Trialing DeerPro Spring & Summer and Plantskydd Repellents to Control White-tailed Deer Depredation of Soybeans

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Introduction

In areas with high white-tailed deer densities, damage to field crops through feeding, trampling and bedding can reduce harvestable yields. Research has suggested that crop losses to deer greater than 10%-15% of the total crop or $20 per acre are viewed as significant and requiring remedy by Michigan producers and hunters (Fritzell et al., 1995). Parts of Northern Lower Michigan and the Upper Peninsula have been identified as areas of special concern for white-tailed deer management due to deer population densities above DNR goals and the high prevalence of crop depredation (MDNR, 2010). Damage to soybeans has become problematic for growers in in the region as production of the crop has expanded to approximately 67,000 acres.

Soybeans are a favorite food of white-tailed deer, meeting their dietary requirements all season long (Colligan, 2011). Substantial defoliation by deer (>30%) prior to the V6 growth stage can significantly reduce soybean yields (DeDecker, 2018; Garrison and Lewis, 1987). On the other hand, mild or passing damage has been shown to increase soybean yield in some cases by stimulating additional branching and pod set (Rogerson et al., 2014). Deer damage is more likely in small fields with a high proportion of forested edge (Braun, 1996). Research conducted in the region during 2015 recorded early season defoliation in soybeans ranging from 0 to 87.5%. Deer browsing significantly reduced soybean yields that year. Yield loss at the field scale ranged from 0% to 100%, averaging 10% or 3.89 bushels per acre (DeDecker, 2016).

Chemical repellents are one tool available to growers for controlling wildlife crop damage. They are uncommon in commodity production systems due to the low value and expansive acreage of crops like corn and soybean relative to the high cost of many repellent products. However, repellents may still offer advantages over traditional control options like fencing or shooting. For example, field crop producers are accustomed to controlling pests via chemical means, and use of a deer repellent spray would therefore be familiar and offer a measure of efficiency. Repellents are also viewed as an ethical alternative to lethal control by some, and could potentially help growers avoid conflict with stakeholders like landlords and neighbors that sometimes oppose lethal controls.

Deer repellants vary greatly in their composition and effectiveness. Repellant products can be classified into two different groups, area repellants and contact repellants. Area repellants are applied on or around the plants desired to be protected, using odors to repel deer. Examples of area repellants considered effective for white-tailed deer are putrescent egg solids, ammonia soaps of higher fatty acids, predator urine, blood or meat meal, human hair, and bar soap. Effectiveness of these products is variable, typically ranging from 15-43% effective (Hillock et al., 1991). Putrescent egg solids and blood/meat based repellents are among the most effective products available (Trent et al., 2001).

Putrescent egg solids have been used successfully as a deer repellent, and included as an active ingredient in several commercial repellent products. Decomposing eggs emit a sulfurous odor that is thought to mimic the smell of predator urine and thus discourage deer from browsing on treated foliage. In one trial, Deer Away™ Big Game Repellent powder, containing 36% putrescent whole egg solids, outlasted nineteen other repellent products, preventing deer damage to Western red cedar seedlings for fifteen weeks (Trent et al., 2001). DeerPro™ Spring & Summer manufactured by Great Oak Inc. is another commercial repellent product containing 2.6% putrescent egg solids, plus capsaicin. In a

2016 study by Clemson University, DeerPro significantly reduced deer damage to soybeans relative to an untreated control and other repellent products. In 2017 and 2018, MSU Extension Presque Isle Co. trialed DeerPro Spring & Summer as a means of reducing deer depredation of soybean. In 2017, the treatment significantly reduced depredation and yield loss at one location, but failed to do so at a second location (DeDecker and Tollini, 2017). In 2018, an early application of DeerPro Spring & Summer was paired with a later application of DeerPro Winter, a contact repellent containing thiram, a combination that did not perform as well (DeDecker and Tollini, 2019).

