

Research Article

Laboratory Assays with Various Insecticides against Bed Bugs Taken from a Poultry House in Mississippi

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Abstract: Bed bugs may be severe pests in poultry houses, especially broiler breeder houses, leading to stress, anemia, and lowered egg production in the birds. Insecticides are important tools in managing these pests; however, efficacy data for many commercially available products is lacking. This laboratory study evaluated 8 insecticides (5 traditional residual products and 3 natural or “green” products) against bed bugs collected from a poultry house in Mississippi during August 2014. Invader[®] (propoxur), Ravap[®] (rabon and vapon), and Cimexa[®] (silica gel) killed 100% of bed bugs when exposed to ceramic tiles sprayed with the products 24 hours earlier. Interestingly, Ravap[®] (rabon/vapon combination) is labeled for use inside poultry houses even with birds present. Cimexa[®] is a non-toxic powder which desiccates bugs. Tempo[®] and Suspend[®] (pyrethroids) killed 73% and 93% of bed bugs, respectively, indicating that the poultry house field strain used in this study was likely not pyrethroid resistant. The organophosphate, Durashield[®] (chlorpyrifos), also showed good efficacy against poultry bed bugs, killing 96% of the bugs in this test, but cannot be used in the presence of birds. Alpine dust[®] (diatomaceous earth/dinotefuran) and EcoExempt[®] (phenethyl propionate/soybean oil/clove oil), both considered natural products, only killed about half of the exposed bed bugs in this study (46% and 45% control, respectively).

Keywords: Bed bugs, insecticides, poultry

Introduction

Bed bugs, *Cimex lectularius*, Linnaeus (Hemiptera: Cimicidae) are small, flat, oval-shaped wingless insects that feed on the blood of warm-blooded animals such as humans, bats, birds, and pets (Usinger 1966, Ryckman et al. 1981, Thomas et al. 2004, Reinhardt and Siva-Jothy 2007, Little and West 2008). They have traditionally been common in the developing world, and especially in areas of extreme poverty and crowding. These blood-sucking parasites have recently increased in both numbers and geographic distribution (Potter 2006, Goddard and de Shazo 2008), and are increasingly being reported inside U.S. hotel rooms, dorms, and apartments (Cleary and Buchanan 2004, Gangloff-Kauffmann et al. 2006, Anderson and Leffler 2008, Goddard 2011). Bed bugs can survive long periods without feeding, and when their preferred human hosts are absent they may take a blood meal from any warm-blooded animal, including poultry (Kahn et al. 2008, Steelman et al. 2009). Poultry houses, and especially broiler breeder houses, may be affected, leading to stress, anemia, and lowered egg production in the birds (Steeleman et

al. 2009, Cater et al. 2011). This study was initiated to examine the effectiveness of several commercially available insecticides against bed bugs collected from a broiler breeder poultry house.

Methods

Eight commercially-available insecticides were used in this study (Table 1) and are all appropriately labeled for bed bug control except for Invader[®] (propoxur, a carbamate), which was included as a standard known to kill 100% of bed bugs (Goddard 2013). EcoExempt[®], Alpine dust[®], and Cimexa[®] are all considered low-toxicity, natural or green products. Durashield[®] and Ravap[®] are older organophosphate insecticides, while Tempo[®] and Suspend[®] are commonly used pyrethroid products. All bed bugs used in this study were field-caught from a poultry house on August 6, 2014, located near Noxapater, MS, and were used within two weeks of capture. Substrates used in this study were 4.5 cm square ceramic tiles (Lowe's Inc.) which were sprayed/dusted exactly as per pesticide label directions. They were then flipped over and the other side treated (bed bugs will invariably crawl to the underside of a substrate). Tiles were allowed to dry for 45 minutes and then placed in standard 80mm x 15mm petri dishes (Fisher Scientific Co.). Bed bugs were then placed directly on the tiles in the dishes, 20 per dish, and allowed to remain on the treated substrates for 24 hour, after which they were moved to clean plates with filter paper for another 24 hours before observation. There were 20 bed bugs used per petri dish x 9 treatments (8 treatments and 1 water control), 3 replicates of each treatment yielding a total of 540 bed bugs tested. Bed bugs were examined for mortality only – those with no leg movement were considered dead. Results were recorded and entered into an Excel spreadsheet for analysis.

Results and Discussion

All control bed bugs were alive at the time of observation, allowing for good comparisons with the treatment groups (Figure 1). Tempo[®] and Suspend[®] (the pyrethroids) killed 73% and 93% of bed bugs, respectively, indicating that the poultry house field strain used in this study was likely not pyrethroid resistant, a finding similar to that published earlier (Goddard 2013). NOTE: many populations of human dwelling-inhabiting bed bugs are highly resistant to pyrethroids (Romero et al. 2007, Gordon et al. 2014), but none of those found in Mississippi chicken houses have thus far shown any resistance (JG, unpublished data). Invader[®] killed 100% of bed bugs, which was not unexpected, but so did Ravap[®] and Cimexa[®]. The Ravap[®] result is good news in that the product is labeled for use inside poultry houses even with birds present. Other products like Durashield[®] and Tempo[®] require birds to be absent. Cimexa[®] is a non-toxic silica gel which dries out the bugs, and has recently been shown to hold great promise in bed bug control (Potter et al. 2014). The organophosphate, Durashield[®], also showed good efficacy against poultry bed bugs, killing 96% of the bugs in this test, but as mentioned, can only be used when birds are not present. Alpine dust[®] and EcoExempt[®], both considered natural products, only killed about half of the exposed bed bugs in this study (46% and 45% control, respectively).

