EFFECTIVENESS OF DRC-1339 BAITING FOR REDUCING BLACKBIRD DAMAGE TO SPROUTING RICE

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Abstract: Under a Special Local Needs (Section 24[c]) registration, the effectiveness of a 2% DRC-1339-treated brown rice baiting program to reduce bird damage to sprouting rice was evaluated during 1989 and 1990 at the Millers Lake blackbird roost, Evangeline Parish, Louisiana. After prebaiting with untreated rice, treated bait diluted with untreated rice at a ratio of 1:50 or 1:25 in 1989, and 1:10 in 1990, was applied at a rate of 112 kg/ha at sites strategically located under blackbird flightlines. Total treated bait mixtures applied to these sites were 3,487 kg in 1989 and 3,071 kg in 1990, of which an estimated 70% was consumed by primarily red-winged blackbirds (*Agelaius phoeniceus*) and brown-headed cowbirds (*Molothrus ater*) each year. Based on bait consumption data, blackbird kills were roughly estimated between 1.3 and 2.7 million birds annually. Following these baiting programs, roosting populations prior to the time of rice planting during both years were the lowest ever recorded for this roost (6 previous years without baiting). Compared with baseline data from 2 previous years, roadside censuses within an 8-km radius of the roost also indicated significant reductions in foraging blackbirds during the bird damage period of both baiting years. Questionnaires were sent to rice growers within a 16-km radius of the roost each year, asking them to compare sprouting rice damage at their farms in 1989 and 1990 with that during the 1986, 1987, and 1988 baseline years. An analysis of the responses indicated an estimated average reduction in losses of 81 and 85% in 1989 and 1990, respectively. No detectable impact on nontarget bird populations was observed during these baiting programs and more recent detailed hazard studies of these appear to confirm these observations. Based on grower estimates of costs of bird damage with and without baiting, and the estimated costs of these programs, we conclude that these baiting programs are cost-effective for reducing bird damage to sprouting rice.

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Blackbirds (Icterinae), particularly red-winged blackbirds, can cause locally-severe damage to sprouting rice in Louisiana (Wilson 1985), and are estimated to cost $4 million annually statewide (Wilson et al. 1989). Spring-roosting redwing populations appear to be responsible for most damage, and the greatest rice losses may be associated with proximity to roosts (Wilson 1985). This is particularly true in Evangeline Parish, Louisiana, where the Millers Lake winter blackbird roost occurs each year. Spring-roosting populations of 0.5-1.0 million birds persist throughout March causing severe damage to early- planted rice (Labisky and Brugger 1989). Although delaying rice planting would likely reduce damage (Wilson et al. 1989), the standard technique for damage control has involved using exploders, supplemented with shooting. Results of this are often variable and limited in effectiveness depending on the persistence of the user (Wilson 1985). Although testing with the avian chemical repellent methiocarb has shown effectiveness at high application rates (Holler et al. 1982), cost-effectiveness, residue problems and recent Environmental Protection Agency (EPA) cancellation of the methiocarb label for other bird control uses has resulted in curtailed interest of this product as a rice seed treatment. Thus, the ineffectiveness of nonlethal methods has stimulated interest in lethal control strategies for alleviating locally-severe damage.

One lethal control strategy that appeared applicable to this situation was baiting pre- and post-roosting congregations of birds, often referred to as "staging-area baiting." Staging-area baiting with DRC-1339 baits has shown some potential for reducing blackbird and starling populations associated with winter roosts (West 1968, Knittle et al. 1980). Initial studies demonstrated the feasibility of reducing the spring-roosting population at Millers Lake by baiting strategically located staging areas near the roost (Glahn et al. 1986, Glahn et al. 1989). However, further studies were needed to evaluate the overall effectiveness of these baiting programs.

Based on results of preliminary studies, Louisiana granted a Special Local Needs (EPA Section 24[c]) registration for use of DRC-1339 brown rice bait for controlling spring-roosting blackbirds at the Millers Lake roost in Evangeline Parish, Louisiana in 1989. This report summarizes data collected during the first 2 years of this operational baiting program, and assesses the effectiveness and safety for reducing bird damage to sprouting rice.

