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WILDLIFE DAMAGE TO CORN IN SOUTHERN ILLINOIS: ASSESSMENT AND CONTROL

D. Westmoreland
Department of Animal Ecology
Iowa State University
Ames, Iowa 50011
A. Woolf
Cooperative Wildlife Research Laboratory
Southern Illinois University
Carbondale, Illinois 62901

ABSTRACT

In 1981, 2 techniques of controlling deer depredation to corn ears were tested in 24 plots at Union County Conservation Area: (1) HINDER, an odor repellent; and (2) a molasses-based attractant sprayed on plots of native vegetation to attract deer from crops. Ear damage was not significantly ($P > 0.1$) reduced by either technique. Four species of depredators and 1 disease were encountered. Depredator species differed significantly ($P < 0.1$) in importance; bird damage occurred most frequently, raccoons were second in importance, and damage by squirrels and deer was minimal. Losses to disease were also minimal.

INTRODUCTION

Wildlife depredation to agricultural crops is common in the United States, and probably will intensify in the future (Swanson 1970). Many wildlife species inflict damage, but white-tailed deer (*Odocoileus virginianus*) are the most common vertebrate pests (McDowell and Pillsbury 1959). The problem of deer depredation has been studied in many states, including Florida (Stith 1969, Barker 1971), Pennsylvania (Pasto and Thomas 1954), California (Biehm 1951), and Maryland (Flyger and Thoerig 1962). In Illinois, significant depredation sometimes occurs near areas of high deer density such as state parks and refuges; the most commonly damaged crop is corn (D. Westmoreland 1982).

Traditional techniques of controlling depredation include hunting, habitat manipulation, scaring devices, fences, and chemical repellents (olfactory or taste aversive). Unfortunately, the most successful techniques are often the most expensive. In a novel approach, Dasmann *et al.* (1967) used an attractant composed of molasses, salt, and water. When sprayed on native vegetation, the mixture successfully attracted deer away from sensitive areas. Wagnon and Goss (1961) used a similar solution to increase cattle use of rank weeds; however, the technique had not received further attention until now. We compared a molasses mixture and an odor repellent for control of deer depredation to field corn in southern Illinois. Our objectives were (1) to evaluate the effectiveness of the 2 control techniques, (2) to compare the impact of different depredator species, and (3) to investigate the temporal distribution of damage.

STUDY AREA

Experiments were conducted from May through September 1981 at Union County Conservation Area (UCCA), Illinois. The area is a 2500 ha section of the alluvial Mississippi River floodplain (Mohlenbrock 1975). The characteristic lowland flora and plant communities have been described by G. Westmoreland (1982). UCCA is intensively managed for wildlife, with priority given to overwintering Canada geese (*Branta canadensis*). Approximately 1000 ha are planted to corn, wheat, and milo; ¼ of each corn and milo crop is left standing to feed wildlife. As a result of abundant food and infrequent harvest, UCCA sustains large populations of deer and other wildlife species. No control measures are taken against depredating animals.

MATERIALS AND METHODS

During plant emergence, the extent of depredation was noted in all corn fields, and observations of foraging deer were recorded. On the bases of dispersion and intensity of deer use, proximity to native understory, and accessibility, we selected 3 fields for experiments. Field A was composed of 33.1 ha of corn interspersed with 2 23.8-ha strips of weeds. The southern edge was bounded by woods; other boundaries were access roads. Field B (7.1 ha) was bordered on 2 sides by woodlands, and was adjacent to a milo field on its southern edge; an access road formed the eastern boundary. Field C (10.6 ha) was surrounded by open woodlands except on its southern edge, where it was adjacent to a weedy meadow.

We tested the efficacy of the 2 control techniques during the period from ear formation to harvest. The odor repellent, HINDER (Leffingwell Chemical Co., Brea, California), was diluted with 30 parts water and applied at a rate of 3.8 l per plot. This was within manufacturer's specifications. The attractant was prepared by soaking 100 cc of candied molasses (Kandy Kid Dri-Lasses, Harvest Brands, Inc., Pittsburg, Kansas) in 3.8 l of water. After 24 h, the supernatant was separated and used for treatment. On 3 occasions 115 g of salt was added to increase its attractiveness; on 1 occasion a sticker (Vapor Gard, Miller Chemical and Fertilizer Co., Hanover, Pennsylvania) was added to enhance weathering ability. The molasses mixture was applied at a rate of 3.8 l per plot. Treatments were made with an 11.4 l back-pack sprayer (Solo 425 Jet-Pack sprayer), which was thoroughly cleaned between applications. Because of heavy rainfall during ear maturation, frequent resprayings were necessary. HINDER was applied July 9, 17-19, and 26, and August 8 and 30. The molasses was applied July 12 and 22, and August 9, 16-17, and 29.

