November 1979

EXTENDED USE OF STARLICIDE IN REDUCING BIRD DAMAGE IN SOUTHEASTERN FEEDLOTS

Allen R. Stickley Jr.
USFWS Kentucky Research Station, Bowling Green KY

EXTENDED USE OF STARLICIDE IN REDUCING BIRD DAMAGE IN SOUTHEASTERN FEEDLOTS

Allen R. Stickley, Jr.
U.S. Fish and Wildlife Service
Denver Wildlife Research Center
Kentucky Research Station
Bowling Green, Kentucky

The livestock industry is a major agricultural activity in the Southeast where large numbers of wintering blackbirds and starlings *(Sturnus vulgaris)* consume and contaminate feed at livestock feeding operations. This study was conducted in Tennessee, where the 1977 cash sales for cattle, hog, and dairy products approximated $579 milion or 42% of sales of all Tennessee farm commodities (Tennessee Crop Reporting Services 1978). Although no feeding operation damage figures are available, losses to birds at feedlots may be as great or greater than depredations to wheat and corn crops (Stickley et al. 1976, Dolbeer et al. 1978, Dolbeer et al. 1978-79, and Stickley et al. 1979).

Besser et al. (1968) calculated the average daily time starlings fed at Colorado feeding operations, and, on the basis of feed consumption by caged birds, estimated that one starling would consume 28.3 g of livestock feed per day. Farmer questionnaire data (Russell 1975) indicated substantial feeding operation losses, but these data were not differentiated into disease versus feed losses or losses by bird species.

DeCino et al. (1966) showed that 3-chloro-4-methyl benzamine HCI (the active ingredient in Starlicide) was highly toxic to starlings (acute oral LD_{50} of 3.8 mg/kg), well accepted by the species, generally less toxic to other avian forms, and relatively nontoxic to mammals. They found hawks to be particularly resistant to the chemical, and indicated that hazards to hawks from eating Starlicide-affected birds would be low. The compound causes a slow, nonviolent death primarily through uremic poisoning and congestion of major organs. Most birds ingesting the chemical die within 8-48 h. The formulated product is now registered under the trade name "Starlicide Complete[R]" by Ralston Purina Company, St. Louis, Missouri. It consists of 160-180 mg protein-based pellets of which one in 10 contains 1 % of the avicide.

Besser et al. (1967) were the first to test this chemical operationally by ground-baiting a two-acre Nevada cattle feeding operation with 10 Ib of 1% Starlicide-treated poultry pellets that reduced a population of 2280 starlings approximately 75 percent within seven days. No secondary hazards were noted. In a similar study Royall et al. (1967) reduced a population of 1800 starlings at a Utah turkey farm by about 93% after four days. West (1968) conducted the only published long-term study of the effectiveness of baiting with Starlicide at a feeding operation. Preroosting birds using a Colorado feedlot were baited in the afternoon 19 times from 23 November to 3 March with pellets broadcast on the ground once. During this period, the initial 250,000 starling population was reduced 80% by 29 January.

The above studies were conducted at western feedlot operations, and, with the exception of the West (1968) study, were of short duration. Further, effectiveness of these studies was determined by the estimated reduction of starling populations at the feeding operations based on area population estimates and bait consumed. This present study was designed to determine the effectiveness of extended baiting under eastern livestock feeding conditions by evaluating activity of starlings/blackbirds at specific feed troughs or feeding areas. Eastern livestock operations tend to be smaller scale than western operations and more variable in terms of operating conditions.

STUDY AREA AND METHODS

General

The study involved monitoring three individual cattle feeders and two pig feeding areas located 1.4 to 8.8 km from a blackbird/starling roost near Arrington, Wiliamson County, in central Tennessee (Fig. 1). Starlicide was used at the three cattle feeders and one of the two pig feeding areas. The second pig feeding area was designated as a control because the owner did not care to have Starlicide used there. The test began on 27 January and ended on 14 March 1979.

General methods at the treated feeding operations consisted of four days of pretreatment (defined as the period before prebaiting) bird activity estimates that established baseline bird entries per minute for each operation. This was followed by prebaiting with untreated bait for three or four days until birds readily accepted it. Prebait was exposed in 0.9 m-long V-shaped wooden troughs or three-gallon capacity, black, molded rubber pans manufactured by the Fortrex Company, Puerto Rico (reference to trade names or commerical suppliers does not imply endorsement by the U.S. Government) that were placed on top of feeders out of reach of livestock. One liter of bait (defined as a half and half mixture of prebait and Starlicide) was then placed in these troughs and pans and units were refilled when empty. Consumption of the prebait and bait was visually estimated. After baiting two or three days, the troughs and pans were removed. Estimates of bird entries per minute on troughs and pans were made when possible.

