Reducing Deer Browse Damage 1/

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A Summary of Techniques to Reduce Deer Browse Damage on Newly Planted Trees and Shrubs

Excessive deer browsing on newly planted trees and shrubs reduces the benefits of conservation practices. Gaps in windbreaks, erosion in riparian areas and reduction of plant and wildlife diversity are a few of the impacts of deer predation. For the affected trees, deer predation creates double or multiple leaders, increases susceptibility to frost damage, weakens branching, creates poor form, provides a path for disease or insect infestation, suppresses seedling height and increases mortality. Row planting of woody species in windbreaks, living snow fences, riparian forest buffers, bottomland forests and wildlife habitats lays out a cornucopia for deer that they cannot resist.

The problems associated with deer predation are not new. Studies of deer-deterrents, even electric fencing, were published as far back as 1939. In the past 10 to 15 years a number of products, techniques and methods have been developed and marketed that claim to deter deer from munching on newly planted trees and shrubs. Products include physical barriers such as bud caps, fencing or individual protectors and chemical deterrents using malodorous formulations or bitter tasting compounds. This document summarizes different techniques to discourage deer predation and offers guidance on developing a deer browse control plan. Realistically, deer predation will not be completely eliminated by any method; a 50 percent reduction is an achievable goal and will usually result in satisfying program cover requirements.

By analyzing deer behavior and reaction to barriers more effective deterrent methods can be developed. Listed below are some behaviors deer exhibit that may be useful in developing a deterrent plan.

- Learns to tolerate:
  - bad taste or smell,
  - colored strobe lights,
  - sirens and loud noises;
- Jumps high (up to 12 feet with sufficient motivation) or far (up to 30 feet with sufficient motivation), but not both at same time;
- Crawls through openings as small as 7.5 inches;
- More likely to jump fences in woodlands than in open areas;
- Learns to remove bud caps and netting protecting terminal buds;
- Follows customary paths to known food sources;
- Tests for weaknesses in any and all barriers, repeatedly;
- Nibbles young stems emerging from tube protectors and chemical repellents.

The more stressed the deer, the more vulnerable the plant. Extreme cold and deep snow restricts the movement of deer thereby intensifying the pressure on seedlings and saplings in a locale. If food supplies are decreased due to drought, flood, over-population, competition from other browsers or another reason, a sturdier barrier is required. No solution is 100 percent effective; a 50 percent reduction of deer browse is considered very successful; 30 percent is more likely.

The level of protection and the associated expense depends on the value of the plants to be protected. A greater level of protection is needed around crops, orchards and tree plantations such

1/ Authored by Ginger Kopp, NRCS State Staff Forester, St. Paul, MN, 55101, Dec. 2007

as for Christmas trees than for riparian areas and windbreaks. Still, a failed planting due to deer predation degrades the conservation practice, costs the landowner and wastes public financing.

METHODS OF DETERRENTS

- Replanting – if you have the resources, time and patience; may or may not work
- Exclosures – fencing, netting, protectors and other physical barriers; variable effectiveness
- Avoidance – shock, smell, noise, visual cues (flagging); may work for a short time
- Undesirability – fear repellents, irritants, flavor avoidance conditioning; must reapply often
- Availability – accessible and desirable alternative forage; very effective with other methods
- Elimination – fatal solution, carcass disposal, laws; very effective – few permits granted.

REPLANTING

When deer predation creates a practice failure, replanting may be required. However, replanting alone without any other form of deterrent is a path to future failures. Consider substituting a less desirable species (see Appendix A) when replanting the conservation practice and couple this with an easily accessible food plot or hedgerow with desirable plants to draw deer away from the conservation area. Another strategy is to hide the conservation plants among undesirable species creating a visual and physical barrier. The 'cover' trees can be designed to lead deer to a more acceptable feeding site.

