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Study of house sparrow (*Passer domesticus*) feeding preference to natural color and guard coat blue coated seeds

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In the Canadian prairies there is a concern about flocks of migrating and breeding birds landing on agricultural fields and ingesting pesticide treated canola seeds. We studied the potential of blue color coating (GUARD COAT) to repel house sparrows (*Passer domesticus*) from canola and mixed bird seeds in laboratory. Thirty-six sparrows of equal sex ratio were distributed among 12 cages. On the average each group of birds consumed 2.7 g (68%) of natural canola seeds and 1.2 g (32%) of blue coated ones daily. However, both sexes lost weight on the canola diet despite sufficient available food, suggesting that canola does not constitute a preferred diet to sparrows. An additional experiment with natural color and blue coated mixed seeds supported the above observations. The average daily consumption of natural color and blue coated seeds was 18.42 g (97%) and 0.49 g (3%), respectively. Both sexes maintained their body weights throughout the experiment. The results suggest that, when offered a choice, sparrows select natural color preferred food and avoid blue coated and/or less preferred food.

Keywords: house sparrow; *Passer domesticus*; repellents; birds

The agricultural seed producers are striving to develop the best quality seeds for seed growers. They use control agents (insecticides, fungicides, herbicides) to protect these seeds from disease and predation (Crocker and Reid, 1993). However, with the increased use of those agents, there is a growing threat of poisoning to granivorous avian species (Balcomb, 1983; Rusk, 1993) and other wildlife because of secondary poisoning. Some avian species are able to identify and avoid chemically treated seeds but they may consume them when there is a shortage of food (Hill, 1972; Bennett and Price, 1981; Babu, 1988). To avoid the non-target mortalities, seed producers are interested in incorporating repellents into their coating formulations.

Color coating may have the potential to repel avian species. Ridsdale and Granett (1969) observed that common grackle (*Quiscalus quiscula*) preferred undyed or yellow-dyed cracked corn to cracked dyed blue, red, or green. Pank (1976) found that Douglas fir seeds treated with coloring agents were less accepted than untreated ones by thrushes (*Ixoreus naevius*), Oregon juncos (*Junco hyemalis*), and California quail (*Iophortyx californicus*). Avery and Decker (1991) reported that red-winged blackbirds (*Agelaius phoeniceus*) consumed less dyed rice than natural color rice. Others have found that several ground feeding birds consumed less blue or green color grain than any other color (Kalmbach and Welch, 1946; Brunner and Coman, 1983; Bryant *et al.*, 1984; Greig-Smith and Rowney, 1987).

In the Canadian prairies there is a concern about migrating and breeding birds landing on agricultural fields and ingesting canola seeds treated with control agents (P. Mineau, Can. Wild. Serv., pers. commun). In 1984, 2000 Lapland longspurs died on a quarter-section of canola field after consuming carbofuran applied in a granular form (Rusk, 1993).

Grow-Tec Ltd., Alberta developed blue color coating (trade mark GUARD COAT) to apply with control agents on canola seeds initially for the ease of distinguishing them from non-treated seeds. The properties of the coating were carefully selected to protect seeds without altering their germination. Because color could be used as a feeding deterrent (Ridsdale and Granett, 1969; Pank, 1976; and others), our objective was to assess the potential of GUARD COAT to deter captive house sparrows (*Passer domesticus*) from feeding on canola and mixed seeds. We assumed that the color would be the first cue the birds would use to select the seeds. However, the physical properties of the coating itself, taste and odor, could contribute to the birds' response. House sparrows

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were chosen for the study because they were easily available, had non-migratory status, and represented gregarious granivorous species that was observed feeding on canola seeds (Pawlina, unpublished data). Also, if poisoned they could cause secondary poisoning of other wildlife.

Study area and methods

The study was carried out in November 1991, at the Alberta Research Council's research station in Vegreville, Alberta. Thirty-six house sparrows (18 females and 18 males) were live-trapped in walk-in traps and mist nets and kept in an outdoor aviary from 2 to 4 weeks to acclimate them to captivity. During this time they received naturally colored, commercially available, mixed bird seeds and water *ad libitum*.

Pre-treatment

The acclimation was followed by a 7 day pre-treatment period. Sparrows were weighed and randomly distributed among 12 wire cages (122 × 91 × 61-cm). Each cage contained three birds of the same sex. The birds were housed in groups because it would more closely match the intended application of the result to granivorous birds feeding in flocks. All experimental cages were kept indoors with a 8:16 light:dark cycle and at a temperature of 12°C during the day and 8°C at night.

Experimental birds were provided with mixed seeds (millet, sunflower seeds, barley, wheat) in two experimental dishes, bird grit, and water *ad libitum*. The amount of seeds consumed was recorded to determine the amount of seeds that should be provided to sparrows during experimental trials.

