BIRD REPELLENT SEED CORN TREATMENT: EFFICACY EVALUATIONS AND CURRENT REGISTRATION STATUS

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Bird damage to sprouting corn can be a serious problem for some farmers. Questionnaire surveys returned by 337 wildlife and agricultural specialists in 25 States indicated that losses of corn sprouts to birds in 1971 could amount to as much as $49 million (Stone and Mott 1973). Objective surveys in Kentucky and Tennessee in 1978 and 1979, respectively, set annual sprout losses to blackbirds (mainly common grackles *[Quiscalus quiscula]*) and crows (*Corvus brachyrhynchos)* at $1.8 million (Heisterberg, in press). Although losses in both states averaged $<1\%$, 32 (7%) of the 485 fields surveyed received $>1\%$ losses accounting for 82% of the total damage.

Treating seed corn with a chemical repellent is frequently used to reduce blackbird and crow damage to sprouting field corn in the Southeastern and mid-Atlantic States (Stone and Mott 1973). However, quantitative surveys of sprout losses to birds in treated fields in Kentucky and Tennessee indicated some federally registered seed treatments do not always give satisfactory results (Heisterberg, in press). One treated field had an estimated 64% sprout loss to blackbirds. This prompted me to compare the efficacies of the most frequently used, commercially available seed corn treatments.

Presently there are four commercially available seed corn treatments specifically registered in the United States as bird repellents: Borderland Black®, Crow-Chex®, and Stanley's Crow Repellent® (Borderland Products, Inc.); and Mesurol 50% Hopper-Box Treater® (Mesurol) (Mobay Chemical Corp.). The active ingredient in Mesurol and Borderland Black is methiocarb (3,5-Dimethyl-4-(methylthio) phenol methylcarbamate); the active ingredient in Crow-Chex is copper oxalate; and the active ingredients in Stanley's Crow Repellent are coal tar and creosote. All products are registered for use in all states except for Borderland Black, which can only be applied by a certified applicator in states east of the Mississippi River. This paper compares the bird repellent efficacies of Borderland Black, Crow-Chex, Mesurol and Curb® (Sphere Laboratories, Ltd., London) with controls. Curb, containing aluminum ammonium sulfate as the active ingredient, was also tested as it is marketed as a bird repellent seed corn treatment in Europe. Stanley's Crow Repellent was not tested because the manufacturer plans to take the product off the market as soon as current inventories are depleted.

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METHODS

Two cage trials, using a change-over test design (Federer 1955) in which treated and untreated seed corn was planted and subsequent emerged sprouts unearthed and offered in different treatment sequences to common grackles, were used to compare the efficacies of the different treatments. The change-over design selected allowed for estimation of and adjustment for any potential residual effects that might carry over from a previous treatment. Because of the chemical nature of the treatments, it was felt that there existed some potential for residual effects from a treatment given the preceding test period. In the first trial (Trial I) in August 1980, label application rates for 100 lbs of seed corn of 8 oz Mesurol (0.25% methiocarb/seed wt.), 16 oz Mesurol (0.5% methiocarb/seed wt.), and 16 oz Crow-Chex (0.04% copper oxalate/seed wt.) were compared with controls. In the second trail (Trial II) in July 1981, label application rates for 100 lbs of seed corn of 14.3 oz Borderland Black (0.17% methiocarb/seed wt.), 8 oz Mesurol, and 80 oz Curb (5.0% aluminum ammonium sulfate/seed wt.) were compared with controls.

For each trial, 36 grackles were trapped in the early summer and cage-acclimated a minimum of two weeks prior to testing. All birds were given poultry pellets and water *ad libitum* before and during testing. The 36 grackles were assigned to three groups to maximize among-group heterogeneity while minimizing within-group heterogeneity. Groups in Trial I consisted of 12 after-hatching-year birds, 12 hatching-year birds in first winter plumage, and 12 hatching-year birds in juvenile plumage. Groups in Trial II consisted of 12 after-hatching year males, 12 after-hatching-year females, and 12 hatching-year birds of unknown sex. Birds within each group were randomly placed in four 5 x 10 x 5 ft outdoor cages containing three birds each, henceforth referred to as grackle units. A 4-by-4 Latin square block was randomly assigned to each of the three groups, and each grackle unit within a group was randomly assigned a specific treatment sequence.

Commercial seed corn, treated with the appropriate seed treatment, was planted 6-8 days before the beginning of the first test period each year. Sprouts averaged 1-4 in tall when unearthed and offered to birds. Test birds were preconditioned to eating

unearthed sprouts by offering each grackle unit 100 untreated sprouts each day beginning three days before the first test period. Each grackle unit received 120 sprouts of the designated treatment from 8:30 to 11:30 a.m. daily, during each four-day trial. Unearthed sprouts were intact with most of the soil shaken from the roots.

Damage to sprouts was assessed after a 3-hour exposure to each grackle unit. A sprout was recorded as damaged when the seed had been consumed or partially pulled apart. The total number of sprouts damaged daily by each grackle unit was used in the anlaysis of variance as outlined for the change-over design (Federer 1955). Duncan's New Multiple Range Test was used to identify differences between treatments. For a more detailed description of the change-over test design and its application for comparing efficacies of seed treatments see Heisterberg and Otis (1983).

