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Introduction

Sweet cherries provide a major source of income to Michigan fruit growers. Annual production in Michigan during the period 1963-1971 averaged 44 million pounds, or 18 percent of the national total (Smith, *et al*. 1973). Bird damage to Michigan cherries is a major problem. Although no figures are available on the extent of sweet cherry damage, Stone (1973) estimated that in 1972 bird damage to Michigan tart cherries amounted to 17.4 percent of the crop. According to growers we interviewed, damage to black sweet cherries is often more severe than to tart cherries. These growers also report some damage to white sweet cherries but, since whites are harvested before they ripen fully, they are less likely to be damaged than blacks.

Because cherries are damaged primarily by species protected by the Migratory Bird Treaty Act, nonlethal means of controlling damage are required. One promising means is a chemical (methiocarb [3,5-dimethyl-4-(methylthio)phenol methylcarbamate = Mesurol]), which has shown good results when used as a nonlethal bird repellent on several crops (Guarino 1972). In 1971, Guarino, *et al.* (1974) applied methiocarb to half a row of 17 sweet cherry trees and to half a block of 22 tart cherry trees in Michigan. The trees within each treated area were sprayed to drip with a 75-percent methiocarb wettable powder formulation combined with 0.25-percent Dow Latex 512R (now Dow Latex 205) sticker. This sticker was added to improve retention of the chemical on the fruit. One pound active methiocarb per 100 gal. of water was sprayed at the rate of 6.4 gal. per sweet cherry tree (tart cherry trees were sprayed at the rate of 4.1 gal. per tree). Estimates of damage reduction were 80 percent in sweet cherries and 63 percent in tart cherries.

To determine the minimum amount of chemical needed for protection, Guarino, *et al*. (1973) applied methiocarb in 1972 at the application rate of 1/3 lb. active material per 100 gal. of water on one-half a row of 18 sweet cherry trees in Michigan. Although a 42-percent reduction in damage was reported, the 32-percent loss in the treated trees was unacceptably high.

Methiocarb will likely be submitted for registration for use as an insecticide on cherries at 1 lb. of active material per 100 gal. of water *sans* the latex sticker. The tests presented in this paper were conducted because the bird repellent efficacy of methiocarb on cherries has not been tested (under a replicated experimental design) without the sticker.

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Procedures

Test sites. The test was conducted in the upper part of the lower Michigan peninsula near Traverse City at the Mawby Orchards. Two sites were selected: a 9-acre mature sweet-cherry orchard adjoining a wooded area, and a 12-acre young sweet-cherry orchard located in a rolling pasture area approximately 1.5 miles west of the first site.

Both orchards had a history of heavy bird damage. The young orchard, particularly, had been subjected to such heavy losses from flocks of "blackbirds" (presumably grackles) that the owners provided the black cherry crop on the assumption the birds would take it anyway (lack of registration of methiocarb for use on fruit precludes harvest of treated cherries).

Both orchards contain black sweet cherries *(Prunus avium* var. 'Schmidt' and 'Windsor') and white sweet cherries (*Prunus avium,* primarily varieties 'Napoleon' and 'Gold'). In the mature orchard, black cherries predominate and generally occur in bands three to five rows wide separated by one to three rows of whites. The blacks were the varieties used to test methiocarb. Both orchards had average crops in 1973.

Test Design. A separate test, involving a completely randomized experimental design, was conducted in each orchard to evaluate the efficacy of methiocarb. Each orchard was subdivided into an even number of plots or experimental units. Half of the plots in each orchard were randomly selected to receive the methiocarb treatment; the other half remained untreated.

The mature orchard was divided into 14, 0.23-acre plots. A plot contained 21 trees with a center row of seven white cherry trees separating side rows of seven black cherry trees. A buffer at least two cherry trees in width separated plots at the ends except where plot ends bordered on a natural boundary. Single rows of white sweet cherries bordered plots on the sides except for three plots located at the orchard edge.

The young orchard was divided into 12 plots averaging 1 acre in size and containing 17-53 black cherry trees each. Natural boundaries or plantings of white cherries were used to separate plots on the sides. Buffers, at least one cherry tree in width, separated the ends of plots that did not border on natural boundaries.

