

Blackbird Population Management to Protect Sunflower: A History

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ABSTRACT: Sunflower (*Helianthus annuus*) growers in North Dakota and South Dakota harvested 593,522 ha in 2012, valued at \$US600 million. Blackbirds, numbering about 75 million, annually damage 2 to 3% of the crop. Damage tends to be clumped around cattail (*Typha* spp.) dominated wetlands with standing water. In an attempt to reduce sunflower damage, three general population management strategies have been tested over the past three decades. One potential strategy was to reduce blackbird numbers during winter in the southern U.S. A second strategy was to use an avicide at spring roost sites in eastern South Dakota. A third approach was to reduce local blackbird populations that were doing or about to damage ripening sunflower. All three schemes largely relied on the use of DRC-1339 (3-chloro-4-methylaniline hydrochloride) and related compounds and all failed because of logistics, cost-effectiveness, environmental risks and societal concerns. In this paper, I chronicle significant research efforts to implement these strategies.

Key Words: blackbirds, crop damage, nonlethal management, North Dakota, Prairie Pothole Region, South Dakota, sunflower

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INTRODUCTION

Scientists have labored for over three decades to discover an environmentally-safe and cost-beneficial strategy for managing blackbird populations responsible for damaging ripening sunflower (*Helianthus annuus*) in the Prairie Pothole Region (PPR) of the northern Great Plains (Linz and Hanzel 1997, Linz et al. 2011). Fall-migrating blackbirds, composed mainly of red-winged blackbirds (*Agelaius phoeniceus*), common grackles (*Quiscalus quiscula*), and yellow-headed blackbirds (*Xanthocephalus xanthocephalus*), number about 75 million (Peer et al. 2003). Damage can be so severe in the PPR that some growers will eliminate this otherwise profitable crop from their rotation (Kleingartner 2003). In 2009 and 2010, sun

flower damage in the PPR of North Dakota averaged 2.7% and was valued at US \$3.5 million (Klosterman 2011). Levels of damage are locally variable, both within and among years, because of cropping patterns and suitability of wetlands for roosting blackbirds. Losses, which can exceed 20%, have driven growers to seek methods of managing blackbird populations (Linz and Homan 1998). Among the various methods prescribed to limit blackbird damage to sunflower, lethal control with avicide-treated grains and aerial application of avicides have received extraordinary attention from researchers. In this paper, I chronicle significant research efforts to assess the cost-effectiveness and environmental-safety of

DRC-1339 (3-chloro-4-methylaniline hydrochloride) and related compounds, for managing blackbird populations responsible for damaging sunflower.

IMPETUS FOR MANAGING BLACKBIRDS

1977

In 1977, representatives from North Dakota State University (NDSU), North Dakota Sunflower Council, and U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, National Wildlife Research Center (formerly Department of Interior, U.S. Fish and Wildlife Service, Animal Damage Control, Denver Wildlife Research Center) met at NDSU to discuss options for managing blackbird damage to ripening sunflower (Anonymous 1978). At this meeting, industry representatives expressed doubt that scaring birds with propane boomers, guns, and chemical repellents would ever be effective and that reducing the blackbird populations would be more appropriate. Biologists explained that numerical reductions are not always accompanied by an equal reduction in depredation. Even so, they suggested research on poisoning blackbirds in the roosts, placing avicides at bait stations, and developing chemosterilants as viable options.

1982

Using a new mass-marking method, scientists from the U.S. Department of Interior, Fish and Wildlife Service, Animal Damage Control, Denver Wildlife Research Center (in 1997, transferred to U.S. Department Agriculture, Animal and Plant Inspection Service, Wildlife Services, National Wildlife Research Center [WS-NWRC]) found that red-winged blackbirds (RWBL) migrating through northwestern Missouri ended their migration in the sunflower growing areas in the Dakotas, Minnesota, and Canada (Knittle et al. 1987, Knittle et al. 1996, Homan et al.

2004). The NSA supported the notion that population control in Missouri could effectively reduce sunflower damage. Biologist cautioned that population suppressants would require intensive testing of safety hazards to humans and nontarget species, a long and costly process.

