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EFFICACY AND POTENTIAL NONTARGET IMPACTS OF DRC-1339 AVICIDE USE IN RIPENING SUNFLOWER FIELDS: 1999 PROGRESS REPORT

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Introduction

Prelude.--In August and September 1998, an emergency operational DRC-1339 (3-Chloro-p-toluidine hydrochloride) avicide program was carried out to reduce post-breeding blackbird populations responsible for damaging sunflower in North Dakota and South Dakota. The economic costs and benefits and nontarget hazards of this program were difficult to assess because a systematic approach to gathering these data was not in place. As such, the U.S. Environmental Protection Agency, the National Sunflower Association, North Dakota and South Dakota natural resource and agriculture agencies, and the U.S. Fish and Wildlife Service have asked the USDA's National Wildlife Research Center (NWRC), in cooperation with the North Dakota/South Dakota Wildlife Services (ND/SD WS), North Dakota State University (NDSU), and U.S. Geological Services (USGS) to develop and execute a study plan to answer the following questions: 1. Will an operational avicide program reduce sunflower damage caused by blackbirds compared to harassment techniques now used by sunflower growers? 2. Can DRC-1339-avicide treatments stop damage after blackbirds begin feeding in a sunflower field? 3. What are the costs and benefits of using DRC-1339 to kill blackbirds damaging sunflower? 4. What species of nontarget birds could be adversely affected by a late-summer baiting program? 5. What bait locations are likely to attract nontarget birds? 6. What are the relationships between sunflower field locations and late-summer blackbird roosts?

The Problem.--Production of sunflower in North Dakota and South Dakota has increased from several thousand acres in the early 1960's to nearly 3.0 million acres in 1998. Ripening sunflower can be severely damaged by red-winged blackbirds, common grackles and yellow-headed blackbirds in the northern Great Plains. To prevent heavy losses from bird damage, growers are advised to avoid planting sunflower near traditional roost sites. However, the sunflower growing region is centered in the Prairie Pothole Region, which is characterized by many cattail-choked wetlands, making it nearly impossible for growers to avoid roost sites. Growers and government agencies have used non-lethal techniques, such as cattail management, aerial hazing, and pyrotechnics, to reduce blackbird damage to ripening sunflower but nonlethal methods often have limitations of costs, logistics, and effectiveness.

Blackbird Populations and Damage.--During late-May and early June 1996-1998, breeding male blackbirds were counted in Clark and Brown counties in South Dakota and Stutsman and Pierce counties in North Dakota. Combined male and female blackbird densities in the four counties across the three census years averaged 26±1.7 (SE) birds/quarter section (0.44 birds/ha). At these estimated densities and at a projected recruitment rate of one offspring per bird, the local population in the four counties in late-summer was 1.4 million blackbirds. During those same years, quantitative bird damage surveys also were conducted in these four counties. Annual sunflower damage averaged 2.4% and was valued at >$2 million over the three-year sampling period. Assuming that 75% of the sunflower damage was caused by the 1.4 million local birds within 18 days after anthesis, an individual blackbird damaged 1.7 kg per year, or $0.36 per bird per year.

DRC-1339 Labels.--DRC-1339 has been used in Louisiana, North Dakota, South Dakota, and Texas under Section 24C of the Federal Insecticide, Fungicide, and Rodenticide Act to reduce blackbird populations causing agricultural damage. In February 1995, the Environmental Protection Agency granted a Section 3 label for *'Compound DRC-1339 Concentrate-Staging Areas'* for population control in noncrop staging areas associated with blackbird roosts. Although canceled in Texas and Louisiana, the Section 24[c] labels for *Compound DRC-1339 Concentrate - ND and SD* are still in effect for North Dakota and South Dakota. This 24[c] label allows a broader use pattern than the Section 3 label, including baiting within ripening sunflower fields during late summer.

