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Mite Predators of the Southern Pine Beetle[1]

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ABSTRACT

Of 51 mites found with brood of the southern pine beetle, *Dendroctonus frontalis* Zimmermann, and tested in the laboratory, four are primary candidates for use as natural control agents in reducing field infestations: *Histiogaster arborsignis* Woodring, *Proctolaelaps dendroctoni* Lindquist & Hunter, *Macrocheles boudreauxi* Krantz, and *Dendrolaelaps neodisetus* Hurlbutt. Four others are secondary choices: *Eugamasus lyriformis* McGraw & Farrier, *Dendrolaelaps neocornutus* Hurlbutt, *D. isodentatus* Hurlbutt, and *Proctolaelaps fiseri* Samsinak.

Mites are frequently observed on brood of the southern pine beetle, *Dendroctonus frontalis* Zimmermann, and are commonly assumed to cause mortality (Rust 1933, Hetrick 1940, Fronk 1947). Studies of mites as possible natural control agents against the beetle have been hampered because mites are reluctant to feed when exposed to light; consequently, scientists have been unable to observe and characterize the biology of important associated species. Acceptable natural control agents must be common or abundant under bark and should aggressively attack one or more brood stages; phoresy on the beetle would be desirable to ensure mite dispersal but is not crucial because other insects are effective vectors (Moser and Roton 1971).

A laboratory test was employed to determine which mite species are capable of killing beetle brood and to observe the behavior of the chief predators.

MATERIALS AND METHODS

Specimens of 51 mite species were collected from galleries of the southern pine beetle. Plaster of Paris substrates were poured into petri dishes painted black to exclude excessive light (Fig. 1). Several small compartments (15 mm diam by 2 mm deep) were drilled into each substrate; the porosity of the substrate kept the humidity near 100% without allowing water to accumulate in the compartments. Specimens of each species were individually placed in the compartments with one beetle stage. When enough mites were available, male, female, and preadult (deutonymph or tritonymph) mites were individually tested against eggs, 1st-stage larvae, last-stage larvae, pupae, and adults of the beetle. Insect specimens were never used for more than one bioassay; but for a few mite species it was necessary to reuse individual specimens because new ones were unavailable. Specimens were confined to separate chambers by glass cover slips cemented with liquid plaster of Paris over each of the compartments and were visible through the covers of the petri dishes.

The behavior of each mite on various beetle stages was recorded; aggressiveness and the amount of prey consumed were emphasized. Each chamber was checked at least once every 12 h for beetle mortality. If a mite did not attack and kill the beetle within 3 days, the specimen was discarded and the test repeated.

Data describing the occurrence of mites under bark are taken from Moser and Roton (1971), where the term relative frequency denotes the percentage of study trees containing a particular mite species. Phoresy ratings for each mite species on the southern pine beetle were taken from an unpublished study.