Blood and/or meat meal has also been used successfully to repel deer from crops. Similar to putrescent eggs, blood based products are thought to mimic odors associated with predator activity, triggering a flight response in deer. In 2018, commercial soybean and dry bean growers in Northeast Lower Michigan began experimenting with Plantskydd™, an area repellent manufactured by Tree World Plant Care Products, Inc. containing 99.84% dried blood (porcine and/or bovine). Plantskydd is a minimum risk pesticide product exempt from EPA registration and approved for use on many different crops, including certified organic crops. Growers reported success using Plantskydd to reduce deer damage in beans, which encouraged us to include it as a research treatment for the first time in 2019.

Methods

Two production soybean fields in Northeast Lower Michigan (Metz) and the South Central Upper Peninsula (Cooks) were selected for the trial based on landscape factors known to increase the likelihood of deer damage (forested field edges), and a history of significant deer damage as reported by the cooperating growers. At the Cooks location, MG 0.9 soybeans were planted in 30 inch rows at 110,000 seeds per acre on May 25, 2019. Plots 80 ft. wide by 300 ft. long were established running perpendicular to the south field edge shortly after planting (Figure 1). At the Metz location, MG 1.7 soybeans were drilled in 15 inch rows at 183,000 seeds per acre on May 28,2019. Plots 60 ft. wide by 300 ft. long were established running perpendicular to the west field edge shortly after planting (Figure 2). Plot width was determined by the width of the cooperating farmer's sprayer boom. Two 4 X 4 X 5 ft. tall exclusion cages constructed of steel fence posts and Tenax C flex plastic mesh fencing were placed in each plot, one being 50 ft. from the field edge and another 150 ft. from the field edge, to measure soybean development and yield potential with zero deer pressure (Figure 3).

Treatments included 1) DeerPro Spring & Summer (1.25 gal/a in 8.75 gal water) applied at the VC and V3 growth stages, 2) Plantskydd (1.5 lb/a in 10 gal water) plus a NIS and defoamer applied at VC and V3, and 3) an untreated control. Treatments were systematically assigned to plots to avoid confounding edge effects and replicated four times for a total of twelve plots arranged in a complete block design. In Metz, repellent applications were made on June 11 and July 12 using the cooperating grower's self-propelled sprayer. In Cooks, repellent applications were made on June 18 and July 11, using the cooperating grower's pull type sprayer. Both repellents were mixed and applied according to manufacturer instructions.

Deer damage was monitored from V1 until the V6/R1 growth stage, after which damage is thought to be less detrimental to yield. Our primary method was hand counting the number of plants damaged and percent defoliation relative to undamaged plants in 17.4 ft. of row (Metz) or a ¼ m^2 PVC quadrat (Cooks), at four random locations per plot every 6-10 days (Figure 4). Counting began on June 17 in Metz and June 18 in Cooks, continuing for seven weeks. At crop maturity, two methods were used to measure soybean yield on October 20 in Cooks and November 18 in Metz. The first method was to harvest soybeans within each exclusion cage. Beans were hand harvested from the cages, threshed using a stationary plot thresher and weighed. After the exclusion samples were harvested and cages removed, a strip was harvested from each plot using the cooperating grower's combine and weighed using a weigh wagon to determine average plot yield. All yield data was adjusted for grain moisture at harvest.

Results & Discussion

Deer damage resulted in 26% peak defoliation (Avg. 13.64%), and reduced soybean yield by 10 bu/a (30%) in untreated control plots at Cooks, MI. (Figure 5) Deer damage resulted in 31% peak defoliation (Avg. 20.25%) and reduced soybean yield by 30 bu/a (70%) in untreated control plots at Metz, MI. Assuming a soybean price of $9.00 per bushel, uncontrolled deer damage cost our cooperating growers $90 per acre at Cooks and $270 per acre at Metz.