The objective of the Starlicide treatment was to reduce the baseline bird entries per minute at each feeding operation by 90%. To determine this, posttreatment (defined as the period following baiting, including the period between baiting and any ensuing prebaiting) bird activity estimates were made in the same manner as in the pretreatment period. These estimates were made on alternate days where possible, When the bird entries per min exceeded the level of 90% reduction, prebaiting was initiated again. Once the prebait was again well accepted, baiting was resumed for one day, the bait then withdrawn, and bird activity again estimated periodically. This procedure was repeated as needed. Bird activity estimates were also taken on alternate days when possible at the control feeding operation throughout the test period to monitor the level of starling populations.

Four bird activity estimates were made each observation day. The daylight hours (0700-1700) were divided into four intervals (2.5 h each) and a 0.5 h observation period was randomly selected within each interval. Before each estimate, birds were flushed from the feed sources. The observation period began when the first birds landed in the feed sources, or after a 15-min wait, whichever came first. During the observation period numbers of birds landing were tabulated at one-min intervals by an observer inside a parked vehicle so that their presence had little apparent effect on bird activity.

Top priority was given to obtaining pretreatment bird estimates and secondary priority to posttreatment observations. Therefore, these latter observations were conducted on an irregular basis (Figs. 2-6). The extent of hazard to nontarget birds was estimated by observing birds feeding on the bait.

Population and species composition estimates at the Arrington roost were made weekly by four observers counting the four major flight lines during the early mornings as birds left the roost. Counts were continuous and were derived by blocking off equal-sized groups of birds and tabulating the blocks. Species composition counts were made as birds returned in the evening by randomly spotting individual birds with binoculars and recording the species on multibank counters. Cowbirds *(Molothrus ater)* and female red-winged blackbirds *(Agelaius phoeniceus)* were grouped together because of the difficulty in distinguishing them from each other. The roost area was composed mainly of red cedar *(Juniperus virginiana)* and second-growth hardwoods.

A time-lapse camera set to take one picture every 10 min was operated at the control feeding operation to record starling activity throughout the study period. Climatological data was recorded because weather, especially snow and frozen soil, appear to increase the numbers of birds frequenting feedlots as alternate food sources become restricted.

Individual feeding operations

Data pertinent to all feeding operations are presented in Tables 1 and 2.

Crosslin I. This operation consisted of a single 3.0 X 1.5 m self-feeder for cattle located in an approximately 16-ha pasture. A barn approximately 230 m from the feeder contained a roost of about 200 starlings. Ten pans placed on the feeder roof were used in the first prebait-bait period and five in the second. Because the feeder was designed with troughs on both sides, we could observe only one trough. Therefore, during pre- and posttreatment activity estimates, we counted starlings landing in the observable trough and counted all starlings disappearing behind the feeder on the likely assumption that they were landing in the trough we could not see.

We found that feed was not always in the feeder because the owner was trying to reduce bird numbers and at the same time keep his herd of young Red Angus bulls from gaining excess weight. He also added salt to the diet to reduce feed intake. Both factors probably reduced bird activity.

Crosslin II. This operation consisted of a calf feeder in a pasture. The feeder contained only one feed trough which was visible to the observer.

McCanless'. a single cattle self-feeder, similar to that used at Crosslin I, was located adjacent to a secondary road in a large pasture. We placed V-shaped troughs on top of the feeder. As at Crosslin I, the feeder contained two feed troughs but only one was visible to the observer. We made pre- and posttreatment activity estimates as at Crosslin I.

Cotton's. This pig operation differed from the other operations in that the study area consisted of 0.02 ha of an approximately 0.8 ha piglot. The study area in the piglot was selected because it had more birds and contained a small self-feeder with flaps on the feed openings. We placed three bait pans on top of the feeder. During pre- and posttreatment periods birds were counted as entering the 0.02 ha study area if they landed on the ground, on the backs of pigs, or if they perched on the feeder.

Pratt's. This control pig operation consisted of three large covered self-feeders under the roof of an open-sided barn. Starlings were the problem here even though the birds could only feed on spilled pellets or occasionally on pellets in the feeders when the pigs had the feed opening flaps up. Starlings were counted if they landed on the feeders, on the ground, or on the backs of pigs within a specified area (40 m^2) containing the feeders. Birds were also counted as entering the feeding area if they landed on barn structures within 1.5 m of the feeders. The Pratt operation differed from the others in that the barn provided convenient loafing space for birds during the day, and perhaps served as a roost at night.

