AN OVERVIEW OF CURRENT BLACKBIRD RESEARCH IN THE SOUTHERN RICE GROWING REGION OF THE UNITED STATES

JOHN L. CUMMINGS, USDA, APHIS, Wildlife Services, National Wildlife Research Center, 4101 LaPorte Avenue, Fort Collins, CO 80525, USA
MICHAEL L. AVERY, USDA, APHIS, Wildlife Services, National Wildlife Research Center, 2820 East University Avenue, Gainesville, FL 32641, USA

Abstract: Red-winged blackbirds (*Agelaius phoeniceus*), common grackles (*Quiscalus quiscula*), and brown-headed cowbirds (*Molothrus ater*) cause extensive damage to newly planted and ripening rice. The blackbird-rice problem has generated considerable public pressure in states such as Louisiana, Texas, California, Arkansas and Missouri, to find more effective methods of reducing damage caused by blackbirds. USDA/APHIS/WS National Wildlife Research Center (NWRC) works closely with various state rice growers associations and the USDA Wildlife Services (WS) state operational programs to address this high-priority issue. NWRC conducts a multi-faceted research program aimed at resolving blackbird-rice problems. Research focuses on determining the status of depredating species in southern rice growing states, assessing the impact of birds on production, evaluating and developing potential bird repellents, improving the effectiveness of DRC-1339, and developing new strategies and/or tools to manage bird damage to rice.

Key words: *Agelaius phoeniceus*, bird damage, bird management, blackbirds, DRC-1339, repellents, rice, red-winged blackbird

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INTRODUCTION

Several species of blackbirds, particularly red-winged blackbirds (*Agelaius phoeniceus*), common grackles (*Quiscalus quiscula*), and brown-headed cowbirds (*Molothrus ater*) cause extensive damage to newly planted and ripening rice. Annual losses to rice growers have been estimated at $11.5 million (Besser 1985). In Texas, blackbird damage to newly seeded rice is estimated at $4.2 million (Decker and Avery 1990). Damage is not uniformly distributed, but is localized and proportional to the size of the nearby bird roost. In Louisiana, blackbird damage to newly planted rice can be locally severe (Wilson 1985). Some growers report 100% loss and replanting is required.

The blackbird-rice problem has generated much interest from states such as Louisiana, Texas, California, Arkansas, and Missouri; and considerable public pressure now exists to find better management methods of reducing damage caused by blackbirds. Many state rice growers' associations, stakeholders, USDA Wildlife Services and the National Wildlife Research Center consider resolving blackbird damage to rice a high priority. A USDA Research Needs Assessment in 1992, 1996 and 2001 placed a high priority on understanding and finding solutions to resolving blackbird/agriculture problems. Research efforts to resolve this problem were initiated in mid-70's. The National Wildlife Research Center has made progress in addressing these problems, and since 1999, has developed a research project that focuses entirely on reducing bird damage

to rice, improving profitability to growers by developing new and improved management strategies, and developing partnerships between rice producers, rice commodity groups, rice research boards, universities, and local state and federal agencies. This review summarizes current research regarding the status of blackbird populations in the southern rice growing states, economic impacts of birds on the rice crop, evaluation and development of bird repellents for rice, improving the effectiveness of DRC-1339, and developing new strategies and/or tools to manage bird damage to rice.

RICE PRODUCTION

The major rice-producing states are Arkansas, California, Louisiana, Texas, Mississippi and Missouri. Rice producers in these states planted about 3.3 million acres of rice in 2001 (National Agricultural Statistics 2003). Of that, Arkansas represented about 49%, Louisiana about 18%, California about 16%, Mississippi about 8%, Texas about 7% and Missouri about 6%. In California, production costs are about $800 per acre and require a yield of 8,500 lbs/acre to break even.

Rice is planted in three basic ways: water-seeded (dry or pre-sprouted seed dropped into a flooded field), drill-seeded (planted with a drill on 7- to 10-inch rows) or broadcast dry (broadcast on dry seedbed by either ground equipment or airplane). Location and farm practices usually dictate the type of seeding. Regardless of the seeding system used, the optimum stand is 10-15 plants per square foot; the minimum strand is six to eight plants per square foot. Generally, the planting rate is about 120 lbs/acre or about 46-61 seeds/ft^2 for water-seeded rice. Under typical conditions, about one-half of the seeds survive to produce a plant. Add other factors such as birds into the equation and production losses can be substantial. Blackbirds will consume seeded rice once it has been planted and up until the plant is about 2 inches tall. It is estimated that 500 blackbirds can destroy an acre of newly seeded rice per day (Cummings et al. 2002a). In the ripening crop, blackbird damage usually starts to occur when rice reaches the milk stage of growth (the endosperm is beginning to develop) and continues until the rice is harvested from the field. In Louisiana, the rice growing season is long enough so that rice farmers can grow two crops of rice. Blackbird damage is generally greater in the second crop, which is harvested in November when large flocks of migratory birds are present.