Selection of Damage Assessment Sample. Prior to spraying methiocarb in the mature orchard, a single sample of four 25-cherry clusters was marked off, according to the method described by Guarino, *et al.* (1974). One cluster was marked on each of four sides of each tree (on the two sides facing

adjacent trees in the same row and the two sides facing trees in adjacent rows). The clusters were generally selected above the midpoint of each tree because the cherry crop was poor below that point. The samples were placed in seven randomly-selected trees in each 14-acre plot (only trees with at least average cherry crops were chosen). In the young orchard the same procedure was followed, except that four 10-cherry clusters were counted and marked on each of 10 randomly-selected cherry-bearing trees in each plot.

spray Application. In accordance with the proposed insecticide label specifying that methiocarb must be applied at least 14 days prior to harvest, methiocarb was applied 2 weeks prior to the projected black cherry harvest date in each site. However, in the mature orchard where we had contracted to purchase the methiocarb-treated crop, hot dry weather accelerated the maturation of the crop and advanced the commercial harvest date to 6 or 7 days after spraying. In order to test the repellent over a 14-day period, we purchased the entire crop and did not remove any cherries until 14 days after spraying.

A tractor-mounted Meyers 32A Air Blast Speed Sprayer applied 1 lb. of active methiocarb (1.33 lb. of 75-percent wettable powder) per 100 gal. of water. Spray was applied at the rate of 270 gal./acre (2.7 lb. active ingredient per acre) or 2.9 gal./tree in the mature orchard. This rate is 45 percent of the amount per tree that was applied in the 1971 test (Guarino, *et al.* 1974), and is the amount normally considered “spraying to drip” by orchardists. Approximately 19 percent of the trees (both blacks and whites) in the mature orchard were treated.

In the young orchard, the same spray formulation was used except that 1 lb. of active ingredient was combined with 25 gal. of water. The spray was applied at the rate of 0.5 gal. per tree in this 4x concentration. Approximately 30 percent of the trees, both blacks and whites, were sprayed.

The intermixture of black and white sweet cherries in the orchards presented a problem in complying with the 14-day delay between spraying and harvest. Whites are normally harvested within the 2-week period prior to the black harvest. To prevent the whites from being sprayed within 2 weeks of harvest, the rows of white cherry trees adjacent to and in the plots in the mature orchard were sprayed with ethepon, a chemical that caused fruit to drop early. Methiocarb was then sprayed immediately following harvest of the whites. Foliage of white cherry trees in the treated plots was also sprayed to provide uniform treatment effect in each plot.

Bird Censuses. Tabulations of species and numbers of birds entering the test areas were made intermittently throughout the test periods. Counts were made in the mature orchard on 7 days out of a possible 13; in the young orchard, counts were taken on 9 of 20 days. Observers at vantage points for each plot recorded all birds seen in the plots, whether or not a given bird was likely to be counted more than once. On a given census day each plot was generally censused once in random sequence. Plots were observed for 15-minute periods in the mature orchard and for 30-minute periods in the young orchard. We usually took counts during the period from 0700-1115 in the mature orchard, and during the periods 0700-1031 and 1600-1930 in the young orchard.

Rainfall. Rainfall, which might reduce the amount of chemical on the cherries, was minimal (0.06 inch) during the period between spraying and harvest.

Damage Assessment. Harvest and assessment of the marked samples occurred 2 weeks after methiocarb application in the mature orchard. Harvest and assessment in the young orchard was delayed an additional week due to light loss. Marked clusters were clipped from trees, and cherries counted. Missing cherries were considered lost either through natural drop or to birds. Counts were made of pecked cherries remaining in the clusters.

Results

Mature Orchard Test

Damage Assessment. Cherry losses to birds and to natural drop were estimated at 5.0 percent (95 of 100 cherries left per tree) in methiocarb-treated plots (Table 1) compared with 4.2 percent (95.8 cherries left per tree) in untreated plots. A student's t-test showed no difference between treated and untreated plots at the 0.05 level of significance. Virtually no pecked cherries were found.

