Controlling Cigarette Beetles

KSU professor outlines a method to control beetles with heat.

The cigarette beetle, *Lasioderma serricorne (F.)*, is not as common as red and confused flour beetle in flour mills but is a common pest of feed mills and retail stores. The adults do not feed and are short-lived (23-35 days). Larvae cause most of the damage to stored commodities.

This insect can attack cereal grains, as well as spices. Very little is known about its susceptibility to high temperatures typically used for disinfesting structures.

We evaluated the susceptibility of cigarette beetle eggs, young larvae, old larvae, pupae, and adults to high temperatures during heat treatment (32 hours) at a breakfast cereal manufacturing facility.

Pest Management

Dr. Bhadriraju Subramanyam

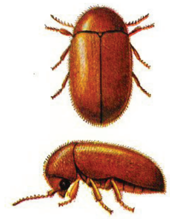
The results were inconclusive, because within the plant eggs survived the heat treatment, when all other stages died.

At other locations, either the adults or the young larvae were found to be less susceptible than the other stages tested.

Therefore, laboratory tests in temperature-controlled growth chambers were designed to determine stage-specific susceptibility of the cigarette beetle.

Laboratory Tests

Eggs, young larvae, old larvae, pupae, and adults of the cigarette beetle were exposed to 46, 50, and 54 degrees Centigrade (120, 122, and 129.2 degrees Fahrenheit).



Cigarette beetle adult. (Courtesy of PestWeb)

Three growth chambers were set to provide a constant temperature of 46, 50, and 54 degrees C and 22% relative humidity. A fourth growth chamber, set at 28 degrees C and 65% humidity served as a control (unheated) treatment.

Individual life stages (eggs, young larvae, old larvae, pupae, and adults) were placed with 100 mg of ground, pelleted feed in square plastic boxes with lids covered with mesh. In a previous experiments, we found ground pelleted feed to be an opti-

Table 1. Average Mortality (± standard error) of Cigarette Beetle Life Stages at the Three Temperatures

Stage	46°C (240 min)	50°C (60 min)	54°C (30 min)
Eggs	5.4 ± 1.1e	36.3 ± 0.7d	79.5 ± 1.5c
Young larvae	16.5 ± 1.0d	56.4 ± 2.3c	97.4 ± 1.0b
Old larvae	48.1 ± 1.4c	79.8 ± 0.7b	100.0 ± 0.0a
Pupae	59.8 ± 1.8b	83.9 ± 1.4b	99.0 ± 0.6b
Adults	68.0 ± 1.5a	96.3 ± 2.3a	100.0 ± 0.0a

Means in a column followed by different letters are significantly different ($P < 0.05$) from one another.

mal diet for rearing this species. In each box, 50 insects at each stage were added.

Boxes of insects were placed in the four growth chambers. Exposure time was 300 minutes at 46 degrees C, 90 minutes at 50 degrees C, and 40 minutes at 54 degrees C.

The tests were repeated three times. All life stages died at 54 degrees C (data not shown), and therefore, in a separate test, the exposure times were changed to 240, 60, and 30 minutes at 46, 50, and 54 degrees C, respectively.

Clear cut susceptibility differences among stages were observed at 46 degrees, but at 50 degrees and 54 degrees C differences among certain stages disappeared because of increased susceptibility (**Table 1**).

However, eggs were always significantly less susceptible when compared with other stages at each of the temperatures. These experiments also confirmed eggs to be the most heat tolerant stage.

Time/Mortality Response of Eggs

Table 1 (above) is based on examining susceptibility at each temperature, after a fixed time period. In a separate test, we wanted to know how fast eggs die at 46, 50, and 54 degrees C. Eggs were exposed to the three temperatures as explained above.

Test boxes at 46 degrees C were removed after 240, 280, 300, 320, 360, 400, 420, 460, 500, and 600 minutes; at 50 degrees C, eggs were exposed for 20, 40, 60, 80, 90, 100, 110, 120, 140, 150, 160, and 180 minutes; and at 54 degrees C, eggs were exposed for 5, 10, 15, 18, 20, 22, 25, 28, 30, and 35 minutes. These experiments were replicated three times.

The survival of eggs to adulthood after exposure at the selected time periods was used to determine mortality. Time/mortality data at each temperature was subjected to regression analysis to determine the time required to kill 99% of the exposed eggs.

Test Times

The time required to kill 99% of the eggs at 46 degrees C was 598 minutes, whereas at 50 degrees C it took 166 minutes and only 38 minutes at 54 degrees C.

> ...eggs of the cigarette beetle are consistently the most heat-tolerant of all stages tested at three high temperatures.

The time to kill 99% of the exposed eggs decreased drastically at 50 and 56 degrees C compared with 46 degrees C.

These findings are consistent with previous data with life stages of red flour beetle, Indianmeal moth, and confused flour beetle where we found that a temperature of 50 degrees C was needed for effective kill of insects.

During heat treatment temperatures should generally be between 50 and 60 degrees C.

Conclusion

In summary, eggs of the cigarette beetle are consistently the most heat tolerant of all stages tested at three high temperatures.

Therefore, eggs should be used as test insects in evaluating heat treatment effectiveness because heat treatment designed to control eggs should be able to control all other life stages.

In our laboratory, we tested the susceptibility of red flour beetle, confused flour beetle, Indianmeal moth, and cigarette beetle life stages to high temperatures.

The young larvae of red flour beetles are heat tolerant, whereas in the confused flour beetle and Indianmeal moth, the old larvae are heat tolerant. In cigarette beetles, the eggs are the most heat-tolerant stage. Among these four species, the young larvae of the red flour beetle require longer exposures at high temperatures when compared with the other species.

Understanding the temperature/time/mortality relationships of insects is important to know minimum temperature and time to which the insects should be exposed for effective control.

Bhadriraju Subramanyam (Subi) is a professor in the Department of Grain Science and Industry at Kansas State University, Manhattan. He can be reached at 785-532-4092 or sbhadrir@ksu.edu. ■