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Final Report

Evaluations of Averzion with Arizona Bark Scorpions

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Report title: **Evaluations of Averzion with Arizona Bark Scorpions**

Test Species: *Centruroides sculpturatus*

Date of trial initiation: October 1, 2021

Location of Test Site (physical address): New Mexico State University, Las Cruces, NM

Date of Report Completion: October 22, 2021

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1.0 STUDY TITLE

Evaluations of Averzion with Arizona Bark Scorpions

2.0 OBJECTIVES

- Evaluate the efficacy of Averzion as a paint to prevent scorpion climbing
- Evaluate the efficacy of insecticide formulations on Arizona bark scorpions when applied on Averzion-treated surfaces

3.0 MATERIAL AND METHODS

3.1 Scorpions

The scorpions used in the trials were provided by 95 Applications

3.2 Experiments

3.2.1 Experiment 1: *Evaluation of responses of scorpions to areas treated with Averzion only*

This trial consisted in setting a concrete slab (12 × 12 inches) whose left side was treated with Averzion while the right side remained untreated (Fig. 1). Three coats of Averzion was applied on the surface to achieve a smooth surface. The pait was allowed to dry overnight before use. On the Averzion-treated side, a folder paper harborage of 3 inch × 4 inch was positioned on the center of the treated area as a way to encouage harborage-seeking behavior in scorpions. Ten were scorpions were released and their position was recorded every five min (Fig. 1).

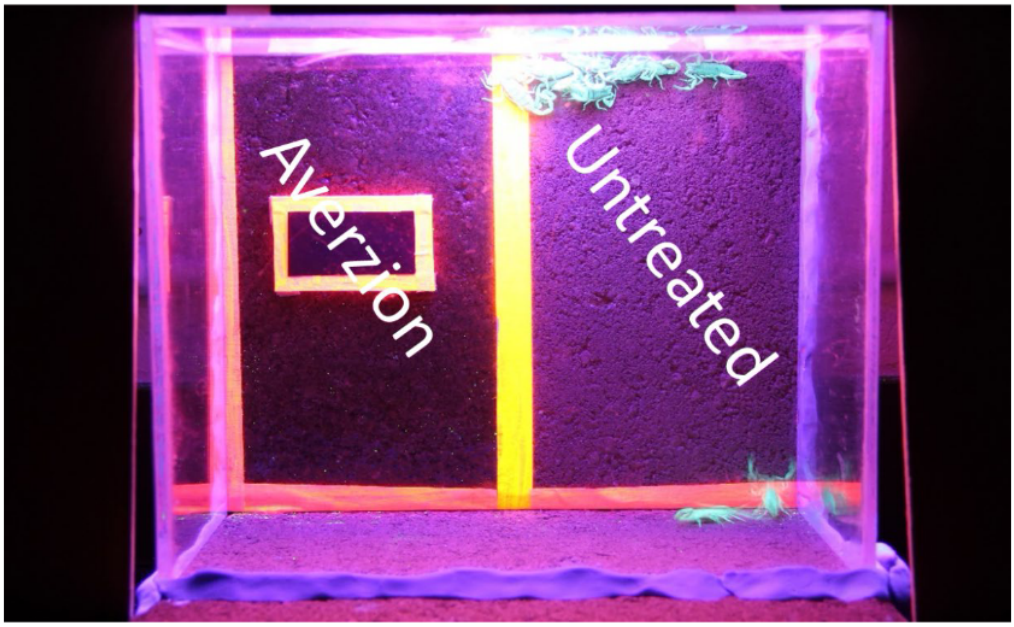

Fig. 1. Scorpions interacting with a half of an arena treated with AVERZION. Number of scorpions crossing the tape and crawling on the treated were recorded every 5 min overnight (8 hrs).

