A *Mattesia* Pathogenic for Stored-Product Insects

Jeffrey Lord and Sheri Anderson

GMPRC
GRAIN MARKETING AND PRODUCTION
RESEARCH CENTER

USDA-ARS, Manhattan, Kansas, USA

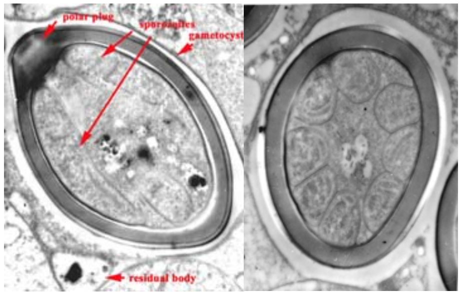

Figure 1. Sporocysts of *Mattesia* nr. *oryzaephili* containing 8 sporozoites. 20,000X

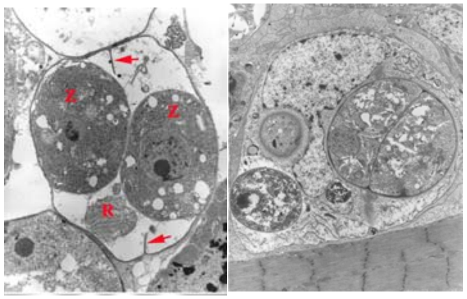

Figure 3. Left: Zygotes (Z) and residium (R) within gametocyst. Note persistent membranes of gamonts (arrows). 1200X . Right: Intracellular development of gamonts in syzygy within gametocysts. 7500X

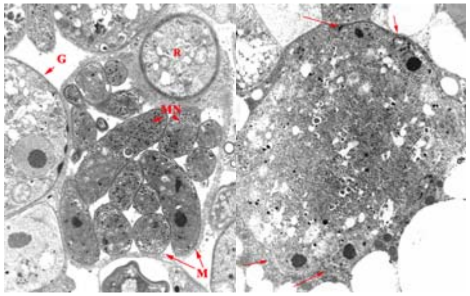

Figure 5. Left: Merozoites (M) in development within a disintegrating cyst with a residium (R). 10,000X G - gametocyst. Right: Peripherally budding micronuclear meronts. 7,400X.

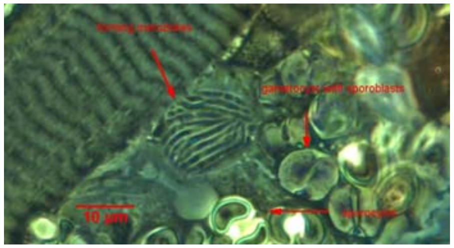

Figure 7. Light micrograph of *Mattesia* sp. in rusty grain beetle fat body showing merozoites formed in a bundle.

A neogregarine parasite of the genus *Mattesia* is a prevalent mortality factor for the rusty grain beetle, *Cryptolestes ferrugineus,* in colonies at GMPRC.   It is infectious for the sawtoothed grain beetle *Oryzaephilus surinamensis* and two Lepidoptera pests of stored products, *Plodia interpunctella* and *Ephestia kuhniella.* It is more virulent for rusty grain beetles than for sawtoothed grain beetles (Fig. 4,6). The parasite has characteristics of two *Mattesia* species of overlapping host range, but does not fit exactly into either of those species as they are described. Like all members of the genus, it produces paired, navicular sporocysts formed within a persistent gametocyst (Fig. 1). Its host range (Table) overlaps with *Mattesia dispora,* which has been reported from *C. ferrugineus*, *P. interpunctella* and *E. kuhniella*, but the infectivity and virulence for *E. kuhniella*, the type host for *M. dispora*, were considerably lower (Fig. 2). *Mattesia oryzaephili*, which has been reported only from European *O. surinamensis*, shares a distinctive formation of bundled merozoites in its development (Fig 5,7). The described *Mattesia* species all undergo two merogonial sequences. The first sequence includes multinuclear cells with nuclei of 1-2 µm that divide into vermiform merozoites with nuclei of similar size. The micronuclear merozoites develop into multinuclear cells that have nuclei of 2-4 µm that, in turn, divide into merozoites with large nuclei. The nuclei of our isolate range from 2 to more than 5 µm. Another anomaly that we have observed is a paucity of macronuclear plasmodial meronts. We have seen the lobed macronuclear meronts similar to those that typify *M. oryzaephili* in *E. kuhniella* but only once in the type host *O. surinamensis* (Fig. 8A) and never in *C. ferrugineus*. This suggests that the development is host dependent. In our isolate, we have not seen any consistent pattern in the occurrence meronts of any particular nuclear size range, except that the vermiform merozoite bundles that correspond to the micronuclear stages of *M. oryzaephili* have been seen only in concurrence with sporogony. This suggests that they may not be the initial merogonial products. In the case of *M. oryzaephili*, the micronuclear merozoites are formed from large micronuclear plasmodia. We have seen such for our parasite only when *E. kuhniella* was the host (Fig. 8B). The macronuclear meronts ultimately form gametocytes. The gametocytes enter into syzygy and form a gametocyst, within which sexual development proceeds.   Each gametocyte produces two gametes and a binucleate residual cell (Fig. 3).   Each zygote resulting from gamete fusion (Fig. 3) develops into a sporocyst with eight sporozoites (Fig. 1).

