# Evaluation of Sodium Lauryl Sulfate as a Blackbird Wetting Agent

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**ABSTRACT** New and improved strategies are needed for managing overabundant blackbird (*Icteridae spp*.) populations in some areas of the United States. From 2004 to 2007, we evaluated sodium lauryl sulfate (SLS) as a wetting agent during controlled outdoor cage and flight pen tests in Colorado and small-scale field tests at urban blackbird roosts in Missouri. In the outdoor cage tests (ambient temperature -5 to 2° C), mortality of male red-winged blackbirds (*Agelaius phoeniceus*) sprayed with 1, 2, and 5 ml of SLS on the back feathers only, on the breast feathers only, or on both breast and back feathers ranged from 25% to 100%. A SLS spray on male red-winged blackbirds at 2° C ambient temperature with 1 ml of SLS sprayed on breast feathers and back feathers resulted in 90% mortality in less than 60 minutes. In a flight pen test (-12 to -5° C ambient temperature ), SLS sprayed at 20 l per 3,400 l of water with a single ground-based sprinkler-head system over 35 male red-winged blackbirds roosting in cedar trees (*Juniperus virginiana*) resulted in 53% mortality. There was no mortality in the control group exposed to the same treatment without the SLS. Small-scale field tests conducted in Missouri at 6 sites with a single ground-based sprinkler-head spray system and at 2 sites with 4 sprinkler-head spray systems resulted in mortality that ranged from 0 to 4,750 and 4,500 to 15,000 blackbirds and starlings, respectively. Spray operations lasted from 28 to 208 minutes. Each spray covered about 200 $m^2$. At all sites, mortality of blackbirds sprayed with the SLS occurred as soon as 30 minutes post-SLS application. Mortality at two sites where pump problems precluded completing the spray ranged from 0 to 800 birds. Air leaving the system as the system was activated caused birds to flush from the roost trees. Poor water quality and pump durability were problems at some sites.

**KEY WORDS** *Agelaius phoeniceus*, human-wildlife conflicts, nonlethal deterrent, red-winged blackbird, sodium lauryl sulfate, wetting agent, wildlife damage management

Red-winged blackbirds (*Agelaius phoeniceus*), common grackles (*Quiscalus quiscula*) and brown-headed cowbirds (*Molothrus ater*) cause extensive damage to agriculture commodities. A 2001 survey of rice producers in Louisiana, Arkansas, California, Texas and Missouri indicated that the minimum economic loss to the rice industry from blackbirds due to direct damage, prevention and lost price support is estimated at $21.5 million (Cummings et al. 2005). Large roosts of blackbirds and European starlings (*Sturnus vulgaris*) often establish in areas where they are objectionable for agricultural, health, aesthetic and nuisance reasons. Of concern is the noise, fecal accumulation, nuisance and disease threat caused by roosting blackbirds and starlings (Garner 1978). There are also concerns regarding conflicts between blackbirds and starlings with other avian species. For example, introduced starlings have been documented as competitors for nest sites with indigenous species (Feare 1984). Additionally, parasitism by brown-headed cowbirds has been implicated as a major factor in population declines of neotropical migratory birds (Askins 1995, Robinson et al. 1995).

During the 1960s and 1970s, the National Wildlife Research Center of the U.S. Department of Agriculture (USDA),

Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program conducted research to identify and register a wetting agent for blackbird and starling population reduction at winter roosts (Lefebvre et al. 1971, Stickley and Suddarth 1981). The USDA, APHIS, WS program (formerly US Department of Interior, US Fish and Wildlife Service, Animal Damage Control Program) registered tergitol nonionic 15-8-9 (PA-14) with the Environmental Protection Agency (EPA) in 1973, and subsequently used this surfactant for 18 years for the lethal control of roosting blackbirds and starlings. In 1992, APHIS withdrew the registration of PA-14 because of the cost required to provide additional data requested by the EPA.

In 2004, there was a renewed interest in developing a wetting agent for managing blackbird and starling populations. In 1996, the EPA published a list of 31 chemicals they determined to be of minimal risk and therefore exempt from registration under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) ("Minimum Risk Pesticides Exempted under FIFRA Section 25(b)" Pesticide Registration Notice-2000-6. The list included sodium lauryl sulfate (SLS), a surfactant commonly used in soap products. Because SLS is categorized as a 25(b) substance that is exempt from EPA registration requirements, we selected it for evaluation as a blackbird and starling wetting agent. The primary purpose of this study was to determine the efficacy of SLS as a wetting agent for blackbirds under controlled outdoor cage and flight pen conditions and in small scale roost tests in Missouri. We also evaluated the effectiveness of equipment designed to apply SLS to roost sites.