RESULTS AND DISCUSSION

After the initial baiting ceased, feeding operations were studied for an average of 14.75 days, ranging from nine days for the McCanless to 15 days for Crosslin I sites. Starlings were the principal problem species at all but Cotton's feeding operation, and only starling numbers were used to compute bird reduction and Starlicide efficacy for these sites, excluding Cotton's. At Cotton's, the depredating birds were primarily grackles *(Quiscalus quiscula)* but considerable numbers of starlings and lesser numbers of redwings also frequented the lot; therefore, numbers of all blackbird species and starlings were used to calculate population reduction and efficacy.

Crosslin I. Bird activity at this operation was generally high (Fig. 2) during the pretreatment observations even when there was little or no snow cover. A bird flightline directly over the site and its close proximity to the roost probably contributed to the high activity. Little feed was available in the feeder during the prebait-bait period. This forced birds to the bait pans and resulted in a high consumption of Starlicide (Table 3) with 84% reduction of activity; at least 50 dead starlings were found in the nearby barn roost. Even after the feeder was filled on 13 February, bird activity remained low, perhaps due to the effects of Starlicide, but also possibly because birds that normally fed here found other food sources. Snow on 18 February was attributed to have caused the increase of the starling population to the point that prebaiting had to be resumed the following day. The populations, after being reduced 99%, did not rise after the second baiting, probably because the snow made the feed wet and unpalatable to the birds (Harriman and Kare 1967).

An apparent aversive response occurred on the second baiting. During the first baiting, starlings fed on the bait in the same manner they had fed on the prebait. But on the second baiting, when the bait replaced the prebait, the birds were skittish. They would perch in nearby trees for 15 or 20 minutes and then suddenly descend on the bait pans, feed in a frenzy for no more than a minute at a time, and then fly back to the trees.

Crosslin II. Despite problems with this feeder being empty part of the pretreatment period, starlings flooded the feeder during heavy snow on 7 and 8 February (Fig. 3). Activity was high (7.9 bird entries per minute) for the next three days, and bait acceptance was high the first day but declined during the day and remainder of the baiting period. The bait pan had 6.9 bird entries per minute the first day, 1.4 the second, and zero the third. Due either to the effect of Starlicide, the mild weather, or some combination of the two, no starlings were recorded at the feeder during the succeeding three days. Figure 3 details the recurring pattern of snowfalls apparently forcing starlings back to the feeder to the extent that the population reduction did not reach the 90% level. Each time this set in motion another prebait-bait-posttreatment cycle. No aversive reaction such as that which occurred at Crosslin I was observed. Probably due to the increasingly mild weather, bird activity declined after 26 February, and the study here was terminated.

McCanless'. Pretreatment starling numbers at this feeder were not nearly as great as at the Crosslin I and II feeders despite the feeder having feed at all times (Fig. 4). The prebait was taken well (8.9 bird entries per minute) as was the bait (4.0 bird entries per minute) the first day (Table 3). The second day bait was well accepted early in the day but midday consumption declined drastically resulting in 0.3 bird entries per minute overall for the day. On this day not as many starlings were in the vicinity. Either Starlicide or lack of snow cover or some combination of the two kept starling numbers low. The snow on 18 February probably caused the reduction to be slightly less than 90%. This necessitated another cycle of prebaiting, baiting, and posttreatment observations, but with no starling activity on 22 February, and with generally low bird activity throughout the course of this feeding operation, the study here was terminated. Aversive feeding behavior on the second baiting was very similar to that observed at Crosslin I.

Cotton's. The comparatively high blackbird/starling activity at this feeding operation during the pretreatment period was probably due to snow cover most of the period (Fig. 5). Starlings and grackles took the prebait well (14.2 bird entries per minute); but redwings and cowbirds were a rarity in the pans, although not in the study area itself. During the initial two days of baiting, bait was well accepted (29.5 bird entries per minute on the first day) and the population was reduced 86% (Table 3). But Figure 5 records our failure to reduce the blackbird/starling population to the 90% level. This is probably due to a refractory reaction of grackles to Starlicide, as we did reduce the starling population by 94% overall. By the third prebait period, grackles were no longer taking Layena prebait, only corn. However, due to the Starlicide, mild weather, or combination of the two, population reduction was still substantial (Table 3). No aversive reaction similar to that occurring at Crosslin I and McCanless' was observed.

