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Prevalence and amount of feral swine damage to three row crops at planting

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ABSTRACT

Feral swine damage to corn, cotton and peanut crops at planting was assessed for 46 fields in Alabama. Damage was assessed on the basis of prevalence among fields and the quantity lost within each damaged field. Feral swine control by professionals dedicated to that task appeared to greatly reduce the prevalence of damage among fields, as the 14 fields which were within the areas where professional swine control operations took place were not damaged. For the 32 fields not receiving such protection, seven (21.9%) received some level of damage. Of those, 40% (four of 10) peanut fields, 15.4% (two of 13) cotton fields, and 11.1% (one of nine) corn fields were damaged. Damage levels were highly variable, both between and within crops. Losses were typically low < 1.3%, but there were very notable exceptions where more substantial losses were incurred. One peanut field experienced a loss of 54.2% representing 32,401 kg of crop lost, valued at $15,779. Feral swine damage to freshly planted row crops has previously received little, if any, in-field quantification in the literature, with this study possibly being the first of its kind.

1. Introduction

Feral swine (*Sus scrofa*; other common names include wild boar, wild/feral hog, and wild/feral pig; Keiter et al., 2016) are destructive invasive animals in North America. Their presence on the continent can be traced to introductions by early European explorers, beginning in 1539 with introductions by the Spanish explorer Hernando de Soto in Florida (Towne and Wentworth, 1950). Many deliberate and inadvertent introductions have ensued over the years (Belden and Frankenberger, 1977; Mayer and Brisbin, 1991; Towne and Wentworth, 1950), and now invasive feral swine populations are found in at least 35 of the 50 states in the USA (Corn and Jordan, 2018; Snow et al., 2017; U.S. Department of Agriculture, 2016). Globally, feral swine also are one of the world's most destructive invasive species, thereby earning their inclusion as one of the 100 “World's Worst” invaders by the IUCN Invasive Species Specialist Group (Lowe et al., 2004). They are infamous for their damage to native plant and animal species, habitats, as well as archaeological sites (Choquenot et al., 1996; Engeman et al., 2007, 2013a, 2016, 2017; Seward et al., 2004; U.S. Department of Agriculture, 1999, 2015, 2016). They also carry diseases transmissible to livestock, wildlife, or humans (e.g., Corn et al., 2005; Leiser et al., 2013; U.S. Department of Agriculture, 2015, 2016; Wyckoff et al., 2009). Making matters worse, feral swine have the highest reproductive potential of all large wild mammals in North America, matching their destructive capabilities with their reproductive vigor (Bieber and Ruf, 2005; Hellgren, 1999; West et al., 2009; Wood and Barrett, 1979).

Crop losses form one of the primary damage issues posed by feral swine (e.g., Seward et al., 2004; U.S. Department of Agriculture/Animal and Plant Health Inspection Service, 2015), with the most commonly damaged field crops including corn, peanuts, grain sorghum, wheat, oats, sugar cane, and rice, among many others (U.S. Department of Agriculture/Animal and Plant Health Inspection Service, 2015). Collectively, states with a confirmed feral swine population account for 60–80% of row crop production in the US (NASS, 2014). Crop fields offer high concentrations of highly digestible plants, and often become a highly preferred source of food for feral swine (Ditchkoff and Mayer, 2009). Feral swine may travel considerable distances for such desirable foods, having been found in one study to travel nearly 10 km to feed on sorghum (Mungal, 2001). Near croplands, feral swine densities can be fourfold higher than they would have been otherwise (Caley, 1993). Agricultural crops have been found to comprise as much as 71% of plant material consumed by feral swine (Mayer and Brisbin, 2009). Crops adjacent to riparian areas, a preferred habitat for feral swine, are particularly prone to being damaged. Damage is produced by consumption, rooting, digging, and trampling of crops (Seward et al., 2004).

Most information generated on crop losses to feral swine has originated as a result of surveys of farmers/producers across various geographic scales where producers have answered questionnaires about feral swine impacts to their crops (e.g., Anderson et al., 2016; Mengak,

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2012, 2016; NASS, 2018a; Ober et al., 2011). For example, in one of the most comprehensive surveys on feral swine damage, Anderson et al. (2016) recently found that the highest yield loss estimates were in peanut and corn production in Texas and the Southeast. Within-state surveys have produced comparable results. A survey in Texas found that the most common (75%) issue with feral swine was damage to agricultural crops including hay, corn, peanuts, and small grains like milo, rice, and wheat (Rollins, 1993). Respondents to a questionnaire in Georgia averaged $12,646 per respondent in crop losses by feral swine during 2011 (Mengak, 2012) and $6780 in 2015 with total crop losses for the state estimated as $98, 870, 961 (Mengak, 2016), and in 2009 feral swine damage losses across 29 counties in northern Florida were estimated at $314,739 for corn, $327,943 for cotton, $1,151,178 for peanuts, and $30,815 for soybeans (Ober et al., 2011).

