Monitoring Deer Preferences on Popular Landscape Plants

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Subject Category: Deer Damage and Landscape Plants

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Additional index words. deer, feeding, grazing, landscape, residential, garden.

Abstract

The following research utilized representative landscape plants to track the tendencies of deer browsing. The project included four test plots and one control plot. Each plot was 1.2m x 1.8m. The plant varieties used were Lantana 'Confetti' (*Lantana camara)*, Echinacea 'Big Sky Sunrise' (*Echinacea hybrid)*, Zonal Geranium 'Allure Lilac Chiffon' (*Pelargonium hortorum)*, Azalea 'Snow' (*Rhododendron mucronatum),* and Golden Euonymus (*Ovatus Aureus)*. The sites were evaluated three times each week, for six months by counting the tips of plants that were eaten. These assessments provided the opportunity to evaluate the severity of browsing on each plant that was eaten and the preference of deer for each plant species. After six months of plots subject to herbivory, Euonymus and Azalea received the greatest amount of foraging activity.

Introduction

Homeowner's frustrations rise when money and time are wasted due to deer damage on their landscape and it is common that deer-resistant plants are sought after by owners of residential landscapes in suburban or rural areas. From experience, while operating a greenhouse at Blacksburg High School, many customers seek solutions to deer herbivory in their landscape. There are existing lists that recommend woody landscape plants that are less preferred by deer

such as: American Holly, Flowering Dogwood, Common Boxwood, and White Pine (Marsh, 1991). A Rutgers extension publication categorized common landscape plants as rarely damaged, seldom severely damaged, occasionally severely damaged or frequently damaged by deer (Perdomo et al., 2004). Plant species selected for use in the study have various ratings (Fig. 1)

Figure 1. The following is the rating provided by the Rutgers publication pertaining to each species used in the research plots.

Plant Species	**Rutgers Rating**
Azalea	Occasionally Severely Damaged
Echinacea	Rarely Damaged
Euonymus	Occasionally Severely Damaged
Geranium	Occasionally Severely Damaged
Lantana	Seldom Severely Damaged

About one-third of plant producers and landscape firms surveyed in New York believed that some consumers had ceased buying plants because of repeated experiences with deer damage (Sayre et al., 1992). White-tailed deer are extremely adaptable *(Odocoileus virginianus)*, both in habitat and diet selection (DeNicola et al., 2000). The adaptability of deer makes landscape or garden sustainability difficult. Deer densities are often highest in locations that provided the best habitat (DeNicola et al., 2000).

Deer thrive in edge habitats-areas where one habitat type transitions into another (MacGowan et al., 2008). Edge habitats occur along the suburban/woodland interface, where forest abuts residential areas. These areas provide ideal habitat for white-tailed deer because of an abundance of food and often protection from hunting and predation (DeNicola et al., 2000). As an example, the Town of Blacksburg VA displays a mixture of rural areas, single-family residential areas, business areas, and higher density properties such as apartments and townhomes. The development associated with the land uses provide with viable wildlife habitats in the form of residents' landscapes and gardens. Edge habitats are common and increase throughout the U.S.

as development activity increases habitat fragmentation and road networks (Williams et al., 2008).

One of the first things that a landowner must learn is how to accurately identify the deer damage (Baugher et al., 1985). According to these authors, most deer damage occurs at night, so the landowners should confirm deer browsing by looking for tracks and deer droppings. Additionally deer do not have upper incisor teeth, and when eating they pull or tear the part being eaten (Fig 2) as opposed to rabbits or woodchucks who leave clean cuts on the plants (Baugher et al., 1985).

Figure 2.
A Euonymus plant in the research study that was foraged by deer. Picture taken May 28th, 2010

The effects of plant herbivory are displayed within three contrasting ideas: that herbivory is always detrimental to the browsed plant, that low levels of herbivory result in no net change in plant fitness, and that moderate levels of herbivory may result in overcompensation by the plant, increasing plant fitness (McNaughton, 1982). Deer browsing can lower reproductive output of native species by reducing plant size or by directly targeting flowers (Fletcher et al., 2001). Paige and Whitham (1987) experimentally demonstrated that, under natural field conditions, scarlet gilia *(Ipomopsis aggregate)* benefited from the effects of herbivory.

Goals of this research were to determine which of the plants used in the research study were "deer resistant" or deer preferred. Most herbivorous mammals demonstrate diet selectivity, illustrated by their feeding on some plants or crops and not others (Marsh, 1991). As a result of the research, we will be able to advise homeowners on plants that can be planted without deer disturbance .