Pratt's, Because of problems with vehicle access into this feeding operation, observations were made on the average of once every four days instead of two. Examination of Figure 6 indicates that the peak starling numbers in the feedlot (2, 8, 17, and 19 February) coincided either with the periods of snow cover or days in which the ground was frozen (indicated by air temperatures), thus prohibiting ground probing by starlings. The comparatively high starling population at the feedlot on the relatively mild day of 5 March remains unexplained. The starling activity derived from the time-lapse camera data (percent of pictures with starlings present) was correlated ($r = 0.68$) with mean air temperature. Thus, in this case, mean air temperature appeared to be related to the presence of starlings in the feedlot. However, these data indicate that considerable numbers of starlings were present at this feeding operation throughout the study period. This may have been due in large part to the large open-sided barn that provided loafing sites protected from weather.

Starlicide efficacy

A 90% average reduction in starling activity (blackbird and starling activity at Cotton's) at the four treated feeding operations over a combined 36 days was achieved using 51 kg of Layena prebait and 58.5 kg of Starlicide bait. The cost was approximately $98, or $2.72 per day exclusive of materials and labor.

Weather effect

A Spearman's rank correlation coefficient was determined for bird entries (pre- and posttreatment) and snow cover, and for bird entries and air temperature for each feeding operation (Table 4). Correlation between percent snow cover and bird entries was inconsistent; correlation with air temperature was nonexistent with the exception of Pratt's. The extremely low correlation between bird entries and percent snow cover at Crosslin I could have resulted from the salty ration and lack of feed. No reason can be given for the lack of correlation with snow cover at McCanless'.

Roost counts and species composition

Six roost counts ranged from a low of 188,000 on 4 February to a peak of 304,000 on 18 February, and down to 194,000 on 8 March. Snow cover was fairly well correlated with high roost counts (Spearman's coefficient of rank correlation was 0.67), but high roost counts were not correlated with mean daily air temperature.

Grackles dominated the species composition counts at the roost with an average percentage of 47.6. Male redwings averaged 21.7% of the population, followed by starlings with 18.8%, and cowbirds and female redwings with 12.1 %. This pattern held true for all counts except for the 25 January count when starlings predominated with 41 % of the total. The overall consumption of 26 kg of Starlicide (Table 3) at the four treated feeding operations may have contributed to the starling percentage reduction.

Nontarget and secondary poisoning hazards

No nontarget dead birds were found. In eighteen 0.5 ha observations very few birds other than starlings and grackles were seen in the bait pans or troughs. One cardinal *(Cardinalis cardinalis)* and one blue jay *(Cyanocitta cristata)* were seen feeding once in one bait pan, and a red-bellied woodpecker *(Centurus carolinus)* (presumably the same bird) made several trips to one pan. On several occasions, a number of cardinals, savannah sparrows *(Passerculus sandwichensis),* and Eastern meadowlarks *(Sturnella domesticus)* were seen on the ground around the feeders. I consider the nontarget hazard using our baiting technique minimal.

A marsh hawk *(Circus cyaneus)* and an unidentified buteo were seen once near one feeding operation, and sparrow hawks *(Falco sparverius)* occurred with some regularity around two feeding operations. We never saw these hawks feeding on birds.

CONCLUSIONS AND RECOMMENDATIONS

Unfortunately, the inconsistent pattern of snow cover, which coincided in 79% of the cases with posttreatment bird activity estimates, precluded determination of the effectiveness of Starlicide baiting. The observed posttreatment bird activity reductions of about 90% may have been caused as much by lack of snow cover as by Starlicide. Circumstances in which occasional snows force bird activity at feedlots up to a level where prebaiting and baiting is required but the snow melts by the time posttreatment bird activity estimates can be taken, confounds analyses and interpretation of the data. In addition, the winter was abnormal (the mean daily air temperature was 6.7 degrees colder than normal--no records are kept on snowfall, only precipitation). Future studies of this type should be of an experimental design to compensate for variations of weather on bird activities.

Bait aversion may be a problem in long-term use of Starlicide. The notable change in starling behavior in Crosslin I and McCanless' feeders when they were baited for the second time indicated the possibility. Even though Starlicide was used judiciously (i.e.,exposing it for short periods of time [1 or 2 days]), bait aversion began to occur; however, aversion was not observed at the other two sites.

