



# Responses of House Crickets and Field Crickets to Ultrasound



Fangneng Huang, Bhadriraju Subramanyam, and Russell Taylor\*

Department of Grain Science and Industry, Kansas State University, Manhattan, KS 66506

\*Electronics Design Laboratory, Kansas State University, Manhattan, KS 66506

E-mail: huang@oznet.ksu.edu; bhs@wheat.ksu.edu; rdtaylor@ksu.edu

## Objective

To determine responses of house crickets, *Acheta domesticus*, and field crickets, *Acheta assimilis*, to pulses from commercial ultrasonic devices under laboratory and field conditions.

## Materials and Methods

**Sound output measurements:** Sound pressure levels (SPLs) were measured using a Bruel and Kjaer (B&K) type 4939 condenser microphone, B&K type 2670 preamplifier, and B&K NEXUS conditioning amplifier. Data were collected using a Tektronix 544A digitizing oscilloscope. Measurements were calibrated using a B&K type 4231 sound level calibrator.

**Ultrasonic devices:** Three commercial ultrasonic devices, labeled as “A”, “B”, and “C” for proprietary reasons, were tested. Device “A” generated peak frequencies of 26 kHz and 34 kHz and a  $95 \pm 1$  dB sound pressure level (SPL) at 50 cm ( $0 \text{ dB} = 20 \log_{10}(20 \text{ uPa}/20 \text{ uPa})$ ) (Figure 1A). Device “B” generated peak frequencies of 27 kHz and 35 kHz and a  $92 \pm 4$  dB SPL at 50 cm (Figure 1B), and device “C” generated peak frequencies of 27–28 kHz, 36 kHz, and 42 kHz and a  $88 \pm 2$  dB SPL at 50 cm (Figure 1C).

## House cricket tests:

● **Test enclosures:** Plexiglas enclosures (cubes), each of 1.73 m<sup>3</sup> volume (Figure 2), were constructed. A 61 cm long and 7.5 cm wide square conduit connected the 2 enclosures. In both enclosures, the ultrasonic device was mounted on the top corner, diagonally opposite from the conduit openings.

● **Test insects:** The house cricket colony was obtained from Rainbow Mealworms (Compton, CA).

● **Assay procedure:** In each test, 50 house crickets (80% adults and 20% nymphs) were released into each of the enclosures and allowed to acclimate to the test conditions for 24 h (Day 0). During this period, ultrasonic devices in both enclosures were turned off. The ultrasonic device in one of the enclosures was turned on for 2 d (days 1 and 2) and then turned off. The ultrasonic device in the other enclosure was then turned on for an additional 2 d (days 3 and 4). The five-day test period constituted a replicate. Enclosures were used to evaluate devices A and C. Each device was replicated 3 times. After insect introduction, the enclosures were covered with black plastic sheets to exclude light. Plastic sheets were removed and the gates were closed temporarily to facilitate counting during the tests. Within each enclosure, 50 mg of Pedigree® dog food and water-saturated cotton swabs were provided in separate Petri dishes. The test conditions were 21–23°C and 60–75% RH.

● **Data analysis:** Data on the daily changes in cricket numbers in an enclosure were calculated based on the number of insects found on days 1 and 2 minus the number of insects found on day 0 for the first 2-d test period. Similarly, the number of cockroaches found on days 3 and 4 were subtracted from the numbers found on day 2 for the second 2-d test period. Daily changes in insect numbers were subjected to an analysis of variance in a strip split-plot design, using the PROC MIXED procedure of SAS. The enclosure and first and second 2-day test periods were considered as the strip factors and whole plots, respectively. Each combination of the enclosure and test period was a subplot. Day was considered as a subplot within a test period. Treatments were assigned to interceptions of test periods and enclosures.

