungi of Poland. — Ph. D. Univ. Warsaw. [In Polish]

— 1974. Filogeneza a struktury taksonomiczne *Entomophthoraceae.* — In : Ewolocja Biologiczna : Szkice Teoretyczne i Metodologicze (C. NOWINSKIEGO, ed.). — *Polska Akad. Nauk, Inst. Filizof. Socjol.,* Wroclaw, 209-304. [In Polish]

CARNER, G. R. — 1976. A description of the life cycle of *Entomophthora* sp. in the two-spotted spider mite. — *J. Invertebr. Pathol.,* 28, 245-254.

HUMBER, R. A., SOPER, R. S., MACLEOD, D. M., TYRRELL, D., KENNETH, R. G. & BEN-ZE'EV, I. — 1981. Proposal to conserve the entomopathogenic fungal genus *Triplosporium* (THAXTER) BATKO against *Neozygites* WITLACZIL [Entomophthorales]. — *Taxon,* 30, 187-191.

KENNETH, R., WALLIS, G., GERSON, U. & PLAUT, H. N. — 1972. Observations and experiments on *Triplosporium floridanum* [Entomophthorales] attacking spider mites in Israel. — *J. Invertebr. Pathol.,* 19, 366-369.

MORAES, G. J. & FLECHTMANN, C. H. W. — 1981. Ácaros fitófagos do Nordeste do Brasil. — *Revista PAB,* 16, 177-186.

NEMOTO, H. & AOKI, J. — 1975. *Entomophthora floridana* [Entomophthorales : *Entomophthoraceae*] attacking the Sugi spider mite, *Oligonychus hondoensis* [*Acarina : Tetranychidae*], in Japan. — *Appl. Entomol. Zool.*, 10, 90-95.

NEMOTO, H., KOBAYASHI, M. & TAKIZAWA, Y. — 1979. Scanning electron microscopy of *Entomophthora (Triplosporium) floridana* [Zygomycetes : Entomophthorales] attacking the Sugi spider mite, *Oligonychus hondoensis* [*Acarina : Tetranychidae*]. — *Appl. Entomol. Zool.*, 14, 376-382.

PETCH, T. — 1940. An *Empusa* on a mite. — *Proc. Linnean Soc. N. S. Wales*, 65, 259-260.

— 1944. Notes on entomogenous fungi. — *Trans. Br. Mycol. Soc.*, 27, 81-93.

RAMALHO, F. S. & FLECHTMANN, C. H. W. — 1979. Níveis de infestação de *Tetranychus (T.) evansi* BAKER & PRITCHARD, 1960, em diferentes fases de desenvolvimento do tomateiro. — *Rev. Agricultura*, 54, 51-56.

RAMASESHIAH, G. — 1971. Occurrence of an *Entomophthora* on tetranychid mites in India. — *J. Invertebr. Pathol.*, 18, 421-424.

REMAUDIÈRE G. & KELLER, S. — 1980. Révision systématique des genres d'*Entomophthoraceae* à potentialité entomopathogène. — *Mycotaxon*, 11, 323-338.

SILVA, P. — 1954. Um novo ácaro nocivo ao tomateiro na Bahia (*Tetranychus marianae* MCGREGOR, 1950 — *Acarina*). —*Bol. Inst. Biol. Bahia*, 1, 18-37.

TSINTSADZE, K. V. & VARTAPETOV, S. G. — 1976. A new fungus, *Entomophthora adjarica* sp. n. [Phycomycetes : *Entomophthoreae*], affecting *Tetranychus urticae* KOCH. — *Soosch. Akad. Nauk Gruzinskoi SSR [Bull. Acad. Sci. Georgian SSR]*, 83, 465-468. [In Russian]

WEISER, J. — 1968. *Triplosporium tetranychi* sp. n. [Phycomycetes, *Entomophthoraceae*], a fungus infecting the red mite *Tetranychus althaeae* HANST. — *Folia Parasitol. (Praha)*, 15, 115-122.

WEISER, J. & MUMA, M. H. — 1966. *Entomophthora floridana* n. sp. [Phycomycetes : *Entomophthoraceae*], a parasite of the Texas citrus mite, *Eutetranychus banksi*. — *Fla. Entomol.*, 49, 155-159.

WITLACZIL, E. — 1885. *Neozygites aphidis*, eine neue Gregarine. — *Arch. Mikroskop. Anat.*, 24, 599-603.