## METHODS

Male red-winged blackbirds used in controlled outdoor cage and flight pen tests were captured with a cannon net in the vicinity of Fort Collins, CO. Birds were grouped communally in 3 x 3 x 7 m pens during a 14-day quarantine period. Following quarantine, we selected 123 male red-winged blackbirds that met our selection criterion of weighing greater than 60 grams. Birds were weighed and banded with individually numbered leg bands. During the quarantine and study periods, birds were offered a fresh maintenance diet (combination of hen scratch, sunflower seeds, millet and safflower) and water *ad libitum* each day.

### Experiment 1

Determine the efficacy of sodium lauryl sulfate as a wetting agent for male red-winged blackbirds under controlled outdoor cage testing. From the pool of male red-winged blackbirds, we selected 53 birds, and individually housed them in outdoor 61 x 46 x 33 cm test cages. We conducted tests only if night time ambient temperatures were predicted to remain below 4° C for more than 3 hours following the treatment period. Birds were allowed to acclimate to cages for 2 days prior to testing. Birds were divided into 6 groups based on weight, with the heaviest birds assigned 1 to each group, the next heaviest birds assigned 1 to each group, and so forth until all birds were assigned to a treatment group. Groups of birds were randomly assigned one of the following treatments: (1) sprayed with 5 ml of SLS on back feathers, n=10; (2) sprayed with 10 ml of SLS, 5 ml on back feathers and 5 ml on breast feathers, n=10; (3) sprayed with 10 ml of water only, 5 ml on back feathers and 5 ml on breast feathers, n=10; (4) sprayed with 2 ml of SLS, 1 ml on back feathers and 5 ml on breast feathers, n=8; (5) sprayed with 1 ml on back feathers, n=8; and (6) sprayed with 1 ml on breast feathers, n=7.

Following the cage acclimation period, birds were removed from their cage starting

at 1700 hours, held by outspread wing tips, sprayed with their assigned treatment (mixed with 10 ml of water) on treatment areas and placed back into their cage. The bird's condition and outside temperature at the front of the cage were recorded at time of treatment and every 10 minutes until 0600 hours or until death occurred. Non-responsive birds or birds showing signs of pain or distress observed during the test were euthanized. At the completion of the test, all birds were weighed and euthanized. EPA guidelines for assessing efficacy were followed for this experiment (EPA 1982). Bird mortality had to be greater than 90% for it to be considered effective.

**Experiment 2**

Determine the efficacy of sodium lauryl sulfate as a wetting agent for male red-winged blackbirds under stimulated field conditions in a flight pen, and evaluate the effectiveness of specialized equipment designed to apply sodium lauryl sulfate to blackbird roost sites.

From the pool of male red-winged blackbirds, 70 birds were selected for use in this experiment, with 35 housed in each of two 10 x 10 x 4 m outdoor flight pens. Birds were allowed to acclimate to the flight pens for 2 days prior to testing. During acclimation and while on the test, birds were offered a fresh maintenance diet and water *ad libitum* each day. Birds were fed at a central location in each flight pen. Roosts were provided by placing 5 cedar trees between 2–3 m tall in a cross configuration starting at the center of the flight pen for roosting. Trees were spaced about 0.6 m apart. A flight pen was assigned one of the following treatments: 1) sprayed with 20 l of SLS or 2) sprayed with water only.

Following the flight pen acclimation period, 1–2 hours prior to sunset a ground-based sprinkler system consisting of a base stand, one aluminum stand pipe (2.54 cm diameter) in 2 3.3 m sections with a Wobbler® standard angle sprinkler head was placed in the center of the flight pen. The sprinkler head throw angle was set at 24 degrees and had a nozzle opening of 0.43 cm. The height of the sprinkler system was 7 m with a coverage radius of 8 m. Guy wires were attached to the sprinkler system stand pipe at 3 m intervals and anchored to the ground for support. A 3.66 cm (1.5 in) water hose was attached to the base of the sprinkler system and to a 1/3 hp Kawasaki® TF-22 pump that was located 35 m from the flight pen. The pump was connected to a water supply. In addition, a rain gauge was placed at 2, 5 and 8 m from the base to measure the amount of water reaching the ground at these locations.