1984

In 1984, Congress considered appropriating \$25 million over a 10-year period to develop methods for reducing blackbird populations (Anonymous 1984a). The goal was to development of chemosterilants and avicides that would ultimately be implemented on an operational basis. This request for funding of chemosterilants and toxicant research failed in Congress but additional money was added to the NDSU research program on developing bird-resistant sunflower (Anonymous 1984b). Development of bird-resistant sunflower was abandoned in the early 1990s because yield and oil content could not be maintained along with bird resistant traits (e.g., concave heads and large bracts) that seemed to thwart blackbird feeding.

LATE WINTER AVICIDE TESTS

1979–1981

An effective roost dispersal technique was needed where high blackbird concentrations resulted in crop damage or were a nuisance in urban areas. In winters 1979, 1980, and 1981, Cummings (1979, 1980, 1981) assessed use of Avitrol (a.i., 4-Aminopyridine, 4-AP) for dispersing blackbird roosts. Prior to death, Avitrol causes birds to convulse and emit distress calls that sometimes will frighten other birds. Cummings (1979, 1980) successfully dispersed two wetland roosts (50,000 – 1 million blackbirds) in Colorado and Kansas by placing 4-AP-treated cracked corn on bait trays within the wetlands. However, Cummings (1981) was not able to disperse a 2-million

bird roost from a cedar-hardwood roost using the same technique. He speculated that the extent of the roost (51 ha) and dense undergrowth reduced the distance that distress calls could be heard.

This roost dispersal method was not widely used in the PPR because blackbirds tend to use large cattail-dominated wetlands which could also muffle distress calls. Additionally, 4-AP is a nonselective compound putting nontarget granivorous birds at risk. However, Cummings success at attracting blackbirds in winter was the impetus for using bait trays to attract fall roosting blackbirds in North Dakota (Linz et al. 2012).

1979–1994

The surfactant, Compound PA-14 Avian Stressing Agent, was used successfully to reduce local winter populations of blackbirds (Heisterberg et al. 1987, Glahn et al. 1991, Dolbeer et al. 1995). PA-14 use was limited, however, because low temperatures and copious amounts of water were needed for a successful application. To overcome these limitations, aerially applied roost toxicants were touted as potential alternatives to PA-14. In 1979 and 1980, terrestrial blackbird roosts were sprayed with compound CAT (DRC-2698, N-[3-chloro-4-methylphenyl]acetamide), a compound closely related to DRC-1339 (3-chloro-4-methylaniline hydrochloride and CPT (DRC-1347, 3-chloro-4-methylbenzenamine). Although the effects of these sprays were difficult to assess because of bird movement, they were judged to be unsuccessful and the authors recommended that the pursuit of a roost toxicant be abandoned (Lefebvre et al. 1979, Lefebvre et al. 1980). Regardless, on 1 March 1989, Heisterberg et al. (1990) aerially sprayed CPT on a 330,000-blackbird roost at a woodlot near Crawford, Mississippi. Mortality in the roost was only 3% of the 330,000 bird population but out-of-roost mortality was unknown. Pilot misapplication and probable

CPT volatilization of the spray formulation may have contributed to the low mortality in the roost. Searchers found 10 northern cardinals (*Cardinalis cardinalis*) and a single American robin (*Turdus migratorius*) in and near the roost.

In 1989 and 1990, Glahn and Wilson (1992) evaluated the use of 2% DRC-1339-treated brown rice for reducing blackbird populations in Louisiana. The authors prebaited with untreated rice and baited with treated rice at a ratio of 1:50 or 1:25 in 1989 and 1:10 in 1990. Treatment included 3,487 kg and 3,071 kg of bait in 1989 and 1990, respectively, with an estimated 70% of bait eaten. Blackbird mortality was estimated at 1.3 and 2.7 million birds. The baiting significantly reduced the number of blackbird at a nearby roost and growers reported a reduction in losses >80%. The authors concluded that the baiting program was cost-effective for reducing blackbird damage to sprouting rice.

