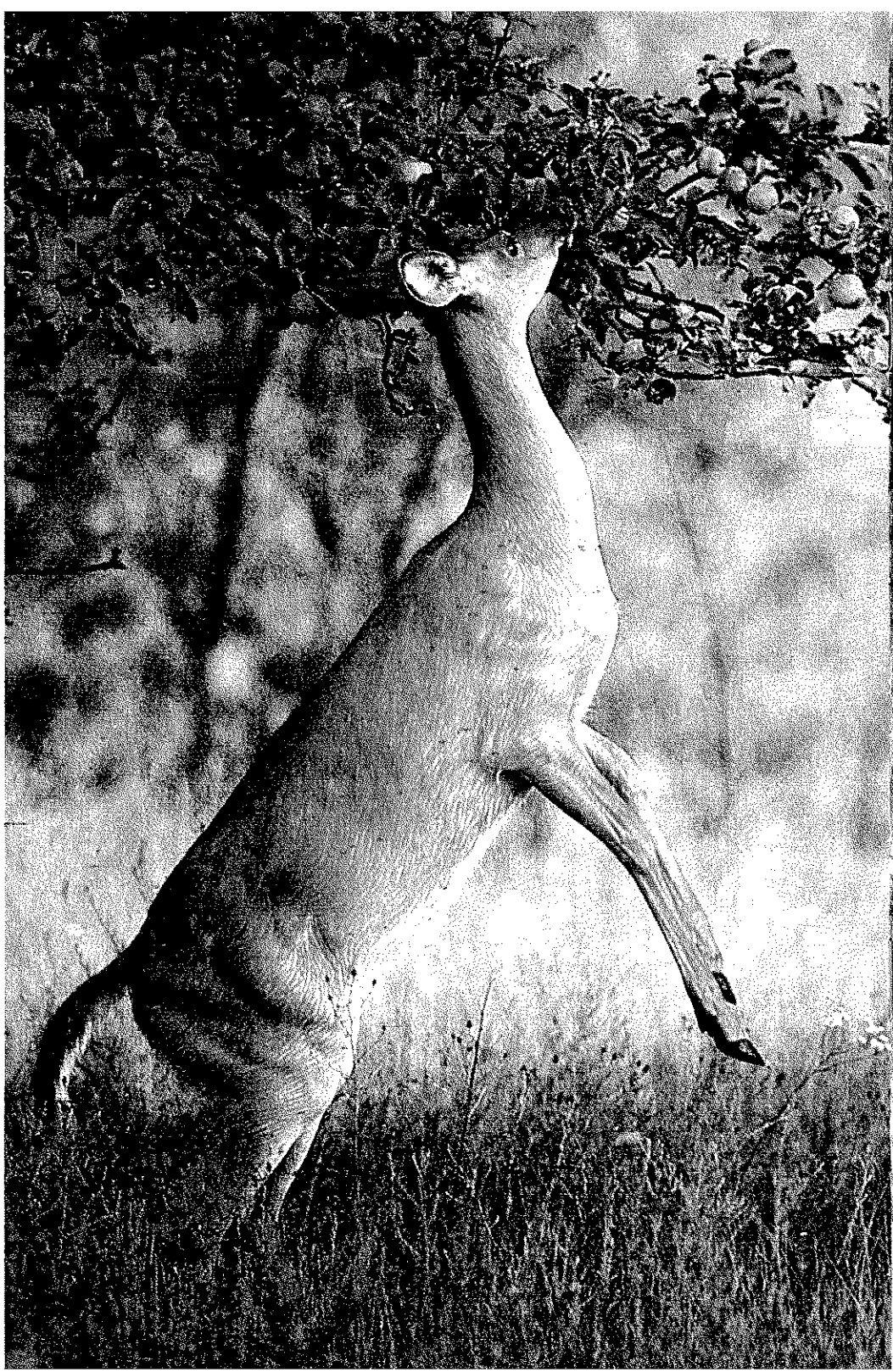

Reducing Deer Damage to Home Gardens and Landscape Plantings

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U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

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Introduction

The past 30 years has been a period of major change in the relationship of man to the white–tailed deer. From the animal's point of view, they have made a remarkable recovery since the early 1900's, when there were perhaps no more than 500,000 deer over their entire range in the United States. While virtually extirpated in many areas early in this century, whitetail numbers now exceed 15 million across the country. Some states including New York, Pennsylvania, New Jersey, Florida, Ohio and Illinois, have seen dramatic population increases, particularly during the past 10 years. Every state east of the Rocky Mountains has experienced a large increase in herd size.

