

TWO *NEOZYGITES* SPECIES (ZYGOMYCETES: ENTOMOPHTHORALES) INFECTING APHIDS AND MEALYBUGS ON LEYTE ISLAND

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ABSTRACT

The presence of two species of *Neozygites* (Zygomycetes: Entomophthorales) in the Philippines is documented. Epizootics due to *Neozygites fresenii* (Nowakowski) Remaudiere & Keller were observed on *Aphis craccivora* Koch populations on *Gliricidia sepium* (Jacq.) Steud. and string beans, *Vigna sesquipedalis* Fruw., and on *A. citricola* van der Goot infesting *Mikania cordata* (Burm f.) B.C. Rob., both in 1994, in ViSCA, Baybay, Leyte. Also in 1994, epizootics due to *N. fumosa* (Speare) Remaudiere & Keller were also observed on the mealybug, *Coccidohystrix insolita* (Green) infesting eggplant (*Solanum melongena* L.) in Inopacan and later on unidentified mealybugs on *Sida rhombifolia* L. Epizootics of both *N. fresenii* and *N. fumosa* resulted to drastic reduction in the aphid and mealybug populations. Enhancing the occurrence of these fungi may have potential in the biological control of these pests.

Key words: Entomophthorales, *Neozygites fresenii*, *Neozygites fumosa*, aphids, mealybugs, entomopathogenic fungi

INTRODUCTION

Aphids, particularly *Aphis craccivora* Koch, infest different leguminous plants in Leyte. This species could be serious on vegetable beans where colonies concentrate on growing tips, buds and fruits. In 1994, epizootics due to *Neozygites fresenii* (Nowakowski) Remaudiere & Keller were observed on *A. craccivora* populations on madre de cacao, *Gliricidia sepium* (Jacq.) Steud. and string beans, *Vigna sesquipedalis* Fruw., in ViSCA (Villacarlos, 1995). The same species was collected on *A. citricola* van der Goot infesting the weed locally known as "asyang", *Mikania cordata* (Burm. f.) B.C. Rob. In the same year, epizootics due to *N. fumosa* (Speare) Remaudiere & Keller was also observed on the mealybug, *Coccidohystrix insolita* (Green) infesting eggplant (*Solanum melongena* L.) in Inopacan and later observed on unidentified mealybugs on the weed, *Sida rhombifolia* L. This paper officially documents the presence of these species of *Neozygites* in the Philippines.

MATERIALS AND METHODS

Freshly dead insects were collected and brought to the laboratory for processing. Some cadavers were placed in a humid chamber consisting of a petri dish lined

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with moist tissue paper. Conidial deposits were collected on glass slides placed 3 mm above the cadaver. Some were mounted in lactophenol aceto-orcein (LPAO), lactophenol cotton blue (LPCB) or plain lactophenol as described by Keller (1987). Other slides containing the conidia were retained in the humid chamber to allow the primary conidia to form secondary conidia before mounting in LPCB. The fungal species were identified based on their conidial morphology and dimensions of important structures. An ocular graticule calibrated to mm was used for measurement. The sample size varied from 1-5 series, each consisting of 10-50 measurements. Tentative identifications were verified by Dr. Siegfried Keller (Swiss Federal Station for Agro-ecology & Agriculture, Zurich, Switzerland).

