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ENTOMOPATHOGENIC FUNGI AND THEIR INSECT HOSTS IN ISRAEL: ADDITIONS

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A B S T R A C T

A second list of entomopathogenic fungi of Israel is presented. New fungal records (on insects) for Israel are ***Nomuraea rileyi, Dactyiaria*** sp., ***Verticillium lecanii, V.. psalliotae, Aspergillus candidus*** and ***A. oryzae,*** as parasites; ***Aphanocladium album*** as a suspected or doubtful parasite. New hosts for ***Entomophthora*** species are listed as well as new hosts in Israel of various fungi. A new species of ***Entomophthora*** was found attacking ***Pterochloroides (Lachnus) persicae.***

In 1971, a first "List of entomogenous fungi of Israel was published (Kenneth ***et al.***, 1971). It was ascertained at that time that the climate of Israel, characterized by hot, rainless late springs, summers and early falls, and cool, rainy winters, did not prevent the existence of many species of entomopathogenic fungi. They attacked insects belonging to a fair number of orders, particularly Rhynchota, Diptera, Lepidoptera and Coleoptera, as well as mites. These fungi were noticeable particularly in irrigated fields and groves, on insects attacking crops and weeds. Seven species of ***Entomophthora*** were identified and at least one or two others of this genus were found but not determined to species. The most frequently met species were ***Beauveria bassiana, Verticillium*** spp. and ***Entomophthora (Triplosporium) fresenii.*** Since the publication of that list, a considerable number of fungi, were observed on insects in Israel and are presented below: some had not been recorded before, a few previously reported were now fully identified, and a number of isolates

of fungi were tested for pathogenicity to various insects. Again, the entomopathogenic fungi were noticeable particularly under irrigated conditions, and the same insect orders as before were those on which fungi were found *E. fresenii* was found attacking two species of aphids at Elisha's Spring, Jericho, in mid-March, and *E. sphaerosperma* attacked the spotted alfalfa aphid in the Bet Shean Valley in mid-summer; these two localities are among the hottest in the world, and the former is an oasis town with almost no vegetation in the surrounding countryside. In the list, most of the species of fungi had been previously recorded (Kenneth *et al.*, 1971), but the list of insect hosts has been greatly extended, encompassing some hosts for which various *Entomophthora* species were previously unknown anywhere.

PHYCOMYCETES

ENTOMOPHTHORACEAE:

Entomophthora aphidis Hoffmann ex Fresenius

Aphis fabae Scopoli: RHYNCHOTA
Brevicoryne brassicae (L.): RHYNCHOTA
Dactynotis sonchi (Geoffroy): RHYNCHOTA
Hyperomyzus lactucae (L.): RHYNCHOTA
Rhopalosiphum maidis (Fitch): RHYNCHOTA
* Various undetermined aphid species: RHYNCHOTA

Entomophthora echinospora (Thaxter) M. Gustafsson

Pollenia rudis F.: DIPTERA

Entomophthora exitialis Hall & Dunn

* *Brevicoryne brassicae* (L.): RHYNCHOTA (Wallis, 1972).

Entomophthora (Triplosporium) floridana Weiser & Muma

** *Eutetranychus orientalis* (Klein): ACARI

Entomophthora (Triplosporium) fresenii Nowakowski

Acyrthosiphon pisum (Harris): RHYNCHOTA
Aphis craccivora (Koch): RHYNCHOTA
Dactynotis jaceae (L.): RHYNCHOTA
Dactynotis sonchi (Geoffroy): RHYNCHOTA
Hyalopterus pruni (Geoffroy): RHYNCHOTA

Entomophthora planchoniana Cornu *sensu* Petch non Thaxter

Aphis fabae Scopoli: RHYNCHOTA
Rhopalosiphum maidis (Fitch): RHYNCHOTA
Schizaphis (Toxoptera) graminum (Rondani): RHYNCHOTA

Entomophthora sphaerosperma Fresenius (= *E. radicans* Brefeld)

Acyrthosiphon pisum (Harris): RHYNCHOTA
* *Empoasca lybica* (Bergevin): RHYNCHOTA
Myzus persicae (Sulzer): RHYNCHOTA
Spodoptera littoralis (Boisduval): LEPIDOPTERA
Therioaphis maculata (Buckton): RHYNCHOTA
Small flies: DIPTERA

Entomophthora spp.

