Diseases (Drion Boucias)

Pathogens and symptoms

The entomopathogenic fungi are the only reported microorganisms that have been determined to be causal agents of disease in mole cricket populations. The green muscardine, *Metarhizium anisopliae*, is the predominant fungal pathogen associated with mole crickets. This fungus is characterized by the production of compact colums of green pigmented spores (*conidia*) on the external surface of diseased insects. The white muscardine, *Beauveria bassiana*, a fungus which produces singly-borne white conidia on infected hosts, has been detected on several mole cricket cadavers. Two other entomopathogenic fungi, an *Isaria* species that produces unbranched, thick, white stalk-like structures and a *Sorosporella* species characterized by its brick red mycelium-spore complex, have been identified from nymphal and adult tawny mole crickets, respectively.

To date no protozoan, viral, or bacterial agent has been reported to be a mole cricket pathogen. The reasons for this apparent lack of detection of these causal agents may be the lack of an extensive survey of various geographical populations of mole crickets for the presence of disease, and the fact that mole crickets are soil-inhabiting insects, making it extremely difficult to collect diseased larvae prior to putrification and/or contamination of the cadavers by soil saprophytes. Fungal infections, resulting in the production of a mummified cadaver, are somewhat protected from degradation by the soil microflora.

The relative susceptibility of mole crickets to viral, bacterial, and

protozoan agents isolated from other orthopteran insects has not yet been fully assessed. However, preliminary bioassays with three microsporidian isolates, *Nosema locusta, N. acridophagus*, and *N. cuneatum*, incorporated in food substrate (10^6 spores/gram) demonstrated that neither southern nor tawny mole crickets supported pathogen development.

Activity of *Metarhizium anisopliae* against mole crickets

The majority of recent research on mole cricket pathogens has involved laboratory studies on *Metarhizium anisopliae*. Conidia of this fungus will germinate on the host insect, penetrate through the cuticle via germ tube formation, and multiply in the hemocoel and other tissues, causing eventual mummification of the host. Under proper environmental conditions (that is, high humidity), filaments (*conidiophores*) will emerge through the cuticle, producing large numbers of progeny conidia (Fig. 17) arranged in a typical palisade pattern (Fig. 18). These conidia, being produced in aggregate bundles and having hygroscopic properties, are well adapted for survival in the soil ecosystem. In fact, many *M. anisopliae* strains have been isolated from soil inhabiting insects.

The relative activity of *M. anisopliae* against mole crickets appears to depend upon both the specific strain of *M. anisopliae* assayed and on the particular mole cricket species tested. Various *M. anisopliae* isolates (Table 2) were bioassayed in the laboratory against first instar nymphs of southern and tawny mole crickets (Table 3). The MATR-20, MADA-24, and MAPG-77 strains originally isolated from scarab beetle hosts (Table 2) were highly virulent to both species and produced large numbers of progeny conidia on 100% of the mole cricket cadavers. Other *M. anisopliae* isolates appeared either to be less virulent or were not capable of producing progeny conidia on cadavers. The MC-3057 and MC-3059 strains, originally isolated from tawny mole cricket nymphs, although capable of killing mole crickets under laboratory conditions, did not produce conidia on the resulting cadavers. The production of progeny conidia is considered to be of paramount importance for the establishment of *M. anisopliae* as a long-term microbial agent.

Future research

To date an extensive survey of entomopathogens of mole crickets has not been undertaken. One would expect that this insect, like other arthropods, is susceptible to a wide spectrum of disease agents.