BRIEF ACCOUNT OF SPECIES

Neozygites fresenii (Nowakowski) Remaudiere & Keller **Figures 1A-F**

N. fresenii has been reported to be a common disease of aphids such as *A. craccivora*, *A. fabae* Scop., *A. rumicis* (L.), *A. urticata* (L.), *Brevicoryne brassicae* (L.), *Microlophium evansi* (Theob.), *Myzus persicae* (Sulzer) and *Rhopalosiphum padi* (L.) (Keller, 1997). It is an important mortality factor of *A. gossypii* Glover on cotton in Arkansas, U. S. A. (Steinkraus *et al.*, 1991). In the Philippines, probably the earliest record on *N. fresenii* was based on samples of *Longiunguis sacchari* (Zehntner) (= *Aphis sacchari*) from Dr. G. O. Ocfemia sent to Petch (1931) who identified it as *N. fresenii* (= *Empusa fresenii*). This was the same *Entomophthora lecanii* Zimm. that Gabriel (1968) mentioned in his article. He further reported an *Entomophthora* sp., infecting *A. craccivora* and *M. persicae*. However, because he did not provide any description, it is difficult to be certain about the identity of the fungus. In the early period of entomophthoralean taxonomy, many species were placed under one genus, *Entomophthora*. Presently, there are several accepted genera under this order of fungi (Humber, 1989).

Neozygites-infected insects were easy to recognize because cadavers appeared brown, black or smoky upon sporulation of the fungus. The cadavers, which were usually fixed on the plant surface with their stylets, appeared shriveled and brittle when condition was very dry. These can easily be "rejuvenated" by placing in humid chamber for 4-6 h to enhance the production of conidia. Conidial deposits were commonly observed on the wings of adult *A. craccivora* (Figure 1A).

Entomophthoralean species form different types of conidia. The first group, which are produced from matured conidiophores, are known as primary conidia, which in *N. fresenii* appear subspherical with distinct blunt papillar protrusion (Figure 1B). The primary conidia can either form subspherical secondary conidia on very short stalk (Figure 1C), or almond-shaped capilliconidia formed at the tip of long (20-55 μ m) capillary conidiophores (Figure 1D). Capilliconidia are the infective stage of the species. The tip of capilliconidium has a mucoid droplet, known as haptor that is responsible for adherence onto the surface of the insect integument (Humber, 1989). Thus, when an aphid walks on a field of capilliconidia on the leaf surface, the conidia adhere onto the legs or antennae then germinate and penetrate the insect integument. Figure 1E shows a germinating capilliconidium on a femur of aphid exuvium.