From man's point of view we often applaud this story of wildlife population recovery. However, many homeowners increasingly view the situation with mixed feelings. The downside of increased deer numbers is that damage to ornamental plants, gardens, and commercial crops has increased greatly over the past two decades. Serious damage and economic losses have been associated with: (1) increasing deer abundance, (2) human population shifts to rural and suburban homes, (3) the natural conversion of abandoned farm land to deer habitat, (4) landowner decisions to prevent deer hunting, (5) restrictions on the use of firearms in suburban regions, and (6) enforcement of leash laws for dogs. These changes have been gradual, and even with foresight, it is unlikely that any government agency or organized group could have foreseen and altered the course of events that has brought this beautiful, adaptable species into direct confrontation with man. **The purpose of this publication is to: (1) provide some background on the current dilemma, (2) suggest state of the art actions that a homeowner or landowner may take, and (3) offer information that will allow for informed decision–making as professional wildlife biologists attempt to custom–fit solutions to deer damage problems in urban and suburban landscapes.**

Deer Feeding Habits

While deer are known to eat more than 500 different kinds of plants, they are often selective feeders that forage or browse on plants and plant parts with considerable discrimination. This is particularly true when a variety of foods are available. **However, when natural, preferred foods become scarce, there are relatively few species that deer will not eat.** Whether or not a particular plant species or variety will be eaten depends upon the deer's nutritional needs, previous feeding experience, plant palatability, seasonal factors, and the availability of alternate foods. Deer develop predictable travel patterns, and prior damage is often a good indicator of potential future problems. Any new plantings added to an existing landscape or garden already suffering from deer damage will likely experience extreme browsing pressure. Deer also are known to feed selectively on fertilized plantings and in managed crops and gardens.

In general, most damage occurs when winter snow cover reduces the availability of natural foods. However, in suburban settings with high deer numbers, year–around damage may be evident. In reality, the wide range of plants and plant parts eaten, their nighttime foraging habits, and their adaptability to a man–made ecosystem (suburbia), all serve to make the white–tailed deer one of the most annoying and economically–significant problem wildlife species in all of North America.

Food Requirements

The amount of food eaten daily by a deer depends upon the sex and body weight of the animal as well as the season. A buck ranging in size from 125 to 250 pounds requires 4,000 to 6,000 calories each day, which can usually be obtained from 4 to 10 pounds (0.5 to 1.5 bushels) of grass, forbs, and twigs. A lactating

doe requires 4,500 calories daily. As a general rule, deer consume about 3 percent of their body weight in forage each day. **This may seem a small amount, but when taken as buds, leaves, tender shoots and flower parts, the impact on horticultural and garden plants can be devastating.**

Behavior and Social Organization

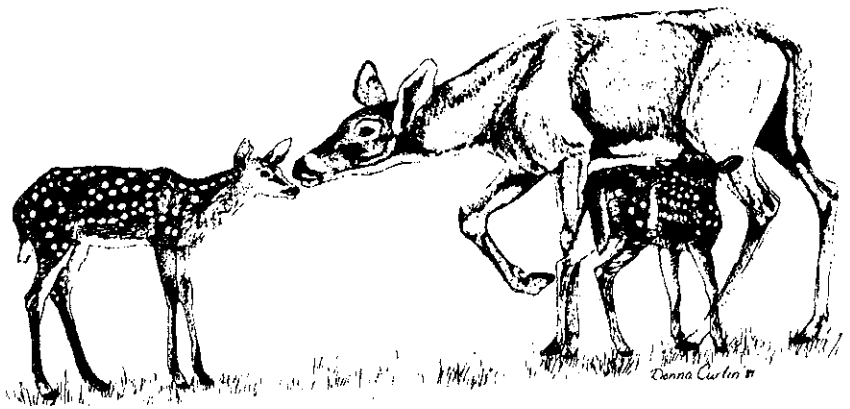
White–tailed deer are polygamous, with a flexible harem arrangement during the late–autumn breeding season. At other times of the year, groups of 2–7 animals are usually led by an adult doe. In late winter, this group may consist of one or more adult females and their offspring from the past two breeding seasons. During spring and early summer, these groups disperse to some degree and become more secretive in their behavior. This pattern of dispersal and secretive behavior continues through the fawning period in May and June and persists until fall.