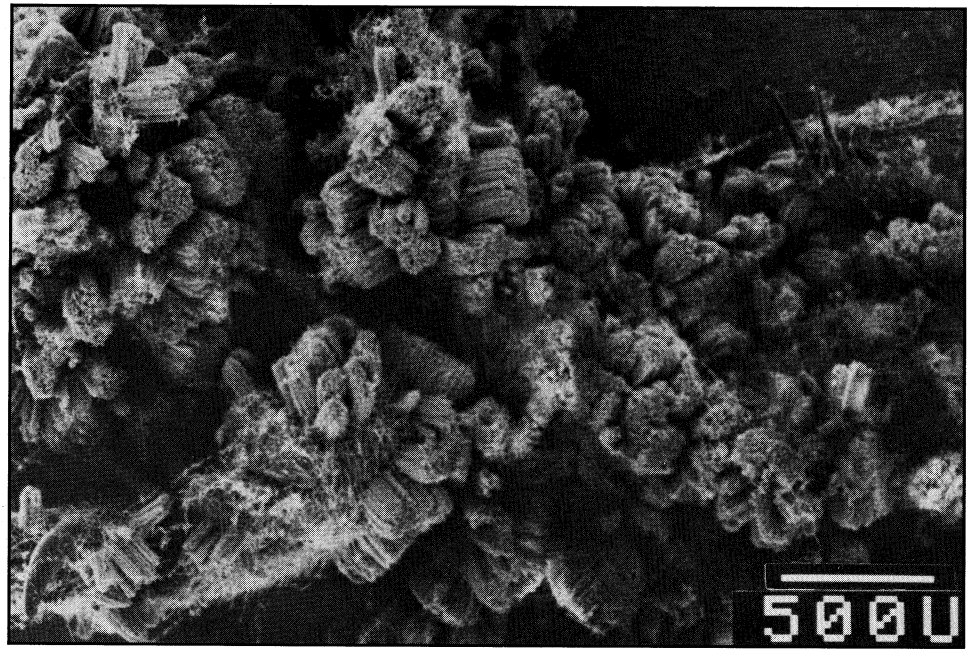

Fig. 17. Scanning electron micrograph of first nymphal instar of cadaver of tawny mole cricket infected with *M. anisopliae* (MADA-31).

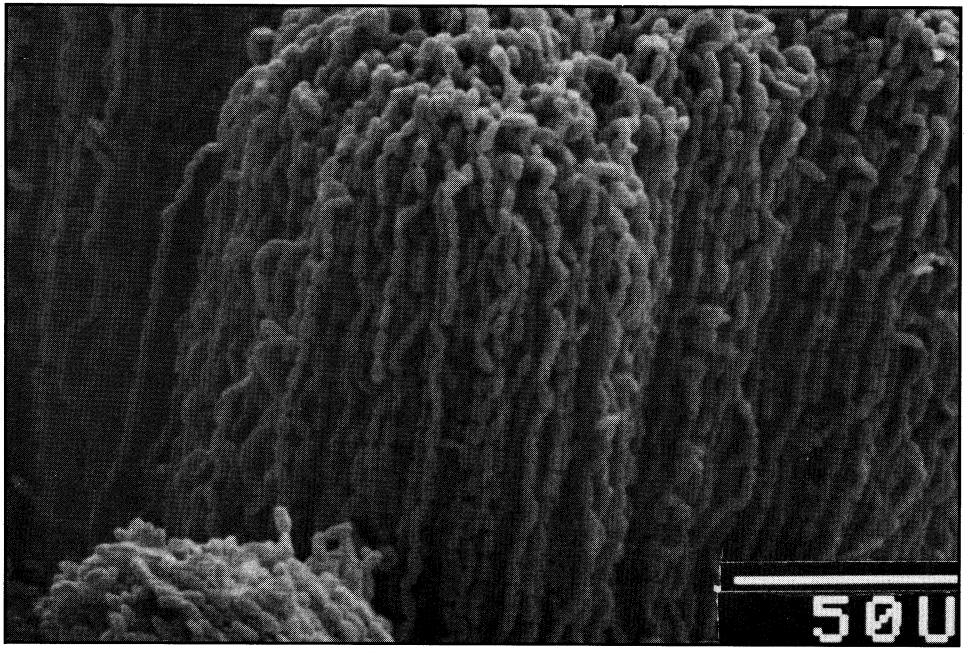

Fig. 18. Scanning electron micrograph of an individual *M. anisopliae* "palisade" produced on cadaver of tawny mole cricket. Note tremendous numbers of conidia within each palisade.

Table 2. Host distribution of the *Metarhizium anisopliae* isolates.

Isolate	Insect host	Location
MATRAW 20	Fuller rose weevil	Bradley Jct., Florida
MADA 24	citrus root weevil	Apopka, Florida
MADA 31	citrus root weevil	Puerto Rico
MAPG 77	Fuller rose weevil	Duetle, Florida
MARB 297	"Rhinoceros beetle"	Apia, West Samoa
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MABP 456	"Brown planthopper"	Irri, Philippines
MADA 472	*Dasygnathus* scarab beetle	Australia
MC-3057	tawny mole cricket	Uruguay (1982)
MC-3059	tawny mole cricket	Uruguay (1982)

For example, *M. anisopliae* is a pathogen that is isolated frequently from mole crickets. This fungus, infectious to a wide spectrum of soil-inhabiting insect pests and amenable to mass production on artificial substrates, is currently being studied for its potential as a microbial control agent. The protocols currently being developed for the production, formulation, and application of *M. anisopliae* against other soil inhabiting and pasture land insect pests are directly applicable to managing mole cricket populations with *M. anisopliae.*

IFAS research has demonstrated that certain strains of this fungus are highly virulent to and are capable of sporulating on southern and tawny mole cricket nymphs. Ideally, one would like to be able to inoculate *M. anisopliae* into mole cricket populations and establish it as long term biological control agent. Current research is underway to further define the relative activity of *M. anisopliae* isolates against mole crickets. Future research will involve small plot evaluations of the "high" virulent isolates against natural populations of mole crickets. This research, aimed at quantifying the virulence, persistence, and spread of this disease under field conditions, is vitally important for developing *M. anisopliae* as an effective microbial control against mole cricket populations.