DRC-1339 Primary Hazard Profile.--DRC-1339 was selected for controlling blackbirds because of its high toxicity to blackbirds and low toxicity to most mammals, sparrows, and finches. Poisoned birds die of irreversible necrosis of the kidneys and subsequent inability to excrete uric acid (i.e., uremic poisoning). Birds ingesting a lethal dose of DRC-1339 usually die in 1 to 3 days.

The LD_{50} values for European starlings, blackbirds, and magpies range from 1 to 5 mg/kg. DRC-1339 is toxic to doves, pigeons, quails, chickens, ducks, and geese at ≥5.6 mg/kg. In cage trials, NWRC found that 2% DRC-1339-treated rice baits did not kill savannah sparrows. Gallinaceous birds and waterfowl may be more resistant to DRC-1339 than blackbirds, and their large size may reduce the chances of ingesting a lethal dose of poison.

Whooping cranes are the only endangered granivorous birds in the northern Great Plains that could potentially be affected by the consumption of DRC-1339 rice baits. However, DRC-1339 is degraded rapidly by ultraviolet light and heat and has a half-life of less than two days. If whooping cranes are detected in the study area, the baiting program will be stopped so as to minimize the risk to this species.

DRC-1339 Secondary Hazards.--DRC-1339 is rapidly metabolized and excreted and thus does not bioaccumulate, which probably accounts for its low secondary hazard profile. For example, cats, owls, and magpies are at risk only after exclusively eating DRC-1339-poisoned starlings for 30 continuous days. Studies using the American kestrel as a model for raptor species showed that secondary hazards to raptors were minimal, and are not put at risk by DRC-1339 baiting

Previous DRC-1339 Use.--DRC-1339 was used under a *Special Local Needs (EPA 24 [c] and Emergency Exemption (EPA 18)* registrations to control blackbird damage in rice paddies in Louisiana. In the late 1980's and early 1990's, scientists at NWRC compared the field effectiveness

of DRC-1339-treated rice diluted with untreated rice at ratios of 1:50, 1:25, and 1:10 (treated:untreated). These different dilutions were placed at high-use sites located under major flight-lines in Louisiana. Paradoxically, the strong 1:10 dilution was not as effective as the weaker dilutions. NWRC scientists speculated that the 1:10 dilution may have caused bait-site shyness by causing too rapid a reduction in the target population. The 1:25 and 1:50 dilutions may have thus been more efficient at overall reduction of blackbird populations while also reducing the risk of killing nontarget granivorous birds. Evaluation of the effectiveness of population control is difficult in rice-growing areas because of seasonal migration, local movements of birds, and difficulties in obtaining reliable damage estimates.

Concurrent with the investigations in Louisiana on target (i.e., blackbird) effects of DRC-1339-treated baits, NWRC scientists also studied the effects on nontarget species. Thirty nontarget species were seen using the experimental sites, but no dead nontarget species were found. This led to the conclusion that DRC-1339-treated rice baits were of minimal impact to nontargets in Louisiana. Even so, estimating avian mortality caused by a slow-acting poison is difficult at best, and failure to find dead nontarget birds does not mean that nontargets were not killed.

Encouraged by the apparent successful use of DRC-1339 for reducing blackbird damage to rice in Louisiana, research was conducted from 1994-1999 in eastern South Dakota to assess if DRC-1339 could reduce blackbird damage to sunflower. The research had two strategies: one was to bait spring-migrating blackbirds (spring-baiting strategy) as they moved north to their nesting areas, the second involved baiting blackbirds in and around ripening sunflower fields as they migrated south in late-summer (fall-baiting strategy).

In early April each year, millions of blackbirds migrate through eastern South Dakota. These large concentrations can be drawn to 2-acre bait plots placed in stubble cornfields near the roosts. A risk assessment of the nontarget birds using DRC-1339-treated fields suggested that some individual species (e.g., western meadowlarks, ring-necked pheasants, and American robins) may be killed, but the numbers were likely to be so low as to have no effect on the viability of these populations. Searches of baited plots and nearby areas for carcasses, did not reveal any dead nontarget birds that had succumbed to DRC-1339. In 1998 and 1999, scientists from South Dakota State University (SDSU) independently observed the baited plots and similarly conducted intensive searches for dead animals. Their findings mirrored results found in previous studies.

