Effect of Repellex™ Deer Repellent on Browsing of Container-grown Ornamental Shrubs

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INTRODUCTION

Agricultural and wildlife agencies show that plant damage caused by wildlife has increased significantly over the past 30 years (Conover and Decker, 1991). In the eastern United States, the wildlife species that is causing the most damage to landowner's property is the white-tailed deer (*Odocoileus Virginianus*). This damage occurs when deer feed on commercial crops, nursery grown ornamentals and regenerated forest seedlings, resulting in serious economic losses to the property owner (Curtis and Richmond, 1994). Causes for this increase in deer damage include increased deer abundance, human population shifts to suburban areas, conversion of abandoned farm land to deer habitat, landowner decisions to prevent deer hunting, restrictions on the use of firearms in suburban regions, and enforcement of dog leash laws (Curtis and Richmond, 1994).

When food is scarce, deer are known to eat almost any kind of plant species (Curtis and Richmond, 1994). In general, deer seem to highly prefer fertilized plants over unfertilized plants (Conover and Kania, 1988). This puts agricultural crops, landscape plants and nursery grown ornamentals at a greater risk of being chosen as the food source for localized deer. In addition, deer consume approximately 3% of their body weight in food each day (Curtis and Richmond, 1994).

Deer population in the U. S. has increased from 12 million in 1988 to 30 million today (Jescavage-Bernard, 1998). When under stress, deer are known to produce multiple offspring, and the incidence of twin and triplet births increases (Jescavage-Bernard, 1998). Relatively speaking, an average doe and her female fawns can produce up to 100 fawns in a 10-year life span (Jescavage-Bernard, 1988).

A common complaint in the Southeast is the white-tailed deer's ability to cause major damage to the nursery industry as well as to residential and commercial landscapes. Landscape browsing reduces the aesthetics of the environment and results in financial loss to the homeowner in the form of decreased property value. Deer browsing of nursery grown plants drastically decreases their marketability. (Swihart and Conover, 1990). Huge economic losses to nurseries occur each year as a result of deer browsing (Conover, 1984).

Many nurserymen and landscapers attempt to deter deer by spraying ornamental plants with foliar applied repellents. However, when applied to containerized nursery plants, foliar applied repellents are diluted and washed off by frequent overhead irrigation and rain, thereby losing their effectiveness.

This study is intended to evaluate the effectiveness of a systemically absorbed deer repellent

tablet, Repellex™, and it's foliar applied counterpart, Repellex™ liquid, manufactured by Repellex Seeding Protection Systems, British Columbia, Canada.

According to the manufacturer, the systemic repellent is absorbed through the plant's roots into the stems and leaves and imparts an undesirable taste to the foliage. Compared to foliar-applied liquid repellents, which are worn away over time due to weathering or new plant growth, Repellex marketers say the systemic has repellent qualities for up to 2 years once inside the plant. The manufacturer also states that the systemic requires 4 to 6 weeks to be effectively absorbed by the plant. Therefore, it is recommended that the foliar applied spray, Repellex liquid, be used initially in conjunction with the tablet to protect the plant while the systemic repellent is being absorbed.

METHODS AND MATERIALS

Repellex liquid concentrate contains dried animal blood plasma (30%, active ingredient), natural latex sticker (20%, inert), Paprika Resin concentrate (0.05%, inert), and a bitter/ denaturing agent (0.05%, inert). Instructions say to mix 3 parts water to 1 part concentrate.

The systemic tablet form of Repellex is a 14-2-2-fertilizer, marketed as a 1.5gm tablet (about the size of antacid tablet). It contains denatonium benzoate, lactose, ammonium phosphate, hydrous magnesium and potassium sulfide. It is recommended that two to eight tablets, depending on the size of the container, be placed adjacent to the root ball, two inches below the surface, during transplant. To date, the product had been used, to a large extent, to protect transplanted forest seedlings from deer browsing.

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Plants for this study (in trade gallon containers) were provided by the Center for Applied Nursery Research. They were grown in a standard growing medium consisting of pine bark/sand(9:1 ratio), dolomitic lime(4 lbs./cu.yd.), gypsum(2 lbs./cu.yd.), Micromax micronutrient mix(1.5 lbs./cu. yd.), and 19-6-11 slow-release fertilizer(14 lbs./cu. yd.) Four to six replications of each treatment were used, depending on the study.

