White-tailed Deer Use of Clover Patches and Soybean Fields in an Agricultural Area

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Abstract: To effectively manage a white-tailed deer *(Odocoileus virginianus)* population in an agricultural area, information regarding habitat use and selection is needed to aid in reducing crop damage. We gathered data on deer use of clover *(Trifolium repens)* and soybean (*Glycine max* [L.]) fields at Chesapeake Farms, Maryland. We surveyed soybean and clover fields to test the hypothesis that deer distribute themselves proportionally to availability of soybeans and clover fields. Clover patch height and mass were also measured to quantify the amount of use by deer. Deer density in clover fields was always higher than in soybean fields in both years of the study (1997 and 1998). Browsing by deer significantly reduced clover patch height and mass. Our data suggested that active selection of crops by deer did not occur.

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Agricultural damage by deer has become a widespread and increasingly complex problem (Moore and Folk 1978, Matschke et al. 1984), often involving unique interrelationships between natural habitats, crop species, deer population densities, land management objectives, and landowner profit margins (Moore and Folk 1978: 266). The only way to eliminate deer damage to crops is to eliminate deer (Matschke et al. 1984) or protect crops by preventing deer access. Because these are sometimes difficult or often impractical solutions, the alternative is to reduce the amount of deer damage to an economically acceptable level.

White-tailed deer spend more time feeding than on any other activity (Marchinton and Hirth 1984). Deer prefer to eat a variety of plants and are less selective when forage abundance is high (Mooty et al. 1987, Weckerly and Kennedy 1992). This feeding strategy follows the selective quality hypothesis which states "animals are less selective during periods of high resource abundance because high-quality food resources are in greater supply and, concomitantly, more homogeneously distributed" (Weckerly and Kennedy 1992:433). Reduced selectivity can increase foraging efficiency and increase the processing rate of low fiber foods, thereby allowing deer to maintain or increase nutrient absorption (Weckerly and Kennedy 1992).

There is a distinct seasonality in forage abundance in an agricultural area. During spring and summer, highly productive crops supplement native forages. In fall and winter, lands that supported crops previously are barren, producing little forage. If the selective quality hypothesis holds true, deer in agricultural areas should not be selective during spring and summer when resource abundance is high. Therefore crop damage resulting from non-selective deer browsing would be a function of habitat composition, not active selection of individual plant species.

Deer browsing patterns and the damage that results may be related to a lack of habitat diversity in agricultural areas. Deer depredation of crops is primarily concentrated along field edges and in fields that are in close proximity to woodlands (Garrison and Lewis 1987, Vecellio et al. 1994). Transitional zones between crop fields and wooded areas usually do not exist, reducing habitat diversity. Based on our understanding of white-tailed deer feeding strategies, patterns, and preferences, the crop damage problem may be exacerbated due to the lack of transitional zones, i.e. habitat diversity, in agricultural areas. Forage plantings have long been used in attracting and feeding deer (Waer et al. 1997). These food plots could serve as transitional zones in agricultural areas to increase habitat diversity. Despite the possible usefulness of food plots, few state agencies have incorporated the planting of food plots as a means to reduce crop damage (Conover and Decker 1991).

Habitat augmentation, in the form of food plots, in an agricultural setting to reduce crop damage has not been evaluated. To date, little or no evidence has been gathered on the effectiveness of clover plots to reduce deer damage to cash crops. Therefore, the goal of this study was to determine whether supplemental plantings of clover, within an agricultural area of soybeans and corn, would be consumed by deer and, hence, might offer the potential to reduce crop damage. Specifically, objectives were to 1) test the hypothesis that deer distribute themselves proportionally to availability of soybean and clover fields, and 2) test the hypothesis that deer feeding on clover significantly reduce plant height and mass.

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Methods

Study Area

Field work was conducted at Chesapeake Farms, Kent County, Maryland, a 1,330-ha agricultural development and wildlife management demonstration area operated by Dupont Agricultural Enterprise. Twenty percent of the Farms was active crop fields; 30% was classified as fallow fields and wildlife cover area; the remaining 50% of the study area was forested. During the 1997 growing season, there were 188 ha of corn (14% of the Farms), 57 ha of soybeans (4%), and 45 ha of clover (3%) available for deer browsing. During the 1998 growing season, there were 129 ha of corn (10%), 31 ha of soybeans (10%), and 55 ha of clover (4%).