Aphis craccivora (Koch): RHYNCHOTA
Aploneura lentisci (Passerini) (resting spores): RHYNCHOTA
Brachycaudus amygdalinus (Schouteden): RHYNCHOTA
Capitophorus eleagni (del Guercio): RHYNCHOTA
* *Myzus persicae* (Sulzer): RHYNCHOTA
Rhopalosiphum maidis (Fitch): RHYNCHOTA
Rhopalosiphum padi (L.): RHYNCHOTA
Rhopalosiphum rufiabdominalis (Sasaki), (resting spores): RHYNCHOTA
Schizaphis (≙ Toxoptera) graminum (Rondani): RHYNCHOTA
Sitobion avenae (F.): RHYNCHOTA
Spodoptera littoralis (Boisduval): LEPIDOPTERA
Flies, gnats, Tachinidae, Syrphidae: DIPTERA

Entomophthora sp. nov.

Pterochloroides (Lachnus) persicae (Cholodkovsky) (Resting spores and conidia): RHYNCHOTA

A

MUCORALES

Choanephora sp.

Empoasca sp. RHYNCHOTA

DEUTEROMYCETES

MONILIACEAE

Aphanocladium album (Preuss) W. Gams

Aphid:RHYNCHOTA
Lasiocampidae: LEPIDOPTERA

Aspergilluscandidus Link

Thaumetopoea wilkinsoni Tams: LEPDOPTERA

Aspergillusoryzae (Ahlb.) Cohn

Chilocorus bipustulatus (L.) COLEOPTERA
Spodoptera (Laphygma) exigua (Hübner): LEPIDOPTERA

Beauveria bassiana (Balsamo) Vuillemin

Boarmia (Ascotis) selenaria Schiff., larvae: LEPIDOPTERA
Curculio elaphus Gyll.: COLEOPTERA
** *Earias insulana* Boisduval, larvae: LEPIDOPTERA
Ectomyelois ceratoniae (Zell.): LEPIDOPTERA
** *Ephestia elutella* (Hübner), larvae: LEPIDOPTERA
Geometridae, larva: LEPIDOPTERA
** *Heliothis armigera* (Hübner), larvae: LEPIDOPTERA
Lasiocampidae pupa: LEPIDOPTERA
Lymantridae pupa: LEPIDOPTERA
** *Pyrausta nubilalis* Hübner, larvae: LEPIDOPTERA
** *Sesamia cretica* Led.: LEPIDOPTERA
Sphingidae larva: LEPIDOPTERA
Steraspis squamosa Klug, larva: COLEOPTERA
** *Spodoptera (Laphygma) exigua* (Hübner) larvae: LEPIDOPTERA
Zeuzera pyrina (L.): LEPIDOPTERA

Dactylaria sp.

Thaumetopoea wilkinsoni Tams: LEPIDOPTERA

Fusarium sp.

Liloceris saldermani Guer.: COLEOPTERA

Nomuraea rileyi (Farlow) Samson:

Spodoptera littoralis (Boisduval): LEPIDOPTERA

Verticillium lecanii (Zimmermann) Viégas

Boarmia (Ascotis) selenaria Schiff., larvae: LEPIDOPTERA
* *Ceroplastes floridensis* (Comstock): RHYNCHOTA
Coccus hesperidum L.: RHYNCHOTA
* *Saissetia oleae* (Olivier): RHYNCHOTA

Verticillium psalliotae Treschow

Aonidiella aurantii (Maskell): RHYNCHOTA

Verticillium sp.

Empoasca sp.: RHYNCHOTA
Aphid: RHYNCHOTA

DEMATIACEAE

Hirsutella thompsonii F.E. Fisher

** *Tetranychus cinnabarinus* (Boisduval): ACARI
** *Eutetranychus orientalis* (Klein): ACARI

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* Isolated on numerous occasions
** Not found on host in the field; inoculation successful.,

Of the foregoing fungi, the following are new records for Israel:

(1) *Aspergillus candidus.*

(2) *A. oryzae.*

(3) *Nomuraea rileyi. N. rileyi* was found in the coastal plain (in culture in our department, accession No. 2843) and in the Huleh Valley; it caused an estimated 20% mortality in larvae of the Egyptian cottonworm (*S. littoralis)* in a field of alfalfa at Neot Mordechai. It is interesting to note that *N. rileyi* was identified as the fungus found by Prof. I. Harpaz of the Faculty of Agriculture and Dr. D. Gerling, U. of Tel Aviv, attacking this insect at Antsirabe, Madagascar in 1971 (our accession No. 2623).