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METHODS

Bait Formulation and Application

DRC-1339, 98% active ingredient, (3-chloro-4-methylbenzamine HCL) was surface-coated on medium-grain brown rice (2.0% w/w) using 0.75% Alcolec S as a sticker. Before use, treated baits were mixed with untreated brown rice in a cement mixer at a ratio of 1:50 and 1:25 in 1989, and 1:10 in 1990.

Baiting Sites and Operations

Potential bait sites consisted of fallow fields and pastures (4-8 ha) with livestock excluded, owned by cooperating rice growers. We selected sites for baiting based on their proximity to the roost (within 1.6 km) and the size of flightlines passing over them. Eight sites were baited in 1989 and 17 in 1990. In 1989, we selected 2 additional sites, 3.2 km from any treated site, for use as untreated reference sites and nontarget census evaluations.

Before applying DRC-1339-treated baits, sites were prebaited with untreated brown rice broadcasted with an all-terrain-vehicle-mounted seeder or aircraft at a rate of 56 kg/ha. At some sites, between 45 and 91 kg of untreated cracked corn were poured out perpendicular to bait lanes as a visual attractant. Prebait was applied in 2-9 bait lanes per site. Each lane was 0.9 m wide and separated by 15-30 m, resulting in 0.2-2.4 treated ha/site. Treated bait was applied to the same bait lanes at a rate of 112 kg/ha only after at least 75% of the prebait had been removed, and prebaiting observations indicated no appreciable nontarget hazards. Additional bait applications were made following the same criteria as long as blackbirds on flightlines continued to use these sites.

To assess bait consumption, 10-50 (proportional to treated area) sampling locations were established along bait lanes at each site. At each sampling location a wire flag was placed in the center of the bait lane. When assessing bait, a 0.09-m^2 grid was nonselectively tossed down within a 1.5-m radius of the flag. The area within the grid was examined for the presence or absence of rice grains. Based on "all or none" rice-consumption patterns by blackbirds in previous studies (Glahn et al. 1989), percent consumption of rice was calculated as the number of plots without rice divided by the total number of plots. Bait consumption was estimated as the percent of plots without rice times the amount of bait applied. Bait consumption estimates were made within 48 hours of each prebait or bait application.

The extent of blackbird use of bait sites was determined by observing all sites within 48 hours of each prebait and bait application (1-7 applications), both in the morning and the evening, as flightlines exited and returned to the roost. During these periods, observers recorded the number and species of blackbirds passing directly over and landing on each bait site. Nontarget species using these bait sites were also recorded. All sites being baited or prebaited were assessed, and based on blackbird use, bait consumption, and absence of nontarget species, each site was scheduled for further baiting.

Baiting Program Evaluation

Evaluation of the baiting program involved monitoring blackbird roosting populations, monitoring nontarget bird populations at bait sites, and assessing the impact of the baiting program on area-wide blackbird populations and sprouting rice damage. Evaluation methods are described below.

Roost counts.— Roosting population estimates were made from mid-February through the end of March before, during, and after baiting by a single trained observer (Wilson 1985). Seven estimates were made in 1989, and 4 in 1990. In 1989, the species composition of the roosting population was also estimated 4 times by identifying individual birds selected at random from flightlines.

Nontarget Hazards Evaluation.— At each of the 4 initially-selected treated sites in 1989 and 2 untreated control sites, we established a 0.8-km transect for surveying nontarget bird species. Approximately half of each transect was adjacent to (within 6 m) a field edge, while the remainder traversed the interior portion of the field. Each transect was surveyed on foot on 4 mornings immediately before, and 4 mornings immediately after the baiting program. The 3-4 hours of observations commenced on the first site between 0700 and 0730, and sites were surveyed in the same sequence throughout the study. All species and numbers of birds seen or heard along these transects were recorded and the location of each bird (edge or interior) noted.

Damage Reduction Evaluation.— Two methods were used to assess potential sprouting rice damage reduction resulting from the baiting program. The first method consisted of conducting posttreatment censuses of foraging blackbirds within an 8-km radius of the Millers Lake blackbird roost along a 32-km roadside route censused during 1986-88 (Labisky and Brugger 1989). Blackbird flocks and territorial males were counted within a 0.4-km radius at each of 20 stops located at 1.6-km intervals along the route. Surveys were begun approximately 30 minutes after sunrise and completed in 2-3 hours. These were conducted 2-3 times per week from 28 March until 13 April and 12 April in 1989 and 1990, respectively. This monitoring period was selected because it coincided with the time when most bird damage usually occurs. Birds observed per census were compared with each previous year of census data for the same time period, using a Mann-Whitney U test.

