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A Crack-and-Crevice Application Assay for Selected Insecticides to Control the Ham Mite, *Tyrophagus putrescentiae* (Schrank)[1]

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The ham mite, *Tyrophagus putrescentiae* (Schrank), is a serious pest for a variety of pet foods, stored products, and processed foods (Aygun et al. 2007, J. Food Eng. 78: 878–881; Thind and Clarke 2001, Exp. Appl. Acarol. 25: 203–215; USDA ARS [1991] Insect and Mite Pests in Food, USDA Agri. Handbk. No. 655, Washington, DC). These mites are particularly damaging to cheeses, hams, and sausages, and may lead to closure of production facilities for fumigation with methyl bromide to eliminate the mites (Rentfrow et al. 2008, Univ. Kentucky Ext. Serv. Tech. Rep. No. 867). Currently, there is intense interest in finding safe and efficacious insecticides (acaricides) to control these pests in food production facilities. Most previous work has involved surface sprays with insecticidal products (Abbar et al. 2016, J. Pest Sci. doi: 10.1007/s10340-016-0766-3; Freitag and Kells 2013, J. Econ. Entomol. 106: 1920–1926). An integrated approach to managing urban arthropod pests includes crack-and-crevice applications of insecticides because they reduce the total amount of pesticide used and also reduce release of pesticides into the environment (Bonnefoy et al. 2008, Public Health Significance of Urban Pests, WHO, Geneva, Switzerland). The purpose of this study was to develop an assay and evaluate five commercially available insecticides as crack-and-crevice sprays against the ham mite.

This insecticide testing was performed in the Department of Biochemistry, Molecular Biology, Entomology, and Plant Pathology, Mississippi State University, between 5 January and 8 February 2016. Mites used for these tests were from a colony housed at the Mississippi State University Department of Food Sciences which was originally obtained from Kansas State University courtesy of Dr. Thomas

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Table 1. Insecticides used in the study.

Product	% Active ingredients	How applied
PT Alpine® Pressurized Insecticide (BASF Corp.)	0.5% dinotefuran	Per label as crack-and-crevice using injection tip along crack at rate of approximately 0.3 m/sec
CB-80 Insecticide (FMC Corp)	0.5% pyrethrins 4.0% piperonyl butoxide	Per label for crack-and-crevice using injection tip along crack at rate of approximately 0.3 m/sec
Invader (FMC Corp.)	1.0% propoxur	Per label, direct spray for crack-and-crevice using injection tip at rate of approximately 0.3 m/sec
PT Phantom® II Pressurized Insecticide (BASF Corp.)	Chlorfenapyr 0.5%	Per label as crack-and-crevice using injection tip along crack at rate of approximately 0.3 m/sec
Transport Mikron (FMC Corp.)	5.0% acetamiprid 6.0% bifenthrin	Per label (9.4 cc/L or 1.25 oz/gal)** crack-and-crevice using nozzle set on pin-stream along each crack at rate of approximately 0.3 m/sec

** We also evaluated 4.7 cc/L (0.635 oz/gallon), but this is not a commercial use rate.

Phillips. Five insecticide products were included in this study (one with two dilutions) (Table 1). All were mixed and applied per label directions. For the crack-and-crevice assay, 7.6 × 15.2-cm ceramic tiles were chosen and painted gloss black on the undersides and "glued" together—bottom to bottom—with modeling clay on three sides (Fig. 1A–C). This allowed easy "reopening" for observation. For the treatments, one side remained open with a crack approximately 2 mm in diameter leading back into crevices between the tiles (Fig. 1B). To expose mites to the various treatments, we placed approximately 20 mites between each set of tiles,