Materials and Methods

The project was carried out in a previously undisturbed meadow on the property of Blacksburg High School, 520 Patrick Henry Dr. Blacksburg Virginia. The project area lies on the top of an east-facing hillside adjacent to woods that surround a residential area. The study consisted of assessing damage on plants in four plots. The plots 1.2m x 1.8m in size, each plot contained three replications of each plant species that were planted in a random pattern that was used in each randomized complete block design (Figure 2). Plant varieties tested were Lantana 'Confetti' (*Lantana camara)*, Echinacea 'Big Sky Sunrise' (*Echinacea hybrid)*, Zonal Geranium 'Allure Lilac Chiffon' (*Pelargonium hortorum)*, Azalea 'Snow' (*Rhododendron mucronatum),* and Golden Euonymus (*Ovatus Aureus)*. The species Echinacea, Lantana, and Zonal geranium were chosen based on sales at the Blacksburg High School plant sale. Azalea and Golden Euonymus were woody perennials that are popular in resident landscapes.

Figure 3. Organization of Plants in 1.2m x 1.8m Project Plots.
Three replications of five plant species were randomly assigned to a location in the 1.2m x 1.8m plot.

Azalea #3	Geranium #3		Geranium #2	Lantana # 1
Lantana #3		Euonymus #2		
	Azalea 2		Echinacea #1	Euonymus #1
Echinacea #3				
Euonymus #3	Lantana 2	Echinacea #2	Geranium #1	Azalea #1

Before testing could be done, each test plot was treated with glyphosate herbicide on 6 May 2010(Roundup Ready-to-Use Plus, Monsanto Company St. Louis, Missouri). On 13 May 2010 the plots were tilled with a tiller. Plots were planted on 14 May 2010 and were maintained for twenty-three weeks until 22 Oct. 2010. Maintenance of the plots included: sidedressing with a 10-10-10 fertilizer on 24 May 2010, irrigation once a week, and manual weeding when needed. For the duration of the study each plant evaluation consisted of counting each plant's stem tips. The plants in the research were considerably lasting, during the six months all plants survived except for one Lantana plant. The plant sampling method included counting the stem tips that were removed or torn. Each time the plots were evaluated the newly grazed portion of each species was assessed and added to the sum for that species for a monthly total. Identifying the new deer damage was done by comparing the previous amounts that were grazed and by looking at the plant for new tissue damage.

To determine the most foraged plant species, the data were analyzed using the one-way ANOVA test. Initially the quantities of eaten growing tips of each species did not create normal distribution. Data were transformed by applying Log, which yielded a normal distribution.

Results

After six months all species were browsed. Browsing occurred in each month (Figure 3). The severity of grazing was the most extreme in September, especially for the Euonymus. During the study plants recovered slowly, new growth was noted on 28 July 2010 for each species. Deer preferred various parts of each species. Each time the Echinacea plants were eaten only the flower was removed. The geranium's flowers were also the main target, some leaves were eaten. Azalea plants were mainly eaten at the end of the branches leaves were clustered. The most browsing damage occurred on Euonymus where leaves where torn off of the stems leaving them bare. Lantana plants were mostly untouched throughout the study. The number of tips eaten for each month was used to compare the herbivory among the five plant species. Deer damage was most abundant on Euonymus and Azalea plants, followed by Geranium and Lantana plants, and the least herbivory occurred on the Echinacea plants (Figure 5; $F= 27.32$, $P<.0001$).

Figure 4. Total Numbers of Grazing Trends
This figure displays the total counted tips eaten per plant species per month. The recordings were taken three times a week during each month. The counted tip sums start on the left with May and conclude at the end of October. This figure displays the large amounts of herbivory on Azalea and Euonymus plants.