The second method used to evaluate sprouting rice damage reduction was a questionnaire mailed to 49 growers in 1989 and 53 growers in 1990 who planted rice within a 16-km radius of the Millers Lake blackbird roost. The questionnaire was designed to compare damage in 1989 and 1990 with that observed during 1986-88 in the same area.

RESULTS

Baiting Operations

Bait sites were almost exclusively used by red-winged blackbirds and brown-headed cowbirds. Flightlines of common grackles (*Quiscalus quiscula*), which at times made up more than 10% of the roosting population, passed over bait sites, but few landed. Bait site use by red-winged blackbirds and cowbirds varied greatly among sites and years during prebaiting and baiting. Usually, only 1 day of prebaiting was required to establish bird use, but this ranged up to 5 days in some cases, and in other cases bird use was never established. After baiting commenced in 1989, bird use of bait sites persisted for 5-13 days, and 2-3 days with the 1:50 and 1:25 dilution, respectively (Table 1). Bird use persisted for 2-15 days with the 1:10 dilution in 1990 (Table 2). When bird use occurred, the percent of total flightlines using sites varied from < 1% up to 56%, but followed no consistent pattern over time.

In 1989, birds consumed an estimated 2,443 kg (70%) of the bait applied (Table 1). Almost all consumption by birds took place on or before 15 March. In addition, 317 kg of a 1:25 dilution were applied to 3 smaller sites on or after 17 March, and birds consumed only 150 kg or 47% of the applied bait (Table 1). In 1990, 3,071 kg of a 1:10 bait dilution were applied to 17 sites at rates ranging from 50-524 kg per site, and birds consumed 2,139 kg or 70% of the applied bait (Table 2).

Baiting Program Evaluation

Although generally lower in 1990 than 1989, pretreatment and treatment roosting population counts (Fig. 1) were similar to those reported during the previous 3 years at Millers Lake (Labisky and Brugger 1989). Although successive counts from mid-February to mid-March during all years show a negative exponential decline due to migration, posttreatment counts taken the last week of March in 1989 and 1990 (approximately 1 week after cessation of baiting) were substantially lower than any counts recorded in late March during 6 years of previous data (Labisky and Brugger 1989) (Fig. 2).

Comparison of 1989 and 1990 posttreatment roadside censuses of blackbirds with 2 years (1986 and 1988) of baseline data (Labisky and Brugger 1989) generally suggested reduced foraging populations (Fig. 3). Although 1989 counts were significantly different ($P < 0.01$, $U = 15$) from the 1986 data, they were not significantly different ($P > 0.05$, $U = 21$) from 1988. In 1990, blackbird numbers were significantly reduced ($P < 0.01$) compared to 1986 and 1988 baseline data (Fig. 3). Insufficient baseline data were collected in 1987 for statistical comparison, but visual inspection would suggest lower blackbird numbers in 1989 and 1990 compared with 1987 as well.

Table 1. Blackbird use and consumption of 2% DRC-1339-treated brown rice bait diluted 1:50 and 1:25 with untreated rice at staging areas near the Millers Lake roost, Evangeline Parish, Louisiana, March 1989.

Bait Site	Bird Use Dates	Bait Applied (kg)	Bait Consumed (kg)	% Consumption
1:50 dilution				
F1	3/7-3/17	854	647	76
F2	3/9-3/21	922	668	72
F3	3/7-3/18	634	508	80
F3b	3/11-3/15	510	288	56
V1	3/11-3/15	567	332	59
Total		3,487	2,443	$\bar{x} = 70$
1:25 dilution				
F4	3/17-3/20	181	93	51
F6	3/18-3/20	91	48	53
B1	3/10-3/12	45	9	20
Total		317	150	$\bar{x} = 47$

Table 2. Blackbird use and consumption of 2% DRC-1339-treated brown rice bait diluted 1:10 with untreated rice at staging areas near the Millers Lake roost, Evangeline Parish, Louisiana, March 1990.

