SUSCEPTIBILITY OF FLOUR BEETLE LIFE STAGES TO PYRETHRIN AEROSOL

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Aerosol insecticides are being used as methyl bromide alternative for control of flour beetles in milling and processing facilities. A number of studies have been conducted recently to assess efficacy of aerosol insecticides on adults. However, in many field situations adults comprise only a small percentage of the total population. We conducted a series of tests to assess efficacy of pyrethrin on different life stages of the red flour beetle *Tribolium castaneum* (Herbst), and the confused flour beetle, *Tribolium confusum* Jacqueline duVal, through indirect and direct exposure methods. These studies were done inside experimental sheds measuring approximately 42 m^3 (1,500 ft^3). Beetle life stages were treated with the aerosol and then placed on unexposed flour or the insects were untreated and placed on exposed flour. Flour and insects were also exposed together to the aerosol. When the insects were directly treated the adults were killed and the immature stages generally failed to emerge as adults. When the flour and insects were treated together or the untreated insects were mixed with treated flour adult mortality was reduced and more of the immature stages were able to successfully emerge as adults. Also, the confused flour beetle was the more tolerant of the two species, so further tests were conducted with just this species. Results emphasize the importance of cleaning and sanitation, because direct exposure with pyrethrin aerosol will exert more control over a resident population than indirect exposure.

In expanded studies confused flour beetle larvae were exposed to the aerosol in dishes containing 100 mg or 1, 5, and 10 g of flour. As the amount of flour increased more immature were able to emerge as adults. Efficacy of pyrethrin aerosol on adults and pupae of *T. confusum* was also evaluated at open and obstructed positions underneath wooden boxes inside the sheds, at target temperatures of 22, 27 and 32 °C. These boxes were 1 m long, open at one end, and closed at the other end. Mortality of adults and pupae of *T. confusum* was greater in the open area compared to the concealed areas underneath the boxes. Aerosol dispersion decreased as the distance from the box opening increased, which led to a corresponding increase in adult recovery from knockdown and adult emergence from exposed pupae. Pyrethrin aerosol can control *Tribolium spp* and is not affected by temperatures in the range evaluated in this study. However, it may not provide control in concealed areas such as in flour residues, underneath pallets, and in the open spaces underneath and between milling equipment.

Initial research shows that when aerosols are applied in a flour mill, dispersion and resulting efficacy is greatly reduced in areas such as the corners of a room, positions near support beams, and underneath pieces of equipment and machinery. Therefore, sanitation and cleaning should be emphasized prior to aerosol application, especially in those areas that would obstruct or hinder aerosol

dispersion. There are few recent studies that have evaluated the dispersion of aerosols in field sites, and how different aerosol application systems are affected by the presence of obstructions that are commonly encountered in a flour mill. Also, the actual size of the aerosol particles may affect efficacy. Under a new grant funded by the Methyl Bromide Transitions Program, "Evaluation of New Strategies and Tactics to Manage Insect Pests in Mills", these factors will be further evaluated in field sites.