Experimental trials

The study was comprised of two experiments: in experiment A, birds received blue coated (GUARD COAT) and natural color canola seeds (*Figure 1*). We suspected that canola seeds may not be the preferred food for sparrows (Geis, 1980), therefore, in experiment B, sparrows received blue coated (GUARD COAT) and natural color mixed seeds. The mixed seeds contained, among others, millet and sunflower seeds, which according to Geis (1980), are the preferred foods of house sparrows. In both experiments, seeds were free of control agents and the natural color seeds were not treated with non-colored coating because of possible alternations to the taste and odor of the seeds.

Procedure

After 7 days of pre-treatment, cages were randomly assigned to each experiment. Females were located in cages A1–A3 and B1–B3, and males in cages A4–A6 and B4–B6. Each cage was placed inside a 50 cm high plastic sheet to collect all spilled seeds. The night before the trials begun, all seeds and grit were removed from cages and only water was provided *ad libitum*. The next day, at 08:30 h, sparrows received 50 g of blue coated and 50 g of natural color canola seeds (experiment A), or 80 g of blue coated and 80 g of

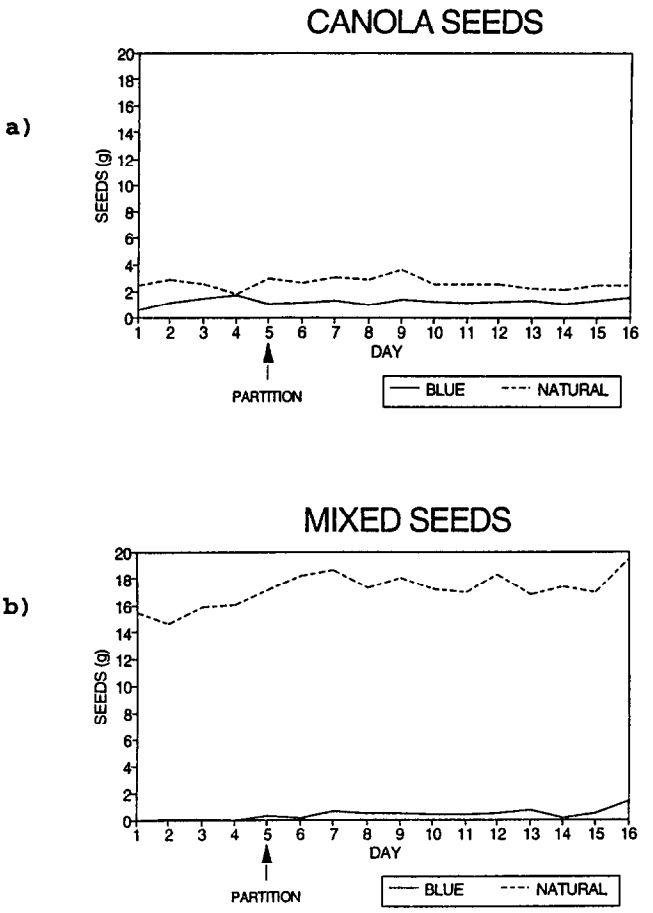

Figure 1. Average daily consumption of natural and blue coated experimental seeds by house sparrows per cage, November 1991

natural color mixed seeds (experiment B). After 6 h of undisturbed feeding, seeds were removed from cages. Those seeds spilled and captured in the plastic sheets also were retrieved.

The weight difference between the amounts of seeds provided in the morning and collected at the end of the 6-h feeding period was the amount of seeds consumed by sparrows. The presence of empty husks was recorded as an additional indicator of seed consumption. This was especially important when the measurements suggested that a very small amount of treated seeds was eaten. Because canola alone does not constitute a proper diet for sparrows, canola-fed birds also received 80 g natural color mixed seeds for 2 h after the 6-h experimental trial. All birds were deprived of food over night and only water was provided. This procedure was repeated daily for the duration of the experiments.

Both experiments were run in parallel over a 12-day period. Originally, seeds were placed in two aluminium dishes located insde a 25 × 35 × 20-cm box. Their position within each box was changed daily. However, because birds frequently spilled and mixed the seeds together, it was difficult to distinguish between the dark blue and the natural brown color canola seeds. On the fifth day, transparent partitions were added to the boxes to separate the seeds and a new 12-day experimental period was started. The data gathered during the first 4 days (no partition in boxes) preceding the 12-day trials were excluded from statistical analyses but were discussed.

At the end of the experiments, the sparrows were weighed and released as soon as the weather permitted. One bird from cage B1 got stuck in the wire mesh of its cage and died. The final mean body weight for this group was calculated from the two remaining sparrows. Also, the seed consumption in this particular cage was adjusted accordingly.

Blue coating

GUARD COAT is a combined product consisting of blue dye and a coating. The color and the hue of the dye together with the information on how the dye was applied on the seeds are a trade secret. However, the color when digitally analyzed could be described by the following RGB (R: red, G: green, and B: blue) values: millet – R = 72, G = 120, B = 160; sunflower – R = 56–72, G = 90, B = 80–160; canola – R = 80, G = 72, B = 78; Barley – R = 64, G = 104, B = 128; and grass – R = 88, G = 104, B = 128. The variation in the RGB values among seeds depend on the level of dye absorption by the seeds' husks. The coating itself is transparent but has some odor and possible taste.

