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Comparison of Commercial Deer Repellents

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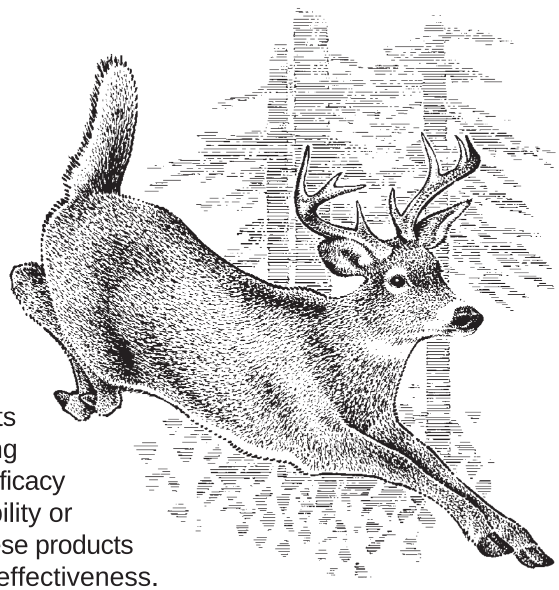

Foraging deer can severely hinder regeneration of newly stocked stands. Chemical repellents (along with fencing and individual tree shelters) are socially acceptable nonlethal tools to reduce deer damage. New products are continually entering the market, but their efficacy varies greatly. Availability or even registration of these products does not equate with effectiveness. Some repellents may contain active ingredients at concentrations below avoidance thresholds. Others may contain ingredients that don't repel the target species. The Olympia Field Station of the USDA Animal and Plant Health Inspection Service, Wildlife Services, National Wildlife Research Center has conducted numerous studies to identify trends that could help predict the efficacy of repellents. A recent test evaluated 20 commercially available repellents representing a variety of active ingredients (Wagner and Nolte 2001).

How Repellents Work

Deer repellents generally rely on fear, conditioned avoidance, pain, or taste.

Fear-inducing repellents contain compounds that emit sulfurous odors (such as predator urine, meat proteins, or garlic). We interpret the avoidance of these odors as a fear response, suggesting herbivores perceive sulfurous odors as indicators of predator activity.

Conditioned avoidance occurs when ingestion of a food is paired with nausea or gastrointestinal distress. Animals generally don't eat as much of a food if it is associated with illness.

Active ingredients, such as capsaicin, allyl isothiocyanate, and ammonia, cause pain or irritation when they contact trigeminal receptors in the mucous membranes of the mouth, eyes, nose, and gut. An inherent problem of using pain repellents is that they are universally aversive to all mammals.

Bad taste can also induce avoidance. Bittering agents are often used to induce a bad taste. Unfortunately, while omnivores normally avoid bitter tastes, herbivores are generally indifferent, at least at the concentrations used in most repellents.

Delivering Repellents

Repellents may be incorporated into the plant (systemic delivery), spread throughout an area (area delivery), or applied to the plant (contact delivery).

Systemic repellents are compounds absorbed and translocated by the plant, rendering the foliage less desirable. Systemic delivery is ideal. The repellents are contained within the plant. They cannot be washed off, and the aversive agents are moved to new foliage as it grows. Few, if any, products have effectively incorporated repellents into a plant at concentrations that did not harm the plant.

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Area repellents are products that create a chemical barrier animals will not cross, or products that permeate an area with an odor that cause animals to avoid the area. Little evidence suggests animals will abandon areas treated with area repellents except when highly palatable alternative foods are readily available elsewhere.

Contact repellents are products that are topically applied or attached directly to a plant. If the goal is to reduce consumption of plants, available evidence suggests that chemical repellents are most effective when they are applied directly to the plants.

Test of Commercial Repellents

A study directly compared 20 commercially available deer repellents (table 1). These products relied on fear, conditioned avoidance, pain, and taste. Fifteen products were contact repellents. The others were area repellants. All products were applied according to the manufacturer's recommendations. An initial test to screen all 20 repellents was conducted during the winter while seedlings were dormant.