(4) *Verticillium lecanii* was very frequently encountered here, and it is now evident that most of the isolates of '*Verticillium* sp.' mentioned in our previous report (Kenneth *et al.*, 1971) were actually this species. The *V. lecanii* isolates attacking *S. oleae* (black scale) and *C.*

floridensis (Florida was scale) in Tel Mond, Bet Herut and Hamaapil citrus groves in the Sharon Plain differed in conidiophore morphology from other isolates of this species found on the same and other scales elsewhere; they were considered, nevertheless, to belong to *V. lecanii* by Dr. W. Gams, C.B.S., Baarn, Netherlands, to whom they were referred (pers. comm.). In June, 1972, this fungus was responsible for a spectacular epizootic on the aforementioned scale insects which were infesting citrus groves, primarily grapefruit, in the Sharon Plain, leading to the death of almost all of them by early fall, and a consequent almost complete lack of sooty mold during the following winter. Leaves and twigs of citrus trees appeared to have been sprinkled with whitewash, which, on closer examination, was simply the sporulation of the fungus over scales of all stages. Two of our strains from scale insects were found by Dr. R.A. Hall, Glasshouse Crops Research Institute, Littlehampton, England, to be pathogenic toward the aphid *Macrosiphoniella sanborni* (pers. comm.).

(5) *V. psalliotae,* found twice on *Aonidiella aurantii;* the isolates have not yet been tested for parasitism on mushrooms, but the same species has been found by us (unpublished data) on the cultivated mushroom in Israel.

(6) *Dactylaria* sp. on the Cyprus pine processionary caterpilar.

(7) A new species of *Entomophthora* (to be described elsewhere) on the peach trunk aphid. Conidia and resting spores were present among the many stricken insects found at Rishon-le-Zion and Rehovot, the former differing from those of others of this genus, the latter resembling those of *E. fresenii*. No member of the Lachnidae is listed as being attacked by an *Entomophthora* (Thoizon, 1970; MacLeod and Müller-Kögler, 1970, 1973).

Entomophthora exitialis, not mentioned before in our previous report (Kenneth *et al.*, 1971) was recorded as occurring in Israel on the spotted alfalfa aphid (Hall and Dunn, 1957). In comparing our observations on *Entomophthora* in Israel with those of Thoizon's host list (1970), we find that the following insect species are new hosts of specific fungi: *E. exitialis* -- *Brevicoryne brassicae; E.*

fresenii -- Dactynotis jaceae, D. sonchi; E. planchoniana -- Rhopalosiphum maidis, Schizaphis graminum; E. sphaerosperma - Therioaphis maculata, Toxoptera aurantii. Aphid species attacked here by various species of *Entomophthora*, but not listed by Thoizon as being attacked by any *Entomophthora* are: *Aploneura lentisci, Capitophorus eleagni, Dactynotis sonchi, Rhopalosiphum rufiabdominalis,* and *Pterochloroides persicae.*

Hirsutella thompsonii (our accession No. 2856, accession No. HTRM-3 of Dr. C.W. McCoy, Lake Alfred, Florida) has not been found in nature in Israel. The species was tested on a number of mite species here, but has not yet been released and disseminated in this country. Suspected or doubtful parasites listed above are: (1) *Aphanocladium album,* which had been found sporulating from dead aphids on rust-stricken oat plants held under humid conditions. It is known to grow over uredial pustules and to induce teliospore formation (Biali *et al.*, 1972). Of the four known species of this genus, *A. album* has been found at times on insects and *A. aranearum* on spiders (Gams 1971). (2) *Choanephora* sp. The fungus was found on two occasions sporulating from dead cicadas, *Empoasca* sp. In our previous report, *C. conjuncta* was recorded on *S. littoralis,* as a possible parasite.

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