Survey Methods and Field Techniques

To estimate deer use of soybean and clover fields, we conducted observational surveys of deer in crop fields. We established a survey route along roadways that encompassed as many soybean and clover fields as possible. Deer were accustomed to traffic along these roadways and were not disturbed by vehicles. Surveys began 1 to 1.5 hours before sunset with a different starting point each evening and were completed when all fields on the survey route were checked for deer. Surveys were conducted from July to October in 1997 and 1998. This period included the growing

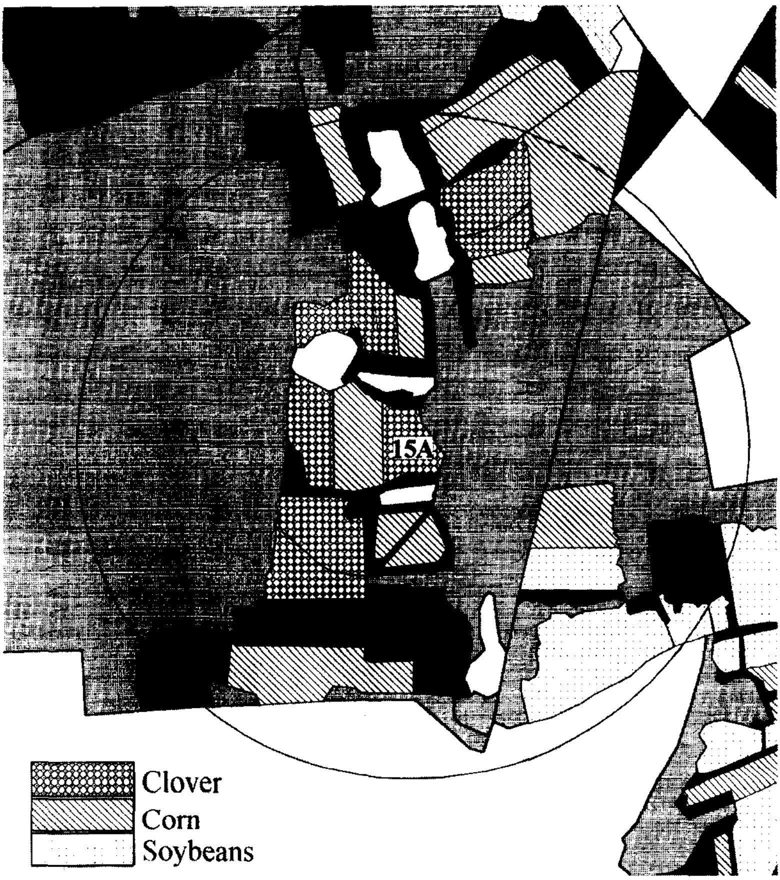


Figure 1. Field 15A and surrounding cover types within 259 ha, Chesapeake Farms, Maryland, 1998.

season from emergence of soybeans to harvest. We recorded number of individuals present in each field and noted age and sex composition of groups when possible.

To investigate impact of deer on height and mass of clover, 2 clover fields were chosen for their proximity to crop fields, and paired plots were placed in each clover field. Because the home range of a white-tailed deer is usually less than 1 mi^2 (259 ha) (Wiles and Weeks 1992, Storm et al. 1995, VerCauteren and Hygnstrom 1998, Tardiff 1999), this area was used to define the amount of forage available to a deer. Clover field 15A was 2.4 ha and was surrounded by relatively few crop-producing fields (Fig. 1). Within 259 ha, there were 23 ha of corn, 10.5 ha of soybeans, and 19 ha of clover. Clover field 42C was 2.95 ha and was entirely surrounded by crop-producing fields (Fig 2). Within 259 ha of this field, there were 40.9 ha of corn, 39.7 ha of soybeans, and 4.2 of clover. The clover fields were mowed to a uniform height of 10.16 cm, and 12 paired test plots were placed in each field in a systematic fashion. Each pair consisted of an unprotected and a protected plot. Protected plots were

