10-1983

CHEMICAL CONTROL OF DEPREDATING BLACKBIRDS IN ONTARIO FIELD CORN

J. D. Somers
Alberta Environmental Center

F. F. Gilbert
Washington State University

R. J. Brooks
University of Guelph, rjbrooks@uoguelph.ca

D. E. Joyner
University of Southern Illinois

CHEMICAL CONTROL OF DEPREDATING BLACKBIRDS IN ONTARIO FIELD CORN

J. D. Somers
Alberta Environmental Center
Vegreville, Alberta
F. F. Gilbert
Department of Zoology
Washington State University
Pullman, Washington
R. J. Brooks
Department of Zoology
University of Guelph
Guelph, Ontario
D. E. Joyner
Department of Zoology
University of Southern Illinois
Carbondale, Illinois

INTRODUCTION

Corn depredation by red-winged blackbirds (*Agelaius phoeniceus*) has been an agricultural problem in southwestern Ontario for many years. Large marsh areas along the shoreline of Lakes Erie and St. Clair provide ideal habitat for breeding and roosting. Concurrently, the vast monocultural field corn acreages in Kent and Essex Counties have over the years been the centers for blackbird depredation in the province. The expansion of corn production into other areas of Ontario has, however, resulted in a province-wide distribution of damage, and substantial crop losses for specific individual farmers (Tyler and Kannenberg, 1980).

The Ontario Ministry of the Environment (OME) provided funding for a four-year research program on the importance, ecology and control of blackbirds in 1976 following mounting concern by Ontario corn producers. Dyer (1968) completed a major study on red-winged blackbirds in Dover Township, Kent County during the period 1964-68; however, the evaluation of 4-AP efficacy was a minor component of the project (Dyer, 1976). Thus, the OME required efficacy data on 4-AP for current Ontario conditions for registration purposes, regardless of the 1972 registration in the U.S.A. Methiocarb (3,5-dimethyl-4(methylthio) phenol methylcarbamate) (Mesurol®, Mobay Chemical Corp.) was also a candidate compound because of the known taste aversion properties (Rogers, 1974; Crase and Dehaven, 1976). Again, the OME required data on the efficacy of methiocarb as a bird repellent in ripening field corn. Research on the potential for lethal roost control was an initial objective; however, this component of chemical control was not pursued. Conversely, lethal control at foraging sites was not an initial objective, however, ecological studies completed (Somers et al., 1981b) suggested that the use of toxicants in a corn field may have potential. Pilot studies using Starlicide® (Ralston-Purina Co.) and α-chloralose at foraging sites were completed to evaluate this hypothesis.

The ultimate objective of the four-year study was to formulate a management plan for applications. Regardless, because non-target hazards appeared minimal (Somers et al., 1981a), the OME re-classified the commercial 4-AP product for controlled use in field corn in Ontario. Subsequent use of 4-AP by Ontario corn growers has, however, been limited because of the uncertainty of efficacious bird control.

The results of the 1976 methiocarb pilot study in Kent County were encouraging because bird damage was marginally reduced (Table 4) in the non-treated plots. Field observations supported the illustrated reduction in the damage data in that foraging birds appeared to avoid the methiocarb treated rows (particularly $control_2$ rows). The proximity of treated rows to $control_1$ rows within each block may in fact have produced an avoidance of both, but not the $control_2$ rows elsewhere in the field. The subsequent field-scale methiocarb applications in Simcoe County to the fields suffering extensive depredation were not effective ($p > 0.05$) in reducing bird damage to maturing field corn (Table 5). Although environmental factors may have reduced the efficacy of methiocarb treatments in 1977 (Joyner et al., 1980), the cost:benefit analysis showed that exorbitant methiocarb treatment costs would exceed the practical limits for use in field corn.

Dolbeer et al. (1976) proposed that the percentage of ears damaged was a valid index of bird numbers in the 4-AP test area. This assumption has merit; however, if the assumption is valid, the overall percentage of ears damaged in both Ontario counties indicated that bird pressure was therefore high in both test areas. However, the small but significant ($p < 0.05$) amount of damage inflicted in 1976 was comparable to that reported by Dolbeer et al. (1976) and Stickley et al. (1976b) where 4-AP did not reduce bird damage. Overall bird damage to corn in Simcoe County (compare Kent County) was over 7 times greater (Table 1) for 4-AP trials, and even greater in methiocarb-treated fields; hence bird pressure was greater. Thus, the proposed relationship between bird pressure and 4-AP efficacy (Dolbeer et al., 1976) was not evident in our trials. Consequently, even in areas under severe feeding pressure an individual corn grower in Ontario, and perhaps elsewhere, could not be assured of satisfactory protection by using the commercially available 1% 4-AP repellent.