In late-summer 1993 and 1994, NWRC scientists conducted a small-scale experiment designed to test the use of DRC-1339-treated rice baits for reducing ongoing blackbird damage to ripening sunflower. After prebaiting, DRC-1339-treated brown rice (diluted 1:25 with untreated rice) was applied on bait lanes within damaged sunflower fields. Observations showed that some blackbirds could be attracted from the sunflower heads to the baits on the ground; however, sunflower damage was not reduced in the treated fields compared to unbaited reference fields.

Ring-necked Pheasants and DRC-1339.--The potential effects of DRC-1339-treated rice baits on ring-necked pheasants is of special concern for wildlife managers because of the pheasant's status as a game bird. Experiments were conducted to determine caged female pheasants' preference for brown rice. The cage studies indicated that most females preferred cracked corn and sorghum over rice. In times of food scarcity in the wild, however, pheasants probably accept novel foods more readily.

The effect of chronic DRC-1339 exposure on pheasant reproduction was investigated by scientists from SDSU. These studies, conducted independently of NWRC research, showed that DRC-1339 did not significantly affect normal egg-laying, egg hatching, chick survival, or adult survivorship until accumulated dosage neared lethal levels. The median acute lethal dose of DRC-1339 to pheasants was 10 mg/kg. At a 2% treatment rate, a 20-mg particle of brown rice contains 0.4 mg of DRC-1339; thus to obtain an acute lethal dose of 10 mg, a pheasant would need to eat 25 treated rice baits. Treated baits are diluted 1:25 with brown rice, and pheasants would have to eat 650 rice grains to obtain a lethal dose of 25 treated grains. A pheasant eating one grain per second would require more than 10 minutes to eat that much rice. During the late-summer, it is certainly possible for pheasants to eat enough treated rice to cause death. However, due to the variety of foods available, and the diversity of diets reduces the probably of selecting sufficient amounts of treated rice to cause physiological harm.

In this paper, we report results from an experimental fall-baiting project with DRC-1339 conducted in 1999 in 10 counties in North Dakota and two counties in South Dakota. In addition, we describe use of bait plots by nontarget birds and sunflower damage caused by blackbirds.

Methods

Study area.--Ninety townships with a history of extensive blackbird damage to sunflower were selected from a pool of 276 townships that received DRC-1339-treated rices baits in 1998. Forty-five townships were randomly selected for treatment with DRC-1339, while the other 45 served as references.

Baiting Procedures.—In the treated townships, rice-baited plots were established in sunflower fields in areas of high blackbird use. Plots were about 0.1 ha (1/4 acre) and were opened by knocking down standing sunflower plants with an all-terrain vehicle. A seed broadcaster was used to spread 2.8 kg (6.25 lb) of untreated rice in the opening. After 50% of the untreated prebait was eaten, 100 grams (3.5 oz) of 2% DRC-1339-treated rice was mixed with 2.8 kg of untreated rice and spread evenly in the plot. The plots were rebaited with treated baits after blackbirds had eaten >75% of the bait, or after heavy precipitation washed the bait from the site.

Damage Surveys.--From 19 September to 1 October, sunflower damage assessments were completed in the selected 90 townships in 10 counties in North Dakota and two counties in South Dakota. Two fields (if available) were sampled per township. We used 2-stage cluster sampling with townships as clusters and sections (259 ha) as elements. Each field was divided into two sampling strata with an equal number of rows of sunflower in each stratum. Six plots, each comprised of five sunflower heads, were placed in one randomly-selected row from each stratum. The first plot was a random distance between one and 135m; the remaining five plots were placed every 135m. Percent bird damage on the sunflower heads in each plot was measured with a template.

