METHIOCARB, A CHEMICAL BIRD REPELLENT: A REVIEW OF ITS EFFECTIVENESS ON CROPS

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ABSTRACT: Since 1964, when the effectiveness of methiocarb for preventing pheasants (Phasianus colchicus) from damaging sprouting corn was proven in South Dakota, an aggressive program has been carried out by personnel of the Denver Wildlife Research Center and many cooperators to develop methiocarb as a broad spectrum avian repellent.

The successful use of methiocarb for preventing damage caused by several species of birds to sprouting corn in several states and to sprouting soybeans in South America is reviewed. Recent results obtained from spraying methiocarb on ripening rice in California, ripening sorghum in Colorado and Oklahoma, cherries in Michigan, and grapes in New Hampshire are summarized.

INTRODUCTION

Chemical approaches to alleviating problems caused by birds are as varied as the problem situations that exist and the species of birds involved. Bird problems are extremely complex, and physical, biological, and chemical approaches for reducing damage may be used in various combinations and with varying degrees of success. One primary consideration in choosing a method of attack is the species of birds causing damage. In most cases these species are desirable, and damage must be reduced without destroying them. Therefore, one method sought is the use of nonlethal chemical repellents.

Chemical repellents have been used on crops to protect them from birds for about 150 years, and much of the literature has been well summarized by Neff and Meanley (1956). Of the myriad of compounds that have been tested for bird repellent activity, thiram (tetramethylthiuram disulfide) has been shown to be the most effective by Klein (1957), Young and Zevallos (1960), and Royall and Ferguson (1962); it is now used as a comparative standard.

Recently, an experimental compound, methiocarb [4-(methylthio)-3,5-xylyl N-methylcarbamate], has shown excellent potential as a broad-spectrum avian repellent. Of 724 compounds tested on red-winged blackbirds (Agelaius phoeniceus), methiocarb was one of only two that showed excellent repellent activity (Schafer and Brunton 1971). The reason that methiocarb and other chemicals repel birds is not well understood. Several decades ago most repellents were believed to be merely distasteful substances. However, recent information indicates that taste may play a secondary role and that aversion to a particular substance is caused primarily by an initial post-ingestinal disturbance (nausea, lack of appetite, etc.) from eating varying amounts of that substance.

Personnel of the Denver Wildlife Research Center subsequently chose methiocarb for field testing in various parts of the country to determine its effectiveness for reducing bird damage to several crops by different species of birds. The following studies were conducted to gather efficacy data from many different locations that may lead to eventual registration.

SPROUTING SEEDS

Initial studies with methiocarb were conducted in South Dakota in 1967 by West et al. (1969). Corn seed treated with a methiocarb slurry reduced pheasant (Phasianus colchicus) damage to sprouting corn by more than 90%. Of two concentrations (0.5 and 3.0%), the 0.5% treatment was the best on an effectiveness-cost basis. The 3.0% concentration of methiocarb was twice as effective as the same level of thiram, one of the most promising repellents recommended by earlier investigators. In Texas, West and Dunks (1969) showed that a 0.5% methiocarb treatment on corn seed reduced losses from boat-tailed grackles (Cassidix mexicanus) by about 70%.

Later, in order to gather geographic data on the repellency of methiocarb and its effectiveness against other species of birds, tests were conducted in several other areas.

In New York, Guarino and Forbes (1970) showed that the 0.5% treatment level on corn seed provided as much as 83% protection from various species of birds, including red-winged blackbirds, common grackles (Quiscalus quiscula), brown-headed cowbirds (Molothrus ater), common crows (Corvus brachyrhynchos), and pheasants. In South Carolina, Stickley and Guarino (1972) found that a 0.5% treatment level was effective for reducing damage to sprouting corn by blackbirds and crows. Sprout damage in untreated fields averaged 44%, versus 0.3% in fields treated with methiocarb.

