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Dedicated to Professor Maria Ławrynowicz on the occasion of the 45th anniversary of her scientific activity

Grazing preference of *Ceratophysella* sp. 1 (*Collembola*) for *Pseudoperonospora cubensis* – fungal pathogen of *Cucumis sativus*

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Grazing preferences of collembolans *Ceratophysella* sp. 1 were noted. The collembolans feed on the sporangia of *Pseudoperonospora cubensis* growing on plants *Cucumis sativus* in greenhouses in Esfahan province in Iran. Sporangia of *Pseudoperonospora cubensis* were the preferred food of all fungal species noted in the alimental tract of the springtails. All digestive tracts of the springtails contained sporangia of *P. cubensis*.

Key words: cucurbit downy mildew, *Pseudoperonospora cubensis*, springtails, feeding preferences

INTRODUCTION

There are many interactions between insects, fungi and plants, i.e. *Botanophila*, *Epichloë* and *Dactylis*/*Puccinellia* (Górzyńska et al. 2010, 2011) or *Phalacrus*, *Anthracoidea* and *Carex* (Steiner 1984; Chlebicki 2007, 2011). Many microarthropods are mycophagous. Some species of collembolans feed on the mycelium of pathogenic fungi (Sabatini, Innocenti, 2000, Lootsma, Scholte, 1997). Also grazing preferences of collembolans for endomycorrhizal fungi are well known (Timm, Larink 1995). There is single article devoted collembolan species *Sinella curviseta* which feeding of mycelium of *Fusarium oxysporum* f. sp. *cucumerinum* parasitizing cucumber seedlings (Nakamura et al. 1992). We found the next collembolan species feeding on plant pathogen *Pseudoperonospora cubensis* (Berk. & M.A. Curtis) Rostovzev growing on leaves of *Cucumis sativus*. The collected springtails belong to the unknown species of the genus *Ceratophysella* from *C. denticulata* group that might be a new species to the world (Nematollahi et al. 2009).

MATERIAL AND METHODS

Collembolans were found feeding on cucumber seedlings in greenhouses in Esfahan province during 2005-2006. Juvenile individuals was preserved on 96% ethanol. Then, they were prepared as fallow: 18 hours in lactophenol (lactic acid 100 ml, glycerol 200 ml, distilled water 100 ml, phenol 100 g), 10-40 minutes in 10% KOH, few seconds of heating in lactophenol. At the end of the specimen was closed on a slide in the medium Marc André II (distilled water 50 ml, chloral hydrate 200 gram, glycerol 30 gram, gum arabic 20 gram). 70 specimens of collembolans were checked up for fungal sporangia. 30 sporangia of *P. cubensis* were measured. The morphological characters of the fungi and collembolan body were examined using light microscopy (Nikon SMZ 1500, Nikon Eclipse 80i). Microphotographs were taken with these microscopes equipped with a digital camera Nikon DS R1. Morphological terminology of the mildew was used after Savory et al. (2011).

RESULTS AND DISCUSSION

Pseudoperonospora cubensis (Berk. & M.A. Curtis) Rostovzev, Annals Inst. Agron. Moscow 9: 47, 1903.

Sporangia elliptical, lemon-shaped, grey-purple 22-27(33) x 17-25 μm. Sporangiophores slender, branches in the dichotomous manner, branches and tips straight, tips gradually tapering to a point (Fig. 1A).

All digestive tracts of the springtails contain sporangia of *P. cubensis* (Fig. 2). Moreover spores of other species were found. Only three dark spores of *Acremonium* group (*Gliomastix*, *Pseudogliomastix*) together with spores of *P. cubensis* were found (Fig. 1B). The spores (Fig. 1B) were similar to these of plate 52 A (Seifert et al. 2011). In the same figure a single ornamented spore is presented. In the next picture (Fig. 1C) are showed pollen grains of unidentified plant. Some hyphae of dematiaceous fungus are illustrated in the Figure 1D.

The cucurbit downy mildew (*Pseudoperonospora cubensis*) is currently the most destructive disease of cucumber which have been responsible for annual yield losses of up to 80% (Lebeda, Urban 2007; Savory et al. 2011). It has wide host range and occurs approximately on 20 different genera of *Cucurbitaceae* (Lebeda, Urban 2007). Sporangia of *Pseudoperonospora cubensis* became the preferred food of all fungal species noted in the alimental tract of the springtails. Sporangia lying in alimentary tract of collembolans are mostly disfigured. It suggest that *Ceratophysella* sp. 1 not disperse sporangia of the fungus via gut passage. Nematollahi et al. (2009) suggest that in the infested plants secondary roots were devoured completely by collembolans and the plants could be easily infected by pathogens. But our observations indicate that collembolans reduced number of fungal sporangia. However, the fungal sporangia can be transported by the springtails on their body and this way contributing to the spread of the disease. Amount of sporangia transported on springtail bodies is distinctly smaller than its amount in alimental tract. On the basis of our investigation it is difficult to precise determination of influence of the collembolan species on cucumber cultivation in greenhouse. *Ceratophysella* sp. 1 is probably a rare species with occurrence