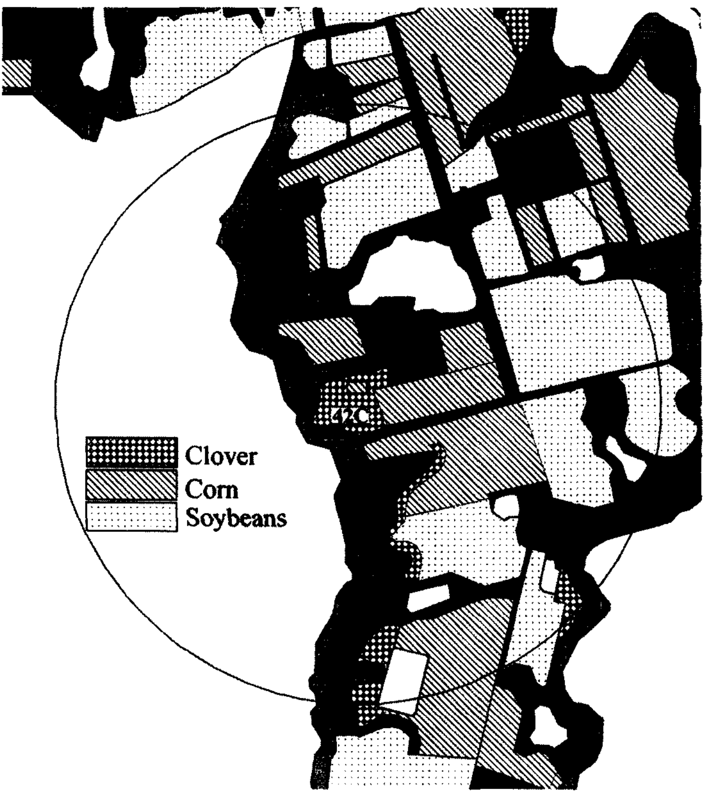


Figure 2. Field 42C and surrounding cover types within 259 ha, Chesapeake Farms, Maryland, 1998.

created using 10.16 × 5.08 cm mesh field fencing 1.22 m high; protected plots encompassed a 0.266-m^2 area. Fiberglass poles were used to stake the fencing in place in the clover fields.

Test plots were measured and clipped at 6- to 8-week intervals (when sufficient growth warranted clipping) from May 1998 through October 1998 (from crop planting until crop harvest). This approach allowed for 2 trials in each field. We measured average clover height in each test plot for each trial. Clover was then hand-clipped to ground level. Samples were placed in paper bags, dried according to Harlow (1977), and weighed to the nearest hundredth gram. After clipping, fields were again mowed to a uniform height of 10 cm.

Data Analysis

For observational surveys of clover and soybean fields, deer density (deer/ha) in clover and soybeans was calculated for each survey. This measure is statistically independent as well as biologically independent (Millspaugh et al. 1998) allowing the number of deer/ha of clover/survey and deer/ha of soybeans/survey to be compared with a 2-sample *t*-test. Coefficients of variation for individual survey data and for pooled monthly data were calculated as a measure of relative variability of deer density in clover and soybean fields. For clover test plot data, we compared unprotected and protected plots in each field with a 2-sample *t*-test.