Tests were conducted in five pastures containing five or six captive black-tailed deer (*Odocoileus hemionus columbianus*). Pastures varied from 2 to 5 acres with natural habitat consisting of Douglas-fir, alder, and associated understory vegetation (figure 1). Trees were planted in 21 plots scattered evenly across each pasture. A separate plot was used for each repellent with one plot of untreated seedlings serving as a control. Plots consisted of three rows of three western red cedar (*Thuja plicata*) seedlings planted at about

Table 1—Product names, sources, active ingredients, and modes of action for repellents evaluated as a means of reducing black-tailed deer damage to western red cedar seedlings during deer repellent tests from October 1998 to July 1999 at Olympia, WA.

Mode	Product and Manufacturer	Active Ingredient
[1]CA	**Detour** (Sudbury Consumer Products Co., Phoenix, AZ)	7% thiram
Fear	**Deerbuster's Coyote Urine Sachet** (Trident Enterprises, Frederick, MD)	50% coyote urine
Fear	**Wolfin** (Pro Cell Bioteknik, Hornefors, Sweden)	Di (N-alkyl) sulfides
Fear	**Deerbuster's Deer and Insect Repellent** (Trident Enterprises, Frederick, MD)	99.3% garlic juice
Fear	**Deer Away Big Game Repellent Powder** (IntAgra, Inc., Minneapolis, MN)	36% putrescent whole egg solids
Fear	**Deer Away Big Game Repellent Spray** (IntAgra, Inc., Minneapolis, MN)	4.93% putrescent whole egg solids
Fear	**Bye Deer** (Security Products Co., Phoenix, AZ)	85% sodium salts of mixed fatty acids
Fear	**Hinder** (Pace International LP, Kirkland, WA)	0.66% ammonium soaps of higher fatty acids
Fear	**Plantskydd** (Tree World, Lackawanna, NY)	87% edible animal protein (in concentrate)
Pain	**Hot Sauce** (Miller Chemical and Fertilizer Corp., Hanover, PA)	0.53% capsaicin and related compounds
Pain	**Get Away Deer and Rabbit Repellent** (DRR), IntAgra, Inc., Minneapolis, MN)	0.625% capsaicin and related compounds, 0.21% isothiocyanate
Taste	**Ropel** (Burlington Scientific Corp., Farmington, NY)	0.065% denatonium benzoate, 0.35% thymol
Taste	**Tree Guard** (Nortech Forest Technologies, Inc., St. Paul, MN)	0.2% denatonium benzoate
Taste	**Orange TKO** (TKO Industries, Calgary, Alberta, Canada)	d-limonene
Multiple	**Deer Stopper** (Landscape Plus, Chester, NJ)	3.8% thiram, 0.05% capsaicin, 1.17% egg solids
Multiple	**Not Tonight Deer** (Not Tonight Deer, Mendocino, CA)	88% dehydrated whole egg solids, 12% Montok pepper (in concentrate)
Multiple	**Plant Pro-Tec** (Plant Pro-tec, LLC, Palo Cedro, CA)	10% oil of garlic, 3% capsaicin and related compounds
Multiple	**Dr. T's Deer Blocker** (Dr. T's Nature Products, Inc., Pelham, GA)	3.12% putrescent whole eggs, 0.0006% capsaicin, 0.0006% garlic
Multiple	**Deerbuster's Deer Repellent Sachets** (Trident Enterprises, Frederick, MD)	99% meat meal, 1% red pepper
Multiple	**N.I.M.B.Y.** (DMX Industries, St. Louis, MO)	0.027% capsaicin and capsaicinoid product, 4.3% castor oil

[1]Conditioned avoidance

Figure 1—Penned black-tailed deer (*Odocoileus hemionus columbianus*) in one of the five pastures used during deer repellent tests from October 1998 to July 1999 at Olympia, WA.

3-foot intervals. At planting, seedlings were about 20 inches high with many lateral branches (figure 2). All seedlings were planted immediately before treatment.

Seedlings were examined for browse damage at 24 hours, 48 hours, and 1 week after planting, and then at 1-week intervals for 18 weeks. Damage was determined by counting the number of bites taken from each seedling. No more than 25 bites were recorded because seedlings were generally defoliated by then. Seedlings pulled from the ground were considered destroyed and recorded as having 25 bites.