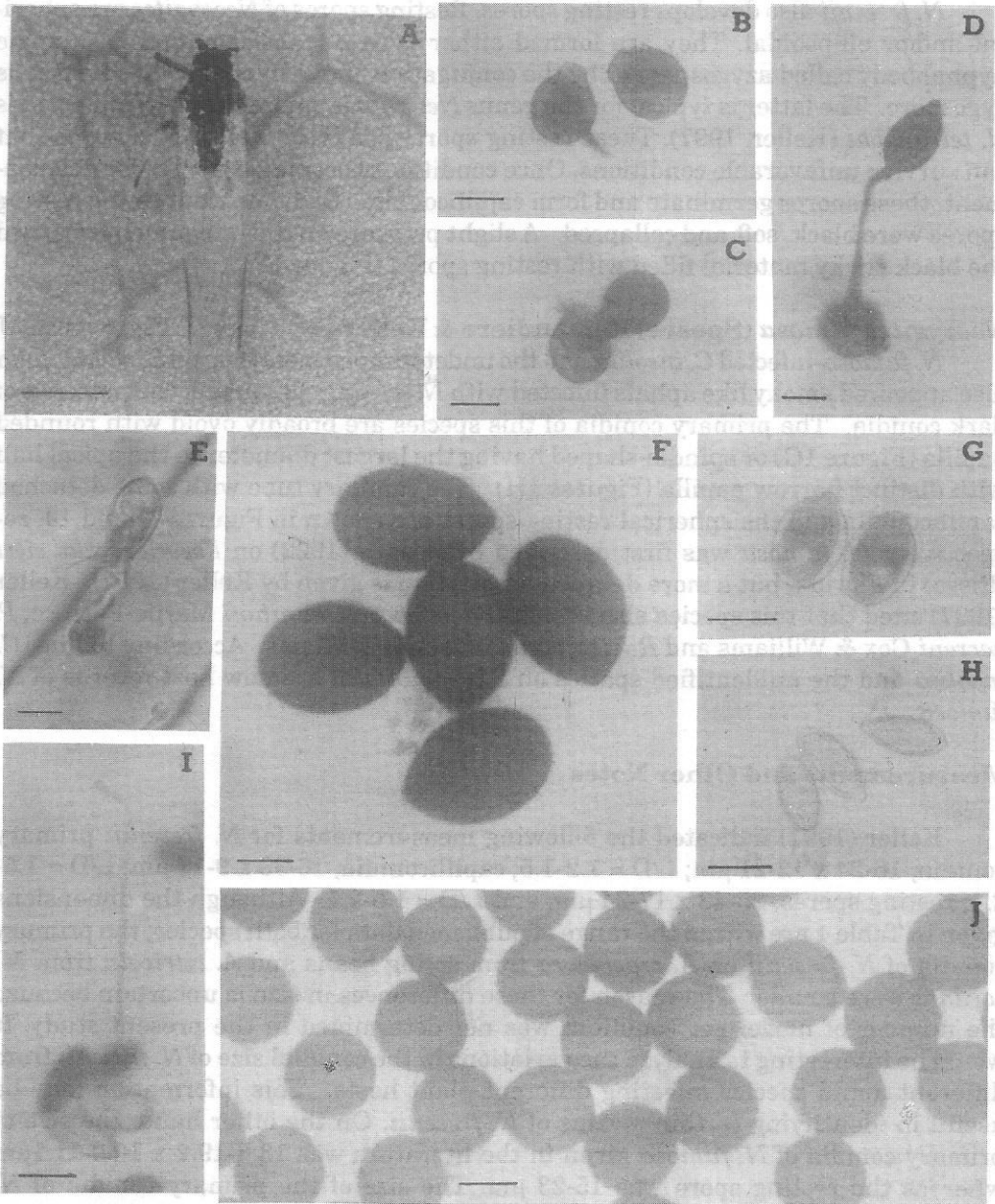


Figure 1. Structures of *Neozygites fresenii* (A-F) and *N. fumosa* (G-J) **A.** cadaver of infected alate *Aphis craccivora*, note conidial deposits on wings; **B.** primary conidia, one forming a short capillary tube; **C.** primary conidium forming secondary conidium similar to the primary; **D.** primary conidium with fully developed capilliconidium; **E.** germinating capilliconidium on exuvium of femur; **F.** ellipsoid, dark brown resting spore; **G.** ovoid primary conidia; **H.** spindle-shaped primary conidia; **I.** capillary conidiophore; **J.** spherical resting spores. Bar in A = 1 mm; the bars in B-J = 10mm.

N. fresenii also develops resting spores. Resting spores of *Neozygites* are spherical and/or ellipsoidal. They are formed either by the transformation of a single hyphal body called azygospore or by the conjugation of two hyphal bodies known as zygosporangium. The latter is typical for the genus *Neozygites* where the only exception is *N. tetranynchi* (Keller, 1997). These resting spores are thick-walled structures that can survive unfavorable conditions. Once conditions become conducive for development, these spores germinate and form capilliconidia. Cadavers containing resting spores were black, soft and collapsed. A slight pressure on the integument released the black sticky material filled with resting spores (Figure 1F).

Neozygites fumosa (Speare) Remaudiere & Keller

Figures 1G-J

N. fumosa-infected *C. insolita* and the undetermined mealybug on *S. rhombifolia* also appeared smoky like aphids infected with *N. fresenii*, because of the presence of dark conidia. The primary conidia of this species are broadly ovoid with rounded papilla (Figure 1G) or spindle-shaped having the largest diameter in the apical half with distinct narrow papilla (Figures 1H). The capillary tube with some detached capilliconidia and the spherical resting spores are shown in Figures 1I and 1J, respectively. *N. fumosa* was first described by Speare (1922) on *Pseudococcus citri* (Risso) in Florida, but a more detailed description is given by Keller (1997). Keller (1997) cited that this species also attacks *Phenacoccus manihoti* Matile-Ferrero, *P. herreni* Cox & Williams and *Rastrococcus invadens* Williams. According to him, *C. insolita* and the unidentified species on *S. rhombifolia* are new host records of *N. fumosa*.