[1] *Dendroctonus frontalis* Zimmermann (Coleoptera: Scolytidae).
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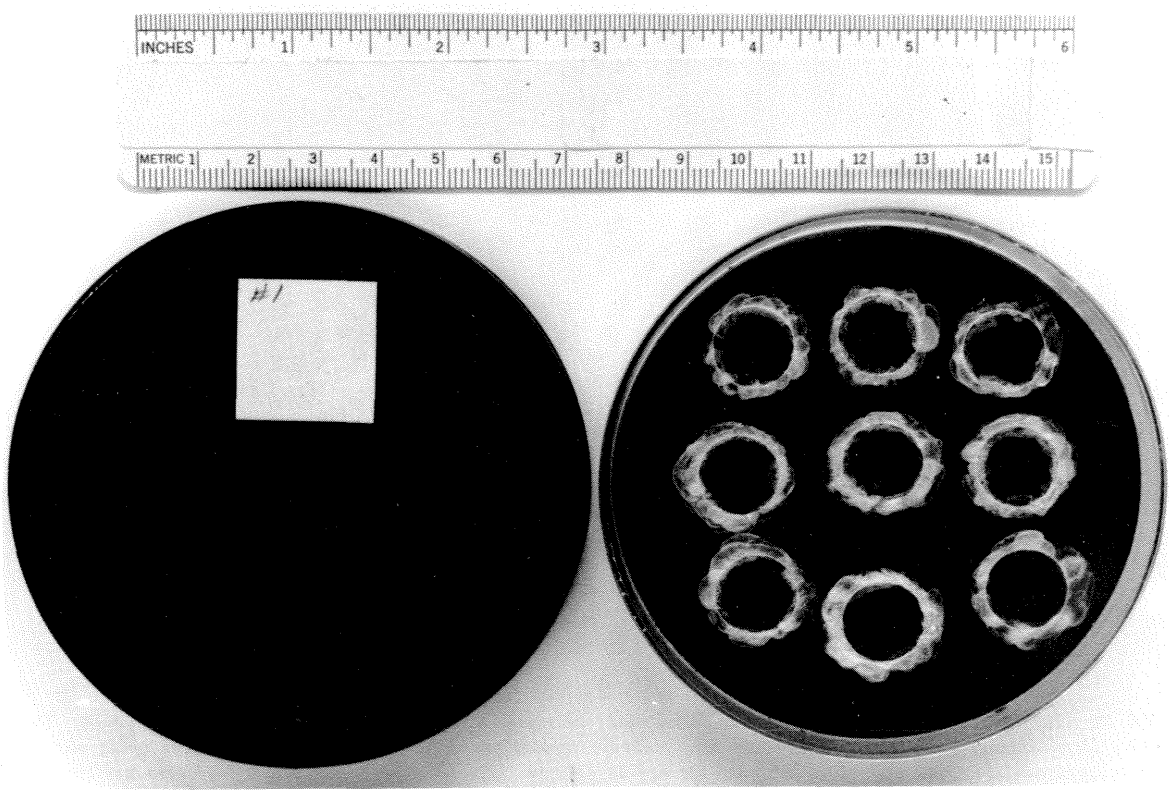

FIG. 1.—Nine chambers in plaster of Paris for bioassay of mites.

RESULTS AND DISCUSSION

Of the 51 mite species surveyed, 32 showed predation on one or more brood stages (Table 1). Several species that belong to predatory groups did not attack the beetle. These species were *Ameroseius longitrichus, Longoseius cuniculus, Trichouropoda australis, T. hirsuta, Uroobovella orri,* and *Ereynetoides scutulis.* The 2 species of *Histiogaster* were unexpectedly aggressive and attacked all brood stages.

Preadult mites attacked fewer southern pine beetle stages than adults, and the female somewhat fewer than the male. Preadults of 5 of the 32 predators would not attack, but both male and female adults of all 32 species fed on at least one beetle stage.

The 1st-stage larva was preferred to all other host stages and was followed by egg, last-stage larva, and pupa. Two dominant genera, *Proctolaelaps* and *Dendrolaelaps,* showed contrasting egg preferences: none of the *Proctolaelaps* would accept eggs, but at least 3 species of *Dendrolaelaps* attacked them vigorously. Six species attacked only 1st-stage larvae; late larvae or pupae were never eaten unless the early larvae were also attacked. Late larvae were usually preferred to pupae, even though pupae are presumably more vulnerable because of reduced irritability.

Mite preferences for certain brood stages may be a function of accessibility. Eggs and 1st-stage larvae are located near parent galleries; last-stage larvae are in cells detached from the galleries and connected only by a narrow passage constructed by the larvae in an earlier stage. Pupae are in chambers that may be totally isolated from mites. The pupal chamber lies in the middle bark above the larval chamber, and the 2 compartments are connected only by a small, vertical gallery tightly plugged by frass. Numerous examinations of pupae and larvae in these chambers revealed no mites.

Adult beetles were never attacked, a fact that may be explained by the phoretic habits of the mites. Most were dependent on the adult beetles for dispersal to new host material.

Observations of feeding preferences and of relative frequency and phoresy revealed 4 species as prime candidates for use as biological control agents (Table 2): *Histiogaster arborsignis, Proctolaelaps dendroctoni, Macrocheles boudreauxi,* and *Dendrolaelaps neodisetus,* which showed the highest relative frequency and was phoretic but was not quite so aggressive as the other 3.

