Contributed paper. Monday, 15:00. **29**

Use of *Beauveria bassiana* (Bals) in the management of larger grain borer, *Prostephanus truncatus* (Horn.) (Coleoptera: Bostrichidae) on stored maize in Tanzania

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Maize (*Zea mays* L.) is important for livelihoods in sub-Saharan Africa as it is the major staple food for the majority of people. In Tanzania 82 % of all farms, 4.5 million farmers in total, produce maize. The greater proportion of the maize (98 %) is produced by resource poor farmers, on an average of 0.8 hectares, in remote villages with poor road networks and post- harvest storage facilities which often make them incur high post-harvest losses. Grain loss in Africa due to insect pests' damage in storage systems is estimated at 20 to 30 %. The larger grain borer (LGB), *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae), a native to meso-America, is known to cause considerable economic losses of up to 48% dry weight. While satisfactory control of LGB has been obtained by use of synthetic pesticides in Tanzania, since its accidental introduction in the late 1970s, their adverse effects on environment, possible development of resistance and residues in food have motivated the search for safer alternative methods. One such strategy is the use of biological control using entomopathogenic fungi such as *Beauveria bassiana* (Bals.-Criv.) Vuill. The current paper presents the findings of an ongoing laboratory study to evaluate the efficacy of a formulation (8.65×10^8 CFU g^{-1} spore powder) of *B. bassiana*, isolate IMI 389521 against unsexed adult LGB and the maize weevil, *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae) in Tanzania.

Contributed paper. Monday, 15:15. **30**

Management of *Frankliniella occidentalis* (Thysanoptera: Thripidae) with granular formulations of entomopathogenic fungi

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Western flower thrips (WFT), *Franklinella occidentalis*, is a major pest of ornamentals. Mycotized millet grains with entomopathogenic fungi applied to soil of potted marigold plants was tested to target pupating thrips. Two experimental fungal isolates, (*Beauveria bassiana* [ARS7060] and *Metarhizium anisopliae* [ERL1171]), were compared with the registered *B. bassiana* strain GHA [commercialized as BotaniGard®] and untreated controls in greenhouse caged trials. Mycotized millet grains were mixed into the upper surface of the potting soil in pots of flowering 'Hero Yellow' marigolds (4 g/pot). One week after application five mated WFT females were released onto each plant (four plants per cage). At 8 wks post-infestation, the mean total number of thrips per plant was 81 and 90% less in the ERL1171 and ARS 7060 treatments, respectively, than in the controls. The mean numbers of thrips per plant for the control and GHA treatments were not significantly different. Plant damage was 60% less on plants treated with the experimental fungi than the control and GHA treatments. At 10 wks post-application, 75-90% of WFT collected from the treatments were infected with the experimental isolates. These results demonstrate that soil applications of entomopathogenic fungi can reduce WFT populations significantly and prevent damage.

SYMPOSIUM 2 (Microsporidia) Monday, 16:30-18:30

Microsporidiology: Advances in Europe

Symposium. Monday, 16:30. **31**

A new intracellular parasite is a missing link between fungi and microsporidia

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Intracellular obligate parasitism results often in extreme adaptations, whose evolutionary history are difficult to understand, because intermediate forms are hardly ever found. Microsporidia belong to an early-diverging clade of fungi, which evolved extreme physiologic and genomic simplification as well as exceptionally high rates of molecular evolution. They possess the smallest eukaryotic genomes with very few introns, short intergenic regions and bacterial-sized ribosomal genes. As observed in other eukaryotic intracellular parasites, mitochondria in microsporidia have degenerated into small double-layered organelles called mitosomes, which have lost the genome and cannot produce ATP anymore. Instead, they steal it from their hosts. We describe the evolutionary history of a gut parasite of the crustacean *Daphnia* with remarkable morphological similarity to the microsporidia, but genomic features of ancient fungi. This parasite, which we formally name *Mitosporidium daphniae* gen. et sp. nov., possesses mitochondria, genes for oxidative phosphorylation and an infection apparatus typical for microsporidia. Phylogenomics places *M. daphniae* together with the microsporidia in a clade that also includes the most ancient fungi, the Cryptomycota. Comparative genomics further supports the missing link status of *M. daphniae* highlighting both its microsporidian and fungal like characteristics, and reveals the intermediate evolutionary steps that led to extreme metabolic simplification. The new species demonstrates that the extreme reduction in energy metabolism genes as well as the loss of introns in microsporidia was preceded by a reduction in the machinery controlling cell cycle, DNA recombination, repair and gene expression that may have contributed to the characteristically accelerated rate of microsporidia evolution..