Gartshore et al. (1982) found that weediness in field corn had little effect on blackbird field use and corn damage; however, certain weeds may impede the efficacy of 4-AP applications (Forbes, 1974). Others disagree (De Grazio et al., 1972), but the only positive cost:benefits in 1977 4-AP trials were in essentially weed-free corn fields. Therefore, regardless of bird pressure, uncontrollable environmental and human factors may have influenced our 4-AP trials, and are likely to be operative under practical grower programs as well.

A greater percentage of treated particles in the 4-AP bait may be necessary at locations subjected to extreme foraging stress. This was proposed by Dolbeer (1976) for areas with low but persistent bird pressure. However, regardless of the treatment form of the 4-AP repellent, foraging blackbirds must eventually feed in the repellent-stressed areas if alternate sites are unavailable (Dyer, 1976). This phenomenon may have been demonstrated in Simcoe County in 1977 because alternate corn-feeding areas for birds were limited. An alternate but complimentary hypothesis may be that over time many of the individuals of a foraging flock are constantly changing (Somers et al., 1981b). Hence a re-learning process must occur each time new individual birds enter a repellent-treated field. This lack of aversive conditioning in new individuals could therefore contribute to the inefficiency of repellents (Martin, 1977).

In summary, the lack of effective control of depredating blackbirds by the use of a repellent in Ontario, and perhaps elsewhere, may in reality be a function of the above hypotheses: bird pressure (Dolbeer et al., 1976); weediness (Forbes, 1974; Somers et al., 1981a); the 4-AP treatment level (Dolbeer et al., 1976; Somers et al., 1981a); the lack of alternate primary feeding areas (Dyer, 1976); and the turnover of individuals in foraging flocks (Somers et al., 1981b).

Concurrently, the apparent turnover of individuals suggested that employment of lethal compounds (versus repellents) at corn fields may have potential as a addressing blackbird depredation problems in Ontario. This strategy would incorporate ecological data into physical and chemical control programs unique to specific regions of the province. This overall objective was not realized at an operational level; however, recommendations to OME and producers were forthcoming. This report details the results of various trials on chemical control of depredating blackbirds in Ontario. Portions of this report have been previously documented (Joyner et al., 1980; Somers et al., 1981a,b); however, unpublished data on methiocarb, Starlicide® and α -chloralose is also presented.

METHODS AND MATERIALS

The initial studies on 4-AP and methiocarb were completed in Dover Township, Kent County in 1976 (Fig. 1). Five corn fields (2-20.3 ha; 3-12.2 ha) on different farms with historically high crop losses were treated with 1.12 kg/ha of 4-AP (3.36 kg/ha of bait to one-third of each field). Excluding that bait was applied by hand-operated cyclone seeders, the 4-AP applications followed the regulations specified by the registration label issued by the U.S. Environmental Protection Agency. Non-treated (control) fields with the same corn varieties, similar stage of maturity, and equal size on the same farms were selected for comparison purposes. One field received only two applications of 4-AP, and four were treated three times during the period 9 August to 2 September 1976. Fixed times and dates of application would be more statistically sound perhaps; however, we were attempting to maintain a practical approach to all trials. Thus, treatment dates varied (cf. decisions a producer might make) because of rainfall, bait loss, bird pressure or crop development.

Studies in 1977 were in Tay and Medonte Townships, Simcoe County, Ontario (Fig. 1). In this region the productive agricultural land is limited, hence corn acreages are typically small (3-15 ha) and scattered. Conversely, in Dover Township in Kent County, corn fields less than 20 ha are rare and contiguous tracts up to 400 ha are common. Thus, in Simcoe County 16 locations (3.7 to 13 ha) totalling only 118.5 ha were treated with 4-AP. Respective control fields were again employed for comparison; however, eight of the 16 4-AP fields (selected randomly and totaling 74.2 ha) were treated aerially (Piper Pawnee aircraft with Venturi spreaders). Each farm (location) was considered as a block in an RCB design with subsampling (Steel and Torrie, 1960) for analysis of the respective trials. Specific details of 4-AP trials are documented in Somers et al. (1981a).

