

Using Commercial Deer Repellents to Manage Deer Browsing in the Landscape

Damage to ornamental plants by white-tailed deer (*Odocoileus virginianus*) has increased dramatically over recent years. Deer damage to home landscapes and gardens is the number one complaint in suburban areas. An integrated approach to deer damage management can often be the most optimal way to deal with the problem. Using any one or a combination of strategies including population management, fencing, vegetation management, and commercial repellents or scare tactics is the best approach to minimize negative impacts from deer. Commercial deer repellents have become increasingly popular with residential homeowners as a means of keeping deer damage at tolerable levels. For more information on deer management strategies, refer to Maryland Cooperative Extension Bulletin 354, "Managing Deer Damage in Maryland," and Extension Fact Sheet 655, "Resistance of Ornamentals to Deer Damage." Additional sources of information can be found at www.naturalresources.umd.edu.

Repellents discourage deer feeding by having an offensive taste, odor, or a combination of the two. Repellents generally are not continuously effective, and a repellent that works in one location may not work in another. Repellents are gen-

erally more effective when the following conditions exist:

- 1) Low to moderate deer pressure
- 2) Light to moderate feeding damage
- 3) Small acreage
- 4) Repellents are not being used on adjacent properties
- 5) Alternative food sources are available

If any of the above conditions are not typical of your situation, then you should compare the cost of using repellents to fencing systems or other available deer management practices.

How Repellents Work

Taste-based (also known as contact) repellents are applied directly to plants and repel deer due to their foul taste. Taste-based materials must be consumed to be effective. Some damage can occur before deer become trained to the fact that the plants have an offensive taste. Because a number of deer may try the treated plant, substantial damage can occur.

Odor-based repellents deter by their offensive smell. These types of repellents are generally more effective if sprayed directly on the plants to be protected as deer are not as inclined to try the plants. Their effectiveness however, may be reduced under very cold conditions.

Odor-based repellents are also used as area repellents. Area repellents are designed to deter deer from a specific site rather than from a particular plant. Human hair, bar soap, and tankage (slaughterhouse by-products) are sometimes used as area repellents. Many liquid formulations of both taste- and odor-based repellents have a sticker that allows them to adhere to the treated plants for up to several months. Due to concerns for safety and potential negative impacts on plant palatability the use of repellents on edible plants is lim-

ited to a few materials that usually will wash off with rainfall.

Combination odor- and taste-based repellents provide the benefits of both kinds of materials. New formulations continue to become available. Multiple types of repellents and modes of action allow homeowners to switch or rotate materials. It is generally recommended that repellents be changed with each application. Deer will become used to repellents over time so changing repellents often will keep the deer herd cautious and confused. This will tend to increase the effective-

Table 1. Popular Deer Repellents.

ActiveIngredient	Mode of Action	Use on Edibles	Longevity	Trade Names
Salts/fatty acids of ammonia	Odor	Yes	Up to 4 weeks depending on the amount of rainfall	-Hinder -Deerbusters Deer and Rabbit Repellent
Garlic oil	Odor	Yes	Reapply after a heavy rain	-GD Deer and Insect Repellent -Garlic Barrier
Capsaicin Castor Oil	Taste	Yes	Up to 30 days depending on the amount of rainfall	-Miller's Hot Sauce -Scoot Deer
Predator Urines	Odor	Not Directly	± 30 days	-Coyote, wolf urine—many products available
Fish and/or beef by-products	Odor/taste	Not within 8 weeks of consumption	± 30 days during dormant season, every 10 to 14 days during the growing season	-Bobbex -Deerbusters Plant Growth Stimulant
Putrescent egg-based products	Odor	No	1 to 3 months or more	-Deer Away BGR -Rejex -It Deer Chaser
Thiram fungicide-based products	Taste/odor	No	1 to 3 months or more	-Bonide Chew-Nott -Deerbusters Deer Repellent and Turf Fungicide -Shotgun Deer & Rabbit Repellent
Blood-based products	Taste/odor	No	1-3 months or more	-Plantskydd -Repellex
Denatonium benzoate or bitrex	Taste	No	1-3 months or more	-Tree Guard -Ropel, Repel
Egg, garlic, fish oil, hot pepper, bitrex or some combination	Taste/odor	No No No No No Yes Yes	1-3 months or more	-Deerbusters Deer I -Deer Stopper II -Deer Off -Bobbex -Liquid Fence -MGD Deer Repellent -Not Tonight Deer -Deer Blocker