Plants treated with the systemic tablet were maintained at the Center for six to eight weeks to give the material sufficient time to be absorbed by the foliage (manufacturer recommendations). Then all plants were transported to the Whitehall Forest Research Station at The University of Georgia in Athens. Once there, the foliar spray was applied to selected treatments, according to the manufacturer's recommendations, and allowed to dry. Then all plants were placed randomly throughout a deer holding pen, ½- to 1 acre in size, containing a constant number of deer throughout the study (study 1 had 5 deer in a ½ acre pen, study 2 had 16 deer in a 1-acre pen, and study 3 had 7 deer in a ½ acre pen).

To prevent the deer from knocking over the containers or pulling the plants out of the containers, the containers were secured with two metal rods (½ inch wide and 12 inches long) placed just inside the rim and on opposite sides of the container. A hammer was used to pound the rods through the bottom of the container and into the ground, leaving about 1-inch of each metal rod above the soil line. Then a 10-inch length of 12-gauge wire was carefuly placed across

the top of the container and secured to each metal rod to prevent the deer from pulling the plants from the container. Once secured, the wire was pushed down to the soil surface to mask its visibility.

Plants were watered by hand three times per week by applying approximately 240 milliliters (8 ounces) of water onto the surface of the container. Plant growth index, initially and at weekly intervals, was used to measure the degree of deer browsing. This was done by multiplying three measurements: plant height, plant width at the widest point and plant width perpendicular to the first width measurement. Growth index was then analyzed statistically using the Proc Mixed program (SAS Institute Inc, 1989). This program contrasted and statistically analyzed the difference between treatments at each observation..

Deer were given supplemental feed and water by the forestry staff, and the only vegetation in the pens, in addition to native pines and hardwoods, were native broadleaf weeds. Rainfall data at the site was monitored during studies 1 and 2 and is shown in Table 1.

Table 1. Average Weekly Rainfall (inches) during Study # 1 and Study # 2

	Week								
	1	2	3	4	5	6	7	8	Total
Study #1	0.15	0.43	0.00	0.15	0.92	0.27	0.53	0.18	2.63
Study #2	0.78	0.97	0.29	0.94	0.094	0.00	n/a	n/a	3.02

Study 1

The first study evaluated the effectiveness of foliar applied Repellex liquid on deer browsing. There were two treatments: Repellex liquid applied to the foliage according to manufacturer recommendations and untreated check. Three common ornamental plants reported by nurserymen to be highly preferred by deer were used for this study: Gumpo Azalea (*Azalea* spp.), daylily (*Hemerocallis* spp.) and Indian Hawthorne (*Raphiolepis indica*).

Results of Study 1

Results of this study showed that amount of deer browsing varied by species. For azalea, there was no significant difference between treated and untreated plants during the first 5 weeks of observation (Fig. 1). By week 6, growth index for the untreated azaleas declined significantly as deer began to feed heavily on the untreated plants. However, the sprayed plants remained unbrowsed throughout the 8-week study. By week six, deer had begun browsing lightly on the treated daylilies, while the untreated plants were browsed to the container by week two (Fig. 2.). Untreated Indian Hawthorn plants were browsed significantly by the end of week one, remained relatively unbrowsed through week five, then were browsed to the container by week six (Fig. 3). Treated plants remained unbrowsed through week six, then were browsed significantly.

One may question whether a delay in initial browsing might be attributed to the timidness of the deer following the introduction of foreign objects (containerized plants) into their environment. However, it was our observation that the deer, being curious animals, began exploring the containers soon after they were placed in the pen.

Study 2

In this study, the effect of both foliar applied Repellex liquid and the systemic Repellex tablet on deer browsing was measuered. Two plant species reported by nurserymen to be commonly browsed by deer were used: Gumpo Azalea (*Azalea* spp.) and daylily (*Hemorocallis* spp.). Treatments were as follows:

1. Two Repellex tablets/plant at transplant + foliar spray
2. Foliar spray (no tablets)
3. Two Repellex tablets/plant at transplant (no foliar spray)
4. Untreated check

Results of Study 2

Azaleas treated with liquid Repellex, with or without the systemic tablet, were nibbled slightly initially but were not significantly browsed throughout the study (Fig. 4.). Azaleas treated with the systemic tablet alone were browsed immediately and were browsed to the container by week two. Daylilies treated with Repellex tablets and liquid were browsed slightly by week one, but remained unbrowsed for the remainder of the study, whereas plants treated with the tablets alone or untreated were browsed to the container by week two (Fig. 5). Again, the liquid Repellex was significantly better than the systemic tablet in preventing deer browsing.