BLACKBIRD RESEARCH

Our research efforts are focused on reducing bird damage to rice caused from several species of blackbirds, (particularly red-winged blackbirds, common grackles, and brown-headed cowbirds), and improving profitability for growers. The research effort is divided into the following specific research areas: status of blackbird populations in the southern rice growing states, economic impacts of blackbirds on the rice crop, evaluation and development of blackbird repellents for rice, improving the effectiveness of DRC-1339 for blackbirds, and development of new strategies and/or tools to manage bird damage to rice.

Population Status of Blackbirds

We have summarized the breeding bird surveys for the rice growing regions in Louisiana, Texas, Arkansas and Missouri. The trend from 1966-2002 for red-winged blackbird breeding populations in Arkansas shows an increase, whereas the population has declined slightly in Louisiana, Texas and Missouri. A more definitive look at the Mississippi Alluvial Plain, which encompasses most of the rice growing region of the Southeastern U.S., shows an increase in the red-winged blackbird population. Brown-headed cowbird and common grackle breeding populations show an overall decline

in numbers in the same states and period. They also show a decline in the Mississippi Alluvial Plain.

Since 1996, we have monitored blackbird roosts in a five-parish area in Louisiana where DRC-1339 is being used to manage blackbird populations that damage newly planted rice. At each roost site, the number and species of blackbirds and roost location were documented. The numbers of roosts, numbered between 8 and 14, and their locations have stayed relatively constant since 1996. However, the blackbird populations at these roost sites have fluctuated from a low of 1.3 million in 2001 to a high of 12.4 million in 2003. Changes in blackbird population size are related to a combination of the DRC-1339 baiting program and environmental events.

Local and migratory movements, and roost interchange of blackbirds that damage newly planted rice in Louisiana have been documented using a mass-marking technique. The method is a simple aerial application of day-glo pigment on blackbirds as they arrive at the roost site. We used this technique during January and February 1995 to mark an estimated 7.2 million red-winged blackbirds at 4 roost sites. The total roosting population was about 15.2 million blackbirds. The distance between roost sites varied from 30 to 60 km. Over 3,600 red-winged blackbirds collected post-spray from 93 locations in rice-producing parishes indicated that most blackbirds foraged within 35 miles of the roost. Dispersal patterns from roost sites tended to be conical in shape. Of 1,150 marked blackbirds, 30 were marked with two different colors, indicating that blackbirds moved among roost sites.

Twenty-seven of 2,437 blackbirds collected from breeding areas in 13 states and 3 Canadian provinces were marked. Most of the marked birds were from 2 of the 3 roost sites in Louisiana. The greatest number of recoveries was from central Iowa. Other birds moved as far north as central Manitoba, Canada. The data give us some basic insight into which blackbird populations might be impacted from blackbird management programs in southern rice producing states.

Economic Impacts of Blackbirds on Rice Production

In 2002, we cooperated with the Louisiana Rice Research Board, Louisiana State University, and the USA Rice Federation to conduct a study to estimate the economic impacts of blackbirds on newly planted and ripening rice in Louisiana, Texas, Arkansas, Missouri and California. We identified areas in rice producing states to survey based on the 1999 National Agricultural Statistic Services rice harvest records. Farm Service Agencies in each of those areas compiled a mailing list of rice producers. Over 5,000 surveys were mailed to one third of all rice producers. Surveys included questions about rice production, bird damage, specifically blackbirds, and bird management practices. The following numbers of questionnaires were returned from the respective states: Arkansas 262, Louisiana 202, California 136, Texas 110 and Missouri 65. The survey results are currently being analyzed.

Repellents for Reducing Bird Damage to Rice

We continue to work with Arkion Biological Sciences (formerly Environmental Biocontrol International, or EBI), the registrant of the anthraquinone-based product Flight Control, to develop this product as a seed treatment for newly planted rice and as an over-spray for ripening rice. A series of field tests have shown that Flight Control, (1% anthraquinone), applied to newly planted rice seed significantly reduces blackbird damage (Avery et al. 2000, Cummings et al. 2002a, Cummings et al. 2002c). In March 2000, a field residue trial was initiated to determine chemical residues of Flight Control