Even though phoresy on the beetle is desirable in a biological control agent, other insects that carry the mites usually invade dying trees at the same time that the beetles attack and would probably insure mite dispersal. Therefore, phoresy on the southern pine beetle may not be crucial in order for a mite to be regarded as an acceptable agent for biological control. Elimination of the phoresy requirement would qualify

Table 1.—Predation of 51 mite species on various stages of the southern pine beetle.

Mite species	Female mites				Male mites				Preadult mites (deutonymph or tritonymph)			
	E	F	L	P[a]	E	F	L	P	E	F	L	P
Ameroseius longitrichus Hirschmann	1	1	1	1[b]	1	1	1	1	1	1	1	1
Kleemannia sp.	1	1	–	–[c]	1	2	–	–	–	–	–	–
Lasioseius dentatus (Fox)	3	–	–	–	3	–	–	–	–	–	–	–
Lasioseius epicriodopsis DeLeon	–	3	2	2	–	–	–	–	–	–	–	–
Lasioseius tubiculiger (Berlese)	3	1	1	1	3	1	1	1	1	1	1	1
Melichares n. sp.	–	–	–	1	–	–	–	–	–	–	–	–
Proctogastrolaelaps libris McGraw and Farrier	–	–	–	1	–	–	–	–	–	–	–	–
Proctolaelaps bickleyi (Bram)[d]	–	3	1	1	–	3	1	1	–	1	1	1
**Proctolaelaps dendroctoni* Lindquist and Hunter	1	3	1	2	1	3	2	2	1	1	1	1
**Proctolaelaps fiseri* Samsinak	1	3	3	1	1	3	3	1	1	3	3	1
Proctolaelaps hystricoides Lindquist and Hunter	1	2	1	1	1	2	1	1	1	1	1	1
Proctolaelaps hystrix (Vitzthum)	1	3	2	1	1	3	2	1	1	2	1	1
**Dendrolaelaps isodentatus* Hurlbutt	3	3	1	1	3	3	1	1	3	3	1	1
**Dendrolaelaps neocornutus* Hurlbutt	3	3	1	1	3	3	1	1	3	3	1	1
**Dendrolaelaps neodisetus* Hurlbut	1	2	1	2	1	2	1	1	1	2	1	1
Dendrolaelaps rotoni Hurlbutt	3	3	2	1	3	3	2	1	3	2	2	1
Dendrolaelaps varipunctatus Hurlbutt	1	3	3	1	1	3	3	1	1	3	1	1
Longoseius cuniculus Chant[d]	1	1	1	1	–	–	–	–	1	1	1	1
Androlaelaps casalis (Berlese)	3	–	–	–	3	–	–	–	–	–	–	–
Gymnolaelaps sp.	–	–	–	–	–	–	–	1	–	–	–	–
Hypoaspis disjuncta Hunter and Yeh	–	–	–	1	–	–	–	–	–	–	–	–
Hypoaspis sp. nr. *praesternalis* Willman	3	–	–	1	3	–	–	–	–	–	–	–
Hypoaspis vitzthumi (Womersley)	–	3	–	–	–	3	–	–	–	–	–	–
Pseudoparasitus thatcheri Hunter and Moser[d]	2	2	1	1	–	–	–	–	–	–	–	–
**Macrocheles boudreauxi* Krantz	3	3	1	3	3	3	1	3	3	3	2	1
Macrocheles mammifer Berlese	3	3	3	3	3	3	3	3	3	3	3	3
**Eugamasus lyriformis* McGraw and Farrier	1	3	3	3	1	3	3	3	1	3	3	1
Gamasolaelaps subcorticalis McGraw and Farrier	1	3	3	1	1	2	2	1	1	1	1	1
Cercoleipus coelonotus Kjnn	1	3	1	1	1	3	1	1	1	3	1	1
Pleuronectocelaeno drymoecetes Kinn	3	3	2	1	2	3	2	1	2	1	1	1
Trichouropoda australis Hirschmann	1	1	1	1	1	1	1	1	1	1	1	1
Trichouropoda hirsuta Hirschmann	1	1	1	1	1	1	1	1	1	1	1	1
Trichouropoda lamellosa Hirschmann	1	2	1	1	1	2	1	1	–	–	–	–
Uroobovella americana Hirschmann	–	3	1	1	–	3	1	1	–	–	–	–
Uroobovella orri Hirschmann	1	1	1	1	1	1	1	1	–	–	–	–
**Histiogaster arborsignis* Woodring	3	3	3	3	2	2	1	1	3	3	3	3
Histiogaster rotundus Woodring	3	3	3	3	3	3	3	3	3	3	3	3
Tyrophagus putrescentiae (Schrank)	1	1	1	1	1	1	1	1	1	1	1	1
Anoetus insolita Woodring and Moser	1	1	1	1	1	1	1	1	1	1	1	1
Anoetus sordida Woodring and Moser	1	1	1	1	1	1	1	1	–	–	–	–
Anoetus varia Woodring and Moser	1	1	1	1	1	1	1	1	1	1	1	1
Pyemotes parviscolyti Cross and Moser	3	3	3	3	0	0	0	0	0	0	0	0
Pygmephorellus bennetti Cross and Moser	1	1	1	1	0	0	0	0	0	0	0	0
Siteroptes fuserii Smiley and Moser	1	1	1	1	0	0	0	0	0	0	0	0
Heterotarsonemus lindquisti Smiley	1	1	1	1	0	0	0	0	–	–	–	–
Iponemus calligraphi calligraphi Lindquist	3	1	1	1	0	0	0	0	1	1	1	1
Iponemus confusus oriens Lindquist	3	1	1	1	0	0	0	0	1	1	1	1
Iponemus truncatus eurus Lindquist	3	1	1	1	0	0	0	0	1	1	1	1
Tarsonemus krantzi Smiley and Moser	1	1	1	1	0	0	0	0	1	1	1	1
Tarsonemus ips Lindquist	1	1	1	1	0	0	0	0	1	1	1	1
Ereynetoides scutulis Hunter	1	1	1	1	1	1	1	1	1	1	1	1