Our conservative use of only 57 kg of rather expensive bait (approximately $1.50 per kg) product in pans and troughs is in contrast with the liberal baiting instructions on the Starlicide label. This label has directions to spread as much as 20 lb/acre (22kg/ha) on the ground in areas larger than 10 acre (4 ha) and as high as 50 lb/acre (55kg/ha) in areas less than 10 acres. When the bait is spread on the ground, the operator in effect loses control of it. He cannot retrieve it in cases of impending precipitation, which breaks down the pelletized baits thereby resulting in having to rebait, or in cases where bait aversion is beginning to occur.

A better way to use Starlicide is to prebait and bait in pans or troughs (even on hay wagons, which can be drawn under shelter) so bait can be removed when bait aversion or precipitation occurs. In situations where starling populations are low, one baiting may suffice. But in cases where a feeding operation is subject to continued high bird activity, Starlicide may eventually become ineffective even if many bait stations are used and the chemical employed judiciously. Thus, the use of Starlicide should be part of an integrated pest management program for alleviating bird problems at feedlots.

ACKNOWLEDGEMENTS

I thank Ginger Murphy, Sandy Suddarth, and Alfred Collins who helped with the study; H. Y. Beeler, Williamson county Extension Agent for his cooperation in locating sites; and the feeding operation owners Justin Crosslin, Ennis Wallace, James McCanless, Ted Thomas, Robert Cotton, and Dallas and Clair Pratt for their cooperation. I also thank Sandra Silvey for drawing the figures, Mean air temperature for each 24-hr period was taken from the U.S. Weather Bureau records Franklin, Tennessee.

LITERATURE CITED

Besser, J. F., W. C. Royall, Jr., and J. W. DeGrazio. 1967. Baiting starlings with DRC-1339 at a cattle feedlot. J Wildl. Mgmt. 31:48-51.

Besser, J. F., J, W. DeGrazio, and J. L. Guarino. 1968. Costs of wintering starlings and red-winged blackbirds at feedlots. J. Wildl. Mgmt. 32:179-180.

DeCino, T. J., D. J. Cunningham, and E. W. Schafer, Jr. 1966. Toxicity of DRC-1339 to starlings. J. Wildl. Mgmt. 30:249-253.

Dolbeer, R. A., A. R. Stickley, Jr., and P. P. Woronecki. 1978-79. Starling *(Sturnus vulgaris)* damage to sprouting wheat in Tennessee and Kentucky, U.S.A. Protection Ecology 1:159-169.

Dolbeer, R. A., P. P. Woronecki, A. R. Stickley, Jr., and S. B. White. 1978. Agricultural impact of a winter population of blackbirds and starlings. Wilson Bull. 90:31-44.

Harriman, A. E., and M. R. Kare. 1967. Tolerance for hypertonic saline solutions in herring gulls, starlings, and purple grackles. Physiol. Zool. 39:117-121.

Royall, W. C, Jr., T. J. DeCino, and J. F. Besser. 1967. Reduction of a starling population at a turkey farm. Poult. Sci. 46:1494-1495.

Russell, H. G. 1975. Blackbird control at two Army installations--Environmental Impact Statement. Office Chief, Eng., Directorate Facilities Eng., Wash., D.C. (A copy has been place in the Van Tyne Library, Univ. of Mich., Ann Arbor.)

Stickley, A. R., Jr., R. A. Dolbeer, and S.B . White. 1976. Starling damage to sprouting wheat in Tennessee. Proc. Seventh Bird Control Seminar, Bowling Green, Ohio. pp. 30-38.

Stickley, A. R., Jr., D. L. Otis, and D. T. Palmer. 1979. Evaluation and results of survey of blackbird and mammal damage to mature field corn over a large (three-state) area. *In* Vertebrate Pest Control and Management Materials. American Society for Testing and Materials, Philadelphia, PA. pp. 169-177.

Tennessee Crop Reporting Service. 1978. Tennessee Agricultural Statistics. Annual Bulletin T-15.

West, R. R. 1968, Reduction of a winter starling population by baiting its preroosting areas. J. Wildl. Mgmt. 32:637-640.

DISCUSSION

Q: When you employ Starlicide, are you putting it in trays or in troughs where the cattle and pigs can get to it?

A: No, these were out of range of the cattle, on top of the feeders.

Table 1. Pertinent data on feeding operations -- Starlicide test, late winter, 1979, Williamson County, Tennessee.