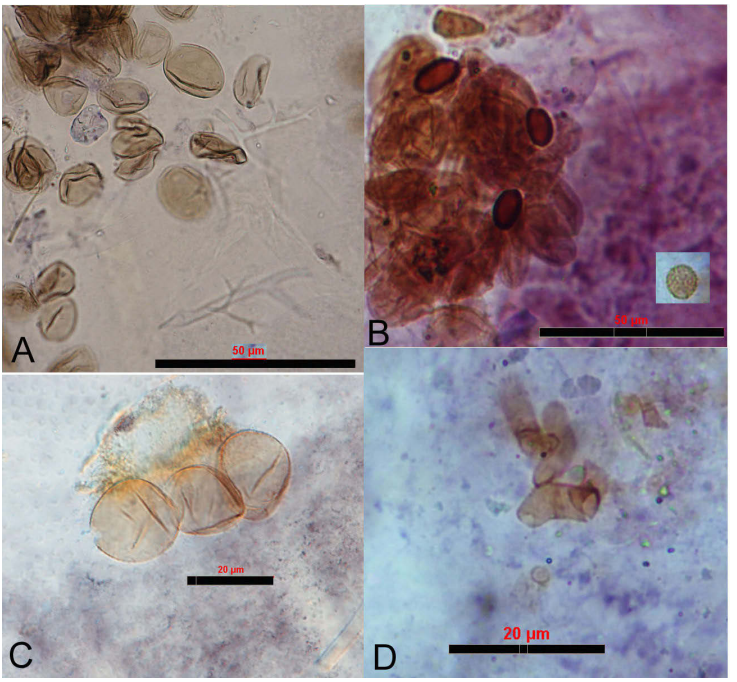

Fig. 1. A – Sporangia and sporangiospores of *Pseudoperonospora cubensis*, B – 3 dark spores of *Acremonium* group fungus and single hyaline, ornamented spore, C – plant grains, D –dematiaceous hyphae.

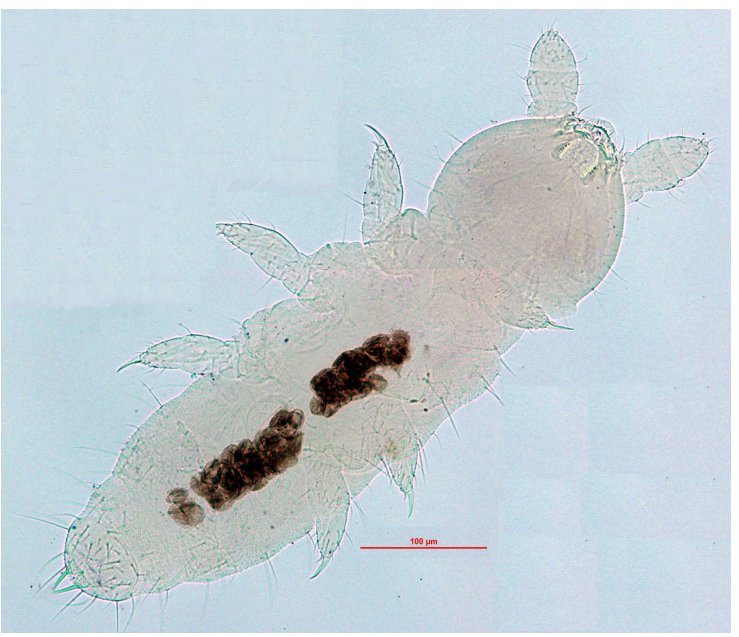

Fig. 2. Springtail *Ceratophysella* sp. 1 juv. with spores in the alimental track.

restricted to the Near East. Other species of the *C. denticulata* group have similar food preference (Babenko et al. 1994). Next investigation are necessary for recognition of influence of *Ceratophysella* sp. 1 on pathogenic fungi of greenhouse plants.

It is possible that these collembolans can be used for protection against pathogenic fungi (biological control agent – BCA) as in the case of *Proisotoma minuta* (Isotomidae) used for suppression of *Rhizoctonia solani* on cotton in a greenhouse environment (Lartey et al. 1994, 2008).

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Preferencje pokarmowe skoczogonka z rodzaju *Ceratophysella* do grzyba *Pseudoperonospora cubensis* – grzybowego patogena ogórków *Cucumis sativus*

Streszczenie

Preferencje pokarmowe skoczogonków z rodzaju *Ceratophysella* sp. 1 (nowy gatunek do opisania) zostały przedstawione. Skoczogonki spożywały sporangia grzyba *Pseudoperonospora cubensis*, który zaatakował rośliny *Cucumis sativus* rosnące w szklarni w prowincji Esfahan w Iranie. Sporangia grzyba *Pseudoperonospora cubensis* były notowane w układzie pokarmowym wszystkich badanych skoczogonków.