blast from the Past

PMPs currently lack effective and efficient insecticides for controlling bed bugs. Recent testing by the University of Kentucky suggests Nuvan Prostrips may fill an important niche in the industry's arsenal

By Michael F. Potter, Kenneth F. Haynes, Mark Goodman, Shelby Stamper and Sarah Sams • Contributors

In early 2009, AMVAC Chemical Corp. received a supplemental registration to control bed bugs with its dichlorvos-containing Nuvan Prostrips™. The decision by the U.S. Environmental Protection Agency to grant such an approval ranks as one of the greatest comeback stories for a pesticide. Discovered in the 1950s, dichlorvos (DDVP) was first marketed in 1960 by the Shell Chemical Co. under the trade name Vapona. In 1963, the company incorporated the volatile organophosphate into vinyl strips (popularly known as Shell No-Pest Strips) to extend its residual life. Senior members of the pest management industry will also recall applying dichlorvos in liquid and aerosol form to provide rapid knockdown of flies, cockroaches, fleas, lice — and bed bugs.

In the late-1980s, the EPA began a long and controversial review of the potential health risks from dichlorvos exposure. After 20 years and millions of dollars worth of testing (funded largely by AMVAC), the agency issued a final determination that dichlorvos could remain on the market with certain restrictions. Since then, the manufacturer has been relabeling and marketing its dichlorvos-based products, with bed bugs a prime target.

While much is known about the performance of available sprays and dusts, no studies have been published on the effects of Nuvan Prostrips on bed bugs that have entered items that are hard to treat conventionally. This article presents our initial findings and discusses how the strips can be used to help manage infestations.

Study Methods

To evaluate the ability of Nuvan Prostrips to control bed bugs in various household items, bugs and eggs were confined in six different objects — suitcases, shoes, framed pictures, books, clock radios and computer keyboards. Such items, which are listed on the product label, are representative of those that are hard to treat using conventional methods.

Bed bugs used in the study originated from an apartment in Cincinnati and were previously found to be highly resistant to pyrethroid insecticides. Groups of adults, nymphs or eggs were confined in small containers made of 1/2-inch diameter PVC pipe cut to 3/8-inch length and sealed at both ends with organza screening. A total of 324 such containers were used in the experiment, each housing 10 eggs, 5 nymphs or 5 adults (2,160 bed bugs total). These were then placed inside the various objects in locations where bed bugs might hide, such as beneath the nylon liner of a suitcase, inside shoes, and behind picture frames. To simulate bed bugs hiding in book bindings, the pages and spine were hollowed out to provide space for the containers housing the insects. Clock radios and computer keyboards were dismantled so that the small bug containers could be placed inside. Then the electronic equipment was reassembled.s

Objects provisioned with bed bugs were then placed inside 5.5 cubic foot, sealed cages constructed of PVC pipe covered with a 4 mil clear plastic bag. One 0.56 ounce full-size Nuvan Prostrip was hung inside each cage suspended on a

wire from the top.

To study the effect of duration of exposure, one third of the bed bug containers from each object were removed after 3, 7 and 14 days of continuous exposure to the vapors from the strip. Four cages (replicates), each housing the six different objects, were treated with a Nuvan strip while two additional cages were left untreated as controls. Cages were held in a heated room averaging 72.5 °F, with a range 70 to 75 °F. Mortality of bugs and eggs was assessed 0, one and seven days following each period of exposure to allow for any delayed mortality or hatching of eggs.

Results

Bed bug mortality resulting from exposure to Nuvan Prostrips is summarized in Figure 1. High levels of kill were achieved in most objects, especially after longer periods of exposure to the strips. In suitcases, for example, all nymphs and adults were killed when exposed for seven days. To kill 100 percent of the eggs, however, 14 days of exposure to the dichlorvos strip was required. Two weeks exposure to the Nuvan Prostrips was also needed to kill 100 percent of adults, nymphs and eggs located behind picture frames and inside clock radios.

Eliminating bed bugs inside shoes, books and computer keyboards was more difficult, and some survived even after 14 days of continuous exposure. Books proved to be the most difficult object to de-infest in this experiment which likely was the result of where the insects were placed. It is likely the bed bugs would have succumbed more quickly to the dichlorvos vapors if they had been present along the outer seams and edges of the books, as is often observed with field infestations. The same might be true when treating shoes since bed bugs often hide in crevices on the outside of footwear, rather than inside where the bed bugs were placed for purposes of this experiment.