Use NRCS Conservation Practice Standard Tree/Shrub Establishment, Code 612, for replanting trees and shrubs damaged or consumed by deer. Complementary practices for controlling deer incursion into the new stand include Hedgerow Planting, Code 422 for wildlife food, cover and corridors; Fence, Code 382 for excluding deer, and if an alternative food plot is used Upland Wildlife Habitat Management, Code 645. Replanting, *by itself*, under most circumstances will not result in successful establishment. Using exclusively undesirable plants (see Table 1) may be successful only if the site conditions are suitable for the species and the deer are not starving.

EXCLOSURES

Exclosures are physical barriers that keep deer out and away from conservation plantings. The exclosures may fence out an area, or protect an individual plant or even just cover the terminal leader of a plant. In general exclosures are non-lethal, labor intensive, costly, maintenance demanding plant protection devices. There are advantages and disadvantages for each type of exclosure. Fences, whether permanent or temporary, are the most effective exclosure method but need regular maintenance and are the most expensive choice. Tree shelters protect newly planted seedlings yet may be considered unsightly and are often poorly installed. Bud caps or terminal nets are inexpensive yet can be lost under varying conditions. Judge whether it is best to protect individual plants or vulnerable plant parts or exclude the whole area when deciding on a deer deterrent.

<u>Bud Caps/Netting</u>

Bud caps work on the theory of "out of sight, out of mind". If the deer does not see the terminal bud, then it will not eat it – hopefully. This method can be effective where deer browsing is light yet persistent; but if not applied securely, deer learn to pull the caps off. Bud caps do not work well on hardwoods because at the time they are needed, flower or leaf buds are sprouting and cannot be covered; also hardwoods have multiple flushes during the growing season and there is no way to secure bud caps on elongating shoots. Apply bud caps in the fall, before snow covers the ground. They should be reapplied every year until the tree is at least 4 feet tall, and the terminal bud is out of easy reach of the deer.

The bud cap itself is a simple device consisting of a piece of paper wrapped around the leader, covering the terminal buds. Covering about ⅓ to ½ of the plants is usually as effective as covering every single plant. Put more around edge rows than middle rows to keep deer from entering the planting. Use lightweight paper such as computer or typing paper cut into 4" x 6" pieces (quarters) so the caps are light enough that they do not cause the leader to bend over due to the weight of the bud cap. Other bud capping materials include: office paper, computer paper, old forms printed on card stock, index cards, envelopes, waterproof paper, tin foil, and plastic mesh or netting among other materials. The bud cap should be stapled in at least 3 places forming a tube. The staples should catch some needles to hold it in place.

Trees should be at least 1½ feet tall or have a sturdy leader if shorter, before bud caps are applied. A strong leader is important or the weight of the cap, particularly when wet, may cause the leader to droop thereby deforming the tree. Terminal buds should be about ½ inch below the top of the bud cap. Ideally this protects the terminal bud while still allowing the tree to grow through the paper during the next growing season. Browsing of side branches and buds is not as detrimental to the health and survival of pines unless the trees are to be used as Christmas trees or landscape trees. However, bud capping is probably not the best choice for these types of trees anyway.

Other than deer learning to pull them off and limited to conifer plantings; disadvantages include premature deterioration of the paper type bud caps from excessive moisture, bending or disfigurement of the terminal leader, regular or annual reapplication, aesthetics and incompatibility with some land uses.

Plan the use of bud caps when implementing the NRCS Conservation Practice Tree/Shrub Establishment, Code 612. Be aware that new seedlings may have terminal leaders not strong enough to support a bud cap; especially when the cap becomes wet. Consult with the local DNR office and the landowner to find out the level of deer browse and when it occurs before applying bud caps to determine that the use will likely be effective.

