

Field Evaluation of Ultrasonic Devices:
Transonic Cix Heavy-Duty Commercial Electronic Pest
Repeller on wild Norway rats (*Rattus norvegicus*)

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Objective

Testing evaluated the performance in the field of the Transonic Model 600 (Cix) heavy-duty pest repeller on a population of wild Norway rats (*Rattus norvegicus*).

Materials and Methods

The field trial was established in two adjacent barns. The barns had previously been used as a hog farrowing operation. The buildings were similar in size with each building having two floors. The lower level of Building A was finished block construction with windows along the southern side. Doors were present at the east and west end of the building while the north side of the building was surrounded by dirt. The area also contained 12 farrowing pens. Six farrowing pens were located on each side of the building with farrowing boxes immediately outside and adjacent to each pen. These boxes were filled with straw to provide harborage for rats. Water was available throughout the lower portion of the building. Food was provided in open (uncovered) Solvit metal bait stations. Cracked and whole corn was provided in the feed stations during the year to maintain the population. This lower portion of Building A was used for the ultrasonic evaluation.

The upper portion of Building A contained a workshop, auto and parts storage. There was a considerable collection of junk in the upper portion of the building, but little harborage and no source of food or water. This area was monitored for rodent activity, but no food or water was provided during the maintenance (pre-trial) program.

The lower level of Building B was used as an exterior control plot. This area also contained 12 farrowing pens, six on each side of the barn and each pen had an adjacent farrowing box along the center aisle. These boxes also were filled with straw for harborage. Food was provided in open Solvit metal bait stations, as in Building A. Water was provided ad libitum.

The upper level of Building B was a former straw mow and still contained a single layer of straw bales. It was not unusual to see rodents moving up the wall between lower and upper level of Building B, although little visible rodent activity was observed on top of the straw bales. This area was monitored for rodent activity, but no food or water was provided during the maintenance program.

Results

Phase 1—Device Measurements

BUILDING A

Set Up

Thirteen Transonic Cix heavy-duty units were examined in the laboratory for sound output. Sound was measured at distances of 0.5 and 1.0 meters (Table 1).

Table 1. Sound pressure measurements (dB at 1 meter) of 12 Transonic Cix Heavy-Duty Commercial Electronic Pest Repeller (no serial numbers) at selected frequencies (kHz), background range in parentheses.

Setting	Unit No.	Linear (52)	40 kHz (34)	31.5 kHz (34)	25 kHz (34)	20kHz (34)	16 kHz (33)	12.5 kHz (33)	10 kHz (33)	8 kHz (33)
C-Medium	1	80	55	62	63	60	49	49	58	52
	2	91	81	87	86	79	65	61	73	62
	3	93	89	91	88	70	60	55	60	60
	4	95	86	89	93	72	60	55	60	60
	5	91	81	85	86	84	67	63	69	59
	6	90	76	85	86	84	64	63	71	60
	7	91	79	81	86	87	63	62	70	61
	8	91	83	85	86	84	68	69	69	60
	9	93	83	86	89	86	68	65	72	62
	10	92	78	85	90	83	64	60	69	62
	11	91	80	86	88	83	68	64	72	61
	12	92	80	88	87	82	67	68	70	61
	13	93	82	87	88	85	68	64	68	61
	14	96	80	88	95	84	79	67	67	60
	15	95	81	85	91	91	73	68	67	63
	16	93	87	87	89	81	67	67	75	61
	17	96	83	92	92	89	73	68	70	62
	18	96	82	87	94	87	72	69	71	62
	19	90	77	86	84	81	69	66	71	61

The field trial utilized two census methods for measuring rodent activity, bait consumption and tracking boards. Each barn contained 12 farrowing pens. Paired farrowing pens made a group with six groups per barn. Odd numbered groups (Groups I, III, & V) in Building A were used as the treated pens. Each pen contained one bait station with bait and a tracking board and one bait station with only a tracking board. A total of twenty-four bait stations were placed in each barn. The type of census alternated with each station (i.e. station numbers 1, 3, 5, etc. were bait stations and numbers 2, 4, 6, etc., contained tracking boards. Group I contained bait stations 1 & 3 and tracking boards 2 & 4. Other groups were numbered in a continuing sequence.

