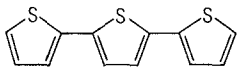

Figure 1. Alpha terthienyl.

UV without α-T. In both cases, the initial growth rate is the result of decreased initial feeding rates. Rapid growth began when the larvae began feeding at a normal rate.

Larvae exposed to both α-T and near-UV also showed initial poor growth which may be attributed to poor feeding rates. However, when these insects started feeding normally, they did not enter a phase of rapid growth. The larvae continued to show poor relative weight gain and all larvae died by the end of the 4th week, before molting to the fifth instar. These results are indicative of the photosensitizing effect of α-T. Results similar to these have been observed with the feeding specialist *Manduca sexta*[9]. In our experiments, larvae were exposed to only 1 W/m^2 near-UV and 100 ppm α-T. In full sunlight in summer at Ottawa, Canada (45° N), the near-UV component may exceed 50 W/m^2. Concentrations of α-T in plant material often exceed 1000 ppm. Our results then strongly suggest that α-T has an important function in protecting the plants that contain it from insect herbivores.

The ability of α-T to photosensitize insects is comparable to other known naturally occurring photosensitizers, including furanocoumarins[10]. The latter interfere with gene product synthesis by forming monofunctional or difunctional adducts with DNA. In contrast, α-terthienyl is a photodynamic sensitizer which produces activated species of O_2 that oxidize target molecules[11,12]. The site of action of α-T appears to be membranes, but another photodynamic secondary plant substance, berberine, may intercalate and photooxidize DNA[13]. Thus, a wide variety of mechanisms is possible in photosensitization reactions with plant secondary metabolites. A particular selective advantage may be conferred on plants containing these substances; this advantage may occur in the access to excited state chemistry in which phototoxins can initiate many more damaging processes than occur in the ground state.

Variations in larval weight gain, diet consumption, and assimilation efficiencies, with exposure to combinations of α-T and near-UV

Treatment	Diet consumption (g/unit wt/day)	Larval weight gain (%/day)	Efficiency of conversion (%)[a]
Control	205.8 ± 27.1	49.8 ± 9.7	65.8 ± 8.5
+ UV	212.1 ± 31.0	47.6 ± 7.0	76.7 ± 5.5
α-T − UV	170.0 ± 29.1	22.5 ± 7.0	34.9 ± 7.6
α-T + UV	125.6 ± 19.1	15.9 ± 7.4	35.7 ± 10.7

[a] Larval weight gain (g/insect/day) divided by diet consumption (g/insect/day), × 100.

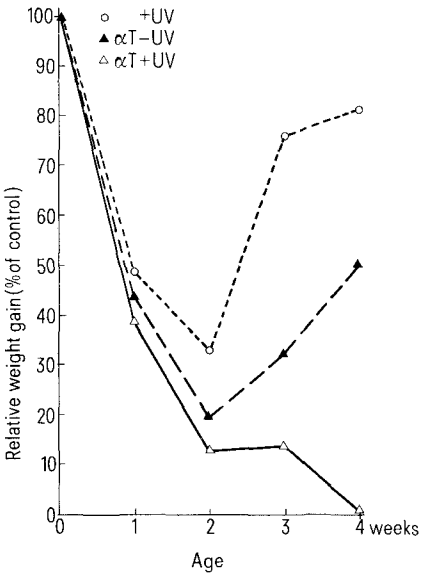

Figure 2. Effect of α-T and near-UV on larval growth of *Euxoa messoria*.