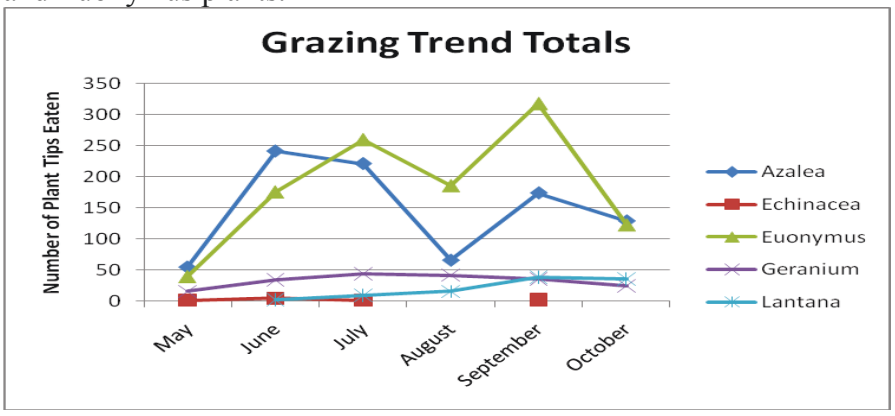
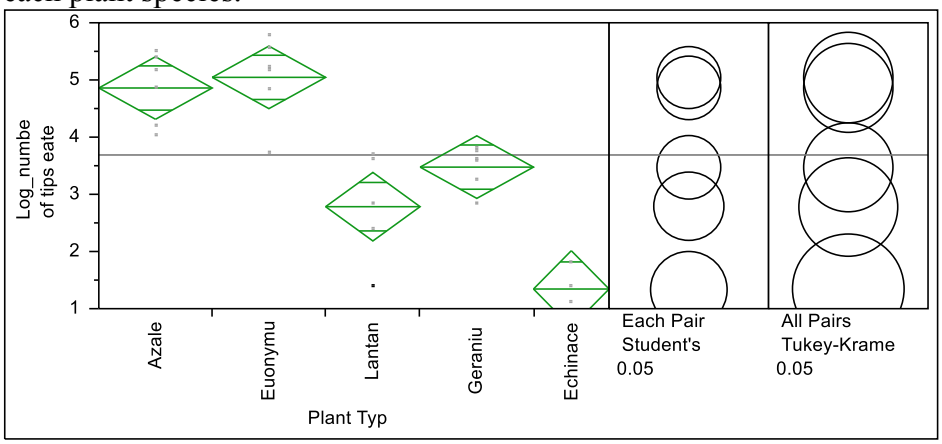


Figure 5.
One way Analysis of Log_number of tips eaten By Plant Type
The log transformation of the total number of tips eaten during the six-month period. The one-way ANOVA analysis allows the comparison of the number of shoot tips eaten on each of the plant species. The data were entered using the log transformation which created a normal distribution. The statistical transformation applied resulted in significance between herbivory of each plant species.



The deer herbivory damage from most significant to least significant mean was: Euonymus (5.04), Azalea (4.85), Geranium (3.47), Lantana (2.78), Echinacea (1.34) (Figure 4).

Discussion

This habitat in Blacksburg, Virginia exhibited high amounts of deer pressure and their selection of landscape plants can be nonspecific, however plants such as Euonymus offering more vegetation could be a prime target. For the duration of the study, Euonymus and Azalea plants were consumed often and in large amounts. Echinacea was grazed less than the other species. Lantana and Zonal Geranium were moderately grazed by deer.

Deer grazed consistently throughout the six-month period and, when their natural habitat lacks palatable resources, they seek out other options. Deer eat very little grass, preferring to eat weeds, annual plants, and bud, shoots, and tender leaves of shrubs and trees. (Ripleyand Begnaud, 2011). In a drought situation when very few of these plants are available in pastures and rangeland, deer lose their shyness and begin to invade outlying landscapes (Ripley and Begnaud, 2011).

Homeowners should consider local resources such as greenhouse operators, nursery, and landscape firms to select their landscape and garden plants in order to deter deer herbivory. Plants are often classified according to the degree to which they either resist herbivory or tolerate it (Côté et al., 2004). Resistant plants have traits that reduce plant selection (such as chemical defenses or low digestible content) or traits that reduce intake rates such as leaf toughness or morphological defenses (Côté et al., 2004). Careful plant selection for home landscapes and gardeners combined with selective use of repellants may minimize damage if deer pressure is low to moderate (Marsh, 1991). Another method a homeowner could use to deter deer herbivory is exclusion. Deer can be kept out of a landscape by building a tall fence, however this is usually not a method preferred due to the aesthetic value (Ripley & Begnaud, 2011).

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Appendix: Detailed data and additional plant photos

Figure 6. May Grazing Trends
This figure represents the herbivory present in the month of May for each of the plant species. The plots were evaluated for newly eaten plant tips three times a week. This figure represents the sum of tips eaten for the month of May by species.

