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INTRODUCTION

The chemical frightening agent 4-aminopyridine (4-AP) has been repeatedly tested as a means of protecting both ripening corn (De Grazio et al. 1971, 1972; Besser et al. 1973; Besser 1976; Dolbeer et al. 1976; Stickley et al. 1972, 1976; Woronecki et al. 1979) and sunflower (Besser and Guarino 1976; Besser and Pfeifer 1978; Henne et al. 1979; Besser et al. in press) from depredating blackbirds. It was reported that less than one percent of a flock need ingest the treated baits and respond with distress symptoms in order to move birds from a corn field (De Grazio et al. 1972) or even shift roosting aggregations from night roosts (Cummings 1979). However, there is still conflicting evidence as to whether frightened blackbirds will subsequently avoid nearby fields, or even the same treated fields, resulting in efficient protection. The efficacy of 4-AP has not been resolved because of questions about the presentation and formulation of the treated baits and the difficulty of conducting a valid, unambiguous field test.

This study was a large-scale evaluation of Avitrol® (HCl) FC-Corn Chops-99S[1], where all commercial sunflower fields were monitored within a 144-sq mi block centered around a major concentration of roosting blackbirds; and all those fields with significant bird pressure were baited. The test was designed to answer two questions: can selective baiting (1) reduce damage overall when compared with pre-treatment damage from 1981, and (2) disperse it within the block? In other words, can the treatment keep blackbirds out of preferred fields? If so, is the result an overall reduction in damage within the surrounding area, or is it a redistribution of the damage?

METHODS

Study Area

Pre-treatment damage assessments and blackbird counts were made by Sterner and Hothem in 1980, 1981, and 1982 (unpubl repts[2]) in a 144-section block surrounding Sheyenne Lake, Sheridan County, North Dakota. In both 1980 and 1981 the major blackbird roost for the area was at Sheyenne Lake. In 1982, however, the roost shifted to Johnson Marsh at the NE edge of the block. In this study the block was moved so as to be centered around Johnson Marsh, where the major roost was again situated in 1983 (Figure 1).

Field Selection

All sunflower fields within the block were mapped and periodically checked for evidence of bird pressure. The principal method of locating damage was by following major flightlines of birds departing roosts each morning. Baiting was initiated on 19 August when bird damage was first beginning. Criterion for selecting a field for treatment was the presence of 1,000 or more blackbirds on two or more separate days.

Baiting

Baiting lanes usually were made in fields to be treated by knocking down a single row of sunflower every 55 yds (or 66 rows, assuming a 30-inch spacing). (See Table 1 for exceptions.) Avitrol baits were applied at 1 lb/field-acre with a three-wheeled, all-terrain cycle to which was mounted a Herd, Model GT-77 seed broadcaster. Bait swaths were 10 ft. in width. Individual bait lanes were re-baited following $\geq$ 0.50 in of rainfall or the otherwise disappearance of baits, but only if $\geq$1000 birds continued to use the fields.

Analysis of Baits

Baits were analyzed by thin-layer chromatography (TLC) before, during, and after the study to determine 4-AP levels. Blackbirds also were caught in the test area and dosed with treated bait to measure the distress response.

Test Design and Analysis

Bird damage in 40 fields from 1983 was compared with that obtained from 38 fields in 1981. In both years fields were randomly selected by block quadrant (NE, SE, NW, SW), the number selected being proportional to the total number of fields in each quadrant. By extrapolating these assessments to the total number of fields within blocks, an estimate was made of overall damage in each 144-sq mi block for comparison between years. In addition, the distribution of damage for both years was compared by ranking sampled fields by level of total damage, then comparing them using the non-parametric Kolmogorov-Smirnov Test. These comparisons assume similar bird numbers in both years and the equivalence of two different areas. It was originally intended to compare results from a treatment year to three years of baseline data, but damage assessments from 1980 and 1982 could not be used because of the incompatibility of the field sampling method or lack of bird pressure. Thus, the results of statistical comparisons must be viewed in the context of very limited baseline data.