Efficacy of repellents may vary depending on several factors, including available resources and seasonal changes in plant palatability. Red cedar seedlings are generally more palatable after winter dormancy has broken. Therefore, repellents that worked during the winter were tested again during the spring when seedlings were actively growing.

Figure 2—Olympia Field Station personnel planting western red cedar for the deer repellent tests. The 20-inch seedlings were planted at 3-foot intervals in three rows.

Results

Figure 3 shows the results of the winter test. None of the repellents eliminated deer browsing throughout the 18-week test. However, there were distinct differences among the repellents. In general, topical repellants performed better than area repellents. Fear-inducing repellents performed better than the other types of repellents. Eight of the nine repellants considered most effective for the first 11 weeks emitted sulfurous odors. Repellents containing decaying

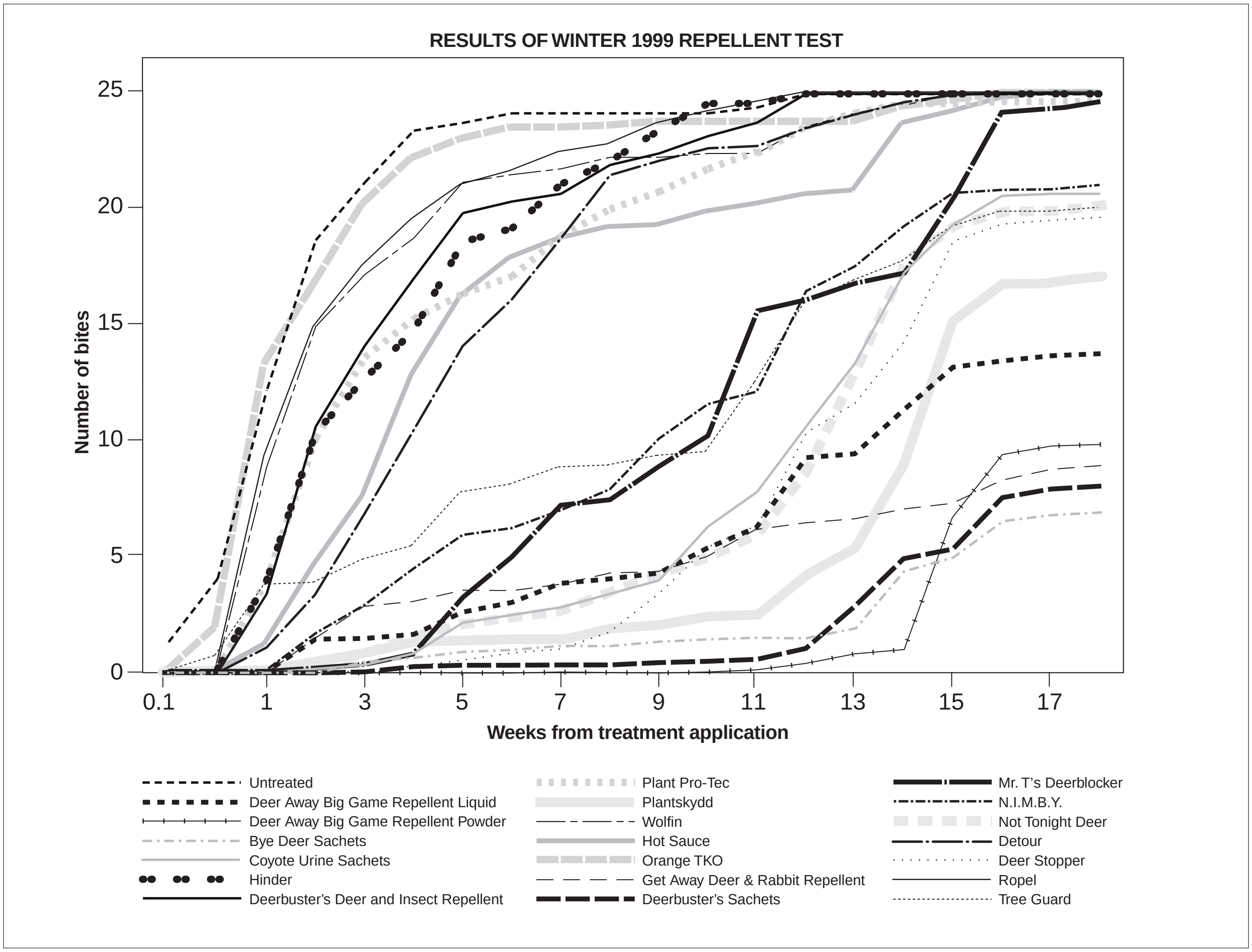

Figure 3—Average number of bites (maximum bites = 25) taken from repellent-treated western red cedar seedlings by black-tailed deer in an outdoor pen study from October 1998 to March 1999 at Olympia, WA.

animal proteins, such as egg or slaughterhouse waste, appeared to be the most effective. These repellents include Deer Away Big Game Repellent Powder (and liquid), Bye Deer Sachets, Deerbuster's Sachet, and Plantskydd.

Results were similar for the test conducted during spring 1999 (figure 4). None of the repellents provided complete protection throughout the 11-week test. Deer Away Big Game Repellent Powder was the most effective repellent tested, followed by Plantskydd, Deerbuster's Sachets, and Bye Deer Sachets. Get Away Deer and Rabbit Repellent failed to protect seedlings during this test.

Conclusions

During trials comparing the efficacy of repellents, those emitting sulfurous odors are generally the most effective. Deer Away Big Game Repellent Powder has been effective in several trials conducted by the Olympia Field Station, as well as in trials conducted by others. Browsing generally is eliminated for 4 weeks. The repellent provides good protection for 8 to 12 weeks, sometimes longer. Efficacy can be expected to decline significantly after 12 to 16 weeks.

Surprisingly few commercial repellents have effectively incorporated trigeminal irritants as active ingredients. Most likely, current repellents that depend on pain to induce avoidance are ineffective because concentrations are too low. Taste repellents, such as bittering agents, have proven ineffective in most trials. Efficacy of repellents based on conditioned avoidance is generally limited because