Bait Site	Bird Use Dates	Bait Applied (kg)	Bait Consumed (kg)	% Consumption
F1b	3/3-3/5	150	49	33
F2	3/3-3/13	499	62	93
F3	3/5-3/6	150	75	50
F4	3/5-3/19	349	272	78
F5	3/5-3/19	100	25	25
F6	3/7-3/20	524	444	85
F7	3/5-3/6	50	27	54
F8	3/10-3/19	274	188	69
F9	3/8-3/17	150	84	56
V1	3/11-3/13	150	69	46
V2	3/13-3/14	100	100	100
V3	3/18-3/19	75	25	33
A1	3/13-3/14	150	150	100
M1	3/18-3/19	75	50	67
L1	3/15-3/19	100	48	48
Total		3,071	2,139	$\bar{x} = 70$

Because bird damage is correlated with timing of planting (Wilson et al. 1989), analysis of 33 and 31 rice grower questionnaires returned during 1989 and 1990, respectively, required using only responses from growers who reported planting rice about the same time as previous years. Of 24 such growers in both 1989 and 1990, 17 (71%) reported much less bird damage

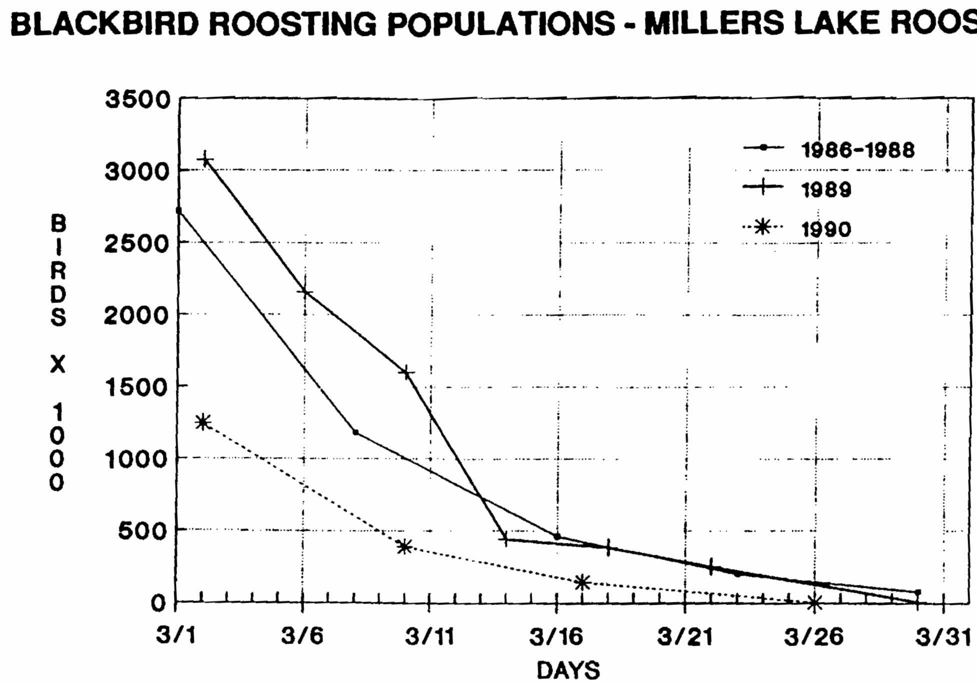

Fig. 1. Blackbird roosting population trends for 1986-88 (Labisky and Brugger 1989), and during baiting years 1989-90 at Millers Lake roost, Evangeline Parish, Louisiana.

