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Biosystematics of the straw itch mite with special reference to nomenclature and dermatology

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SUMMARY

1. Cross-mating of various populations of *Pyemotes* obtained from laboratory insect cultures demonstrated that the straw itch mite is a single, widely dispersed species, different from *P.ventricosus*, which was probably associated with the furniture beetle.
2. *P.ventricosus* should not be the approved scientific name for the straw itch mite. The correct name for the straw itch mite is *Pyemotes tritici*.
3. Various *Pyemotes* species differ in preferred habitats, hosts, and toxicity to man. Whereas *P.tritici* commonly attacks grain insects and is highly toxic to man, other species attack wood boring insects and may cause little or no irritation. *P.scolyti* and *P.parviscolyti*, which attack bark beetles, cause no observable symptoms.
4. It is suggested that before *Pyemotes* are used as biological control agents against bark beetles, it is important to identify the species correctly.

INTRODUCTION

'Straw itch mite' is the common name for a species of *Pyemotes* (Acarina : Pyemotidae) that can cause severe dermatitis in man. It is a common tramp species and is historically associated with grain insects.

From about 1882, most scientists have applied this common name to *Pyemotes ventricosus* (Newport, 1850), a species originally found infesting laboratory cultures of a bee and its chalcidoid parasite in England. The Entomological Society of America accepts *P.ventricosus* as the approved scientific name for the straw itch mite (Blickenstaff, 1970).

Krczal (1959*a*) postulated that *P.ventricosus* is an uncommon species, possibly restricted to attacks on Hymenoptera. He suggested *Pyemotes tritici* (Lagrèze-Fossat & Montagné, 1851) as the appropriate name for a species that attacks grain insects and produces a rash on human skin.

P.ventricosus has been suggested as a possible biological control agent of *Dendroctonus* bark beetles and other insects (Chamberlin, 1939; Gäbler, 1947; Hensel, 1875; Harman & Kuhlman, 1967; Struble, 1957; Taylor, 1927; Walters & Campbell, 1955). Efforts to use it or any other *Pyemotes* for biological control have been hampered because workers have not known which species they were testing.

This paper describes biosystematic experiments to determine the identity of (1) the straw itch mite, (2) *P.ventricosus*, and (3) *P.tritici*. A companion article (Cross & Moser, 1975) provides taxonomic keys to these and other *Pyemotes* species. The mites were also tested for toxicity to human skin.

MATERIALS AND METHODS

Cultures of the straw itch mite were obtained from three widely separated geographical sources—Savannah, Georgia; Sonora, Mexico; and Honolulu, Hawaii. Since females of this group of *Pyemotes* are not diagnostic (Cross & Moser, 1975), only males of the three populations were compared morphologically. All three appeared identical, but the cross-mating technique of Moser & Roton (1972) was applied to determine if they were the same species.

Savannah cultures

The Savannah material was obtained from the USDA Stored-Product Insects Research and Development Laboratory at Savannah, Georgia, in January and March 1971. Straw itch mites were infesting cultures of the sawtoothed grain beetle *Oryzaephilus surinamensis* (L.), the cowpea weevil *Callosobruchus maculatus* (Fab.), and the rice weevil *Sitophilus oryza* (L.). The fact that all life stages of the three species were attacked indicates that the straw itch mite is not phoretic. Species of the *scolyti* group of *Pyemotes* with obligatory phoresy never attack adults (Moser *et al.*, 1971).

Male mites from the three cultures appeared morphologically identical, but all were cross-mated for verification: ten female mites taken from *O.surinamensis* were crossed with five males each from *C.maculatus* and *S.oryza*; ten females from *C.maculatus* with five males each from *O.surinamensis* and *S.oryza*; and ten females from *S.oryza* with five males each from *O.surinamensis* and *C.maculatus*. Since all 30 matings produced normal progeny, the three populations were of the same species.

The mite progeny were easily reared in the laboratory on brood of *Scolytus multistriatus* (Marsham) by the method of Moser *et al.* (1971). Males assisted in birth of females, which were born head first; copulation released searching behaviour in newly mated females.

Sonora cultures

The material collected near Magdalena, Sonora, Mexico, on 17th and 18th November, 1969, consisted of bolls containing weevil brood from both wild (*Gossypium thurberi* Todaro) and cultivated (*G.hirsutum* L.) cotton. The material was taken to the USDA Boll Weevil Research Laboratory, State College, Mississippi, where it was put in clean but not sterilised rearing cages. On 5th January, 1970, four engorged *Pyemotes* females were seen feeding on a larva of *Habrocytus piercei* Crawford, a pteromalid parasite of the boll weevil. Three weeks later numerous *Pyemotes* were found on all life stages of the weevils, including several adults in glass trap jars. One or more swollen females were under the elytra of all adults (fig. 1). No morphological differences were apparent between this and the Savannah population. Cross-mating confirmed that they were the same species (Table 1).