Results

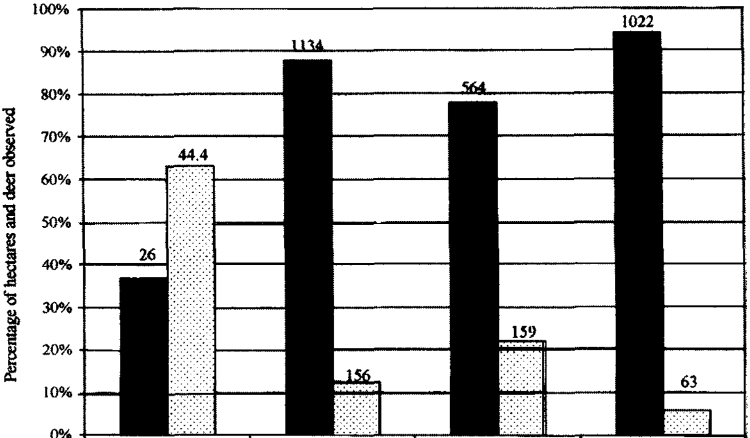
Observational Surveys

Based on observational surveys, deer density in clover was higher ($P<0.0005$) than in soybeans for both 1997 and 1998. Figures 3 and 4 depict the percentages of observed hectares relative to the monthly percentages of deer observed. The 1997 coefficients of variation (CV) were 29.5% for pooled monthly clover data and 86.6% for pooled monthly soybean data. Coefficients of variation for 1998 were 45.5% for pooled monthly clover data and 38.5% for pooled monthly soybean data.

The density of deer observed in soybean fields was always <1 deer/ha/survey, while density in clover fields was always >1.5 deer/ha/survey in 1997 and 1998. The percentage of deer in soybean fields increased in 1998 as did the percentage of soybeans observed.

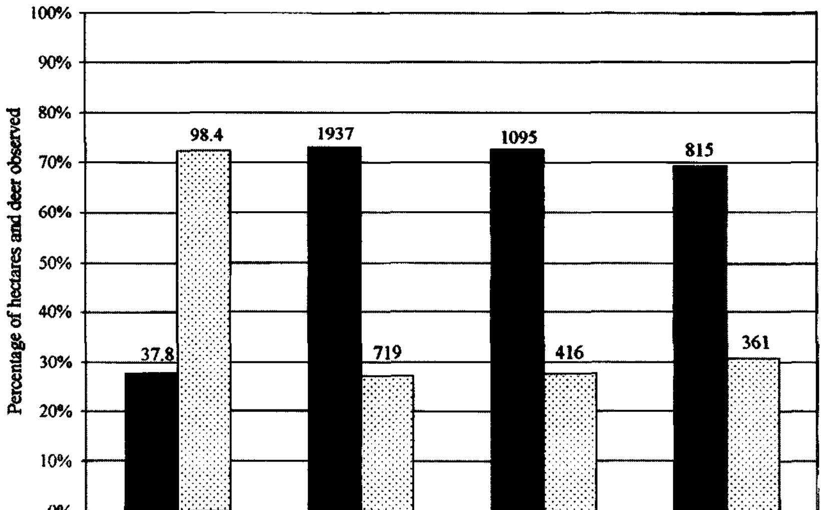
Trial 1 was conducted from late May through mid-July; trial 2 from mid-July through early October for both field 15A and 42C (Table 1). For field 15A, trial 1, clover height and mass in protected plots were greater ($P<0.0005$ and $P<0.02$, respectively) than in unprotected plots. Trial 2 in field 15A showed only height in protected plots being greater ($P<0.0005$) than in unprotected plots. Differences in mass for trial 2 between protected and unprotected plots were not significant ($P>0.09$).

Field 42C, trial 1 and 2, exhibited significant differences for both height and mass. For trial 1, height and mass in protected plots were greater ($P<0.01$) than in



	Hectares Observed	Deer Observed in July	Deer Observed in August	Deer Observed in September
■ clover	37%	88%	78%	94%
□ soybeans	63%	12%	22%	6%

Figure 3. Percentage of hectares and deer observed in clover and soybean fields during observational surveys, Chesapeake Farms, Maryland, 1997. Numbers above the columns indicate actual number of hectares and deer observed. Coefficient of variation equals 29.5% in clover and 86.6% in soybeans.



	Hectares Observed	Deer Observed in July	Deer Observed in August	Deer Observed in September
■ clover	28%	73%	72%	69%
□ soybeans	72%	27%	28%	31%

Figure 4. Percentage of hectares and deer observed in clover and soybean fields during observational surveys, Chesapeake Farms, Maryland, 1998. Numbers above the columns indicate actual number of hectares and deer observed. Coefficient of variation equals 45.5% in clover and 38.6% in soybeans.

Table 1. Average height and mass for unprotected and protected plots in clover fields 15A and 42C for trial 1 and 2, Chesapeake Farms, Maryland, 1998. Number of plots in each trial is also included. Means within a category followed by the same letter were not different ($P > 0.05$).

