SCIENTIFIC NOTE

OBSERVATIONS ON THE MITE *SCHIZOSTHETUS LYRIFORMIS* (ACARI: PARASITIDAE) PREYING ON BARK BEETLE EGGS AND LARVAE[1]

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Many species of mite that live exclusively in decaying wood and subcortical environments have intricate relationships with bark beetles (Coleoptera: Curculionidae, Scolytinae) (e.g., in the genus *Dendroctonus*, *Ips*, *Scolytus*) (Lindquist, 1969; Moser, 1975; Hirschmann and Wisniewski, 1983; Karg, 1993). These mites depend on bark beetles or other subcorticolous insects for dispersal and introduction into appropriate living substrates. Mite communities associated with bark beetles can be large and complex, with multiple feeding guilds and trophic levels (Lindquist, 1969; McGraw and Farrier, 1969). However, because of the difficulty in observing subcorticular mites, very little is known about their biology and feeding behavior.

Here, we describe observations of the feeding behavior of the mite *Schizosthetus lyriformis* (McGraw and Farrier, 1969) (Acari: Parasitidae) within the galleries of the bark beetle, *Ips pini* (Say) (Coleoptera: Curculionidae, Scolytinae). Three mite species have been described in this genus (*S. lyriformis*, *S. simulatrix* Athias-Henriot and *S. vicarious* Athias-Heriot) with virtually nothing known about their feeding behavior (Athias-Henriot, 1982; Al-Atawi et al., 2002; Kaluz et al., 2003). *Schizosthetus vicarious* is found only in Oregon, U.S.A. and is believed to be associated with bark beetles (Al-Atawi et al., 2002). *Schizosthetus simulatrix* occurs throughout Europe, Russia, and the Canary Islands (Tikhomirov, 1977; Kaluz et al., 2003) and is most abundant under bark and in the galleries of bark beetles in dead or beetle-infested conifers (Blaszak and Madej, 1997). *Schizosthetus lyriformis* (Fig. 1) has been observed in the galleries and the bodies of many bark beetle species that inhabit conifers across North America (McGraw and Farrier, 1969; Kinn, 1971). Both *S. lyriformis* and *S. simulatrix* exist in a variety of environmental conditions encompassing various temperature and humidity extremes (Al-Atawi et al., 2002; Kaluz et al., 2003).

To observe *S. lyriformis* within phloem, we set up an arena or window by which we could observe the natural behavior of mites using a microscope (Meiji EMZ-13TR) attached to a digital video camera (DCM-130, Hangzhou Huzxin IC

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Tech. Co., Ltd.). An intact sample of phloem (20 x 30 cm) was taken from a freshly felled healthy *Pinus ponderosae* Douglas ex Lawson near Flagstaff, Arizona U.S.A., and immediately placed between two sterile pieces of Plexiglas (Lexan Polycarbonate; CE Plastics, HomeDepot Inc.). The edges of the Plexiglas were sealed with 100% white petroleum jelly (Personal Care Products, Inc.) to minimize drying and exposure to air. Newly emerged *Ips pini* adults, collected from infested *P. ponderosae* in Coconino Co. 10 miles southwest of Flagstaff, Arizona, were introduced into the phloem via a 2 mm diameter hole drilled through one of the Plexiglas sheets. An adult male *I. pini* was introduced into the hole, followed one day later by an *I. pini* female. Upon entry, the female began to tunnel in the phloem at a rate of 1-2 cm per day. During this time, she was observed to mate multiple times with the occupying male. After three days the female began to lay individual eggs along the gallery at intervals of ~0.5 mm.

Figure 1. (A) The mite *Schizosthetus lyriformis* (Parasitiformes: Parasitidae). Collected May 19, 1965, by J. Moser (Slide #4133); The deutonymph mite was found on a male *Strategus julianus* Burmeister 1847 (Family: Scarabaedidae; Subfamily: Dynastinae), Pineville, Louisiana, U.S.A. Photo by Stacy Blomquist. (B) Head region and mouth parts of the mite *S. lyriformis.* Collected June 14, 1965 by L. Roton (J. Moser Slide #4766); mite found on Histerid beetle, *Cylistix attenuate* LeConte (= *C. attenuate*) Elizabeth, Louisiana U.S.A. Photo by Stacy Blomquist.

Several deutonymph *S. lyriformis* mites, phoretic on the introduced *Ips*, were observed in *Ips* galleries within the phloem. One day after the first *Ips* egg was laid, an adult *S. lyriformis* mite was observed to puncture the egg and feed on the material within. In all, five eggs were killed by the inhabiting three *S. lyriformis* over a three-day period. Each mite also appeared to vigorously defend the egg and chase away conspecifics. Mites from different genera, such as the myco-

phagous *Tarsonemus ips* and the predatory *Trichouropoda australis* Hirschmann were not chased away. Kinn (1982) witnessed *T. australis* consuming both nematodes and fungi, but in this study we observed a deutonymph or adult *Trichouropoda* sp. to prey on eggs of *I. pini*. Although we were unable to recover this specimen, we believe this mite was indeed *T. australis*, as our past collections of phoretic uropodids of *I. pini* have revealed only those of *Trichouropoda australis*. Individual *S. lyriformis* (Fig. 1A) were also observed to kill two first instar *I. pini* larvae by stabbing the larvae with their mouthparts (Fig. 1B) under the head capsule ventral to the larva's mandibles. The mites appeared to feed on the fluids within the larvae. Second instar or older *I. pini* larvae, were not attacked by the mite. Our results support earlier observations by Moser (1975) of *S. lyriformis* feeding on solitary eggs and larvae of the southern pine beetle (*Dendroctonus frontalis* Zimmermann) in a Petri dish arena. Within our phloem arena, *S. lyriformis* were not observed to feed on nematodes or other mite species found within the galleries. To confirm mite species identification, mites were removed from the phloem arena after two weeks and identified to species by J.C. Moser.

Bark beetle egg and larval predation has been reported previously in the mites *Proctolaelaps dendroctoni* Lindquist and Hunter, *P. fiseri* Samsinak, *Dendrolaelaps isodentatus* Hurlbutt, *D. neocornutus* Hurlbutt, *D. neodisetus* Hurlbutt, *Histiogaster arborsignis* Woodring, *Iponemus truncates truncatus* (Ewing), *Insectolaelaps quadrisetus* (Berlese, 1920), *Macrocheles boudreauxi* Krantz, *Paracarophaenax* sp., and *Pyemotes parviscolyti* Cross and Moser (Lindquist, 1969; Moser, 1975; Kinn, 1983, Krug, 1993). This is the first reported observation of feeding preferences by *S. lyriformis* within the phloem environment and the first observation of it feeding on *Ips* eggs and larvae. Other species in this genus, also associated with bark beetles, may have similar feeding behavior.

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