RESULTS AND DISCUSSION

CHANGE-OVER TEST DESIGN

The number of sprouts damaged by grackle units in Trials I and II are given in Tables 1 and 2, respectively. In both trials, analyses of variance yielded differences ($P<0.01$) among test periods, grackle units within groups, and direct treatment effects. In Trial II, test period-by-group interaction and residual treatment effects were also different ($P<0.05$). Because of the design used, the differences among test periods, units within groups, test period-by-group interaction, and residual treatment effects could be removed from the experimental error, thereby resulting in a more efficient and sensitive comparison of the bird repellent efficacies of the seed corn treatments.

Comparison of the mean daily consumption values for different treatments showed that sprouts treated with the methiocarb products were consumed significantly less ($P<0.05$) than either Crow-Chex, Curb, or untreated sprouts (Table 3). There were no differences ($P>0.05$) in consumption between Crow-Chex and untreated sprouts (Trial I) nor between Curb and untreated sprouts (Trial II). There were also no differences ($P>0.05$) in consumption between 16 and 8 oz Mesurol-treated sprouts (Trial I) nor between 8 oz Mesurol and Borderland Black-treated sprouts (Trial II). These same significant differences between treatments were detected using mean consumption values unadjusted for residual effects except for Borderland Black and control (Table 3). By using unadjusted means, the faulty conclusion would have been drawn that Borderland Black did not protect corn sprouts from bird damage.

The three rates of methiocarb treatments tested, 0.17% (Borderland Black), 0.25% (8 oz Mesurol), and 0.5% (16 oz Mesurol), offered the best protection of the seed repellents tested. The success of the 0.5% methiocarb seed treatment is not unexpected as a number of researchers including Guarino and Forbes (1970) and Stickley and Guarino (1972) have had similar favorable results. The success of the 0.17 and 0.25% methiocarb treatments is somewhat unexpected as previous tests with methiocarb seed corn treatments of <0.5% have met with mixed results (West 1968, Hermann and Kolbe 1971). Although grackles consumed an average 36% more 0.25% methiocarb-treated sprouts than 0.5% methiocarb-treated sprouts (Trial I), and an average 41% more 0.17% methiocarb-treated sprouts than 0.25% methiocarb-treated sprouts (Trial II), these differences were not significant ($P>0.05$). This does suggest, however, that the higher the methiocarb treatment rate, the greater the protection.

ECONOMIC CONSIDERATIONS

Based on 1983 suggested retail prices and an average planting rate of 14 lbs seed corn (20,000 kernels) per acre, 8 oz Mesurol (0.25% methiocarb/seed wt.) can be applied for $1.31 per acre, 16 oz Mesurol (0.5% methiocarb/seed wt.) for $2.62 per acre, and Borderland Black (0.17% methiocarb/seed wt.) for $1.74 per acre. The sporadic nature and severity of bird damage in sprouting cornfields makes it impossible to make concrete recommendations on which methiocarb treatment rate to use. For purposes of discussion, I will select the

Table 1. Treatment sequence (A = control, B = 16 oz Mesurol, C = 8 oz Mesurol, D = Crow-Chex) and number of unearthed corn sprouts eaten by common grackles over three-hour test periods in Trial I.

Test Period (Date)	Group 1 3 hatching-year birds in first winter plumage/unit					Group 2 3 after-hatching-year birds/unit					Group 3 3 hatching-year birds in juvenile plumage/unit					Grand Total
	Unit 1	Unit 2	Unit 3	Unit 4	Total	Unit 5	Unit 6	Unit 7	Unit 8	Total	Unit 9	Unit 10	Unit 11	Unit 12	Total	
I (7 Aug)	A=99	B=44	C=64	D=92	299	A=118	B=36	C=56	D=91	301	A=107	B=61	C=31	D=75	274	874
II (8 Aug)	B=41	A=47	D=111	C=117	316	D=88	C=43	B=31	A=46	208	C=107	D=97	A=36	B=24	264	788
III (9 Aug)	C=20	D=29	A=96	B=47	192	B=32	A=40	D=88	C=25	185	D=77	C=26	B=8	A=60	171	548
IV (10 Aug)	D=42	C=23	B=42	A=106	213	C=19	D=79	A=100	B=14	212	B=26	A=80	D=18	C=21	145	570
Total	202	143	313	362	1020	257	198	275	176	906	317	264	93	180	854	2780

Table 2. Treatment sequence (A = Curb, B = control, C = Borderland Black, D = 8 oz Mesurol) and number of unearthed corn sprouts eaten by common grackles over three-hour test periods in Trial II.