A tape strip was painted with a fluorescent paint and placed between the treated and untreated area (Fig. 1). This tape was used as a way to determine whether the scorpions were able to cross and crawl the treated surface (Fig. 1). An infrared sensitive digital camera was positioned at 3 ft away the arenas and a photograph was taken every 5 min for 8 hours in dark conditions. Light for the photography was provided by two IR illuminators. The digital photos were analyzed at 5 min intervals (observation of two consecutive pictures allowed the detection of positional changes). Based on a preliminary comparison with videorecording we concluded that a 5 min sampling interval was adequate in capturing the pattern of movement. Scorpions were acclimatized to the experimental conditions by placing them in the arenas two hours before the beginning of the recording. Scorpions were enclosed in a acetate tube during the aclimation/prereleasing time. Ten scorpions (mixed genders) were randomly selected from a larger group of scorpions. At least 96 photos registered the activity of the scorpions. Number of scorpions crossing the fluorescent tape were average for each hour.

3.2.2 Experiment 2: *Ability of scorpions to climb Averzion-treated bands*

This trial consisted in setting two concrete slabs (12 × 12 inches) side by side, and painting with Averzion the lower parts (3 inch-band) of one slab (Fig. 2, left) while the other slab remained untreated (Fig. 2, right). Ten scorpions (mixed genders) from each experimental group were randomly assigned to the arenas. At least 144 photos registered the activity of the scorpions. Number of scorpions crossing the fluorescent tape were average for each hour.

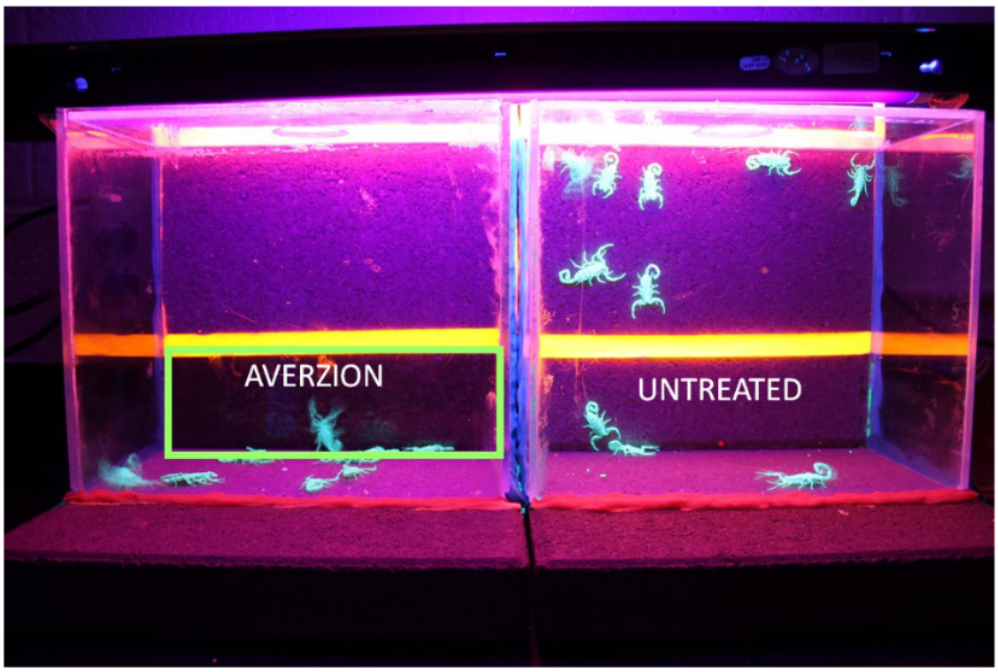

Figure 2. Arenas with scorpions interacting with areas treated with AVERZION. Number of scorpions crossing the tape were recorded every 5 min for 12 hrs.

3.2.3 Experiment 3: *Effectiveness of various formulated insecticides applied to surfaces treated with Averzion*

The objective of this experiment was to evaluate the performance of insecticides commonly used for scorpion control when applied on Averzion-treated surfaces. We selected concrete slabs as substrates as scorpions are commonly found on these surfaces. The hyphothesis is that Averzion applied to porous materials decrease the absorption of insecticides, therefore it will be more available to be picked up by the scorpions. The way this is measured is by recording the mortality rate (speed) that scorpion dies on each treatment.

The experimental arena consisted on concrete slabs that were painted with Averzion with a brush and let it dry overnight. Two additional coats were neccesary to achievea smooth surface (Fig. 3).

