Effect of Heat Treatments on Efficacy of Residual Insecticides

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As the production and usage of methyl bromide declines in response to the global restrictions that are being imposed, new management options must be developed to control stored-product insects in milling and processing facilities. Recent research has documented the effectiveness of heat treatments as an alternative to fumigation with methyl bromide, and several major milling and processing companies are using this technology to help control stored-product insects. Temperatures of 120 to 140°F are generally lethal to insects, though the actual time required for complete kill will depend on the interaction of several physical and biological factors.

Two insecticides that are currently being used as general surface treatments are the pyrethroid insecticide cyfluthrin and the insect growth regulator hydroprene. Unlike older organophosphate chemicals, these insecticides do not degrade at high temperatures. Combinations of heat treatments and residual insecticides may be a useful strategy for controlling insects in mills and processing plants. However, information regarding the effects of high temperatures on efficacy of cyfluthrin and hydroprene is limited. Laboratory and simulated field tests were conducted to determine if the temperatures normally attained during a heat treatment would affect insecticidal efficacy of these insecticides.

Concrete disks measuring 9.61 in2 (62 cm2) were treated with cyfluthrin (Tempo WP) at the high label rate of 40 mg [AI] per m2, then heated for either 4, 8 or 16 hours at either 140 or 156°F (45 or 55°C). A separate set of disks were treated but not heated (7 treatments). Adult red flour beetles, *Tribolium castaneum* (Herbst) were exposed for 0.5, 1, and 2 hours without food, then removed and held for 1 week, also without food. Residual bioassays were conducted at biweekly intervals for 6 weeks. Mortality increased with exposure interval and decreased with each residual bioassay, and although mortality varied among the treatments, there were no consistant significant differences among the 7 treatments. Heating did not appear to decrease the residual efficacy of cyfluthrin. Laboratory studies were also conducted in which concrete disks were treated with the label rate of hydroprene (Gentrol, 1.9×10^{-3} mg [AI]/per cm^2), then heated in the same manner as described for cyfluthrin. Late-instar red flour beetles and confused flour beetles *Tribolium confusum* were exposed along with 500 mg of flour, and bioassayed by exposing late-instar larvae on the treated concrete. All treatments produced arrested larval growth and morphological defects in adults, and there were no significant differences among the 7 treatments.

Several field trials were conducted by placing disks treated with varying rates of cyfluthrin inside flour mills that were being heated, and removing these disks after different time intervals. A separate set of treated dishes were placed in unheated rooms, and bioassays were conducted with red flour beetles as described above. Results usually showed either increased mortality or no difference on heated dishes versus unheated dishes, except for one field trial in which temperatures attained during the heat treatment were 150 to 160°F.

Results of these laboratory and field tests indicate the potential for using combination treatments of heat and insecticides to disinfest specific target areas with a processing facility. This approach would be applicable for pest management programs in which insect sampling and trapping data are used to develop infestation profiles within a facility.