We would like to have continued this study a few more weeks, but researchers at the deer research facility needed to use the deer for another project, so we had to terminate the study at the end of five weeks.

Study 3

Study 3 evaluated the effect of Repellex tablets on deer browsing when used at time of propagation and again at the time of transplant. Once again, plant species reported by nurserymen to be highly browsed by deer were used: Gumpo Azalea and Manhattan Euonymus (*Euonymus kiautschovicus* 'Manhattan'). Treatments were as follows:

1. One Repellex tablet adjacent to the cutting at time of propagation + two Repellex tablets adjacent to the root ball at time of transplant.
2. One Repellex tablet adjacent to the cutting at time of propagation (no tablets at time of transplant)
3. No tablets (untreated check)

All cuttings were treated with Dip and Grow rooting compound at 2000 ppm concentration at time of propagation and placed in 3-inch pots. Plants were maintained 8 weeks under mist to allow for sufficient rooting, then transplanted into trade gallon containers, held an additional 8 weeks in the nursery, then placed in the deer pens.

Results of Study 3

After two days, all treatments of both species had been browsed to the container.

CONCLUSION

Based on parameters of these studies, the foliar applied Repellex deer repellent was consistently more effective in preventing deer browsing than the systemic Repellex tablet. However, our irrigation was applied directly to the container by hand whereas in a nursery situation water is applied via overhead irrigation. Therefore, it's likely that the foliar applied liquid may not have the same residual in a nursery as it did in this study.

Due to the growing deer pressure in our urban environments, an effective systemically absorbed deer repellent could potentially have a tremendous impact on the nursery and landscape trade. The manufacturer is encouraged to continue perfecting the absorptive and dosage properties of the material to assure a more rapid and complete uptake of the repellent.

ACKNOWLEDGEMENT

Appreciation is expressed to the Center for Applied Nursery Research for funding this study, to Kay Bowman and Aaron Leachman at the CANR for their assistance with the treatments, and to McCorkle Nursery for providing the plants. Appreciation is also expressed to Dr. Glenn Ware, Statistician for the College of Agricultural and Environmental Sciences, for his assistance with data analysis. We also are grateful for the assistance and cooperation of David Osborne, Research Associate in the School of Forest Resources, who provided us access to the deer holding pens at the Whitehall Forest Research Station.

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Fig. 1. Average Weekly Growth Index by Treatment for Azalea

