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FLIGHT PEN EVALUATION OF EYESPOT BALLOONS TO PROTECT CITRUS FROM BIRD DEPREDATIONS

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ABSTRACT: The effectiveness of eyespot balloons in discouraging boat-tailed grackle (Ouiscalus major) use of a simulated orange grove was investigated in a series of 4-day trials. The mean distance to the trees of 6-bird experimental flocks was the same with a plain white balloon present as with no balloon. A white balloon with red and black eyespots kept birds at a greater distance from the trees throughout the trial. The presence of a black balloon with orange and yellow eyespots did not repel the birds from the grove. Observations of birds using the area within 1 m of the trees revealed no effect due to the eyespot balloons nor was the number of oranges pecked reduced in the presence of the eyespot balloons. These results were primarily due to a single bird that consistently ignored the white eyespot balloon during the 4-day trial, entered the grove, and avidly pecked the fruit. In combination with other crop protection devices, eyespot balloons may prove effective in deterring bird use of citrus trees.

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INTRODUCTION

Various balloons and balloon-like objects have been tested for use against birds in protecting crops or dispersing roosts, and most have achieved some success (e.g., Hothem and DeHaven 1982, Mott 1985). One variation of this technique that has received only limited attention is the eyespot balloon. In this context, an 'eyespot' consists of a large circle of one color (the 'iris') within which a smaller circle (the 'pupil') is centered. Five or 6 of these eyespot patterns are then spaced evenly along the equator of the inflated balloon which is usually of a contrasting color.

Eyespot patterns in various insects have long been recognized as protective devices (e.g., Blest 1957) which startle would-be avian predators. Experiments involving young chickens (Scaife 1976) and adult European starlings (Sturnus vulgaris) (Inglis etal. 1983) demonstrated that at least some birds display avoidance reactions to eyespot patterns under laboratory conditions. In Japan, Shirota et al. (1983), in apparently the only published account on eyespot balloons as a bird deterrent, reported reduction of damage by gray starlings (Sturnus cineraceus) to grapes, cherries, and peaches on an experimental farm. Their helium-filled vinyl balloon was 2.6 m in diameter, had 5 eyespots with red irises and black pupils, and floated about 15 m above the ground.

A smaller (37 cm diameter) version of the eyespot balloon is marketed by a Japanese company as a bird-scaring device. This product has black, white, or yellow as the background color, and 6 eyespots. The outer diameter of the iris and the pupil are approximately 16 cm and 8.4 cm, respectively. In addition, these balloons have a narrow concentric ring, the same color as the background, separating the iris and pupil. There is also a small, shiny ring in the center of each pupil. From the bottom of the balloon hangs a cardboard square with an eyespot design on each side. Two 50-cm mylar ribbons hang from the card. This balloon is used extensively by agronomists at the University of Florida to protect corn and soybean seedlings in experimental plots from damage by common grackles (Ouiscalus quiscula). boat-tailed grackles, and American crows (Corvus brachvrhychos) (Dr. F. P. Gardner, pers. comm.). Balloons are always used in combination with mylar reflecting tape (Bruggers et al. 1986).

As part of a comprehensive study of great-tailed grackle (Q. mexicanus) predation on citrus fruit in south Texas (Hobbs and Leon 1987), we evaluated the potential usefulness of eyespot balloons as a grackle deterrent. The objectives of this preliminary study were:

1) to determine whether eyespot balloons can reduce boat-tailed grackle use of a simulated orange grove, and

2) to determine the rate of habituation to the balloons.

METHODS

This study was conducted during July-September 1987 in the 0.2-ha flight pen at the Florida Field Station (Daneke 1987). In the southeast corner of the flight pen we established a simulated orange grove. Because suitably large citrus trees were not available, we used 3 to 4-m tall magnolia (Magnolia grandiflora) trees in 150-liter pots. Ten magnolia trees were arranged between naturally occurring wax myrtle (Myrica cerifera) and sweetbay (Magnolia virginiana) trees to create a grove 20 m long and 3 m wide (Fig. 1). During each trial, 24 oranges, attached to short hooked wires, were suspended in the trees 1-2 m above the ground. Maintenance food (Purina Layena Etts(R)) and water were provided in the center of the grove at ground level.

In the northwest corner of the flight pen, maintenance food and water were also available continuously. A tarp suspended 1.5 m above the ground provided shade at this feeding site, and perches were also provided. During

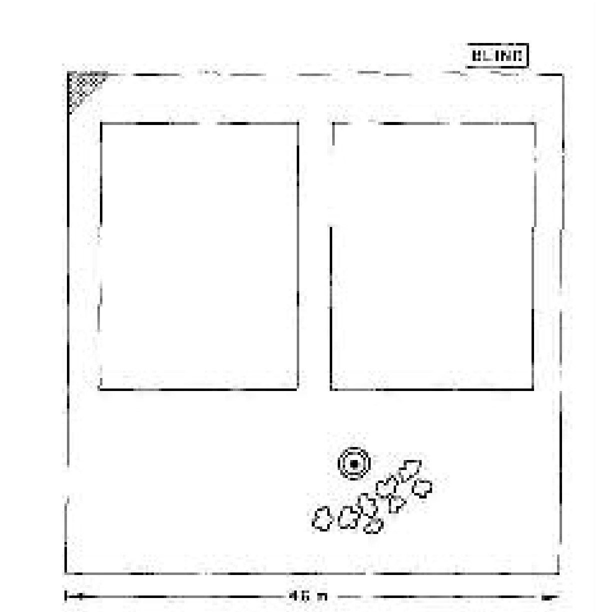

Fig. 1. Locations of eyespot balloon, orange trees and alternate feeding site within 0.2 ha flight pen.