ness of repellents in general. Table 1 lists a number of popular deer repellents.

The number and type of commercial repellents continues to grow as new products are developed. Repellents should be selected based on the active ingredient in the material rather than based on brand name. Brand names often sound similar and can be somewhat confusing. As an example, one of the repellents used in this trial was Deer Away Big Game Repellent (Deer Away BGR). Deer Away BGR is an odor-based repellent derived from putrescent egg solids. A different repellent also sold as Deer Away is derived from chili and mustard oil. It repels by

both odor and taste. Deer Away BGR was used in this study.

Applying Commercial Repellents

The most important consideration when preparing to apply a commercial deer repellent is the label. Always follow label directions carefully. The recommended application of most repellents is during the dormant season. In general, repellents should be applied on windless days when the temperature exceeds 40°F. This can be challenging during the winter months when temperatures may remain at or below freezing for long periods of

Table 2. Cost of Commercial Repellents from Ready-To-Use (RTU) Sources or Derived from Concentrate Formulations (2002).

Trade Name	Cost/Gallon RTU	Cost/Ounce RTU	Cost/gallon from concentrate	Cost/ounce from concentrate
Plantskydd	\$92.16	\$.72	\$17.12	\$0.13
Deer Off	\$88.32	\$.69	\$29.95	\$0.23
Hinder	\$85.76	\$.67	\$ 3.66	\$.03
Deerbusters Deer I	\$79.36	\$.62	\$20.74	\$.16
Deer-Away BGR	\$79.36	\$.62	\$24.95	\$.19
Deer Blocker	\$76.80	\$.60	\$11.99	\$.09
Bobbex	\$71.68	\$.56	\$13.25	\$.10
Scoot Deer	\$67.84	\$.53	n/a	n/a
Plant Growth Stimulant	\$67.84	\$.53	\$ 6.65	\$.05
MGD Deer & Insect Repellent	\$67.84	\$.53	\$18.36	\$.14
Shotgun Deer and Rabbit Repellent	\$66.56	\$.52	n/a	n/a
MGD Deer Repellent	\$65.28	\$.51	\$22.95	\$.18
Repellex	\$64.00	\$.50	\$23.62	\$.18
Ropel	\$60.16	\$.47	n/a	n/a
Tree Guard	\$57.60	\$.45	n/a	n/a
Liquid Fence	\$39.68	\$.31	\$8.75	\$.07
Not Tonight Deer	n/a	n/a	\$1.99	\$.02
Rejex-it Deer Chaser	n/a	n/a	\$5.99	\$.05
Deerbusters Deer & Rabbit Repellent	n/a	n/a	\$2.00	\$.02
Miller's Hot Sauce + Vapor Guard	n/a	n/a	\$.46	Less than \$.01

n/a – not available

time. Rainfall should not be expected for a number of hours so the repellent can dry properly.