Pretreatment Census

Food consumption (Tables 2 & 3) and tracking boards (Tables 4 & 5) were measured for 10 days in both buildings. Cix units were installed to be turned on later during the trial. Background sound readiness was measured in both buildings (Figure 2). Background sound measured approximately 65 dB.

Treatment A

Twelve Cix units were used in Building A. Speakers were placed 0.5 meters over census points in Groups I, III & V. The Cix units were set at the manufacturers suggested setting of C-Medium for sound output. Sound readings at the census points were measured for all 24 stations. Sound levels at census points with speakers were generally > 96 dB. Sound levels at census points without speakers were generally approximately 63 dB. Sound levels in the center of each pen also were recorded with treated pens having sound levels of 66-77 dB and untreated pens with sound levels of 62-65 dB. Food consumption and tracking board activity were measured daily for eight (8) days.

Treatment B

The twelve Cix units in Building A were moved to a point 1.0 meters over census points in Groups I, III & V. The Cix units were set at C-Medium for sound output. Sound readings at the census points again were measured for all 24 stations. Sound levels at census points with speakers were generally > 86 dB. Sound levels at census points without speakers were generally in the low 60's dB range. Sound levels in the center of each pen also were recorded with treated pens having sound levels of 69-77 dB and untreated pens with sound levels of 63-69 dB. Food consumption and tracking activity were measured daily for eight (8) days.

Lag Phase

There were no activities during the lag phase. All Cix units were turned off.

Treatment C

The twelve Cix units in Building A were moved to ceiling height, approximately 2 meters above the floor. Sound readings were measured as above with the Cix units still at C-Medium for sound output. Sound levels at census points with speakers were generally > 79 dB. Sound levels at census points without speakers were generally in the mid to upper 60's dB range. Sound levels in the center of each pen were also recorded with treated pens having sound levels of 66-73 dB and untreated pens with sound levels of 72-75 dB. This treatment lasted for eight (8) days. Food consumption and tracking board activity were measured for six (6) days.

Treatment D

The twelve Cix units remained in their 2.0 meter locations while the sound output setting was changed to C-Loud. Sound levels, food consumption and tracking board activity were recorded for six (6) days. Sound levels in the center of each pen were recorded with treated pens having sound levels of 83-88 dB and untreated pens with sound levels of 80-86 dB.

Treatment E

The twelve Cix units were returned to the 0.5 meter level and the sound output setting was changed to C-Quiet. This setting measured highest in the laboratory for ultrasonic output. Sound output over census points increased to 93-102 dB. Correspondingly, sound levels in the center of each pen declined with treated pens having sound levels of 67-74 dB and untreated pens with sound levels of 61-65 dB. Sound output, food consumption and tracking activity were recorded for six (6) days.

BUILDING B

Building B was set up in the same manner as Building A except there were no Cix units installed in the building. Census methods and treatment times were the same as in Building A.

PART C (Upper level, Building A).

Part C monitored for rodent activity. Food takes, using all-weather census blocks and tracking boards were used as census methods. Pretreatment activity was measured for eight (8) days with tracking boards, while all other census methods and treatment periods were the same as in Building A, lower level.

PART D (Upper level, Building B).

Part D was census in the same manner as Part C.

Phase 2—Animal Observations**RESULTS AND DISCUSSION**

Food consumption data is presented in Tables 2 and 3. A graphic presentation of the average daily food consumption per treatment period is presented in Figures 1 & 2. The figure demonstrates the change in feeding behavior in the treated and untreated areas of Building A. One location was particularly difficult to control (Station 17) and food consumption remained high. Eventually, food consumption would begin to decline in this station as well. The focal point of the population was in the nest boxes adjacent to Stations 17, 19 and 21. Additionally, the unit at Station 19 malfunctioned and required replacement. The high rate of food consumption at Station 17 and the unit failure at Station 19 undoubtedly complicated the censusing effort. Consequently, the data in Table 2 are examined with and without the consumption from Station 17. There is an immediate reduction of over 86% (Treatment A) when the units became operational (excluding #17).