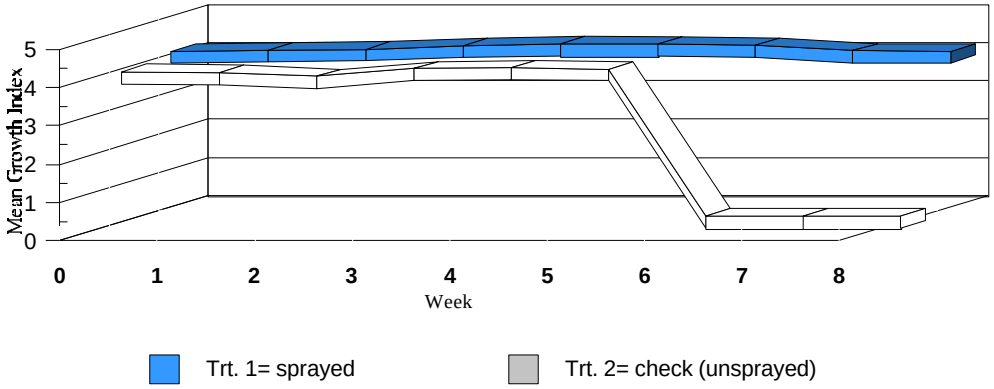

Fig. 2.. Average Weekly Growth Index by Treatment for Daylily

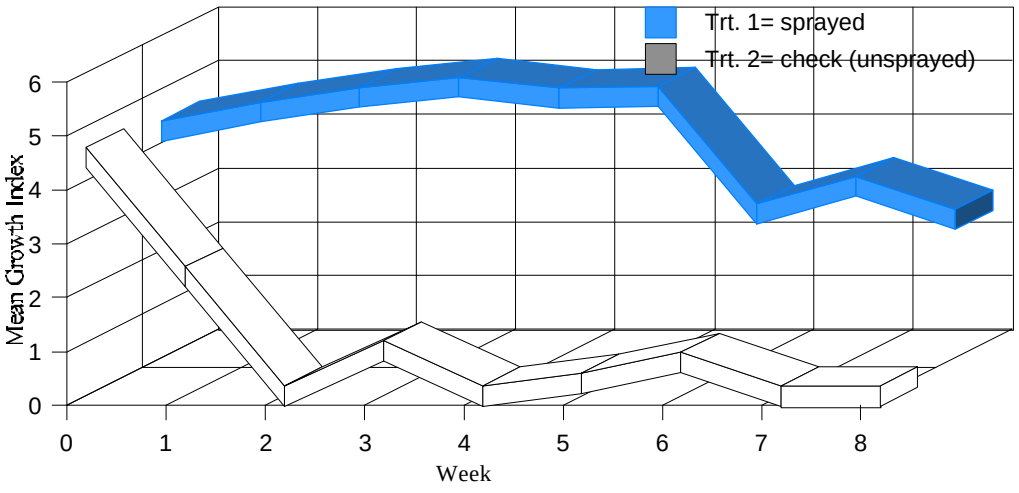

Fig. 3. Average Weekly Growth Index by Treatment for Indian Hawthorne

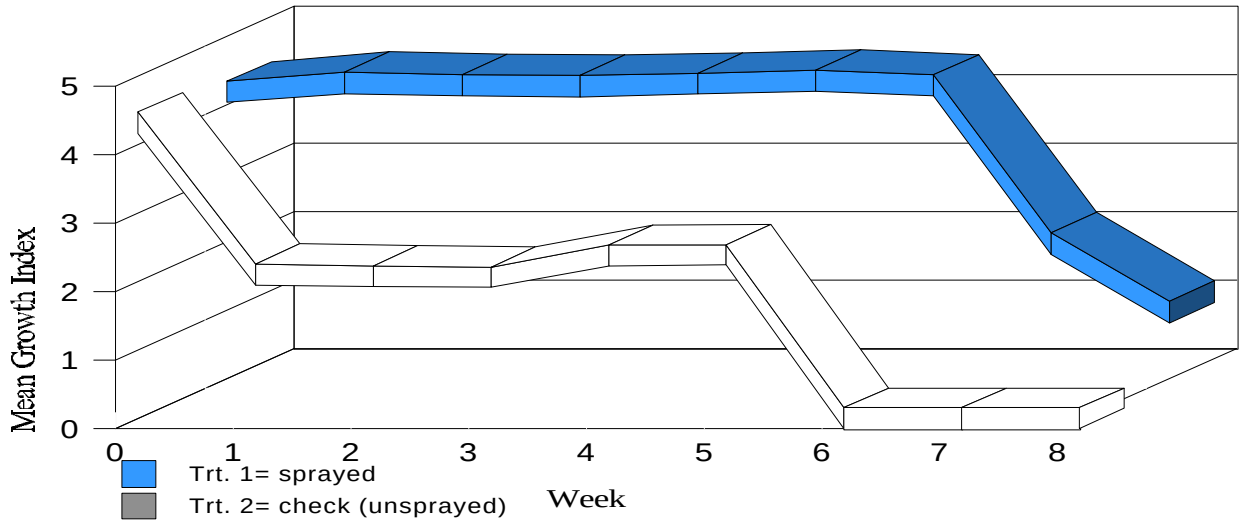

Fig. 4. Average Weekly Growth Index for Azalea

