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VISUAL CUE FAILS TO ENHANCE BIRD REPELLENCY OF METHIOCARB IN RIPENING SORGHUM

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INTRODUCTION

Methiocarb (Mesurol®) produces a conditioned aversion which birds associate with a particular treated food and then avoid (Rogers 1974). Numerous field tests have shown that methiocarb is generally effective in reducing bird damage to ripening fruits when applied at rates of 1 to 2 kg/ha. Methiocarb was registered in the United States by the Environmental Protection Agency for use in cherries and blueberries during the 1980's (Dolbeer et al. 1988). These registrations were withdrawn by the proprietary company in 1989 because of additional studies required by EPA related to methiocarb residues and environmental effects.

These registrations could perhaps be reinstated and additional registrations for other crops obtained if application rates of methiocarb could be reduced to lower levels without compromising efficacy. Previous studies (Bullard et al. 1983) indicate that aversion to methiocarb often occurs at levels lower than birds can discriminate due to taste alone. To increase discrimination, inexpensive visual, olfactory or tactile cues have been added to methiocarb in laboratory tests to enhance detection and substantially reduce efficacious levels (Bullard et al. 1983, Mason and Reidinger 1982, 1983, Avery 1984, Mason 1989, Avery and Nelms 1990). The cue, in theory, enhances the birds' ability to recognize that a familiar food has been altered and to associate this alteration with illness.

The study reported here represents an effort to reduce the amount of methiocarb used in field applications by treating a crop (ripening sorghum) with methiocarb in association with a visual cue. The specific hypothesis tested was that methiocarb, applied to fields of ripening sorghum at 1.1 kg/ha in association with a visual cue [calcium carbonate (Elmahdi, et al. 1985)], would result in less bird damage than would occur in fields with methiocarb alone. Previous field studies have indicated that application rates of 2 to 3 kg of methiocarb (without

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visual cue)/ha are necessary to protect small grain crops such as sorghum from birds (DeHaven et al. 1971, Crase and DeHaven 1976, Bruggers et al. 1981, 1984).

METHODS

Nine 60-row by 171-m (0.8 ha) plots of sorghum (Jacques 377-w) were planted on 17 June 1987 in a 30-ha field at Ottawa National Wildlife Refuge, Lucas County, Ohio. Plant spacing averaged 5 cm and row spacing was 0.75 m within plots. Plots were 60 to 90-m apart (Fig. 1). The field was 2 km S of Metzger Marsh, a traditional late-summer roosting site for blackbirds on the Lake Erie shoreline (Dolbeer 1980).

Starting 15 August and at 2-day intervals until 10 September, an observer walked through each plot and examined 100 arbitrarily selected plants to determine the date when 50% of the plants had infloresced (head or panicle emerged from boot) and when ripening grains received initial bird damage. Maturity differed among plots because of variable field moisture following planting; therefore, the plots were grouped into three maturity groupings or blocks (Fig. 1). One of three treatments (methiocarb at 1.1 kg/ha A.I.; methiocarb at 1.1 kg/ha A.I. plus visual cue at 15.7 kg of calcium carbonate/ha; and untreated) was assigned randomly to each of the three plots within each maturity grouping.

Methiocarb was obtained from Mobay Chemical Corporation (Mesurol® 75% WP). The visual cue was an economy interior flat latex paint with the white pigment replaced with calcium carbonate at 0.88 kg/L. For application, visual cue was mixed with water in ratio of 1:1.6. The treatments were applied by a licensed aerial applicator using a Pawnee C agricultural spray aircraft. On treatment days, the applicator first applied visual cue to the three designated plots. Then, the applicator landed, rinsed the tank, and refilled the tank with Mesurol® which was promptly applied to the six designated plots.

The first application was on 10 September, the day after initial bird damage had been detected in the plots. Two subsequent scheduled applications were made on 21 and 30 September and a supplemental application was made on 14 September following a 3.0-cm rainfall on 11 September. No other methods to repel birds were employed in the plots.

On six dates from 14 September to 8 October, a total of 14 upper leaves from randomly selected sorghum plants in the methiocarb-plus-cue plots were photogaphed with a reference measurement scale. The number of white spots was counted on four randomly located areas of the leaf in each photograph. The diameters of a sample of spots were also measured.