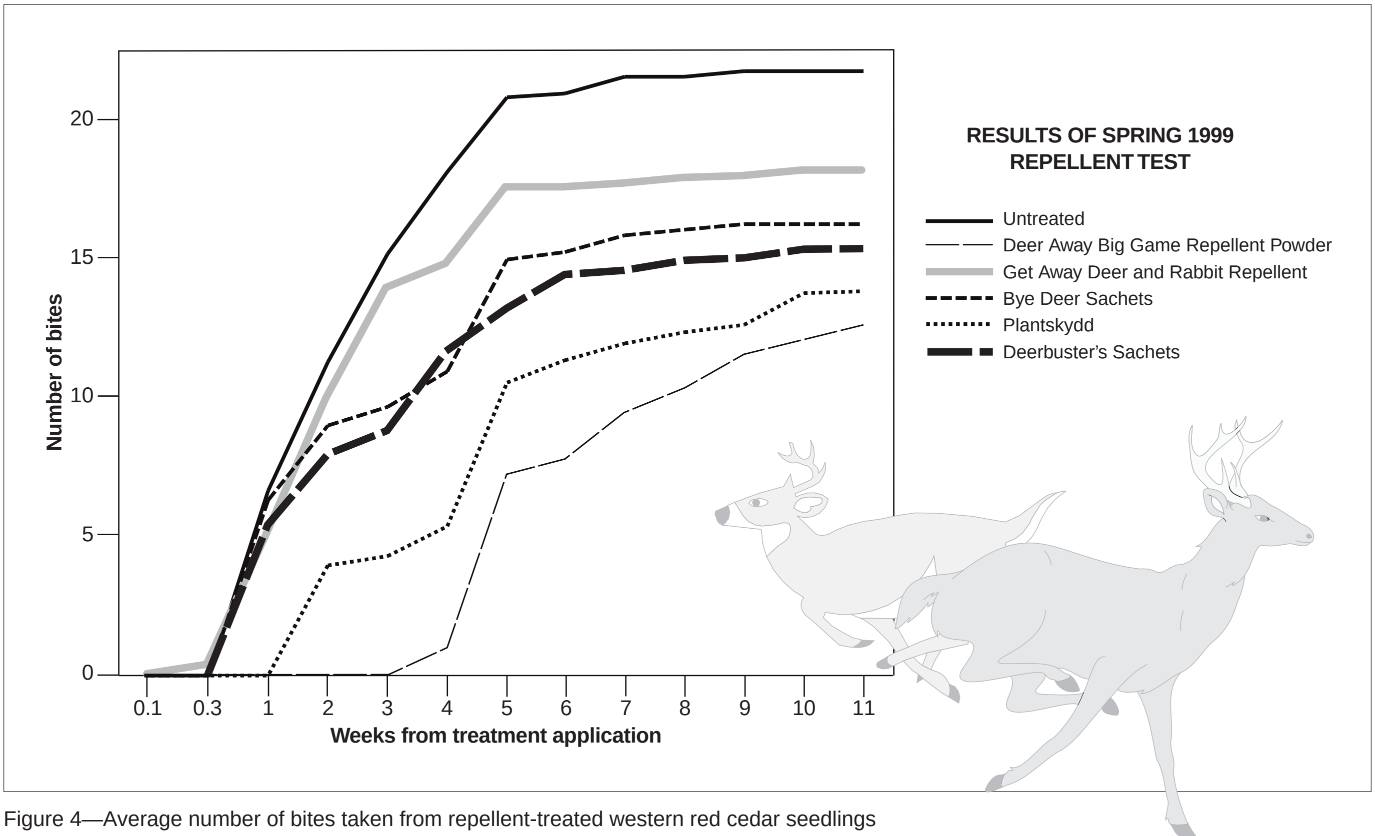

Figure 4—Average number of bites taken from repellent-treated western red cedar seedlings by black-tailed deer in an outdoor pen study conducted from May to July 1999 at Olympia, WA.

animals must be trained to avoid these materials. Damage inflicted on seedlings during training or subsequent sampling can be extensive. Repellents based on training are not likely to be effective for a transitory or migratory species (such as elk moving from winter to summer range).

Repellency is always susceptible to failure (Mason 1998). Many factors other than aversive properties affect a repellent's efficacy. Ultimately, avoidance of the protected plant is affected by:

- Number and density of the animals inflicting problems.
- Mobility of the problem animals.
- Prior experience of animals with foods and their familiarity with the surroundings.
- Accessibility of alternative sites.
- Availability of alternative foods.
- Palatability of the treated plants.
- Weather conditions.

Repellents that protect highly palatable plants from dense animal populations with few alternative foods will probably be effective under more favorable conditions. However, repellents that are successful under favorable conditions are not necessarily likely to be successful under less favorable conditions. It is difficult for someone to predict the efficacy of repellents in the field by extrapolating from empirical data. Anecdotal or testimonial evidence is even less reliable.

Source Material