After exposure ended, there was little lingering effect of exposure on survivors. In other words, few insects that survived the treatment died subsequently. In respect to killing the eggs, many did not hatch when exposed to the vapors. Other times the newly-formed nymphs failed to emerge successfully, or died soon after hatching. Previous tests by our group showed that Nuvan Prostrips were efficacious against pyrethroid susceptible and resistant bed-bug strains — an encouraging finding also seen in the present study.

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Practical Considerations

Our findings show that confined vapors produced by Nuvan Prostrips penetrate and kill bed bugs and their eggs in a variety of hidden locations. Consequently, the product can be useful when treating various household items, especially those that are troublesome to treat conventionally. Besides their usual hiding places, bed bugs can infest electronics (televisions, telephones, radios, computers), appliances, books, boxes, files, CDs, suitcases, wall hangings, footwear, carrying bags, musical instruments, knick knacks and collectables. Such items often can't be fully inspected, treated with insecticide sprays or dusts, laundered, run through a dryer or treated with steam. Firms that do not fumigate or perform heat treatments have even fewer management options. Even when the chances of having bed bugs in such items is low, companies and customers may still want to ensure that they are bed bug free, and Nuvan Prostrips can help accomplish this.

Travelers concerned about transporting bed bugs home in their suitcases can lessen the risk by placing a Nuvan Prostrip inside their empty suitcase or in a large plastic bag with the suitcase open for about a week. If bed bugs were present, this probably would be more reliable than inspecting and/or vacuuming out the suitcase as advised on many internet sites since bed bugs can easily crawl beneath the inner liner or otherwise be missed.

With bed bugs, complete control of all life stages is important. Otherwise, any surviving bed bugs could immediately cause re-infestation. Results of this study indicate that confinement of infested items for the shorter 48 to 72 hour durations listed on the product label may be insufficient to kill 100% of adults and nymphs. The Supplemental Use Directions for bed bugs further state that if eggs are suspected to be present, items should be confined and treated for seven days. In our view, if adults and nymphs are present, it is prudent to assume there also may be eggs, especially with items that are hard to fully inspect. Based on our findings, seven days will not always be sufficient to kill all the eggs wherever they may be. Depending on conditions, two weeks or longer may be necessary for the vapors to penetrate and kill all bed bug life stages. If bugs and eggs are in exposed locations,

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Bed bugs, in this case nymphs, were confined in small mesh covered containers.

The experiment required more than 300 containers, each housing 5 adults, 5 nymphs or 10 eggs.

Bed bug containers were placed under the nylon liner of a suitcase and inside shoes, clock radios, computer keyboards and books.

Treatment cages were provisioned with six different objects containing bed bugs and the Nuvan Prostrip was then suspended from the top of the cage.

Cages were sealed and bed bugs were exposed to the vapors for 3, 7 or 14 days.

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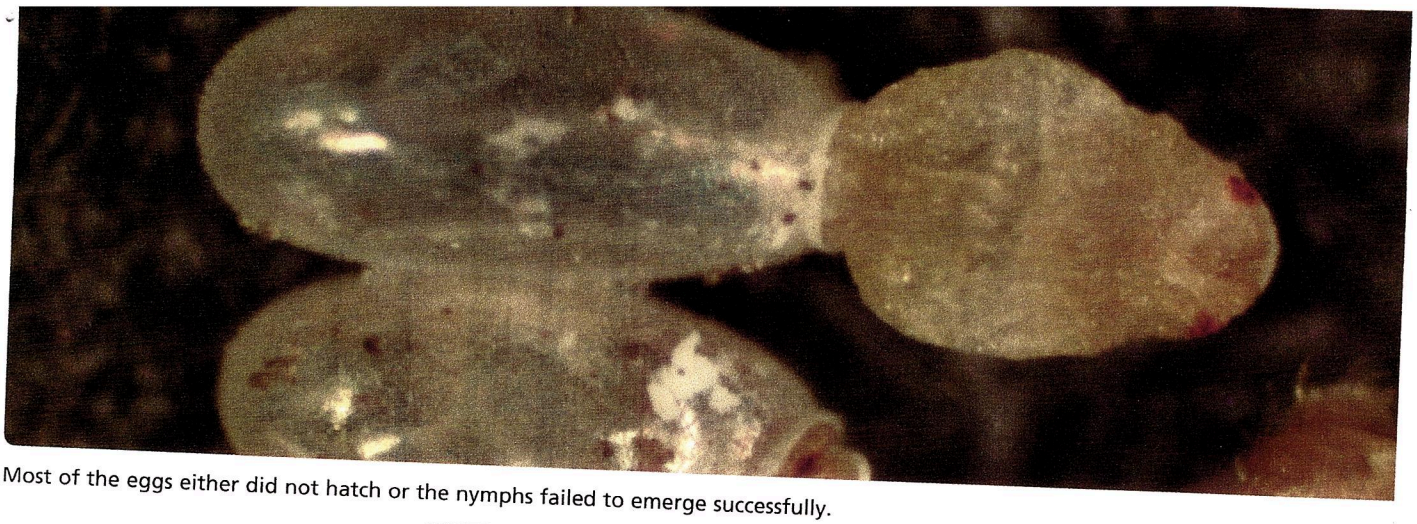
they will die more quickly. Faster results can also be achieved at higher temperatures which help to disperse the vapors (recall that the temperature in our experiment averaged 72.5 °F, which is fairly typical in occupied dwellings.

