

EFFECTIVENESS OF SEVERAL OILS TO REDUCE HATCHABILITY OF CHICKEN EGGS

PATRICIA A. POCHOP,¹ U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Denver Wildlife Research Center, Denver, CO 80225, USA

JOHN L. CUMMINGS,¹ U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Denver Wildlife Research Center, Denver, CO 80225, USA

JOHN E. STEUBER,² U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control, Moses Lake, WA 98837, USA

CHRISTI A. YODER,¹ U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Denver Wildlife Research Center, Denver, CO 80225, USA

Abstract: Oiling eggs with white mineral oil was successful with several bird species and has potential as a management tool within an integrated bird management program. We conducted an incubator study from 22 February to 20 March 1995 to determine if castor, corn, linseed, safflower, or soybean oil was as effective as white mineral oil in reducing the hatching success of chicken eggs, and if timing affected treatments (early vs. late incubation). We treated the first sets (9 eggs/set) of eggs on the fifth day of incubation (early) and the second sets of eggs on day 16 of incubation (late). There was a 68% hatching success in control eggs whereas none of the treated eggs hatched. All 5 oils were as effective as white mineral oil in suppressing hatchability of eggs.

JOURNAL OF WILDLIFE MANAGEMENT 62(1):395-398

Key words: egg oiling, hatchability, incubation, management technique, nontoxic, registration.

1998

Egg addling, including shaking, freezing, removal, destruction, puncturing, and oiling is among several strategies to manage bird populations such as Canada geese (*Branta canadensis*) and gulls (*Larus* spp.) that are implicated in agricultural crop damage, health and safety problems, and nuisance concerns (Laycock 1982, Christens and Blokpoel 1991). One advantage of oiling over other techniques is that the incubating birds continue to incubate eggs well past the normal hatching time, which precludes renesting (Christens and Blokpoel 1991). Further, egg oiling is more socially acceptable than destroying adults (Laycock 1982). For example, a survey of Washington residents indicated no opposition to an egg-oiling program in the Seattle area (M. E. Pitzler, U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control, personal communication).

In laboratory and field tests, white mineral oil (Daedol 50 NF; Daminco, Mississauga, Ontario, Canada) has been used successfully as an egg

treatment to almost completely suppress hatchability of chicken, ring-billed gull (*Larus delawarensis*), herring gull (*L. argentatus*), and Canada goose eggs (Blokpoel and Hamilton 1989, Christens and Blokpoel 1991, Cummings et al 1993). One advantage of using white mineral oil on an operational level is that it is chemically inert, nonpoisonous, highly purified (100%), and would not create an environmental hazard (Christens and Blokpoel 1991). In 1994, the U.S. Environmental Protection Agency (EPA) announced in the Federal Register a proposal to deregulate several types of "food" oils from the formal registration process (Federal Register 1994). The substances listed would not need registration as long as the mode of action of the pesticide is considered nontoxic. However, a registration label would still be needed if any of the oils are used on an operational level. The purpose of our incubator study was to evaluate 5 of the listed oils (castor, corn, linseed, safflower, soybean) to determine if they would be as effective in reducing hatching success as white mineral oil, and to evaluate if there is a difference in egg hatchability when treatments are applied (early vs. late incubation).

METHODS

We purchased chicken eggs from the Dekalb Ozark Hatchery (Neosho, Missouri, USA). The

¹ Present address: USDA, APHIS, ADC, National Wildlife Research Center, 1716 Heath Parkway, Fort Collins, CO 80524, USA.

² Present address: USDA, APHIS, ADC, Federal Building, 2800 Cottage Way, Room W-2316, Sacramento, CA 95825, USA.

eggs were from Dekalb Delta pullets, which are bred for producing large, high-quality eggs. We ranked eggs by mass and placed them in sets of 9 with the heaviest egg placed in the first set, the second heaviest in the second, etc., until all eggs were assigned to 1 of 18 sets (162 eggs). We placed 6 sets of eggs in each of 3 incubator trays that were spaced evenly from top to bottom in the incubator. Each set of 9 eggs per treatment was chosen randomly and placed in each position on each level of the tray. We numbered the levels with 1 at the top. In addition, we placed extra eggs in the incubator until day 5 of incubation, at which time we candled all eggs to determine viability. We replaced eggs without embryos with viable eggs and discarded the remaining nonviable eggs.