weeks 1-3 of the study, a decoy trap (10 x 1.5 x 1.5 m) was located in the southwest corner of the flight pen (Daneke 1987), and the birds frequently used the roof of the trap as a loafing site. To encourage greater use of the trees and the alternate feeding site, the trap was dismantled at the start of week 4.

Three balloon types were used in the study, 2 custom-made and another of commercial design. The 2 balloons we created were modified multi-colored beach balls. After being inflated (approximately 76 cm diameter), they were painted white. One balloon remained white, while on the other, 5 eyespots were painted along its equator. The iris of the eyespots (outer diameter 24 cm) was painted black, the pupil (outer diameter 18 cm) was painted red, and a central spot (outer diameter 4 cm) was left white. Distance between centers of the eyespots was 48 cm. With this design, 2 eyespots were visible from almost any angle. The other balloon was a commercial Japanese type, as described earlier. It was black with a narrow black ring separating the yellow iris and orange pupil of each of the 6 eyespots.

Each balloon was filled with air and suspended about 3 m above the ground by a short string tied to the end of a bamboo pole. The pole was held at an angle (approximately 60° from the horizontal) in a short piece of pipe driven into the ground. In this way, the balloon was positioned midway along the grove, approximately 3 m from the nearest tree.

The study lasted 8 weeks. During weeks 1 and 2, no balloon was present. The plain white balloon was used in weeks 3 and 4. The white eyespot and black eyespot balloons were deployed during weeks 5 and 6 and weeks 7 and 8, respectively. Each trial lasted 4 days, except for weeks 6 and 7 when personnel shortages necessitated 2-day trials.

A different group of 6 boat-tailed grackles (3 males, 3 females) was used each week. All birds were trapped locally and had been in captivity at least 4 wk prior to use. Each 6-bird group used in the trials had consistently pecked oranges during several days of pre-test screening in its communal holding cage. In weeks 1-4 of the study, test birds were put into the flight pen on the day before the start of the trial. Thereafter, birds were released into the flight pen immediately before the start of the initial day's observations. The balloons and oranges were put in place 10-15 min prior to the start of the observations. After the final observation period in each 4-day trial, the oranges were removed and the number of damaged fruit was recorded.

Initially, observations of bird activity were made each day during 8 30-min periods: 0700-0730,0830-0900,1000-1030, 1130-1200, 1300-1330, 1430-1500, 1600-1630, and 1730-1800. Beginning with week 6, observations were made during 5 periods: 0730-0800,0900-0930, 1130-1200, 1300-1330, and 1600-1630. For each observation period, at 3-min intervals, the locations of all visible birds were recorded on gridded, schematic drawings of the flight pen (Fig. 1). Observers sat in a blind outside the north end of the flight pen, approximately 40 m from the balloon. The observed bird locations were then converted to x,y coordinates and a mean coordinate value for each group was calculated for each 30-min observation period. The mean coordinate values were plotted on a scale drawing of the flight pen and the distances to the grove of trees were measured. The mean distances were then used to determine an average mean for each group. Pairwise comparisons were made between the no-balloon groups and each of the balloon treatments using Lord's range test (Moore 1957, Langley 1971). A similar analysis was made on the proportion of time each group spent within 1 m of the grove. An alpha level of 0.1 was accepted as significant.

RESULTS

With no balloon present, grackles maintained a mean distance of 8 to 14 m from the grove (Fig. 2). Conversely, the mean distance from the trees with the white eyespot balloon was significantly ($P<0.1$) greater, and generally exceeded 20 m. The birds' responses to the plain white and black eyespot balloons were variable, and not measurably different ($P>0.1$) from the no-balloon groups.

Bird use of the trees and the area immediately adjacent varied weekly from 8 to 32% (Table 1). Tree area use was least with the eyespot balloons, but even then it averaged 12-13%. Differences among treatments were not significant ($P>0.1$).