The Cix units were moved to 1.0 meter above the census locations in Treatment B. Note the food consumption differential between treated and untreated areas was not as pronounced. The sound patterns decline for the station but begin to cover a larger area as stations are moved higher. The overall sound pressure at ground level begins to rise very slowly. The decrease in sound pressure at the bait stations allow for an increase in rodent activity.

The sound pressure in the center of each stall continues to rise as units are moved to 2.0 meters, while sound pressure at the census points continues to decline. There is a corresponding loss of repellent effect on rodent activity as the sound pressure at the floor level is reduced. Changing the output switch from C-Medium to C-Loud brought a slight increase in repellent effect, but was noticeably irritating to the investigators.

The final move of the units back to 0.5 meters and a setting change to C-Quiet brought increased sound pressure to the census points and a slight increase in repellent effect.

Table 2. Summary of average daily food consumption in Building A per treatment phase.**Building A sound treated bait stations (Groups I, III, V).**

Census Station Setting	Pretest	Test A		Test B		Lag Off	Test C		Test D		Test E	
		C-Med	Reduction	C-Med	Reduction		C-Med	Reduction	C-Loud	Reduction	C-Quiet	Reduction
A1	14.9	0.1	99.3%	1.3	91.3%	1.3	5.6	62.4%	8.7	41.6%	16.9	-13.4%
A3	3.7	0.8	78.4%	5.0	-35.1%	0.8	17.4	-370.3%	12.5	-237.8%	5.8	-56.8%
A9	15.3	3.1	79.7%	0.5	96.7%	5.2	0.6	96.1%	1.0	93.5%	1.4	90.8%
A11	9.5	1.3	86.3%	10.1	-6.3%	2.6	3.5	63.2%	4.5	52.6%	0.9	90.5%
A17	36.4	77.0	-111.5%	100.0	-174.7%	65.1	48.0	-31.9%	20.6	43.4%	3.1	91.5%
A19	3.0	1.0	66.7%	1.3	56.7%	16.7	1.2	60.0%	0.7	76.7%	0.7	76.7%
Total	13.8	13.9	-0.6%	19.7	-42.8%	15.3	12.7	7.9%	8.0	42.0%	4.8	65.2%
Excl. A17	7.7	1.1	86.4%	3.0	60.8%	4.4	4.7	39.0%	4.6	40.9%	4.3	44.6%

Building A untreated bait stations (Groups II, IV, VI).