Damage Assessments

Bird damage in the test fields and in all the treated fields from 1983 was sampled by dividing each field into three strata of equal width, randomly selecting four rows from each stratum, and sampling systematically along each of the rows. Seventy-five 5-ft linear plots were placed in each field, the number of plots in each stratum being proportional to its area. A template grided into 5cm^2 units (Stone 1972, unpubl rept; Otis 1981, unpubl rept) was used to measure the total area of bird damage on each head within plots. Diameters of sunflower heads and their undeveloped centers were measured with a steel tape measure, the area of the undeveloped center being subtracted. All fields were harvestable at the time of assessment.

Bird Observations

Blackbird numbers and species composition were estimated by periodic counts of numbers in the dawn flightlines from roosts within the block. Treated fields were checked daily for the presence of blackbirds; and flock size, species composition, affected birds, and flock response were recorded. Searches for 4-AP-HCl killed or affected blackbirds and for non-target birds were made periodically on both bait lanes and in nearby roosting vegetation.

RESULTS

Treated Fields

Twenty-three fields (1402 acres) from a total of 204 within the block were baited, the

first on 19 August and the last on 19 September. The location of these fields is illustrated in Figure 1. The number of baitings/field, the quantity of bait/field, and bird damage/field are listed in Table 1.

Analysis of Baits

Avitrol corn baits were analyzed for levels of 4-AP on 11 August. The amount of 4-AP (free-base equivalent) from five sets of randomly selected baits ranged from 1.7 - 3.7%, averaging slightly above the desired 3.0%. Stored baits were similarly analyzed after terminating the field work; they showed no chemical loss. Further testing indicated that the 4-AP was near the bait surface, facilitating rate of uptake during digestion. Baits exposed in the field for six days to 0.62 inches of rainfall range from 1.1 - 2.0% 4-AP (free-base equivalent). This represents a dosage from 2 to 8 mg/kg for a 75 g bird, or a time to first distress ranging from 21 to 75 minutes (Cunningham et al. 1982, unpubl rept).

During the course of the field work 10 male red-winged blackbirds (*Agelaius phoeniceus*) were captured by mist net and dosed by gavaging a single treated corn particle ($\bar{x}$ = 29.9 mg) into the gizzard. The median time to first distress vocalization was 59 minutes (range 30 to 127 min), with one bird showing no effect. These times are consistent with field observations.

Bird Observations

The main roost at Johnson Marsh peaked in early September at approximately 100,000 blackbirds. At this time, the nearby roost at Seibels was an estimated 14,000 (Table 1, Figure 1). By 7 September the two of these had dropped to a combined 56,000, while at the same time smaller, scattered roosts (up to 15) simultaneously appeared with combined numbers of 57,000. Scattered roosts persisted until termination of the study on 7 October. The Sheyenne Lake roost peaked at 2,500 on 25 August. Overall, redwings represented 60-70% of observed blackbirds, with common grackles (*Quiscalus quiscula*) varying from 15-30%, and yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) varying from 10-15%. On 12 October 1981 Sterner and Hothem (1982, unpubl rept) estimated numbers were a combined 104,000 from Johnson Marsh and Sheyenne Lake with the species composition in general agreement with that from 1983. Thus there was a similarity in observed blackbird numbers between 1981 and 1983.

Bait-lane checks and field observations in treated fields yielded 184 4-AP affected birds: 176 dead or immobile and 8 in the erratic flight referred to as towering. Of this number 26% were redwings, compared with 30% yellowheads, 16% grackles, 20% undetermined, and 8% non-target species. Treated field numbers 9, 12, 20, 21, 22, 25, 26, and 34 (see map of Figure 1 and Table 1) received the most persistent bird pressure; and it is these fields in which observations of feeding birds were concentrated. Intensive observations were made each morning (0730-0930) from 20 August to 20 September and on most afternoons (1600-1800) of these days; at least two fields were observed during each two-hour period. These fields were occasionally observed after 20 September.

It was common to see 5,000 blackbirds stop briefly at the first sunflower field in the path of the morning flightline, but the greatest number was about 15,000 on 26 August in Field 34. Many birds would stop only briefly before drifting further down the flightline. In those fields with a slough or marsh (9, 12, 20, 21, 22, 25, & 26), 2-3,000 birds often remained throughout the day. Flock response to an affected bird (mobbing/hovering) was noted 30 times; on several occasions two or more occurred during the same observation period in a field. Generally the response would occur at least one hour after birds entered the field and would last less than one minute before the flock re-settled in the field. However, flocks departed the field following 11 of these mobbing/hovering responses. In fields 8, 10, 13, 32, and 46, birds did not return following baiting, In fields 9, 12, 20, 21, 22, 25, 26, 34, 42, and 43, blackbirds continued to return in similar numbers from two to six weeks.