An important consideration as a motorist is that deer seldom travel alone, and seeing one cross the road at a distance should signal the need for extreme caution because other deer are likely present. In fact, the behavior of individuals in the family group is so tied to the adult doe that others often cross the road in the face of oncoming traffic in an effort to be near the adult leader. State transportation and wildlife agencies have tried to alert motorists by posting signs at frequently–used deer crossings, however, deer are a potential hazard along nearly any stretch of road. The risk is highest during peak activity periods for deer, near dawn and dusk.

Deer like squirrels, raccoons, rabbits, and even the coyote, are quite adaptable and seem to thrive in suburbia with its mix of woodlots, old fields, landscaped plants and gardens. **Many have lost their fear of people and boldly browse on tulips, broccoli, hedgerows and ornamental shrubs.** Deer quickly learn which areas have dogs and children and adjust their feeding schedules

accordingly. Deer are capable of learning, and it is this particular characteristic of their behavior that is useful for applying some of the damage prevention techniques suggested later.

The antler–rubbing behavior of males during fall is particularly damaging to small saplings or ornamental trees that are selected. Deer will rub both conifers and hardwoods, and "rub lines" tend to follow field edges along primary travel lanes. Trees and shrubs with stem diameters of about 6 inches or less are at risk from September through November. Special precautions should be taken to protect valuable, rare, or otherwise unique woody shrubs and trees. A buck marking his territory and rubbing the remaining velvet from his antlers chooses a sapling or shrub based upon its size, shape and location rather than its nutritive value or palatability.



Population Regulation

Biologists with state wildlife management agencies have a comprehensive knowledge base for understanding natality, mortality and population growth for white–tailed deer. Age and sex ratios at harvest, coupled with knowledge of carrying capacity of the habitat and estimates of overwintering populations, allow most

states to reliably predict fall populations on at least a regional basis and often for areas as small as a township or deer management unit. **Hunting has traditionally been used to keep local subpopulations in balance with their habitat. In many parts of the whitetail's range man is the only significant predator.** Combining hunting take with estimates of deer–automobile collisions and natural losses, establishes the mortality rate for the herd. In many eastern states the growth potential (natality) of the herd currently exceeds the mortality rate, resulting in increasing deer populations. Also for a variety of reasons, we no longer hunt some herds and deer numbers in those areas are rapidly increasing. At present practical methods for reducing deer numbers other than through hunter harvest are limited. Agency biologists, university researchers, and other interested parties are pushing hard for alternative management procedures that may prove useful in reducing populations in certain non–hunted parks and other protected areas. Foremost among the new options is an effort to regulate birth rates through immunocontraceptive procedures. While this may be a partial solution in some areas, we are likely 8 to 10 years away from having field–applicable contraception for free–ranging deer. **Currently, the only relief for suburban homeowners will come from: (1) applying state–of–the–art damage abatement techniques, (2) learning to tolerate a certain level of deer damage, and (3) selectively culling the herd.**

The Prognosis

In the short term, the prevailing conditions are largely irreversible. Damage problems in suburban areas, particularly those having good quality deer habitat, are likely to intensify in the future. **It is rather easy to predict that the elimination of hunting due to firearms restrictions, safety concerns, and changed landowner values will only intensify the conflicts between man and deer in many areas.** In the longer view, citizens in each affected region will have to face the challenge that they are now

stakeholders in this issue and can no longer sit back and ask their state wildlife agency and local town or county authorities to solve this problem without additional financial support for research and management. State wildlife agencies manage their deer herd to satisfy several interest groups. Landowners enjoy seeing some deer on their property in spite of the damage potential they bring. The aesthetic and economic values of deer are both important. Management of the herd through hunting, combined with a reasonable approach to damage abatement, is a reasonable goal. Several state agencies have developed and successfully used public–involvement procedures to manage a variety of wildlife populations including the white–tailed deer. However, the problem we now face in suburbia goes beyond the techniques, expertise, and authorized funding of most state agencies, and new approaches must now be considered.