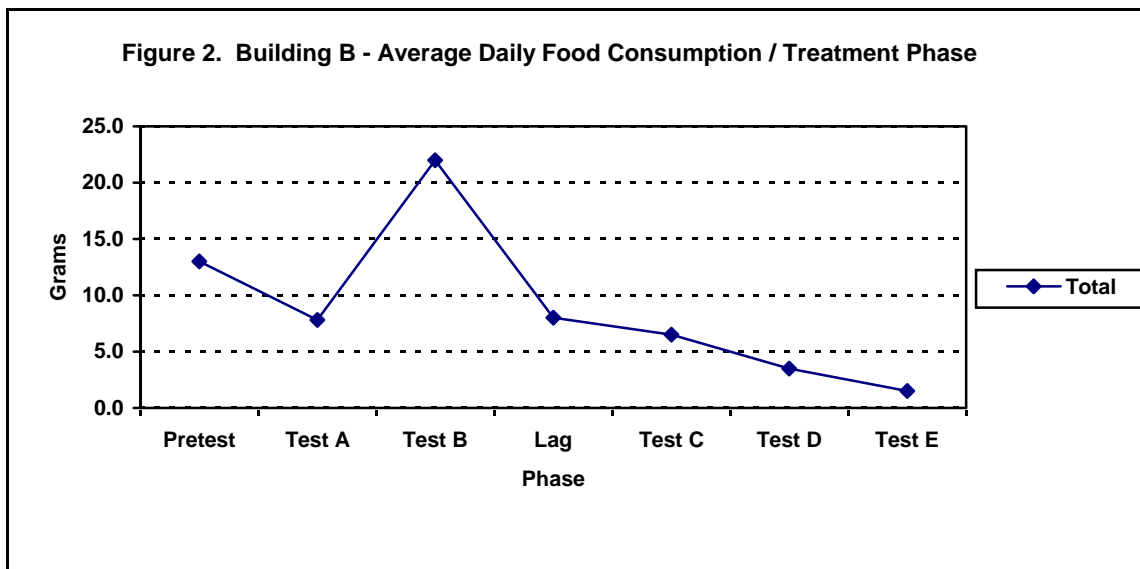
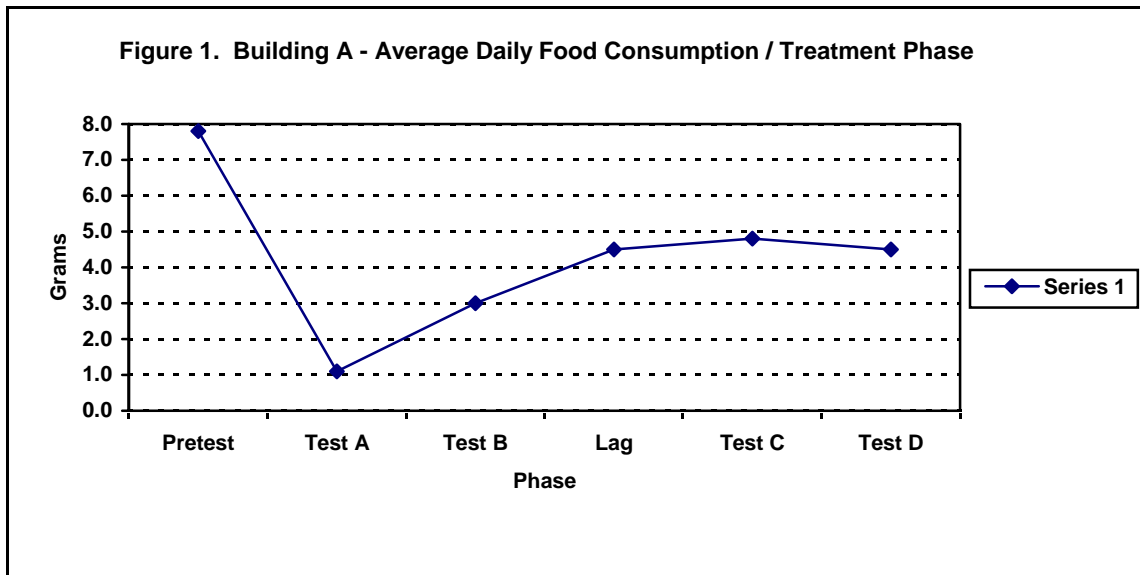
Census Station Setting	Pretest (Off)	Test A		Test B		Lag Off	Test C		Test D		Test E	
		C-Med	Reduction	C-Med	Reduction		C-Med	Reduction	C-Loud	Reduction	C-Quiet	Reduction
A5	7.7	8.6	-11.7%	7.9	-2.6%	3.2	5.9	23.4%	12.1	-57.1%	35.0	-354.5%
A7	5.1	23.7	-364.7%	12.9	-152.9%	2.9	9.7	-90.2%	5.2	-2.0%	4.7	7.8%
A13	26.0	51.8	-99.2%	18.8	27.7%	32.7	28.5	-9.6%	26.3	-1.2%	21.4	17.7%
A15	11.6	6.5	44.0%	12.1	-4.3%	6.5	3.1	73.3%	1.1	90.5%	6.3	45.7%
A21	67.0	71.9	-7.3%	110.1	-64.3%	54.4	42.1	37.2%	40.8	39.1%	63.8	4.8%
A23	2.2	11.9	-440.9%	2.2	0.0%	12.0	1.7	22.7%	0.6	72.7%	0.7	66.2%
Subtotal	19.9	29.1	-45.8%	27.3	-37.1%	18.6	15.2	23.9%	14.4	28.0%	22.0	-10.3%