Test Period (Date)	Group 1 3 after-hatching-year females/unit					Group 2 3 after-hatching-year males/unit					Group 3 3 hatching-year birds (sex unknown)/unit					Grand Total
	Unit 1	Unit 2	Unit 3	Unit 4	Total	Unit 5	Unit 6	Unit 7	Unit 8	Total	Unit 9	Unit 10	Unit 11	Unit 12	Total	
I (9 July)	A=104	B=91	C=33	D=43	271	A=87	B=83	C=59	D=21	250	A=64	B=100	C=18	D=37	219	740
II (10 July)	B=89	A=95	D=11	C=65	260	D=26	C=51	B=79	A=3	159	C=31	D=19	A=30	B=28	108	527
III (11 July)	C=30	D=30	A=1	B=23	84	B=20	A=35	D=20	C=3	78	D=26	C=38	B=14	A=96	174	336
IV (12 July)	D=24	C=20	B=11	A=96	151	C=9	D=29	A=5	B=4	47	B=42	A=33	D=15	C=68	158	356
Total	247	236	56	227	776	142	198	163	31	534	163	190	77	229	659	1959

Table 3. Mean consumption per three-hour test period per grackle unit of unearthed corn sprouts. Any two means not connected by the same line are different ($P < 0.01$ for Trial I, $P < 0.05$ for Trial II; means connected by the same line are not different ($P > 0.1$) for Trial I, $P > 0.05$ for Trial II).

Treatment	Unadjusted Mean	Mean Adjusted for Residual Effects
Trial I		
16 oz mesurol	33.8	33.1
8 oz Mesurol	46.0	43.9
Crow-Chex	73.9	74.3
Control	77.9	80.4
Trial II		
8 oz Mesurol	25.1	21.0
Borderland Black	35.4	34.5
Control	48.7	51.7
Curb	54.1	56.0

most economically priced, 8 oz Mesurol. Based on a grain harvest of 100 bushels per acre valued at $2.50 per bushel, a field would have to have received at least a 0.5% sprout loss to grackles before an 8 oz Mesurol treatment could be considered cost-effective. This is assuming that percent sprout losses are comparable to percent harvest losses. However, compensatory corn production by undamaged plants next to removed sprouts and factors such as replanting of damaged fields tend to lessen the impact of sprout losses by harvest time thus making this assumption untenable. Further, methiocarb apparently conditions birds to avoid treated food (Rogers 1974), meaning that birds have to damage some sprouts to acquire the necessary aversive conditioning. Therefore, I recommend that corn growers do not use 8 oz Mesurol unless they anticipate at least a 1% sprout loss to grackles. A similar recommendation can probably be followed if crows, ring-necked pheasants *(Phasianus colchicus)*, or red-winged blackbirds *(Agelaius phoeniceus)* are the depredating species. Stickley and Guarino (1972) and Hermann and Kolbe (1971) found methiocarb to be equally effective on these species albeit at a higher rate (0.5% methiocarb/seed wt.).

Some data indicate that damage may be predictable. In the Kentucky and Tennessee bird damage surveys, 99 (24%) of the 419 corn growers in whose fields sprout loss surveys were conducted considered past sprout loss to birds to be moderate or serious (Heisterberg, in press). Those growers who indicated that past losses were moderate or serious tended to be more likely to receive >1% sprout losses to their fields than growers who considered past losses to be of little or minor importance (2 x 2 contingency table analysis, $\underline{P} = 0.003$). This suggests that corn growers who felt that sprout losses to birds in past years was more than just a minor problem would probably benefit from an 8 oz Mesurol treatment. In especially serious cases of past damage, corn growers might want to use a 16 oz Mesurol treatment.

SUMMARY

Two trials, using a change-over test design in which treated seed corn was planted and subsequent emerged sprouts unearthed and offered in different treatment sequences to caged common grackles, were used to compare the efficacies of four bird repellent seed corn treatments. Label application rates for 100 lbs seed corn of 8 and 16 oz Mesurol 50% Hopper-Box Treater (Mesurol) (0.25% and 0.5% methiocarb/seed wt., respectively), 14.3 oz Borderland Black (0.17% methiocarb/seed wt.), 16 oz Crow-Chex (0.04% copper oxalate/seed wt.), and 80 oz Curb (5.0% aluminum ammonium sulfate/seed wt.) were tested. In the initial trial, grackles consumed fewer ($\underline{P} < 0.01$) 8 and 16 oz Mesurol-treated sprouts than either Crow-Chex-treated or untreated sprouts. There were no differences ($\underline{P} > 0.10$) in consumption between the two Mesurol application rates nor between Crow-Chex and untreated. In the second trial, grackles consumed fewer ($\underline{P} < 0.05$) 8 oz Mesurol-treated sprouts and Borderland Black-treated sprouts than either Curb-treated or untreated sprouts. There were no differences ($\underline{P} > 0.05$) in consumption between 8 oz

Mesurol and Borderland Black nor between Curb and untreated.

Based on 1983 suggested retail prices and efficacy, 8 oz Mesurol is recommended for protecting sprouting corn from birds. Corn growers are advised to use this seed corn treatment only if they expect at least a 1% sprout loss to birds. Those growers who consider past sprout losses to birds to be a moderate to serious problem should consider an 8 oz Mesurol treatment for their seed corn.

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