RED FLOUR BEETLE SURVIVAL AFTER TIMED EXPOSURES ON CYFLUTHRIN-TREATED CONCRETE

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The red flour beetle, Tribolium castaneum (Herbst.), is a common world-wide insect pest of food storage facilities. Residual insecticidal sprays are often applied to floors and walls to control this species and other stored-product beetles. However, these residual treatments may not eradicate a resident population because the infestations may be in protected harborages, and the insects may spend a comparatively short time foraging on a treated surface.

Currently the pyrethroid cyfluthrin is the primary insecticide used in the United States as a residual substrate treatment. The wettable powder (WP) formulation is more effective on concrete than the emulsifiable concentrate (EC), and the label for the WP specifies application at either a low rate of 9.5 grams or a high rate of 19.0 grams per 1,000 ft^2. The purpose of this study was to determine survival of red flour beetles exposed for short time intervals on treated concrete, evaluate residual control at both label rates, and for both rates, estimate the residual week when survival exceeds a threshold of 10%.

Concrete treatment panels were constructed by pouring ready-mix concrete into 1 ft^2 plywood forms. Four panels were treated with cyfluthrin WP at the low label rate and four panels were treated with cyfluthrin at the high label rate. Untreated controls were included for both rates. Four plexiglass rings were placed on each panel, and 10 adult red flour beetles were exposed in each ring for intervals of 0.5, 1, 2, and 4 hours. After the exposure interval was completed, beetles were removed from the concrete and classified as active, knocked down, or immobile. The beetles were then transferred to Petri dishes that did not contain food, held in the laboratory for one week, and again classified as active, knocked down, or immobile. Beetles that were active after I week were considered to have survived the treatment. Residual bioassays were conducted at selected post-treatment intervals for 24 weeks. Statistical analyses were conducted and regression equations were fit to the 1-week data to estimate the time when survival exceeded 10%.

At the low application rate of 9.5 g per 1,000 ft^2, knockdown generally increased as exposure interval increased. Survival initially decreased as exposure interval increased, but by week 6, beetles exposed for 0.5 and 2 hours began to recover from knockdown and were active and mobile after the I -week holding period. By week 18, survival was 60 to 100% at all exposure intervals. The residual time at which survival exceeded 10% was 2.3, 3.3, 5.6, and 3.2 weeks for the 0.5,1, 2,and 4-hour exposure intervals.

Knockdown also increased as exposure interval increased at the high application rate of 19.0 g per 1,000 ft^2, but there was little survival at any exposure interval until week 18. Survival at the 2 and 4-hour exposure intervals was less than 10% for the entire 24 weeks. The residual time at which survival exceeded 10% was 8.5 and 14.3 weeks for the 0.5 and I hour exposures. The time period in which survival was below 10% was 3 to 10 times longer for beetles exposed to the high label rate as compared to the low label rate, depending on the exposure interval.

The actual time that insects are exposed on a treated surface is an important consideration for dosage mortality studies involving stored-product beetles. Resident infestations are often present in cracks, wall spaces, and other hidden sites, and beetles will be exposed on a treated surface only when they are foraging for food. Insecticides that are used as surface treatments should either quickly knock down and kill exposed insects so that they cannot escape the treated surface, or have delayed toxicity so that the insect is ultimately affected by the residues after it leaves the treated surface. This would be especially important for spot treatments or targeted applications to specific areas, because the total treated area would be small in comparison to the untreated areas within a warehouse, mill, or food storage facility. Quick knockdown and kill would also be important in cases where the infestation is severe and must be immediately controlled.

In conclusion, the high label rate for cyfluthrin was much more effective than the low rate when red flour beetles were exposed for short time intervals. Three applications at the low rate would be required to achieve the same level of residual control as one application at the high rate. Infestations in food warehouses are usually in protected sites where insects have limited exposure to a treated surface, therefore the high label rate may be necessary to control beetle pests in food warehouses.