Based on the apparent success of DRC-1339 in Louisiana, winter baiting in the southern U.S. was discussed as a possible strategy for reducing blackbird damage to sunflower. This notion was abandoned because the blackbirds in Louisiana emigrated all across the eastern half of the U.S. (Dolbeer 1982, Dolbeer et al. 1995). Regardless, results reported by Glahn and Wilson were the driving force behind the spring avicide tests conducted in South Dakota in the 1990s.

Finally, Glahn et al. (1994) reviewed the potential for using native bamboo (also cane; *Arundinaria* sp.) and an introduced species (*Phyllostachys* sp.) to attract blackbirds and starlings away from problematic urban sites. Glahn and colleagues suggested that bamboo was a preferred habitat for blackbirds because of its dense canopy and extensive lateral branching that serve as ideal bird perches. Allen Wilson (Louisiana Wildlife Services, pers. comm.) relayed that biologists

discussed spraying PA-14 on bamboo roost sites or baiting birds staging around the roosts with DRC-1339. These management actions were not carried out. Although researchers planted a couple of experimental plots of bamboo in Louisiana (Allen Wilson, pers. comm.), the concept was not supported as a useful management tool and was abandoned.

2000–2003

The USEPA label ‘Compound DRC-1339 Concentrate – Staging Areas’ (EPA Reg. No. 56228-30) instructions require that baiting sites be abandoned when nontarget birds are observed eating bait. Thus, studies on the prevalence of nontarget birds at DRC-1339 bait sites and toxicity tests were initiated.

In late winter 2000 to 2002, Pipas et al. (2003) assessed nonblackbird use of DRC-1339 bait sites in newly planted rice in Louisiana and Texas. In both states combined, they observed 81 bait sites for 249 h and conducted 486 flush-counts. The nontarget bird species most commonly observed on DRC-1339 bait sites was the savannah sparrow (*Passerculus sandwichensis*) followed by killdeer (*Charadrius vociferus*), mourning dove (*Zenaida macroura*), meadowlarks (*Sturnella* spp.), and American pipit (*Anthus rubescens*). Pipas et al. (2003) concluded mourning doves and meadowlarks were of greatest concern because of their susceptibility to DRC-1339.

Cummings et al. (2003) reported on 5-day dietary toxicity tests for six species of birds fed DRC-1339-treated rice diluted 1:25 with untreated rice. Of these, savannah sparrows, Canada geese (*Branta canadensis*), and snow geese (*Chen caerulescens*) showed little effects from eating the rice. On the other hand, 9 of 10 mourning doves, 8 of 9 western meadowlarks (*Sturnella neglecta*), and 8 of 10 American tree sparrows (*Spizella arborea*) died during the same test. All six

species showed some aversion to the DRC-1339 bait, and Cummings et al. (2003) suggested that bait avoidance might reduce risk of mortality.

SPRING AVICIDE TESTS

1994–1995

Barras (1996) evaluated the efficacy of DRC-1339 for reducing spring roosting blackbird populations in eastern South Dakota. Her objective was to determine if baiting in this area would ultimately decrease sunflower damage during the fall in the sunflower production area. DRC-1339-treated brown rice was applied to corn stubble fields located near one roost in 1994 and near two roosts in 1995. In 1994, the number of dead birds as a result of the baiting was not calculated. In 1995, 422 blackbird carcasses were found near the treated roosts. Based on the amount of baits eaten, about 230,000 (assumes one bait per dead bird) birds were killed (Barras 1996). Roosting populations at all study sites exhibited large weekly fluctuations; thus, estimates of treatment effects on the blackbird populations could not be determined from the roost counts. Even so, Barras (1996) concluded that DRC-1339 could be used to kill blackbirds during spring migration in South Dakota, but the window of opportunity for baiting was only about 3–4 weeks and wet weather could limit the number bait applications.

Linz et al. (2002) also evaluated nontarget risks associated with the use of DRC-1339-treated rice baits on corn stubble in east-central South Dakota. No difference was found in nonblackbird abundance in rice-baited and unbaited plots. Of the 15 nonblackbird species identified, ring-necked pheasants (*Phasianus colchicus*), and meadowlarks were identified as most at risk because of their susceptibility to DRC-1339. Based on these observations, the authors recommended that bait sites should not be placed close to field edges.