In the interim, landowners must work with wildlife management agencies to find acceptable long–term solutions. While new techniques are being developed, state–of–the–art recommendations should be employed to limit deer damage around the home and in the garden.

Choosing a Deer Damage Management Option

Choosing the appropriate deer damage management option depends upon many variables. The primary factors include deer foraging pressure, damage levels observed, and the economic losses sustained. Deer feeding pressure is influenced by weather conditions (especially winter snow depths), and the amount and types of different plants that are available. Damage to ornamentals or gardens depends upon the frequency of deer feeding attempts, the proportion of the plant within the reach of deer, and the potential for the plant to recover from a given level of feeding.

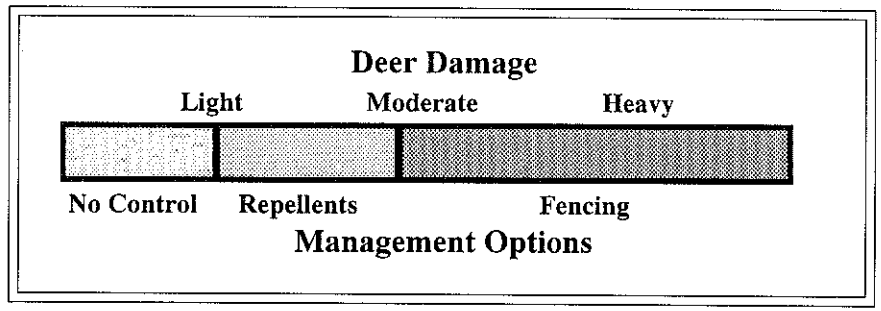


Fig. 1. Choosing a deer damage management option.

The intensity of perceived damage is influenced by people's past experiences with deer and their personal level of tolerance. **What may seem like light and inconsequential deer damage to one individual, may be completely intolerable to a neighbor.** Thus, it's often difficult for a community to determine an appropriate deer density and population management strategy. Consequently, fencing and/or repellents are frequently used to address site-specific problems.

If very low deer pressure and damage is experienced, the cost of control efforts will likely be greater than the plant losses (Fig. 1). For low to moderate deer pressure, repellents may provide an effective solution. With moderate to high deer feeding pressure, multiple applications of repellents are usually required, and fencing is likely the most cost-effective solution.

Reducing Deer Damage to Ornamental and Garden Plants

Fencing

Where deer are abundant or crops are especially valuable, fencing can be an effective means of reducing deer damage. A variety of fence types may successfully deter deer depending upon the situation and desired level of protection.

Fencing as an absolute barrier can be achieved in one of two ways. The preferred approach is the construction of at least an 8–foot–high, woven–wire fence that completely encloses plants requiring protection (Fig. 2). If deer must be kept out entirely, this is the only reliable method. Fences reaching 5, 6, or even 7 feet high are useful deterrents, but do not always provide complete exclusion. The 8-foot fence is expected to last 20–30 years, and costs $3 to $5 per foot to install. Details of construction, cost, materials needed, and design information can be found in the references listed at the end of this document.