Deer change their feeding patterns seasonally in response to changes in available foods. For example, deer may feed heavily on acorns and other fruits and nuts in early fall. When these foods are mostly gone by late fall they shift their feeding patterns to focus on tender tips and buds (next years flowers and leaves) of woody plants and ornamental evergreens. Damage to most residential landscapes, nurseries, and forest tree plantings occurs during the winter months. It is better to apply repellents before a pattern of feeding is established, so that deer focus their browsing elsewhere. Once deer establish their feeding patterns, repellents may be less effective. In Maryland and surrounding areas, a first application is recommended for late October or early November. Additional applications may have to be made. It's also important to note that if no alternative foods are available or if the deer pressure is too high, even the best planned repellent program may fail. For example, if a few residents in a development initiate a repellent program, it may be effective, but, if all residents participate, it is less likely to be effective. If the deer pressure is extremely high in an area, repellents may not be very effective even on single properties, or may be effective only for a few weeks.

Repellent formulation and ease of application are other factors to consider when selecting a commercial repellent. Repellents are packaged as either Ready-To-Use (RTU) materials or as concentrates, which must be mixed with water and applied with a pressure sprayer. RTU repellents, as the name suggests, are purchased in the actual spray container and are easy to use. You simply shake or agitate the container, point and spray. They are also much more expensive than those

mixed from concentrates. RTU repellents are generally most appropriate when you have a limited number of plants to treat.

Information on the cost of applying some of the more popular commercial repellents has been compiled in Table 2. The cost is listed for both Ready-To-Use (RTU) materials and for those mixed with from concentrate products. All products may not be directly comparable as there may be differences in concentrations and coverage of different products, enabling one product to treat more vegetation per ounce than another.

Repellents can be purchased locally at garden stores and other outlets or from supply companies found on the Internet. In many cases, products can be purchased at a lower price from supply companies.

Results from Applied Research on Commercial Repellents

Maryland citizens want to know which repellents are most effective, the duration of effectiveness, and how much they cost. Eight different brand name repellents were tested during the winter months of 2000, 2001, and 2002 in Montgomery County, Maryland. Table 3 lists the repellents and the years they were tested. The repellents were tested over three winters to determine their effectiveness in protecting Japanese yews (*Taxus cuspidata*) in 2000, azaleas (*Rhododendron* sp.) in 2001, and English yews (*Taxus baccata*) in 2002. Each of these shrubs is highly preferred by deer. The repellents were chosen to represent the range of active ingredients available in commercial preparations.

Sites for the trials were located in areas known for deer populations that usually resulted in heavy deer pressure on landscapes. Deer populations in the areas where research was conducted exceeded

Table 3. Commercial Repellents Tested (2000-2002).

Brand Name	Mode of Action	Active Ingredient	Year Tested		
			2000	2001	2002
Repellex	odor	Blood by-products		X	X
Plantskydd	odor	Blood protein	X		
Deer I	odor/taste	Putrescent eggs, garlic, pepper	X		
Liquid Fence	odor/taste	Whole eggs, garlic		X	X
Plant Growth Stimulant	odor	Food by-products & fertilizer	X		
Bobbex	odor/taste	Fish by-products, garlic & fertilizer		X	X
Deer Away BGR	odor/taste	Putrescent egg-based	X	X	X
Tree Guard	taste	Denatonium benzoate or bitrex	X	X	X

100 deer per square mile. The population estimates were developed with the assistance of surveys conducted using Forward Looking Infrared Radar (FLIR) photography. During winter months, warmer objects such as people and animals stand out in FLIR aerial photography from typically cooler backgrounds consisting of vegetation. These thermal imagers enable surveyors to count deer in the dark. Consistently high deer numbers were recorded in the study areas. Park property and private residences located near parkland were used for the repellent trials.

The trials were designed so products tested each year represented a range of active ingredients available on the market. During the winter of 2000, Tree Guard, Deer Away BGR, Plantskydd, Plant Growth Stimulant, and Deerbusters Deer I were applied. In years two and three, Repellex was substituted for Plantskydd. Both repellents are blood-based and have similar modes of action. Bobbex was substituted for Plant Growth Stimulant in 2001 and 2002. These are also similar compounds, repelling deer by both odor and taste. They each contain plant fertilizer and are derived from similar parent materials. Liquid Fence was substituted for

Deerbusters Deer I for the last two years of the study. Both are garlic- and egg-based and repel by odor and taste. The substitutions were made to provide testing of a range of products where the substituted material was less expensive or had different mixing instructions.

