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Effectiveness of Flagging and Propane Cannons to Disperse Canada Geese in Winter Wheat Fields

Abstract
We conducted a study to evaluate the efficacy and cost-effectiveness of propane cannons and flagging to reduce or eliminate Canada goose damage to winter wheat. Our preliminary results indicate that propane cannons and flagging offer cost-efficient, non-lethal options for protecting winter wheat from Canada goose damage. Propane cannons seem to be more effective than flags and may be recommended by Extension professionals where applicable and in situations where crop losses exceed the cost to purchase and operate a propane cannon.

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Introduction

Canada goose (*Branta canadensis*) populations have increased dramatically in the Atlantic Flyway during the last 50 years, primarily due to large increases in nonmigratory, resident Canada goose populations (Atlantic Flyway Council, 1999; Castelli & Sleggs, 2000). Among the associated problems resulting from increased goose numbers are grazing and trampling damage to agricultural crops ranging from grain and forage to turf (Conover & Chasko, 1985; Flegler, Prince, & Johnson, 1987). Although " on-the-ground" studies to quantify goose damage to agriculture are lacking in many Atlantic Flyway states, statewide estimates of damage vary from $8,400 to over $1 million annually (United States Fish and Wildlife Service, 2002).

In an attempt to reduce or eliminate nuisance geese and associated problems, many lethal and non-lethal management practices have been tried. While lethal management is necessary to reduce goose numbers in overpopulated areas and manage populations, the effectiveness of lethal options may be limited due to public opposition, safety concerns in areas with large human populations, and local ordinances (Conover & Chasko, 1985; Heusmann, 1999). A range of non-lethal control techniques is also available. However, non-lethal management practices can have variable and relatively short-term effectiveness or applicability (Cleary, 1994).

An additional disadvantage of all lethal options and many of the non-lethal techniques is the requirement of human presence to employ the management practice. For example, only when a human is present to shoot them off are frightening devices like screamer or banger shells effective (Aguilera, Knight, & Cummings, 1991). Due to farm responsibilities, many farmers are not available to consistently implement management options that require regular attention for maximum effectiveness. Available options that don't require constant human presence include exclusion practices, repellents, and frightening devices like propane cannons and flagging. However, exclusion options and repellents may not be cost-effective for large areas like agricultural fields.

The effectiveness of propane cannons and flagging has not been evaluated for dispersing Canada geese from winter wheat fields. Therefore, the objective of our study was to evaluate the efficacy and cost-effectiveness of propane cannons and flagging to reduce or eliminate Canada goose grazing damage to winter wheat.

Methods

We selected four winter wheat fields in Somerset County, New Jersey, as the study area. All fields were approximately 3 acres and were far enough from each other to prevent interference between locations when the propane cannons detonated. We did not replicate the study because of the difficulty of finding a suitable number of fields in central New Jersey with similar characteristics spaced far enough apart to avoid interference with one another.

Winter wheat was grown on all of the fields, using identical wheat varieties and cropping practices. A visual count at each site prior to employing any harassment method was conducted at different times of the day over a period of 2 weeks to ensure that a relatively constant number of geese occupied each site.

We randomly assigned one field to serve as the control, and randomly assigned one of three treatment methods to the remaining fields. A treatment method consisted of flagging, a propane cannon, or a propane cannon and flagging.

Flags consisted of 35-gallon, black plastic trash bags that were stapled to a wooden post. Each flag was stapled to the post so the top of the flag was about 5 feet above the ground. We drove the wooden posts into the ground at a slight angle to ensure movement of the flags even in the slightest wind. We used four flags per acre.

The propane cannons were M8 Multi-bang cannons with rotating bases manufactured by Reed-Joseph International Company. Six bangs were produced within a 90-second duration, and we set the timer so 6 bangs were produced every 4 to 14 minutes. We changed the timer setting at least twice per week. Each cannon was placed in the center of the treatment field.

We visited each field two to three times per week, with at least 2 days between each visit, during December 2000 and January 2001. Each time a field was visited, we randomly threw a 3-foot by 3-foot square constructed of PVC three times per field. Within the square, we counted the number of goose droppings to monitor goose presence and recorded wheat height to assess efficacy of treatment methods relative to the control field.

Our study was the basis for an undergraduate independent research project, and therefore, we were operating on a contracted data collection schedule to conform to the academic year. Due to this contracted schedule, we were unable to maintain the project until the fields were harvested and we could measure yield in bushels per acre. Instead, we measured wheat height as a proxy for grazing damage, with the assumption that the fields with shorter wheat height experienced a greater amount of grazing pressure.

For each field, we averaged the weekly data for wheat height and goose droppings. We analyzed the data using a Wilcoxon signed-rank test ($P = 0.05$) to determine if there were differences in average weekly wheat growth and goose droppings between the treatment and control fields. We also performed Pearson's correlation analysis to examine the relationship between wheat height and number of goose droppings in each field.

Results

Average weekly wheat growth differed ($P = 0.05$) for all treatment fields compared to the control field (Table 1). The two treatment fields containing a propane cannon demonstrated the greatest average weekly and total wheat growth over the duration of the study period.