Bird damage was assessed in the plots at 7, 14, 21, 28 and 67 days after the first application (10 Sep). In each plot, eight rows were randomly selected (two each from rows 1-15, 16-30, 31-45 and 46-60). In each row, a subplot was randomly located within the first 24 m from the plot edge and five subsequent subplots were at 24-m intervals. At each subplot the lengths of four heads (one plant in each of four adjacent rows) were measured to nearest cm and the percent of grain removed by birds was visually estimated (Manikowski and DaCamara-Smeets 1979, Seamans and Dolbeer 1989).

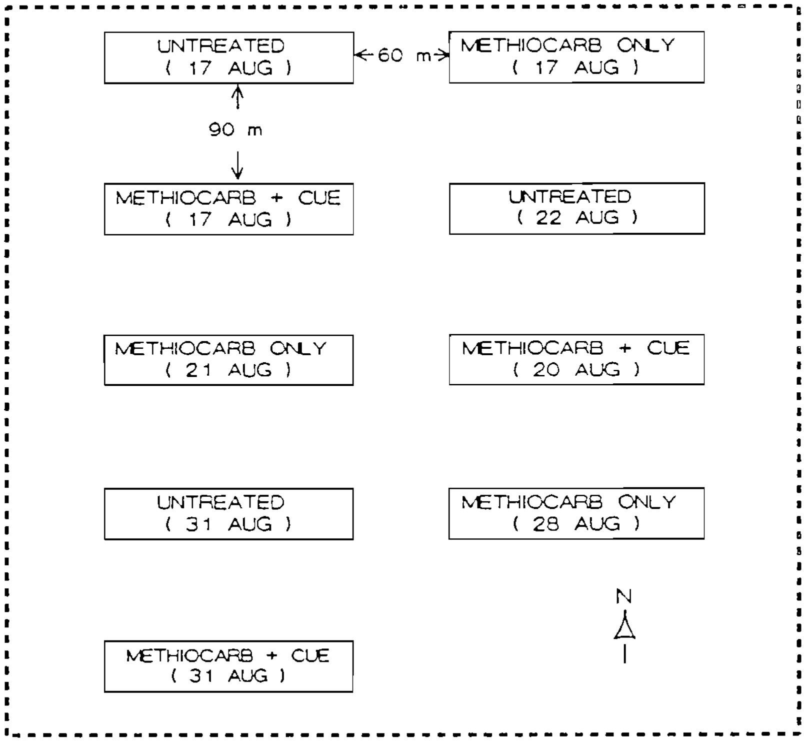

Fig. 1. Schematic map of nine 0.8-ha sorghum plots at Ottawa National Wildlife Refuge, Lucas County, Ohio. Dates in parentheses are when 50% of the plants had flowered.

The population size of the blackbird roost at Metzger Marsh was estimated on 1, 5, 9 and 17 September. Two or four observers estimated numbers of blackbirds [Red-winged blackbirds (Agelaius phoeniceus), common grackles (Quiscala quiscula), brown-headed cowbirds (Molothrus ater)] and starlings (Sturnus vulgaris) entering the roost in the evening by "block counting" flightlines of birds (Meanley 1965).

From 27 August until 8 October, bird observations were made in plots between 0800 and 1800 h, 1 to 4 times per day on 3 to 4 days per week. Each plot was observed for 2 minutes from an elevated spot 60 to 90 m from the plot edge. The number of blackbirds in the plot was estimated. The sequence of plots observed was randomly chosen each time, beginning with either the south or north end of the test area.

A repeated measures, randomized block analysis of variance was used to test for differences in mean daily percent loss among the three treatment groups and between two time periods. Time periods were 10 September to 8 October (date of first treatment application to 8 days after last application) and 9 October to 16 November (posttreatment damage period). In addition, a randomized block analysis of variance was used to test for differences in final percent loss among the three treatment groups. An arc sine transformation was performed on the percent damage estimates for individual heads. Bird numbers were compared among the three treatment groups by a chi-square analysis of the proportion of observations in which a flock of ≥100 blackbirds was observed.

