

SUSCEPTIBILITY OF SPIDER SPECIES TO THE FUNGUS *NOMURAEA ATYPICOLA*

One of the most common pathogenic fungi attacking spiders is the hyphomycete *Nomuraea atypicola* (Yasuda) Samson (see Nentwig, W. 1985. J. Arachnol., 13:272-274, for review of literature). There are three known species in the genus *Nomuraea*. The best known, *N. rileyi* (Yasuda) Samson (Samson, R. A. 1974. Studies in Mycol., 6:80-85), is primarily a pathogen of insects and the causative agent for natural epizootics in populations of many lepidopteran larvae (Ignoffo, C. M. 1981. In Microbial Control of Pests and Plant Diseases, 1970-1980. ed. H. D. Burges, Acad. Press. 914 pp). *N. atypicola* has been primarily isolated from spiders; Petch (1939. Trans. Br. Mycol. Soc., 23:139-140) reported its isolation from the ctenizid *Kishinoeyus typicus* Kisida (since renamed *Latouchia typica*). The third species, *N. anemonoides* Hocking, has been isolated only from soil (Hocking, A. D. 1977. Trans. Br. Mycol. Soc., 69:511-513).

N. atypicola was named and described as a species of *Spicaria* on the basis of herbarium specimens and living cultures, and combined by Samson (loc. cit.) in

Table 1.—Relative susceptibility of spiders to topical applications of conidia of *Nomuraea atypicola*.
* Diagnosed as positive mycosis.

Species	No. Tested	No. Positive	Minimum Time (Days) to Death*
Loxoscelidae			
<i>Loxosceles reclusa</i> Gertsch & Mulaik	7	2	2
Theridiidae			
<i>Achaearanea tepidariorum</i> (C. L. Koch)	2	2	6
Linyphiidae			
<i>Frontinella pyramitella</i> (Walckenaer)	1	1	3
Araneidae			
<i>Argiope aurantia</i> Lucas	2	2	12
<i>Acanthepeira stellata</i> (Marx)	2	2	20
<i>Cyclosa</i> sp.	1	0	—
<i>Neoscona</i> sp.	2	1	31
Tetragnathidae			
<i>Tetragnatha laboriosa</i> Hentz	7	7	3
Agelenidae			
<i>Agelenopsis</i> sp.	3	2	11
Lycosidae			
<i>Lycosa rabida</i> Walckenaer	1	1	21
<i>Lycosa</i> sp.	1	0	—
<i>Pardosa</i> sp.	2	0	—
Anyphaenidae			
<i>Anyphaena</i> sp.	1	1	9
Thomisidae			
<i>Misumenops</i> sp.	1	1	15
<i>Xysticus</i> sp.	4	1	27
Salticidae			
<i>Henizia ambigua</i> (Walckenaer)	1	1	3
<i>Phidippus audax</i> (Hentz)	7	4	10
<i>P. clarus</i> Keyserling	6	6	2
<i>Phidippus</i> sp.	11	8	1
<i>Metaphidippus galathea</i> (Walckenaer)	1	1	13