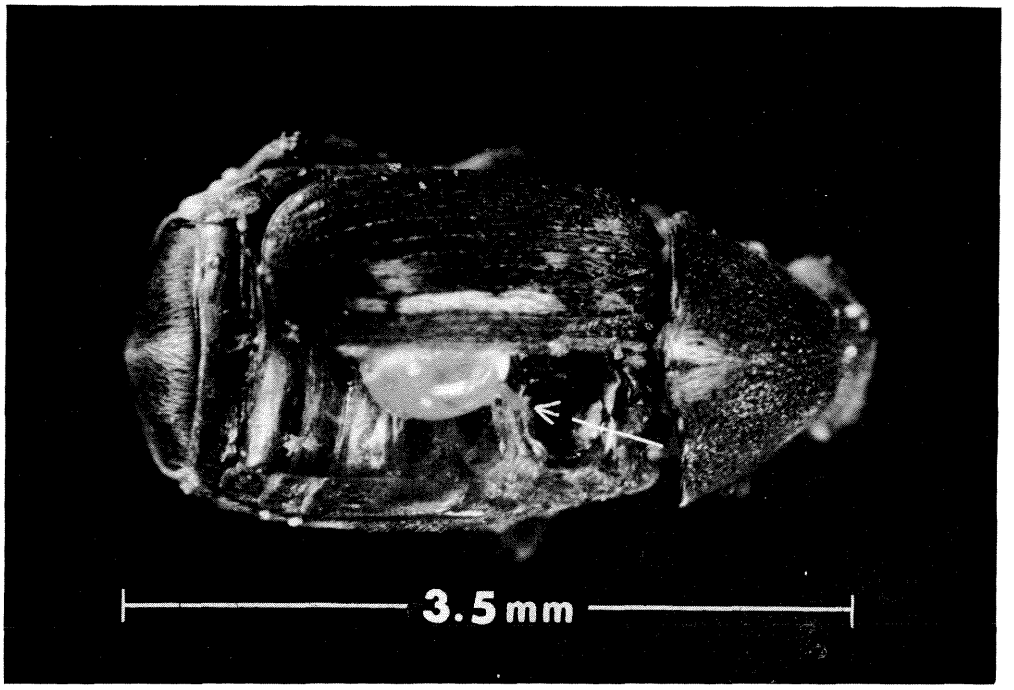

Fig. 1. *Pyemotes* sp., an engorged female of the Savannah population under the elytra of a mature adult of the cowpea weevil. Mouthparts of mite are embedded in abdomen (arrow).

Table 1. F_1 progeny of Savannah and Sonora populations*

Population	Total offspring	% males	Mean offspring ♀	Mean offspring ♂	Standard error ♀	Standard error ♂	Maximum ♀	Maximum ♂	Minimum ♀	Minimum ♂
Savannah	3324	2·8	161·6	4·6	10·45	0·47	281	12	99	2
Sonora	3489	2·3	170·9	3·6	12·93	0·17	293	5	79	2
♂ Sonora × ♀ Savannah	2884	3·3	111·52	3·9	9·36	0·23	211	10	40	2
♂ Savannah × ♀ Sonora	2729	2·6	106·3	2·9	7·70	0·18	221	5	45	2

* From 20 fully swollen mothers fed nine days. Only one mite placed on each beetle larva.

Hawaiian cultures

The Hawaiian material, obtained in June 1972, consisted of six gravid *Pyemotes boylei* females that had been reared in the laboratory on *Neotermes connexus* Snyder, the forest tree termite. *P.boylei* is commonly found in the field on a variety of insects (Vaivanikul & Haramoto, 1969). The *Pyemotes* females used to establish the laboratory culture were collected in the field at the same locality and from the same host (*Arecerus levipennis* Jordan) that Krczal (1959*b*) used for description of the species. There appeared to be

Table 2. F_1 progeny of the Savannah and *boylei* populations*

Population	Total offspring	% males	Mean offspring ♀	Mean offspring ♂	Standard error ♀	Standard error ♂	Maximum ♀	Maximum ♂	Minimum ♀	Minimum ♂
♂ *boylei* × ♀ Savannah	4981	1·75	195·76	3·48	6·40	0·22	250	5	130	1
♂ Savannah × ♀ *boylei*	5274	1·74	207·28	3·68	9·01	0·17	313	5	121	2

* From fully swollen mothers fed nine days. Only one mite placed on each beetle larva.

no morphological differences between *P.boylei* and the other two mite populations, but cross-mating was attempted with the Savannah population. The data in Table 2 show that the two populations are the same species.