Tree/Shrub Protective Devices

Individual protective devices also known as shelters, tubes, protectors and cylinders, are commonly used in Minnesota. This type of protective device was developed in Britain and made public in 1979. Shelters are made of plastic materials designed to deteriorate after about five years. Shelters were originally developed to protect hardwoods from deer browse damage but other advantages were also discovered such as:

- Tree shelters allow plantings in irregular patterns or patterns better reflecting the landscape and aesthetics of the site;
- Tree shelters provide a microclimate similar to that of a greenhouse with increased concentrations of CO_2, higher temperatures and elevated humidity levels that encourage plant height growth;
- Tree shelters encourage single stems in trees and shrubs that tend to have multiple stems or sprouts.

Although temperatures in the shelter during summer months were higher than the ambient temperatures, rarely were plants killed by the heat. In fact larger trees with more leaves had lower mortality rates than smaller trees likely due to greater transpiration rates of the larger plants that provided enough of a cooling effect. Increased CO_2 levels stimulate stem elongation while extra humidity reduces moisture stress.

Excessive stem elongation, physiologically known as etiolation, is linked to lower light levels in opaque shelters which can be up to 77 percent less than ambient light levels. Lower light levels

cause etiolation because the plant is drawn towards the brighter light source at the top of the shelter. Etiolation occurs at the expense of diameter growth and taper (narrowing of stems towards the top of the plant).

Lack of wind action on woody plants grown in shelters causes them to form weak stems without a taper. This makes them susceptible to lodging and breakage on windy days if the shelters are removed too early. Keeping the shelters in place two to three years after crown emergence, even if the terminals are out of reach to deer, is recommended to give time for the stems to become windfirm. Once the shelters are removed, height growth slows down in favor of diameter growth and a natural taper is formed. The shelters need to be removed before the stem diameter reaches that of the shelter. Studies show that after six to twelve years depending on the species and site conditions, sheltered trees and unsheltered trees have the same average height and diameter.

There are disadvantages with using individual shelters.

- Trees in shelters often do not harden off in time to avoid die-back of new growth from extreme cold weather. To avoid this situation it is recommended that the shelters are 'lifted-up' a few inches in the fall to facilitate hardening-off, then re-positioned before snow and extreme cold sets in. In a large area this would be prohibitively labor intensive. Another alternative is to use shelters with vent holes.
- "Goose-necks" or crooks in stems are malformations that are a result of stems rubbing up against the edge of the shelter. These deformations may make the tree more susceptible to wind or ice damage. Some shelters have smoothed or rolled edges to avoid this type of damage.
- Shelters do not overcome inherently poor site conditions such as a low site index for the species. Do not depend on the 'greenhouse effect' to substitute for poor soil or site conditions.
- Weed control is essential for the success of tree shelters; however, one problem brought up in the literature is that the use of fabric mats with tree shelters acts as a magnet for deer. The theory is that the mats make the plants more visible to them.

Other considerations

- Installing shelters on individual trees and shrubs is labor intensive and time consuming. For very large areas a fence will probably be more effective and economical.
- Adequate maintenance is required to straighten leaning trees, secure stakes heaved by frost action and replace broken stakes. Most metal stakes oxidize and become weak making them a poor substitute for wood stakes. Rotting and breakage of wood stakes can be minimized by applying a wood preservative before using. Using treated stakes is another alternative.
- In general rigid (solid), plastic tree shelters are for hardwoods not conifers.
- If conifers need protection beyond bud caps, netting or mesh type tree shelters are recommended.
- If mesh, wire or netting shelters are used, check regularly that branches are not growing through the openings to ensure easier removal and less damage. Mesh openings no larger than 3/8 inch are recommended.
- Wire cylinders are more expensive, but can be re-used unlike the polypropylene or plastic which may or may not breakdown as advertised.
- Improperly installed shelters can become a nesting and feeding ground for rodents. Shelters must at least touch the ground and it is best to slightly sink them into the ground when securing them. Adequate weed control will discourage rodents from feeding around the stems.

- Trees and shrubs will be girdled and killed if the shelter does not deteriorate or is not removed by the time the stem diameter expands to the shelter diameter.
- Shelters can harbor bark-damaging insects if left on too long, weakening or killing the tree or shrub.