Trial Design

The dormant season is considered the prime season for deer browse damage on ornamentals in home landscapes. The plants in this study were anchored in place in mid-January each year and removed in late March or early April depending on the time period of the trial. Each site used in the study contained 24 potted plants placed four meters apart and anchored securely to the ground by large steel stakes driven through the root ball and pot. This assured the plant would maintain its position for photographic purposes. The study was replicated using six different treatments with four shrubs per treatment. The four plants receiving the same treatment were randomly picked to avoid any predictable pattern. The six treatments consisted of one control where no repellent was applied, and five other



Figure Left, the parkland used for the Year 2000 trial. Right, the process of photographing plants against a white board with a digital camera.

treatments of different repellents as noted in Table 3.

A digital camera was used to take a photograph of each plant at the time of planting and on a regular basis afterward, usually once per week. A large white piece of cardboard was positioned behind each plant so that all plant material showed up black against the white background (See Figure 1). The photos were taken from the same location (one meter from the plant) and height on each occasion. An image software program was used to measure the amount of deer browse that had occurred. The software measured the amount of black area in plant material against the white background and expressed it as the

total number of pixels. As deer browsed the plants the amount of dark plant material decreased against the white background resulting in a reduction in the total number of pixels. The total numbers of pixels from the photographs taken at planting time were compared to the number of pixels in subsequent photographs. The decrease in the number of pixels was expressed as the percentage loss of plant material or the area of the plant reduced by browse.

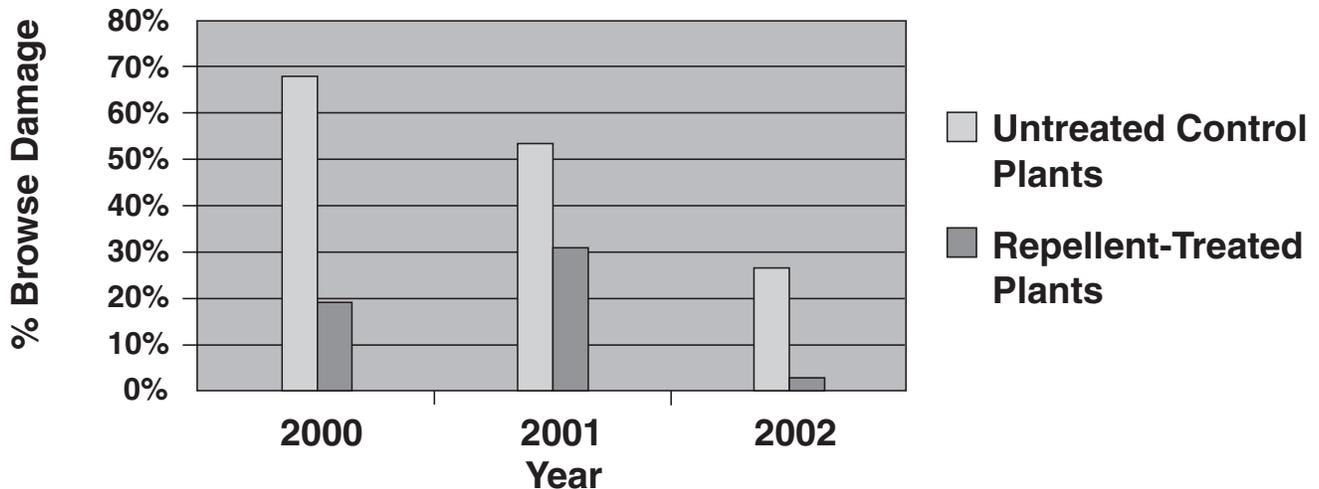
Results

The results of the three-year study are listed by individual treatment, summarized in Table 4 and illustrated in Figure 2.