NOMENCLATURE

The data strongly suggest that these identical populations are the species commonly known as the straw itch mite, a cosmopolitan species that is found both in association with man and in the field, has a wide host range, and is toxic to humans. The question now arises as to which scientific name should be linked with the straw itch mite—*P.tritici* as Krczal suggests or the currently accepted *P.ventricosus*.

Newport (1850) described *P.ventricosus* from specimens collected near Gravesend, Kent, England. He erected no type specimens and his drawings (1853) did not provide enough detail to distinguish between closely related species. Newport found the mites infesting laboratory cultures of the bee, *Anthophora retusa* (L.) and its chalcidoid parasite *Monodontomerus* sp. five days after they were brought in from the field. Being an acute observer, he would probably have noticed if his bee and chalcidoid immatures were infested at the time of collection. In fact, he stated that on the fifth day the objects were 'little', but by the seventh day the 'vesicles' had become much larger, and the cultures became infested wherever they were placed in the room.

Since *Pyemotes* females are capable of attacking and swelling in a day or less, Newport's statements about the time lapse between the collection of the sample insects and the first observation of mites seem to confirm that the mite was not collected in the field but that it invaded his cultures in the laboratory. In subsequent literature many authors have attributed the presence of *Pyemotes* in laboratory cultures to field rather than laboratory infestations (Hunter & Hinds, 1905; Nyiira, 1971). If Newport's mites were actually collected in the laboratory, the material that he described as *P.ventricosus* may have been a *Pyemotes* that frequently attacks the furniture beetle (*Anobium punctatum* DeGeer) in England (Baker & Harris, 1969). *Pyemotes* mites from *A.punctatum* often become abundant in houses (Scott & Fine, 1967), and Newport's laboratory was a room in his home.

In January 1973, live *Pyemotes* females infesting laboratory cultures of *A.punctatum* were obtained from England. These females were designated as *P.schwerdtfegeri* Krczal (1959*a*) by E.A.Cross, who compared them to Krczal's types. Five males and five females from this population were mated to males and females of the Savannah popula-

tion. The fact that only males were produced confirms morphological evidence that *P.schwerdtfegeri* and the straw itch mite are not the same species.

If Newport's cultures were infested by the species now called *P.schwerdtfegeri*, the name should be considered as a synonym for *P.ventricosus*. This assumption should be tested in England, and Newport's host bee *Anthophora retusa* should be re-investigated for association with a *Pyemotes*. Additional field populations of the furniture beetle should be collected from Kent to confirm if *P.schwerdtfegeri* is a true associate and if other *Pyemotes* species also attack the insect. Cross & Moser (1975) record at least one other species (*Pyemotes anobii* Krczal) associated with *A.punctatum* in Denmark, and the same population is discussed by Meyer (1970). Moser *et al.* (1971) found a *Pyemotes* species (*P.beckeri* Krczal) infesting cultures of another wood boring beetle (*Lyctus planicollis* LeConte) at Gulfport, Mississippi.

These experiments indicate that the name *P.ventricosus* should not be used for the straw itch mite; *P.tritici* is more appropriate. Cross & Moser (1975) resurrected the species, as suggested by Krczal (1959*a*). *P.tritici* is more suitable because both the straw itch mite and the French species are associated with grain insects. *P.ventricosus* was associated with either wood boring beetles or a bee. No types were ever designated for *P.tritici* nor do any of the original specimens remain. A neotype should be selected as soon as a male is found near the type locality in France. *P.boylei* should be a synonym for *P.tritici*, since the *boylei* population was genetically compatible with the Savannah '*tritici*' population. Krczal's type specimens of the Hawaiian *P.boylei* are inappropriate designations for a species from France.

DERMATOLOGY

An important criteria for separating species of *Pyemotes* is their relative toxicity. Most of the literature about the straw itch mite deals with its effects on human skin, but little is known about the toxicity of other mite species. Moser *et al.* (1971) established that two species of the *scolyti* group, *P.scolyti* and *P.parviscolyti*, had little or no venom and took as long as 24 h to paralyse brood of the southern pine beetle, whereas a species of the *ventricosus* group, *P.beckeri* Krczal, was highly toxic and paralysed the host within 5 min.

Experiments were therefore undertaken to compare the toxicity of the species from the 1971 study to that of the three straw itch mite populations and the *P.schwerdtfegeri* from England. Tests were made on humans and on southern pine beetle larvae. Two criteria were used to measure toxicity: (1) time required for females to paralyse mature larvae of the southern pine beetle and (2) the occurrence of dermatitis on the forearm of a human subject after actively feeding females were applied.

The straw itch mite populations and *P.schwerdtfegeri* paralysed the beetle larvae much more quickly (within 5 min after mouthparts were inserted) than the species of the earlier study (Moser *et al.*, 1971), but *P.schwerdtfegeri* seemed much less aggressive than the straw itch mites. To bioassay toxicity to humans, three slightly swollen females that had been feeding on larvae of the southern pine beetle for 24 h were placed under a 9 mm (inside diameter) plastic cap taped to the arm (fig. 2). After four days the cap was removed and the arm appraised for itching, redness, and blisters. The experiment was repeated when little or no dermatitis was observed.