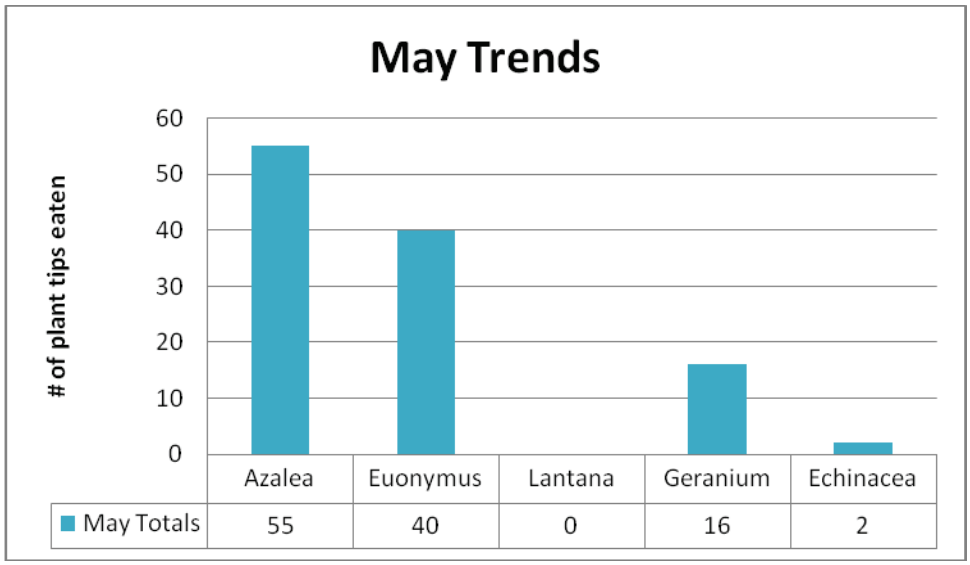


Figure 7. June Grazing Trends
This figure represents the herbivory present in the month of June for each of the plant species. The plots were evaluated for newly eaten plant tips three times a week. This figure represents the sum of tips eaten for the month of June by species.

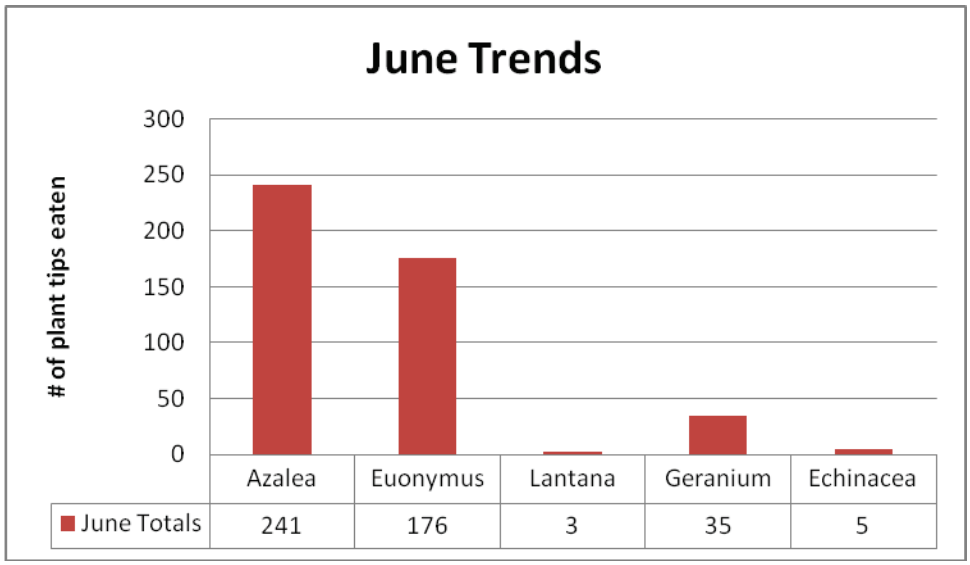


Figure 8. July Grazing Trends
This figure represents the herbivory present in the month of July for each of the plant species. The plots were evaluated for newly eaten plant tips three times a week. This figure represents the sum of tips eaten for the month of July by species.

