# Field evaluation of Flight Control™ to reduce blackbird damage to newly planted rice

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**Abstract** An effective, economic, and environmentally safe bird repellent is needed to reduce blackbird (Icterinae) depredations to newly planted rice. We evaluated Flight Control™, a 50% anthraquinone product, as a seed treatment for newly planted rice. We treated rice seed with Flight Control at a 2% (g/g) concentration (1% active anthraquinone) the day of planting. This concentration reduced the number of blackbirds ($P$=0.0003) using treated fields and blackbird damage to rice seed ($P$=0.0124). The chemical concentration of anthraquinone on rice seed averaged 0.79% (SE=0.06%) at planting; 0.39% (SE=0.04%) at day 1, 0.34% (SE=0.05%) at day 3, and 0.41% (SE=0.06%) at day 5 post-planting. Rice seedling counts were similar between treated and untreated exclosures, suggesting that Flight Control had no phytotoxic effects to rice seed. Our results showed Flight Control to be an effective blackbird repellent that warrants further development as a management tool to reduce blackbird damage to newly planted rice and other agricultural commodities.

**Key words** *Agelaius phoeniceus*, anthraquinone, blackbird, Flight Control™, red-winged blackbird, repellent, rice

Several species of blackbirds (Icterinae), particularly red-winged blackbirds (*Agelaius phoeniceus*), common grackles (*Quiscalus quiscula*), boat-tailed grackles (*Quiscalus major*), great-tailed grackles (*Quiscalus mexicanus*), and brown-headed cowbirds (*Molothrus ater*) cause extensive damage to newly planted and ripening rice. Losses to rice growers in the United States have been estimated at up to $11.3 million (Besser 1985). Blackbird damage to newly planted rice in Texas is estimated at $4.2 million annually (Decker and Avery 1990). Damage is not uniformly distributed but is localized and proportional to the size of nearby blackbird roost sites (Wilson 1985). In Louisiana, damage to newly planted rice can be locally severe, with some growers reporting 100% loss, requiring replanting (Wilson 1985).

Techniques available to rice growers for alleviating blackbird damage include mechanical and pyrotechnic devices, shooting, and hazing (Dolbeer et al. 1994). However, these techniques are limited by effectiveness, cost, and logistics. These limitations have stimulated efforts toward development of an effective, economical, and environmentally safe chemical repellent for newly planted rice. One such chemical is anthraquinone, which has shown

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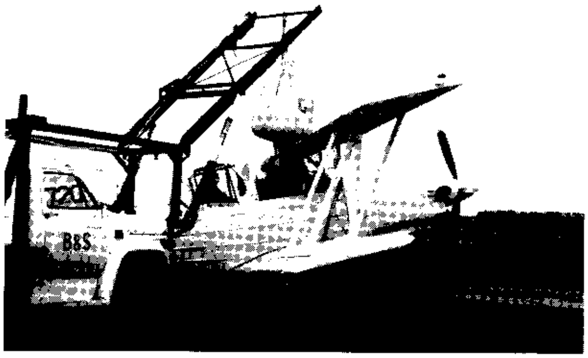


Loading plane with rice seed to be aerially planted on a flooded field. Almost all rice in Louisiana is water planted by plane.

bird-repellency properties (Schafer et al. 1983, Avery et al. 1997) and is the active ingredient in Flight Control™ (Environmental Biocontrol International, Wilmington, Del.). Flight Control is a 50% anthraquinone product that has shown promise as a bird repellent for rice under limited aviary and field tests (Avery et al. 1997). In our study we evaluated the repellency of Flight Control to reduce blackbird damage to commercially planted rice.

## Methods

We conducted our field study in Vermilion, Cameron, Calcasieu, and Jefferson Davis parishes, Louisiana during March 1998. We selected 14 rice test fields; however, 4 fields were excluded from the evaluation due to disease problems and lack of bird use. The remaining 10 test fields averaged 5 ha (range = 4–10 ha); were the same cultivar (Drew) except for 1, which was Maybell; were close (approximately 2 km) to large blackbird roosting populations; had histories of extensive blackbird damage; and were planted earlier than surrounding commercial fields to maximize potential blackbird use. We planted 6 test fields with Flight Control-treated rice seed and 4 with untreated rice seed. The 47 ha planted to Flight Control-treated rice seed did not exceed our Louisiana State Department of Agriculture Special Use Permit. Rice farmers prepared fields following normal rice planting practices: a field was plowed, leveled, flooded, planted, drained, and re-flooded (Louisiana State University 1999). We recorded the location of each field using a geographic positioning system (GPS) and separated test fields by a minimum of 10 km to reduce any chance of treatment bias (Cummings et al. 1995). Prior to planting, we soaked rice seed in a water bath for 36 hr; it was then pulled from the water bath and drained for 2 hr, covered and pre-germinated for 36 hr, and then aerially planted on flooded test fields at a rate of 136 kg/ha (Louisiana State University 1999). We planted all test fields within a 4-day period. Following the draining phase, rice seed slated for treatment was treated with a solution of 2% Flight Control and 0.4% Exhalt 800 (PBI-Gordon, Kansas City, Mo.), a chemical sticker to adhere the Flight Control product to the rice seed. The application rate was 0.91 kg of Flight Control per 45.4 kg of rice seed (0.455 kg of anthraquinone/45.4 kg of rice). We used a commercial seed treater to apply the treatment to rice seed.