Deer pressure and soybean defoliation were generally low at Cooks until July 11. Both the DeerPro and Plantskydd repellent treatments significantly reduced soybean defoliation by 71% and 66% respectively at 7, 10 and 20 days after the second application at Cooks, MI ($P < 0.10$) (Figure 6). However, soybean yield was not significantly different between treatments within the exclosure cages or in the exposed plots at Cooks. The difference in soybean yield between exclosure cages and exposed plots was also not significantly different between treatments at Cooks (Figure 7).

Soybean defoliation was not significantly different between the treatments at any timing at Metz, MI (Figure 8). There were numeric reductions in defoliation at six days after application one and ten days after application two at Metz, but these differences were not statistically significant. Soybean yield was not significantly different between treatments within the exclosure cages or in the exposed plots at Metz. The difference in soybean yield between exclosure cages and exposed plots was also not significantly different between treatments at Metz (Figure 9).

Our data suggest that neither the DeerPro nor Plantskydd repellent products were able to control deer depredation to the point of significantly protecting soybean yield. This finding was somewhat unexpected at Cooks based on the significantly lower amount of early season defoliation in treated plots. However, a great deal of late season pod feeding was observed at Cooks, which we would not expect to be affected by early season repellent applications to vegetative tissue. This is not the first year that late season pod feeding has reduced soybean yields in our trials, regardless of repellent efficacy early in the season. This suggests that late season control tools are needed to better protect yield. Yet, the economic cost of a third or fourth repellent application could outweigh the value of yield preserved in a commodity crop like soybeans.

Deer damage began earlier and increased more rapidly at Metz relative to Cooks, appearing to quickly overwhelm the repellent treatments. White-tailed deer density is significantly higher at Metz than in Cooks, which likely explains the poor performance of our repellent treatments at Metz. It is also interesting to note the possibility that previous use of DeerPro repellents at the Metz site in 2017 may have contributed to habituation in the local deer herd and reduced efficacy, although we have no data to support this conclusion. If that were the case, one would expect that the novel repellent product, Plantskydd, may still be effective. The authors would like to thank Great Oak Inc. and Tree World Plant Care Products, Inc. for supporting this research, and also the Brandt and Robere families for their time and effort in conducting the trials.

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Figure 1. Experimental design in soybeans at Cooks (45.993835, -86.424072). Red 'X' indicates approximate location of exclusion cages. Not drawn to scale.

Figure 2. Experimental design in soybeans at Metz (45.238810, -83.784314). Red 'X' indicates approximate location of exclusion cages. Not drawn to scale.

Figure 3. Exclusion Cage Design at Cooks, MI

Figure 4. Damaged soybeans on July 11th at Cooks, MI

Figure 5. Damaged (fore) vs. protected (back) soybeans on Sept. 4th in a control plot at Cooks, MI