Table 4. Winter Deer Browse Study Results (2000-2002).

Treatment	Percentage of plant area reduced by deer browse for each treatment on all sites by year (Year)			Percentage of plants browsed for all three years
	2000	2001	2002	
Control Plants	68	53	27	49
Tree Guard	15	35	2	17
Deer Away BGR	10	26	1	12
Bobbex	N/A	27	7	17
Liquid Fence	N/A	36	4	20
Repellex	N/A	31	2	16
Deer 1	21	N/A	N/A	21
Plantskydd	26	N/A	N/A	26
Deerbusters PGS	26	N/A	N/A	26
Average loss all repellents	20	31	3	18

Figure 2. Amount of Deer Browse Damage for Treated and Untreated Shrubs for 2000 through 2002.



All repellent treatment results are grouped together and compared to browse reduction losses suffered by the control plants in Figure 2. The plants treated with repellents experienced less browse damage from deer relative to control plants each year.

Year 2000 Results

The plants chosen for the trial in year 2000 were Japanese yews in one-gallon pots. The winter of 2000 was near normal on average in terms of both temperature and precipitation. January, however, was very cold with heavy snowfall that persisted for about three weeks. The rest of the winter featured above normal temperatures. Three different sites with 24 plants at each site were used. Two of the test sites were located on parkland in the northern portion of Rock Creek Regional Park in Montgomery County. Each site was located within 100 yards of a stream and was adjacent to woodland. One of the two sites on parkland was adjacent to private land that was undergoing active development within a few hundred yards. The third test site was located in an established residential suburban development about two miles south of the other two sites and within 100 yards of county-owned parkland. All three sites represented near ideal deer habitat in a suburban environment.

In the 2000 trial, the average reduction due to deer browse was 68 percent, for the 12 untreated control plants. The 60 plants treated with a repellent had average reductions of plant area of only 20 percent. The most effective repellent was Deer Away BGR with only 10 percent of the plant lost to deer browse. Tree Guard was second in effectiveness with 15 percent of the plant lost to browsing followed by Deer 1 (21%), and Plantskydd and Deerbusters PGS at 26 percent each. This represented a range of 16 percent between the various products and was not statistically different.

One parkland site adjacent to an active development project had erratic test results. The active development appeared to be disruptive to traditional deer movements in the area. The other parkland site and the residential site showed a more consistent pattern. The results are summarized in Table 4.

Year 2001 Results

Three different varieties of azaleas in three-gallon pots were chosen for the trial in 2001. The winter featured less than average snowfall with slightly above average temperatures. Two different sites were used with 24 plants at each site. Each test site was located within or adjacent to



Figure 3. The residential site used for the 2001 trial (left). The stream on the right was within 50 feet of the trial plants. Large numbers of deer (up to 20 at a time) were seen in the area on multiple occasions.

Rock Creek Regional Park. A residential landscape on a small farmette (9 acres) with a stream and adjoining wooded parkland was one location. Park property was used for the second test site (the same location used in Year 2000 that was adjacent to active development on private land).

Once again the repellent-treated plants suffered less browse damage when compared to the control plants that had no repellent applied. The control plants suffered average browse losses of 53 percent, while the plants treated with one of the commercial repellents had an average browse loss of only 31 percent. Plants treated with Deer Away BGR and Bobbex had the lowest browse levels of only 26 and 27 percent, respectively. These were followed by Repellex (31%), Tree Guard (35%), and Liquid Fence (36%). The range of browse losses was only 10 percent between all the products and statistically was not significantly different.

Similar to the trial in Year 2000, the trial on the parkland site adjacent to active development had erratic results. The residential site demonstrated the expected pattern, with the control having high amounts of browsing, while the plants treated with repellents had lower levels of browsing.