Measurements and Other Notes

Keller (1991) indicated the following measurements for *N. fresenii*: primary conidia, 16-24 x 12-21 μm ; L/D = 1.2-1.5; capilliconidia, 16-33 x 9-17 μm ; L/D = 1.5-2.4; resting spores, 25-48 x 17-24 μm , and L/D = 1.5-2.1. Although the dimensions given in Table 1 are within the range of published data for both species, the primary conidia of *N. fresenii* on *A. craccivora* from string beans and *A. citricola* from *M. cordata* were smaller. The reason for these differences in size is uncertain because the number of nuclei per conidium was not determined in the present study. It would be interesting to analyze the variations in the conidial size of *N. fresenii* from different aphid species infesting different plant hosts. This information may be useful in identifying certain strains of *N. fresenii*. On the other hand, the size of primary conidia of *N. fumosa* given in the literature was 18.6-19.2 x 10.0-11.1 μm whereas the resting spore was 15-23 μm . The size of the primary conidia of *N. fumosa* in *C. insolita* (15 x 7 μm) was noticeably smaller. Keller (1997) also noted this and indicated that the present knowledge does not allow it to be considered a distinct species.

Both *N. fresenii* and *N. fumosa* were collected when there were on going epizootics resulting to the drastic reduction in the aphid and mealybug populations. Enhancing the occurrence of these fungi may have potential in the biological control of these pests.

Table 1. Dimensions (μm) of conidial structures of *Neozygites fresenii* and *N. fumosa*¹

Insect/Plant Host (Date and place collected)	Type of conidia		
	Primary conidia	Secondary conidia (capilliconidia)	Resting spores
<i>N. fresenii</i>			
<i>A. craccivora</i> on: madre de cacao, <i>Gliricidia sepium</i> (17.V.94, ViSCA)	15.0-22.5 x 10.0-20.0 (18.2 x 15.6) L/D = 1-1.6 (1.2)	12.5-15.0 x 7.5-12.5 (17.5 x 10.0) L/D = 1.4-2.0 (1.8)	
string bean, <i>Vigna sesquipedalis</i> (31.V.94, ViSCA)	12.5-20.0 x 10.0-12.5 (14.5 x 10.5) L/D = 1.2-1.5 (1.4)	15.0-25.0 x 10.0-12.5 (20.8 x 11.5) L/D = 1.4-2.3 (1.8)	
mung bean, <i>Vigna radiata</i> (5.III.94, ViSCA)	15.0-17.5 x 10.5-15.0 (15.4 x 12.7) L/D = 1-1.5 (1.2)	15.0-22.5 x 10.0-12.5 (19.1 x 11.9) L/D = 1.4-2.0 (1.7)	25.0-32.5 x 15.0-20.0 (29.2 X 17.5) L/D = 1.6-1.7
<i>A. citricola</i> on <i>Mikania cordata</i> (12.II.94, ViSCA)	12.5-17.5 x 10.0-15.0 (13.2 x 12.5) L/D = 1-1.4 (1.1)	12.5-22.5 x 7.5-12.5 (17.3 x 10.4) L/D = 1.2-2.3 (1.7)	
<i>N. fumosa</i>			
<i>Coccidohystrix insolita</i> on eggplant, <i>Solanum melongena</i> (16.VI.94, Conalum, Inopacan)	10.0-17.5 x 5.0-10.0 (14.8 x 7.1) L/D = 1.8-2.1 (2.0)		12.5-17.5 (14.5) L/D = 1.0
Unidentified mealybug on <i>Sida rhombifolia</i> L. (16.VII.96, ViSCA)	17.5-20.0 x 7.5-10.0 (18.2 x 8.4) L/D = 2.0-2.3 (2.2)	12.5-18 x 5-10 (15 x 8) L/D = 1.8-2.5	

¹ Dimensions given as: Range: Length x Diameter (mean); L/D = ratio of length to diameter. Blanks indicate the structures were not observed for that particular sample

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