Figure 6.
Soybean Defoliation by Treatment at Cooks

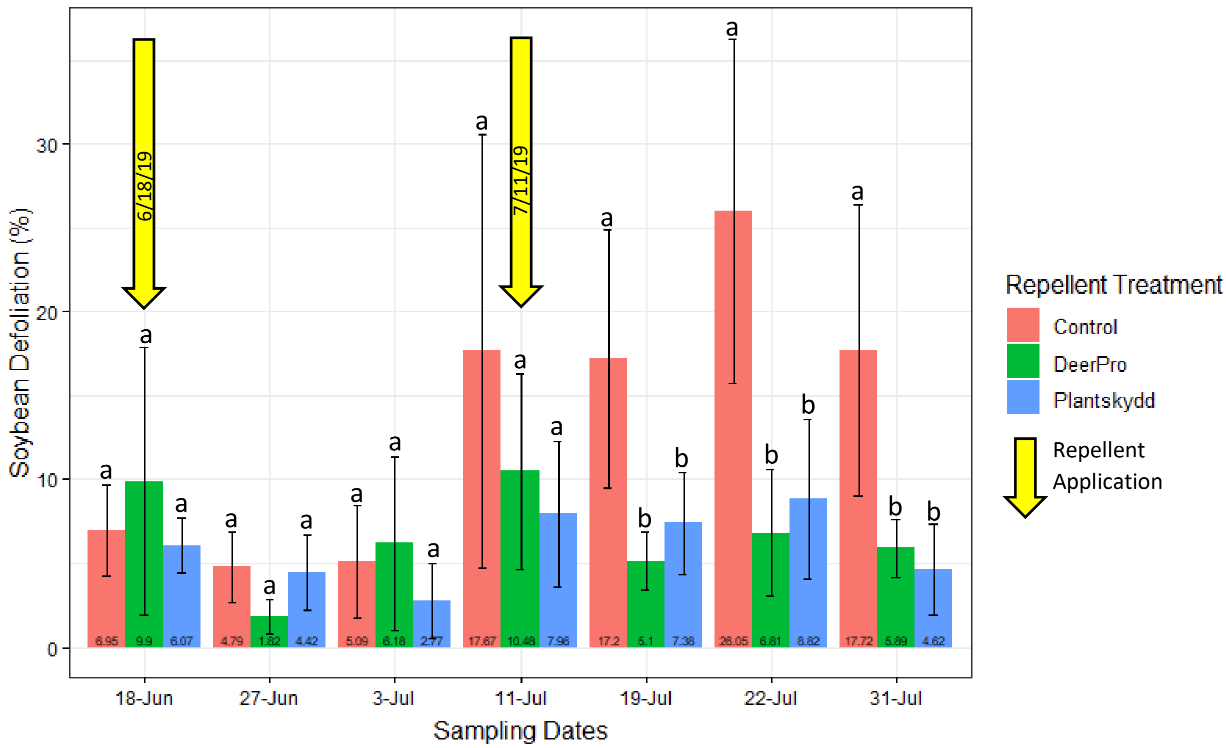

Figure 7.