We randomly assigned 2 sets of 9 eggs to each of the following treatments: control, castor oil, corn oil, linseed oil, safflower oil, soybean oil, or white mineral oil. We applied a treatment to 1 set of eggs at 5 days after the start of incubation and to the remaining set at 16 days. We left the extra 4 sets of 9 eggs untreated, but with the original 2 sets of controls, placed them equally (2 sets on each level) among the 3 different levels of the incubator to monitor any vertical differences in hatching success. Extra, viable eggs were placed in the brooding tray for exchanging with nonviable eggs on day 16 of incubation (late) treatment. On the day of treatment, we removed 1 tray at a time from the incubator and treated each individual egg with 2 mL of oil. We applied the treatments with a calibrated, hand-held plant mister held approximately 3 cm from the egg. For maximum coverage, we held the egg with our fingers while rotating the sprayer around the egg. After the eggs were sprayed, we quickly replaced them into the carton so the oil could continue to spread around the egg. We used aluminum foil to cover eggs not being treated. Open spaces were left between sets of eggs to avoid contamination, and we used cotton balls beneath each egg to absorb excess oil. We determined the final status of embryos in unhatched eggs 5 days after the expected hatching date (21-day incubation period). We observed the age of embryo death by breaking open the eggs to visually examine the embryo. We compared observations of our embryos against a photo series of embryos at 3, 6, 9, 12, 15, and 18 days (Nebraska Cooperative Extension Service *no date*).

The incubator (No. 1202 Sportsman, Valen-

tine, Chicago, Illinois, USA) automatically turned the eggs in the incubator trays approximately every 2 hr. We turned extra eggs manually 2 times/day. We maintained eggs at about 37.0–38.0°C and 55–61% humidity during incubation and about 36.9–37.3°C and 69–73% humidity 4 days before the expected hatching date. We followed criteria outlined by the Animal Welfare Act and the Denver Wildlife Research Center Animal Care and Use Committee.

RESULTS

Treated eggs did not hatch, whereas hatching success in control eggs averaged 68% (Table 1). Hatching success was 67% for the control eggs in level 1, 64% for level 2, and 73% for level 3.

Of the embryos treated early in incubation (5 days), 46 were >3 but <6 days old, and 8 were ≤3 or ≥6 days old when they died. Of the embryos treated late in incubation (16 days), 46 were >15 but <18 days old and 8 were ≤15 or ≥18 days old when they died. The 15 control embryos that died varied in age, but most (11) were between 15 and 21 days old.

We observed differences in the thickness, color, odor, and drying time of the oils (Table 2). Castor oil was the thickest, wherein we had to submerge the plant mister in hot water to spray the oil. White mineral oil was the thinnest, and the rest of the oils were intermediate. Linseed oil had the most detectable odor, whereas the other oils had mild to no detectable odors. The oils tended to dry in 24–48 hr, except for castor oil for which we could not determine a drying time. Costs of the oils ranged from \$2.10/L for corn oil to \$25.56/L for virgin linseed oil.

DISCUSSION

The hatchability of control eggs in the incubator experiment was lower than the 96.1% (Blokpoel and Hamilton 1989) and 87.5% (Morris and Siderius 1990) obtained by other researchers using chicken eggs in incubator experiments. Dekalb Delta pullets have an average hatching success in the 90% range, but this is not guaranteed. Of the incubated eggs that we candled on day 5, 19% were stale or infertile, and another 10% were added. We observed no differences in hatching success between eggs in the incubator trays compared to the eggs that spent the first 5 days in the brooding tray. Our examination of the postexpected

Table 1. Hatching success of chicken eggs treated with various oils during the incubator study, 22 February through 20 March 1995.

Treatment	Hatching success		Cause of failure			
	%	No.	Oil		Other ^a	
			%	No.	%	No.
Early incubation (5 days)						
Castor oil	0	0	78	7	22	2
Corn oil	0	0	78	7	22	2
Linseed oil	0	0	78	7	22	2
Safflower oil	0	0	89	8	11	1
Soybean oil	0	0	89	8	11	1
White mineral oil	0	0	100	9	0	0
Control	56	5	0	0	44	4
Late incubation (16 days)						
Castor oil	0	0	89	8	11	1
Corn oil	0	0	67	6	33	3
Linseed oil	0	0	89	8	11	1
Safflower oil	0	0	89	8	11	1
Soybean oil	0	0	100	9	0	0
White mineral oil	0	0	78	7	22	2
Control	78	7	0	0	22	2
Average control ^b	68	32	0	0	32	15

^a Eggs suspected of failing due to conditions other than the treatment after examination of the embryos.