1996-1997

In spring 1996 and 1997, Linz et al. (2003) simulated a baiting program in South Dakota to compare attractiveness of ~1 ha plots placed in corn and soybean stubble and baited with untreated rice. Red-winged blackbirds accounted for 90% of all birds observed in the plots and selected rice-baited plots over plots without rice. Blackbirds preferred foraging in corn stubble over soybean stubble, suggesting that waste corn was more palatable than soybean. Additionally, cornfields appeared to contain more weed seeds, which would serve as an additional attractant. Linz et al. (2003) concluded that 1) RWBL numbers generally peak during the first 2 weeks of April but migration could be delayed by adverse weather, particularly late spring snows; 2) blackbirds are attracted to brown rice, and thus it is an acceptable bait carrier; and 3) avicide-treated brown rice should be placed in stubble fields of corn to maximize efficiency.

In 1997, Hubbard and Neiger (2003) conducted laboratory experiments to investigate the effects of repeated dosages of compound DRC-1339 on ring-necked pheasants. Over 5 days, they administered 3 doses of 4 mg DRC-1339 to one group and 3 doses of 2 mg to another group, and a third group served as controls. Doses were administered over a 5-day period. Females were mated with males and reproductive variables (clutch size, fertility, hatchability, 10-day chick survival, and final brood size) were analyzed. One female dosed with 4 mg died of toxicosis. Incidence of egg yolk peritonitis was significantly higher in the females that received DRC-1339. Although females produced slightly smaller clutches and brood sizes at the higher dose rate, the difference among treatment levels was not statistically significant. Males given high doses produced significantly smaller broods. The authors

concluded that sub-lethal doses of DRC-1339 might affect reproduction in pheasants.

1998-1999

In response to concerns that using DRC-1339 could impact RNPH populations in east-central South Dakota, Avery et al. (1998) conducted pen studies to 1) determine bait preferences and feeding behavior of hen RNPH and 2) assess their behavioral effects after dietary exposure to DRC-1339. Avery and colleagues concluded that penned RNPH will eat brown rice treated with DRC-1339 and avoidance of feeding sites following sublethal exposure could not be assumed.

Smith (1999) observed DRC-1339-treated plots in South Dakota and reported that granivorous nonblackbirds were observed more often in rice-baited plots than in adjacent unbaited plots. Ring-necked pheasants were observed around the treated plots but only twice inside treated plots. Smith noted that 84% of the granivores in the treated plots were feeding and concluded that the rice-baits were attracting nonblackbirds. Smith's team, consisting of 2-7 observers and, sometimes retrieving and pointing dogs, conducted extensive searches but did not find any dead or sick nonblackbirds. Smith (1999) concluded that "at the current scope" the blackbird baiting program may not be having a negative impact on nonblackbird species.

2002

In April 2002, Custer et al. (2003) collected nonblackbird species in three harvested cornfields in eastern South Dakota. Each field contained two 0.4-ha plots baited with 23 kg untreated brown rice. They observed the plots for 128 hr and saw 49 nontarget birds and about 37,000 blackbirds in the plots. Of the 49 nontarget birds, 29 were granivores. This equates to about one granivorous nontarget bird every 6 hrs of observation. Three song sparrows (*Melospiza melodia*), one northern flicker (*Colaptes*

auratus), two American robins, five common grackles and 12 RWBL were collected in the rice-baited areas. All three of the song sparrows, one grackle, and ten RWBL contained rice in the upper GI tract.

2003

Blackwell et al. (2003) studied the potential population effects of the removal of up to 2 million RWBL annually under a 5-year program of baiting during spring migration. They also examined whether lethal control, in combination with current levels of breeding-habitat management, would be cost-effective in decreasing depredation of sunflower crops during late summer. Assuming a population of 27 million blackbirds staging in eastern South Dakota and migrating into North Dakota, they evaluated the associated costs of the management relative to potential sunflower crop losses. Variable annual culls yielding mean annual removals of ~1.2 million birds with and without density compensation and produced negative cost-benefit ratios of 1:2.3 and 1:3.6, respectively, under the assumptions of \$0.07 in damage per bird and 4% loss to other factors. The authors concluded that spring baiting would not be beneficial for sunflower growers. This study, combined with concerns about killing song birds, ended research on spring baiting with DRC-1339 (Gamble et al. 2003).