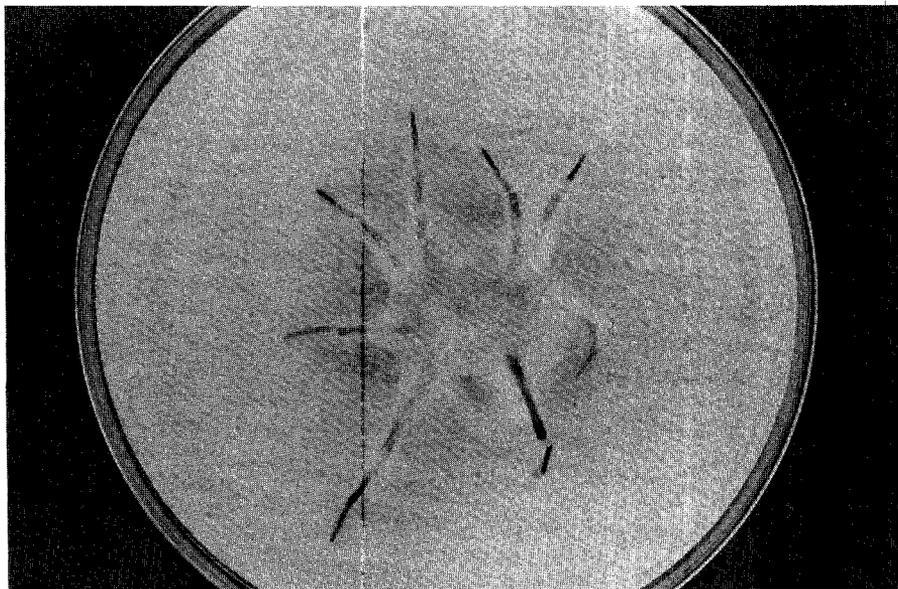


Fig. 1.—Mycelial outgrowth of *N. atypicola* from an adult of *Lycosa rabida*.

Nomuraea. It is considered to be the anamorph of *Cordyceps cylindrica* Petch (Petch, T. 1938. Trans. Br. Mycol. Soc., 21:34-67). In a recent observation (Nentwig, loc. cit.) natural mycoses of *N. atypicola* were reported from the araneids *Argiope argentata* (Fabricius), *A. savignyi* Levi and *Nephila clavipes* (Linnaeus). The objective of the present study was to determine the susceptibility of a taxonomically and ecologically diverse range of spider species to *N. atypicola*.

We used *Nomuraea atypicola* (Yasuda) Samson isolate #CBS, R-01000, from the laboratory of the third author. The isolate was obtained by culturing ascospores of the fungus parasitizing an unidentified trap door spider and found in forest soil in Guamá, Pará, Brazil. Inoculum from this isolate was transferred to petri dishes and *N. atypicola* was then cultured and propagated on malt-ager at $25 \pm 1^\circ\text{C}$. Conidia were harvested after incubation of the cultures for at least 7 days. Adult and subadult spiders were collected between September 6 and October 18, 1985, in buildings, backyards, an alfalfa field and a native tall grass prairie in Boone and Callaway counties, Missouri, U.S.A.

All spiders were exposed to the fungus within 24 h of collection. They were first immobilized with CO_2 (flow rate of $30 \text{ cm}^3/\text{min}$, Lab-Crest Mark III Flowmeter®, Fisher and Porter, Chicago, III. 60651) and then conidia were topically applied to the ventral and dorsal surfaces of the cephalothorax and abdomen. Approximately $50 \mu\text{l}$ of a conidial suspension, containing 3×10^5 conidia per ml in 0.03% of the detergent Tween-80®, was used for each spider. Treated spiders were individually placed in either a standard 100 X 15mm petri dish (with wet filter paper) or, for larger individuals, a 1/2 pint ice-cream container (with a wet, 4 cm-long dental wick) that was covered with a petri plate lid. The treated spiders were incubated at $25 \pm 1^\circ\text{C}$ and checked daily for mortality. After three days, all surviving animals were fed appropriate sized cabbage looper larvae, *Trichoplusia ni*, twice weekly until they died or the experiment was terminated (a maximum of 78 days). Spiders appeared to remain