In a cooperative study with the Denver Wildlife Research Center, Thompson and Agudelo (1969) showed that a treatment of soybean seed with 0.5% methiocarb was clearly effective in preventing eared doves (Zenaida auriculata) from completely destroying emerging soybeans in Palmira, Colombia. In a quarter-acre plot planted with untreated seed, 100% of the cotyledons were removed, compared with 26% in the same size treated plot about 100 yards away. However, in a different test, where a 0.5% methiocarb treatment was alternated every six rows in about a 1-1/4-acre soybean plot, methiocarb was not effective in preventing dove damage. The researchers concluded that the experimental design of using treated and untreated rows side by side was not adequate for appraising the repellent and that treatments should be separated to get a proper evaluation.

In a similar situation in Hawaii, where small adjacent plots of seed corn (20 rows by 160 feet) were used for testing methiocarb, damage by pheasants was severe in all plots regardless of treatment (Thompson et al. 1970). The pheasant population in the area was extremely high (over 20 birds observed in the plot area at one time), and the researchers concluded that the plots were probably too small under this high density of birds to properly determine the effectiveness of the repellent.

In all the above tests with methiocarb, seed was treated with a water slurry. To evaluate a different treatment technique (dusting), tests were conducted during 1970 in Michigan and South Carolina. In Michigan, corn seed was treated with 0.25% and 0.5% methiocarb applied as dry material in the hopper or planter box before planting. Results showed that methiocarb was effective in reducing sprout damage which was being caused by blackbirds primarily (Shake and Guarino 1971). Control fields showed about 10% damage, the 0.25% treatment fields about 5%, and the 0.5% fields less than 3%. Differences in damage among treatments were significant at the 10% level. In South Carolina, 0.25% and 0.5% hopper-box treatments were compared with a 0.5% slurry treatment (Stickley et al. 1970) There were no significant differences in damage among treatments, even though damage in control fields was three times greater than in fields planted to seed for either 0.5% treatment. An average of 199 corn sprouts was damaged per sample plot for the 0.25% hopper-box treatment, 82 for the 0.5% hopper-box treatment, 68 for the 0.5% water slurry, and 258 for the control. These results, along with the earlier information from other areas, indicate that hopper-box treatments generally provide less protection to corn seed than water-slurry treatments.

RIPENING GRAIN

Only a few results have been published for repellents used on ripening grains. Griffin and Baumgartner (1959) gave several coded compounds good ratings as repellents from "pan" tests and from spraying ripening sorghum, and stated that a thiram formulation (Arasan 42-S) repelled birds exceptionally well. Metzer and Royall (1961) found thiram to be the most effective of three chemicals sprayed on mature grain sorghum for repelling house sparrows (Passer domesticus) in Texas.

The successful use of methiocarb on sprouting seeds prompted testing of the compound as a head spray on ripening grains. Tests were conducted: on rice in California, in cooperation with the University of California and the California Cooperative Rice Research Foundation, Biggs, California; on sorghum in Colorado; and on sorghum at Tishomingo National Wildlife Refuge in Oklahoma, in cooperation with the Division of Wildlife Refuges and the Division of Wildlife Services, U. S. Fish and Wildlife Service.

Rice

DeHaven et al. (1971a) conducted field tests that showed the potential effectiveness of methiocarb as a blackbird repellent for ripening rice. A 12- x 100-ft-plot treated with 10 lb/acre methiocarb had significantly less damage than an adjacent untreated plot in all five parameters measured: panicle weight, threshed weight, threshing percent, missing kernels per panicle, and estimated damage. In small (6 x 6 ft) individually caged rice

plots, two levels of methiocarb (3.2 and 10.0 lb/acre) sprayed on the ripening heads reduced damage from tricolored blackbirds (Agelaius tricolor) enclosed in the cages by more than 55%. The researchers suggested that these, and perhaps lower levels, might effectively reduce blackbird damage to large rice fields. The concept of not testing repellents in small plots with treated and control plots side by side was upheld in these cage tests. Less protection was afforded by methiocarb when treated and untreated subplots were within the same cage than when treated and untreated plots were in separate cages.

