PHYSICAL MANAGEMENT OF PEST BIRDS IN AGRICULTURAL SETTINGS

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Introduction

Since their introduction to the east coast of the United States in the early 20th century, European starlings (*Sturnus vulgaris*) have become an invasive, non-native species causing high-impact economic and ecological damage. Originally, only 16 starlings were brought into North America to provide immigrants with a remnant from their homeland and to control insect populations. However, the starling population rapidly expanded and there are now estimated to be over 200 million starlings in North America (Linz et al. 2007). During certain seasons, specifically fall and winter, the presence of starlings on livestock and crop management operations increases due to the lack of available resources for starlings in their natural environment.

Flocks containing thousands of pest birds can be seen on a farm at any given time. For example, in the mid-1980s, 59–20,000 starlings were counted on various sunflower fields in Ohio over the span of three months (Bruggers et al. 1986; Dolbeer et al. 1986).

Across the United States, crop farms that grow vegetables or grain incidentally provide food opportunities in the winter in the form of winter vegetables or residual post-harvest products, while livestock operations provide feed and desirable roosting habitats (Figure 1).

Figure 1. Photograph of pest birds flying over a livestock farm in Eastern Washington.
*Photo taken by Heather Young, Washington State University.

Easily accessible roosting sites encourage pest birds to nest, which leads to defecation throughout the property and subsequent damage to fences or walls because of the acidity in their feces. In addition, disease transmission on farms and dairies are a concern because fecal matter can contaminate crops and the feed consumed by livestock. To prevent this invasive species' destructive behavior, deterrent and exclusionary strategies are implemented, often with no success, illustrating the need for more efficient and economically sound methods.

Economic Impact

Not only do producers invest money into deterrent strategies and damage restoration projects, they also lose income from the destruction birds cause on agricultural crops. Various crops are readily available each season, providing an easily accessible food source for birds, especially because they do not have to forage for food and can migrate between farms (Bailey 1966).

Lettuce, pistachios, rice, and walnuts are less affected by the foraging damages caused by pest birds, because they are more difficult to consume and digest and are not part of the starlings' normal diet. Starlings are more attracted to the fructose that is provided in fruits such as blueberries, cherries, grapes, and apples, hence higher estimated damages on these farms (Fischl and Caccamise 1987).

For crops with long growing seasons (such as apples), Anderson et al. (2013) estimated a loss of $50–$200 per acre for apple crops. Nevertheless, seasonal crops with a concentrated harvest like blueberries can have an estimated loss ranging from $1000–$5000 per acre, shown in Figure 2 (Anderson et al. 2013). Although the estimates for economic damage are based mostly on consumption, product losses also account for crops that are partially consumed, have fallen on the ground, or have become contaminated by fecal matter. Monetary losses include the money spent on pest bird deterrents that may cause more harm than good.