Soybean Yield by Treatment at Cooks

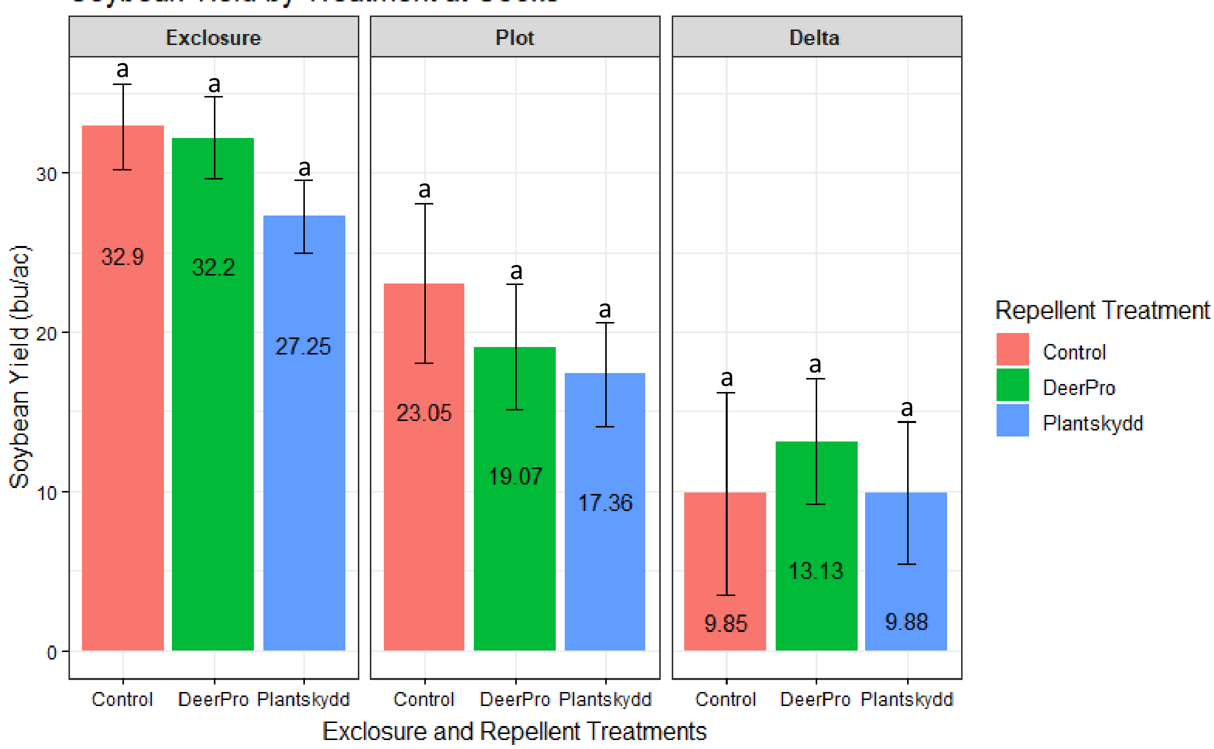

Figure 8.

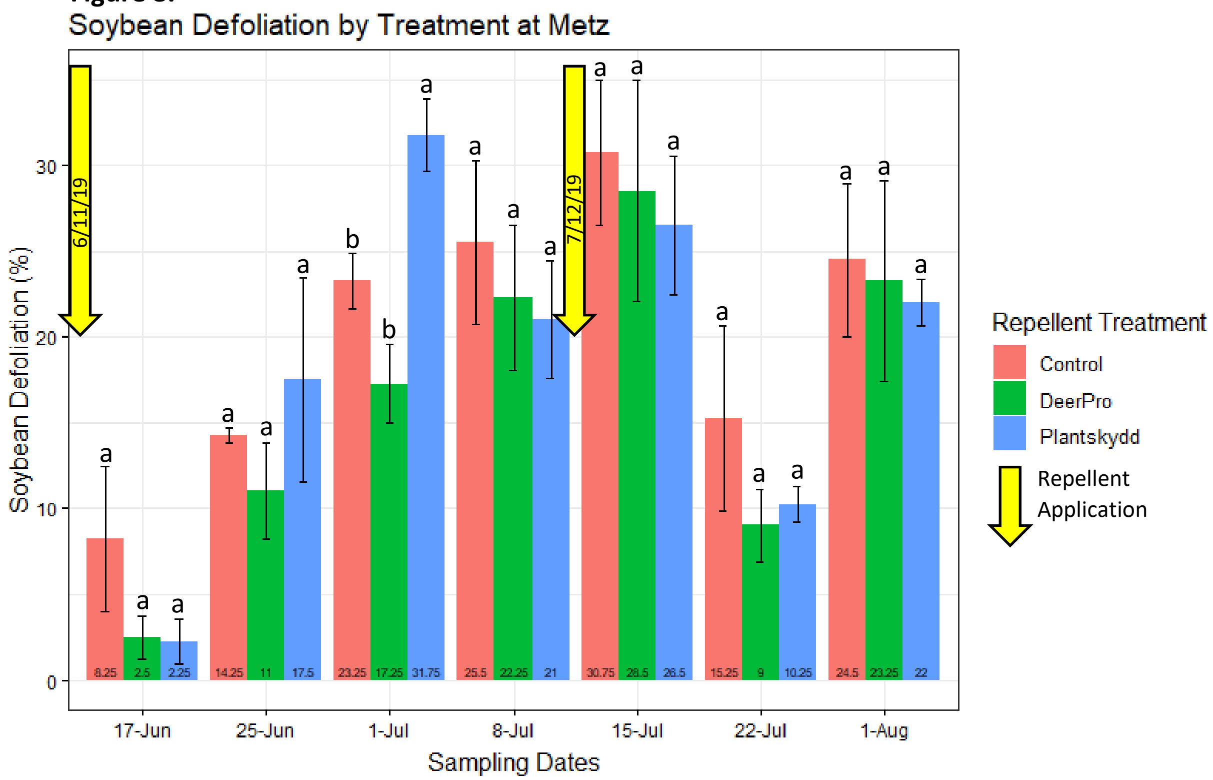

Figure 9.