

8. Stored product pests

8.1 Official examination of consignments 2001

DPIL examines consignments of grain and other dried plant products intended for export. Based on the results of these examinations, the Plant Directorate of the Ministry of Food, Agriculture and Fisheries issues a phytosanitary certificate for countries requiring such certification. In 2001 a total of 976 consignments were examined: 135 lots of grain, 43 lots of malt, 67 lots of pulses (dried peas and beans), 143 lots of tobacco and 588 consignments of other products. Live insects were found in 1% of the consignments, mostly in lots of grain. The following pests were found: *Sitophilus granarius*, *Oryzaephilus surinamensis*, *Tribolium confusum* and Psocoptera.

L. Stengård Hansen

8.2 Biological control of the Mediterranean flour moth *Ephestia kuehniella*

The aim of this project was to develop biological control methods for *Ephestia kuehniella*, a major pest in Danish flour mills. Two beneficials (the predatory mite *Blattisocius tarsalis* and the parasitoid *Trichogramma turkestanica*) were tested in field trials in 2000, and the data have subsequently been subjected to analysis to determine the effect of the beneficials. The results of these trials are being prepared for publication.

This project has been the direct reason for the engagement of DPIL in the preparation of a proposal for the EU 5th Framework Programme on this subject.

L. Stengård Hansen and K.-M. Vagn Jensen

8.3 Ecological constraints and spatial distributions of an introduced agricultural pest *Prostephanus truncatus* in natural habitats in West Africa

Christian Nansen defended his thesis on this subject on January 30 and received his Ph.D. degree from the Royal Veterinary and Agricultural University, Copenhagen.

C. Nansen and L. Stengård Hansen

8.4 Rapid analysis methods for detection of pests and moulds in stored grain

The potential application of near infrared transmittance spectroscopy (NIT) for detection of mycotoxins and pests in grain was investigated in a one-year study. The results concerning mycotoxins and storage mites were considered promising, and a three-year continuation of the project has been granted, starting on January 1, 2002. The project is supported by the Nordic Industrial Fund and is based on collaboration between research institutes and commercial companies in Denmark, Sweden, Norway and Finland. The Danish Pest Infestation Laboratory is responsible for determining the lower detection limit for mite densities and the correlation between mite density and NIT analysis results. The storage mite *Lepidoglyphus destructor* will be used for the main investigations; other storage mite species will be included.

L. Stengård Hansen and M. Kristensen

8.5 Storage pests in Northern Guinea Savannah of Benin in West-Africa with special reference to the Angoumois grain moth *Sitotroga cerealella*

Rationale

Growth of maize in West Africa has changed considerably within the last 10 to 20 years, e.g. by the introduction of the crop into areas of the Northern Guinea Savannah, greater use of high-yielding crop varieties and the inclusion of insecticides for the control of pest species.

In such areas stored maize is at significant risk of being attacked by pests, such as the moth *Sitotroga cerealella*, the larger grain borer *Prostephanus truncatus* and the maize weevil *Sitophilus zeamais*. Although *S. cerealella* has been relatively well studied on maize in Asia, South and North America, its population dynamics, destructive potential and ecological relations as a pest of maize in West Africa are not well understood. During the last 10 years *P. truncatus* and *S. zeamais* have been studied extensively by the International Institute of Tropical Agriculture (IITA) in Benin. In close collaboration with the Danish Institute of Agricultural sciences (DIAS) this has led to the development of weather-driven demographic simulation models of *P. truncatus*, *S. zeamais* and a biological control organism, *Teretrius nigrescens*. The models have been used successfully to interpret results from field experiments and to indicate aspects of pest ecology and behaviour that need further research. However, the application of the models has not been expanded to the Northern dry and hot regions of Benin where especially *S. cerealella* is supposedly a major pest on stored maize, most likely in competition with *S. zeamais* and *P. truncatus*.

Therefore a two-year project (starting 1st April 2001) was funded by DANIDA with focus on the ecology of key pests of stored maize in the Northern Guinea Savannah of Benin, the Angoumois grain moth, and the economics of maize storage in this environment.

The project includes an investigation of the ecology of *S. cerealella* in the Guinea Savannah, particularly its interaction with *P. truncatus* and *S. zeamais* (their natural enemies included). An African M.Sc. student supervised by IITA and DPIL will be responsible for this part of the project. The interaction between *S. cerealella* and *S. zeamais* will be examined by a Danish M.Sc. student, supervised by DPIL and the University of Copenhagen (see below II).

A population simulation model of *S. cerealella* will be constructed using the paradigm already developed by DIAS and IITA. This part of the project will be based on investigations of life history parameters of *S. cerealella* conducted at the DPIL (see below I) and subsequently combined in the model by DIAS.

H. Skovgård

I: Developmental time and age-specific fecundity of *Sitotroga cerealella* in relation to temperature and humidity

For the experimental trials a culture of *S. cerealella* was established in March 2001 at DPIL from individuals originally obtained from infested maize in Benin. The experiments will all be conducted on a local maize variety imported from Benin. As temperature is the driving factor in most simulation models of arthropod pests, duration of development from the egg stage to adult emergence will be determined at 20, 25, 30 and 35°C, each temperature regime at 40% and 80% relative humidity, respectively.

The onset of the investigations was delayed by an infestation of a parasitic mite (*Pyemotes* sp.) that eradicated the colony. New individuals were obtained from Benin and precautions were taken to minimize the risk of problems in the future. Initial test series at 20 and 30°C have been carried out. The remaining studies on development time and age-specific fecundity will be conducted in 2002 and will finally form the backbone of a simulation sub-model. In addition the model will be validated against “real” data from the field.