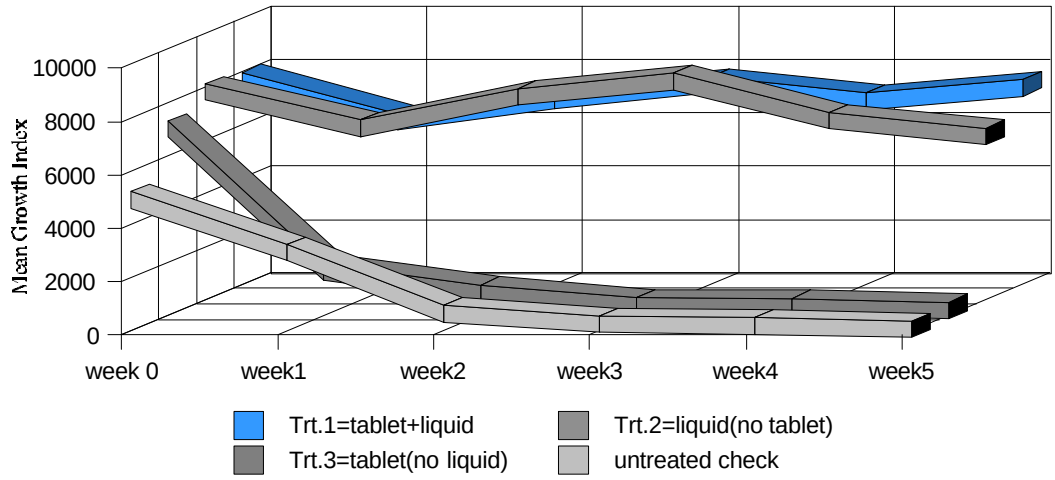

Fig. 5. Average Weekly Growth Index for Daylily

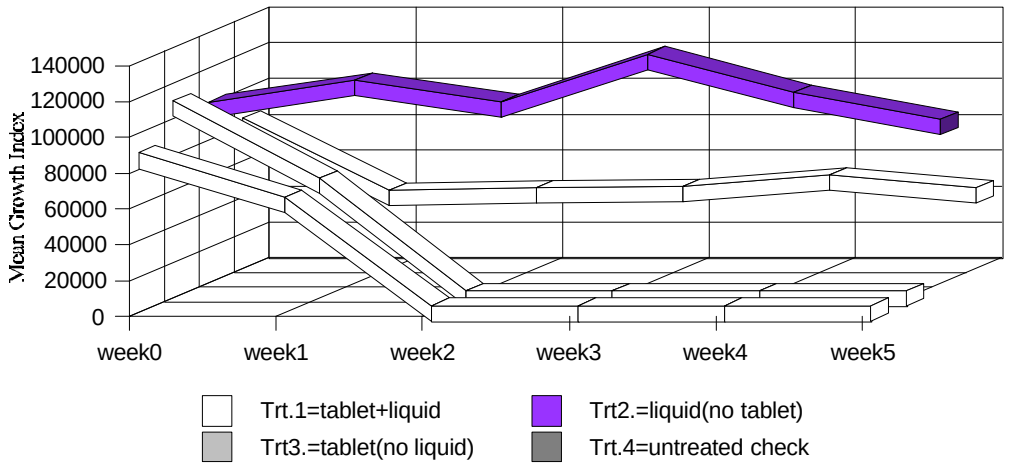

Fig. 6. Average Weekly Growth Index by Treatment for Azalea

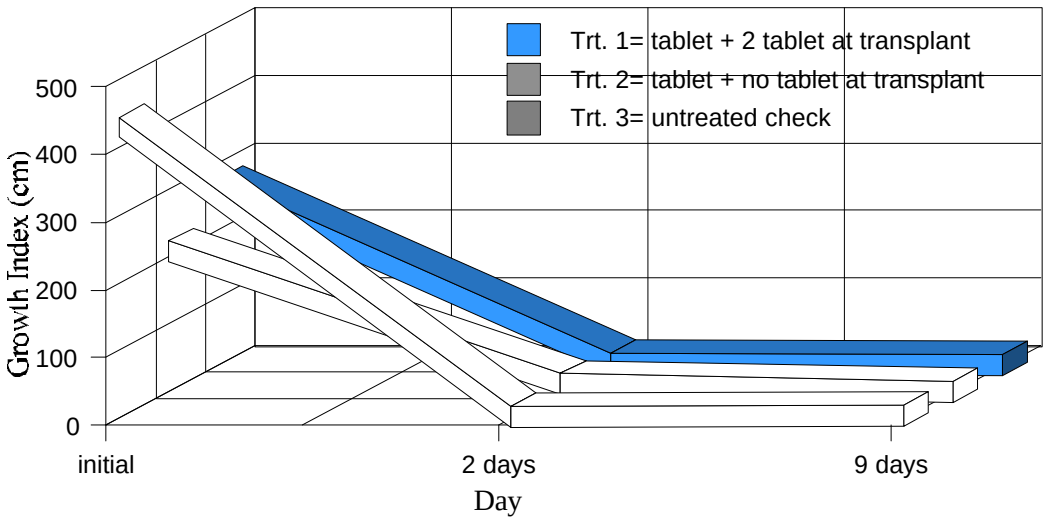

Fig. 7. Average Weekly Growth Index by Treatment for Euonymus