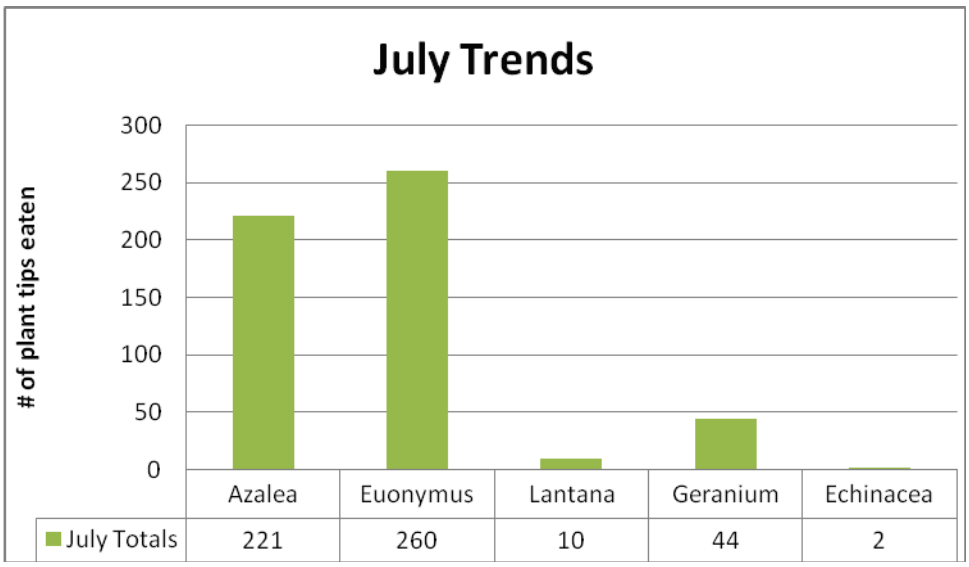


Figure 9. August Grazing Trends
This figure represents the herbivory present in the month of August for each of the plant species. The plots were evaluated for newly eaten plant tips three times a week. This figure represents the sum of tips eaten for the month of August by species.

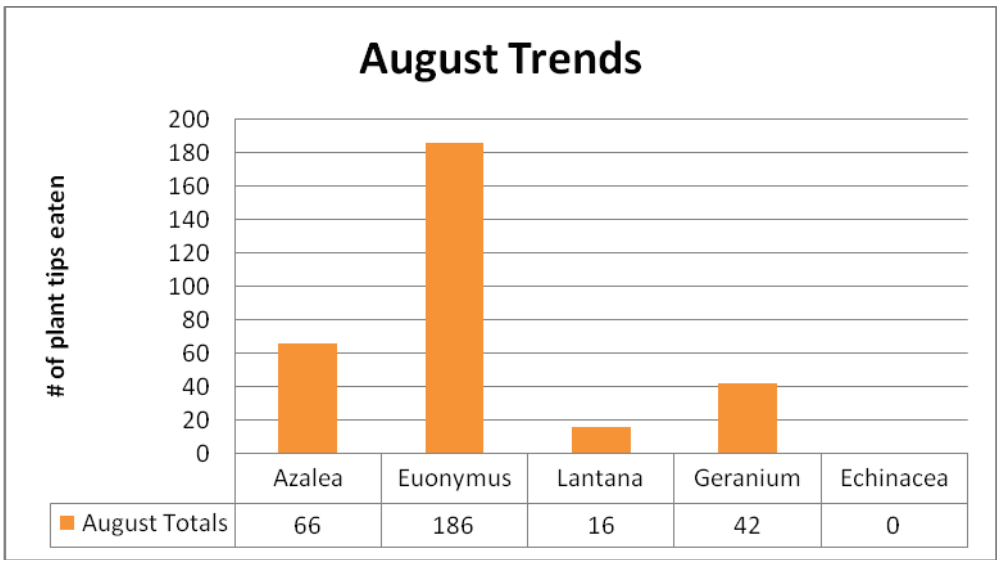


Figure 10. September Grazing Trends
This figure represents the herbivory present in the month of September for each of the plant species. The plots were evaluated for newly eaten plant tips three times a week. This figure represents the sum of tips eaten for the month of September by species.