Nontarget Surveys.–Nontarget surveys were carried out between August 19 and October 8, 1999 in Barnes and Stutsman counties in central North Dakota (latitude 47° N, longitude 98.5°W). Fifteen rice-baited plots, located with 75 m of a wetland, were observed for nontarget birds from sunrise to 2 hr after sunrise or from 2.5 hr before sunset to 0.5 hr before sunset. Five of the 15

plots were observed only in the morning from 2-m high permanent stands. The remaining 10 plots were observed from a portable stand in the evening. The observer, equipped with 10 x 50 binoculars, was on the stand at least 15 minutes before the beginning of each observation period. Plots were visited in the same order throughout the study.

Observation periods consisted of 5 min intervals during which any bird seen in the plot was recorded. Activity upon initial sighting was recorded unless the same bird was later seen foraging. Thus, the activity index was biased toward foraging behavior. When large flocks were seen flying into and out of the plot, we estimated the number of birds in the plot at the beginning of each 5 min period. Birds were identified to their highest taxonomic group. Additionally, WS field personnel, visiting the plots to assess rice consumption, recorded bird activity for 10-minute periods before entering to check the baits.

The morning after observations were conducted, each morning plot was censused with mist nets for 2 hr beginning at sunrise. Two 30-m mist nets were set up parallel to and within 1-2 m of two adjacent plot edges. Mist nets were checked at 20-30 min intervals, depending on weather conditions. Field observations and mist-netting did not occur in winds ≥15 km/h.

Field personnel also periodically recorded bird activity from the edges of the plots for 10 minutes prior to checking the bait consumption plots.

Aerial photographs were taken of the habitats surrounding the 15 plots with a 35mm SLR camera using Color Infrared film. These photographs will be analyzed using Geographic Information Systems (GIS) software to quantify the area of available cover types within 250 m of the bait sites. These data will be used to find associations between nontarget use and the proportions of available habitats at the bait sites.

Results

Damage Survey

Baited Fields.–Before treatment with DRC-1339, the six treated fields averaged 4.4% (95% C.I. = 6.6%) damage (Fig. 1a). After the study was completed on 20 September, they averaged 6.8% (95% C.I. = 9.4%).

Field Scale.–Across all 168 surveyed fields in 90 townships, damage averaged 5.3% (95% C.I. = 1.4%). Nine (5.3%) of these fields had blackbird-inflicted damage >20%, 38 (22.5%) fields >10% damage, and 90 (54%) fields >1% damage (Fig. 1b). Damage to oilseed and confectionery varieties averaged 5.7% (n = 129, 95% C.I. = 1.4%) and 4.3% (n = 39, C.I. = 2.6%), respectively. Solid seedings (n = 27) tended to sustain higher damage (8.0%, C.I. = 3.4%) than sunflower seeded in rows (n = 141, 4.9%, C. I. = 1.3%).

Township Scale.--In 1999, sunflower damage averaged 5.3% (n = 45, 95% C.I. = 2.0%) in the reference townships, 5.4% (n = 37, 95% C.I. = 2.4%) in the townships eligible for treatment but not treated, and 4.9% (n = 8, 95% C.I. = 3.1%) in the treated townships. Four (4.4%) of 90 townships sampled had blackbird-inflicted damage >20%, 15 (17.6%) townships >10% damage, and 59 (65.5%) townships >1% damage (Fig. 1c).

The three major blackbird species that reside in the Dakotas forage on sunflower from August until migration in mid October. Assuming that the selected townships represented the damage in our 12 experimental counties, blackbirds reduced annual sunflower production from about 522 million kg to 495 million kg, costing growers an estimated $5,900,000 per year (@$0.22/kg) in the 12 counties.