Year 2002 Results

English yews in three-gallon pots were used for the trial in 2002. Two sites within the county park system were selected. Twenty-four plants were used at each site for a total of 48 plants. Park property adjacent to a stream within Rock Creek Regional Park was one location. The second site was located in an old hayfield adjacent to a heavily wooded area with heavy deer pressure within Little Bennett Regional Park. The winter was unusually warm with almost no precipitation. Temperatures for January through April averaged 3.9°F above normal. Precipitation was almost 4 inches below normal for the four-month period.

The plants treated with repellent had almost no browse damage. Browse losses on the treated plants averaged 3 percent, with the highest amount at 7 percent. The untreated plants had average browse losses of only 27 percent, compared to 68 and 53 percent in the previous two years of trials. The winter was so unusually warm and dry that the repellents would have been expected to perform well. Deer required less food to maintain their body needs and there was more vegetation available from other sources.

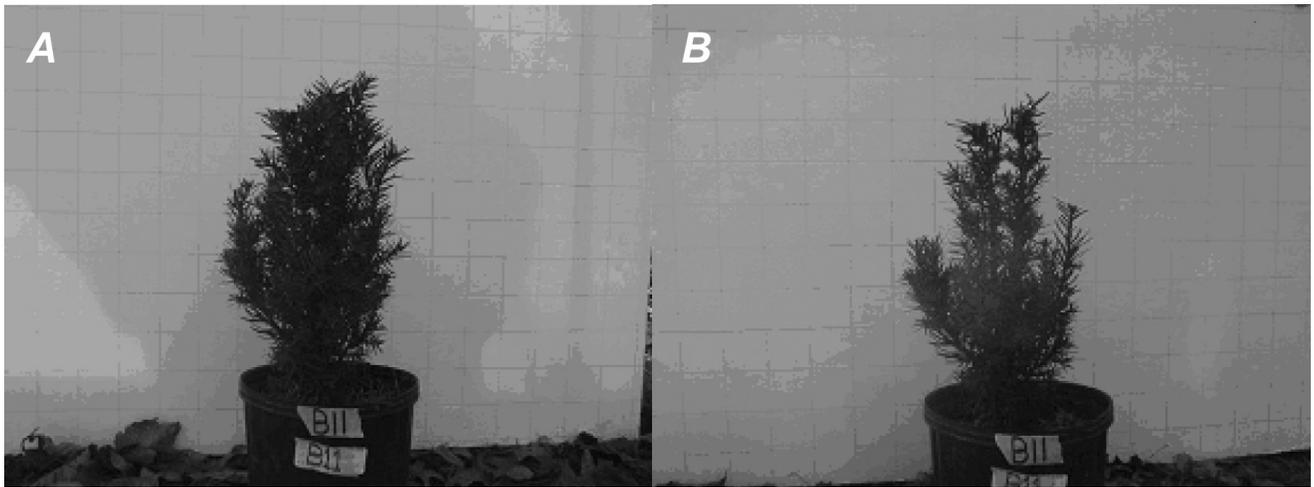


Figure 4. Browse Damage Levels (0-20%). Photo A represents the plant (B11) as it was first placed. Photo B represents the same plant with browse losses of 20%.

