

Donahaye, E.J., Navarro, S. and Varnava, A. [Eds.] (1997) Proc. Int. Conf. Controlled Atmosphere and Fumigation in Stored Products, 21–26 April 1996, Printco Ltd., Nicosia, Cyprus, pp. 673–687

SESSION 1: BIOLOGICAL RESPONSES OF ARTHROPODS TO TREATMENTS WITH CA AND/OR FUMIGATION

N. IORDANOU

*Agricultural Research Institute, Ministry of Agriculture,
Natural Recourses and Environment,
P.O. Box 2016, 1516 Nicosia, Cyprus*

Rapporteur's Report

In session 1 a total of ten papers were presented covering in general the results of research carried out in different countries on arthropods' biological responses to treatment with CA's and/or fumigation. The research work presented at the session covered several subjects.

The first paper was "The use of mixed-age cultures in the measurement of response to phosphine." This work was conducted in Australia by E.A. Hyne and R.W. Winks, who also presented the results. They found that the use of mixed-age cultures in laboratory assay tests is an effective approach, and the results of such tests are of high value for field applications. The main advantage of this method is that it is unnecessary to know which is the most tolerant stage of the test insects because all developmental stages are exposed to the toxicant at the same time. For the application of this method it is necessary that all stages, and especially the most tolerant ones, be available in adequate numbers. Dosage rates and exposure periods can be adjusted accordingly until full control of the most tolerant stage is obtained.

The second paper, "On the efficacy of sulfuryl fluoride against stored-product pest moths and beetles," was presented by M. Schöller from Germany. The results of the experimental work on the effectiveness of this chemical against eight species of stored-product pests were presented, and the methodology followed was described. It was concluded that in practice the use of sulfuryl fluoride for stored-product insect control in the future is rather limited due to the high dosage rates required for complete control of the most tolerant stages of insects, the high cost of the material, its limited efficacy and its potential for high levels of residues.

The next paper, "The sensitivity of narcissus flies to methyl bromide," was presented by J. Donahaye. The work was conducted in Israel by the speaker in cooperation with S. Navarro and others. The objective was to find the most suitable dosage rates of methyl bromide (MB) for complete control of both species of narcissus flies without causing any phytotoxic effects on treated narcissus and amaryllis bulbs. The characteristics of both

narcissus flies, the methodology used and the results obtained were presented. It was established from the results that a higher dosage of MB is required to achieve 99% mortality of the large narcissus fly than that required for the small narcissus fly.

The next paper, on the effect of temperature on the response of susceptible and resistant strains of stored-product beetles to phosphine (PH_3), was presented by E.A. Hyne. The work was carried out in Australia by the speaker and R.G. Winks. It was found that although in general insects are more tolerant to PH_3 at low temperatures, this model does not always hold when resistant strains are examined. In their trials, populations of test insects were exposed to constant PH_3 concentrations at temperatures ranging from 15 to 35°C, and the times required for population extinction of susceptible and resistant populations were established. At all concentrations tested, the higher temperatures reduced the exposure period required for complete mortality of the susceptible strains of *Sitophilus* spp. and *Rhyzopertha dominica* and the resistant strains of *S. oryzae*. In contrast, the exposure period for complete control of resistant *R. dominica* was longer at 35°C than at 25°C at all except one of the concentrations tested. It was concluded that insect response to PH_3 at any temperature depends on species resistance to the fumigant, the concentration and the time of exposure.

The next paper, "The toxicity of methylphosphine to susceptible and phosphine-resistant strains of four species of stored-product insects," was presented by M.Q. Chaudhry. The experiment was carried out in the UK by the speaker in cooperation with two other researchers. The objective was to study the insecticidal value of methylphosphine, a close analog of PH_3 , against PH_3 -resistant strains. The mode of action, the uptake rate by susceptible and resistant strains and the mechanisms of resistance to PH_3 were discussed. Higher mortalities were obtained with exposure of four species of PH_3 -resistant strains to methylphosphine than were obtained with susceptible strains. It was noted that it is likely that the methyl group in the fumigant prevents exclusion of the fumigant by the resistance mechanism. It is also possible that the PH_3 -resistance mechanism in resistant strains metabolizes methylphosphine to toxic products.

The next study, "Effects of carbonyl sulfide on *S. granarius*, *Fusarium avenaceum* and *F. culmorum* and with regard to possible corrosion of copper," was presented by Rudy Plarre, USA, in collaboration with C. Reichmuth, Germany. All the life stages of *S. granarius* and of both *Fusarium* species were tested for their susceptibility to different exposure times and concentrations of this fumigant at 20°C and 70% r.h. The dosage rates and exposure periods for complete kill of *S. granarius* were established. Eggs of this beetle were the most tolerant stage to this fumigant, followed by pupae and adults. Larvae were the most susceptible stage. It was also found that dosages lethal to *S. granarius* caused inhibition of *Fusarium* growth during the fumigation period only. In the presence of high relative humidity (r.h.), this fumigant caused copper corrosion. The possibility of future practical use of this fumigant as an alternative to MB was discussed.

The next paper, "The effect of modified atmospheres on the juvenile stages of six grain beetles," was presented by Chris Bell. The study was conducted by the speaker and S.T. Conyers at Slough, UK. The effect of three modified atmospheres on adult

emergence after exposure of juvenile stages to these atmospheres at 15°C and 70% r.h. was assessed. The methodology used and the results obtained were presented. It was found that internal grain feeders like *R. dominica*, *S. granarius* and *S. oryzae* were able to emerge after lengthy exposures to modified atmospheres. Similarly, *T. castaneum* was the most tolerant species. Carbon dioxide (CO₂) was the most effective of the MA's tested, followed by simulated burner gas and nitrogen (N₂).

The paper on the control of the dermestid beetle, *Dermestes maculatus*, was presented by C. Adler, who worked in cooperation with C. Reichmuth and Ana Sa-Fischer from Germany. The objective was to evaluate various controlled atmospheres, under laboratory conditions, against all stages of this very serious dermestid beetle. Atmospheres of pure N₂ or pure CO₂ provided complete control of all stages of the test insect within 48 h. Similar control levels were obtained by using an atmosphere consisting of 98% N₂ and 2% oxygen (O₂). Other combinations and concentrations of CO₂, O₂ and N₂ were also evaluated, and exposure periods required for the control of all stages of the pest were established.

The next paper, on rapid disinfestation through the combination of controlled atmospheres and heat, was presented by C. Adler. He reported that in experiments with *S. granarius*, treatments with CO₂ (60% or 90%) in air, and with 98% N₂ and 2% O₂, took 46 and 72 d, respectively, for complete control of the test insect at 10°C, although the exposure period can be reduced to 8 d at 35°C, or even to 2 d at 40°C. Therefore, controlled atmospheres can be used very effectively at high temperatures for disinfestation of valuable crops or stored products in warm climates.

The last paper dealt with a comparative study of PH₃ resistance levels in stored-grain beetles collected from sealed and unsealed farm storages in Western Australia (WA). The paper, presented by Robert Emery, was an analysis of a large survey carried out in 1991 to evaluate the frequency of resistance of *T. castaneum*, *S. oryzae*, *S. granarius*, *R. dominica* and *O. surinamensis* in storage sites in WA. His findings showed that there is no significant difference between sealed and unsealed storages with respect to frequency of resistant populations although whether they give rise to significantly different levels of resistance remains to be determined.