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9. ABSTRACT
Presents the results of trials in Uruguay using two chemical agents for the protection of sprouting and ripening crops from birds. The first is a repellent, methiocarb, and the second a frightening agent, 4-aminopyridine. Bird damage is a serious problem in many Departmentos in Uruguay. Three families of birds are responsible for most of the damage: doves and pigeons, parakeets, and blackbirds. Waterfowl and fringillids also contribute to bird damage problems in the production of cereal grains. It is apparent from these trials that methiocarb has potential value for protecting sprouting seeds from damage by columbids and ducks. Experiments with lower concentrations of methiocarb are planned for soybeans and rice. Initial concentrations appear to be sufficiently effective and economical to warrant the development of methiocarb as a seed protectant. Protection of ripening crops is more difficult and less progress has been made. Methiocarb will repel doves from ripening grain sorghum, but this has not yet been demonstrated to be practical over large areas. The compound, 4-aminopyridine, appears to have definite potential for protecting cornfields from damage by parakeets. Formulation modification, a different compound, or a different application technique will be needed to protect ripening sunflowers from parakeet damage.

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# PROTECTING URUGUAYAN CROPS FROM BIRD DAMAGE WITH METHIOCARB AND 4-AMINOPYRIDINE[1]

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Bird damage to ripening and sprouting agricultural crops is a serious problem in many Departamentos (States) in Uruguay and a limiting factor in the production of some crops. A total of about one million hectares of wheat, corn, sunflowers, grain sorghum, rice, soybeans, barley, oats, and peanuts are grown (De Grazio and Besser, 1975). Grain sorghum and sunflower crops are damaged most seriously by birds; corn and rice, soybeans, peanuts, and fruits (such as apples and pears), to a lesser extent.

Three families of birds are responsible for most of the damage: doves and pigeons, parakeets, and blackbirds. Waterfowl and fringillids also contribute to bird damage problems in the production of cereal grains. Both cereal and oil grains are attacked as they sprout but more serious losses occur as crops ripen. Damage by the Eared Dove (*Zenaida auriculata*) to ripening grain sorghum and sunflowers and by the Monk Parakeet (*Myiopsitta monachus*) to ripening sunflowers and corn are the most serious problems. Eared Doves, the Spot-winged Pigeon (*Columba maculosa*) and Picazuro Pigeons (*Columba picazuro*) sometimes seriously damage emerging soybeans. Blackbirds, chiefly the Chestnut-capped Blackbird (*Agelaius ruficapillus*) and three species of cowbirds (*Molothrus bonariensus, M. badius* and *M. rufoaxillaris*), damage rice both when sprouting and ripening. Waterfowl, mostly the White-faced Tree Duck (*Dendrocygna viduata*), sometimes heavily damage rice seed in flooded paddies. Lesser amounts of damage are caused by parakeets to ripening wheat and grain sorghum fields and by pigeons and doves to ripening barley and oat plantings.

To alleviate these losses, the Department of Plant Health of Uruguay (Direccion de Sanidad Vegetal) began organized campaigns nearly a decade ago to reduce the numbers of Monk Parakeets and Eared Doves in zones where crop damage was most severe. Some measure of success was attained in some areas by spraying the colonial nests of Monk Parakeets with contact toxicants and by baiting harvested fields with oral toxicants for Eared Doves (Martinez, 1971).

In 1973, the Uruguayan Government sought the assistance of the U.S. Fish and Wildlife Service, through the U.S. Agency for International Development, Department of State, for additional methods of protecting their crops from birds. The purpose of this paper is to present the results of trials using two chemical agents: (1) a repellent, methiocarb, and (2) a frightening agent, 4-aminopyridine, for the protection of sprouting and ripening crops.

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## Sprouting Crops

As sprouting crops are the most economical to protect, the greatest progress has been made in this area. Methiocarb, applied to seeds before planting, was used in studies to protect seeded soybeans, rice, and grain sorghum. The results of these studies to date are:

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Soybeans. On November 27, 1975, a 5-ha area of a large (80 ha) field was selected as a test site for the appraisal of methiocarb as a protectant for sprouting soybeans from damage by columbids (*C. maculosa*, *C. picazuro*, and *Z. auriculata*) that regularly used the tree cover adjacent to this area. On this date, 50 kg of seed treated with 0.25% methiocarb (0.33% Mesurol 75% WP) and 0.25% latex adhesive (0.5% Dow Latex 205) was planted on one ha of this area, and a 1-ha portion of the area (100 meters distant) selected as a control.

About 100 columbids were observed feeding in the field during the test. Damage surveys, conducted on December 6 (when the plants were 3 to 5 inches high and not susceptible to further damage) on 20 randomly selected subplots (5 m of row) in each plot, showed that 589 plants (34% of 1,753 checked) had been damaged by columbids on the untreated subplots, whereas only 14 plants (0.6% of 2,409 checked) had been damaged by columbids on the treated subplots.