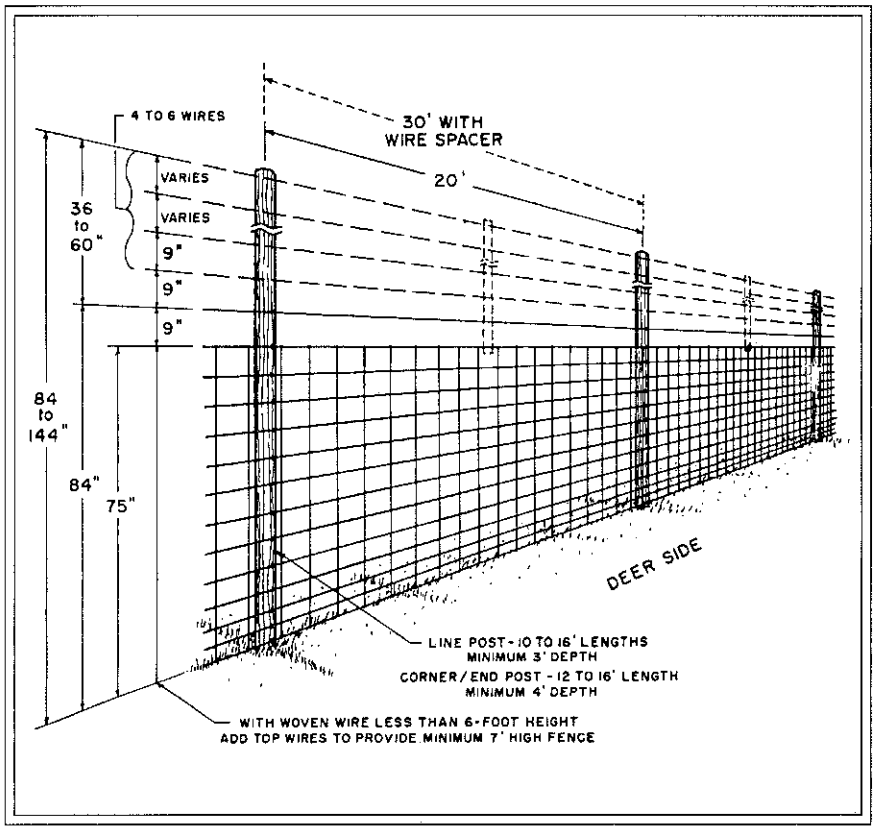


Fig. 2. A high-tensile, woven-wire, barrier fence for complete deer exclusion.

An alternative barrier that may be useful in certain circumstances consists of a lower welded–wire fence with a top completely enclosing the plants to be protected. This design may be more economical for protecting bedding plants or specialty crops such as asparagus, broccoli, or perennial flowers, and can also be combined with other fencing deterrents to save a particular plant or high–value crop. This smaller, complete exclosure can be cost–effective for very small garden plots or isolated plantings. A practical fence of this type can be constructed by installing two parallel fences far enough apart so that one can work comfortably in between, but close enough so that a wire top and ends can be

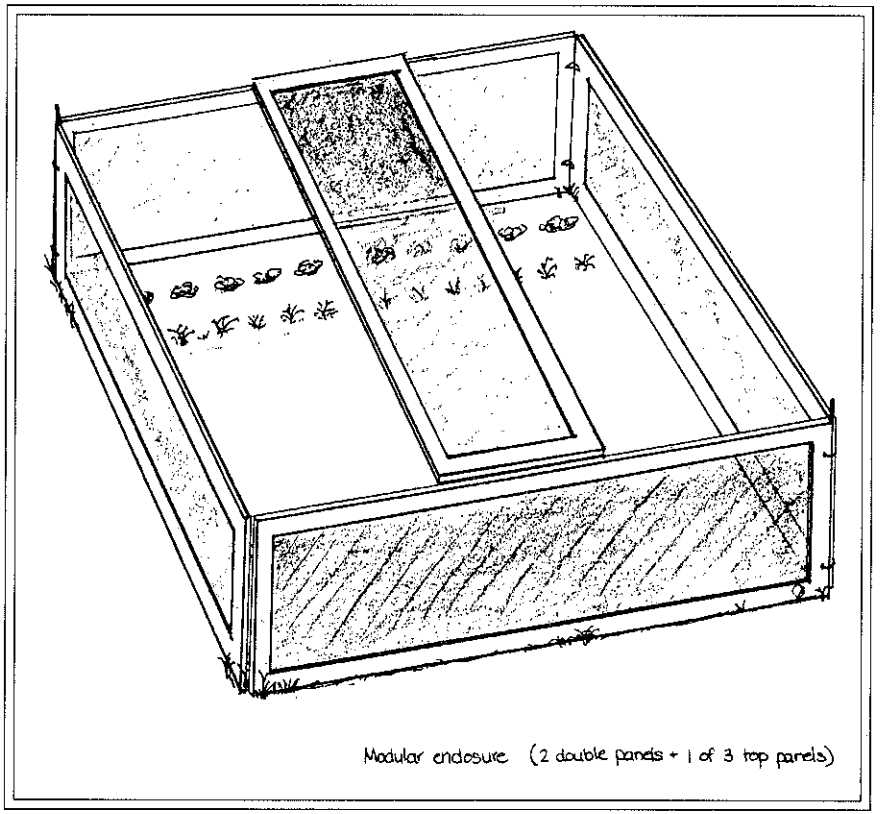


Fig. 3. An alternative exclosure for protecting beddding plants and seedlings from deer or other wildlife.

fitted into place after planting. This modular type exclosure (Fig. 3) is easy to construct, inexpensive, portable, and can be used for several years. The exclosure can provide protection for bedding plants, nursery stock, or specialty crops.

