[4018] ANALYSING THE IMPACT OF *TERETRIUS NIGRESCENS* ON *PROSTEPHANUS TRUNCATUS* IN MAIZE STORES IN WEST AFRICA

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Since its accidental introduction into East and West Africa in the early 1980's the larger grain borer, *Prostephanus truncatus* (Col.: Bostrichidae), has been expanding its geographical range and is rapidly becoming the most serious pest on stored maize and cassava in the whole sub-Saharan region. In its wake, scientists and extension officers have been releasing the predator *Teretrius* (*Teretriosoma*) *nigrescens* (Col.: Histeridae) as a means of biological control. Based on results obtained in the early 1990's in the initial area of release in Togo and Benin, *T. nigrescens* has been described as a successful case of classical biological control. In this presentation we re-evaluate the impact of *T. nigrescens* based on current research on stored maize in Benin. We present results from maize store surveys, trapping networks, natural habitat studies, and pest and predator population dynamics studies. Simulation modelling was used as a tool to gain an understanding of the underlying biological processes and to generate scenarios of potential biocontrol strategies. The surveys showed that *P. truncatus* still causes regular outbreaks and as a consequence farmers still suffer severe losses to *P. truncatus*, although at a lower rate than before. Hence the introduction of *T. nigrescens* to Africa is not a good example of successful, classical biological control. Simulation modelling supported these findings, demonstrating that the life table characteristics of predator and prey is such that *T. nigrescens* density is unlikely to be high enough to prevent an outbreak of *P. truncatus* from building up in a store. *T. nigrescens* has been shown to lower the overall density of *P. truncatus* after its introduction to a new region, yet farmers are in need for effective control measures against pest outbreaks in their stores. Since *T. nigrescens* is apparently regulating the pest regionally, rather than controlling it locally, it lends itself easily to integration with control options, such as resistant cultivars, entomopathogens, and rational use of botanical and traditional pesticides.

Index terms: Biological control, integrated pest management, simulation modelling, pheromone traps

[4019] BIOLOGICAL CONTROL OF STORED GRAIN INSECTS DEMONSTRATED BY TIME-SERIES ANALYSIS

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This paper reports results from a large-scale test of biological control in stored corn. Pest insects were introduced into 6 1000 bushel grain bins filled with stored corn in the fall of 1993, including the angoumois grain *Sitotroga cerealella*. Parasites were introduced into the grain bins the following winter, including the Angoumois parasite *Pteromalus cerealellae* and populations were monitored for the spring and summer of 1994. The pest Angoumois grain moth was monitored by recapture methods, allowing for reporting of either trap catch or estimated population. Dynamics within the bin were correlated, requiring the use of time-series or repeated measures techniques. Populations were significantly reduced when observing population estimates. The difference could not be seen using raw trap catch numbers.

[4020] NEAR-INFRARED SPECTROSCOPY APPLIED TO DETECTING PARASITOIDS AND HIDDEN INSECT LARVAE, IDENTIFYING COLEOPTERA, AND CHRONOLOGICAL AGE-GRADING

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Near-infrared spectroscopy (NIRS) was used to detect parasitoids in insect-infested wheat kernels or parasitoids in house fly puparia, to detect hidden insects in grain, to identify stored-grain Coleoptera, and to age-grade Diptera. In tests to detect parasitized rice weevils, *Sitophilus oryzae* (L.), in wheat kernels, individual kernels containing immature rice weevils parasitized by *Anisopteromalus calandrae* could be separated from uninfested kernels and kernels that contained unparasitized weevils by using NIRS. When detecting viable parasitoids of the house fly, *Musca domestica* L., results showed that 80-90% of puparia containing parasitoids could be identified correctly. Detection of viable hymenopterous parasitoids within puparia could assist insectaries in delivering known quantities of parasitized puparia for use in biological control of pests and in rapidly determining levels of parasitization in the field. In tests to determine if NIRS could detect internally infested kernels, we collected spectra from single kernels infested with the rice weevil, the lesser grain borer, *Rhyzopertha dominica* (F.), and the Angoumois grain moth, *Sitotroga cerealella* (Olivier). For all 3 species, we were able to differentiate uninfested kernels from infested kernels. Larval size was a factor in the sensitivity of the system, with 3rd and 4th instar rice weevil larvae being detected with 95% confidence. This rapid, non-destructive system could be incorporated into the current grain inspection process and provide the grain industry with quantitative data on internal insect infestations. In tests using NIRS to identify insect species, we collected spectra from 11 species of stored-grain insects. We correctly identified >99% of insects as primary or secondary pests and correctly identified >95% of insects to genus. Evidence indicates that absorption characteristics of cuticular lipids may contribute to the classification of these species. To determine if NIRS could be used to determine the chronological age of insects, we collected spectra from house flies, *M. domestica*, stable flies, *Stomoxys calcitrans* (L.), and face flies, *Musca autumnalis* De Geer. Young and old age groups could readily be differentiated based on differences in their NIR absorption spectra. Accuracy of age classification rates were similar when analyzing NIR spectra obtained from whole flies, fresh heads, dried heads, or ethanol preserved heads. This NIRS procedure is simpler and faster than determining chronological age by measuring pterin levels.

Index terms: beetles, taxonomy, flies, biological control, wheat

[4021] TRICHOGRAMmA AND PARAsITIÇ MITE AS POTENTIAL AGENTS FOR STORED GRAIN INSECT CONTROL IN BRAZIL

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Maize and wheat are two very important cereals grown in Brazil. The annual production is around 36 and 3.5 million tons of maize and wheat, respectively. Maize, is stored under a wide range of technology. At least 40% of the maize production is stored on the husk by the small farmers, in well ventilated wood or wired screen made bins under very natural conditions, i.e., without the use of any insect control method. Consequently, the quantitative grain loss caused by insect is about 15% of the maize stored on the husk. Fumigation with phosphine and application of deltamethrin 0.2% dust are very efficient methods to control insects and preserve grain quality. However, it might not be safe to let farmers with low level of technology to manipulate phosphine tablets or contact insecticide. Therefore, some alternative insect control methods such as natural products from Eucaliptus tree leaves and biological control have been tested. *Sitophilus zeamais* and *Sitotroga cerealella* are the two most important pests of maize grain. For the first insect the *Anisopteromalus calandre* have been tested, although with some difficulties to obtain this parasitoid in large number for a field test. For the second some different species of Trichogramma have been tested on a large scale bin storage, since raising large amount of this parasitoid in not difficult. To raise Trichogramma is more productive to use eggs of *Anagasta kueniella* than *Sitotroga cerealela*. The species *Trichogramma atopovirilia* was more efficient parasitism of eggs than the *Trichogramma pretiosum*, in the laboratory. To control *Sitotroga cerealella* infestation in maize stored in wood bins, the more efficient procedure was to release newly emerged adults late in the afternoon. The release of parasitised eggs was not successful due to intense predation by ants. The efficacy of biological control method using Trichogramma was equivalent to the use of malathion or biphenthrin dust, and it was observed significantly less damage than in the control test. For the control of *Rhyzopertha dominica* in wheat grain the parasitic mite species *Acarophenax lacunatus* has shown great ability to suppress eggs, first instar larvae and adults. Mite densities of at least four individuals per 500 mL jar full of grains containing 50 adults of *R. dominica*, resulted in almost complete suppression of eggs, first instar larvae and adults after 45 days. This same range of mite densities led to reductions of wheat grain loss of 15 and 25% after 45 and 60 days, respectively.

Index terms: Biological control, *Sitophilus zeamais*, *Sitotroga cerealella*, *Rhyzopertha dominica*, parasitoids