Tree shelters are planned under the NRCS Conservation Practice Standard Tree/Shrub Establishment, Code 612 and Windbreak/Shelterbelt Establishment, Code 380. Consult with the local DNR office and the landowner to find out if the severity of deer browse suggests that tree shelters are necessary.

Fences

Fences can exclude animals or direct them to another area, or to another control technique. If effective deer predation is essential for highly valuable plantings, or in sensitive areas, then an adequate fence is the only practical and economical solution. Fences can be permanent or temporary, many different materials are available and good designs have been developed. However, fences can be expensive because of labor, materials and maintenance costs. They also limit equipment access to the protected areas. If improperly constructed, a fence could trap an adventurous deer resulting not only harm to the protected plants, but also to the fence and to the deer. Research shows that fences could interrupt natural animal migrations patterns of deer and non-target migrating species.

Jumping to a vertical height of at least eight feet, deer can scale over barriers you may think are impossible. Watching a deer confronted with a vertical, eight-foot tall, high-tensile wire fence then watching it leap over from a standing position makes a startling impression. A frightened deer may hurdle a fence as high as 12 feet if given a running start and enough adrenalin. Horizontally, a deer may leap 15 to 30 feet, the longer distance only when frightened. In general, a deer may jump high or long, but not both at the same time. Deer have also been known to crawl under fences and through openings as small as 7.5 inches. The will of a deer to penetrate a fence is dependent on the force of the motivation behind it.

An excellent treatise on fencing to control deer predation is “Fences and Deer-Damage Management: A Review of Designs and Efficacy” by Kurt C. VerCauteren, et al. You can find a copy of this document in Section I of the eFOTG. Much of the material in this section is summarized from this reference.

Fence Types

Wire Mesh

Wire mesh type fences include: woven wire, chain link, welded wire, ‘v’ mesh and rigid-mesh panels. This type of fence is most suitable for permanent or long-term protection and is also the most expensive option. Woven wire is more expensive than welded wire, but it is more durable, lasting up to 30 years with minimal maintenance, and can follow contours of the land. For deer fencing, 12.5 gauge of high-tensile steel is recommended; using tension curves on horizontal wires. The elasticity of this type of material minimizes harm to a deer that collides with the fence and facilitates instillation on uneven terrain. To prohibit deer from crawling under the fence a single-strand of high-tensile wire or barbed wire can be placed between the fence wire and the ground to narrow gaps greater or equal then 7.5 inches.

Slanted Wire-Mesh Fence

The 3-dimentional effect of slanted fences confuses the depth of field of deer that discourages any attempt to jump over the fence. Electrifying the slanted fence provides even better deterrent capabilities. A typical design is a five-foot tall, seven-strand, high-tensile wire fence at a 45degree

angle to the ground. This type of fence takes up more space than a vertical fence and maintaining vegetation around it is more difficult. Be aware that using barbed wire rather than smooth wire may cause animals to get entangled while attempting to penetrate a barbed wire fence. Spacing between the strands should be less than 7.5 inches.

Electric Fences
These are expensive systems designed to protect high-quality crops, livestock feed, orchards, nurseries and other highly valued woody plants. A common set up is a minimum charge of 6,000 volts on a low-impedance energizer with a six foot tall high-tensile wire fence using 7 to 8 wires with alternative positive and negative current.

Polytape and Polyrope
These alternate materials are durable, easy to work with and cost comparable with traditional wire electric fences. Being highly visible they minimize collisions and there are fewer incidences of vegetation shorting out the fence when used with low-impedance energizers and running positive and negative charges on alternating strands. A single-strand electric fence of polytape or polyrope may be effective if deer pressure is light or if only temporary deterrents are required such as for migrating herds.