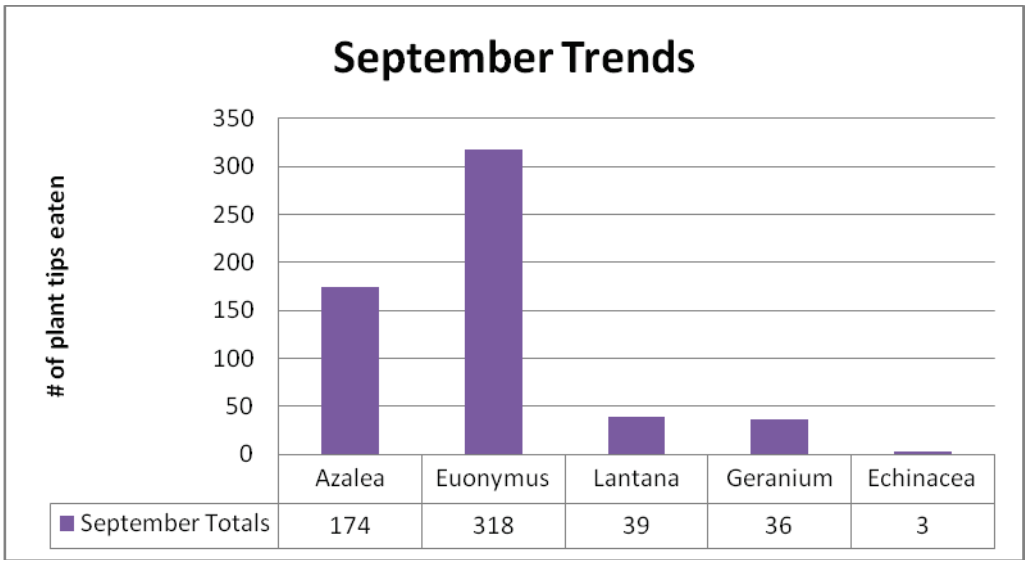


Figure 11. October Grazing Trends
This figure represents the herbivory present in the month of October for each of the plant species. The plots were evaluated for newly eaten plant tips three times a week. This figure represents the sum of tips eaten for the month of October by species.

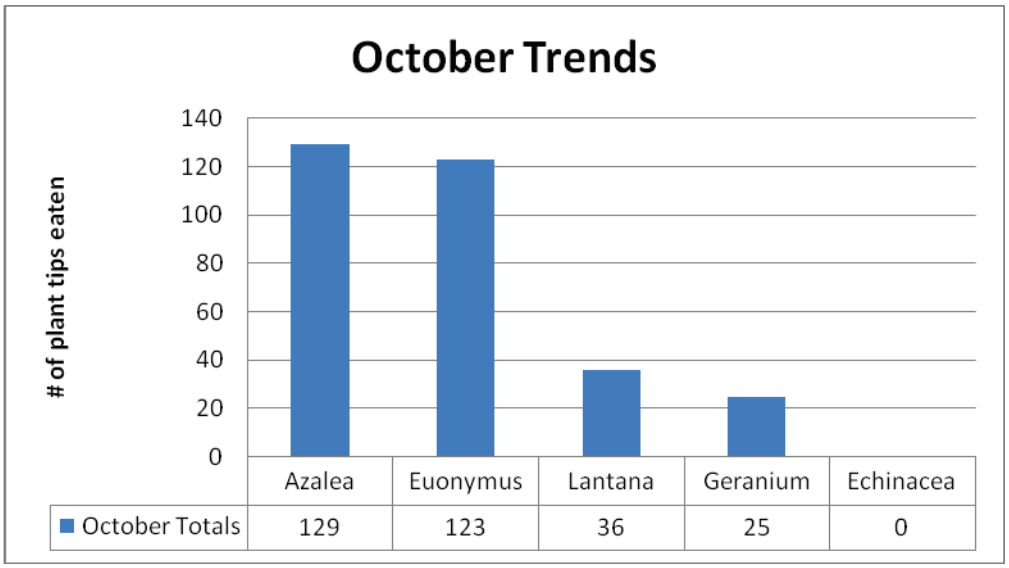
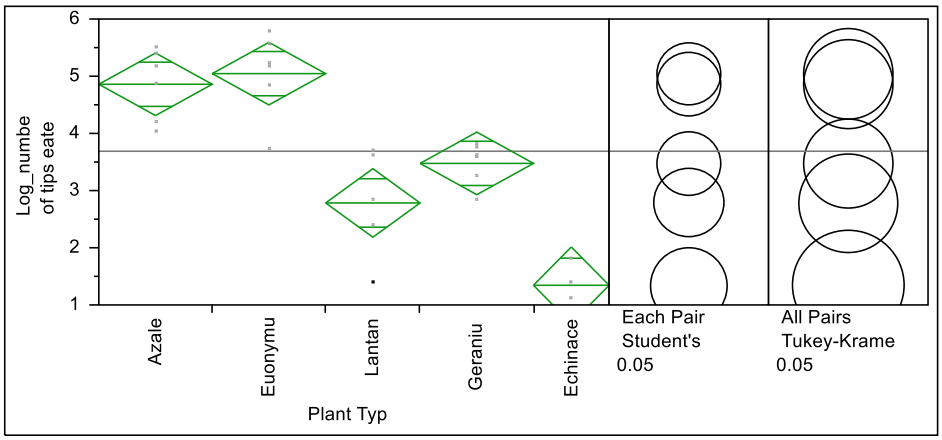


Figure 12. Statistical Analysis
Fit Y by X Group
Oneway Analysis of Log_number of tips eaten By Plant Type
The total number of tips eaten during the six month period per plant species were used to see if there was significance between herbivory of each plant species.