Rank correlation analysis (Spearman's correlation test, Langley 1971) showed no correlation ($P>0.10$) between tree area use and number of pecked oranges (Table 1). This result was largely due to the initial white eyespot balloon trial in which tree area use was relatively low but orange damage was high. Our observations that week suggested that a single male bird (identified by his unique tail feather pattern) was responsible for all of the pecked fruit. He was

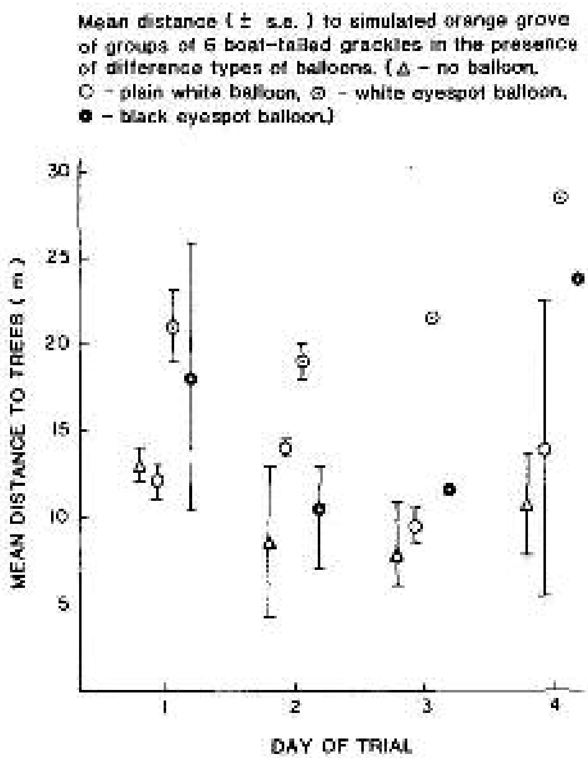

Fig. 2. Results of the balloon study.

the only bird consistently observed using the trees; the other birds seldom came close to the grove. Except for that bird, use of the trees during the week was minimal, and pecking of the fruit inconsequential.

Twice, the test balloon was removed on Day 4 to see if the birds' use of the trees increased in the absence of the stimulus. In the initial white eyespot balloon trial, the balloon was removed after observation period 4. During the next 4 observation periods, the birds' mean distance to the trees was 14.1 m ($\pm$ 8.2 s.e.), considerably less than during any previous day, or during the earlier observation periods that day (Fig. 2). Similarly, bird use of the tree area increased to over 25%, well in excess of that week's mean (Table 1).

On Day 4 of the 2nd trial with the black eyespot balloon, we removed the balloon after 3 observation periods. This manipulation provided no useful information as the birds remained away from the trees (mean distance 38.2 m ± 0.9 s.e.) during the final 2 observation periods. This group used the trees least often of all groups tested (Table 1).

DISCUSSION

Evaluation of the effectiveness of the eyespot balloons is not straightforward. On one hand, the white eyespot balloon kept the birds at the greatest distance from the trees, but 15 of 48 (31%) oranges were damaged (Table 1). On the other hand, the black eyespot balloon was not repellent,

Table 1. Frequency of tree area use and number of damaged oranges (out of 24) by flocks of 6 boat-tailed grackles during trials with different balloon types present.

Balloon	Number of days	Number of periods/day	Percentage of bird observations within 1 m of the trees	Total number of oranges pecked
None	4	8	25 ± 7[b]	3
	4	8	10 ± 3	1
White, no spots	4	8	11 ± 5	0
	4	8	32 ± 7	12
White, eyespots	4	8	11 ± 4[c]	10
	2[a]	5	13 ± 1	5
Black, eyespots	2[a]	5	18 ± 8	4
	4	5	8 ± 1[c]	0

[a] Trial ended after Day 2.
[b] Mean ± 1 s.e. of the daily totals for a given week.
[c] Does not include observations from the last half of Day 4 when balloon was not present.

but only 4 oranges (8%) were pecked with the black balloon in place. Overall, the presence of the eyespot balloons may have increased the mean distance of the birds from the trees (Fig. 2) and reduced the frequency of tree area use (Table 1), but 19 of 96 (20%) oranges were pecked with spotted balloons present compared to 16 (17%) during the 4 trials without spotted balloons.

In assessing the possible usefulness of eyespot balloons to reduce depredations to citrus in the field, it is more appropriate to examine the birds' use of the flight pen area rather than the number of damaged fruit. Even though all of the birds had experience with oranges in their holding cages, most did not peck oranges in the flight pen even when they landed in the trees. In the field, most grackles that enter citrus trees probably do peck the fruit. Eyespot balloons are not intended to deter birds' pecking fruit, but rather to discourage their entering the trees at all. The results of this study suggest that it may be possible to reduce bird use of trees with eyespot balloons.

This project was intended as a preliminary evaluation, not as a definitive study. The findings do indicate that the white spotted balloon affected the birds' behavior. We feel the next step should be evaluation of eyespot balloons at a field site. Field evaluation will be complicated by problems of scale. It is not known how many balloons are needed to protect an orange grove. In one field test, a balloon 2.6 m in diameter successfully reduced bird depredations over approximately 3.5 ha (Shirota et al. 1983). The balloon was helium-filled and floated about 15 m above ground level. Our white eyespot balloon (0.8 m diameter) affected bird use of a grove covering approximately 50 m^2. The specific details (balloon size, style, number, etc.) relating to application of this technique will be best determined through experiments in the field. Although the effect of the white eyespot balloon on birds in the flight pen did not seem to diminish over 4 days (Fig. 2), habituation to a repellent frequently occurs. Thus, any effective field application of eyespot balloons will probably require augmentation by other deterrents, such as shotguns, exploders, or pyrotechnics.

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