### *Bird observations*

We started bird observations on all fields the first day following planting and conducted them daily for 1 hr between sunrise and 1000 hr. At the start of each observation period we recorded the number of blackbirds (by species) in each test field. During observations we recorded the number of blackbirds (by species) entering and leaving each test field. For comparative purposes, we converted bird activity to bird use per minute. Starting time and observer locations at each field were the same throughout the test. We concluded observations when the field was re-flooded or when bird activity ceased, which was about 8 days post-planting.

### *Damage assessments*

We assessed bird damage to planted rice seed on each field 8 days post-planting, which was when most fields were re-flooded or when bird activity had ceased. At this point field flooding prevented access of most blackbirds to sprouting seeds, or blackbirds had consumed all available planted rice seeds and therefore abandoned the field. We used stratified random sampling to assess bird damage. We divided each test field into 4 strata of equal size along the long axis of the field. We determined the starting point in each strata by randomly choosing a number between 1 and the width of the strata in meters. Beginning at the starting points, the assessor walked the length of the strata and assessed bird damage to rice sprouts at 10 evenly spaced sampling points. For example, if the length of the long axis of the field was 200 m, damage assessment points were every 20 m. At each assessment point, a 30 × 30-cm template was placed on the ground and the number of rice sprouts was recorded

(Lefebvre et al. 1987). In addition, we placed 12 evenly spaced 60 × 60-cm welded wire exclosures on the line that separated strata 1 and 2, 2 and 3, and 3 and 4. We used the exclosures to determine field rice sprout density. They were assessed at the same time as the damage assessment plots. We assessed rice sprout density within each exclosure by removing the exclosure, centering the assessment template in the area covered by the exclosure, and counting the number of rice sprouts.

### *Sample collections*

We collected a 100-ml sample of technical anthraquinone prior to the formulation of Flight Control and 100-ml sample of Flight Control product from each Flight Control container prior to mixing for chemical analysis. For each treated rice field, we collected two 100-ml samples of spray formulation from the seed treater, two 50-g samples of treated seed after treatment, and 5 50-g samples of treated seed just prior to loading in the airplane. Of the latter 5 samples, we retained 2 as control samples, put 3 into cheesecloth bags, and randomly placed bags in the test field. We retrieved a bagged sample at days 1, 3, and 5 to determine the degradation rate of anthraquinone.

### *Data analyses*

We analyzed bird activity and rice-sprout density as mixed linear models (e.g., McLean et al. 1991, Wolfinger 1991) using a restricted maximum likelihood estimation procedure (REML). We accepted calculations using SAS PROC MIXED (SAS Institute 1992, 1996, 1997). Results are presented ±1 SE.

## Results

### *Bird observations*

All test fields were located under flightlines of blackbirds emanating from nearby roosts. Species composition of blackbirds using test fields was about 90% red-winged blackbirds, with the remainder being common and great-tailed grackles and brown-headed cowbirds. We observed more ($F_{1,8}$= 34.93, $P$=0.0003) blackbird use of untreated rice fields ($\bar{x}$=280±35) than of Flight Control-treated rice fields ($\bar{x}$=11±28). The largest number of blackbirds ($\bar{x}$=479±87) using untreated fields occurred on day 4 (Figure 1). We attributed the decrease in blackbird numbers on untreated fields after day 5 to blackbirds having consumed all of the planted rice seed on 2 of 4 untreated fields.

### *Damage assessments*

Blackbirds damaged more ($F_{1,8}$ = 10.28, $P$ = 0.0124) untreated rice seed than Flight Control-treated rice seed (Figure 2). Mean number of rice

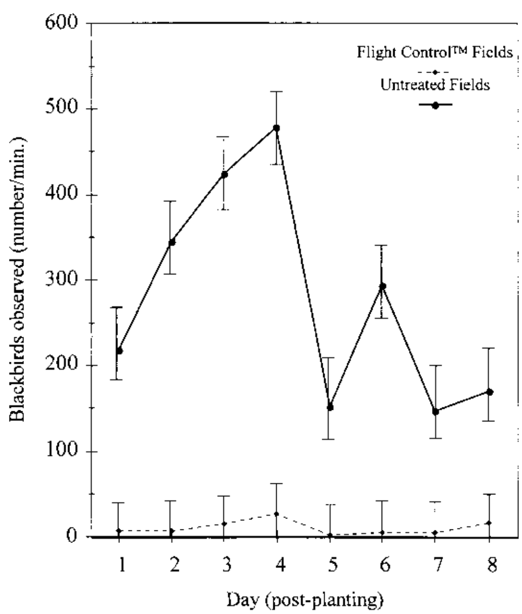


Figure 1. Blackbirds observed per minute ($\bar{x}$ ± SE) in 6 fields planted with Flight Control™ (2% g/g)-treated rice and 4 fields planted with untreated rice near Gueydan, Louisiana, 1998. Capped vertical bars represent standard error.