* Selected as possible agent for biological control.
[a] Beetle stage: E = egg, F = first-stage larva, L = last-stage larva, P = pupa.
[b] 1 = no attack.
2 = mite killed host but ate less than ¼ of its body.
3 = mite aggressively killed host and ate most or all of its body.
0 = mite has no preadult or male has no functional mouth parts.
[c] No observation because mites were unavailable.
[d] Individual mites were used more than once.

Table 2.—Relative frequency and phoresy of mite species selected as possible biological control agents against the southern pine beetle.

Species	Relative frequency (%)	Phoresy on the southern pine beetle
Primary candidates		
Histiogaster arborsignis	94	Common
Proctolaelaps dendroctoni	87	Common
Macrocheles boudreauxi	74	Infrequent
Dendrolaelaps neodisetus	100	Common
Secondary candidates		
Eugamasus lyriformis	55	Rare
Dendrolaelaps neocornutus	35	Rare
Dendrolaelaps isodentatus	35	None observed
Proctolaelaps fiseri	13	None observed

the following additional species as possible natural control agents: *Eugamasus lyriformis, Dendrolaelaps neocornutus, D. isodentatus,* and *Proctolaelaps fiseri* (Table 2). The 8 species are currently being tested against southern pine beetles in pine bolts.

REFERENCES CITED

Fronk, W. D. 1947. The southern pine beetle—its life history. Va. Agric. Exp. Stn. Tech Bull. 108. 12 pp.

Hetrick, L. A. 1940. Some factors in natural control of the southern pine beetle, *Dendroctonus frontalis* Zimm. J. Econ. Entomol. 33: 554–6.

Moser, J. C., and L. M. Roton. 1971. Mites associated with southern pine bark beetles in Allen Parish, Louisiana. Can. Entomol. 103: 1775–98.

Rust, H. J. 1933. Many bark beetles destroyed by predaceous mite. J. Econ. Entomol. 26: 733–34.

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