in mature rice seed at harvest following a seed treatment application of 28 oz. FC per 100 lbs. of rice (2%). The trial followed EPA Residue Chemistry Test Guidelines, which required 6 field trial sites in 2000 and 6 field trial sites in 2001. In the 2000 field trial, the concentration of anthraquinone in the Flight Control product averaged 50.1%, and the spray formulation from the seed treater averaged 21.1%. The projected chemical concentration of anthraquinone on rice seed was 1.0% at planting, but the actual concentration of anthraquinone at planting averaged 0.97%, SE=0.27%. All 36 samples of rice collected at harvest (July) from the six field sites and milled to the brown rice stage were below the MLOD of 0.05 ppm. In July 2001, the final phase of an EPA Residue Chemistry Test indicated that all 36 samples of rice collected at harvest were also below the MLOD of 0.05 ppm. We cooperated with the Louisiana Cooperative Extension Service to compile data to support an Experiment Use Permit for the use of Flight Control as a rice seed treatment and an aerial application to ripening rice. However, in March 2003, EPA rejected the EUP for Flight Control on newly planted rice and ripening rice until toxicology data requirements detailed to Arkion in January 2002 are completed and submitted to EPA.

We have conducted a series of chemical screening tests of new potential chemicals for blackbird repellency on rice, which include moncut (fungicide), aza-direct (neem product), and caffeine (Avery and Cummings 2003). Cage testing of individual blackbirds in 2-choice tests indicates that moncut shows promise as a potential repellent for use on rice. During the treatment phase of the test, consumption of treated rice decreased. In one-choice tests at a 1.0% concentration, blackbird consumption of treated baits decreased about 50% one day post-treatment but returned to normal consumption 4 days post-treatment. Caffeine tested at 3 levels, 0.1%, 0.15% and 0.25% in 1-choice tests reduced rice consumption by brown-headed cowbirds 72% at the 0.25% level relative to the control group. At that same level, consumption by red-winged blackbird males was reduced 76%; consumption by red-winged blackbird females was reduced 56% at the 0.15% level. Aza-Direct, a neem product, evaluated in both two- and one-choice tests at concentrations of 2.8% and 0.5%, 1.0%, 1.5%, 2.0% and 2.8%, respectively, had little or no repellency effects on red-winged blackbirds.

Bird Shield, a commercial product with the active ingredient methyl anthranilate, was recently registered with the U.S. Environmental Protection Agency (EPA) for use on ripening rice. In Missouri during September 2002, five fields with blackbird populations of over 1,000 birds were aerially sprayed with Bird Shield at the recommended rate of 1.7 L/ha. One field received twice the label rate. Daily bird observations before and after an application of Bird Shield indicate that blackbird activity remained unchanged in 4 of 5 fields and decreased in the remaining field. The bird populations in the latter field were already decreasing prior to treatment. Based on these results, we concluded that Bird Shield is not an effective bird repellent for ripening rice and no further testing is warranted.

Improving Efficacy of DRC-1339/ Blackbird Baiting Programs

We have completed tests to evaluate various formulations to reduce the degradation and enhance acceptance of treated baits. DRC-1339 tablet baits were formulated in two sizes, 12 mg and 18 mg, contained 60% brown rice flour mixed with or without calcium, and were three different colors. There was little to no discoloration of DRC-1339 rice tablets for up to 7 days, whereas DRC-1339/alcolec-s treated brown rice (the bait currently used in operational baiting programs) turned a bright rust color within 1 day of exposure. Of the tablet combinations,

light grey, 12 mg tablets containing calcium were most preferred by both red-winged blackbirds and brown-headed cowbirds. However, in field evaluation, consumption of these baits by blackbirds was only about 40%.

Four bait additives, phosphoric acid, ascorbic acid, escadol 557, and escadol 567, were formulated with DRC-1339 and tested in an environmental chamber. All additives were more effective than alcolec-s, the currently used additive, in reducing bait degradation. Phosphoric acid was ranked 1 because DRC-1339 degradation averaged only about 7%, whereas baits containing alcolec-s lost 31% of the DRC-1339. Additional compounds such as Harvest Guard and ethyl cellulose were also evaluated for reducing degradation and color changes of baits. Acceptance based on blackbird mortality indicated that each ranked less than the standard DRC-1339 bait. Similar results for these two compounds were observed in group testing with blackbirds. Addition of sodium bi-sulfide to the DRC-1339 formulation reduced degradation and color change, and resulted in mortality of 100% with newly treated baits and 50% with baits aged 3 days.

Acceptance of different rice baits has been evaluated. There was no difference in mortality among medium-grain brown rice, long-grain brown rice, and rough rice when treated with DRC-1339 and formulated with alcolec-s.