Fencing coated with chemicals
Using an attractant, such as peanut butter, with an electrified fence causes aversion by encouraging the deer to touch the electrified fence, thereby experiencing the shock and henceforth avoiding the area. Peanut butter or another attractant is spread on half of a piece of tin foil and the tin foil is folded over the electrified wire and stuck to itself by the peanut butter. Deer are shocked as they try to taste the peanut butter. Malodorous chemical repellents have also been used with electric fences. In both cases these methods deter feeding under moderate deer pressure.

Gates
The only effective gates are closed gates, obvious yes, yet not always practiced. Gates must be as tall as the fence yet easy to use. In designing gates, consider the means of removing animals that have breached the fence. One-way gates are available for this purpose.

Refer to the NRCS Conservation Practice Standards Fence, Code 382, Hedgerow Planting, Code 422 or Use Exclusion, Code 472 for more information about installing fences or other structures for excluding deer. Deer pressure must be severe and the value of trees or shrubs high to justify the expense of fencing.

AVOIDANCE / UNDESIRABILITY

Avoidance techniques use scare tactics to deter deer from browsing plants. Deer learn from negative feedback when trying to browse protected plants. Avoidance includes bad tasting chemicals, noise, lights, shock or pain. Noise and lights may work for very short periods of time but are not effective for a persistent problem since deer become used to the noise and lights. Note: in the following discussion mention of specific products does not mean endorsement of the product by USDA.

Chemical repellents
Chemical repellents are short-term solutions used in the following situations:

- where deer predation occurs over a limited time period such as during late winter;
- when deer browse can be predicted such as along migration routes; or
- where regular applications are needed and practical until threat of damage has passed.

Chemical repellent effectiveness depends on: palatability of protected plant, population density and number of animals, mobility of the problem animals, availability and palatability of alternate forage, weather, and amount and concentration of repellent. Chemical repellents work best when palatable alternate forage is available or is made available nearby. Repellents are effective only on vegetation (foliage) they cover; new growth emerging after application is not protected.

Repellents work by decreasing a plant's desirability where the efficacy depends on the intrinsic palatability of the crop plant compared to the desirability or availability to any alternative forage plants. If a plant is particularly desirable to deer, it may be consumed regardless of the repellent.

Repellents have different modes of action which include: fear, pain, taste and conditioned aversion. Fear induced aversions are usually sulfurous odors such as predator urines that provoke an aversion response (Wolf! Let's get out of here!). Conditioned aversion causes animals to form an association between the treated plant and illness like a stomach ache, causing the deer to avoid the plant in the future. Pain causing chemicals such as capsaicin (pepper), ammonia or other compounds irritates the eyes, mouth, nose and gut. Bitter tasting compounds containing denatonium benzoate are another mode of chemical repellent that sometimes works.

Repellents are most effective when:

- the damage is inflicted over a specific and relatively short duration such as on a reforestation site where damage occurs as deer migrate between winter and summer ranges;
- they are applied in areas with readily available alternate forage, 'hungry animals are more difficult to deter than satiated animals'.

Products directly applied to the plant (topical application) are more effective than pellets or scent packets, capsules or broadcast spraying. In a head-to-head study of 20 deer chemical repellents, published in 2001 by the Wildlife Society, Deer Away Big Game Repellent (powder form) and Plantskydd consistently reduced deer predations significantly more than any other chemical repellent tested. Both of these repellents rely on fear as a deterrent rather than taste (bitterness). It is important to follow package instructions and repeat applications throughout the year as necessary. In tests, these chemicals were effective for two-three months before reapplication was needed.

There are many other chemical products on the open market and many homeowners have developed their own concoctions touted as being effective as or more so than the commercial products. Only Plantskydd and Deer Away Big Game Repellent (powder form) have documented independent scientific tests showing consistent and effective decreases in deer browse damage and are the only two chemical repellent products eligible for EQIP funding under the Practice Standard Invasive Plant Species Pest Management, Code 797 in the EQIP payment schedule. Any products providing independent reproducible scientific proof of consistent and effective decrease in deer browse damage can be considered for cost-share through the normal approval process with NRCS. Program participants can apply any repellent deemed effective if a deer browse problem exists, however, only the above two products are eligible for EQIP cost-share at this time.