In 1976, a total of 0.8 ha within a 7.3-ha corn field received a methiocarb application. This pilot study was small because the treated crop had to be destroyed. Six adjacent blocks of eight rows separated by a four-row buffer zone comprised the experimental area. Four rows within each block were sprayed with methiocarb while the remaining four rows served as controls ($Control_1$). Six other four-row plots ($Control_2$) were randomly selected elsewhere in the field as a check on the experimental controls. Methiocarb (75% W.P.) was applied by a "Hi-Boy" sprayer equipped with drop nozzles at a rate of 3.36 kg A.I./ha in a water solution at the rate of 393.1 ℓ/ha and 34.1 kg pressure. Weather conditions were calm and clear. Only a single application was utilized.

Physical restraints of the experimental design (four rows/treatment/block) restricted sampling to four ears per sub-sample. Utilizing tables prepared by Granett et al. (1974), 35 sub-sample points were randomly selected for each block/treatment along the rows. Sampling was across the rows, resulting in 840 ears/treatment for the damage assessment. Analysis was based on a CRD design with subsampling (Steel and Torrie, 1960).

Six fields (2.1-4.1 ha) in Simcoe County were sprayed in 1977 with the commercial 75% WP product. Piper Pawnee aircraft fitted with spray booms and Micronair nozzles applied methiocarb in water solutions at the rate of 18.8 ℓ/ha. Treatment levels (Table 5) were varied to control costs, and were assigned randomly. Non-treated areas of equal size were used for comparison, and again, details of the 1977 methiocarb trial are outlined in Joyner et al., 1980.

The pilot studies with Starlicide® and α-chloralose were completed in Simcoe County in 1979. The three fields selected had 75-90% of the ears damaged during methiocarb or 4-AP trials in 1977, thus each was known to have a history of intensive depredation of blackbirds. Four wooden trays (1 m x 1 m x 5 cm) supported about 1 m off the ground were used as bait-stations in pre-baiting and the initial Starlicide® trials at one site, but were abandoned as birds refused to feed from them. Thus Starlicide® and α-chloralose baits were spread on ground-plots within or adjacent to the study fields.

Starlicide® bait in the form of pelletized ground corn was prepared by the Ralston-Purina Co., St. Louis, Mo. Each pellet contained 0.1% by weight active ingredient (3-chloro-p-toluidine hydrochloride). Two study sites of 6.1 and 4.1 ha utilizing eight and six bait-stations (350 m^2) respectively were treated with a total of 136 and 91 kg of bait proportioned over six applications from 22 August through 7 September 1979. Total application averaged 22.2 kg/ha/site. Two additional fields of about 4 ha each were selected as controls and were observed over the same time period. Efficacy of Starlicide® treatments was evaluated by observation of fields to estimate changes in bird visitation, by searching treated fields and adjacent areas for dead birds, by monitoring the roost population, and by assessing crop damage upon termination of baiting.

Alpha-chloralose was obtained from Fisher Scientific Co. Ltd. Twelve 1-kg-lots of bait were prepared by mixing 10 g of α-chloralose with 1 kg of screened (2-4 mm) cracked corn and 20 ml of mineral oil yielding a 1% (wt/wt) mixture. Each kg of bait was prepared separately by mixing the oil with the corn, and then mixing small amounts of the 10 g α-chloralose lot into the oil-corn preparation. All 12 lots were then placed in a plastic bag within a cardboard drum and rolled for 15 min to insure a homogeneous mixing of the total 12 kg of bait. Because only a small amount of chemical was available, the trial was limited in terms of dosage and field size.

One field of 1.6 ha was used for the α-chloralose trial. Half the field (0.8 ha) received 2-6 kg applications of treated bait (31 August and 4 September) yielding a total level of 15 kg/ha. Two swathes of about 750 m^2 were baited in the initial application, while 3-500 m^2 areas received bait during the second application in an effort to increase bait distribution. The remaining 0.8 ha of the study field served as the non-treated control area. Efficacy was assessed by 3-30 min observations/day of bird pressure followed by searches for stupified or dead birds, and by estimating corn damage.

Fifteen random samples of 20 corn ears (2/corn row) in fields treated with 4-AP, methiocarb, Starlicide®, or α-chloralose, and in the respective non-treated corn fields were selected for damage assessment; excluding the 1976 Kent County methiocarb study. A cost-benefit analysis of 1977 4-AP and methiocarb trials (Joyner et al., 1980; Somers et al., 1981a) used a length-weight table (De Grazio et al., 1969) modified for 1977 Ontario conditions by the Crop Science Department, University of Guelph.