In 2002, a model to estimate the take of target blackbirds during DRC-1339 baiting programs in Louisiana used the data from esophagus and gizzard contents of 601 blackbirds collected as they departed 12 DRC-1339 bait sites in Louisiana. Six percent of 524 red-winged blackbirds showed no evidence of having consumed rice grains; 56% consumed between 1 and 25 rice grains; and 38% consumed more than 25 rice grains. Redwings (N=262) that consumed less than 25 rice grains consumed a total of 3,146 rice grains, whereas redwings (N=230) that consumed more than 25 rice grains consumed 11,001 rice grains. Based on these findings, we estimate that for every pound of DRC-1339 treated baits, diluted 1:25 with untreated bait and consumed at bait sites, an average of 370 blackbirds die. In 2003, more than 2,400 blackbirds and 200 non-target birds were collected from DRC-1339 bait sites in Louisiana, Texas and Missouri for analysis of esophagus and gizzard contents to determine consumption of rice from DRC-1339 bait sites. These data will be used in conjunction with 2002 data to construct a predictive model for estimating take of target and non-target birds during DRC-1339 staging area baiting operations.

Non-target bird use of DRC-1339 treated bait sites was assessed during operational baiting programs in Louisiana and Texas from January to March (Cummings et al. 2002b, Pochop et al. 2003). In Louisiana, we observed 55 bait sites during 316 observation periods (158 observation hours) and conducted 312 flush-counts from 2000-2002. In Texas, 26 bait sites were observed during 182 observation periods (91 observation hours) and 174 flush-counts conducted from 2001-2002. Savannah sparrows were the non-target bird species most commonly observed in both Louisiana and Texas. However, mourning doves in Louisiana and meadowlarks in Texas are of greatest concern because of their foraging habits, susceptibility to DRC-1339, and frequency and rate of occurrence at DRC-1339 bait sites. The breeding bird survey indicates that since 1967, mourning dove populations increased significantly in Louisiana and remained stable in Texas. During the same period, meadowlark populations decreased in both Louisiana and Texas.

Ricerca completed a DRC-1339 Confined Rotational Crop Study funded by the Louisiana Rice Research Board to address issues related to the crop plant-back period

following DRC-1339 baiting. In June 2003, the U.S. Environmental Protection Agency approved a 15-day plant back for rice, wheat, corn and barley and a 30 day plant back for sunflowers and soybeans. These plant back periods will allow DRC-1339 operational baiting personnel better access to preferred foraging sites of blackbirds.

Trials with caged birds indicate that blackbirds display a strong preference for rough rice, brown rice or millet when >80% of total consumption was of one seed type or the other. When rough rice was paired with brown rice, 6 of 17 birds showed a preference for rough rice, 4 showed a preference for brown rice, and the remaining birds showed no preference for either seed type. When rough rice and millet were presented, 9 of 17 birds showed a strong preference for rough rice, and 3 showed a strong preference for millet. When millet was paired with brown rice, 5 birds preferred millet and 7 birds preferred brown rice. These results indicate that birds demonstrate seed preferences, and that presenting a mixture of seeds might be a more effective strategy for increasing acceptance of DRC-1339 baits.

We completed dietary toxicity tests to better determine the toxicity of DRC-1339 to savannah sparrows, Canada geese, snow geese, mourning doves, western meadow larks, and American tree sparrows (Cummings et al. 2003, Stahl et al. 2002). During 5-day, no-choice tests during which birds were fed only 2% DRC-1339 treated brown rice diluted 1:25 with untreated brown rice, no mortality occurred to Canada geese or snow geese, and only one savannah sparrow died. Nine of ten mourning doves, eight of nine meadowlarks and eight of ten American tree sparrows died during the same test. Most test species exhibited some degree of aversion to the DRC-1339 bait, indicating that in free feeding situations non-target birds that ingest sub-lethal doses will subsequently avoid treated baits. Rapid degradation and discoloration of DRC-1339 baits further reduced the risk for non-target species at DRC-1339 bait sites. However, mourning doves and meadowlarks that use DRC-1339 bait sites are at risk.

CONCLUSION

Success at reducing blackbird damage to rice requires an integrated research approach. We have focused our research on reducing bird damage to rice and improving profitability to growers by developing new or improved management strategies, while expanding partnerships between rice producers, rice commodity groups, rice research boards, universities and local, state and federal agencies. Our research directly supports the goals of these groups by developing safe and effective management techniques for birds that damage rice. The development and evaluation of non-lethal tools such as chemical bird repellents is an important component of the USDA Wildlife Services Program. The research and development of bird repellents such as anthraquinone, caffeine, and moncut provide a non-lethal approach for resolving damage to rice while minimizing the impact on the environment. The project's research in areas such as blackbird ecology, economics, and DRC-1339 are all important issues to the program and its stakeholders.

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