Weather plays a part in protecting plants. Repellents are dissolved or diluted by rain or covered with snow reducing the effectiveness of the repellents to the point where they become useless. Reapplication may be necessary. The protected area needs to be regularly checked to insure that the repellent is present and in sufficient amount to remain effective. The concentration of the product needs to be sufficient to deter deer and should be the minimal effective amount. If a lower concentration seems to be ineffective then stronger concentration may work; however by this time the deer may already be habituated to the bad taste or smell.

Chemical repellents are often found to be more effective on small areas and less effective on larger areas. Deer must spend more time and energy moving to untreated forage as protected areas increase. In larger areas it is harder to maintain a consistent concentration of the product. Also, the larger the area, the further deer must travel to desirable plants and they may decide that the closer plants, however bad tasting or smelling, are much more convenient.

In published studies no repellent completely stopped predation (browsing) by deer or other ungulates. The goal is to reduce predation so that the tree and shrub establishment practice meets the minimum standard required for the program. The use of chemical deterrents can be included when planning and designing the NRCS Conservation Practice Standard Tree/Shrub Establishment, Code 612. Application of chemical repellents may be cost-shared in EQIP under the practice standard Pest Management, Code 595, in the payment schedule. Timing is important when using chemical repellents and they must be reapplied after a heavy rain or snowfall and until deer pressure is reduced.

AVAILABILITY

The importance of available, palatable forage cannot be overstated. Hungry deer and other ungulates such as elk will feed on treated plants if hunger overcomes their fear response. Studies show that chemical repellents are more effective on less palatable plants than on highly palatable plants, an obvious conclusion verified by studies, but little used in tree and shrub planting designs. Interspersing higher palatable plants in between less desirable plants will help hide the desirable ones and create a physical barrier in getting to them. Establishing a strategically-placed wildlife food plot can work to move deer away from the conservation practice if room exists for the food plot.

Use NRCS Conservation Practice Standards Upland Wildlife Habitat Management, Code 645, to design food plots as alternate feeding areas for troublesome deer or Hedgerow Planting, Code 422 to provide food, cover and corridors. These are supplemental practices that are most effective when combined with other deer management control methods.

ELIMINATION

Eliminating deer that have learned to penetrate barriers is very effective. Deer teach others in the herd where to find food and the only solution may be to remove the lead deer so the learned behavior cannot be passed on. Managing the deer herd population is controversial yet effective. However, a landowner may see an annoying and costly pest while the neighbor sees only ‘Bambi’. Decreasing herd numbers through hunting antlerless deer will reduce deer populations and browse damage. Landowners can decide if they want to rent out their land for hunting or hire a specialist to remove antlerless deer or lead deer.

Minnesota DNR does not consider deer a nuisance animal that can be taken under the nuisance law. In fact MNDNR considers deer a protected game species. The Wildlife Damage Program was created to help resolve problems when wildlife ruins specialty crops. Specialty crops include fruits, vegetables, turf, honey sources, stored forage, row crops when damaged by geese, and disease management within 5 miles of a tuberculosis infected livestock herd. Under these conditions the DNR may be able to provide materials and expertise to reduce or eliminate the damage caused by wildlife.

Special permits for out-of-season hunts are considered as a last resort by DNR. Landowners need to work with their area wildlife manager to get a permit and will need to prove that the damage is severe and all other measures to minimize damage have been unsuccessful. These measures include legal in-season hunts. For row crops, forage or conifer plantations very few permits are issued.

When a permit is issued the hunt is restricted to antlerless deer, the deer must be field dressed and the landowner cannot keep any of the deer taken. There are more rules, contact the local area DNR wildlife manager for more information. There are no NRCS Conservation Practice Standards or cost-share provisions for deer elimination.