We used different experimental designs to test the control techniques. A test block for the repellent consisted of 2 25 m^2 plots placed 10 m apart; 1 was randomly assigned treatment status, and the other served as a control. The plots were non-contiguous to allow the odor of treatment to dissipate. Observations of deer near 2 plots treated with HINDER during corn emergence indicated that a distance of 10 m between plots would minimize any effect of odor dissipation (D. Westmoreland 1982). Both plots were placed within 10 m of the field's edge to maximize depredation rates (Harrison 1979). Each test block for the attractant consisted of 4 25m^2 plots; 1 randomly selected pair (1 plot in the outer 10 m perimeter of corn, the other in nearby understory vegetation) served as a treatment, and the other pair as a control. As with repellent blocks, treatment pairs were spaced 10 m from control pairs. The understory vegetation plot of the treatment pair was sprayed with molasses. Its success was judged by the amount of depredation in the corresponding corn plot and by deer use of molasses-treated vegetation. To quantify the latter, a 5 × 0.3 m strip along the corn-adjacent edge of each plot was cleared of vegetation; deer tracks were counted in these strips twice weekly from August 2 through September 9. All plots were established during tasselling. Because they were intentionally placed in areas where depredation was common, the degree of damage per plot did not represent the actual depredation rate in fields. Two repellent and 2 attractant blocks were placed in each field; the blocks were alternated, with a minimum distance of 35 m between them.

Plants damaged prior to the first treatment were marked and excluded from later counts. The extent of depredation was measured by the relative frequency of ear damage per plot; the degree of damage to individual ears was not recorded. Damage assessments were made at 4 and 9 weeks after initial treatment. During the final count, losses were categorized as having been caused by deer (Harrison 1979), raccoons (*Procyon lotor*) (Dolbeer 1980), squirrels (*Sciurus niger* or *S. carolinensis*) (Cardinelle and Hayne 1945), or birds (Cardinelle and Hayne 1945, Dolbeer 1980). Ears lost to disease also were recorded. When plants were broken or ears were removed, we were unable to determine whether deer or raccoons had caused the loss; therefore, damage of this nature was recorded as "undetermined".

RESULTS AND DISCUSSION

Browsing began within 1 week after corn emergence. Usually this had little effect on future growth; however, some plants were lost due to uprooting and trampling. True (1932) suggested that a few deer feeding consistently on emerging plants could cause extensive losses. We observed that deer tended to feed on native vegetation at field edges and browsed emerging corn only intermittently while crossing fields. Deer actively browsed leaves when corn reached a height of about 60 cm, but the damage incurred was seldom enough to retard growth. Deer did cause losses in 1 area where large groups (>10) were observed feeding on several occasions. According to Calhoun and Loomis (1974), the most common form of corn depredation in Illinois is the removal of stalk tops when plants reach 1-1.3 m. Harrison (1979) reported this type of damage on Crab Orchard National Wildlife Refuge; it did not occur in any of our plots.

We examined 2,280 ears for depredation. The average rate of depredation for all plots combined was 26.1%. We used a two-way analysis of variance with Duncan's multiple range test (Helwig and Council 1979) to test for differences between treatments and causes of depredation. The degree of damage per plot was not significantly ($P > 0.1$) different between any of the treatments or controls (Table 1). However, the difference in deer damage between HINDER treatment and control plots approached significance ($P = 0.12$); inadequate spacing of the plots may have interfered with our evaluation of the repellent. The results of these experiments may also have been affected by frequent heavy rainfall during the first half of the season; however, neither technique improved in performance during the drier second half (Table 2).

Surprisingly, track counts indicated that deer used molasses-treated plots less than control plots; the total number of tracks counted was 14 and 31, respectively ($P < 0.05$, t-test for dependent samples, Glass and Stanley 1970). There were no signs of consistent browsing in any of the plots. Because track counts were low and browsing was absent, we consider the difference in number of tracks anomalous.