1 This work was supported by NSERC and Agriculture Canada.
2 Reprint requests to J.T.A., Dept. of Biology, University of Ottawa, Ottawa, Canada K1N6N5.
3 Arnason, T., Swain, T., Wat, C.K., Graham, E.A., Partington, S., Towers, G.H.N., and Lam, J., Biochem. System. Ecol. *9* (1981) 63.
4 Wat, C.K., Prasad, S.K., Graham, E.A., Partington, S., Arnason, T., Towers, G.H.N., and Lam, J., Biochem. System. Ecol. *9* (1981) 59.
5 Kawazu, K., Ariwa, M., and Yoshiaki, L, Agric. biol. Chem. *91* (1977) 223.
6 McLachlan, D., Arnason, J.T., Philogène, B.J.R., and Champagne, D., Experientia *38* (1982) 1061.
7 Devitt, B.D., Philogène, B.J.R., and Hinks, C.F., Phytoprotection *61* (1980) 88.
8 Campbell, G., Lambert, J.D.H., Arnason, T., and Towers, G.H.N., J. chem. Ecol. *8* (1982) 961.
9 Downum, K., unpublished.
10 Berenbaum, M., Science *201* (1978) 532.
11 Arnason, T., Chan, G.F.A., Wat, C.K., Downum, K., and Towers, G.H.N., Photochem. Photobiol. *33* (1981) 821.
12 Downum, K.R., Hancock, R.E.W., and Towers, G.H.N., Photochem. Photobiol. *36* (1982) 517.
13 Philogène, B.J.R., Arnason, J.T., Towers, G.H.N., Campos, F., Champagne, D., and McLachlan, D., J. chem. Ecol. *10* (1984) 115.

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A fossil entomogenous fungus from Dominican amber

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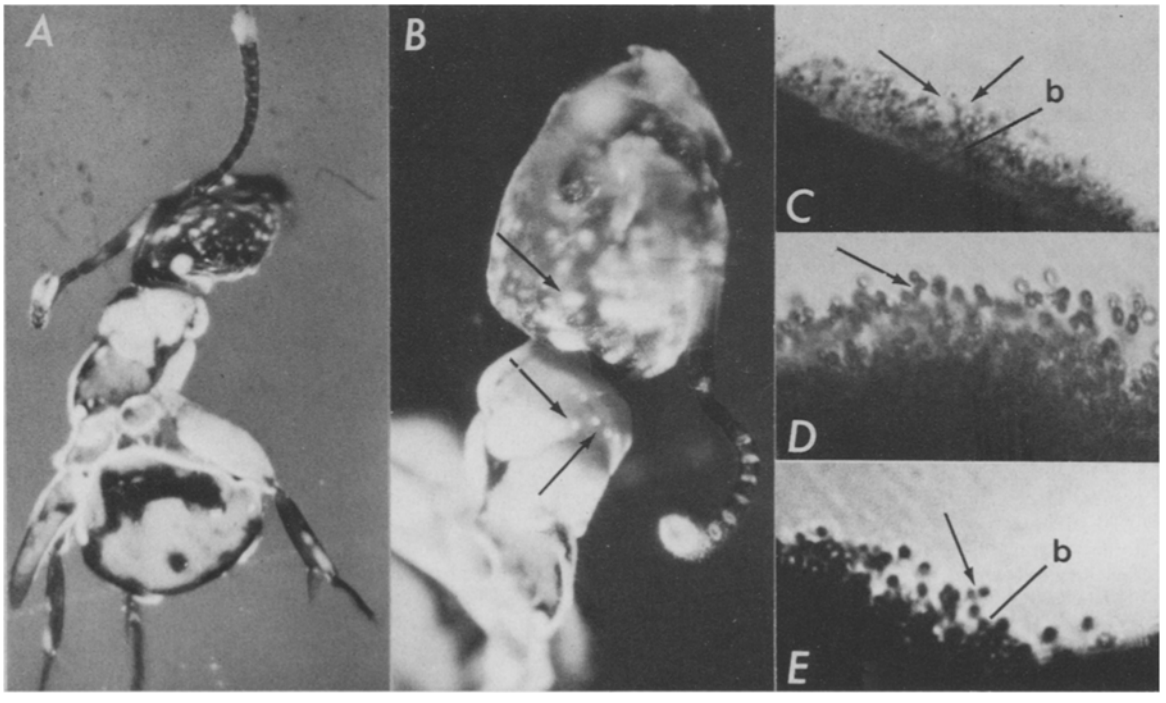
Summary. A worker ant (Formicidae: Hymenoptera) embedded in amber (25 million years old) from the Dominican Republic was covered with an entomogenous fungus containing characters very similar to present day strains of *Beauveria bassiana*. This represents the first report of a fossil insect-pathogenic fungus belonging to the class Deuteromycetes.