Name and type of operation	Square meters of trough or area studied	No. and type of livestock	Ration		Distance from roost (km)
			Feed	Cost (kg)	
Crosslin I (Feeder)	1.6	15 beef cattle	35% crushed corn 35% cotton seed 30% salt	$0.18	1.4
Crosslin II (Feeder)	0.5	3 beef cattle	steam-rolled corn protein pellets molasses, oats	$0.22	7.5
McCanless' (Feeder)	2.9	15 beef cattle	oats and ground corn	$0.11	8.8
Pratt's* (Feeding area)	35.0	100 pigs	coop 16% pig grower pellet	$0.15	2.1
Cotton's (Feeding area)	195.0	60 pigs	whole kernel corn	$0.13	4.7

*Control

Table 2. Prebait and bait applications in each feeding operation -- Starlicide test, late winter, 1979, Williamson County, Tennessee. (Days refer to length of time bait was exposed.)

Type of operation	First Prebaiting-Baiting	Second Prebaiting-Baiting	Third Prebaiting-Baiting	Total Starlicide Used
Crosslin I	Prebait: cattle feed Bait: 10 kg Starlicide w/10 kg cattle feed (2 days)	Prebait: Layena Bait: 5 kg Starlicide w/5 kg Layena (1 day)		15.0 kg
Crosslin II	Prebait: cattle feed Bait: 7.5 kg Starlicide w/7.5 kg cattle feed (3 days)	Prebait: Layena Bait: 1 kg Starlicide w/1 kg cattle feed (1 day)		8.5 kg
McCanless	Prebait: cattle feed Bait: 10 kg Starlicide w/10 kg cattle feed (2 days)	Prebait: cattle feed Bait: 5 kg Starlicide w/5 kg Layena pellets (1 day)		15.0 kg
Cotton	Prebait: Layena and corn Bait: 10 kg Starlicide w/10 kg corn (2 days)	Prebait: Layena and corn Bait: 5 kg Starlicide w/5 kg corn (1 day)	Prebait: corn Bait: 5 kg Starlicide w/5 kg corn (1 day)	20.0 kg

Table 3. Percent reduction in bird entries/min after each baiting compared with prebaiting period -- Starlicide test, late winter, 1979, Williamson County, Tennessee.

Feeding operation	Bird entries/min pretreatment period	After first baiting	After second baiting	After third baiting
Crosslin I	14.37	84% (4 obs days over 6 day period) (7.5 kg Starlicide consumed)	99% (3 obs days over 6-day period) (4 kg Starlicide consumed)	
Crosslin II	20.30	65% (4 obs days over 5-day period) (4.0 kg Starlicide consumed)	94% (2 obs days over a 3-day period) (0.4 kg Starlicide consumed)	
McCanless	3.17	97% (4 obs days over 5-day period) (3.3 kg Starlicide consumed)	100% (1 obs days over 1-day period) (0.2 kg Starlicide consumed)	
Cotton	3.77	96% (1 obs day over 2-day obs period) (6 kg Starlicide consumed)	79% (1 obs day over 2-day obs period) (0.5 kg Starlicide consumed)	82% (2 obs days over 5-day period) (almost no Starlicide consumed)

Table 4. Spearman's Rank Correlation Coefficients for bird entries and percent snow cover, and bird entries and mean daily temperature -- Starlicide test, late winter, 1979, Williamson County, Tennessee.

Feeding operations	Bird entries/min[a] and percent snow cover	Bird entries/min[a] and mean daily air temp.
	(Control operation)	
Pratt's	0.71**	0.80**
	(Treated operations)	
Crosslin I	0.58N.S.	0.68 N.S.
Crosslin II	0.85**	0.40 N.S.
McCanless	0.52 N.S.	0.51 N.S.
Cotton's	0.82*	0.66 N.S.

[a] Pre- and posttreatment combined.

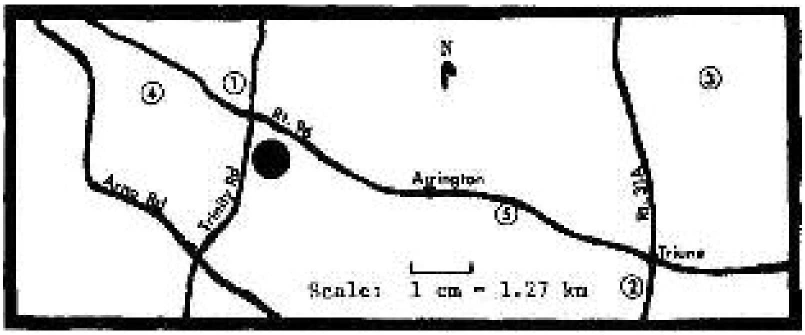

FIGURE 1. Area of Starlicide test in Williamson County, Tennessee, in January-March 1979. Large black circled area is roost. Small circled numbers represent feeding operations: (1) Crosslin I, (2) Crosslin II, (3) McCanless', (4) Pratt's, and (5) Cotton's.