1981 vs 1983 Bird Damage

Overall estimated bird damge in 1983 (7.67×10^8 cm^2 $\pm$ 2.73×10^8, 1 SE) for 204 fields in the block was not significantly different from that in 1981 (10.22×10^8 cm^2 $\pm$ 2.53×10^8, 1 SE) with 143 fields ($z = 0.6856$, $p = 0.4930$). Based on an average seed weight of 0.2 g/cm^2, this represents a loss of 338,471 to 561,086 lbs (or $37,232 to $61,720 at $11.00/100 lbs) in 1981 *vs* 217,632 to 457,548 lbs (or $33,733 to $70,920 at $15.50/100 lbs) in 1983. Average size of sample fields was 45.9 acres ($\pm$ 34.1, 1 SD) in 1981 *vs* 64.4 acres ($\pm$ 54.2, 1 SD) in 1983. Overall loss was 1.7% in 1983 for about 13,138 ac *vs* 5.3% in 1981 for 6,564 ac.

Randomly sampled fields in 1983 ($n = 40$) separate themselves from those in 1981 ($n = 38$) when ranked by total damage/field (Kolmogorov-Smirnov Test, $p = 0.0005$; see Figure 3). This supports a treatment effect which spread the damage. This difference, however, was caused by differences at the low end of the ranking, where damage/field was inconsequential and not by a significant reduction in the number of fields with appreciable loss. Twenty-five of the lowest 32 damaged fields were from 1983, while at the same time 7 of the top 16 and 11 of the top 30 were from 1983. When all fields of one percent or less damage are dropped from the ranking (8 from 1981 and 35 from 1983), there is no difference in the cumulative proportion of the remaining 1983 *vs* 1981 damaged fields at the higher damage levels (Kolmogorov-Smirnov Test, $p = 0.8187$).

DISCUSSION

Although the damage in 1983 appears to be lower than in 1981, there is no statistical difference in overall damage between years. The high variance among sampled fields in both years makes finding a treatment effect unlikely. In fact, it would have been necessary to sample approximately one-half of all fields in order to detect a true difference of the magnitude estimated above. However, these results, together with the observation that blackbird numbers were similar in both years, do not provide sufficient evidence to conclude that blackbirds avoid sunflower as a result of experiencing distressing cohorts. This is consistent with laboratory observations (Jaeger et al. 1983). It is, however, possible that 4-AP-experienced blackbirds departed the block but were replaced by inexperienced migrants. Besser et al. (1973) maintained that an overall reduction in bird numbers can occur in following years when experienced birds go elsewhere.

Sample fields from 1983 ranked lower against 1981 fields for bird damage, suggesting that damage was dispersed as a result of the treatment. Dispersal is a potentially important benefit, if as a result no fields have high damage; and growth compensation occurs or is increased. Evidence suggests that sunflower, damaged within two weeks of anthesis, can compensate for up to 15% loss on a head by increasing the weight of the remaining seeds (Sedgwick et al. 1983, unpubl rept). Spreading damage might, therefore, result in an overall greater growth compensation. While no sample field in 1983 had greater than 11% bird damage, four of the highest nine damaged fields ($>$ 4,400 lbs, Figure 2) were from 1983; and three of these had been treated, one of which lost an estimated 26,289 lbs (valued at $4075).

Alternative explanations to a treatment effect for dispersing damage are that it results from an increase in the number and size of fields in 1983 and/or more scattered roosts within the 1983 block of fields. Assuming that there are roughly the same number of blackbirds in both years and that these birds tend to concentrate damage, as opposed to spreading it, then the addition of 43% more fields in 1983 could result in more randomly selected fields at the low end of the ranking. Roost counts and damage assessments supported these assumptions. The distribution of blackbird roosts within blocks might be another factor contributing to the increase in the number of 1983 fields with light damage. The major roost in 1983 at Johnson Marsh appeared to splinter into smaller roosts in early September. There were at least 15 scattered roosts, ranging in size from several hundred up to 40,000 blackbirds. This roost pattern persisted throughout the remainder of the study.