Anyone who has made a significant financial commitment to the production of bedding plants, cut flowers, Christmas tree seedlings, or speciality fruit or vegetable crops should seriously consider a woven–wire fence that is at least 8 feet in height. While the initial cost is higher than that for other types of fencing, the commercial investment may only be ensured by providing absolute protection. Such a barrier may be practical for plots ranging from 25' x 25', up to 50 or more acres. A finer–mesh wire (i.e., 1-inch hexagonal chicken wire or 1x2–inch welded–wire) can be added to the bottom to prevent other pests such as rabbits and woodchucks from entering the protected area. If raccoons are a problem, the addition of a single strand of electrified wire located 4 inches above ground around the outside of the fence will deter all except the most persistent animals.

The placement of an absolute barrier need not be an eyesore if attention is given to details of construction, including proper setting of corner posts, a wide gate frame for easy access, and addition of screening plants to landscape the fence. Small home–garden–sized plots may be made more accessible to tillers and small tractors by permanent construction of three sides of the fence, leaving the fourth side to be covered by a portable, removable section. Such a portable fence can be built in framed sections small enough to remove by hand if needed (see Fig. 3).

Non–electric fences may be sufficient to protect an area if deer densities are not particularly high ($\leq$10 mi^2) and a variety of natural foods are available. Several sizes of welded or mesh wire can be combined with additional single wires. For vegetable or flower gardeners who do not wish to lose plants to deer or other wildlife pests, we recommend a 1x2–inch welded–wire fence three

feet high, with the bottom edge buried 6 inches buried beneath the soil. This will deter rodents, rabbits, and woodchucks from entering the area. With an additional 3 wires spaced 1 1/2 feet apart above the welded wire, this design is a suitable exclosure but not an absolute barrier for deer.

Electric fences provide a less expensive, yet effective alternative to the physical barriers described earlier. The polytape electrical fence coated with peanut butter can be effective for home gardens, small nurseries, and truck crops up to 40 acres (Fig. 4). This simple, temporary fence works best under light deer pressure during summer and fall. The polytape fence apparently attracts deer with its bright color and peanut butter odor. Deer make nose–to–fence contact when they approach, receiving a substantial shock and quickly learn to avoid the fence. Polytape fences are portable, have a life expectancy of more than 15 years, and can be installed for $0.10 to $0.25 per foot. A variation of this fence includes substituting a suitable repellent such as *Hinder*^{TM} or *Big Game Repellent*^{TM} for peanut butter. In recent studies, this latter design was even more effective at repelling deer. **Certainly the combination of electric shock with either attractants or malodorous repellents is more effective than electric fencing alone.**

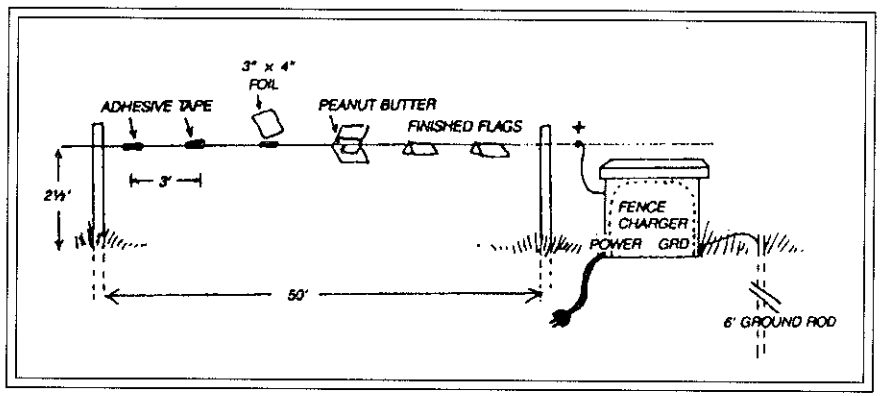


Fig. 4. An electric fence with attractants for excluding deer from garden crops during summer and fall.

