

Dr. Thomas Phillips, Professor of Entomology at Kansas State University (KSU), and Dr. Ellen Thoms, field scientist at Douglas Products, and Dr. Joe DeMark, field scientist at Dow AgroSciences, collaborated to develop a protocol for re-evaluating dosage rate of Vikane® fumigant for control of the common bed bug, *Cimex lectularius*. This is the first protocol evaluating a fumigant for efficacy in controlling bed bugs to be reviewed by the US Environmental Protection Agency (EPA).

Trials were conducted by Dr. Phillips (Figure 4) in his research laboratory at KSU, Manhattan, Kansas. Bed bugs of the Harlan strain were obtained by overnight delivery from two laboratories known for bed bug research. Fumigation trials were conducted at two temperatures: 77°F and 59°F.

To obtain eggs, mated, blood-fed adult bed bug females were held in the KSU laboratory under optimum conditions on colored paper in ventilated vials (Figure 1). Each day, the bed bugs were transferred to new vials with new paper for up to six days. This provided eggs of a known age for fumigant trials. The colored paper allowed small cream-white eggs to be easily counted and observed for hatching (Figure 2).

Dose-Response Trials: Bed bug eggs in ventilated glass vials were wrapped in mattress pad bedding (Figure 3) to simulate household conditions. Vikane was measured using a gas-tight syringe and introduced into each 1-gallon glass fumigation chamber. Five to seven dosages were evaluated per temperature. Each dosage (= chamber fumigation) was replicated four times

with at least 32 eggs per replicate. More than 2800 bed bug eggs were tested. The concentration of Vikane in each chamber was measured 30 minutes after fumigant introduction and before the termination of the 24-hour exposure period using quantitative Gas Chromatography/Mass Spectrometry (Figure 4). These fumigant concentrations were used to calculate the accumulated dosage of Vikane for each chamber. Egg mortality was evaluated daily for at least one week following fumigation until all eggs, fumigated and untreated, had hatched or collapsed, indicating death of the embryo. Delayed mortality of any hatched nymphs was also determined for at least one week following fumigation.

Confirmatory Trials: The dosage required for complete egg control was converted into a Fumiguide™-monitored dosage for confirmatory testing of all bed bug life stages. This dosage was 1.9-fold the drywood termite dosage rate at 77°F and 59°F. Each bed bug life stage — adults, late instar nymphs (at least 13 of each per replicate) and eggs (at least 79 per replicate) — was prepared in separate glass vials covered with mattress pad bedding. More than 600 bed bug adults and nymphs and 1600 eggs were tested for confirmatory trials. There were at least five replicates (chambers) of the dosage rate for each temperature. Fumigations were conducted as described above for a 24-hour exposure period. All bed bug adults and nymphs were dead immediately following aeration of the chambers. Egg mortality was evaluated daily for at least one week as described above. Confirmatory trials verified the following. All bed bugs, including eggs, died when fumigated with 1.9-fold the drywood termite dosage rate at 77°F and 59°F. At dosages below 1.9-fold, a small percentage of bed bug eggs survived and healthy nymphs hatched from these eggs at both temperatures.



Figure 1



Figure 2



Figure 3



Figure 4