Table 1.
Average Weekly Winter Wheat Growth, Total Winter Wheat Growth, and Range of Weekly Winter Wheat Growth for a Control Field and Three Treatment Fields in Somerset County, New Jersey

Field	Average Weekly Wheat Growth (Inches)	Total Wheat Growth (Inches)	Range of Weekly Wheat Growth (Inches)
Control	-0.03	-0.1	0.55 - 1.27
Treatment: Flags	0.03	0.2	0.59 - 1.66
Treatment: Flags/Cannon	0.2	1.2	0.78 - 2.54
Treatment:	0.2	1.5	1.48 - 3.28

Cannon			

Compared to the control field, number of goose droppings differed (P = 0.05) for the treatment field containing flags and the treatment field containing flags and a cannon (Table 2). The average number of droppings counted within the 3-foot by 3-foot square in the control field equaled 1.89. The average number of droppings in the flag field and flag and cannon field equaled 0.78 and 0.56, respectively.

Table 2.
Average Number of Canada Goose Droppings in a Randomly Selected 9-Square-Foot Area for a Control Field and Three Treatment Fields in Somerset County, New Jersey

Field	Average Number of Canada Goose Droppings	Range of Canada Goose Droppings
Control	1.89	0 - 3
Treatment: Flags	0.78	0 - 1
Treatment: Flags/Cannon	0.56	0 - 1
Treatment: Cannon	1.56	0 - 4

There was no relationship (r = 0.06) between wheat height and number of droppings in the control field. The treatment fields containing the cannon (r = 0.22) and flags and cannon (r = 0.41) showed a weak positive correlation. The treatment field containing flags (r = 0.69) showed the strongest positive correlation between wheat height and number of goose droppings.

Discussion

Flagging and propane cannons seemed to offer effective non-lethal management options for reducing Canada goose damage to winter wheat, as evidenced by significantly greater growth in treatment fields relative to the control field. However, our results are preliminary, and we suggest that further research be done to validate our results. Specifically, we recommend conducting a replicated study using more frequent sampling for goose droppings. Furthermore, measuring bushels of harvested wheat per acre to monitor goose damage to winter wheat would be valuable.

The treatment fields containing a propane cannon exhibited the greatest winter wheat growth during the study period. We attribute significant winter wheat growth in the field containing flags and a cannon, relative to the control field, more to the effectiveness of the cannon than the flags. We make this attribution because wheat growth in the treatment field containing a cannon and flags was comparable to wheat growth in the treatment field containing the cannon rather than wheat growth in the field containing only flags.

We suggest that cannons demonstrated greater effectiveness than flags in our study for a number of reasons. First, flags achieve maximum effectiveness only when sufficient wind is present to move each flag. Cannons detonate repeatedly and consistently according to the timer setting. Second, random operation of the cannons appeared to discourage habituation by geese. Each cannon was mounted on a rotating base so they would fire in a different direction every time they detonated. Furthermore, we were unable to leave the cannons on 24 hours per day during the study due to noise disturbance to nearby residences. This resulted in the cannons being turned off near sunset and turned on near sunrise each day. However, we did not turn the cannons off and on at exact times each day because of scheduling difficulties, thereby reinforcing the randomness of the cannons, and most likely, adding to their effectiveness.

However, flagging seemed to be better than no-harassment method. Although flagging may lose its effectiveness due to habituation by geese (Cleary, 1994), our 9-week study demonstrated that flagging might be effective in reducing winter wheat damage by Canada geese, at least in the relative short-term. Furthermore, flagging provides a cheaper alternative than propane cannons. A per-acre cost to operate one propane cannon based on maximum field coverage (10 acres) equaled about $72 per acre. In contrast, a field could be flagged for about $6 per acre.

Goose presence was evident in all fields involved in our study based on goose defecation. However, correlation between goose droppings and wheat height was misleading. We discovered no correlation between goose droppings and wheat height in the control field and weak to strong

positive correlations between droppings and wheat height in the treatment fields. Based on greater wheat height in the treatment fields compared to the control field, we would have expected a negative correlation in the treatment fields between goose droppings and wheat height and a positive correlation in the control field.

Furthermore, the treatment fields containing the cannons had the greatest average weekly and total wheat growth of any of the fields, conceivably because geese were not grazing on the wheat to the extent they were in the control field and treatment field containing flags. Therefore, we would have expected the correlation between goose droppings and wheat height in the treatment fields containing the cannons to be strongly negative. Similarly, we would have expected the correlation between the two variables in the treatment field with flags to be at least weakly negative.

A couple of explanations may aid in understanding the correlation results. First, goose droppings may have come from geese resting in the fields but not actively feeding. Frederick and Klass (1982) observed that geese spend large blocks of time resting in winter wheat fields. Alternatively, sampling error may explain the seemingly contradictory correlation results. We randomly threw the 3-foot by 3-foot square three times per field per visit. We may not have thrown the square a sufficient number of times per visit to get a representative sample of goose droppings in each field. The number of times we threw the square per field was sufficient to get a representative sample of wheat height because the wheat was relatively uniform in height within the square and throughout the field. Our height measurements did not differ noticeably prior to averaging the measurements. Goose droppings, on the other hand, are more stochastic.

Frequently, Extension agents and specialists are contacted as a first resource to assist farmers with reducing wildlife depredation to agricultural crops. Our preliminary results indicated that propane cannons and flagging might offer cost-efficient options for protecting winter wheat from Canada goose damage. Propane cannons seemed to be more effective than flags and may be recommended by Extension professionals where applicable and in situations where crop losses exceed the cost to purchase and operate a propane cannon.

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