RESULTS

Visual-cue Characteristics

The visual cue distinctly speckled the upper leaves of plants with white spots 1 to 3 mm in diameter at a density of 8.6 ± 4.1 spots/cm^2 ($\bar{x}$ ± SD, *n* = 14). Persistence of spots was generally excellent. For example, on 8 October, 9 days after the last application of material, plants in the methiocarb-plus-cue plots were still distinctly marked. Plants in methiocarb-only treated fields had a very light coating of white spots that were generally <1 mm in diameter and much less distinctive and persistent than in the visual cue plots. The visual appearance of the two groups of treated fields was obviously different to human observers.

Bird Numbers in Roost and in Plots

The estimated numbers of blackbirds and starlings entering the roost in the evening were 50,000, 50,600, 15,900 and 55,200 on 1, 5, 9 and 17 September, respectively. Species composition was not determined but our subjective observations indicated that red-winged blackbirds predominated with lesser numbers of brown-headed cowbirds, common grackles and starlings.

Blackbird numbers were generally low in all plots during the pretreatment observation period (27 Aug - 9 Sep) with three of 45 plot observations recording a flock of ≥100 birds. During the treatment period, 26 of 216 plots observations had ≥100 birds with the proportion being significantly (P < 0.01) different among the three treatment groups: 17 in untreated plots, 5 in methiocarb-only plots and 4 in methiocarb-plus-cue plots (Table 1). Overall, the respective treatment groups averaged 30, 0 and 117 birds per plot during observations in the pretreatment period and 103, 35 and 22 during the treatment period. No sick or dead birds were noted during bird observations or during the six damage assessments conducted in the plots.

Blackbird Damage

There were significant differences among the three treatment groups in the mean daily percent loss and in the final percent loss of grain (Table 2). Both groups of methiocarb-treated plots averaged significantly less final loss (29%) than did the untreated plots (48.3%). The temporal pattern of loss was almost identical for the methiocarb-only and methiocarb-plus-cue plots (Fig. 2), indicating that although the birds responded negatively to methiocarb, the visual cue had no apparent additional impact.

There was a significant time x treatment group interaction for the mean daily percent loss (Table 2). Daily percent loss in both groups of methiocarb-treated plots increased during the posttreatment period (9 Oct - 16 Nov) to levels similar to that in control plots. However, because losses had been substantially reduced in the methiocarb-treated plots during the treatment period, final losses in these plots were still significantly less than in the untreated plots (Fig. 2).

DISCUSSION

This study demonstrated that methiocarb, applied to ripening sorghum at the rate of 1.1 kg/ha, can significantly suppress bird damage for at least an 8- to 10-day period following application. Thus, the study confirms previous work (cited in introduction) showing methiocarb to be an effective bird repellent for small grain crops and indicates that rates as high as 2 to 3 kg/ha may not always be necessary. However, the hypothesis that a visual cue would enhance the effectiveness of methiocarb was not supported.

The failure of the visual cue to enhance repellency could be because the methiocarb-only treatment also left a light coating of white spots on the leaves. Although not nearly as prominent or persistent as the calcium carbonate spotting, the birds may have quickly learned to associate any type of spotting with methiocarb. Furthermore, the relatively close proximity (60 to 90 m) of the plots may have aided the birds in quickly discerning treated from untreated plots, regardless of the degree of visual cue present.

Table 1. Number of 2-minute observation periods in which a flock of ≥100 and <100 blackbirds were recorded in 9 sorghum plots, Ottawa National Wildlife Refuge, Lucas County, Ohio during the pretreatment period (PTP) (27 Aug to 9 Sep) and the treatment period (TP) (10 Sep to 9 Oct).

No. of observations	Untreated plots (n=3)		Methiocarb-only plots (n=3)		Methiocarb-plus-cue plots (n=3)	
	PTP	TP	PTP	TP	PTP	TP
with ≥100 birds	2[a]	17[b]	0[a]	4[b]	1[a]	5[b]
with <100 birds	13	55	15	68	14	67
Total	15	72	15	72	15	72

[a]The proportion of observations with ≥100 birds was not significantly ($P = 0.40$) different among the 3 treatment levels during the pretreatment period ($\underline{X}^2 = 2.14$, 2 df).
[b]The proportion of observations with ≥100 birds was significantly ($P < 0.01$) different among the 3 treatment levels during the treatment period ($\underline{X}^2 = 13.7$, 2 df).

