INFLUENCE OF THERMAL ACCLIMATION ON THE SURVIVAL OF SITOPHILUS GRANARIUS (L.) AND ORYZAEPHILUS SURINAMENSIS (L.) AT LOW TEMPERATURES

by

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ABSTRACT

Low temperatures have been used for many years to control populations of stored-product insects. The aim of aeration was primarily to cool down the grain and then to prevent its deterioration by reducing the number of insects. In Belgium, the mild winters enable insects to survive to the next season. In autumn, the progressive lowering of temperature has an acclimation effect on stored-product insects.

The present study was undertaken to determine the survival at low temperatures of non cold-acclimated and laboratory- and field-cold-acclimated insects. We have chosen to work with the granary weevil Sitophilus granarius (L.) and the saw-toothed grain beetle Oryzaephilus surinamensis (L.). They are the most frequent stored-grain pests in Belgium.

To compare the cold-hardiness of different laboratory cold-acclimated insects, S. granarius and O. surinamensis were placed at nine different cold-acclimation temperature regimes. Insects were kept at 5°C for 2, 4 and 6 weeks or at -5°C for 4, 7 and 14 days. To assess the field-cold-acclimation in autumn and in winter, insects were monthly taken from a bin and transferred to 5°C for 6 weeks. S. granarius adults were more cold-hardy than O. surinamensis, but O. surinamensis adults compensated their cold-sensibility by a great ability to acclimate. S. granarius is able to survive the winter in Belgium because of its cold-hardiness while O. surinamensis survives because of its ability to acclimate to low temperatures.

KEY WORDS: Coleoptera, Sitophilus granarius, Oryzaephilus surinamensis, thermal acclimation, low temperatures.

INTRODUCTION

Low temperatures (aeration and refrigerated aeration) have been used for many years to control populations of stored-product insects (BURGES & BURRELL, 1964; BURRELL & LAUNDON, 1967; BURRELL, 1967; DONAHAYE et al., 1973; HUNTER & TAYLOR, 1980). The aim of aeration is primarily to cool down the grain and to prevent its deterioration by reducing the number
of insects, but not to eliminate the whole population. In Belgium, the mild winters and the gradual falling of temperature by aeration enable insects to survive to the next season. It is for this reason that the present study about the role of the acclimation of stored-product insects has been undertaken.

Physical methods of control such as aeration are indispensable to reduce the resistance to insecticides. Resistance increases the cost of chemical control and the quantity of pesticides in the environment. To evaluate the potential of using low temperatures as physical method of control, we have chosen to work with the granary weevil *Sitophilus granarius* (L.) (Coleoptera: Curculionidae) and the saw-toothed grain beetle *Oryzaephilus surinamensis* (L.) (Coleoptera: Silvanidae). They are the most frequent pests of stored-grains in Belgium. LETELLIER et al. (1994) mentioned that these two species make up more than 70% of insects infesting bins and elevators in Belgian farms.

The present study was undertaken to assess the influence of thermal acclimation on the survival of adult *S. granarius* and *O. surinamensis* at low temperatures.

**MATERIALS AND METHODS**

*Insect cultures*

Cultures of *S. granarius* (strain Av2: Anvers-Belgium) and *O. surinamensis* (strain OPe: Perwez-Belgium) were established with initial densities of about 250 adults per 500 g of wheat grains and 65 g of rolled oats, respectively. Both species were reared at 1 °C and 5% RH.

*Low temperature mortality*

Schedules of mortality were established at 0, 5 and 10°C for *S. granarius* and *O. surinamensis*. 50 non-cold-acclimated insects were placed in ventilated 300 ml jars containing 250 g of wheat for both species. Mortality under each temperature was determined at various times. For each observation there were four replicates. The sexes of the beetles were not determined.

*Field cold acclimation*

One bin containing 300 kg of wheat was infested in May 1994 by 4000 *S. granarius* and 4000 *O. surinamensis*. From October onwards, 200 *S. granarius* and 200 *O. surinamensis* were taken monthly and transferred to 5°C for 6 weeks. After this period, their mortality was observed.