The continued presence of similar numbers of blackbirds in some treated fields for up to six weeks does not support a treatment effect. These 10 fields were all closely associated with roosting/loafing marshesWhile blackbirds did not return to the other treated fields, similar abandonment was also seen in untreated fields and can be related to influences, such as seed maturity or variety, availability of new fields, shifts in roosting sites, predators, and inclement weather. In addition, there was no clear and consistent departure of feeding flocks in response to affected birds. Similar observations were made by Mott et al. (1980, unpubl rept) and Knittle et al. (1981, unpubl rept), both of whom also noted that affected birds attracted predators (*Circus cyaneus*) which drove off blackbirds temporarily.

The generally poor flock response to affected birds seems to be at odds with conclusions of other reports, most notably that 4-AP baits can disperse blackbird roosts (Cummings 1979). The difference may lie in the number of affected birds at any one time. We rarely saw more than two affected birds, whereas Cummings reported a minimum of 54 at one evening roost site. Field size also may be an important factor. Larger fields may be more difficult to protect, because they provide greater area in which feeding flocks can avoid affected birds.

Poor flock response may also have been due to the slow response times of affected birds. Redwings captured and dosed by gavage showed a median time of 60 min to first response or double that of the median time for fasted redwings; they also vocalized less. Slower response times may, therefore, be due to the presence of food in the gastrointestinal tract, which slows the rate of assimilation of the 4-AP (Cunningham, Sultana, Besser pers ob).

Bait acceptance by redwings, the predominent species by number (70%), was less than for yellowheads (15%); of the 132 affected blackbirds observed, only 35% were redwings. This is consistent with other observations where chopped corn baits have been used in either ripening corn or sunflower. Redwings tend to break the chopped corn baits before consuming them, perhaps reducing the dosage of 4-AP to ineffective levels. In addition, they prefer to feed on the soft seeds in heads rather than on hard corn baits and prefer sunflower baits to corn baits. Improving bait acceptance by redwings seems to be an important step in increasing the numbers of affected birds.

In conclusion, there is a clear, statistical difference between 1983 and 1981 in the ranking of field damage. This supports a treatment effect which disperses damage. However, there is also a real possibility that this difference was due to the large increase in number of fields and/or a more scattered roost pattern in 1983, rather than to the 4-AP-HCl baiting. It is also important to realize that damage data from two different areas in two different years does not provide a sound basis for valid statistical comparison. Therefore, these conclusions must be viewed as tentative until the study can be replicated during the next two years. Questions on bait acceptance and on the quality of the distress response also need to be resolved.

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LITERATURE CITED

Besser, J. F. 1976. 4-Aminopyridine for protecting crops from birds - A current review. Proc. Vert. Pest Conf. 7:11-16.

Besser, J. F., J. W. De Grazio, and J. L. Guarino. 1973. Decline of a blackbird population during seven years of baiting with a chemical frightening agent. Proc. Bird Control Seminar, Bowling Green, Ohio. 6:12-14.

Besser, J. F. and J. L. Guarino. 1976. Protection of ripening sunflowers from blackbird damage by baiting with Avitrol FC Corn Chops - 99S. Proc. Bird Control Seminar, Bowling Green, Ohio. 7:200-203.

Besser, J. F. and W. K. Pfeifer. 1978. Improvements of baiting methods for protecting ripening sunflowers from blackbirds. Proc. Sunflower Forum. 2:11-12.

Besser, J. F., D. J. Brady, T. L. Burst, and T. P. Funderberg. In press. 4-Aminopyridine baits on baiting lanes protect sunflower fields from blackbirds. Protect. Ecol.

Cummings, J. L. 1979. An evaluation of 4-aminopyridine for dispersing winter blackbird roosts in Colorado. Proc. Bird Control Seminar, Bowling Green, Ohio. 8:248-253.

De Grazio, J. W., J. F. Besser, T. J. DeCino, J. L. Guarino, and R. I. Starr. 1971. Use of 4-aminopyridine to protect ripening corn from blackbirds. J. Wildl. Manage. 35(3):565-569.