RESULTS AND DISCUSSION

Overall, 4-AP reduced ($p < 0.05$) blackbird damage to field corn in two vastly different agricultural regions of Ontario (Table 1). Similar results were reported for 4-AP trials in field corn in South Dakota (De Grazio et al., 1972) and Ohio (Stickley et al., 1976), and for sweet corn in Wisconsin (Knittle et al., 1976) and Idaho (Mott, 1979). However, the lack of 4-AP effectiveness at all test locations (Tables 2 and 3) was comparable to reports by Stickley et al. (1976b) and Woronecki et al. (1979), suggesting that the province-wide use of 4-AP in Ontario would be as inconclusive as in Ohio. Positive cost:benefit ratios at only six of 16 sites in 1977, and an overall negative benefit following 4-AP use in Simcoe County (Table 3) substantiated the guarded University of Guelph recommendation to the OME that 4-AP use would not ensure protection. The amount of damage/ear and the net reduction in damage in Kent County (Table 1) were small, and would probably have yielded a negative cost:benefit. In effect then, only six of 21 corn fields in two counties yielded a positive cost:benefit profile following 4-AP management (control) option in some areas in Ontario. Late summer roosts used by foraging blackbirds in Kent and Simcoe counties in Ontario were *Typha* sp. marshes, with direct contact with open water of the Great Lakes (i.e., L. St. Clair, Georgian Bay). Proper ambient environmental conditions for utilization of Tergitol would be limited in mid-summer, and the ecological consequences of a roost control program in these aquatic ecosystems could be significant. Thus, we conducted the pilot studies with Starlicide® and α-chloralose in 1979 to evaluate the potential for lethal control at foraging sites.

Applications of Starlicide® to corn fields did not reduce depredation (Table 6); however, altering the carrier may have potential. The commercially available pellets were too readily degraded (compare to Avitrol®). Although the trial was limited in size, application of α-chloralose reduced ($p < 0.05$) bird damage to field corn (Table 6), lending support to the hypothesis that lethal control may have potential at foraging sites. The α-chloralose cracked corn carrier was resistant to depredation, thus a similar carrier for Starlicide® may prove advantageous. These results must, however, be treated with caution because of the limited trial size.

Sixty-six blackbirds and starlings (*Sturnus vulgaris*) in various states of narcosis were recovered in 21 searches of the α-chloralose treated and control areas of the α-chloralose study site during the treatment period. Only 27 (40.9%) were dead or subsequently died. Red-winged blackbirds comprised 71.2% (47) of birds recovered with 31.9% (15) ultimately dying. Over 75% were females; however, only 27.8% died compared to 45.5% of captured male red-winged blackbirds. An age-sex partitioning of recovery and mortality data indicated that α-chloralose was most toxic to hatching year birds of both sexes and to adult males. One grackle (*Quiscalus quiscula*) was recovered from the treated field and ultimately died.

The 18 starlings recovered represented 27.3% of all stupified birds found. Although the number found was small, this was perhaps quite ecologically significant as previous definitive evidence of starlings foraging in standing corn crops had been lacking. All starlings were adults with the majority (61.1%) males. Females appeared less susceptible to α-chloralose as only 42.9% failed to recover compared to 72.7% of the males. Because affected birds that did not die at the site could have left the area prior to becoming unconscious, the total impact of α-chloralose on foraging red-winged blackbirds and/or starlings could not be obtained. Further work would be necessary; however, evidence of a negative impact on non-target species was not apparent in these preliminary trials in Simcoe County.

Non-target mortality was minimal with the other chemical trials (Joyner et al., 1980; Somers et al., 1981a) suggesting that although a cognizance of potential hazards must be maintained, the ecological consequences of using repellents or toxicants at monocultural foraging sites in these corn growing regions of Ontario would be insignificant.

We concluded that (1) many corn growers are not in need of chemical repellents or toxicants, (2) mesurol should be limited to crops that produce a high economic return, (3) a strategy for control of depredating blackbirds must be integrated and selective in the use of physical and chemical controls and aware of potential ecological consequences, (4) growers may need to alter cultural practices, (5) a close scrutiny of weed control is necessary, and (6) alterations of currently available chemical products may prove benefical.