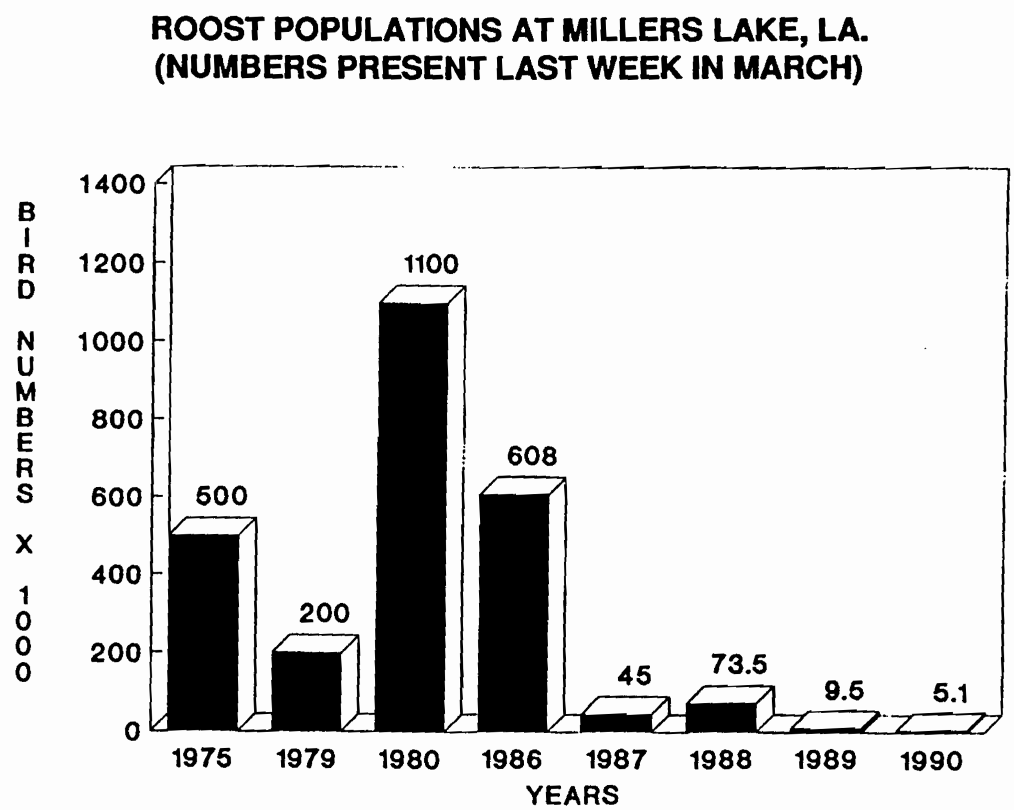

Fig. 2. Blackbird roosting populations during the last week in March during 1975 (Ortego 1976), 1979-80 (Wilson 1985), 1986-88 (Labisky and Brugger 1989), and 1989-90 at Millers Lake roost, Evangeline Parish, Louisiana.

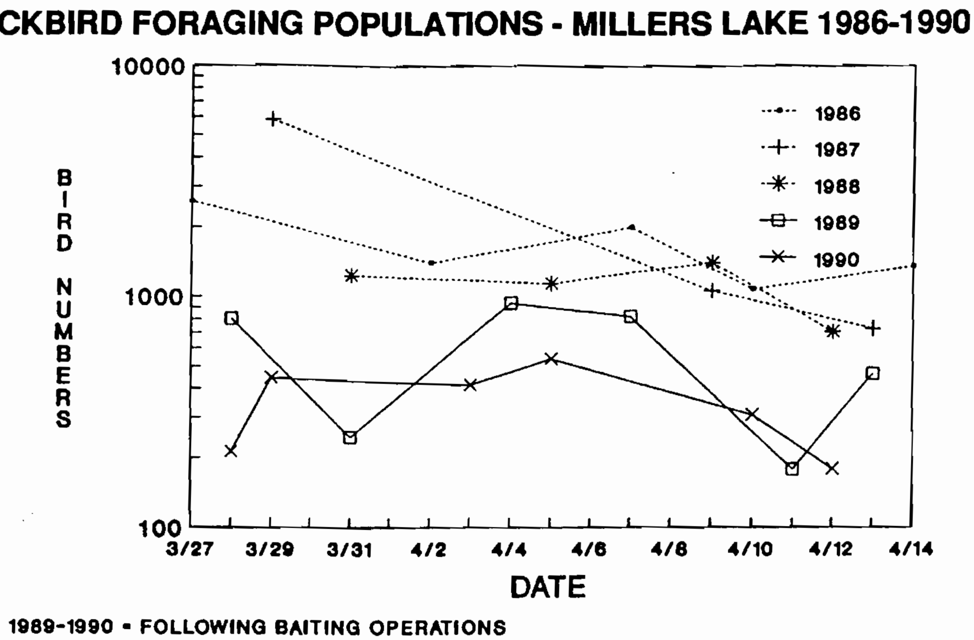

Fig. 3. Foraging blackbird populations censused along a 32-km survey route and within 8 km of the Millers Lake roost, Evangeline Parish, Louisiana, during 1986 through 1990 .

when compared with the previous 3 baseline years. Three (12%) and 4 (16%) reported slightly less damage in 1989 and 1990, respectively, and 4 (17%) reported their damage to be about the same during both baiting years. Of those growers experiencing about the same damage, 3 reported using much less or slightly less bird control in 1989, but about the same or slightly more in 1990 compared with previous years. Overall, 20 (83%) and 17 (71%) growers reported using much less control effort in 1989 and 1990, respectively, compared with that used in the 3 previous years.