Our results with molasses contrasted with those of Dasmann *et al.* (1967). Although the mixture used in our study was prepared differently than theirs, it was identical in color, taste, and viscosity to a mixture prepared using their formula. In our tests, the amount of cover sprayed in each field was small (100 m^2); it is possible that deer simply failed to discover the molasses-treated vegetation.

The damage caused by each depredator species is shown in Table 1. Corn smut (Blair n.d.) was the only disease encountered. Disease did not correlate with depredation rate (all species pooled) ($P > 0.05$, $r = 0.09$), so it is unlikely that animal damage predisposes ears to infection. Common grackles (*Quiscalus quiscula*) were the only birds observed feeding on corn. Although birds damaged 10.1% of the ears, they usually destroyed only a few kernels at the tips. Depredators were pooled into 3 groups ($P < 0.1$) on the basis of importance: bird and "undetermined" damage were most frequent; raccoon damage was second; and deer, squirrel, and disease were the least important causes of loss (Table 1). It should be noted that damage classified as undetermined, if properly identified, would raise the values for deer and/or raccoon depredation. There was no significant (P 0.1) interaction effect between treatments and sources of damage, i.e., the relative importance of each depredator did not change between treatments.

We believe that most of the damage included in the undetermined category was caused by raccoons. Undetermined damage was largely comprised of plants with broken stalks. This type of damage began late during ear maturation, concurrent with the onset of raccoon damage. Deer tend to damage corn during the early milk stages of growth (Harrison 1979). Therefore, deer probably contributed little to this category.

Two-thirds of the total ear damage was incurred during the second half of ear development and maturation (Table 2). This estimate may have been exaggerated because the first "half" of the season was actually a period of 4 weeks, whereas the second "half" was 5 weeks. However, this factor alone probably did not cause the difference to be significant. We attribute the high degree of ear damage in the latter half to the onset of depredation by raccoons.

Fundamental to depredation control is the determination of which species cause problems. Because deer are highly visible in fields, they probably are often blamed for damage caused by other species. Our identifications were based on descriptions by other authors (Cardinelle and Hayne 1945, Dolbeer 1980, Harrison 1979). None of these authors mentioned directly observing a depredator inflict damage; all of our attempts at such observations failed. A reliable method of identifying depredators on the basis of their characteristic modes of feeding would be invaluable to technicians dealing with damage situations.

The degree to which deer feed on corn in southern Illinois varies widely. In our plots, deer were not important depredators; in contrast, Harrison (1979) documented a 25% decrease in corn yield from deer depredation on Crab Orchard National Wildlife Refuge. Both of these areas support large deer herds, and are within a 50 km radius. Research into the proximate factors determining the degree of deer use of corn would facilitate effective control.

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Table 1. Frequency of ear damage by 4 species of depredators and corn smut in 24 plots treated with 2 control sprays, Union County Conservation Area, Illinois. Means with the same letter within a row or column are not significantly (P>0.1) different.

Source of damage	HINDER[1]		Molasses[1]			
	Treatment	Control	Treatment	Control	Mean	(SD)
Birds	10.7	9.5	9.1	11.1	10.1[a]	(5.4)
Undetermined (deer or raccoon)	8.3	10.9	8.1	6.3	8.4[a]	(5.6)
Raccoons	2.8	7.7	2.7	5.4	4.6[b]	(5.3)
Deer	0.2	1.6	0.7	0.3	0.7[c]	(1.3)
Squirrels	0.7	0.3	1.1	0.8	0.7[c]	(1.1)
Corn smut	1.2	1.9	1.4	1.4	1.5[c]	(1.7)
Mean	4.0[a]	5.3[a]	3.8[a]	4.2[a]		
(SD)	(5.7)	(6.1)	(4.6)	(5.1)		

[1] Percent of damage (ears/plot)

Table 2. Temporal distribution of depredation to corn ears in 24 plots during the period from silking to harvest, Union County Conservation Area, Illinois. Means with the same letter within a row or column are not significantly (P>0.1) different.

Test period	HINDER[1]		Molasses[1]		
	Treatment	Control	Treatment	Control	Mean
First 4 weeks	6.2	10.5	6.1	8.2	7.8[a]
Final 5 weeks	16.4	19.5	15.5	15.7	16.8[b]
Mean	11.3[a]	15.0[a]	10.8[a]	12.0[a]	