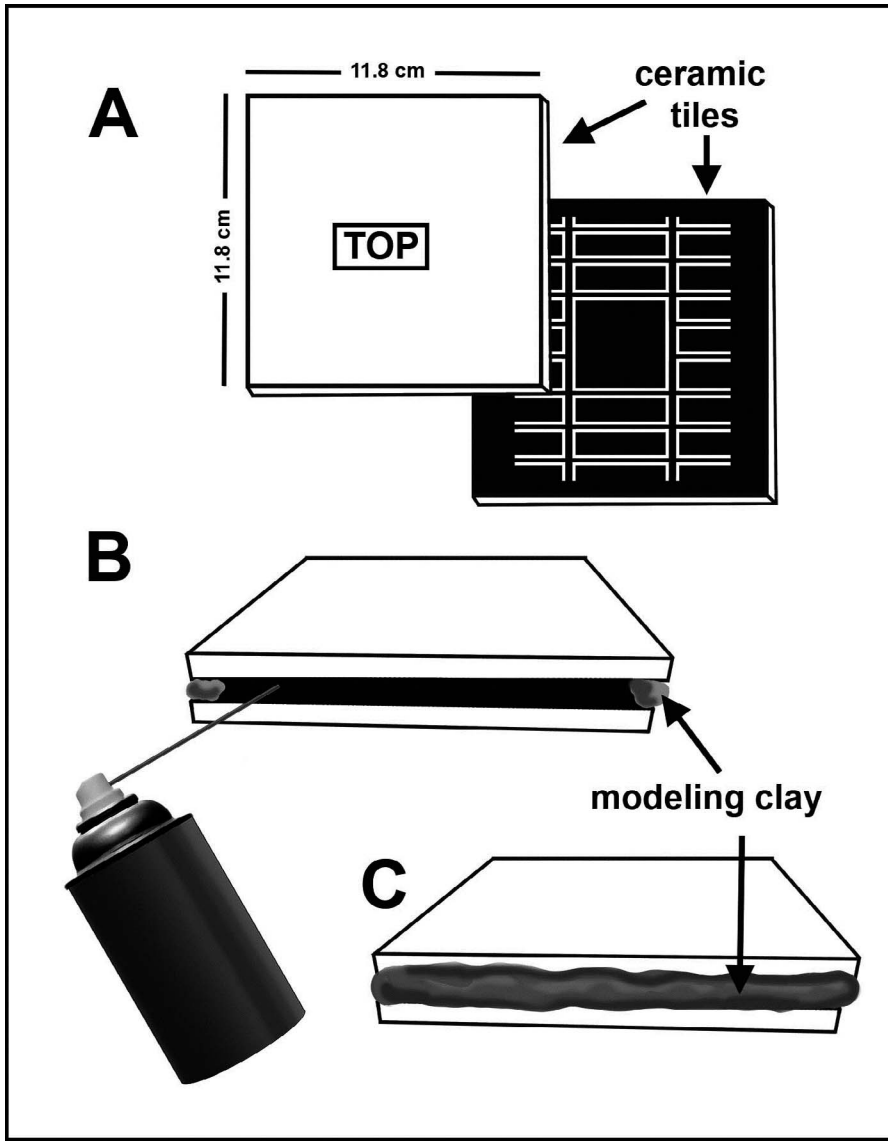

Fig. 1. Assay created to test insecticides by crack-and-crevice application using ceramic tiles and modeling clay to seal the cracks (line drawing courtesy Joe MacGown, Mississippi State University).

"glued" them together, waited 5 min, then applied each product into the open side (cracks) (Fig. 1B). The 2-mm crack was then closed with modeling clay (Fig. 1C). Aerosol products were applied with an injector tip; products which were not aerosols were mixed and applied with new, clean, plastic-pump spray bottles set on "pin

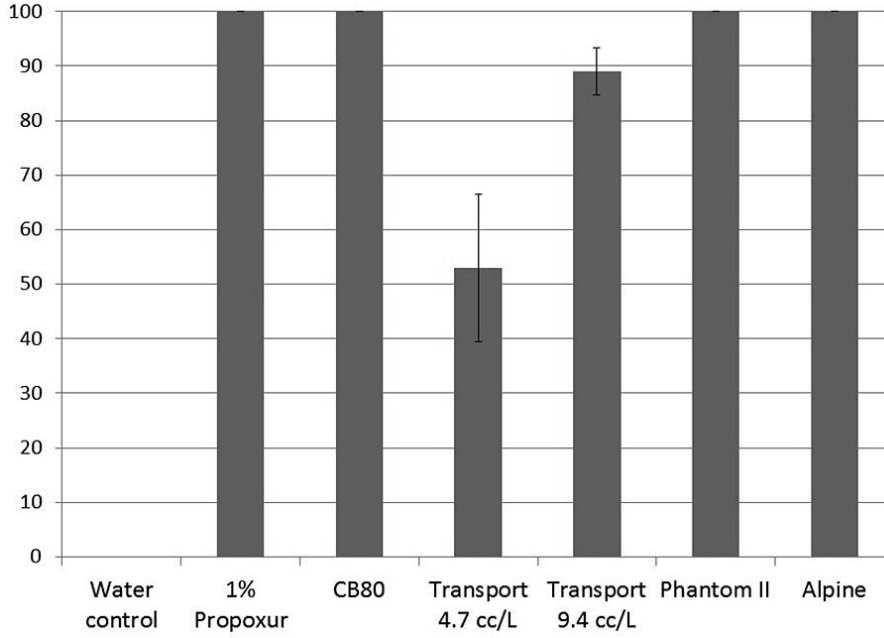

Fig. 2. Percent control of ham mites, crack-and-crevice spray, 1 h posttreatment (SE calculated using Excel Statistical Analysis Package, Microsoft Corporation, 2010).

stream" for crack-and-crevice. After 1 h, tiles were separated and numbers of living mites were counted. In these determinations, a mite was considered dead when there was no leg movement.

Overall, the crack-and-crevice applications were successful against mold mites (Fig. 2). All products tested with the injection-tip performed better than did Transport® (4.7 cc/L), but this may have been due to lack of penetration of product since Transport was applied using a spray bottle with the nozzle set on "pin stream." The Transport 9.4 cc/L rate did, however, yield approximately 90% control. This new assay proved inexpensive and was easy to perform, and should be useful for testing other products by crack-and-crevice against small insects or arachnids.