While examining fossilized resin for evidence of invertebrate diseases, a piece of clear, yellow amber from the Dominican Republic was found to contain a worker ant (Formicidae: Hymenoptera) covered with a white, powdery fungus (fig. A,B). When viewed under the compound microscope, conidiophores, conidiogenous cells and conidia were observed (fig. C,D,E). The conidia were 1-celled, hyaline, smooth and varied in shape from globose to broadly ellipsoidal. Their greatest diameter ranged from 1.2–2.2 µm (N = 25). The conidia were born on a geniculate rachis (fig. C,D) and the basal portions



Entomogenous fungus in Dominican amber. *A* Ventral view of ant fossilized in amber, showing the white fungus covering much of the insect (× 45). *B* Dorsal view of head and thorax showing 'cottony puffs' of fungus (arrows), typical of spore bearing areas for *Beauveria* (×100). *C* Rachis with denticles (2 arrows) and globose base (b) of conidiogenous cell (× 800). *D* Geniculate rachis with spores (arrow) (×1000). *E* Spore rachis with 2 spores (arrow) and swollen base (b) of conidiogenous cell (×1000).

of the conidiogenous cells were globose (fig. E). What we interpreted as denticules appeared on the rachis (fig. C).

On the basis of its white, powdery appearance, (similar to that found in present day *Beauveria* infections; see Poinar and Thomas[1], its spore characteristics and the nature of the conidiogenous cells, we conclude that the fossil fungus belongs to the genus *Beauveria* as defined by De Hoog[2] and characterized by Samson[3]. Using De Hoog's key to the species of *Beauveria*, the fossil species is closest to *Beauveria bassiana* (Bals.) Vuill.

Present day strains of *B. bassiana* attack a wide variety of insects, including ants[4].

To our knowledge, this is the first report of a fossil entomogenous fungus belonging to the class Deuteromycetes. Previous fossil fungi associated with insects were either parasitic members of the Entomophthorales[5] or saprophytic forms[6].

Amber from the Dominican Republic (Palo Alto region) is dated around the Oligocene-Miocene boundary or at approximately 25 million years old[7].

1 Thomas, G.M., and Poinar, G.O. Jr, Hilgardia *42* (1973) 261.
2 De Hoog, G.S., Stud. Mycol., Baarn *1* (1972) 41.
3 Samson, R.A., in: Microbial Control of Pests and Plant Diseases 1970–1980, p.94. Ed. H.D. Burges. Academic Press, New York 1981.
4 Poinar, G.O. Jr, and Thomas, G.M., in: Diagnostic Manual for the identification of Insect Pathogens, p.218. Plenum Press, New York 1978.
5 Poinar, G.O. Jr, and Thomas, G.M., Mycologia *74* (1982) 332.
6 Larsson, S.G., Entomonograph *1* (1978) 1.
7 Sanderson, M.W., and Farr, T.H., Science *131* (1960) 1313.

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Pathological changes in the heterologous phase of antibasement membrane antibody mediated disease in the rat

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Summary. The immunological and structural changes during the heterologous phase of experimental antibasement membrane antibody mediated disease was sequentially studied in the rat following single i.v. injections of rabbit antibodies to basement membrane antigens prepared from kidney, lung and salivary gland tissues. Although each of the anti-bodies bound strongly to GBM, structural changes were initially subtle accompanied by proteinuria and hematuria. More severe structural changes related to dose and duration of the disease did not appear for several weeks.

Antibasement membrane antibody mediated disease first described by Goodpasture in 1919[1] has now become a well recognized clinical entity. It presents with pulmonary hemorrhage associated with florid proliferative glomerulonephritis. Although mediated by circulating auto anti-bodies against glomerular basement membrane (GBM) and alveolar basement membrane (ABM) the initiating factors are unknown even though an increasing number of cases associated with exposure