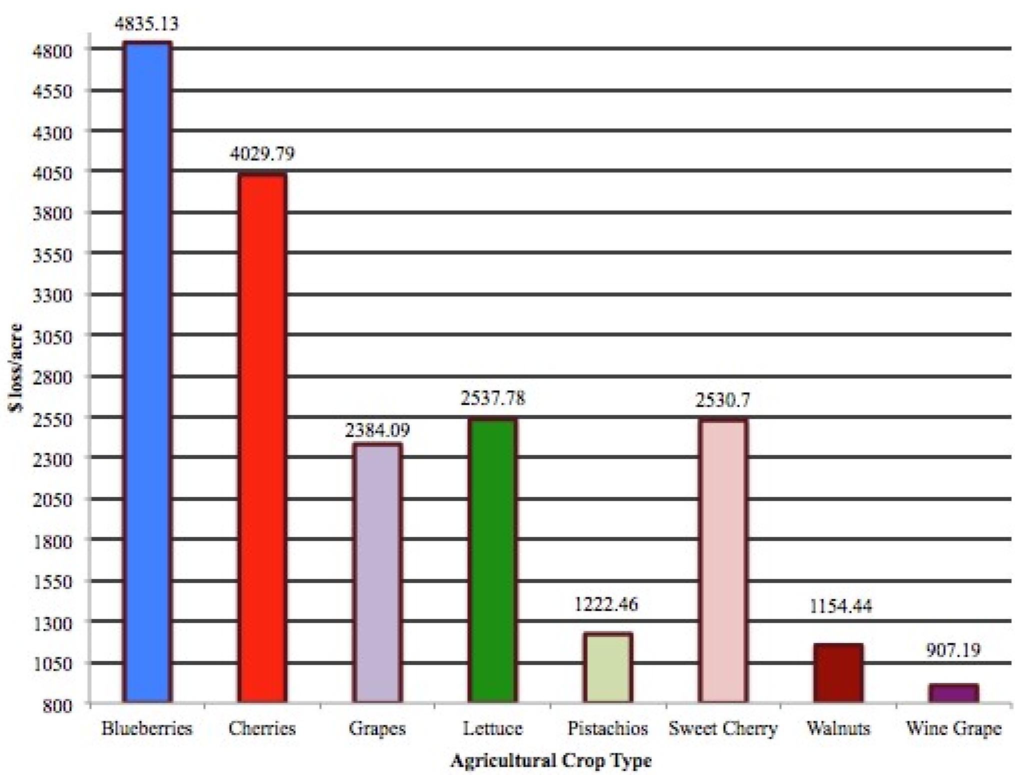

Figure 2. Money lost per acre on various agricultural crop operations.
*Sources: Anderson et al. 2013; Gebhardt et al. 2011; USDA 2015.

On dairy and livestock farms, starlings have also caused damage by consuming livestock feed (Figure 3). The nutritional content and texture of grains provide starlings with supplemental feed, minimizing their need to search for invertebrates during winter months (Glahn and Otis 1986).

Structural damage also occurs on livestock operations because starling roosts damage property, and the structural material of livestock housing facilities corrode over time from acidic fecal droppings (Doroudiani and Omidian 2010). Figure 2 illustrates the monetary loss per acre various agricultural operations endure due to damages caused by the presence of starlings (Anderson et al. 2013; Gebhardt et al. 2011; USDA 2015).

Figure 3. Photograph of pest birds in cattle feed.
*Photo taken by Tyler Caskin, Washington State University.

Transmissible Diseases

One additional concern of pest bird presence on fruit farms, dairies, and feedlots, is the spread of disease. Starlings, for example, are known to be vectors of *Escherichia coli* O157:H7, *Campylobacter* spp., and *Salmonella* spp. (Carlson et al. 2011; Medhanie et al. 2014). Birds can disseminate these disease-causing organisms onto fruits, which are consumed by other animals.

For example, outbreaks of *E. coli* O157: H7 in humans have been linked to the consumption of unpasteurized apple cider and juice. These cases occurred as a result of contaminated apples being used in the cider and juice, even though proper washing techniques were observed (Cody et al. 1999). Animal fecal matter, including from pest birds, is one possible cause of apple contamination (Duffy and Schaffner 2002).

Dairy and livestock producers are concerned about disease transmission to their cattle, because it could lead to animal illness, suffering, and death, as well as associated economic losses. Starlings and other pest birds have been implicated as a potential route of transmission of diseases to the cattle (LeJeune et al. 2008). These are concerns not only for farmers, but also for consumers, because there is a risk of transmission through consumption of contaminated food products. For example, although there is little concern about disease transmission through pasteurized milk, unpasteurized milk is becoming more popular and, thus, the risk of transmission to humans through unpasteurized dairy products has increased (Van Kessel et al. 2011). There is also concern for people who work, or live on, dairy farms because they have an increased risk of acquiring disease (Gilpin et al. 2008).