Figure 3. Slabs painted with Averzion. Three coats were put to achieve a smooth surface.

Two insecticide formulations were used: Demand CS (0.03% Lamba-cyhalothrin) and Talstar P. (0.062 % Bifentrin). The insecticide solutions were applied on the slabs using 118 mL fine-mist spray bottles. The spray bottles were triggered ~10 times over the substrate to achieve an homogenous wet area. Insecticide residues were allow to dry for 3 hrs before use. Control groups consisted in slabs with Averzion only and untreated slabs.

Table 1. Treatments evaluated in this study

Treatment	
1	Untreated
2	Averzion only
3	DEMAND CS only
4	Averzion + DEMAND CS
5	TALSTAR P only
6	Averzion + TALSTAR P

Individual scorpions were forcibly exposed to each treatment by enclosing them in PVC tube section (3 inch diameter, 4 inch tall) (Fig. 4).

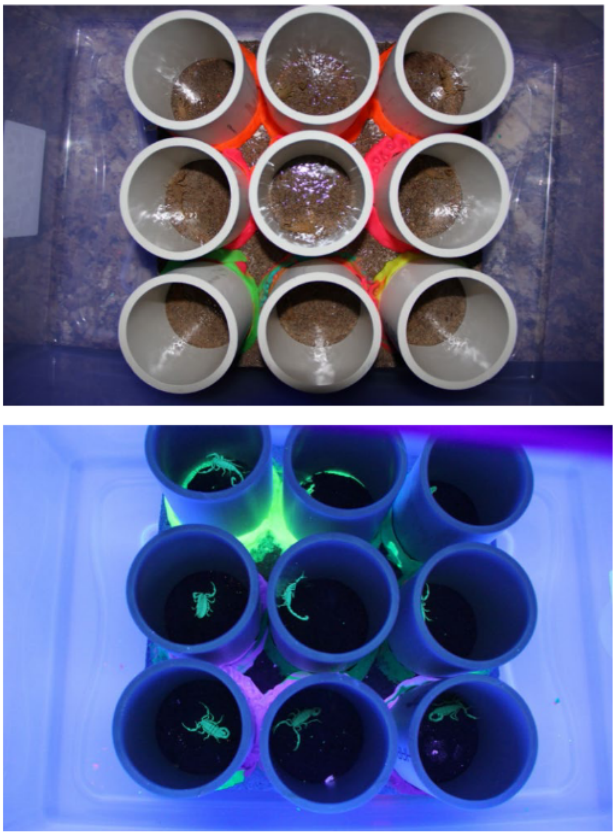

Figure 4. Arrangement of experimental arenas to evaluate the efficacy of insecticides to Arizona bark scorpions when the formulation is applied on surfaces treated with Averzion. Mortality of scorpions was monitored up to 20 days.

Each slabs contained 9 scorpions which were monitored for mortality up to 20 days. Recorded mortality were pooled by treatment and analyzed with Kaplan Meier survival method using the statistical package SPSS 12. Significance differences were determined at p=0.05.

4.0 RESULTS

4.1 *Responses of scorpions to areas treated with Averzion*

Scorpions were reluctant to cross to areas treated with Averzion; they remained either on the un-treated halves (>90%) or on the floor of the arena (Fig. 5).