The most recent tests on rice were conducted in the Sacramento Valley of California during the fall of 1971 (DeHaven et al. 1971b). A 2 lb/acre treatment of methiocarb significantly ($P < 0.05$) reduced damage by blackbirds when applied to the heads with a row-crop boom sprayer. No conclusion could be drawn from an aerial application of 3 lb/acre methiocarb because of insufficient bird pressure.

Grain sorghum

Results from spraying methiocarb on sorghum in Colorado and Oklahoma are difficult to evaluate because a reliable damage appraisal technique for detecting differences in treatments is lacking. However, in Oklahoma, visual estimates of damage in sample plots treated at about 14 and 20 lb/acre in 1970 and a substantially lower rate (3 lb/acre) in 1971 indicated that methiocarb was effective for reducing damage caused by red-winged blackbirds. In Colorado, Schafer et al. (1971) conducted cage tests similar to those used for rice in California.. Their visual estimates showed that methiocarb sprayed on sorghum at 1.0, 3.2, and 10.0 lb/acre provided substantial protection from redwings and common grackles, but that a 0.32 lb/acre treatment did not.

RIPENING FRUITS

The most recent investigations with methiocarb were conducted to determine its effectiveness for preventing bird damage to ripening fruit. In 1971, studies were undertaken in cooperation with the Division of Wildlife Services to treat ripening cherries in Michigan and ripening grapes in New Hampshire.

Cherries

In Michigan, several trees of two varieties of cherries, Prunus mahalob (sour) and P. aviurm (sweet), were sprayed until dripping with a 1 lb/100 gal water formulation of methiocarb (Guarino et al. 1971). Damage was caused primarily by robins (Turdus migratorius) and common grackles in the sweet cherry orchard and by starlings (Sturnus vulgaris) in the sour cherry orchard. Preliminary results from both orchards showed highly significant ($P < 0.001$) differences in damage between treatments and controls. Random samples in the sweet cherry orchard showed that the controls received about 5 times as much damage as the treated trees (36% vs. 7%). In the sour cherry orchard, over 50% damage occurred in the controls and under 20% in the treated.

Grapes

In New Hampshire, grapes were sprayed until dripping wet with the same formulation (Bollengier et al. 1971). Damage in this vineyard was caused mostly by robins, but starlings, catbirds (Dumetella carolinensis), and scarlet tanagers (Piranga olivacea) also fed heavily. Protection was not pronounced during the first week of the test because of light bird pressure, but was dramatic when bird pressure increased. Random samples (clusters) of the two most vulnerable varieties weighed six times more from treated than from untreated vines.

DISCUSSION

Experimental design was shown to affect the results of several of the tests described here. Designs with small, intermixed treated and untreated plots were not as suitable for testing methiocarb as designs where larger plots were used and the treatments were separated. The difference in the repellency of a compound in relation to the size of the treatment area was first reported by Griffin and Baumgartner (1959), who concluded, after a series of repellent tests in grain sorghum, that "a large area made up entirely of treated plots was more effective in repelling birds than a comparable-sized area of small plots interspersed with controls." Later, West et al. (1969) drew the same conclusion from seed corn tests with methiocarb in South Dakota, and stated that effective repellency in their testing did not occur until entire fields were treated instead of small plots within fields. The effectiveness of a treatment level was also closely related to bird pressure.

Even with some difficulties in test design, methiocarb in these tests proved to be an effective repellent for preventing bird damage to sprouting corn and soybeans, to ripening rice and sorghum, and to ripening cherries and grapes. It was also shown to be a broad-spectrum compound with high repellent activity for numerous species of birds, including pheasants, common and boat-tailed grackles, red-winged blackbirds, starlings, robins, house finches, and crows.

LITERATURE CITED

BOLLENGIER, R. M., A. R. STICKLEY, JR., and J. F. BESSER. 1971. The effectiveness of methiocarb for protecting ripening grapes from bird damage in New Hampshire. Unpub. rept. Work Unit DF-102.2, No. 33, Denver Wildlife Research Center 5 pp.

DEHAVEN, R. W., J. L. GUARINO, F. T. CRASE, and E. W. SCHAFER, JR. 1971a. Methiocarb for repelling blackbirds from ripening rice. International Rice Commission Newsletter (In press).