Table 3. Summary of average daily food consumption in Building B per treatment phase.**Building B (Groups I, III, V).**

Census Station Setting	Pretest	Treatment Phase				
		Test A C-Med	Test B C-Med	Lag	Test C C-Med	Test D C-Loud
B1	17.8	5.0	46.9	2.5	8.1	3.5
B3	40.4	10.1	4.1	8.3	5.8	0.7
B9	11.3	4.4	1.7	0.7	1.5	0.6
B11	7.3	6.3	9.4	11.3	12.0	6.0
B17	6.7	26.9	16.1	10.3	8.9	6.1
B19	5.4	4.5	3.8	5.4	2.1	0.5
Subtotal	14.8	9.5	13.7	6.4	6.4	2.9

Building B (Groups II, IV, VI).

Census Station Setting	Pretest	Treatment Phase				
		Test A C-Med	Test B C-Med	Lag	Test C C-Med	Test D C-Loud
B5	14.5	6.5	44.3	0.9	1.5	0.3
B7	12.1	13.2	39.8	3.2	2.7	3.9
B13	8.8	3.1	41.8	18.6	24.1	11.6
B15	3.0	4.2	42.4	33.9	8.1	1.8
B21	9.5	1.7	4.1	0.7	2.8	0.5
B23	15.4	8.5	6.6	1.7	0.8	1.7
Subtotal	10.6	6.2	29.8	9.8	6.3	3.3



Tracking board activity is presented in Tables 4 and 5. There is considerable difference between the treated and untreated groups with Groups I, III & V experiencing a 65% total reduction during Test A. The area without sound treatment had only a 17% combined reduction during this time. It is interesting to note the shift in tracking activity as units are moved higher off the floor, both in treated and in untreated areas. Tracking boards support the notion that the Cix is capable of altering rodent behavior by repelling rodents.

Table 4. Summary of average tracking board activity (average tracks/board) per treatment phase in Building A.**Building A sound treated bait stations with food (Groups I, III, V).**

Census Station Setting	Pretest (Off)	Test A C-Med	Reduction	Test B C-Med	Reduction	Lag Off	Test C C-Med	Reduction	Test D C-Loud	Reduction	Test E C-Quiet	Reduction
A1	76	3	96%	26	66%	9	36	53%	59	22%	61	20%
A3	42	29	31%	50	-19%	14	47	-12%	67	-60%	32	24%
A9	64	9	86%	29	55%	51	23	64%	17	73%	36	44%
A11	78	27	65%	64	18%	15	17	78%	28	64%	12	85%
A17	76	48	37%	37	51%	62	61	20%	49	36%	33	57%
A19	36	39	-8%	35	3%	72	30	17%	18	50%	16	56%
Summary Group Avg	62	26	58%	40	35%	37	36	42%	40	36%	32	49%
Excl #17	49	18	64%	34	31%	27	26	48%	32	36%	26.2	47%

Building A sound treated bait stations without food (Groups I, III, V).

Census Station Setting	Pretest (Off)	Test A C-Med	Reduction	Test B C-Med	Reduction	Lag Off	Test C C-Med	Reduction	Test D C-Loud	Reduction	Test E C-Quiet	Reduction
A2	36	6	83%	15	58%	0	15	58%	13	64%	1	97%
A4	28	4	86%	11	61%	5	7	75%	13	54%	10	64%
A10	20	11	45%	24	-20%	2	10	50%	16	20%	6	70%
A12	19	0	100%	7	63%	15	6	68%	5	74%	13	32%
A18	26	19	27%	34	-31%	22	17	35%	16	38%	10	62%
A20	39	10	74%	17	56%	19	20	49%	8	79%	9	77%
Summary Group Avg	28	8	70%	18	36%	11	13	55%	12	58%	8	71%
Total Group Average	51	18	65%	29	43%	28	28	45%	24	53%	20	60%

Building A untreated bait stations with food (Groups II, IV, VI).