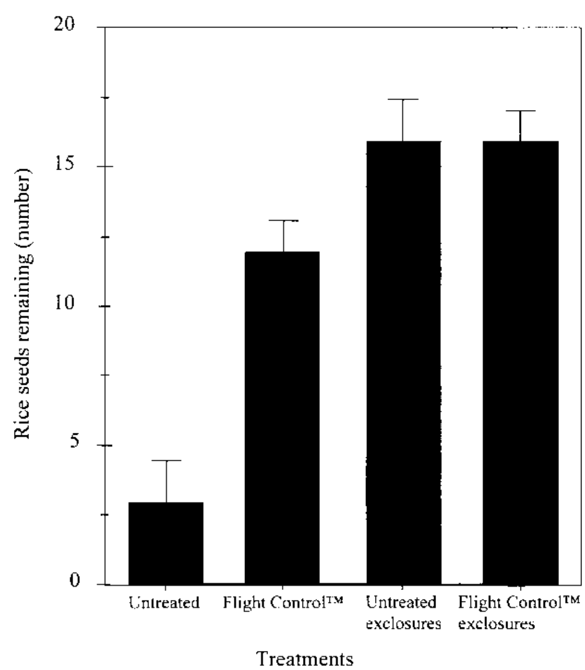


Figure 2. Blackbird damage to rice seeds ($\bar{x}$ ± SE) in damage assessment plots in 6 fields planted with Flight Control™ (2% g/g)-treated rice and 4 fields planted with untreated rice near Gueydan, Louisiana, 1998. Figure also shows the mean number of rice seeds in treated and untreated field exclosures. Capped vertical bars represent standard error.

seeds remaining in Flight Control-treated fields was greater ($\bar{x}$=12±2) than in untreated fields ($\bar{x}$=3±3). Rice seed counts were similar between Flight Control ($\bar{x}$=16±2) and untreated exclosures ($\bar{x}$=16±3), suggesting no phytotoxic effects from the treatment (Figure 2).

### *Sample collections*

Analysis of the technical anthraquinone used to formulate Flight Control determined that it was 99.7% pure. The concentration of anthraquinone in Flight Control averaged 53.4±0.45%, and the spray formulation from the seed treater averaged 38.9± 2.1%. The projected chemical concentration of anthraquinone on rice seed was 1.0% at planting; however, the actual concentrations of anthraquinone on rice seed averaged $\bar{x}$=0.79±0.06% at planting, 0.39±0.04% at day 1, 0.34±0.05% at day 3, and 0.41±0.06% at day 5 post-planting. The slight increase of anthraquinone from day 3 to day 5 could have been due to 1 of 30 sub-samples having a higher than expected concentration of anthraquinone.

## Discussion and management implications

The repellency mechanism of Flight Control is unknown but under investigation. Preliminary observations have indicated that ingestion of anthraquinone may cause a slight (e.g., regurgitation, bill wiping) sickness (Avery et al. 1997). Similar symptoms have been observed in birds that ingested methiocarb (Cummings et al. 1992, 1994). However, with Flight Control, mortality in cage or field tests has not been observed (Cummings et al. 2002). United States Environmental Protection Agency (EPA) data indicated that Flight Control posed no toxicological risk to birds or mammals (EPA 1998). The lethal dose 50 (LD50) was >3,000 mg/kg for bobwhite quail (*Colinus virginianus*) and >5,000 mg/kg for rats (*Rattus norvegicus*; EPA 1998). In cage and field tests, it has been noted that birds avoided consuming Flight Control- treated rice on repeated encounters (Cummings et al. 2002). In addition, it has also been suggested that Flight Control can act as a UV blocker by preventing birds from recognizing treated grains as a food item (K. Ballinger, Environmental Biocontrol International, personal communication).

Blackbirds over a newly planted rice field in Kaplan, Louisiana.

In our field test, Flight Control was effective in reducing blackbird damage to newly planted rice. Following exposure of birds to treated rice, we observed bill wiping, a few cases of regurgitation, and avoidance of test fields. Similar observations have been noted in laboratory tests (Avery et al. 1997) and in preliminary field tests (Cummings et al. 2002). It has been suggested that higher concentrations of anthraquinone (1.0%) might cause blackbirds to curtail foraging rather than attempt to distinguish between treated and untreated rice (Avery et al. 1997). We suggest that the repellency threshold for field applications of Flight Control on water-planted rice is probably between 0.5 to 1.0% anthraquinone. In our study more than 50% of the treatment was lost within the first day of planting, suggesting that a concentration of about 0.5% anthraquinone was effective.

The retail cost of Flight Control is undetermined, pending an EPA registration by the company. However, most rice growers would use the test treatment rate (0.91 kg of Flight Control per 45.4 kg of rice seed) only if it were effective and cost less than $24/ha (D. Hardee, Louisiana Rice Growers Association, personal communication). We recommend additional field trials to evaluate chemical stickers to enhance the retention of Flight Control on water-planted rice seed and to fulfill EPA's data requirements for registration.

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