Rice. On December 4, 1975, near Vergara, Departamento Treinta y Tres, 3 ha of a flooded 10-ha rice field were sown with seed treated with 0.3% methiocarb and 0.1% latex adhesive. During the next 3 weeks, approximately 150 ducks, principally White-faced Tree Ducks, Speckled Teal (*Anas flavirostris*), and Rosy-billed Pochards (*Netta peposaca*), fed in the area. On December 23, damage was surveyed on 20 randomly selected plots (0.283 $m^2$ in size) in each of the treated and untreated areas. The survey showed that only 16 plants (28,000/ha) remained on the 20 untreated plots, whereas there were 519 plants (917,000/ha) on the 20 treated plots.

In addition to ducks eating the seed, the birds' feeding loosened rooted plantlets and muddied the water enough to cause death of the rooted plants because of lack of light. Masses of damaged floating plants were observed, and damaged and undamaged fields were identifiable from a distance by the green color of plants and clean water of the treated area clearly contrasting with the dark color of the water and lack of plants in the untreated area.

Sorghum. Grain sorghum seed was treated with 0.1% methiocarb (0.2% Mesurol 50% HBT) and broadcast on three 0.01-ha plots near Cerro Mulero in December 1975. Untreated seed was broadcast on three interspersed plots of the same size. Seeds were counted on 10 circular 0.005-$m^2$ subplots in each plot at the time of broadcasting and 24 hours later. After one day, Eared Doves had consumed 83.3% (305 of 366) of the untreated seed on these subplots, but only 0.2% (1 of 483) of the seeds on the treated subplots. Several dozen Eared Doves fed in the untreated plots within an hour of their establishment, and undoubtedly many more fed there later.

Ripening Crops

Research into the much more severe and more difficult problem of protecting ripening crops from bird damage was initated with trials of methiocarb for protecting grain sorghum and 4-aminopyridine for protecting field corn and sunflowers.

Grain Sorghum. On April 11, 1973, near Nuevo Berlin, one 0.2-ha plot within an 80-ha field was sprayed with 5.6 kg per ha of methiocarb (in 46 liters of water) with a backpack sprayer. Rhoplex AC-33 (1.1 kg/ha) was used as an adhesive. This plot and an identical unsprayed plot had been heavily damaged by thousands of doves before the treated plot was sprayed. A pretreatment survey was made in the treated and untreated plots by measuring the total head length and length of damage from the top of the head in each of 4 subplots (15 heads of sorghum per subplot). Spray plots had 53% of their total length damaged; control plots, 54%. On April 18, at the conclusion of the test, the length of damage on the heads in the unsprayed plots had increased 21%, whereas damage on the sprayed plot increased 12%. Further evidence indicating the effectiveness of the spray was seen in counts of doves entering the plots. A total of 8,411 doves were counted entering the unsprayed plot in 290 minutes of observation, whereas only 1,726 doves were seen entering the sprayed plot during the same time period--79% fewer.

On March 14, 1976, a rate of 3 kg of methiocarb per ha was aerially applied to 2 ha of a 140-ha grain sorghum field near Nueva Mehlem. A similar 2-ha area, 500 m distant, was selected as a control. A prespraying damage survey on these plots in 10 randomly located subplots (25 consecutive grain sorghum heads per subplot) showed that 36.5% of the sorghum had been eaten in the sprayed plot and 8.6% in the control plot. On March 26, when the test was terminated, damage in the sprayed plot had increased 17.4%, whereas it had increased by 29.1% on unsprayed plots.

On March 23, 3 kg/ha of methiocarb was aerially applied to a 2-ha plot within a 200-ha field of grain sorghum near La Nona. A 2-ha plot 500 m distant was used as the control. All grain except the two plots was cut prior to the establishment of the tests. A prespraying damage survey on each of these plots in 10 randomly located subplots (25 heads per subplot) showed that 10.8% of the sorghum in the sprayed plot and 13.5% of the sorghum on the

control plot had been damaged. On April 11, when the test was terminated, the percent of damage on both plots had increased similarly (by 14%). Although methiocarb did not appear to reduce dove damage to grain sorghum in the latter test, it is expected that a higher degree of protection would have been afforded in all tests had entire fields been treated when damage first began. Future tests of methiocarb in grain sorghum are planned, using a pool of fields from which half will be chosen to be sprayed and half will serve as unsprayed controls.

Corn. On February 16, 1975, near Carmelo (Departamento Colonia), a 6-ha area of a 22-ha field of corn being attacked by a flock of 500 Monk Parakeets was treated with 4-aminopyridine (4AP). A total of 42 plots (10 ears/plot) were treated with a solution of 8% 4AP in a 1% methyl cellulose carrier. About 10 ml of solution were sprayed on each ear. Plots were 40 or more meters from one another. Three kinds of 8% 4AP treatments were applied in a modified Latin Square test design: (A) the upper portion of the husk was removed and the exposed portion sprayed; (B) husks were opened, the ear sprayed, and the husks were closed; (C) the upper portion of husks of unopened ears were sprayed.