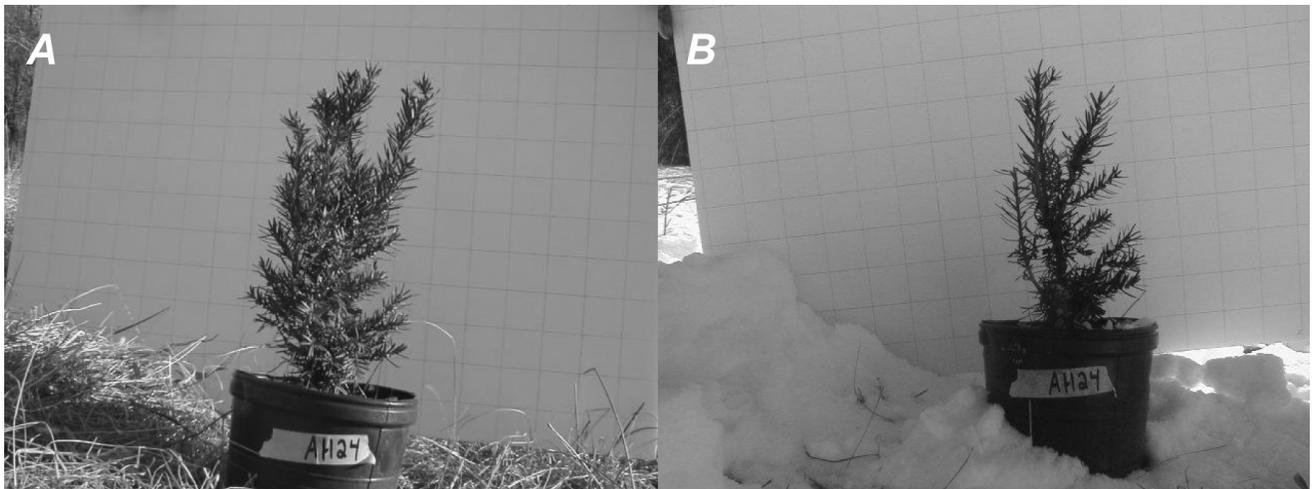


Figure 5. Browse Damage Levels (0-40%). Photo A represents the plant (AH24) as it was first placed. Photo B represents the same plant with browse losses of 40%.

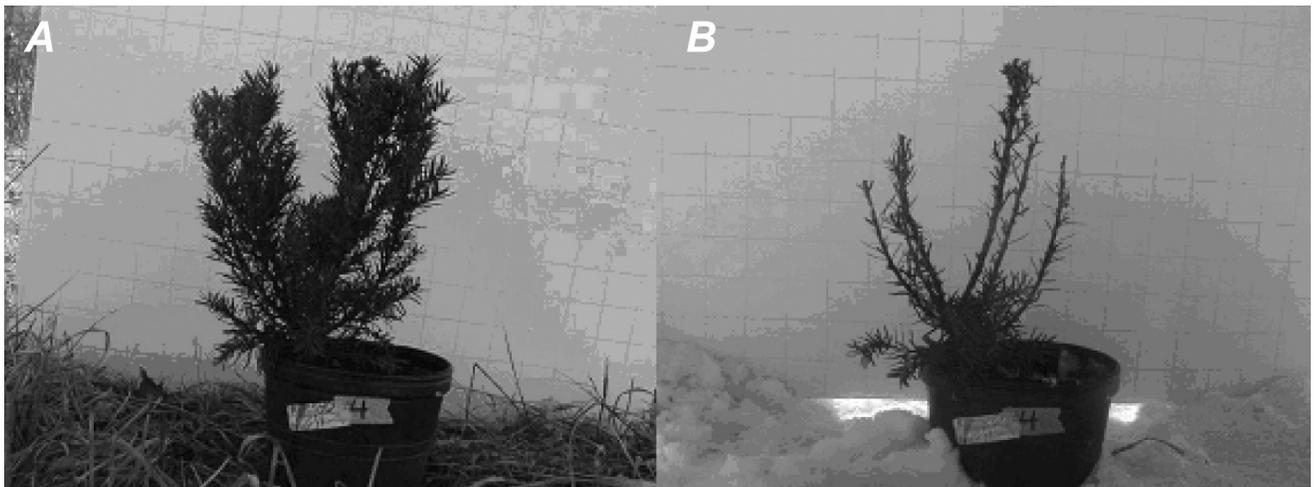


Figure 6. Browse Damage Levels (0-65%). Photo A represents the plant (4) as it was first placed. Photo B represents the same plant with browse losses of 65%.