Actual in-field damage measurements are comparatively uncommon as they require a substantially greater investment in resources, labor, and coordination with farmers. Hence, there are relatively few studies that measure crop losses to feral swine over a number of fields, especially encompassing multiple crops. Even rarer seem to be quantifications of losses to feral swine at planting, and this may be the first presentation of such data. We examined 46 fields to provide information on: 1) the prevalence of feral swine damage to freshly planted fields of corn, cotton, and peanuts, and 2) measures of the amounts of damage when it occurs.

2. Methods

2.1. Crop fields

Forty-six fields from three counties (Coffee, Dale and Henry Counties) in Alabama were examined for feral swine damage at planting. Fields ranged in size from 1.4 to 56.8 ha ($\bar{X}$ = 15.1 ha, SE = 1.6 ha). Three crops were represented among these fields: corn (10 fields), cotton (25 fields), and peanuts (11 fields). Of the 46 fields, 14 were subject to protection by feral swine removal conducted by U.S. Department of Agriculture/Wildlife Services (WS), the Federal agency responsible for managing conflicts with wildlife (U.S. Department of Agriculture/Animal and Plant Health Inspection Service et al., 1997). Agreements with WS to provide feral swine control were formed because of past history of feral swine damage in those areas. Of these protected fields, one was planted with corn, two with peanuts, and 11 with cotton. Thus, the fields receiving protection through feral swine control would presumably be inherently more susceptible to receiving damage due to their past damage histories. WS controlled feral swine using only approved and humane methods to euthanize animals that conformed to the guidelines laid out in the 2000 Report of the American Veterinary Medical Association Panel on Euthanasia (American Veterinary Medical Association, 2013) and set forth as agency policy in USDA/APHIS/WS Directive 2.505. The two primary methods applied to remove feral swine were trapping and sharpshooting.

Feral swine damage to each crop was quantified in two ways: 1) the prevalence of damage among protected and unprotected fields of each crop, and 2) the amount of damage within each of the fields with damage.

Considering that the fields at planting are essentially bare soil without vegetative cover, feral swine rooting along the rows is readily detectable. After crops have been planted, damage can occur on any given day, with the chance of damage to planted seeds reduced as the plants grow. Discussions with farmers indicated that the majority of planting-time damage occurs in the first 10 days to two weeks after planting, and some damaged sections in fields may be replanted during that time period if damage is severe. Thus, there was a potential for some information to be lost if damage was measured only once post-planting. Each field was observed twice to assess how quickly planted fields were damaged, whether or not farmers felt the need to replant, and to assess if replanting actually overcame the damage. As coordination with farmers' schedules allowed, damage assessments were targeted for five and 10 days post-planting, although timing of observations required flexibility due to the logistics of observing a large number of fields in three counties and communication with farmers on planting schedules.

Observations on whether or not each field had been damaged provided information on the prevalence of damage among protected and unprotected fields of each crop type. The prevalence of damaged fields was compared among the three crops using Fishers “exact” test.

2.2. In-field damage sampling

The general concept for determining damage levels for the rooted fields was to estimate the total length of all rows combined, measure all damaged crop row segments in the field, and sum those damage lengths into a combined value for the field. The combined damage segment lengths divided by the estimated combined lengths of all rows in the field provided an estimate of proportion of crop lost (also described in Engeman, 2017). Estimation of the total combined length of all rows in a field required basic information concerning the field size and row spacing. The area of each field was defined by riding the field's perimeter on an all-terrain vehicle (ATV) while a GPS mapped the field and ultimately calculated its area. Dividing the row width into the field area provides an estimate of the total combined lengths of all rows (this avoided measuring the lengths of all rows in the field).

Locating damage was accomplished by searching for damage while slowly driving the perimeter of the field, with damage readily visible in the bare soil of the fields after planting. Each time damage was located it was measured and the length of each row segment of rooting damage was recorded. After all damaged segments in the field were recorded, they were summed to arrive at the total row length rooted in the field. It was also noted if the field had been replanted. If a field was replanted between assessments and further damage occurred in the replanted field, then this was recorded too. The proportion of the field damaged was calculated as the summed length of all damage segments divided by the total combined lengths of all rows in the field. If the field had not been replanted, then the damage proportion at the second assessment represented the cumulative damage to that point. If the field had been replanted (and assuming no further replanting occurred after the second assessment), then the damage at the second assessment represented the proportion of the field that could not grow and eventually be harvested, but the cumulative damage that had taken place to that point was the combined damage at the first and second assessments.

3. Results

The prevalence of damage to fields among crops, and whether or not they were in areas receiving control by WS are summarized in Table 1. Over all crops, seven of the 32 fields (21.9%) not within areas protected by WS feral swine control experts received some level of damage. None of the 14 fields within areas receiving WS control received damage. With four of 10 fields damaged, peanut fields were much more likely to have received damage than fields planted with corn (one of nine) or

Table 1
The prevalence of feral swine damage at planting to fields with corn, cotton and peanuts in areas with and without feral swine control by U.S. Department of Agriculture/Wildlife Services in three Alabama counties.

Crop	Protected by control		Not Protected by control		Total
	# Damaged	# Undamaged	# Damaged	# Undamaged	
Corn	0	1	1 (11.1%)	8	10
Cotton	0	11	2 (15.4%)	11	24
Peanut	0	2	4 (40.0%)	6	12
Total	0	14	7 (21.9%)	25	46