Symposium. Monday, 17:00. **32**

Parasite takes fly - A Drosophila model of Microsporidia infection

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More than 150 years of Microsporidia research led to a basic understanding of many aspects of microsporidial biology, yet little is known about the genetic basis and molecular mechanisms of the intimate host-parasite relationship that govern Microsporidia infections. Genetic model organisms such as *Drosophila melanogaster* are relevant to the study of human infectious disease as most disease-associated genes have homologues in the fly genome. The knowledge about *D. melanogaster* host defense against obligate intracellular parasites remained, however, particularly patchy for lack of good infection models. A few years ago, a strain of *Tubulinosema ratisbonensis* infested our laboratory fly cultures and led us to model Microsporidia infections in *Drosophila*. Thus, we developed the first infection model of parasitism by a eukaryotic intracellular parasite of *Drosophila*, *T. ratisbonensis*. A unique feature of the *Drosophila* model is that we have developed infection models both in permissive cell lines and in adults. In addition, we have identified several nonpermissive cell lines that will allow us to identify some host defense genes. The ease to move from insights gained at the cellular level from *Drosophila* cell cultures to the whole-organism level using transgenic techniques will allow gaining an in-depth understanding of the biology of Microsporidia in flies, especially when combined with multi-'omics' and functional genomic approaches that we have started to implement. This infection system provides thus novel opportunities to understand the mechanisms underlying microsporidiosis in other invertebrate such as bees and vertebrates hosts and may hopefully lead to novel concepts relevant to parasitology.

Symposium. Monday, 17:30. **33**

White Sea metchnikovellids: morphology, life cycles; potential ancestral features of microsporidia

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Family Metchnikovellidae (Class Rudimicrosporea Sprague 1977) seemingly a basal taxon of Microsporidia, remains understudied. We present data on ultrastructure of two species of metchnikovellids infecting lecudinid gregarines from polychaetes *Pygospio elegans* sampled in the White Sea silt littoral zone. The first species, *Metchnikovella incurvata,* Caullery and Mesnil was described in 1914, the second, *M. spiralis* -- only recently (Sokolova et al., in press). The two species have similar structure of free spores, vary in intracellular development, and produce dissimilar spore sacs (cysts). The cysts of the latter species exhibit unusual morphology: they are limited by a thick electron dense wall, externally ornamented with spirally wound cords of dense material. Basing on comparison of fine morphology and life cycles of metchnikovelllids and other microsporidia, I believe that the following traits could be treated as plesiomorphic among microsporidia: paired nuclei, meiosis, division by internal budding (endoplygeny), short or anisofilar polar filaments, and sequence producing thick-walled environmental cysts. Metchnikovellidean spores possess short polar filaments (manubria) and likely do exploit the mechanism of dispersion via everting the polar tube with the attached sporoplasm, the major synapomorphy of Microsporidia. At the same time metchnikovellidan spores are devoid of most elements of the extrusion apparatus: a polaroplast, posterior vacuole, rigid spore wall, and long polar filament connected with a polar disc. The minimal apparatus of metchnikovellids may allow dissemination only within one cell (autoinvasion), whereas production of thick-walled cysts enables horizontal transmission of spores among hosts. .

Symposium. Monday, 18:00. **34**

Microsporidia: Pathogens of Opportunity

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Kudo published the first comprehensive treatise on the microsporidia "A Biologic and Taxonomic Study of the Microsporidia" in 1924 which was a critical review and systematic treatment of all literature on the microsporidia at the time. It would be more than 50 years before another treatise would be produced, "Biology of Microsporidia" in 1976 and Systematics of the Microsporidia" in 1977 by Vavra and Sprague. This would remain the "go to" authority on the microsporidia until 1999 when "The Microsporidia and Microsporidiosis" was published containing chapters on microsporidia in vertebrate and invertebrate hosts and the first comprehensive review of the growing field of molecular biology and phylogeny of the microsporidia. With the field rapidly advancing in many aspects of basic and molecular biology of the microsporidia it was apparent that a revision and expansion of the previous volume was needed. This effort has resulted in the Microsporidia: Pathogens of Opportunity L.M. Weiss and J., J. Becnel (Eds.) John Wiley & Sons, Oxford, UK with 25 chapters complied by experts including evolutionary and molecular biologists, veterinarians, entomologists, ichthyologists and physicians who study microsporidia. This is intended as a resource for those students and young researchers with an interest in the study of microsporidia as well as expanding the knowledge base of microsporidiologists from different disciplines within the field. An overview of the various chapters will be presented and topics of current relevance highlighted.