Oneway ANOVA
Summary of Fit

Rsquare	0.832421
Adj Rsquare	0.801952
Root Mean Square Error	0.646113
Mean of Response	3.687811
Observations (or Sum Wgts)	27

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Plant Type	4	45.620876	11.4052	27.3204	<.0001*
Error	22	9.184166	0.4175		
C. Total	26	54.805041			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Azalea	6	4.85900	0.26377	4.3120	5.4060
Euonymus	6	5.04514	0.26377	4.4981	5.5922
Lantana	5	2.78344	0.28895	2.1842	3.3827
Geranium	6	3.47560	0.26377	2.9286	4.0226
Echinacea	4	1.34382	0.32306	0.6738	2.0138

Std Error uses a pooled estimate of error variance

Means Comparisons
Comparisons for each pair using Student's t
Confidence Quantile

t	Alpha
2.07387	0.05

LSD Threshold Matrix

Abs(Dif)-LSD	Euonymus	Azalea	Geranium	Lantana	Echinacea
Euonymus	-0.7736	-0.5875	0.7959	1.4503	2.8364
Azalea	-0.5875	-0.7736	0.6098	1.2642	2.6502
Geranium	0.7959	0.6098	-0.7736	-0.1192	1.2668

Abs(Dif)-LSD	Euonymus	Azalea	Geranium	Lantana	Echinacea
Lantana	1.4503	1.2642	-0.1192	-0.8475	0.5408
Echinacea	2.8364	2.6502	1.2668	0.5408	-0.9475

Positive values show pairs of means that are significantly different.

Connecting Letters Report

Level				Mean
Euonymus	A			5.0451372
Azalea	A			4.8589966
Geranium		B		3.4756016
Lantana		B		2.7834401
Echinacea			C	1.3438196

Levels not connected by same letter are significantly different.

Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
Euonymus	Echinacea	3.701318	0.4170642	2.83638	4.566256	<.0001*
Azalea	Echinacea	3.515177	0.4170642	2.65024	4.380115	<.0001*
Euonymus	Lantana	2.261697	0.3912409	1.45031	3.073081	<.0001*
Geranium	Echinacea	2.131782	0.4170642	1.26684	2.996720	<.0001*
Azalea	Lantana	2.075557	0.3912409	1.26417	2.886940	<.0001*
Euonymus	Geranium	1.569536	0.3730335	0.79591	2.343160	0.0004*
Lantana	Echinacea	1.439620	0.4334258	0.54075	2.338491	0.0031*
Azalea	Geranium	1.383395	0.3730335	0.60977	2.157019	0.0012*
Geranium	Lantana	0.692161	0.3912409	-0.11922	1.503545	0.0907
Euonymus	Azalea	0.186141	0.3730335	-0.58748	0.959765	0.6227

Comparisons for all pairs using Tukey-Kramer HSD
Confidence Quantile

q*	Alpha
2.96698	0.05

LSD Threshold Matrix

Abs(Dif)-HSD	Euonymus	Azalea	Geranium	Lantana	Echinacea
Euonymus	-1.1068	-0.9206	0.4628	1.1009	2.4639
Azalea	-0.9206	-1.1068	0.2766	0.9148	2.2778
Geranium	0.4628	0.2766	-1.1068	-0.4686	0.8944
Lantana	1.1009	0.9148	-0.4686	-1.2124	0.1537
Echinacea	2.4639	2.2778	0.8944	0.1537	-1.3555

Positive values show pairs of means that are significantly different.

Connecting Letters Report

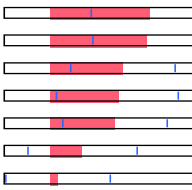
Level				Mean
Euonymus	A			5.0451372
Azalea	A			4.8589966
Geranium		B		3.4756016
Lantana		B		2.7834401
Echinacea			C	1.3438196

Levels not connected by same letter are significantly different.

Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
Euonymus	Echinacea	3.701318	0.4170642	2.46390	4.938739	<.0001*
Azalea	Echinacea	3.515177	0.4170642	2.27776	4.752598	<.0001*
Euonymus	Lantana	2.261697	0.3912409	1.10089	3.422501	<.0001*

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value
Geranium	Echinacea	2.131782	0.4170642	0.89436	3.369203	0.0004*
Azalea	Lantana	2.075557	0.3912409	0.91475	3.236361	0.0002*
Euonymus	Geranium	1.569536	0.3730335	0.46275	2.676319	0.0030*
Lantana	Echinacea	1.439620	0.4334258	0.15365	2.725587	0.0232*
Azalea	Geranium	1.383395	0.3730335	0.27661	2.490178	0.0097*
Geranium	Lantana	0.692161	0.3912409	-0.46864	1.852966	0.4154
Euonymus	Azalea	0.186141	0.3730335	-0.92064	1.292924	0.9866



Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Expected Score	Score Mean	(Mean-Mean0)/Std0
Azalea	6	125.000	84.000	20.8333	2.363
Euonymus	6	131.000	84.000	21.8333	2.714
Lantana	5	41.500	70.000	8.3000	-1.749
Geranium	6	69.000	84.000	11.5000	-0.846
Echinacea	4	11.500	56.000	2.8750	-3.005

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
21.3490	4	0.0003*

Small sample sizes. Refer to statistical tables for tests, rather than large-sample approximations.

Oneway Analysis of Log_number of tips eaten By Month Totals

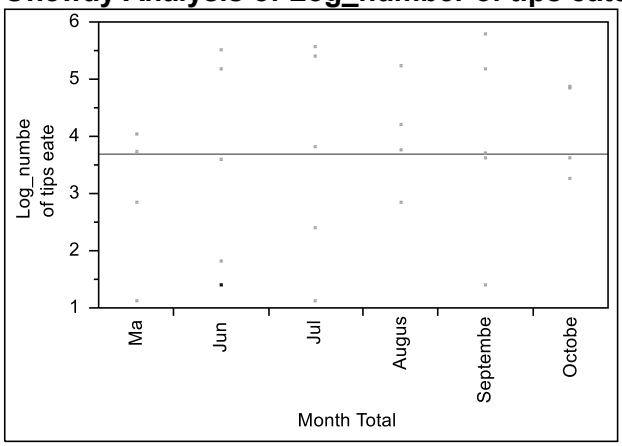


Figure 13. The Research Project
The plots were located at 520 Patrick Henry Drive, adjacent to the Agriculture Department at Blacksburg High School and a neighborhood. The four test plots contained the 5 plant species and three replications of each. Numerous times during the research deer were seen proximal to the research plots.

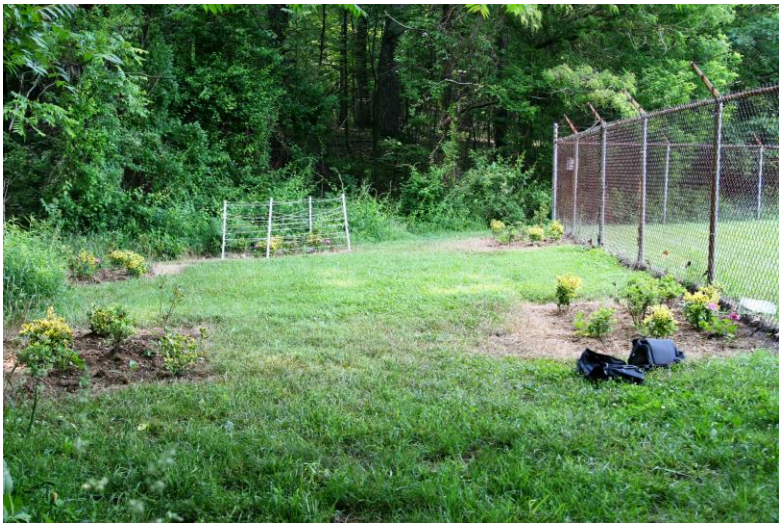


Figure 14.
A geranium plant in the research study that was foraged by deer. Picture taken May 28th, 2010.

Figure 15.
An Azalea in the research study that was foraged by deer. Picture taken May 28th, 2010.

Figure 16.
Google Map image of the project location, with the four research plots located on the former Blacksburg High School property.