De Grazio, J. W., J. F. Besser, T. J. DeCino, J. L. Guarino, and E. W. Schafer, Jr. 1972. Protecting ripening corn from blackbirds by broadcasting 4-aminopyridine baits. J. Wildl. Manage. 36(4):1316-1320.

Dolbeer, R. A., C. R. Ingram, J. L. Seubert, A. R. Stickley, and R. T. Mitchell. 1976. 4-Aminopyridine effectiveness in sweet corn related to blackbird population density. J. Wild. Manage. 40(3):564-570.

Henne, D. R., W. D. Pfeifer, and J. F. Besser. 1979. Bird damage to sunflower in North Dakota in 1978. Proc. Sunflower Forum, Fargo, North Dakota. 3:16-17.

Jaeger, M. M., D. J. Cunningham, R. L. Bruggers, and E. J. Scott. 1983. Assessment of methiocarb-impregnated sunflower achenes as bait to repel blackbirds from ripening sunflowers. Proc. Bird Control Seminar, Bowling Green, Ohio. 9: in press.

Stickley, A. R., Jr., R. T. Mitchell, R. G. Heath, C. R. Ingram, and E. L. Bradley, Jr. 1972. A method for appraising the bird repellency of 4-aminopyridine. J. Wildl. Manage. 36(4):1315-1316.

Stickley, A. R., Jr., R. T. Mitchell, J. L. Seubert, C. R. Ingram, and M. I. Dyer. 1976. Large-scale evaluation of the blackbird frightening agent 4-aminopyridine in corn. J. Wildl. Manage. 40(1):126-131.

Woronecki, P. P., R. A. Dolbeer, C. R. Ingram, and A. R. Stickley, Jr. 1979. 4-Aminopyridine effectiveness evaluated for reducing blackbird damage to corn. J. Wildl. Manage. 43(1):184-191.

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[1] Avitrol is the registered trade name and product of the Avitrol Corporation. Use of trade names does not imply endorsement by the Federal Government. The product contains the chemical 4-aminopyridine-HCl as the active ingredient. Recent studies show the acid salt to be more stable than the free base.

[2] Unpublished reports referred to in this paper are Bird Damage Research Reports available through the Section of Birds, Denver Wildlife Research Center, Denver, Colorado.

TABLE 1. Description of 4-AP treated fields, bait application, and pre-harvest damage for the 144-section block near Harvey, North Dakota in 1983.

Field	Map No.	Area (A)	4-AP Baiting 1st Appl (date)	Rebaitings[1]	Total lbs	Pre-Harvest Bird Damage Status	Total Loss ($cm^2 x 10^{-6} \pm$ 1SE)	% Loss ± 1 SE	lbs Loss[2]
Alexander-1	42	45	19/8	4	184	Sample	6.63 ± 0.91	3.6 ± 0.4	2918.6
Alexander-2	43	21	20/8	4	80		1.73 ± 0.28	2.6 ± 0.4	761.1
Alexander-3	41	12	1/9	2	12		2.16 ± 0.36	5.4 ± 0.9	951.4
Alexander-4	46	77	1/9	2	169	Sample	6.28 ± 2.13	3.2 ± 1.0	2761.2
Seibel-1	21	269	24/8	6	783	Sample	59.75 ± 17.24	6.1 ± 2.7	26289.4
Seibel-2	22	26	25/8	4	140		5.34 ± 0.46	10.6 ± 4.9	2349.3
Seibel-3	20	32	25/8	4	200		4.69 ± 1.80	4.3 ± 2.2	2062.1
Freuh-1	40	27	19/8	3	75		1.58 ± 0.35	3.2 ± 0.8	695.3
Freuh-2	39	28[3]	21/8	2	16		1.20 ± 0.28	2.3 ± 0.5	527.9
Freuh-3	33	9	23/8	2	20		4.00 ± 0.69	12.9 ± 2.2	1761.8
Koble	34	126[4]	20/8	4	244		3.50 ± 0.64	0.8 ± 0.2	1539.8
Feickert-1	29	63	26/8	3	150		1.00 ± 0.36	0.6 ± 0.3	439.4
Feickert-2	37	129[4]	27/8	2	120	Sample	0.96 ± 0.27	0.2 ± 0.1	422.0
Schneider-1	26	112[5]	30/8	3	205		25.08 ± 12.07	8.3 ± 3.3	11033.5
Schneider-2	25	63[5]	31/8	3	95		8.80 ± 2.35	5.3 ± 1.7	3874.0
Schneider-3	31	48[5]	4/9	2	70		0.71 ± 0.35	0.9 ± 0.5	312.8
Hase	8	37	9/9	2	60		1.72 ± 0.74	3.2 ± 1.4	757.2
Faul-1	9	28	9/9	2	43		10.84 ± 2.78	9.5 ± 3.9	4767.9
Faul-2	12	69	10/9	2	80	Sample	11.58 ± 4.20	5.4 ± 0.2	5097.0
Faul-3	10	54	19/9	1	50		5.25 ± 2.06	4.7 ± 2.6	2308.7
Feisel-1	13	35	13/9	2	80		16.84 ± 2.59	12.8 ± 2.0	7411.3
Feisel-2	14	73	16/9	1	45		5.20 ± 1.92	3.1 ± 1.1	2286.5
Schmidt	32	19	14/9	2	50		9.74 ± 1.48	27.7 ± 3.3	4284.8
TOTALS		1402			2971				85613