Bird censuses. Bird pressure in the mature orchard was negligible. In 34 man-hours of censuses, 14 birds (9 Robins, 1 Catbird and 4 unknown) were observed in the treated area compared with 9 birds (6 Robins, 3 Cedar Waxwings) in the untreated area, an overall average of 0.68 bird seen per census hour. Ten of the 15 Robins were seen on the first morning following spray application.

Table 1. Mean number of marked cherries present per tree in each plot in mature orchard at end of test

Treated		Untreated	
Plot	Mean No. cherries/tree[1]	Plot	Mean No. cherries/tree[1]
1	94.4	2	97.7
3	96.0	4	93.7
5	92.4	6	98.4
7	95.9	8	92.3
9	97.0	10	96.4
12	96.7	11	97.6
13	92.3	14	94.4
Mean	95.0†	Mean	98.8†

[1]Of possible total of 100 cherries per tree from marked clusters at start of test

†Treated and untreated means not significantly different at 0.05 level

Young Orchard Test

Damage Assessment. Cherry losses were estimated at 13.5 percent (34.6 of 40 cherries left per tree) in the treated plots (Table 2) compared with 19.3 percent (32.3 cherries left per tree) in the untreated plots. A student's t-test indicated no difference between treatments at the 0.05 level of significance. Damage to three trees in two control plots was abnormally high (some cherries on two of the trees were taken by children), but inclusion of these trees in the analysis did not affect the outcome.

Bird censuses. In 60 man-hours of observation in the plots, we saw only 18 birds, an average of 0.30 per census hour, capable of feeding on cherries. Five birds (2 Cedar Waxwings, 1 Brown Thrasher, 1 Northern Oriole, and 1 Starling) were seen in treated plots compared with 13 (3 Robins, 3 Cedar Waxwings, 3 Red-winged Blackbirds, 2 Common Crows, 1 Brown-headed Cowbird, and 1 Brown Thrasher) in untreated plots. Bird activity was scattered among the 8 days in which counts were taken.

Table 2. Mean number of marked cherries present per tree in each plot in young orchard at end of test

Treated		Untreated	
Plot	Mean no. cherries/tree[1]	Plot	Mean no. cherries/tree[1]
1	34.0	2	34.7
4	37.0	3	37.2
5	36.4	6	35.0
8	35.7	7	30.9
9	33.7	11	33.3
10	30.6	12	22.8
Mean	34.6†	Mean	32.3†

[1]Of possible total of 40 cherries per tree from marked clusters at start of test

†Treated and untreated means not significantly different at 0.05 level

Discussion and Conclusions

The lack of significant differences in cherry loss between treated and untreated plots in both tests may have been due to one or more of the following reasone: (1) methiocarb was ineffective, (2) bird pressure was too low to obtain good tests, (3) birds could not distinguish between treated and untreated plots (either because of small size of plots or because there was no well-defined boundary between plots), and (4) an area-wide repellent effect occurred that kept birds out of both treated and untreated plots.

We speculate that the methiocarb treatment kept birds out of treated and untreated plots alike. Under this speculation, reasons (3) and (4)

above could have precipitated the observed result. Spot-checks indicating considerable bird activity in nearby orchards at the time of our test harvest supports this hypothesis and detracts from the feasibility of reasons (1) and (2). In addition, in the days prior to spraying the mature orchard, we observed an apparent increase in Robins and Orioles there. However, presence of birds in this orchard dropped almost to zero on the day following the application of the spray. In fact, two-thirds of the Robins observed during observation periods in the mature orchard were seen on the morning following the application of the chemical.

Interspersion of black and white sweet cherries causes a cultural problem in the use of methiocarb. Theoretically, the application of ethepon would allow white sweets to be removed 2 weeks before black sweets are taken. Nevertheless, the imponderables of guessing harvest dates several weeks in advance make this technique questionable. An alternative would be to spray methiocarb on all trees, blacks and whites, at least 2 weeks before the white harvest. Thus, methiocarb would be applied up to a month before harvest of blacks, and would likely result in reduced protection to blacks, which are normally damaged more severely than whites.

Recommendations

We feel the bird-repellent efficacy of methiocarb *sans* sticker should be tested again, but only in a situation where whole orchards can be utilized as experimental units instead of plots within orchards. Probably this will not be economically feasibly until or unless an experimental permit is granted which would allow treated cherries to be used commercially.

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