This Tech Tip summarizes two manuscripts produced by the Olympia Field Station:

Nolte, D. L.; Wagner, K. K. 2000. Comparing the efficacy of delivery systems and active ingredients of deer repellents. In: Proceedings of the 19th Vertebrate Pest Conference. 19: 93–100.

Wagner, K. K.; Nolte, D. L. 2001. Comparison of active ingredients and delivery systems in deer repellents. Wildlife Society Bulletin. 29: 322–330.

Another report with information on this subject is:

Mason, J. R. 1998. Mammal repellents: options and considerations for development. In: Proceedings of the Vertebrate Pest Conference. 18: 325–329.

About the Authors

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Library Card

Trent, Andy; Nolte, Dale; Wagner, Kimberly. 2001. Comparison of commercial deer repellents. Tech Tip 0124-2331-MTDC. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 6 p.

Describes tests of 20 commercially available deer repellents in pastures containing five or six captive black-tailed deer. Tests were conducted during the winter and spring of 1999 by the Olympia Field Station of the USDA Animal and Plant Health Inspection Service, Wildlife Services, National Wildlife Research Center. Repellents emitting sulfurous odors were the most effective. Deer Away Big Game Repellent Powder virtually eliminated browsing for 4 weeks. It provided good protection for 8 to 12 weeks, sometimes longer.

Keywords: browse plants, browsing damage, reforestation, repellancy, repellents, wild animals, wildlife

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