Deterrent Strategies

Physical deterrents are common methods used by farmers to deter pest birds from farms and have shown various levels of effectiveness (Table 1). For example, Dolbeer et al. (1986) showed reflecting tape was effective at deterring blackbirds from corn fields. However, reflecting tape has also been shown to be ineffective at protecting both blueberry crops and millet fields because birds can become habituated to the tape, and the tape can become entangled in vegetation (Bruggers et al. 1986; Tobin et al. 1988).

Table 1. Effectiveness of Physical Deterrence Strategies for pest bird species.

Deterrence Strategy	**Crop**	**Effective (Yes or No)[a]**	**Climate/Geographic Region**	**Monoculture/Diverse**
Reflecting tape	Blueberries[1]	No	Warm/Humid	Unknown
Reflecting tape	Corn[2]	No	Humid/Marshlands	Unknown
Reflecting tape	Corn[3]	Yes (10.9–14%)	Unknown	Unknown
Reflecting tape	Millet[2]	No	Unknown	Diverse
Reflecting tape	Millet[3]	No	Unknown	Unknown
Reflecting tape	Sunflower[2]	No	Unknown	Unknown
Eye spots	Grapes[4]	Yes (7.4%)	Temperate	Monoculture
Eye spots	Grapes[5]	Yes	Temperate/Coastal	Monoculture
Introduced falcons	Grapes[6]	Yes	Temperate/Coastal	Unknown
Falconry	Strawberries[7]	Yes (50–100%)	Hot/Coastal	Unknown
Falconry + helium balloons	Strawberries[7]	Yes (65–100%)	Hot/Coastal	Unknown
Peaceful Pyramid	Grapes[4]	Yes[b]	Temperate	Monoculture
Plastic netting	Cherries[8]	Yes (~75–80%)	Moderate	Diverse

	Blueberries[8]	No	Unknown	Unknown
Raptor kites	Grapes[9]	Yes[c]	Hot/Dry	Unknown
	Corn[10]	No	Temperate/Coastal	Unknown
	Cabbage[11]	Yes (~27%)	Cold/Temperate	Diverse
Gas bangers	Cabbage[11]	Yes (~11%)	Cold/Temperate	Diverse

[a]The percentage of reduction in damage, if known, is in parentheses for each deterrence technique that was deemed effective.
[b]The Peaceful Pyramid was only effective the first six days of treatment. [c]Raptor kites were only effective if they were not hidden behind trees or other vegetation.
Sources: [1]Tobin et al. 1988; [2]Bruggers et al. 1986; [3]Dolbeer et al. 1986; [4]Fukuda et al. 2008; [5]McLennan et al. 1995; [6]Kross et al. 2011;
[7]Daugovish and Yamamoto 2008; [8]Curtis et al. 1994; [9]Hothem and DeHaven 1982; [10] Conover 1983; [11]Fazlul Haque and Broom 1985.

There are some promising physical deterrent techniques used in agriculture. For example, the use of falconry and the introduction of native falcons have been shown to be effective in grapes and strawberries (Daugovish and Yamamoto 2008; Kross et al. 2011). In addition, eye spots (concentric circles painted on helium balloons) have been shown to be effective in grape vineyards and have been shown to increase the effectiveness of falconry in strawberries (McLennan et al. 1995; Daugovish and Yamamoto 2008; Fukuda et al. 2008). The next futuristic step in physical deterrent strategies includes the use of drones. Drones emit audio recordings along a determined route to repel pest birds. Primarily used at airports, drones are easily programmed to maneuver around vineyards and other agricultural environments (Grimm et al. 2012).

Conclusion

Pest birds, notably starlings, cause economic damages to fruit farms, dairies, and livestock operations through disease transmission, crop damage, and structural damages. Although farmers use various physical deterrent strategies, these measures are often ineffective at deterring birds completely. There are some physical deterrence methods that have shown some promise of being effective and cost efficient (e.g., falconry and eyespots). However, the research is limited on whether these methods are effective for every crop farm or livestock facility. Therefore, it is imperative that effective and economically efficient deterrence strategies are developed, tested, and implemented to reduce the presence of pest birds on farms.

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