Statistical analyses

The effects of sex, cage, category of seeds (coated and natural), and day of trial on seed consumption were analyzed with the Kruskal-Wallis test (Zar, 1984). The sum of squares to calculate the Kruskal-Wallis H statistics was obtained from repeated measure analyses of variance (procedure PROC GLM, SAS Institute Inc. 1985) on ranked data (procedure PROC RANK). Main effects were sex, cage, category of seeds and interactions; feed consumption was the dependent variable. The day of experiment was the repeated measure. Nonparametric statistics were applied to these tests because of the non-normal distribution of the data (procedure PROC UNIVARIATE). The Tukey's studentized range test was used to separate means if H statistics revealed a significant main effect (procedure PROC GLM). The mean body weight of sparrows before and after the experiments and between sexes were compared to each other with the Tukey's studentized test (procedure PROC GLM).

Animal husbandry and research procedure were endorsed by the institutional Animal Care Committee and were in accordance with the guidelines of the Canadian Council on Animal Care (1984).

Results

Experiment A

Only color of seeds ($H = 120.2$, $df = 1$, $P < 0.05$) and cage ($H = 51.14$, $df = 5$, $P < 0.05$) had a significant effect on the consumption of canola seeds. On the average both sexes consumed daily 2.7 g (69%) natural canola seeds per cage and 1.2 g (32%) of blue coated ones. The consumption of seeds varied among cages ranging from 2.1 to 4.9 g per cage, but did not effect the overall preference to natural color seeds (*Figure 1a*).

The initial mean weight of females and males were 28.1 g (±0.4 SE) and 28.4 g (±1.4 SE), respectively. After the experiments, the average weight of females and males were 27.4 g (±0.3 SE) and 26.24 g (±0.68 SE), respectively. The weight loss was significant in males only ($P < 0.05$).

Experiment B

In experiment B, only blue coating showed a significant effect ($H = 200.88$, $df = 1$, $P < 0.05$) on seed consumption. On the average both sexes consumed daily 18 g (97%) of natural color seeds per cage and only 0.5 g (3%) of blue ones (*Figure 2b*). Consumed seeds were mainly millet and to lesser extend sunflower seeds.

The mean weight of females and males in this experiment were 27.5 g (±0.5 SE) and 29.4 g (±0.4 SE), respectively. Both sexes maintained their body weights throughout the experiment ($P > 0.05$).

Overall, groups of birds of Experiment B consumed 79% more seeds during the 6-hour feeding periods than those of Experiment A (*Figure 1a, b*).

Before plastic partition

Before adding a plastic partition, birds of Experiment B preferred natural seeds over the blue coated ones and their response was consistent with response during the 12-day experiment. However, some variation in the seed consumption existed among groups in Experiment A. Four out of six groups of sparrows preferred natural color canola seeds to blue ones and their response remained the same during the 12-day experiments. The other two groups consumed more blue coated seeds before the partition was added (one group on day 4, and the other on days 2–4) but they preferred natural color seeds when the partition was in place. During the 12-day experiment, one of the groups switched its preference back to the blue-coated seed on the eighth day. The changes did not affect the overall preference to natural color canola seeds (*Figure 1a*).

Discussion

The results showed that the presence of blue coating greatly reduced the consumption of experimental seeds by house sparrows but did not cause a complete avoidance. In the case of canola seeds, we believe that some of the blue coated seeds were accidentally consumed. We found that it was difficult to distinguish the dark blue-coated canola seeds from the natural dark brown ones. Very clear contrast between blue coating and natural color of mixed seeds made it easier for sparrows to select preferred food. Therefore, increasing the contrast on canola seeds would probably further reduce their consumption.

The small amounts of canola seeds consumed in comparison to the mixed seeds and the fact that canola-fed sparrows did not increase their consumption of experimental seeds over time despite loss in body weight, confirm that canola is not the sparrows' preferred diet and this itself had a deterrent effect on sparrows. It is, therefore, possible that under natural field conditions, when alternative food sources are available, and birds are not confined to cages, they

would attempt to search for natural color preferred food.

All the birds offered mixed seeds and five out of six groups presented with canola seeds preferred natural color seeds and maintained their preference throughout the experiments. This suggests that sparrows responded to a change in their environment by avoiding blue-coated seeds and they did not become acclimated to them during the 16-day exposure.

Management implications

Blue-coating (GUARD COAT) has the potential to reduce mortalities in avian species feeding on pesticide-treated seeds. Since it was a first study to evaluate the GUARD COAT, its potential repellency should be tested with migratory avian species. Also, because canola is not commonly consumed by sparrows, it is unlikely that sparrows or potentially other birds would feed on blue-coated canola seeds. This, however, should be further studied under different field conditions.

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