	Trial 1		Trial 2	
	Unprotected	Protected	Unprotected	Protected
Field 15A				
Height (cm)	20.9 (A)	37.38 (B)	7.4 (A)	11.16 (B)
Mass (g)	63.29 (A)	91.66 (B)	16.75 (A)	19.44 (A)
N plots	12	12	12	12
Field 42C				
Height (cm)	24.32 (A)	45.74 (B)	8.04 (A)	12.78 (B)
Mass (g)	56.56 (A)	101.75 (B)	14.97 (A)	20.81 (B)
N plots	12	12	9	9

unprotected plots. Trial 2 yielded similar results with height and mass being greater ($P<0.01$) in protected plots.

Discussion

The most direct method of determining deer-caused damage is observation. A retrospective look at crop damage leaves the investigator guessing as to the number and kind of animal that caused the damage. Observational surveys, although limited to daylight hours, allowed identification of animals using fields as well as an estimate of the actual number. Statistical analysis of the observational data was simplistic and academic in a sense due to the number of deer observed in clover as opposed to soybean fields. However, this does not limit its validity.

When actual measurements of clover were taken, the extent to which deer utilized clover became clearer. During the first trial, the mass in protected plots was 79% higher than unprotected plots for field 42C and 44% higher for field 15A (Table 1). The second trial revealed a much smaller, but still significant, difference. Clover is a cool season plant, growing most extensively and reproducing in the spring and early summer, thus, explaining the height and mass differences seen between trials.

Fields surrounded by differing acreages of crops were chosen specifically to investigate whether deer would use supplemental feeding plots in an agricultural landscape. Clover and soybeans (as well as other warm season forages) have the same percentage of crude protein and comparable total digestible nutrients (Waer et al. 1992, Waer et al. 1994). However, peak clover production occurs in May, whereas peak soybean and other warm season forage production occurs in July (Waer et al. 1992, Waer et al. 1994). Even with abundant crop production, the mass difference between protected and unprotected plots for field 42C, which was surrounded by 41 ha of corn and 40 ha of soybeans, was over 45g. Clearly, clover fields were used even in the presence of actively growing corn and soybeans supporting the selective quality hypothesis.

Even though this test provided information regarding deer use of clover, it was not an experiment which directly compared crop damage and clover use. This was a small part of a larger study investigating overall deer use of agricultural lands. This research suggests that habitat augmentation, in the form of wildlife food plots, has the potential to reduce crop damage. If it is shown through experimentation that increased or strategically placed clover fields resulted in reduced crop damage from deer, then habitat augmentation may become an acceptable method used in reducing deer damage.

Management Implications

The agricultural community and the state agencies that serve them need to use all available tools to reduce crop depredation. Food plots have been viewed as a way for hunt clubs to supplement their habitat and deer population, not as a way of reducing crop damage (Webb 1963, Hehman and Fulbright 1997, Waer et al. 1997). Studies that investigated the cost efficiency of forage plantings have shown that plantings are economical and that a wide variety of forage types are available (McBryde 1995, Waer et al. 1997). The list of forage plantings included red and white clover varieties, oats, rye, fescue, alfalfa, jointvetch, and lespedeza (Waer et al. 1997). The economic efficiency of food plots holds for farmers as well. Substantial deer damage causing yield reduction results in monetary loss. Replacing a crop area, which sustains high damage with a wildlife food plot to act as a transitional zone and increase local habitat diversity, may provide an economically sound alternative to farmers. Depending on the type of crop rotation employed, the cost of producing a cash crop ranges from $516/ha to $778/ha annually (Chesapeake Farms Sustainable Agric. Proj., unpubl. data). Average cost for establishing and maintaining a ladino clover food plot for 5 years is $207/ha annually (Chesapeake Farms Sustainable Agric. Proj., unpubl. data). Creating these supplemental feeding areas in locations with high damage could reduce damage to remaining cash crops and the overall cost of such damage. These clover plots also have the ancillary advantage of attracting deer to areas where they can be harvested, thereby potentially reducing the herd and providing recreational opportunities.

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