^b The original 18 eggs assigned as controls plus an additional 36 eggs incubated but not treated. Seven eggs with healthy embryos (from the additional 36 eggs) were switched for eggs with dead embryos (determined after candling) in the late incubation treatments and were not included in the results.

hatching date of control eggs that did not hatch indicated 11 of the embryos were a minimum of 15 days old and were typically ≥ 18 days old. Four embryos (1 control, 3 treated) were deformed, but the deformities may not have caused the eggs to not hatch. Drent (1975) discusses optimal physical conditions for embryo development, which include gaseous factors, temperature, and egg position.

We found that timing was not a factor in egg hatchability, and that all treatments successfully prevented eggs from hatching; these results contrast with others. Blokpoel and Hamilton (1989) applied white mineral oil to eggs with a cotton gauze pad and found the lowest hatchability (4.4%) when applied 17 days into incu-

bation compared to 52.1% hatchability when applied at 4 days and 34.8% at 10 days. Morris and Siderius (1990) found no difference in timing of application with dormant oil alone, but later treatments were more effective when dormant oil was combined with a penetrating carrier (Dimethyl sulfoxide). They sprayed all eggs at intervals of 0, 7, and 14 days and applied 2 applications of chemical treatment and 1 application of water.

We examined the other characteristics of the oils for properties rendering them less ideal for field use. Castor oil, like white mineral oil, keeps well, but the castor oil was very thick and applying it through a sprayer on cold days could be a problem. Linseed oil had a distinctive odor

Table 2. Characteristics of oils used in the incubator study.

Oil	Thickness ^a (rank)	Color ^b	Odor	Average sprays ^c (No.)	Drying time (hr)
Castor	6	clear	slight	6-7	I ^d
Corn	4	yellow-1	faint	4-5	24-48
Linseed	2	yellow-4	strong	3	24-48
Safflower	3	yellow-3	slight	3	24-48
Soybean	5	yellow-2	slight	5-6	24-48
White mineral	1	clear	odorless	3	24

^a Ranked from thinnest to thickest among the oils used.

^b Yellow oils were ranked from lightest to darkest among the oils used.

^c Average number of sprays to apply 2 mL of oil.

^d I—indefinite period of time (drying time could not be determined).

that could attract predators, which potentially could result in depredation of the nest early enough to allow re-nesting. Corn, linseed, safflower, and soybean oil contain linoleic acid that is characteristic of semidrying oils. However, upon prolonged exposure to air, these oils can thicken and become rancid.

MANAGEMENT IMPLICATIONS

All 5 oils we tested were as effective as white mineral oil in suppressing hatchability of chicken eggs and have potential for field use. These oils would cost less to label for operational use because most are being deregulated by the EPA from the formal registration process. Because all the oils we used were food-grade quality, they would be safe to use and would biodegrade relatively quickly in the environment. Corn oil would be especially promising because of its low cost (\$0.042/100 eggs vs. \$1.69/100 eggs for white mineral oil), availability in most areas, and ease of application.

ACKNOWLEDGMENTS

We thank J. E. Davis, Jr., and the Denver Wildlife Research Center Animal Care Section for technical assistance. Use of a company or trade name does not imply U. S. Government endorsement of commercial products.

LITERATURE CITED

- BLOKPOEL, H., AND R. M. G. HAMILTON. 1989. Effects of applying white mineral oil to chicken and gull eggs. *Wildlife Society Bulletin* 17:435-441.
- CHRISTENS, E., AND H. BLOKPOEL. 1991. Operational spraying of white mineral oil to prevent hatching of gull eggs. *Wildlife Society Bulletin* 19:423-430.
- CUMMINGS, J. L., M. E. PITZLER, P. A. POCHOP, H. W. KRUPA, T. L. PUGH, AND J. A. MAY. 1993. Field evaluation of white mineral oil to reduce hatching in Canada goose eggs. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control, National Wildlife Research Center, Bird Section Research Report 494.
- DRENT, R. 1975. Incubation. Pages 333-420 in D. S. Farner and J. R. King, editors. *Avian biology*, Volume V. Academic Press, New York, New York, USA.
- FEDERAL REGISTER. 1994. Proposed rules. 40 CFR Part 152.25(g), September 15, volume 59, number 178.
- LAYCOCK, G. 1982. The urban goose. *Audubon* 84:44-47.
- MORRIS, R. D., AND J. SIDERIUS. 1990. A treatment for prevention of hatching in field-incubated ring-billed gull eggs. *Journal of Wildlife Management* 54:124-130.
- NEBRASKA COOPERATIVE EXTENSION SERVICE. (no date). *Embryology. Manual EC 14-60-80*. U.S. Department of Agriculture, Cooperative Extension Service, Institute of Agriculture and Natural Resources, University of Nebraska, Lincoln, Nebraska, USA.

Received 9 August 1996.

Accepted 24 March 1997.

Associate Editor: Fairbrother.