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### Author

Besser, Jerome F.

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# IMPROVEMENTS IN THE USE OF 4-AMINOPYRIDINE FOR PROTECTING AGRICULTURAL CROPS FROM BIRDS

JEROME F. BESSER, Biologist, Denver Wildlife Research Center, Denver, Colorado 80225

**ABSTRACT:** In 1976 and 1977, studies to improve the use of 4-aminopyridine (4-AP), a chemical frightening agent for protecting crops from blackbird damage, were conducted in sunflower in North Dakota, corn in Ohio, grain sorghum in Kansas, and sprouting rice in Arkansas and Texas. Because of the high vulnerability of sunflower, much of the effort was concentrated in this crop, despite the 1976 federal registration of a 4-aminopyridine product, Avitrol<sup>R</sup> FC Corn Chops-99S, in 14 midwestern states. Hand baiting the perimeter of fields appeared effective in protecting sunflowers from damage by three species of blackbirds, but was ineffective in protecting grain sorghum being damaged by cowbirds. A 1:33 dilution ratio of 4-AP was more effective than the registered 1:99 dilution ratio in protecting field corn. A concerted effort to bait the most vulnerable sunflower fields in a 7-township area with small tractors on baiting lanes did not provide the degree of protection anticipated. In this study about 38% of radio-equipped blackbirds frightened from ripening sunflower fields fed next in equally vulnerable sunflower fields. Good to excellent results were obtained in initial trials with 4-AP for protecting sprouting rice fields. Fair success was obtained using 4-AP formulations for protecting corn and sunflowers from parakeet damage in South America and rice and millet from damage by weavers in Africa.

From the initial field trials in 1962 through 1975, much of the development of 4-aminopyridine (4-AP) as a chemical frightening agent to protect agricultural crops from damage by blackbirds has been chronicled (Besser, 1976). The status of its use in field corn, sweet corn, sunflowers, grain sorghum, peanuts, and pecans was reported along with numerous suggestions to improve its effectiveness and economical use. This paper summarizes progress made in 1976 and 1977 toward improving protection of agricultural crops with various formulations of 4-AP.

## PROTECTION OF CROPS

### Sunflowers

In August 1976, Avitrol<sup>R</sup> FC Corn Chops-99S (AFCC-99S) was federally registered (EPA Registration No. 11649-15) for protection of ripening sunflowers from blackbird attack in 14 states: North Dakota, Minnesota, South Dakota, Texas, Nebraska, Kansas, Oklahoma, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, and Ohio. However, problems attendant with its effective, safe, and economical use remain, chiefly because ripening sunflower is among the most palatable foods of blackbirds and has the longest period of vulnerability to birds of any crop grown in North America--75 days in North Dakota in 1977 (Henne, personal communication). Therefore, efforts to improve the use of 4-AP baits during the last 2 years have been concentrated in this crop.

In 1976, hand-baiting only the perimeter of ripening sunflower fields with AFCC-99S was tried. This method of treatment (Treatment A) was compared with all other legal means of crop protection that growers wished to use (Treatment B) in five pairs of test fields in Foster and Eddy counties, North Dakota (Besser et al., 1976). The most vulnerable edges of Treatment A fields were baited from three to six times by broadcasting baits while walking between rows 25 yards from the edge. Preharvest damage surveys revealed blackbirds had removed 28.3% (+ SE 12.1) of the crop in Treatment B fields and 12.9% (+ SE 5.9) of the crop in Treatment A fields. The probability of no real difference in damage between the fields receiving the two treatments was 0.13. Costs of this protection for owners of the hand-baited fields were calculated at \$1.93 per acre harvested and benefits at \$15.33 per acre harvested--a return of \$7.94 for each \$1 spent. Despite this very favorable cost-benefit ratio the loss of sunflowers on one of the Treatment A fields (the one receiving the least bait per acre) was nearly 30%, indicating that additional baiting may have been profitable. The experiment indicated the need for greater guidance in the use of crop protection methods, for one grower of a Treatment B field suffered about a 70% (>\$70 per acre) loss without using any form of crop protection.

In 1977, a concerted effort to use AFCC-99S on the most heavily damaged ripening sunflower fields within the feeding range of a roost of more than 1/2 million blackbirds at Fuller's Lake in Steele County, North Dakota, was made by Animal Damage Control personnel of the U.S. Fish and Wildlife Service (Henne and Carney, 1978, in preparation). In this program, 31 fields in a 7-township area in Steele, Traill, and Cass Counties were baited as needed with AFCC-99S using an electric seeder mounted on a small tractor. Baiting lanes, about 25 yards from the edges of fields and at 55-yard intervals within fields, were created by skipping one or two rows of sunflowers when planting, or by pushing over a row of sunflowers with the tractor at the time of application.

