HEAT SUSCEPTIBILITY OF FLOUR BEETLES AS INFLUENCED BY AGE AND SEX

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The application of high temperatures for controlling stored-product insects within commercial grain processing facilities has been successfully used since the early 1900's. With the impending loss of methyl bromide as a tool for controlling insects in processing facilities, high temperature treatments are being reconsidered in many companies. The time required for heat to penetrate into insect harborages may limit the effectiveness of the treatment. A number of studies have reported mortality rates for many temperatures by duration of exposure combinations for different life stages (Fields 1992). However, there are no reports of heat susceptibility of stored-product insects as influenced by insect age or sex. The purpose of this study was to examine the influence of insect age and sex on susceptibility to 50°C for exposure durations up to 100% mortality.

Confused and red flour beetles (*Tribolium confusum*, *T. castaneum*) were reared on whole wheat flour containing 5% torula yeast at 34°C. Female and male adults and pupae of various ages were tested. Confused flour beetles were heat treated at 50°C for 0 to 10 red flour beetles were heated for 0 to 42 minutes. Beetles were heat treated by placing the tubes onto a computer controlled hot block that increased the temperature from 34°C(±0.1°C) to 50°C ±0.1°C) at a rate of 1°C/minute, maintained 50°C for a specified length of time, then returned to the starting temperature. Heat treated beetles were incubated in 8 dram shell vials with flour for 1 week and percent mortality determined. All data were corrected for control mortality and subjected to probit analysis to determine the time necessary for 95% mortality.

For a heat application to effectively disinfest a facility requires high temperatures for a length of time sufficient to kill the most heat tolerant species. Red flour beetles were more tolerant to high temperatures than the confused flour beetles, requiring an average of 17.4 and 29.6 minutes more to cause 95% mortality of pupae and adults, respectively.

Within each species, there was no consistent difference in the amount of time necessary to cause 95% mortality due to the age or sex of adult beetles (Table 1). Confused flour beetle pupae tended to be more heat tolerant than the

adults. However, the reverse was true for the red flour beetles. Because of differences in the heat susceptibility of these species, it is important to know which pest is present so that adequate time is given to control infestations.

Because there is no difference in heat tolerance due to insect sex, we would expect no change in the sex ratio among the surviving beetles after a heat treatment. Additionally, we would expect no change in the age distribution of flour beetles that survive heat treatments. If there are no residual effects caused by exposure to high temperature, then normal population growth and reinfestation would be anticipated.

Future studies will examine the impact of sub-lethal heating on the reproductive potential of confused and red flour beetles in order to quantify any disruption to population growth and development. Additionally, heat tolerance of insects maintained at different temperatures will be examined to determine the effects of acclimation on insect survival.

Table 1. Lethal time (minutes) necessary to kill 95% of male and female confused and red flour beetle pupae and 1, 4, and 8 week old adults.

		adults (age)		
	pupae	1 week	4 weeks	8 weeks
Confused flour beetle				
female	11.6	7.9	7.4	8.2
male	10.7	8.2	11.5	7.7
Red flour beetle				
female	26.7	40.8	39.5	31.2
male	30.4	42.8	34.5	39.5

Reference

Fields, P. G. 1992. The control of stored-product insects and mites with extreme temperatures. J. Stored Prod. Res. 28: 89-118.