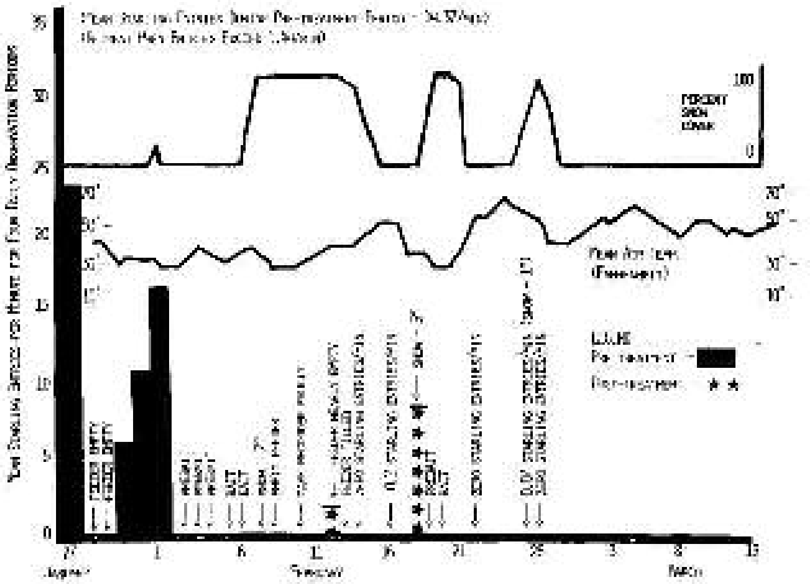

FIGURE 2. Chronology of weather and mean starling entries per minute at Crosslin I feeding ofoperation -- Starlicide test, late winter, 1979, Williamson County, Tennessee.

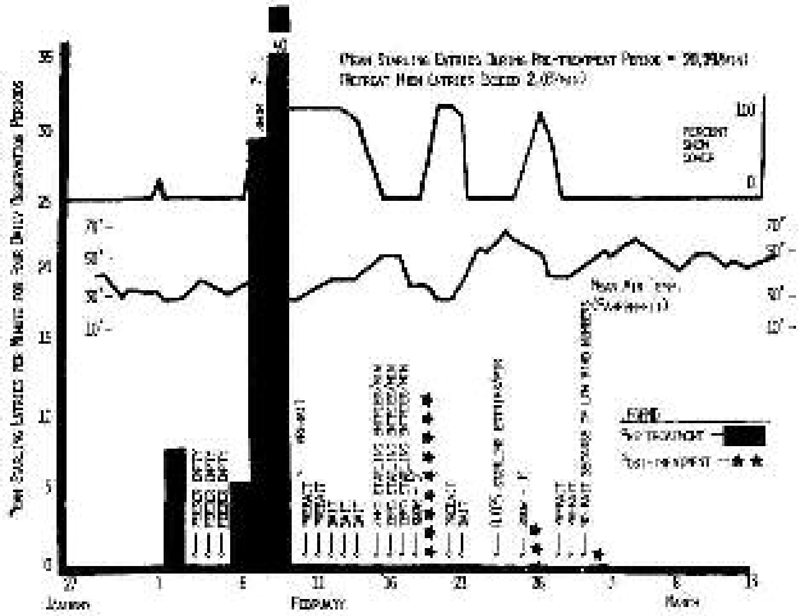

FIGURE 3. Chronology of weather and mean starling entries per minute at Crosslin II feeding operation -- Starlicide test, late winter, 1979, Williamson County, Tennessee.