Once birds had roosted in the trees and the outside temperature was 4° C or below, the spray system was activated. The first group of birds sprayed received water only. Water only was applied through the sprinkler system onto the roost trees at approximately 24 l per minute. The spray was continuous until approximately 4,000 l of water had been used. Bird reaction to the sprinkler system and spray, and observations of the birds' condition were documented using night vision equipment. The outside temperature at the entrance to the flight pen was recorded at treatment and every hour until 0600 the following day. At this point all birds were captured, counted, weighed and euthanized.

On the following day, the sprinkler system was placed in the remaining flight pen using the same procedures with the exception that 20 l of SLS was metered into the spray system with a 1.25 cm injector line connected to the pump. SLS was metered into the sprinkler system after birds had initially been sprayed with 520 l of water and remained in the roost trees. Approximately 3,420 l of water were delivered through the sprinkler system after

metering SLS. Bird reaction to the sprinkler system and spray, and observations of the condition of the birds, were documented using night vision equipment. The outside temperature at the entrance to the flight pen was recorded at treatment and every hour until 0600 the following day. At this point all birds were captured, counted, weighed and euthanized. EPA guidelines for assessing efficacy were followed for this experiment (EPA 1982). Bird mortality for this test had to be greater than 90%.

**Experiment 3**

Determine the efficacy of sodium lauryl sulfate as a wetting agent for both blackbirds and starlings in a small-scale field test in Missouri.

Eight blackbird and starling roost sites in southeast Missouri were selected for the field test; birds from these sites contribute to rice depredations and were considered a health and safety concern. All sites met the following criteria:

1. Contained at least 1 of the following blackbird species: red-winged blackbird, brown-headed cowbird, common grackle or European starling.
2. Were located at least 35 m from any surface water and human habitations.
3. Roosting habitat did not exceed the height of the spray system (<10 m).
4. No nontarget species were observed in the roosting habitat.
5. Spray material or drift from the spray operation would not harm or damage roosting habitat, surrounding vegetation or physical property.

Following the selection of a roost site and starting 3–4 hours prior to sunset, the spray system was erected as outlined in Experiment 2. At 6 sites a single spray system was used and 20 l of SLS were metered into the sprinkler system after birds had initially been sprayed with 600 l of water (15 minutes) and remained in the roost trees. The spray continued until 2,000 to 3,400 l of water had been used. At 2 sites 4 spray systems were used and 80 l of SLS. During the final spray with 4 spray systems, a higher volume pump and a different sprinkler head were used. The pump was a Pacer® 5.5 hp Briggs and Stratton and the sprinkler head was a Wobbler® Standard Angle, with a 24 degree angle and a 0.55 cm nozzle. The birds' reaction to the spray equipment and spray, and observations of the birds' condition were documented using night vision equipment. The outside temperature at the roost was recorded at the start and conclusion of the spray. The roost location, vegetation height, weather, sprinkler height, rain gauge readings, number of roosting birds and species composition, number of birds sprayed and mortality were documented.

**RESULTS**

**Experiment 1**

In outdoor cage tests (ambient temperature 5–2°C), mortality of male red-winged blackbirds sprayed with 5 ml of SLS on both breast and back feathers and on back feathers only was 100% within 70 minutes. No control birds died. Mortality of male red-winged blackbirds sprayed with 1 ml of SLS on breast feathers and back feathers, 1 ml of SLS on the breast feathers only, and 1 ml of SLS on the back feathers only was 88%, 25% and 57%, respectively over a 120-minute period.

**Experiment 2**

The control group of 35 male red-winged blackbirds was sprayed with 3,700 l of water over a 3 hour period. The starting temperature was -5° C at 1700 hours and -12° C at 2010 hours. All birds were alive the following day at 0800 hours.

The same procedures were followed the next night under similar conditions with

another group of 35 male red-winged blackbirds, except that 20 l of SLS was added to the spray system after 520 l of water had been sprayed. A total of 3,400 l of water was sprayed over the test period. Rain gauge readings at 2, 5 and 8 m from the base of the sprinkler system were 4, 0.75 cm and a trace, respectively. The starting temperature was -5° C at 1650 hours and -12° C at 1955 hours. At 0800 hours the following day there was 53% mortality.