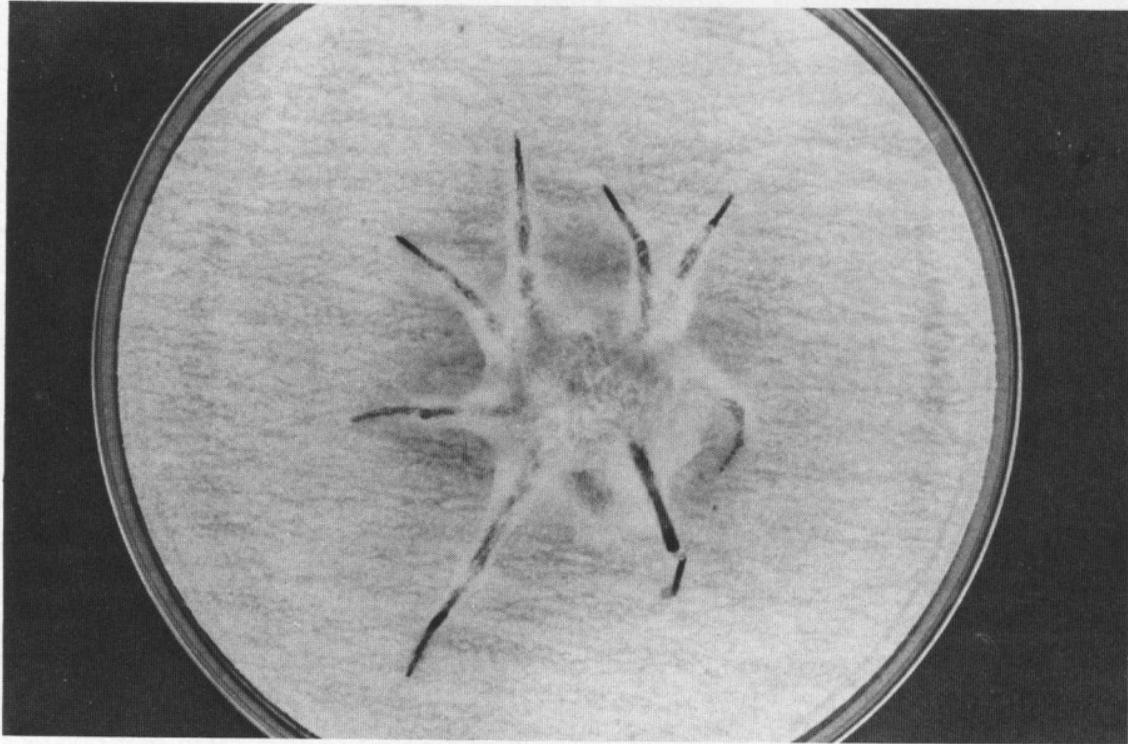


Fig. 1.—Mycelial outgrowth of *N. atypicola* from an adult of *Lycosa rabida*.

healthy, consuming the offered *T. ni* larvae and producing silk, until the time of death. All dead spiders were microscopically examined for the presence of *N. atypicola* mycosis.

Our experiments with *N. atypicola* satisfy Koch's postulates. Seventeen of the 20 species that were treated developed *N. atypicola* mycosis (Table 1 and Fig. 1). The three nonsusceptible species, representing four specimens from two families (Araneidae and Lycosidae), were in the genera *Cyclosa*, *Lycosa*, and *Pardosa*. We also subjected an opilionid, *Leiobunum vittatum* Say (Phalangiidae), to the same protocol. All three individuals tested developed the mycosis, the earliest in two days following application of conidia.

There are no obvious trends in our results. The tested species represent a reasonably broad spectrum of taxonomic and ecological diversity within the spider suborder Labidognatha, as well as a member of one other arachnid order. If the results on *L. vittatum* are any indication, *N. atypicola* may attack not just spiders but arachnids generally.

All previous references to host range of this fungus have been anecdotal. Our results indicate that *N. atypicola* has a broad potential host range; determination of its importance as a mortality agent will require increased awareness on the part of collectors and field ecologists.

We thank Steve Long and Clyde Morgan for collecting spiders, Clemente Garcia and James Smith for performing laboratory experiments, Gerry Summers for identifying the opilionid, Clyde Morgan for Fig. 1., and Keio Aizawa, Randy Cohen, Jim Fuxa, Jim Harper, Leslie Kish, Wolfgang Nentwig and George Uetz for comments on the manuscript.

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