_____, F. T. CRASE, J. CARLILE, and M. D. MORSE. 1971b. Evaluation of low-level applications of methiocarb for preventing birds from damaging ripening rice. Unpub. rept. Work Unit DF-102.2, No. 32, Denver Wildlife Research Center 8 pp.

GRIFFIN, D. N., and F. M. BAUMGARTNER. 1959. Evaluation of certain chemicals as bird repellents. Proc. Oklahoma Acad. Sci. 39:78-82.

GUARINO, J. L., and J. E. FORBES. 1970. Preventing blackbird damage to sprouting corn with a carbamate repellent. New York Fish and Game Journal 17(2):117-120.

_____, W. F. SHAKE, and E. W. SCHAFER, JR. 1971. A concentration-effect study of the avian repellent methiocarb on ripening cherries in Michigan. Unpub. rept. Work Unit DF-102.2, No. 28, Denver Wildlife Research Center 1 pp.

KLEIN, H. G. 1957. Evaluation of some promising pen-tested repellents in field tests with treated corn. New York Fed. Aid Project W-77-R (final report for Job 11-D), N.Y.S. Cons. Dept. (multilith).

METZER, R., and W. C. ROYALL, JR. 1961. Field tests of three chemicals as bird repellents on mature grain sorghum. Texas Agr. Exp. Sta., College Station, Texas 6 pp.

NEFF, J. A., and B. MEANLEY. 1956. A review of studies on bird repellents. Prog. Rept. No. 1--Research on bird repellents. Mimeo. Denver Wildlife Research Center 13 pp.

ROYALL, W. C., JR., and E. R. FERGUSON. 1962. Controlling bird and mammal damage in direct seeding loblolly pine in east Texas. J. Forestry 60(1):37-39.

SCHAFER, E. W., JR., and R. B. BRUNTON. 1971. Chemicals as bird repellents: two promising agents. J. Wildl. Manage. 35(3):569-572.

_____, JR., R. B. BRUNTON, N. F. LOCKYER, and J. L. GUARINO. 1971. Determining concentration-effect levels of two repellents on mature grain sorghum. Unpub. rept. Work Unit DF-102.2, No. 24, Denver Wildlife Research Center 8 pp.

SHAKE, W. F., and J. L. GUARINO. 1971. An evaluation of the bird repellents DRC-736 and DRC-3324 on seed corn and barley in Michigan. Unpub. rept. Work Unit DF-102.2, No. 17, Denver Wildlife Research Center 7 pp.

STICKLEY, A. R., JR., and J. L. GUARINO. 1972. A repellent for protecting corn seed from blackbirds and crows. J. Wildl. Manage. 36(1):150-152.

_____, JR., J. L. GUARINO, O. E. BRAY, and R. E. MATTESON. 1970. A repellent for protecting corn seed from blackbirds and crows. Unpub. rept. Denver Wildlife Research Center 12 pp.

THOMPSON, J. R., R. D. NASS, and J. L. GUARINO. 1970. The effectiveness of DRC-736 and DRC-3324 as repellents for preventing pheasant damage to sprouting corn. Unpub. rept. Work Unit DF-102.2, No. 13, Denver Wildlife Research Center 15 pp.

THOMPSON, R. L., and F. AGUDELO. 1969. Crop Production Program, Subproject: Bird Control. Unpub. Rept. Centro Internacional de Agricultura Tropical 11 pp.

WEST, R. R., and J. M. DUNKS. 1969. Repelling boat-tailed grackles from sprouting corn with a carbamate compound. Texas J. Sci. 21(2):231-233.

_____, R. B. BRUNTON, and D. J. CUNNINGHAM. 1969. Repelling pheasants from sprouting corn with a carbamate insecticide. J. Wildl. Manage. 33(1):216-219.

YOUNG, W. R., and D. C. ZEVALLOS. 1960. Studies with chemical seed treatments as bird repellents for the protection of germinating maize in the Mexican tropics. FAO Plant Protection Bull. 8(4):38-42.