Bird Surveys

Plots were observed for 28h during the morning period and 54h during the evening period. Mist nets were operated for 52h in the five plots selected for morning counts only. Thirteen species were seen in the plots during observation periods: American goldfinch, American robin, black-capped chickadee, common grackle, eastern kingbird, house wren, mourning dove, red-winged blackbird, song sparrow, savannah sparrow, palm warbler, western kingbird, and yellow-headed blackbird. We recorded three additional species not observed in the plots but captured by mist nets: least flycatcher, yellow-rumped warbler, and Lincoln's sparrow. Three species of raptors (northern harrier, sharp-shinned hawk, and merlin) were seen flying just above the plots. Mammals recorded included white-tailed deer, domestic dog, white-tailed jackrabbit, badger, red fox, long-tailed weasel, and thirteen-lined ground squirrel.

Wildlife Services personnel made 131 10-minute observations of rice-baited plots in sunflower fields in Barnes, Foster, Griggs, LaMoure, Nelson, Ramsey, and Stutsman counties in North Dakota and McPherson county in South Dakota. Eighteen species were recorded: American goldfinch, bank swallow, clay-colored sparrow, chipping sparrow, common grackle, house wren, killdeer, mourning dove, northern harrier, northern flicker, orchard oriole, red-winged blackbird, ruby-throated hummingbird, savannah sparrow, Swainson's hawk, tree swallow, vesper sparrow, and yellow-headed blackbird. An immature golden eagle was seen twice in a tree 1/4 mile (400m) from a plot. We observed 10,780 birds of which 9,781 (91%) were red-winged blackbirds, 772 (7%) were yellow-headed blackbirds, 23 (<1%) were common grackles, and 204 (2%) were nontargets. The most common nontargets were mourning doves (n=100) and various sparrows (n=72). Several jackrabbits, a moose, a coyote, and a fox squirrel were observed in the plots.

Discussion

Precipitation, which can quickly render the DRC-1339 rice baits impotent, was frequent and abundant during this study. Additionally, the sunflower crop matured over a longer period than normal causing the birds to move among fields seeking immature achenes that were easier to open. Because of these unusual climatological and phenological events, research will continue in 2000, and perhaps 2001, to accurately measure the efficacy of the fall avicide program and to describe the use of sunflower fields by target and nontarget bird species. Mist-netting and observations from a blind at the bait plots will be discontinued in the 2000 field season. Rather, census points will be established in selected baited and reference sunflower fields. Field selection and censusing will begin in early August and continue until the end of October or until the fields are harvested. WS field personnel will again be recording bird activity before entering the bait plots.

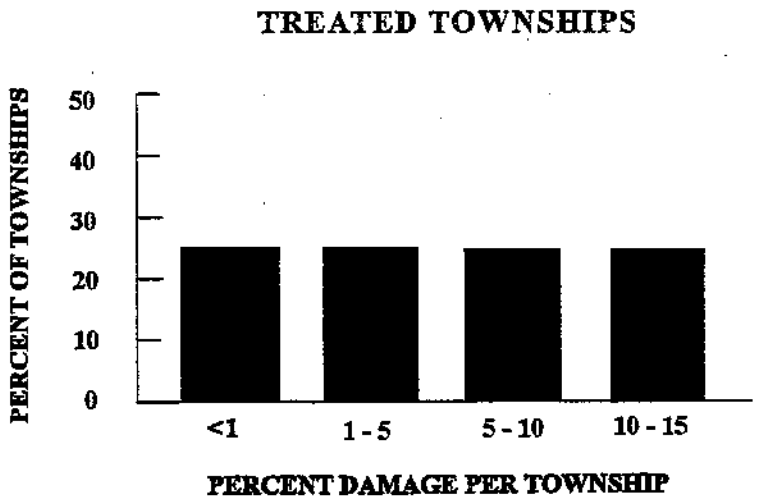

Figure 1a. Distribution of damaged sunflower fields by percent blackbird damage observed in 8 townships treated with DRC-1339 avicide.