H. Skovgård and L. Stengård Hansen

II: Intra- and interspecific competition between *Sitophilus zeamais* and *Sitotroga cerealella*

As part of an M.Sc. study, laboratory experiments are being conducted on the intra- and interspecific competition between two important primary pests on maize, *Sitophilus zeamais* and *Sitotroga cerealella*.

Unlike more traditional competition experiments, the studied species have been placed in an open system allowing for migration between discrete maize samples (patches). Migration may have an influence on the competition ability and is especially interesting for these two species as they have different reproduction strategies: *S. cerealella* only lives for up to two weeks with most of the oviposition taking place within a few days. Because of its superior mobility compared to *S. zeamais*, it should be able to migrate faster and establish populations in new patches. *S. zeamais*, on the other hand, lives for up to 30 weeks with a constant oviposition rate, and with overlapping generations it is likely to become dominant in a patch. At regular intervals maize samples that have been in the set-up for varying periods of time are collected and the number of specimens emerging from the samples is registered. Correlation between the distribution of the species and the age of the maize sample will be examined. The experiment will continue until the end of August 2002.

During a visit to Benin in November 2001 samples of maize cobs were taken in 15 villages. From each store some maize cobs were shelled directly after sampling whereas others were shelled after six weeks of incubation and insects found during shelling were identified. The use of pesticides, harvest date, and temperature, relative humidity and water content of the maize was registered. The material will be analysed to see whether: *i*) the length of the storage period affects the presence of *S. cerealella* and *S. zeamais*, *ii*) the distribution of *S. cerealella* and *S. zeamais* differs within a granary (central/periphery), *iii*) the temperature, the relative humidity and the water contents correlate with the distribution of some species, *iv*) there is a correlation between two or more of the species (primary/secondary pests, natural enemies), *v*) the species composition varies between villages or between granaries. Finally, a list of species found in maize stores will give indications about the species that are important pests and what to look for in future sampling.

M. Nykjær Larsen and H. Skovgård

8.6 Acoustical monitoring of insect pests in stored products

The project with the purpose of developing methods for rapid, reliable and practical acoustic monitoring of larvae of the grain weevil (*Sitophilus granarius*) in grain stores and populations of flour beetles (*Tribolium confusum*) inside building structures or machinery in flour mills was initiated in 2001. During the first year, equipment has been purchased and developed. The instruments can record and analyse sound and vibration signals. The study of the sound produced by the grain weevil larvae has been initiated with focus on the importance of environmental factors such as the state of the grain, temperature, and humidity.

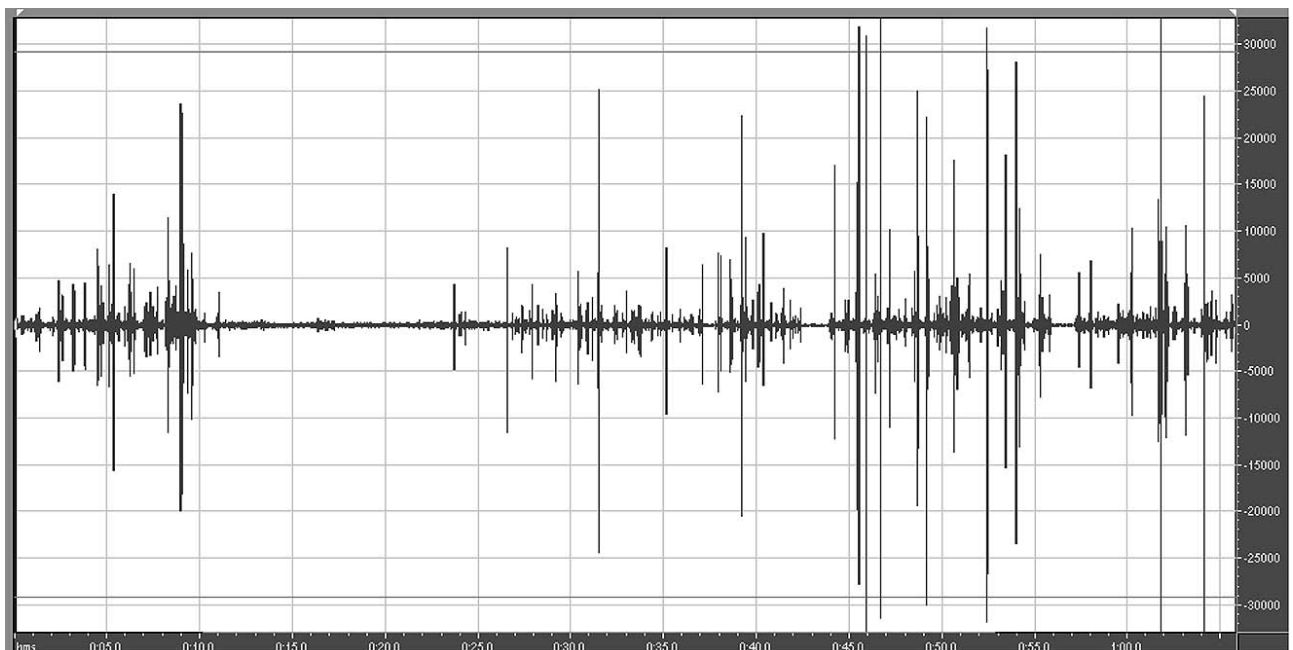


Figure 8a. Diagram showing sound recording of a big grain weevil larva when it gnaws inside wheat

Experiments have been commenced in which sound and video recordings are made simultaneously to correlate the sounds generated by the larva with its mandibular and body movement.

Ole Kilpinen and Karl-Martin Vagn Jensen