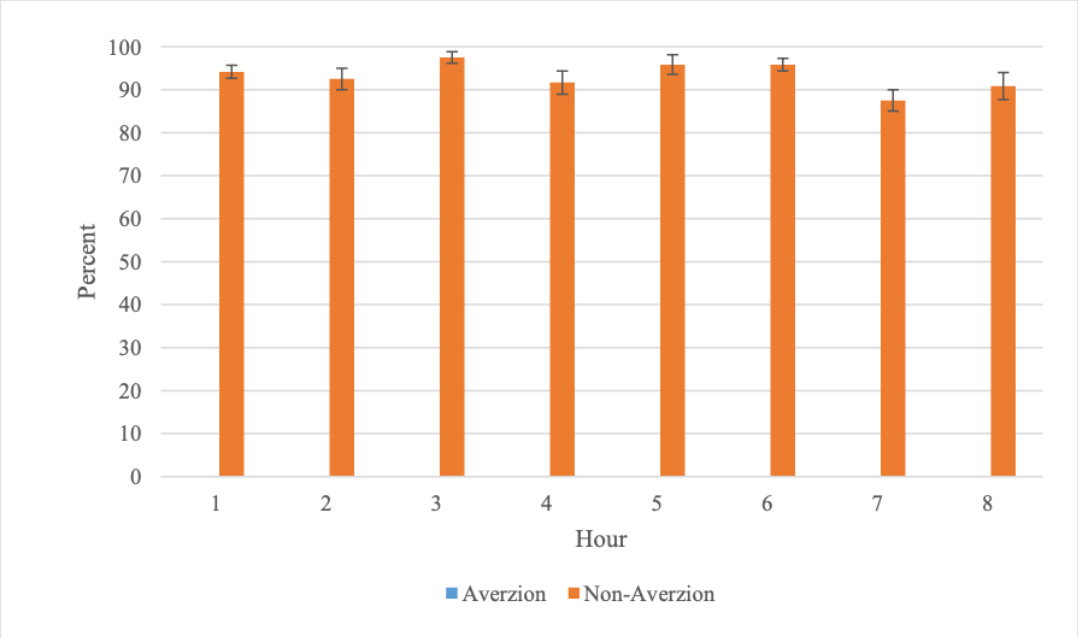

Figure 5. Percent of scorpions that stayed either in Averzion-treated areas or untreated areas. No scorpion were observed on the Averzion-treated area.

4.2 *Ability of scorpions to climb Averzion-treated bands*

None of scorpions were able to crawl on the 3-inch band treated with Averzion (Fig. 6).