Our results, although a preliminary screening only, indicate that several insecticide tools are available for poultry growers and technicians to manage bed bug populations. However, it must be noted that, although certain insecticides have been demonstrated as effective against bed bugs in a laboratory setting, eliminating or even just managing bed bug infestations in an ongoing poultry operation is extremely difficult. No one product is a magic bullet and successful bed bug control involves an integrated approach using both chemical and non-chemical methodologies.

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Table 1. Insecticides used in the study.

Product	% Active ingredients	How applied
Alpine dust (BASF Corp.)	Diatomaceous earth and Dinotefuran 0.25%	0.32 oz per 10 ft ²
Suspend SC (Bayer Corp.)	Deltamethrin 4.75%	1.5 oz per gallon, 1 gallon per 1,000 ft ²
Cimexa (Rockwell Labs)	100% Amorphous silica gel	2 oz per 100 ft ²
Tempo SC Ultra (Bayer Corp.)	B-Cyfluthrin 11.8%	0.54 fl oz per gallon; general surface application, fan spray
Durashield (BASF Corp.)	Chlorpyrifos 20.0%	5 fl oz per gallon, 1 gal per 1,000 ft ²
Invader (FMC Corp.)	Propoxur 1.0%	Per label, “crawling pests, 1 sec spray per spot”
Ravap E.C. (Bayer Corp.)	Rabon 23.0%; Vapona 5.3%	5 fl oz per gallon, 1 gal per 150 ft ²
EcoExempt D (EcoSmart Technologies)	2-Phenethyl propionate 4.5%; Soybean oil 2.0%; Clove oil 1.75%	2 oz per 100 ft ²

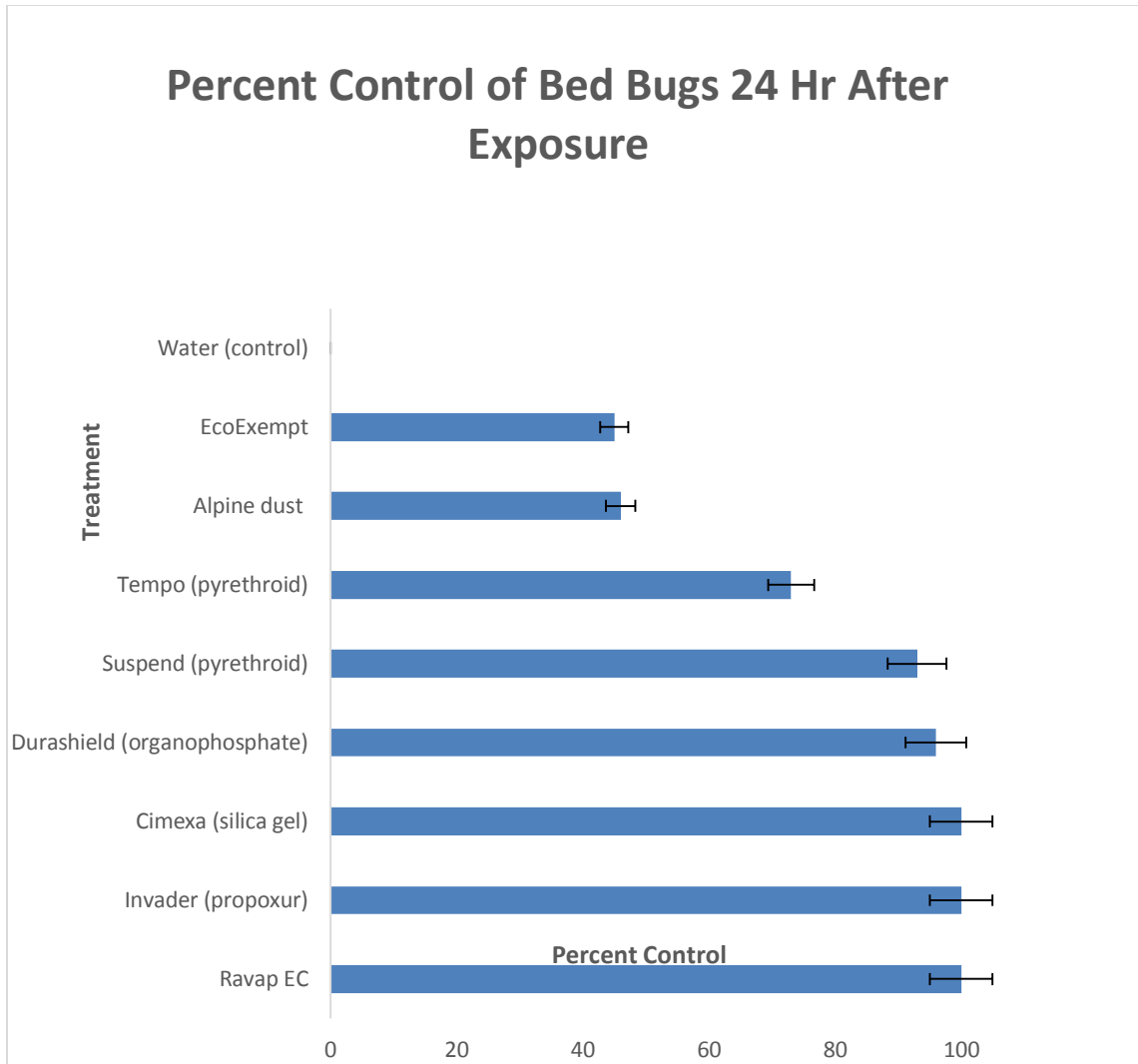


Figure 1. Effectiveness of insecticides tested against a strain of bed bugs removed from a poultry house.