LATE SUMMER AVICIDE TESTS

1985

In late-summer 1985, Cummings et al. (1990) studied the effectiveness of CAT-treated sunflower and cracked corn baits for reducing roosting blackbird populations using three fields established as sunflower decoy crops near Churches Ferry, North Dakota. CAT-treated baits diluted 1:9 with similar mixture of untreated bait were applied at a rate of 56 kg/ha. Peak number of blackbirds feeding in test fields during observation periods varied from ~2,000 to ~11,000, while

peak blackbird numbers in nearby roosts ranged from 60,000 to 90,000. Only 13% of 212 kg of baits were eaten, which was extrapolated to 13,000 to 31,000 birds killed. Estimation of the efficacy of this technique for reducing local populations was complicated by the slow-acting nature of CAT, lack of fidelity of birds to an individual field, location of the fields in relation to roosts, bait removal by small mammals and insects, and the constant turnover of blackbird populations in the treated field.

1986

The Animal Damage Control (ADC) program was transferred from the USDI-USFWS to the USDA-APHIS. Additionally, Congress had appropriated \$500,000 for research on lethal and nonlethal methods of controlling blackbird damage to crops.

With these monetary resources, Cummings and Schafer (1989) were able to evaluate a DRC-1347 (CPT) aerial spray application for reducing a roosting blackbird population. In early September, they sprayed a mixture of CPT (10%), propylene glycol, methanol, and water on a 3.4 ha wetland that harbored 7,000 blackbirds. Three caged RWBL that were placed on top of the vegetation died, whereas one bird placed at the bottom of vegetation survived. No dead blackbirds were found during post treatment searches. The roost population remained stable for two days and then declined rapidly. The authors speculated that the CPT could have caused the population decline. Cummings and Schafer concluded that better methods were needed to estimate mortality from a slow acting avicide such as CPT.

1993-1994

Linz and Bergman (1996) assessed the effects of treating ripening sunflower fields with 2% DRC-1339-treated rice baits on blackbird damage to sunflower fields. Sunflower fields near 10 blackbird roosts were

paired within locations and each set of sunflower fields within the pair randomly designated as either untreated reference or treated. Baiting commenced in August when blackbirds began roosting in wetlands and feeding in nearby sunflower fields. They treated one or two sunflower fields located within 1.6 km of the roost used by at least 1000 blackbirds before treatment. Treated baits were applied at a rate of 28.0 to 56.0 kg/ha when birds began feeding on the prebait. The rate of bait consumption could not be determined because periodic heavy rains washed the bait particles out of the plots. Each field was baited about five times over an average of 12 days. They found that the numbers of blackbirds using roosts within the treated and untreated test areas were similar and the percentage of sunflower damage did not differ between treatments. This work confirmed Cummings et al. (1990) assessment that broadcasting avicide baits in ripening sunflower fields does not reduce local blackbird populations or sunflower damage.

1999-2000

In late-summer 1999 and 2000, an emergency operational DRC-1339 avicide program was initiated to reduce post-breeding blackbird populations responsible for damaging sunflower in Barnes and Stutsman counties in North Dakota. Wildlife Service personnel established rice-baited plots in sunflower fields to test within-field use of the avicide, DRC-1339, as a method of managing blackbird damage (Schaaf 2003). The plots were situated in areas with observed blackbird activity and were re-baited with DRC-1339-treated rice periodically. Schaaf (2003) recorded avian activity on 15 baited plots using morning and evening observations and mist netting. Across all techniques, she saw a combined total of 21 non-blackbird species in the bait plots.