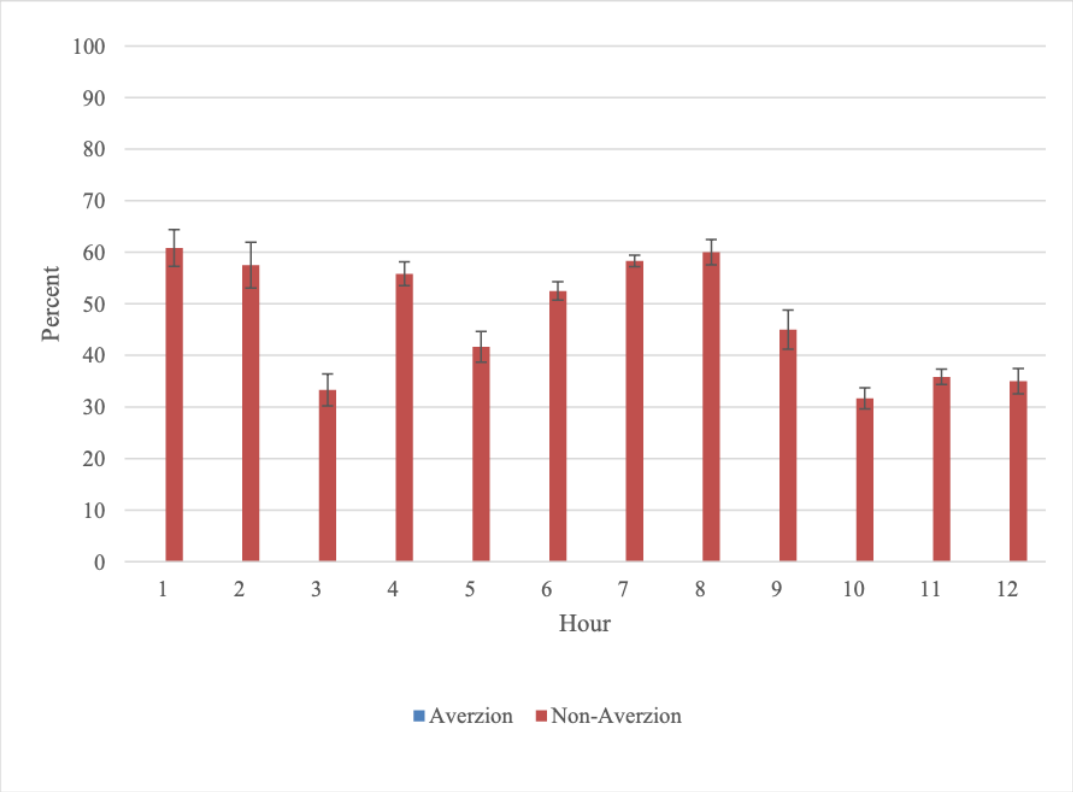

Figure 6. Percent of scorpions that crawled on Averzion-treated band and cross a fluorescent tape. Scorpions did not climb the 3-inch Averzion treated band.

Some scorpions tried to cross the band but they were not succesufully (see videoclip posted in Dropbox). Interestingly, some scorpions tried to make a "bridge" by laying on top of each other, but this sitll did not allow them to cross the band. Al least half of the scorpions remained in the untreated halves, while some other were on the floor of the boxes (Fig. 6).

4.3 Experiment 3: *Effectiveness of various formulated insecticides applied to surfaces treated with Averzion*

Scorpions in control groups (Averzion only or untreated slabs) had 0% mortality. Analysis of scorpion mortality between slabs treated with Demand CS (100% by day 20) or Averzion + Demand CS (88% mortality) demonstrated that there was no significant statistical differences in the rate of mortality (Fig. 7) (p=0.24).

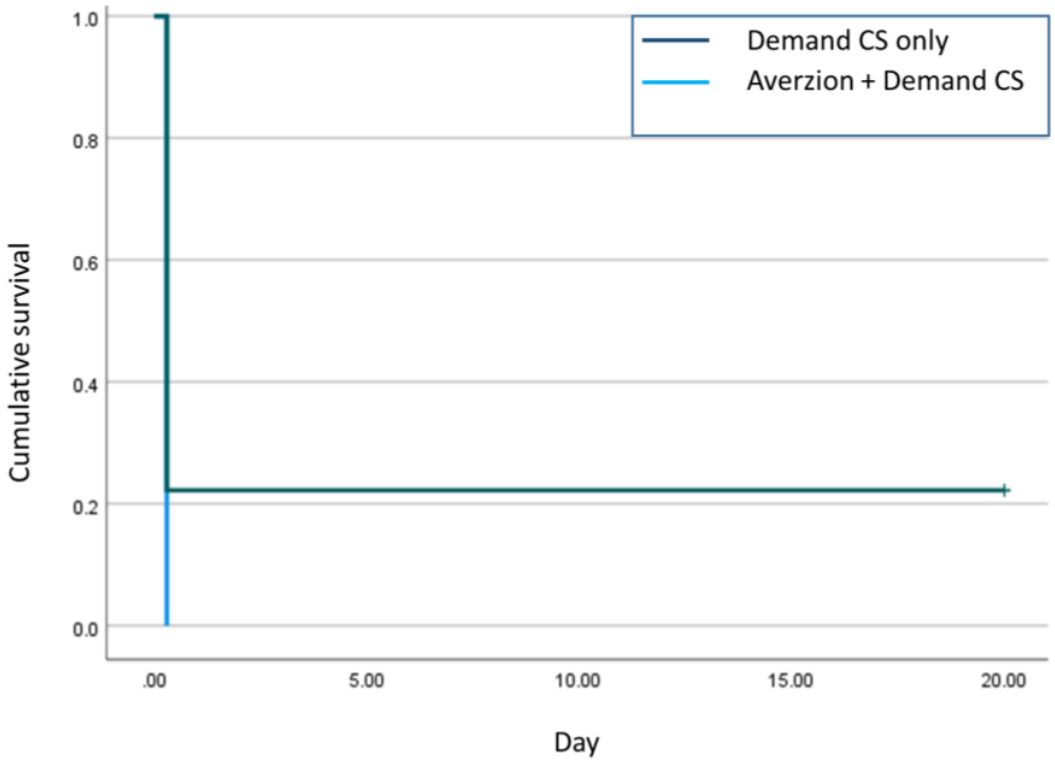

Figure 7. Cumulative survival curve of scorpions exposed to Demand CS on surfaces that had not been treated with Averzion (Demand CS only) or Demand CS on surfaces that had been treated with Averzion (Averzion + Demand CS).