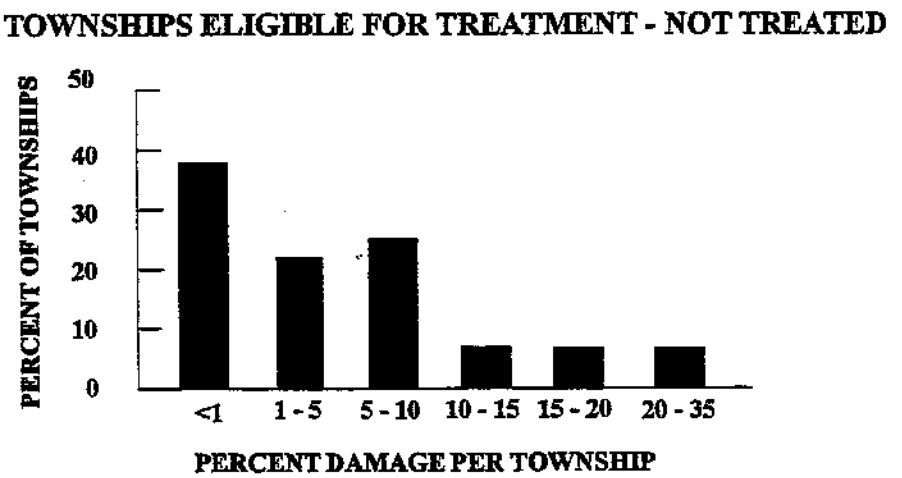

Figure 1b. Distribution of damaged sunflower fields by percent blackbird damage observed in 37 townships eligible for avicide treatment but not treated.

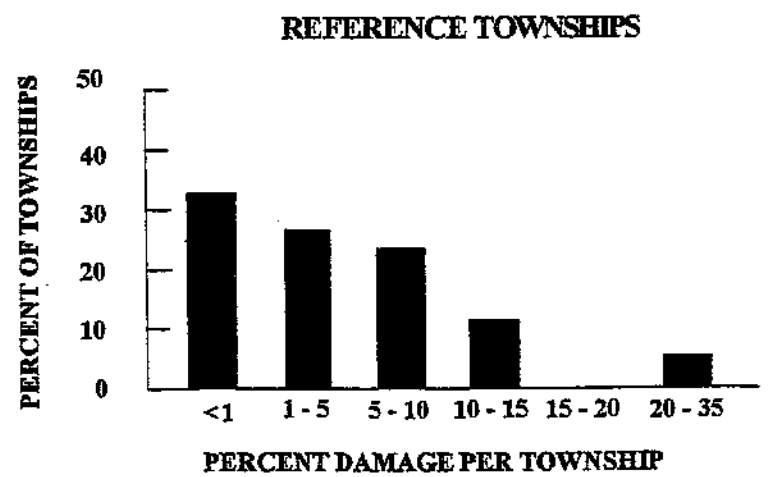

Figure 1c. Distribution of damaged sunflower fields by percent blackbird damage observed in 45 reference townships.