Concurrent with the baiting program, Custer et al. (2003) conducted an independ-

ent study to determine if nonblackbirds eat rice and potentially face exposure to DRC-1339. In 1999, 11 sparrows (*Emberizidae*), two rock doves (*Columba livia*), and one mourning dove (*Zenaida macroura*) were collected in the DRC-1339-treated areas. Eight of the 11 sparrows (73%) contained rice in the esophagus or stomach. The two rock doves and one mourning dove also contained rice. In 2000, two fields near Lakota, North Dakota, were baited with DRC-1339 (Custer et al. 2003). During 60 hr of observations, Custer and colleagues observed 12 mourning doves, 18 sparrows, one American robin, and 350 blackbirds. Five mourning doves, one savannah sparrow, one grasshopper sparrow, and one vesper sparrow were collected at the plots. DRC-1339 was detected in the body tissue or upper GI tract of all three sparrows and four of the mourning doves. Three of the mourning doves had rice in the GI tract; none of the sparrows had rice in their GI tracts. Microscopic examination, however, revealed abnormalities (vacuolar degeneration, nephrosis, and nephritis) in the kidneys of 4 of the birds, which indicates possible DRC-1339 poisoning.

Linz et al. (2000) found that DRC-1339 baited fields averaged 4.4% damage before treatment and 6.8% post treatment. These scientists surveyed 168 fields in 90 townships and found damage averaged 5.3%. Nine of the fields had >20% damage, 38 fields >10%, and 90 >1% damage. The fall baiting program was not continued because the effort was logistically difficult, resource intensive, not cost-beneficial and raised environmental concerns.

2007-2008

Linz et al. (2012) assessed avian use of rice baits placed on food trays attached to the top of wire cages supplied with live blackbirds. They reasoned that the decoy blackbirds could attract conspecifics, while reducing the risk of non-blackbird exposure to

DRC-1339-treated baits. Over 1,011h, Linz and colleagues saw 3,888 birds, consisting of 25 species and 12 families, on the bait trays. Blackbirds made up 90.4% of the bird observations, whereas sparrows made up 1.6% of the birds observed. Overall risk to non-target species appeared minimal. The bait trays, however, attracted a small number of blackbirds compared to the source population feeding in nearby crop fields. The results strongly suggested DRC-1339-treated rice used in this manner was unlikely to be a cost-effective method of reducing blackbird damage to ripening sunflower.

DISCUSSION

DRC-1339 is the only avian toxicant currently registered by the U. S. Environmental Protection Agency (Eisemann et al. 2003) for managing blackbirds, starlings (*Sturnus vulgaris*), and other bird species that cause issues related to human health and safety, agricultural crop losses, and threatened or endangered species. Since DRC-1339 was initially registered in 1967, a wealth of information has been collected on its toxicity, environmental impacts and application methodology. Thus, it makes little sense to register a new active ingredient as a replacement avian toxicant which might cost nearly \$US 8.0 million (Eisemann et al. 2011). Expanding the use of current registered pesticides that show bird repellency (e.g., chlorpyrifos) is more economical but registrants are hesitant to risk a profitable product for a relatively small market (Linz et al. 2006).

Three decades of research by my research team and others has not resulted in an environmentally-safe and cost-beneficial method of using DRC-1339 and related compounds for reducing local, regional and national populations of blackbirds doing or about to do damage to ripening sunflower. None of the strategies including baiting during winter in the southern U.S., baiting at

spring roost sites in eastern South Dakota and baiting to reduce local blackbird populations that were damaging ripening crops is currently used because of logistical difficulties, cost-effectiveness, environmental risks and societal concerns.

I continue to suggest that a grower's best options are to manage dense cattail stands to disperse large roost concentrations of blackbirds, use a plant desiccant to accelerate fall harvest, use visual and auditory scare devices and plant decoy crops in strategic locations (Linz et al. 2011, Linz and Homan 2011). Other options might include synchronizing planting time of sunflower with neighbors to eliminate a mix of early- or late maturing sunflower crops and leave stubble, especially sunflower, to serve as alternate food sites.

In the next decade, I am optimistic that more effective bird repellents will be registered for use on ripening sunflower (and other grain crops) and that a perennial sunflower will be available for use as an alternative food source for blackbirds and other animals (Carlson et al. 2013, Kantar et al. 2009). Alternative sources of foods, in combination with repellents, should help us make significant advances in management of blackbird damage in sunflower (Avery 2002).

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