ACKNOWLEDGEMENTS

The co-operation of many producers in Kent and Simcoe counties was essential and was greatly appreciated. Access to property controlled by Bradley Farms Inc. and the Canadian Wildlife Service (CWS) in Dover Township, and by CWS and the Ontario Ministry of Natural Resources in Simcoe County is acknowledged. We also acknowledge Chipman Chemicals Ltd., Stoney Creek, Ont., Chemagro Ltd., Mississauga, Ont., and Ralston-Purina Co. Ltd., St. Louis, MO., for providing treated bait, chemicals and technical advice; K. Chute and D. Burns of Crop Protection Services, Cambridge, Ont. for completing the aerial applications; and the many students who assisted throughout the study. Funding was provided by the Ontario Ministry of the Environment.

LITERATURE CITED

Crase, F. T., and R. W. De Haven. 1976. Methiocarb: its current status as a bird repellent. Proc. Vertebr. Pest Conf., Davis, Calif. 7:46-50.

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

De Grazio, J. W., . J. F. Besser, J. L. Guarino, C. M. Loveless, and J. L. Oldemeyer. 1969. A method for appraising blackbird damage to corn. J. Wildl. Manage. 33:988-994.

Dolbeer, R. A., C. R. Ingram, J. L. Seubert, A. R. Stickley, Jr., and R. T. Mitchell. 1976. 4-aminopyridine effectiveness in sweet corn related to blackbird population density. J. Wildl. Manage. 40:564-570.

Dyer, M. I. 1968. Blackbird and starling research program, 1964-68. Ontario Dep. Agric. and Food, Toronto. 29 pp.

__________. 1976. Red-winged blackbird flock feeding behaviour in response to repellent stress. Proc. Seventh Bird Control Semin., Bowling Green State Univ., Bowling Green, OH. 7:204-224.

Gartshore, R. G., R. J. Brooks, F. F. Gilbert, and J. D. Somers. 1982. Census techniques to estimate blackbirds in weedy and non-weedy field corn. J. Wildl. Manage. 46:429-437.

Granett, P., J. R. Trout, D. H. Measersmith, and T. M. Stockdale. 1974. Sampling corn for bird damage. J. Wildl. Manage. 38:903-909.

Joyner, D. E., J. D. Somers, F. F. Gilbert, and R. J. Brooks. 1980. Use of methiocarb as a blackbird repellent in field corn. J. Wildl. Manage. 44:672-677.

Knittle, C. E., J. L. Guarino, O. E. Bray, J. L. Cummings, and M. R. Ouellette. 1976. Protecting ripening sweet corn from blackbirds in Wisconsin with 4-aminopyridine. Proc. Seventh Bird Control Seminar, Bowling Green State Univ., Bowling Green, OH. 7:188-194.

Martin, M. L. 1977. Flocking and roosting activities of the red-winged blackbird in southern Quebec. M.Sc. thesis. McGill Univ., Montreal, Quebec. 102 pp.

Mott, D. F. 1976. Protecting ripening sweet corn from blackbirds in Idaho with 4-aminopyridine. Proc. Seventh Bird Control Seminar, Bowling Green State Univ., Bowling Green, OH. 7:195-199.

Rogers, J. G. 1974. Responses of caged red-winged blackbirds to two types of repellents. J. Wildl. Manage. 38:418-423.

Somers, J. D., F. F. Gilbert, D. E. Joyner, R. J. Brooks, and R. G. Gartshore. 1981a. Use of 4-aminopyridine in cornfields under high foraging stress. J. Wildl. Manage. 45:702-709.

Somers, J. D., R. G. Gartshore, F. F. Gilbert, and R. J. Brooks. 1981b. Movements and habitat use by depredating red-winged blackbirds in Simcoe County, Ontario. Can. J. Zool. 59:2206-2214.

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

Steel, R. G. D., and J. H. Torrie. 1960. Principles and procedures in statistics. McGraw-Hill Book Co. Inc. Tronoto, Ontario. 481 pp.

Tyler, B. M. J., and L. W. Kannenberg. 1980. Blackbird damage to ripening field corn in Ontario. Can. J. Zool. 58:467-472.

Wornecki, P. P., R. A. Dolbeer, C. R. Ingram, and A. R. Stickley, Jr. 1979. 4-aminopyridine effectiveness re-evaluated for reducing blackbird damage to corn. J. Wildl. Manage. 43:184-191.

TABLE 1. Effect of 4-AP treatment on blackbird damage to corn in Kent (1976) and Simcoe (1977) Counties, Ontario.