Of 15 growers reporting annual dollar losses from bird damage in previous years, and planting about the same time or earlier, the reduction in losses compared with 1989 was approximately $88,000 (81%). Nine growers reported > 90% reduction in damage. Average annual losses of these 15 growers due to bird damage in previous years amounted to $4,723 (range = $800-$13,500). Based on a sample of 20 growers reporting losses in 1990, the reduction in losses was approximately $61,000 (85%), and average annual losses for previous years amounted to $3,569.

Nontarget Hazard Evaluation

Thirty nontarget species were recorded during nontarget bird surveys in 1989 on 4 treated and 2 control sites. The granivorous nontarget avifauna was dominated by sparrows (Table 3). The savannah sparrow (*Passerculus sandwichensis*) was the most common species at each site except for 1 control site. Savannah sparrow numbers increased from pretreatment to posttreatment on 3 of 4 treated sites, but declined on control sites. Song sparrows (*Melospiza melodia*) were common in the pretreatment survey at 2 treated sites and 1 control site, but this species was seldom observed posttreatment on either treated or control sites 3 weeks later. With one exception, nontarget birds were not observed foraging on baited sites when blackbirds were foraging. The exception to this was common crows (*Corvus brachynchos*). During both years, crows were observed in flocks of up to 10 birds on or near bait lanes foraging either on dead blackbirds or cracked corn used for prebait. Extensive searches of bait sites revealed no nontarget mortality.

Table 3. Numbers of nontarget granivorous birds observed during 4 pretreatment and posttreatment surveys in 4 treated and 2 control sites near Millers Lake, Evangeline Parish, March 1989.

	Treated sites		Control sites	
Species	Pre	Post	Pre	Post
Mourning dove	0	3	1	0
Blue jay	3	1	0	3
Northern mockingbird	3	3	4	1
Northern cardinal	8	13	4	1
Savannah sparrow	65	273	63	28
Song sparrow	23	5	29	0
Lincoln's sparrow	0	1	2	0
Swamp sparrow	7	17	5	2
Field sparrow	1	13	0	0
White-throated sparrow	0	26	0	9
Eastern meadowlark	31	34	0	13

DISCUSSION

Variation in blackbird use among bait sites and corresponding bait consumption appeared to be primarily due to bird affinity for certain sites. Usually, areas where birds were observed to stage prior to prebaiting were the sites that sustained the most bird use during baiting operations. Timing of the operation was critical, because bird use and bait consumption dropped after mid-March, and coincided with alternative food availability from field preparation and rice planting. In several instances, disking strips of ground between bait lanes appeared to be effective in attracting birds to bait sites where no use had occurred previously. The bait dilution ratio may also have contributed to the variation in bait site use. Lower bait dilutions, such as the 1:10 used in 1990, probably reduced populations attracted to a specific site too rapidly. This may have resulted in lower bird use and bait consumption per site, and the need to use more than twice the number of bait sites to obtain approximately the same amount of bait consumption. Although the 1:25 dilution could not be effectively evaluated after mid-March, this dilution or higher may be more efficient for carrying out an effective baiting program with a small number of bait sites.

Despite variation in bird use, an overall 70% consumption of bait was achieved during both years. This was accomplished by close monitoring of bird use and bait consumption, and restricting successive bait applications to portions of the bait sites where birds were seen feeding.

Limiting bait exposure on bait sites may also have been a reason for the lack of nontarget hazards observed. Other possible factors that may have limited nontarget hazards were the high bait dilution, positioning bait lanes away from field edges, and photodegredation of the bait after application. However, finding no dead nontargets is not surprising considering the slow-acting nature of DRC-1339. Because bird species either increased following baiting, or decreased uniformly among treated and control sites, the pre- and posttreatment censuses conducted in 1989 suggest no major impact on nontarget populations because of the baiting programs. More recent studies examining mortality of several nontarget species captured at bait sites also have suggested they are not impacted (J. Cummings, Denver Wildlife Research Center, pers. commun.).