Census Station Setting	Pretest (Off)	Test A C-Med	Reduction	Test B C-Med	Reduction	Lag Off	Test C C-Med	Reduction	Test D C-Loud	Reduction	Test E C-Quiet	Reduction
A5	62	30	52%	43	31%	37	39	37%	57	8%	75	-21%
A7	48	49	-2%	62	-29%	13	25	48%	31	35%	24	50%
A13	81	99	-22%	77	5%	62	68	16%	66	19%	47	42%
A15	46	30	35%	63	-37%	29	27	41%	13	72%	17	63%
A21	99	99	0%	99	0%	92	78	21%	78	21%	89	10%
A23	50	59	-18%	22	56%	55	13	74%	8	84%	8	84%
Summary Group Avg	64	61	5%	61	5%	48	42	35%	42	34%	43	33%

Building A untreated bait stations with food (Groups II, IV, VI).

Census Station Setting	Pretest (Off)	Test A C-Med	Reduction	Test B C-Med	Reduction	Lag Off	Test C C-Med	Reduction	Test D C-Loud	Reduction	Test E C-Quiet	Reduction
A6	18	9	50%	28	-56%	1	19	-6%	23	-28%	6	67%
A8	17	5	71%	10	41%	7	7	59%	12	29%	15	12%
A14	12	8	33%	17	-42%	5	3	75%	4	67%	5	58%
A16	24	17	29%	22	8%	13	15	38%	3	88%	7	71%
A22	14	18	-29%	13	7%	18	14	0%	10	29%	3	79%
A24	62	39	-8%	39	3%	72	59	17%	10	50%	16	38%
Summary Group Avg	25	16	36%	22	12%	19	20	20%	10	60%	9	64%
Excl #24	17	11	29%	18	-6%	9	12	29%	10	41%	7	59%

Table 2. Summary of average tracking board activity (average tracks/board) per treatment phase in Building B.**Building B bait stations with food (Groups I, III, V).**

Census Station Setting	Pretest (Off)	Test A C-Med	Test B C-Med	Lag Off	Test C C-Med (2M)	Test D C-Loud	Test E C-Quiet
B1	94	33	55	22	50	26	10
B3	92	37	38	44	45	6	2
B9	81	40	28	9	22	8	7
B11	52	38	50	31	37	20	3
B17	82	32	78	70	60	39	22
B19	14	30	28	45	16	3	6
Summary Group Avg	69	35	46	37	38	17	8

Building B bait stations without food (Groups I, III, V).

Census Station Setting	Pretest (Off)	Test A C-Med	Test B C-Med	Lag Off	Test C C-Med	Test D C-Loud	Test E C-Quiet
B2	16	4	2	3	5	0	0
B4	29	5	3	1	3	0	0
B10	9	6	0	0	4	1	0
B12	12	4	5	0	3	3	1
B18	2	2	2	1	5	0	1
B20	15	3	0	2	6	0	2
Summary Group Avg	14	4	2	1	4	1	1

Building B bait stations with food (Groups II, IV, VI).

Census Station Setting	Pretest (Off)	Test A C-Med	Test B C-Med	Lag Off	Test C C-Med (2M)	Test D C-Loud	Test E C-Quiet
B5	88	58	31	22	19	3	2
B7	82	30	23	26	27	11	4
B13	72	19	59	51	59	42	3
B15	36	32	69	52	35	9	3
B21	63	19	22	9	34	2	10
B23	45	32	40	34	11	4	2
Summary Group Avg	64	32	41	32	31	12	4

Building B bait stations without food (Groups II, IV, VI).

Census Station Setting	Pretest (Off)	Test A C-Med	Test B C-Med	Lag Off	Test C C-Med (2M)	Test D C-Loud	Test E C-Quiet
B6	7	2	2	0	5	0	0
B8	31	0	7	1	3	1	0
B14	0	1	3	0	0	1	0
B16	6	5	3	2	11	6	0
B22	1	0	0	3	6	1	0
B24	10	1	5	2	3	0	1
Summary Group Avg	9	2	3	1	5	2	0