As noted on the product label, packing loosely and providing as much air space as possible around items will enhance exposure to the vapors. Forcing as many items as possible into plastic bags with a Nuvan strip sandwiched at the top or bottom is less likely to be effective regardless of how long the items are held. Dichlorvos is more volatile than most insecticides, but does not have the fast penetrating qualities of such fumigants as sulfluryl fluoride (Vikane). Some companies have successfully treated sofas and other large items by constructing framing under poly sheeting and treating with the appropriate number of strips for the space being treated (note that two sizes of Nuvan strips are available).

Sealed items should be labeled indicating that a pesticide treatment is in progress and should not be disturbed by unauthorized persons. Product instructions additionally state that after treatment, items should be removed in a well ventilated area and aired out for a period of not less than two hours. According to the manufacturer,



Most of the eggs either did not hatch or the nymphs failed to emerge successfully.

this can be done indoors (such as inside an apartment), although aerating outdoors, or in a garage or basement, is advised when practical. Care should be taken to avoid direct contact of the Nuvan Prostrip with the surface of items being treated. A convenient way to accomplish this is to place the Prostrip within the cage provided. No matter of what consumers may do with retail versions of the product, Nuvan Prostrips should not be used to treat bed bugs in any area that is occupied for more than four hours per day.

Final Thoughts

Nuvan Prostrips can be a valuable tool for killing bed bugs and their eggs on or in objects that are hard to treat using conventional methods. The conditions that we tested were challenging because the insects were confined in small containers placed inside the test objects. Under field conditions live bed bugs could leave these items and be more exposed to the lethal vapors. Nonetheless, people's belongings provide many microenvironments in which bed bugs can hide, and some will be harder for the vapors to reach than others. Increased exposure time and confining objects in a manner that allows maximum penetration of vapors to all surfaces will help ensure a successful outcome. Faster results with dichlorvos on

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bed bugs are expected in the near future when the manufacturer introduces liquid and aerosol formulations. PMP

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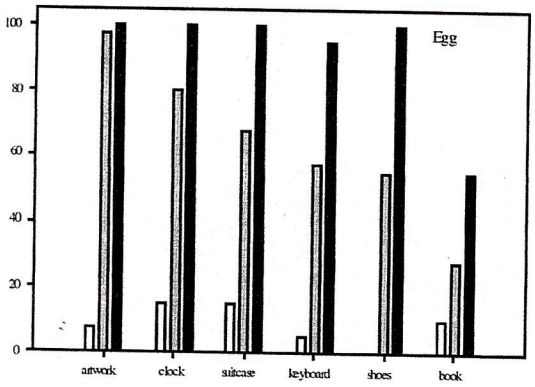

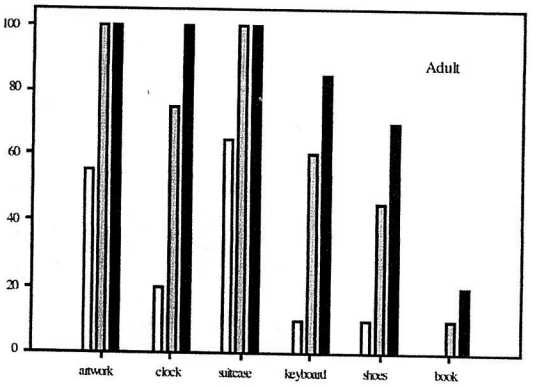

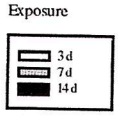

Figure 1. Mortality of bed bug eggs, nymphs and adults in various objects 3, 7 and 14 days with Nuvan Prostrips. Percentages reflect final mortality at the end of the experiment (i.e. 7 days after exposure ended).