Bait consumption data could be used to project the number of blackbirds killed during baiting operations, but is speculative because of assumptions that have yet to be validated in the field. A projected range of the kill can be based on a simple calculation from the number of treated grains available in the amount of bait consumed. Since an average rice grain weighs 18 mg, there are approximately 55,000 rice grains in a kilogram of undiluted treated bait. The 2,443 kg of the 1:50 diluted bait consumed during the 1989 baiting program theoretically would contain approximately 49 kg of treated baits. Assuming a single treated grain was lethal and all birds feeding on the diluted bait mixture consumed no more than 1 treated grain, then the maximum projected kill would be approximately 2.7 million birds. Based on a probable range of bait consumption by blackbirds (20-50 baits/bird/feeding; J. F. Glahn, unpubl. data), it also may be likely that dead birds consumed 2 treated baits, but probably not 3 baits. Thus, the minimum kill would be approximately 1.3 million birds. The small amount of the 1:25 bait mixture consumed in 1989 probably would not affect this range. Using the same assumptions for the 1990 1:10 dilution, there were 214 kg of treated baits or almost 5 times that consumed in 1989. However, because the bait was 5 times less dilute in 1990, the range of the kill would be approximately the same as in 1989.

Despite differences in the baiting programs, they both appeared to be equally efficacious based on our measures of effectiveness. Although difficult to substantiate, the very low roosting populations following the baiting programs during both years would appear to be directly related to mortality and other roost disruptions. Low populations coinciding with the start of rice planting would likely lessen bird damage problems. This is substantiated by the significantly lower foraging populations observed within a 8-km radius of the roost during the period of peak bird damage, compared with previous years. Although not a direct measure of damage, Wilson et al. (1989) indicated a direct relationship between numbers of blackbirds observed in fields and numbers of damaged rice sprouts. The observations of rice growers who compared their blackbird damage following the baiting programs with that of previous years, clearly support the objective data on reduced foraging bird populations. They also provide a basis for examining the cost-effectiveness of baiting programs. The average annual cost of damage reported by growers within a 16-km radius of the roost was $4,146. An estimated 75 growers are reported to plant rice within this radius (A. Mire, Evangeline Parish Extension Service, pers. commun.). Thus, the total projected loss from blackbird damage is approximately $311,000. Considering that the gross value of the rice crop in Evangeline Parish was estimated at $24.8 million in 1987 (Labisky and Brugger 1989), and average blackbird losses to early planted rice in southwestern Louisiana has been estimated at 25% (Goodloe 1983), our projection of grower losses is possibly conservative. With an average 83% reduction in damage reported during the years of the baiting programs, annual savings of $257,000 could be attributed to the baiting programs. Our estimate of the average costs of these baiting operations is $7,500/year, including prorated equipment, supplies, travel, and labor. Thus, the benefit/cost ratio is 34:1. Although this ratio may be inflated by subjectivity and possible sampling errors associated with the grower survey, the magnitude of this ratio and supporting information suggest that these baiting programs are cost-effective.

MANAGEMENT IMPLICATIONS

This study suggests that DRC-1339 baiting programs can be cost-effective for reducing sprouting rice damage from concentrations of spring-roosting blackbirds. The documentation of the cost-effectiveness of this lethal control strategy is important because little economic information exists (Dolbeer 1989). Our findings are contrary to those of previous studies. Lethal control strategies were reported to be ineffective for reducing damage by roosting birds because of the dynamics of those populations (Heisterberg et al. 1984, White et al. 1985). The probable keys to success of this baiting strategy are timing and protracting the operation. Initiating baiting before rice planting, but after most migrant birds have left the area, increases bait acceptance due to lack of alternative food resources, and targets resident and late migrant birds responsible for damage. The sustained nature of the 2-week baiting program appears to effectively remove the foraging population despite blackbird roost dynamics that may reduce the effectiveness of roost spraying (White et al. 1985). Other frightening and repellent control strategies are often less effective with severe bird-feeding pressure normally experienced near roost sites (Jaeger et al. 1983). Clearly, while baiting with DRC-1339 may be applicable to other rice growing areas, it should be reserved for similar severe-damage problems where other methods have failed. The apparent safety of large-scale baiting programs has been confirmed with more recent investigations (J. Cummings, Denver Wildlife Research Center, pers. commun.). Providing safer methods is particularly important for reducing potential illegal use of more hazardous pesticides, caused by grower frustration with their bird damage problems, and lack of effective alternative control measures.

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