Our isolate is similar in host range to *M. dispora* and similar in development to *M. oryzaephili.* Its nuclei are larger than those of either of those species. Accordingly, we believe that the neogregarine discussed above has yet to be described.

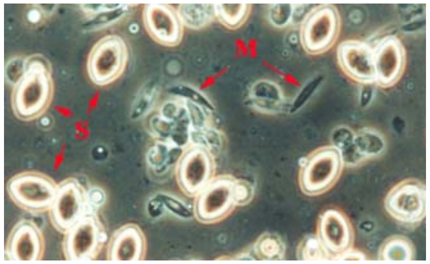

Figure 9. Live spores (S) and merozoites(M) under phase contrast.

Relative susceptibility of various insects to *Mattesia* nr. *oryzaephili*

Susceptible	Infectible	Not infected
Cryptolestes ferrugineus (Col.)	*Rhyzopertha dominica* (Col.)	*Tribolium castaneum* (Col.)
Oryzaephilus surinamensis (Col.)	*Plodia interpunctella* (Lep.)	*Trogoderma variable* (Col.)
Ephestia kuhniella (Lep.)	*Galleria mellonella* (Lep.)	*Zophobas atratus* (Col.)
Cephalonomia tarsalis (Hymen.)		*Manduca sexta* (Lep.)
		Helicoverpa zea (Lep.)
		Aedes aegypti (Diptera)

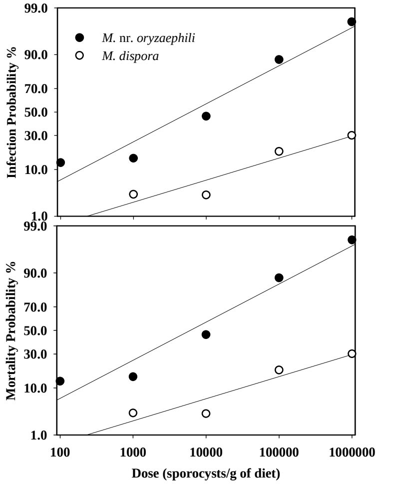

Figure 2. Log-probit regression lines for *Ephestia kuhniella* exposed for 21 days to *Mattesia* spp. in diet.

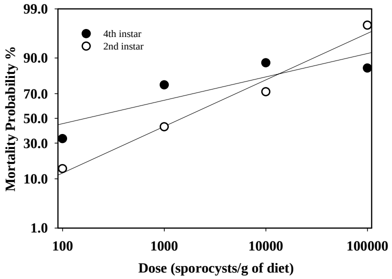

Figure 4. . Log-probit mortality regression lines for *Cryptolestes ferrungineus* larvae exposed for 14 days to *Mattesia* nr. *oryzaephili* in diet.

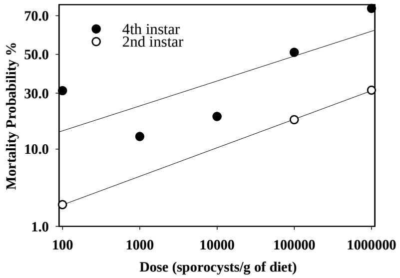

Figure 6. Log-probit mortality lines for *Oryzaephilus surinamensis* exposed for 14 days to *Mattesia* nr.*oryzaephili* in diet.

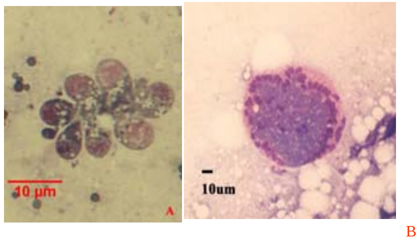

Figure 8. A. Macronuclear meront from *Oryzaephilus surinamensis* larva B. Micronuclear meront budding to merozoites from *Ephestestia kuhniella* larva.