Damage Tolerance Levels

Some representative levels of browse damage are illustrated by the sets of photographs in Figures 4-6. A group of 72 Extension Master Gardeners and homeowners involved in deer management workshops in 2002 were surveyed as to what levels of browse damage they would tolerate. The group was shown seven photographs of plants with deer browse ranging from 0 to 88 percent. Responses indicated that this group was willing to tolerate browse damage levels between 25 and 35 percent. This particular group of people may actually have less tolerance for animal damage to plants than a random population sample due to the fact they are mostly avid gardeners. The data developed over the three-year repellent study provides strong evidence that the materials used will keep damage to tolerable levels for most people. The repellents on average, held browse damage levels to less than 35 percent. Over the three-year trial, only 27 of 140 plants (19%) treated with repellents had browse damage levels above 35 percent. Twenty-one of the 28 untreated control plants (75%) had damage levels exceeding 35 percent.

It must be cautioned that the shrubs in this study were small and the impact of similar levels of browsing on larger shrubs over multiple years is hard to estimate. It is possible that repellents may reduce the browsing losses, but it is unclear if all users will find the reduction acceptable.

Conclusions

Commercial deer repellents had a significant effect on reducing deer browse on ornamental plants in this research trial. It should be noted some repellents tended to perform better than others. The following generalizations seemed to hold true for this study:

- Even at sites with the highest deer pressure, repellents held damage in check for six to eight weeks, in many cases. At sites with less deer pressure, 10 to 12 weeks of effectiveness was common. On sites with high deer pressure, repellents will most likely be effective but may require more frequent re-application (as often as every 6 to 8 weeks).
- Warmer and drier winters will likely increase the effectiveness of repellents due to increased longevity of the repellents and the increased availability of alternative foods. Both odor- and taste-based repellents were tested over the three-year period. Taste-based repellents have proven more effective in the colder northern climates, but they showed no clear advantage in the mid-Atlantic region. Tree Guard was the only taste-based repellent tested. Its performance was comparable to the odor-based repellents.
- There were distinct differences in the ease of use for various repellents.
 - o Plantskydd was available as a wettable powder that was very difficult and time consuming to mix and keep in suspension. It also tended to clog the sprayer.
 - o Some ready to use materials performed poorly after being used initially and then being stored for a day or so. Repellex and Tree Guard tended to clog the sprayer when reused after a period of storage.
 - o Deer Away Big Game Repellent is available in a kit requiring kneading and mixing two packets. The ready to use form is much easier to use but is expensive compared to other products.
 - o Some products will clog sprayers if they are allowed to freeze. In general, it is best to store all repellents in a location that will not freeze.

- Cleaning the sprayers after application requires large amounts of hot water, soap or detergent, and repeated rinsing. In many cases, an odor will still remain even after a thorough cleansing.
- Rubber gloves are recommended for mixing, applying, and clean-up of sprayers used for deer repellent applications. If these materials are spilled on the skin, they are very difficult to remove. It is important to read and follow all label directions when applying repellents.
- Most products have minimum temperature (40°F or above in general) requirements for application. Mid-winter applications may require careful timing to assure the temperature will remain above 40°F for an adequate period of time.
- This research was conducted during the dormant season for ornamental plants. Deer pressure during the winter months is typically higher for suburban landscape plants due to the lack of alternative foods. Applications during the growing season would need to be more frequent as new plant growth would have to be treated regularly to minimize damage.
- If a few residents in a development or community initiate a repellent pro-

gram, it may be effective, but, if all residents participate, the effectiveness may likely be reduced. This is because the need for deer to find food in an area will overcome the deterrent value of the offensive odor and taste provided by the repellents. Repellents can be very costly over the long term (see Table 2). It is unlikely deer pressure will be reduced in the near future. Homeowners should consider the use of deer fencing as a more cost-effective long-term strategy in areas where it is possible.

Note: When trade names are included, no discrimination against similar products is intended. Mention of trade names in this publication does not constitute endorsement by Maryland Cooperative Extension.

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