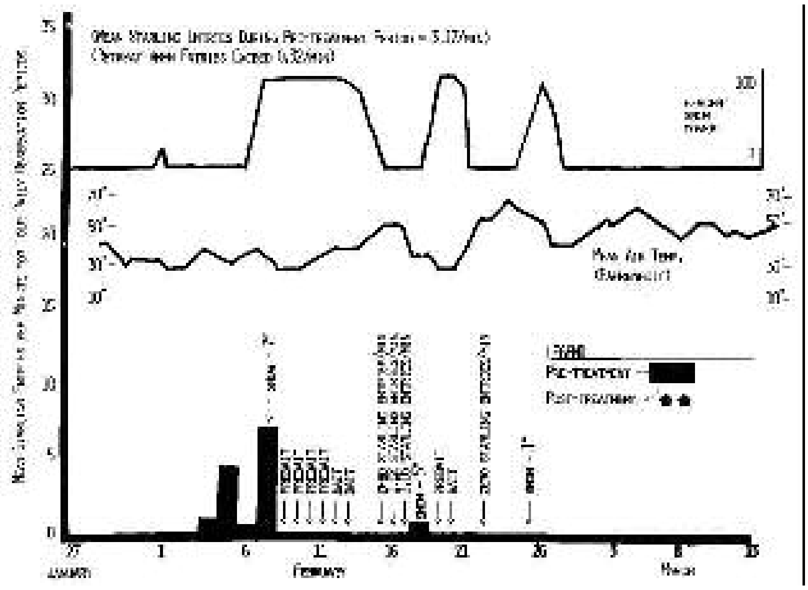

FIGURE 4. Chronology of weather and mean starling entries per minute at McCanless' feeding operation -- Starlicide test, late winter, 1979, Williamson County, Tennessee.

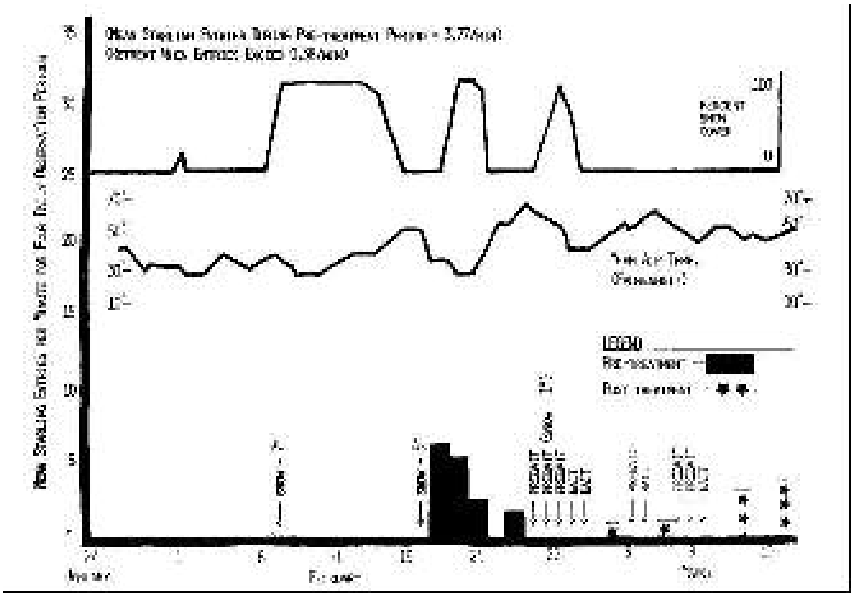

FIGURE 5. **Chronology of weather and mean starling entries per minute at Cotton's feeding operation -- Starlicide test, late winter, 1979, Williamson County, Tennessee.**

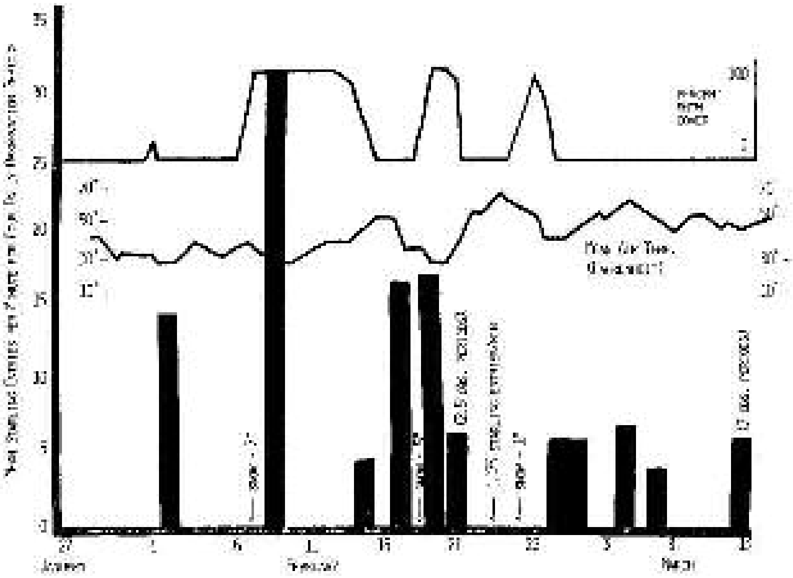

FIGURE 6. **Chronology of weather and mean starling entries per minute at Pratt's feeding operation -- Starlicide test, late winter, 1979, Williamson County, Tennessee.**