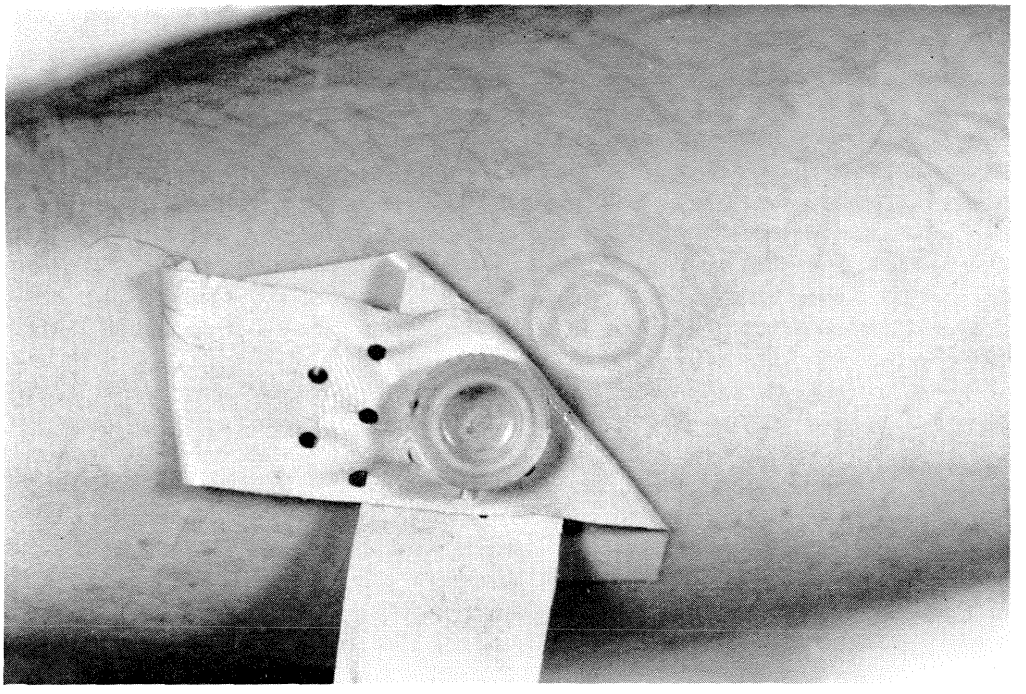

Fig. 2. Bioassay to assess the dermatology of *Pyemotes* spp.

All three populations of the straw itch mite produced dermatitis; the Hawaiian population produced intense symptoms. *P.schwerdtfegeri* caused only mild dermatitis. *P.scolyti* and *P.parviscolyti* were bioassayed twice each, but no symptoms were observed. No deaths have been reported from *Pyemotes* bites, but it is well documented that attacks have caused many victims to be hospitalised. In his discussion of *P.tritici*, Krczal (1959*a*) established that all known cases were associated with stored-products insects. In Georgia, Scott & Fine (1967) recorded the only case of dermatitis where *P.ventricosus* could have been the source of the bite. They traced the *Pyemotes* to a massive infestation of the furniture beetle in floor joists of houses. Unfortunately the preserved specimens were lost, and the specific identity of this population remains unknown. Because the host was *A.punctatum*, *P.ventricosus* might have been involved.

Mite species vary in toxicity to humans as well as insects, and only a species that is relatively safe for man would be a suitable biological control agent against insects such as bark beetles. The *scolyti* group is apparently non-toxic to man and is therefore no threat to forest workers. The straw itch mite is highly toxic to humans, but other members of the *ventricosus* group may be less so.

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Book notices

A field guide to the insects of Britain and northern Europe, by Michael Chinery. Pp. 352, 60 coloured pls., text illustr. London: Collins 1973. £2.95.

This book provides a concise and comprehensive introductory guide to all the orders of European insects. The endpapers illustrate in colour insects representative of each order in northern Europe and are cross referenced to the 60 colour plates, which depict 778 species chosen to show typical features of all major families. The captions to the plates include diagnostic features for the orders and families illustrated. The text begins with a general introduction to insect biology followed by an illustrated key to the insect orders of Europe. The main body of the book comprises a systematic treatment of the orders with information on all aspects of biology. Collecting and preserving methods are given for each order. Illustrated keys are provided to the families of all orders except Hymenoptera, Lepidoptera and Coleoptera, which are keyed to super-family level. Most of the family keys are applicable to the whole of western Europe but some are restricted to British insects. A glossary, a selected bibliography, a list of entomological suppliers in Britain and an index complete the work.