[1] This includes partial baiting and rebaiting [2] Based on 2 g/cm² [3] Single bait lane [4] One-half of field baited [5] Solid-seeded

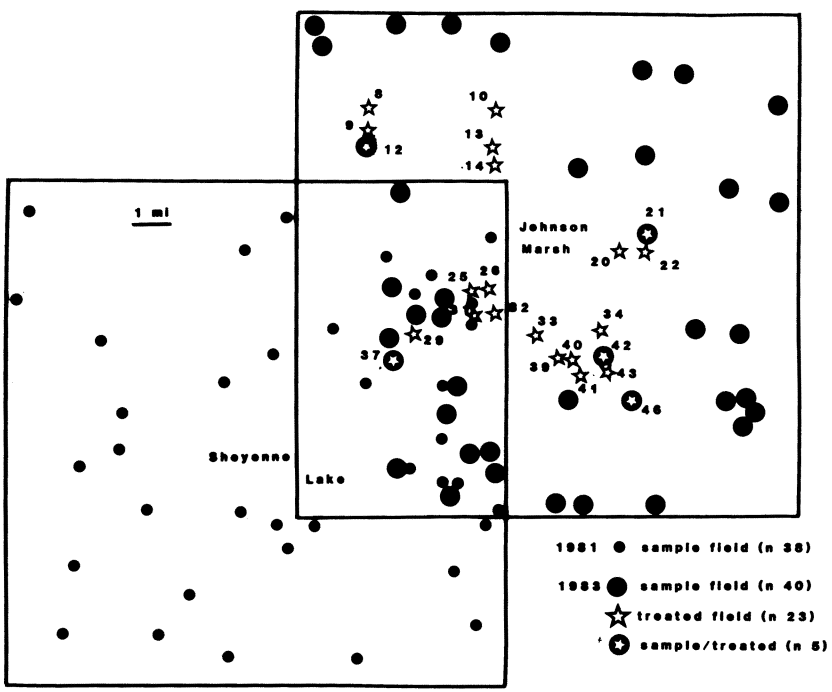

FIGURE 1. Distribution of Sampled and Treated Sunflower Fields Centered Around Sheyenne Lake in 1981 and Around Johnson Marsh in 1983.

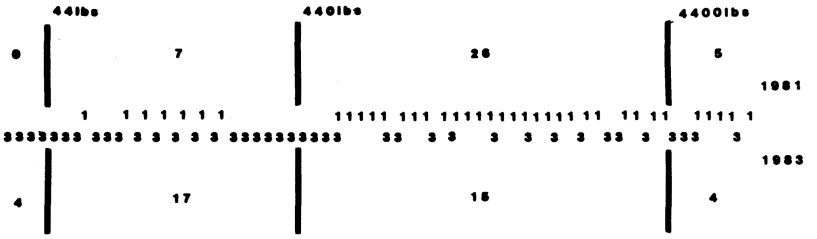

FIGURE 2. Ranking of Sample Fields from 1981 (38) *vs* 1983 (40) Based on Bird Damage (lbs).