DEER BROWSE MANAGEMENT PLAN

Effective management of problematic deer takes a multifaceted approach. Just like controlling weeds takes an integrated pest management approach that considers all the pest's behaviors, habitats and environmental factors, the same can be done for deer (and other animal pests of plants). Table 2 is a synopsis of the methods discussed in this technical note that can be used to help design a deer browse management plan.

Deer browse management plans should consider the following:

1. Assessment – describe the problem and quantify or qualify the damage including costs, determine what is causing the damage (visual sightings, tracks, feces, trails, burrow systems, bite characteristics, scars on stems or trunks and migratory patterns), pattern of damage, population size and density, travel routes, seasonal food preferences, generally more damage occurs with winter feeding than summer feeding due to availability of preferred forage. Site characteristics: size of the site to be protected – proximity to alternative available food, open land is less desirable to deer than cover, can other wildlife predators be controlled as well (rabbits, beaver, woodchucks, etc)
2. Techniques – depends on landowner objectives, goal of project, density, population and type of animal causing the damage, and severity of damage. Determine the consequences of each technique for ecological, economic and social issues. Effectiveness will depend on knowledge and behavior of problem species, ecological consequences of the selected methods, interaction between the environment and the chosen techniques. Assess risk to non-target species, keep costs in mind, are the costs reasonable to the expected reduction in damage?
3. Strategy – plan how the chosen technique(s) will be implemented. One technique can be employed to stop the damage while another to prevent future damage. List equipment and materials needed and amounts. Acquire permits and safety equipment.
4. Implement – apply the techniques to the treatment area. Document the work done, any changes needed once on-site and future management plans.
5. Results – monitor results to judge effectiveness. Changes in usual conditions such as variations in site conditions, population levels, weather, feeding conditions and other factors may affect expected results. Ensure that off-site effects are not damaging nearby ecological communities or threatened and endangered species.

Table 1: Susceptibility of plants to deer damage*

Frequent	**Occasional**	**Seldom****	**Rare****
Cottonwoods	Aspen	American bittersweet	Alders
Cherries	Basswood	Ashes	Beech
Crabapples	Cotoneasters	Lilacs	Balsam fir***
Dogwoods	Downy serviceberry	Norway spruce	Blue spruce
Eastern White Pine	Eastern redcedar	Red pine***	Honeysuckles
Hackberry	Hemlock	Scotch pine	Jack Pine***
Hazelnuts	Juneberry	White birch***	
Maples	Staghorn sumac	White spruce	
Northern white-cedar	Viburnums		
Oaks	Willows		
Plums	Witchhazel		
Smooth sumac			
Yellow birch			

* If feeding pressure is great, use this table to choose plants less desirable to deer.

** Use these species if deer browse is severe, or plant these around more desirable species as physical and visual barriers.

*** These species are preferred by deer in the northwest quarter and north central areas of MN and should be considered in the 'Frequent' category in those regions (Balsam fir 'Occasional'). Lack of diversity in shrubs and hardwoods has altered the typical deer preference for these species. Local herds in other areas may also have preferences different from this table. Contact the local DNR for more information.