AFCC-99S baitings in September readily moved blackbirds from sunflower fields, but baitings were less effective in August when very dense canopies of sunflower leaves obscured both the baits and affected birds. Decreased row widths and increased fertilization in 1977 provided denser canopies than in previous years. The lowered effectiveness of the baits in August, the early harvest of swathed grains, frequent rains, and the delayed harvest (late October) of sunflowers in 1977 resulted in an unacceptable loss of 10.3% of the crop in the 31 baited fields. Trials of less dilute 4-AP baits (1:29 instead of the presently registered 1:99), buffer or lure crop plantings (such as Japanese millet, *Echinochloa frumentacea*) on diverted crop acres, and windrowing of stands of wild foxtail millet (*Setaria sp.*) near the best loafing cover near roosts are three measures that are to be evaluated in

1978 to reduce feeding pressure by blackbirds and improve protection of sunflowers. The 1:29 dilution ratio was highly effective in the initial trials in 1965 in field corn in South Dakota (De Grazio et al., 1972). Current cultural practices in North Dakota sunflower fields--narrow rows and heavy fertilization--appear to warrant a return to the 1:29 dilution ratio for protecting sunflower fields before plant leaves begin to wither. Suitable buffer crops on set-aside acres should provide alternate feeding areas for blackbirds frightened from baited sunflower fields.

The baiting program in sunflower in the 7-township area provided an opportunity for learning where birds go to feed when frightened from high-value ripening crop fields. Many farmers believe frightened birds merely move to their neighbor's crops, causing just as much damage there. By monitoring 21 male redwing blackbirds (*Agelaius phoeniceus*) with radio transmitters, 34 movements of transmittered birds with flocks of birds frightened from ripening sunflowers were recorded--21 from fields baited with AFCC-99S and 13 from unbaited fields where birds were frightened by shooting or other disturbances (Besser et al., 1978). On 13 (38.2%) occasions, the frightened flock next fed in equally vulnerable sunflower fields. On the other 21 (61.8%) occasions, they next fed in stubble fields (9), weed patches (5), sunflower fields in bloom (5), a ripening cornfield, and a field of swathed wheat.

### Field Corn

Less dilute 4-AP baits (1:33) were evaluated in ripening cornfields in Ohio by the U.S. Fish and Wildlife Service in 1976 (Woronecki et al., 1978). They found that twice as much corn was lost to blackbirds in 21 fields treated with the 1:99 bait as in 25 fields treated with the 1:33 bait--2.2% of the surface area of ears versus 1.1% (significantly different at  $P = 0.05$ ).

A program in 1976 to evaluate a concerted effort by growers to bait all fields with AFCC-99 within 10 miles of a roost of about 1 million blackbirds in Kingsbury County, South Dakota, was cancelled when drought caused a complete crop failure.

### Sweet Corn

The registered use of AFCC-99 to protect sweet corn from blackbirds was amended in 1976 to include the Northeastern United States. Thirteen southeastern states are still excluded on the label. Chiefly because of the high value of this crop and its short period (5 to 10 days) of vulnerability, AFCC-99 has been effectively used by sweet corn producers.

### Grain Sorghum

In 1976, an attempt was made to protect grain sorghum fields in Kansas from blackbird attack by baiting only the perimeter of fields with AFCC-99 (Mott et al., 1977). The most vulnerable areas of field edges were baited from two to six times by hand or aircraft on a swath centered 25 yards from the field edge. Baiting was initiated in a field when 1,000 or more blackbirds were causing damage. At the conclusion of the study, the damage was greater in fields with edges baited than in unbaited fields. Brown-headed cowbirds (*Molothrus ater*) were the most numerous birds in test fields and flocks composed largely of this species often did not leave treated fields in response to affected birds.

### Sprouting Rice

In both 1976 and 1977, specified emergency exemptions for the use of AFCC-99 to protect sprouting rice from blackbird damage were granted to Arkansas, Louisiana, and Texas. Approximately 9,000 acres of rice were baited in Texas during the 2 years and with rare exceptions good to excellent damage control was obtained (Ivie, personal communication). About 1,600 acres were treated in Arkansas with similar success (Pierce, personal communication). Exemptions were obtained too late for applications in Louisiana (Fowler, personal communication).

### Agricultural Crops on Other Continents

Experiments for protecting crops with 4-AP continued in South America and Africa. In 1976 in Uruguay, 4-AP was sprayed on ears of partially-husked corn and heads of ripening sunflowers to protect them from damage by monk parakeets (*Myiopsitta monachus*). Sprays containing 12% and 16% 4-AP were used in 1976, compared to the 4% and 8% used in 1975. As in 1975, 4-AP sprays were more effective in protecting corn than sunflowers, but the increased concentrations provided little more protection than the lower concentrations (Calvi et al., 1977). Higher concentrations in methyl cellulose carrier flaked badly. A suitable adhesive will be tried in future tests.

4-AP millet baits have been tried for protecting ripening millet from red-billed quelea (*Quelea quelea*) in Kenya (De Grazio, 1973) and for protecting ripening rice from quelea and other weavers in Somalia (Holcomb, 1976). In the Somalia study, millet baits were glued to millet heads placed above ripening rice. Although affected quelea were noted in the Kenya study and a degree of protection was obtained in the Somalia study, effective crop protection with 4-AP baits has yet to be demonstrated in large-scale field tests anywhere in Africa.

### CONCLUSIONS

Efforts to improve the use of 4-AP in agricultural crops have resulted in improved protection of some crops but not of others. Greater coordinated efforts will be required to develop the data needed to put improved use directions on registered labels and to put these uses into practice.

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