In the evaluations with Talstar P, mortality of scorpion was minimal when the animals were exposed on Averzion-free surfaces (11%). However, a higher significant mortality in scorpions (55%; $p = 0.03$) with Talstar P was recorded when they were exposed to surfaces that had been previosuly painted with Averzion (Fig. 8).

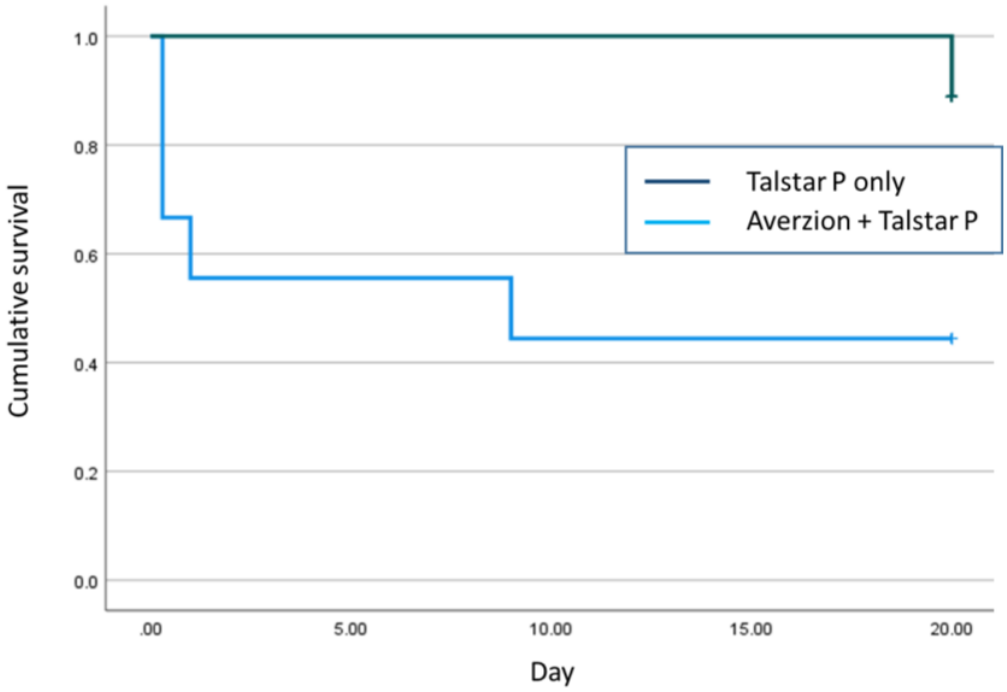

Figure 8. Cumulative survival curve of scorpions exposed to Talstar P on surfaces that had not been treated with Averzion (Talstar P only) or Talstar P on surfaces that had been treated with Averzion (Averzion + Talstar P).

5.0 CONCLUSIONS

- Scorpions did not crawl on vertical surfaces treated with Averzion. It is crucial that the surfaces receive at least three coats to achieve a smoth surface.
- Scorpions did no crawl on 3- inch Averzion-treated bands.
- It will be important to determine the efficacy of Averzion-treated surfaces when aged under extreme enviromental conditions such as heavy rains or high temperatures.
- Two scenarios were observed in the trials where scorpions were exposed to insecticides deposited on Averzion-treated surfaces
    - Demand CS did not cause a greater mortality to scorpions when the deposits were on Averzion-treated areas. This could be explained by the fact that the active ingredient of Demand CS (Lambda cyhalothrin) is contained in microcapsules which decreased the absorption of the active ingredient into the substrate, making the insecticide more available to be picked up by the scorpions.
    - Contrary to Demand CS, Talstar P increased its efficacy on substrates that had been previosuly painted with Averzion.

- Averzion is an interesting tool for the management of scorpions, and should be tested in conjuntion with other Integrated Pest management tools (e.g. exclusion).

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