**Experiment 3**

During January–March 2005 small scale field tests were conducted near Malden, Missouri at 6 blackbird roost sites with a ground-based sprinkler spray system. At each site, 2,000–3,200 l of water was sprayed over an area extending approximately 8 m, or about 2–3 roost trees, from the sprinkler head. Roost counts of the birds using the tree within the spray radius varied from 300–5,000 blackbirds of mixed species and starlings. After the first 400 l of water was sprayed at each site, 20 l of SLS was injected into the system. The pump ran at about 40 psi. The spray operations started between 1830 and 1920 hours and lasted from 28 to 208 minutes. Ambient temperatures at the conclusion of the sprays ranged from -5 to 5° C. The first dead birds were observed approximately 30 minutes into the spray operation. Mortality ranged from 0 to 100% of birds sprayed or 0 to 4,750 birds per site. A few problems were encountered, such as air in the system, which caused birds to flush from the roost trees, water quality and pump durability. At two sites, pump problems precluded completing the spray. Mortality at these sites ranged from 0 to 800 birds.

In February 2006, 4 ground-based spray systems were used in a roost within the city limits of New Madrid, Missouri. It was estimated that one million blackbirds were using the roost and about 150,000 blackbirds and starlings were roosting under the project coverage area of the spray systems. The spray started at 1845 hours and was completed at 2313 hours. The spray system used 80 l of SLS and 8,000 l of water. The SLS was injected into the system after 800 l of water was sprayed or 22 minutes after starting the spray. Ambient temperature at the start of the spray was 8° C and was 2° C at the conclusion of the spray. Problems with the pump contributed to poor coverage of target birds and may have been a factor in SLS solidifying in hoses. Spray pressure ranged from 18 to 20 psi, while pressure should have been 40 psi. Overall mortality from the spray was 4,500 blackbirds.

In January 2007, 4 ground-based spray systems were used in a roost near Malden, Missouri. A higher volume pump and different sprinkler head were used for this spray. It was estimated that 50,000 blackbirds and starlings were in the roost. The spray system covered more than 50% of the roosting birds. The spray started at 1806 hours and was completed at 1924 hours. The spray system used 80 l of SLS and 8,000 l of water. The SLS was injected into the system after 2,900 l of water were sprayed or 29 minutes after starting the spray. Ambient temperature at the start of the spray was 6° C and at the conclusion of the spray was 5° C. Overall mortality from the spray was 12,000 starlings and 3,000 grackles.

## DISCUSSION

Various commodity associations, public heath organizations, and local governments consider large populations of roosting blackbird and starlings objectionable for agricultural, health, aesthetic and nuisance reasons. New and improved strategies for managing overabundant blackbird populations in some areas of the United States are needed. An effective bird management strategy will likely include various components that can be applied in

an integrated manner to produce a desired result.

The results of these experiments suggest that SLS is an effective wetting agent for blackbird population management. The ground-based sprinkler spray system is simple and requires minimal materials, time and labor to erect. One spray system covers about 218 $m^2$; it would take about 55 spray systems to cover a hectare of blackbird roosting habitat. Water availability probably would be an issue if more than 4 spray systems are used (Heisterberg et al. 1987). The effective volume output of each spray system is 20 l of SLS and 2,000 l of water. The key to the spray system's success is the use of a high-volume output pump and sprinkler heads and removal of air from the system before attempting to spray birds. With this type of equipment, spray time is kept to less than 80 minutes.

Because the EPA considers a product containing sodium lauryl sulfate a "Minimum Risk Pesticides Exempted under FIFRA Section 25(b)," any wetting agent containing SLS would not be subject to normal EPA registration requirements. However, EPA still would require that a product label, complete with full disclosure of the product ingredients and directions for use, be submitted for review. This review would be significantly abbreviated compared to a typical pesticide registration. Registration of SLS probably would still take up to 4 months to complete. Not all states accept the EPA minimum risk designation. A wetting agent product label (and sometimes efficacy data) would have to be submitted to each state for approval prior to use in that state. For example, Colorado required registration of a SLS-based product for use in bird baths and backyard water features to control mosquitoes. SLS is a safe, effective alternative to reduce overabundant blackbird and starling roosting populations in areas where nighttime temperatures are favorable.

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