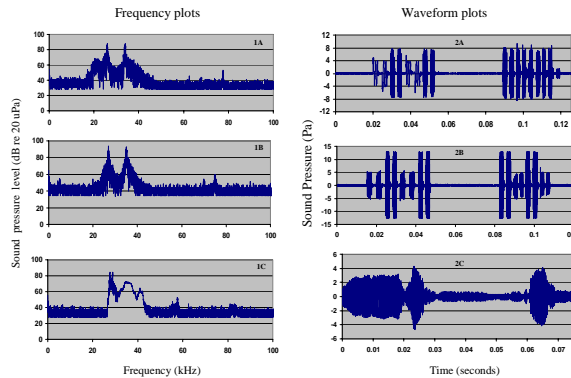


Figure 1. Frequency content and waveform plots for devices A, B, and C.



Figure 2. Plexiglas enclosures used for house cricket tests.



Figure 3. For field cricket tests, ultrasonic devices were set 1 ft away from sticky traps.

Table 1. Changes in number of house crickets in the test enclosures in exposure to ultrasound ( $n = 3$  for each device).

Device	First 2-day period				Second 2-day period			
	Day 1		Day 2		Day 1		Day 2	
	Off	On	Off	On	Off	On	Off	On
A	13.0 ± 1.5	-14.3 ± 6.6	13.0 ± 8.5	-16.3 ± 2.7	13.7 ± 5.9	-18.0 ± 6.9	17.0 ± 7.0	-21.0 ± 6.7
C	12.3 ± 4.8	-15.3 ± 10.3	13.3 ± 3.8	-24.0 ± 6.7	8.3 ± 2.8	-16.7 ± 6.3	9.7 ± 3.5	-12.3 ± 3.3

Table 2. Number of field crickets captured in traps and *t*-test results ( $n = 3$  for each device).

Treatments	No. crickets ± SE	Difference ± SE	<i>t</i> -value	<i>P</i> -value
Control	5.00 ± 4.00			
Device A	4.67 ± 2.60	1.00 ± 2.08	0.4804	0.6784
Control	4.67 ± 1.20			
Device B	3.67 ± 1.20	0.33 ± 2.33	0.1429	0.8995
Control	5.30 ± 2.67			
Device C	2.67 ± 0.33	2.67 ± 1.86	1.4368	0.2873

## Field cricket tests:

● **Assay procedure:** A paired design was used for the experiment. Nine greenhouse rooms (four 208 ft<sup>2</sup>, two 500 ft<sup>2</sup>, and three 625 ft<sup>2</sup> rooms) at Kansas State University, Manhattan, Kansas, were used for the experiment. Experiments were conducted during the summer of 2000. In each room, a pair of unbaited Pherocon 1C sticky traps (Trece Inc. Salinas, CA) were placed on opposite ends of a floor. An ultrasonic device was placed 1 ft away from the sticky trap (Figure 3). One of the ultrasonic devices was turned on all the time, while the other one was off. Each device was replicated three times (3 rooms). Crickets captured in traps were checked twice during a 14 d test period. Sticky traps were replaced after each observation.

● **Data analysis:** Paired *t*-tests were used to analyze the data using SAS.

## Results

**House cricket tests:** Crickets responded to ultrasound from devices A and C. The number of crickets in the enclosures with an active ultrasonic device decreased by 33% for device A and 38% for device C. In contrast, the number of crickets in the enclosures with inactive ultrasonic devices increased by 40% for device A and 27% for device C. The differences were significant (for device A:  $F=42.28$ ;  $df = 1, 9$ ;  $P=0.0001$ ; and for device C:  $F=28.16$ ;  $df = 1, 9$ ;  $P=0.0005$ ). Difference between test periods, and between days within a test period, were not significant ( $P>0.05$ ).

**Field cricket test:** Sticky traps close to active ultrasonic devices captured slightly fewer crickets than those close to inactive devices. For each device, *t*-tests showed that the capture of crickets was similar in the presence or absence of ultrasound ( $P>0.05$ ).

## Conclusions

Ultrasonic devices A and C repelled house crickets in our enclosure tests. Device A, B, and C failed to repel field crickets in the greenhouse.

## Acknowledgment

This research was supported by Weitech, Inc., Sisters, OR.