From 0750 to 0825 hours on the following morning, about 500 Monk Parakeets, 500 Eared Doves, and 300 cowbirds (*M. badius*) and Brown and Yellow Marshbirds (*Pseudoleistes virescens*) entered the field. At 0825 hours, 150 marshbirds and 50 parakeets hovered, then circled and left the field; five minutes later, 100 more parakeets left. At 0850 hours, a second parakeet in a distress flight was noted; at 0955 hours, a third. By 1000 hours, only 25 parakeets remained in the field--a 95% reduction. Many parakeets joined doves feeding in an adjacent wheat field harvested several months before. This phenomenon of parakeets feeding in harvested wheat had not been observed before.

A check of the treated ears that evening showed that 41 (29.3%) of the opened ears (A), 38 (27.2%) of the opened and sprayed and then closed ears (B), but only 7 (5.0%) of the closed ears had been fed upon, mostly by parakeets, but some also by icterids. Parakeets clearly preferred to feed on partially opened ears.

On March 1, 1976, a single plot of 20 partially husked ears of corn was sprayed with a solution of 12% 4AP (in 1% methyl cellulose) in a 21-ha field of corn where about 100 parakeets of a total of 300 using the field were feeding. The flock returned within five minute after the plot was treated and in a 10-minute period, fed on 14 of the 20 ears before being frightened from the field by affected birds. The 14 ears fed on were in the late dough stage; the six ears not fed upon were dented. A total of eight affected parakeets were seen within 10 minutes of initial feeding, and two more were seen within the hour. However, affected parakeets seldom vocalized, indicating an adhesive will be needed in order for the parakeets to obtain greater amounts of the chemical. Although the results from eight other plots treated during the next two days were less spectacular, no more than 25 parakeets were observed in this field at any one time during periodic checks made until March 5, when the sprayed ears were removed and buried.

It is clear that 4AP is not specifically toxic to Monk Parakeets and that an adhesive will be needed to adhere the chemical to corn, especially dented corn. However, the technique of spraying ears in those portions of the field being damaged holds much promise for alleviation of this problem.

Sunflowers. On February 10, 1975, near Carmelo, 300 of the tallest heads in one corner of a 17-ha sunflower field were treated with a solution containing 4% 4AP in 1% methyl cellulose. The field was being heavily damaged by about 300 Monk Parakeets and damage was concentrated in this corner. The florets were brushed from the head before treatment, and only the uppermost third of the head (that portion attacked first by parakeets) was sprayed. The following morning about 100 parakeets fed in this area, and nine were seen affected that morning. Vocalizations of affected birds were weak or absent, indicating the parakeets were obtaining only a small percentage of the chemical (applied to the inedible seed coat) when consuming the edible portion of the seed. About 200 parakeets returned the next day after a 9-cm rain largely inactivated the treated heads.

On March 2 and 3, 1976, near Carmelo, about 170 heads were sprayed with 4AP along the edges of an 18-ha sunflower field just beginning to receive damage from a flock of about 300 Monk Parakeets. About 10 ml of a solution containing 16% 4AP in 1% methyl cellulose again was sprayed on heads that had been brushed to remove the florets. During several hours of observation during the next three days, six parakeets were seen affected, and flocks of up to 100 parakeets were frightened from the field. However, birds were only slightly affected and did not emit distress calls; and 130 parakeets entered the field on March 5, the day that the test was terminated by removal of the treated heads. The 16% concentration flaked badly and appeared to be little more effective than the 4% concentration tried the previous year. An adhesive should be used in any future tests.

Clearly, it will be more difficult to protect ripening sunflowers than ripening corn from parakeets, both because of the lower attraction of a sunflower head compared to a partially husked ear of corn and because only a small portion of the chemical is ingested when the sunflower seed is hulled and the hull discarded.

## SUMMARY

It is apparent from these trials that methiocarb has potential value for protecting sprouting seeds from damage by columbids and ducks. More definitive experiments of lower concentrations of methiocarb are planned for soybeans and rice. However, the initial concentrations tried appear to be sufficiently effective and economical to warrant the development of methiocarb as a seed protectant. These initial trials indicate potentially high benefit to cost ratios.

Protection of ripening crops is more difficult and less progress has been made. It appears that methiocarb will repel doves from ripening grain sorghum, but whether this can be done practically over large areas remains to be demonstrated. The compound, 4-aminopyridine, appears to have definite potential for protecting cornfields from damage by parakeets; but formulation modifications, a different compound, or a different application technique will be needed to protect ripening sunflowers from parakeet damage.

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