Table 2: Synopsis of Deer Browse Control Methods

Method	Conditions Used	Materials	Problems	Cost Estimate
Replanting	Small area Low browse pressure Low cost plants Supplement with other browse control methods	Plants, use less desirable species. Planting bar or spade	Deer know where to find the plants Seedlings may not survive near more mature plants.	$1.33 per tree (hardwoods) $0.81 per tree (conifer seedlings) $1.38 per tree (conifer transplants) The costs associated with replanting depend on the needed site preparation and the type of trees being replanted
Bud caps Includes papers, nettings, and sleeves	Conifer plantings only > 1.5 ft. tall or strong leader Few acres at most Appearance not a concern Low browse pressure Small deer population or migrating herds only	Notebook paper Waterproof paper Computer paper Index cards Wax paper Waste paper Staple, staples	May bend leader if water logged May bend leader if material is too heavy May deform leader Deer learn to remove cap Wind may blow off cap Labor intensive New shoots out-grow cap and are browsed	$0.30 per tree The costs of bud caps depend on the type of bud caps used and the rate of installation.
Tree shelters, tubes, cylinders and protectors including stakes and ties	High value plants Deer pressure is moderate to high Few acres at most Plants too small for bud caps	Many plastic, laminate and vinyl materials Bamboo, oak or metal stakes Ties Netting for emerging terminals	Expensive Labor intensive Time consuming Material does not break down as it is supposed to Buds do not harden off Must be removed before tree diameter reaches that of the tube. Weak stems may form Goosenecks form from rubbing edges of shelter Stakes need maintenance from heaving and breakage or oxidation if metal	$4.10 per tree (installed) There are different styles and sizes of tree shelters, both of which can impact the total cost. Furthermore, the rate of installation is also variable.
Fences, all types	A large area needs protection Heavy browse pressure High value plants such as orchards, Christmas tree plantations, or landscape plants Can be permanent or temporary	Depends on type of fence. Wire mesh, chain link, high-tensile, barbed wire, metal or wood posts, polytape or polyrope, gate(s), energizer, wire, battery	Most expensive Labor intensive to build and maintain Deer may get caught inside the exclosure Damage from attempts to breach May interrupt migration patterns of non-target animals	The cost of fence is extremely variable depending on the topography and type of fence. For one mile of woven wire fence 6 feet tall, the cost would be approximately $2.42 per feet. This includes the cost of one gate. Depending on the type of fence chosen for installation, the cost can differ significantly. Chain link would be one of the more expensive options as compared to other types of fence.

Method	Conditions	Materials	Problems	Cost Estimate
Chemicals Includes attractants such as peanut butter and avoidance chemicals such as Plantskydd* and Deer Away*	Temporary measure that can be reapplied as necessary Use in smaller areas Deer pressure is low to moderate or of a limited time period such as migration Alternate forage is close-by Works best with low susceptible plants	Backpack sprayer and nozzles Water source Chemical Protective clothing and gloves if desired (most stuff is smelly)	May not work if the plant is highly desirable or forage availability is low. Repeat applications may get expensive. Vulnerable new growth emerges beyond the protective coating of the chemical Rain or snow may wash off chemical Deer may learn to tolerate the taste	$0.10 per tree This cost is for the chemical and labor to spray the trees. The cost may differ based on the type and amount of chemical and the method used to apply the chemical.
Forage availability	If possible, create a wildlife food plot away from the area of protection, but not too far away. Size of food plot depends on severity of deer pressure	Forage suitable for deer or other troublesome foragers	Deer may not seek or find alternative source Suitable alternative areas may not be available. Stressed deer will eat everything available.	Typical seeding mix - Alfalfa @ 15 lbs @$2.078 per lb; Red Clover @ 10 lbs @ $2.45 per lb; Alsike @ 6 lbs @ $1.14 per lb; Ladino @ 5 lbs @ $3.41 per lb; Dutch White @ 5 lbs @ $2.97 per lb – total seed cost $94.41 per acre Site preparation would include a form of tillage at a cost of between $8-$15 per acre for tillage and/or chemical application at approximately $30 per acre. Seeding - $10 to $15 per acr
Elimination	Where legal, in season, or allowable. Remove lead deer to prevent learning to the herd	Hunting weapon and ammunition Permit	Carcass disposal Neighbors who don't want to lose 'Bambi' Local laws and regulations	The following are potential costs associated with elimination: purchasing/owning firearms,; obtaining a license; processing or disposing of the carcass or meat; negative public relations; and state and county ordinances.

*Mention of specific products does not mean endorsement of the product by USDA.

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