The fact that bird damage was not suppressed in the methiocarb-treated plots during the posttreatment period (9 to 47 days following the final application) may be related to the rapid turnover in blackbird populations at this time. Previous studies (Dolbeer 1978) have demonstrated that late October and November is the peak period of autumn migration for blackbirds in the Great Lakes region. Thus, most blackbirds feeding in the plots during the posttreatment period were probably migrants with no prior conditioning to the methiocarb-treated grain.

Table 2. Estimated mean daily and final percent loss of grain to blackbirds in nine plots of sorghum at Ottawa National Wildlife Refuge, Lucas County, Ohio, 1987.

Damage measurment	Untreated plots (n = 3)		Methiocarb only plots (n = 3)		Methiocarb-plus-cue plots (n = 3)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Daily % loss during treatment period (10 Sep-8 Oct)	0.98	0.77	0.20	0.20	0.25	0.22
Daily % loss during posttreatment period (9 Oct-16 Nov)	0.54	0.03	0.60	0.25	0.56	0.24
Daily % loss[a,c] (10 Sep-16 Nov)	0.72A	0.33	0.43B	0.23	0.43B	0.24
Final % loss[b,c] (16 Nov)	48.3A	22.3	29.0B	15.1	29.0B	16.1

[a]There is a significant difference among treatment group means ($F = 16.02$, 2 and 4 df, $P < 0.01$) and a significant treatment group x time period interaction ($F = 7.24$, 2 and 6 df, $P = 0.03$).

[b]There is a significant difference among treatment group means ($F = 23.1$, 2 and 4 df, $P < 0.01$).

[c]Means with different letters are significantly ($P < 0.01$) different, Duncan's multiple range test.

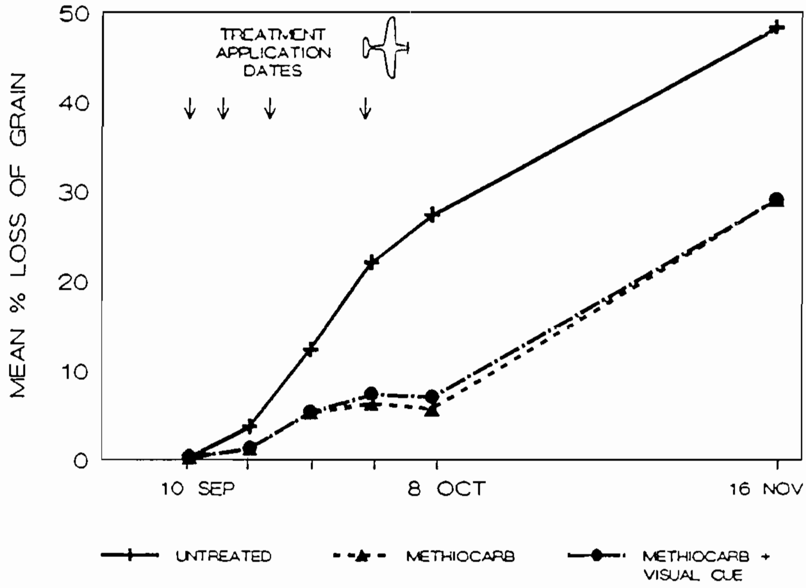

Fig. 2. Blackbird damage to three 0.8-ha plots of sorghum in each of three treatment groups, Ottawa National Wildlife Refuge, Lucas County, Ohio. Plots were assessed for damage on six dates from 10 September to 16 November 1987.

If further field tests of the sensory-cue hypothesis are conducted, a more distinctive cue should be used. Perhaps prominently marking the boundaries of repellent-treated plots with, for example, mylar reflective ribbons (Dolbeer et al. 1986), would be a more practical and effective cue than attempting to spray all plants with particles of a distinctive color. Alternatively, the use of a distinctive gustatory cue, such as tannin or acetic acid (Bullard et al. 1983, Shumake et al. 1976), mixed with the repellent formulation, might be further explored. The fact that controlled tests with birds in cages have repeatedly shown sensory cues to enhance chemical repellents indicates that this concept should not yet be abandoned for field situations.

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