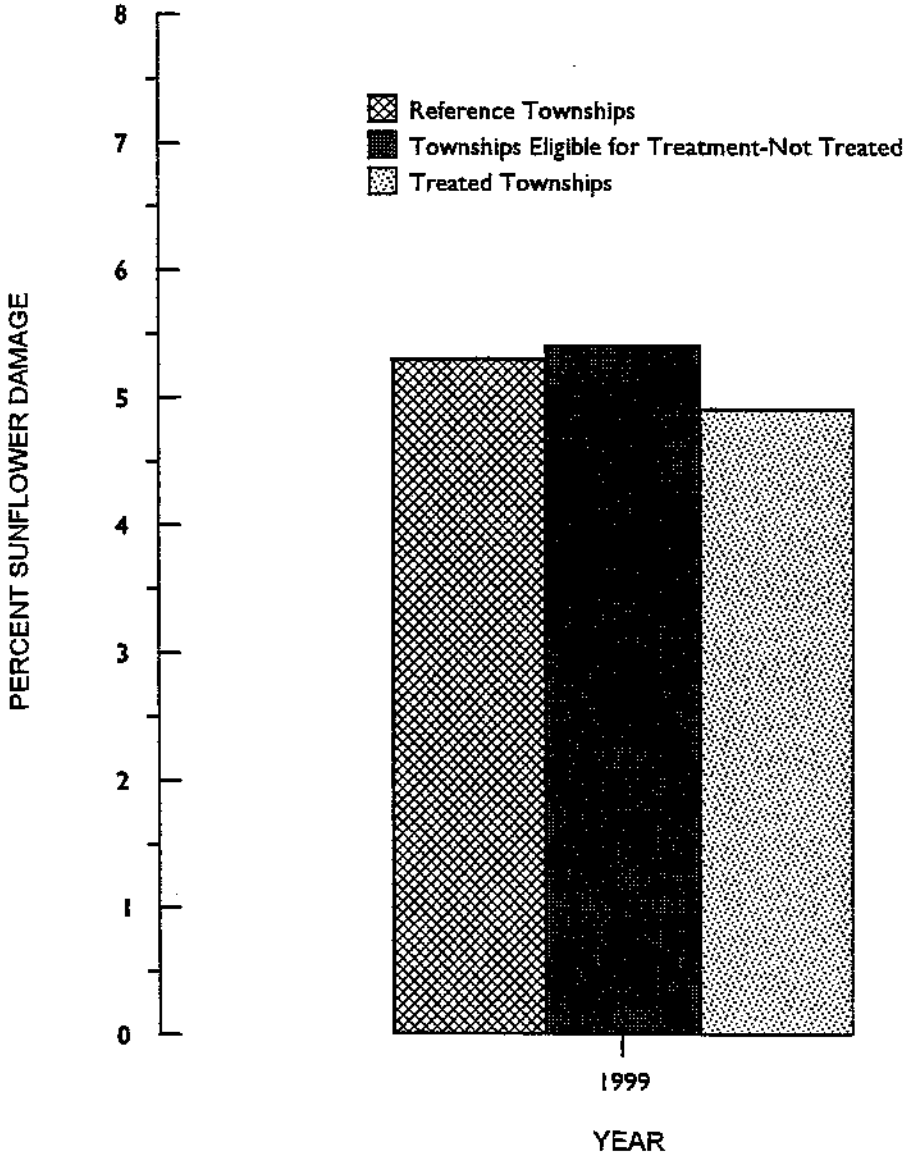

Figure 2. Percent blackbird damage in 45 reference townships, 37 eligible for treatment with DRC-1339-avicide but not treated, and 8 DRC-1339 treated townships (36 sq. miles) in North and South Dakota.

The 1999 Sunflower Research Workshop, sponsored by the National Sunflower Association, took place on January 18 and 19, 2000, at the Ramada Plaza Suites, Fargo, ND. The workshop was very well attended and received by public and private researchers from the United States and Canada, as well as other interested parties.

This volume contains nearly all the presentations given at the 1999 workshop. Some of the papers are summarized or abstract form.

The National Sunflower Association would like to extend its appreciation to those presenting papers/posters at this annual Sunflower Research Workshop and to those who participated by their attendance and questions. Special thanks are extended to the NSA Research Forum Planning Committee, Dr. Dr. Gary J. Brewer, NDSU, Dr. Laurence D. Charlet, USDA-ARS and Pat Duhigg, Seeds 2000. Thanks also to Dr. Laurence D. Charlet, USDA-ARS (Sunflower Research Unit) and Dr. Gary J. Brewer, NDSU, for their expertise in moderating the workshop sessions.

Questions regarding these proceedings may be directed to the National Sunflower Association, 4023 State Street, Bismarck, ND 58501.

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