Treatment[a]	County[b]	Damaged ears (%)	Damage/ear (%)	Damage/ear (row-cm)
Control		33.1	1.3	4.2
4-AP	Kent	20.7	0.6	1.8
Difference		12.4	0.7	2.4
Control		47.5	9.1	24.8
4-AP	Simcoe	32.6	5.3	14.4
Difference		14.9	3.8	10.4

[a] Treatment means/county/variable are different ($p < 0.05$).

[b] Five fields in Kent Co. and 16 fields in Simcoe Co./treatment.

TABLE 2. Impact of 4-AP test location on variability of ear damage assessment variables, Kent County, Ontario, 1976.

Variable	Test location 1	2	3	4	5
Damaged ears, %	16.8[ab]	23.7[ab]	31.6[bc]	51.6[b]	10.7[a]
Damage/ear, %	0.5[ab]	0.9[bc]	1.4[b]	1.8[d]	0.2[a]
Damage/ear, row-cm	1.6[a]	2.8[b]	4.4[c]	5.7[c]	0.7[a]

[a,b,c,d] Location means for each variable followed by the same superscript are not different ($P > 0.05$).

TABLE 3. Cost:benefit analysis of 4-AP efficacy, Simcoe County, Ontario, 1977.

Location[c]	Loss kg/ha[a] NA	A	Δ	Benefit analysis ($/ha)[b] Benefit	Cost	Net
1	521	521			10.53	-10.53
2	509	170	339	23.22	10.53	12.69
3	1,488	998	490	33.57	10.53	23.04
4	521	502	19	1.30	10.53	-9.23
5	998	1,017	-19	-1.30	10.53	-11.83
6	998	1,004	-6	-0.41	10.53	-0.94
7	1,017	1,017			10.53	-10.53
8	44	44			10.53	-10.53
9	170	170			16.59	-16.59
10	1,017	38	979	67.06	16.59	50.47
11	170	521	-351	-24.04	22.12	-46.16
12	170	44	126	8.63	16.59	-7.96
13	1,563	521	1,042	71.38	22.12	49.26
14	521	170	351	24.04	22.12	1.92
15	170	521	-351	-24.04	16.59	-40.63
16	509	170	339	23.22	16.59	6.63

[a]NA = no treatment; A = 4-AP treatment; Δ = difference between treated and untreated values.

[b]Canadian $ and field corn market value of $68.50/tonne.

[c]Locations 1-8 ground treated, 9-16 aerial treated.

TABLE 4. Effects of methiocarb treatment on damage assessment variables, Kent County, Ontario, 1976.

Variable	$Control_1$	$Control_2$	Methiocarb
Damaged ears (%)[a]	9.8^y	17.0^z	8.0^y
Damage/ear (%)	0.36	0.71	0.83

[a] Values followed by the same letter are not different ($p > 0.10$).

TABLE 5. Damaged ears (%), and cost:benefit analysis of methiocarb efficacy, Simcoe County, Ontario, 1977.

	Damaged	Loss (kg/ha)[b]			Value in dollars[c]	
Site[a]	ears (%)	NT	M	Benefit	Cost	Net
1	82.2	1,996	1,996		113.85	-113.85
2	97.2	3,070	3,070		113.85	-113.85
3	93.5	2,028	1,500	36.17	185.14	-148.97
4	94.2	2,078	2,624	-37.40	185.14	-222.54
5	28.0	521	521		37.95	-37.95
6	55.0	998	1,017		37.95	-39.25

[a]Sites 1, 2, single application @2.81 kg A.I./ha; Sites 3, 4, 2.81 kg A.I./ha and 2nd application @ 1.68 kg A.I./ha; Sites 5, 6, single application @ 2.81 kg A.I./ha to 1/3 of field area.

[b] NT = no treatment; M = methiocarb.

[c] Canadian $, and field corn market value of $68.50/tonne.

TABLE 6. Efficacy of Starlicide® and α -chloralose treatments as measured by % damaged ears, row-cm damage and % damage per ear.

Treatment[a]	Damaged ears (%)	Damage (row-cm)	Damage (%)
Starlicide[b]	85.7	69.2	25.3
None	67.0	43.7	16.1
α -chloralose[c]	50.0	35.9	11.7
None	63.0	62.9	19.3

[a] Respective treatments, compared to no treatment are different ($p < 0.05$).

[b] Mean of 2 fields/treatment.

[c] One 1.6 ha field was treated with α -chloralose.