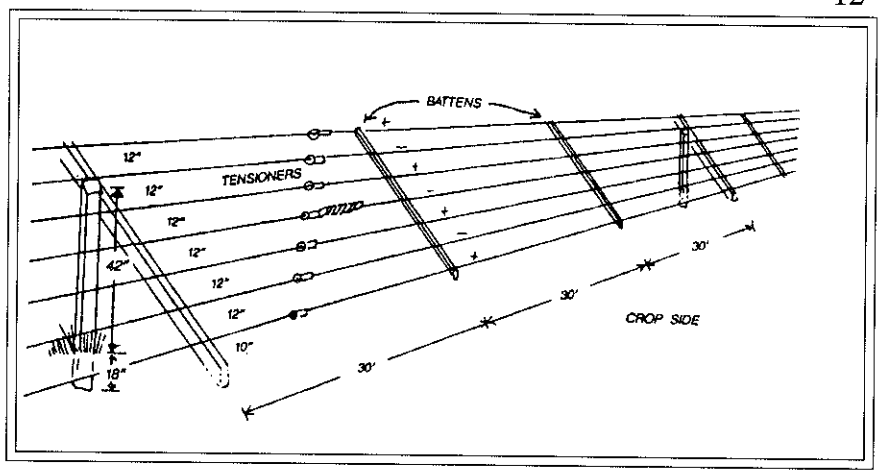


Fig. 5. A slanted, 7-wire electric deer fence.

Another design consists of a 3–wire combination of electrical fencing, deer repellent, and a visual cue. This fence is economical, easy to build, and quite effective if maintained in good working order. Standard 7– or 8–foot wooden or steel posts, with electrical wires placed 18, 36, and 54 inches above ground, can be supplemented with 5– to 6–inch strips of cotton cloth stapled to the wires at 10–foot intervals. The cloth strips are then saturated with odor–based repellents (i.e., *Hinder*^{TM} or *Big Game Repellent*^{TM}) and the wires are energized with at least 5,000 volts. Solar– powered charging units are available that will hold a charge for 24 hours even on cloudy days. The addition of another electrical wire 4 inches above ground will exclude most woodchucks and raccoons, but not rabbits and mice.

Other types of electrical fencing, including 6- or 7-wire, high-tensile, vertical designs, or slanted versions of the same fence (Fig. 5), are proven deterrents to deer. However, these fencing systems are more practical for commercial ornamental plant, fruit, and vegetable growers. With electrical fencing of any design it is important to remember that: (1) a quality energizer that delivers a minimum of 5,000 volts is a must, (2) high–tensile electric fences

require strict adherence to construction guidelines listed in Fig. 6, and (3) the cost per unit area for construction decreases with increasing size of the plot to be fenced.

All Fences

- ✔ Use the best quality materials available.
- ✔ Do not deviate from the recommended specifications.
- ✔ Be sure the bottom wire stays close to the ground, as deer actually prefer to crawl under rather than jump over a fence.

Electric Fences

Advantages:	*Disadvantages:*
✔ Lower cost	✖ Safety concerns
✔ Ease & speed of construction	✖ Ineffective if current fails
	✖ Increased monitoring
✔ Easily modified	✖ Consistent vegetation control
✔ Versatile	✖ May be illegal in some places

Identify all electric fences with warning signs.

Fig. 6. Fence construction tips.

Repellents

Several deer repellents are available to the home gardener, and function either as taste- or odor-based products. Most commercially–available repellents can be applied as a spray to ornamental shrubs and non–bearing fruit trees. **Generally, repellents are only partially effective. There is nothing on the market that provides absolute protection.** Repellents are most effective when applied on a regular 4–week schedule, before serious damage is

noticed. They work best on plants that are low on the deer's preference list, especially when alternative natural foods are available. Satisfactory protection of perennial flower beds and some vegetable gardens has been achieved by alternating the use of more than one repellent. For example, thiram applied as a spray coupled with *Big Game Repellent* (*BGR™*) or *Hinder™* on a cotton rope around the perimeter of the flower bed has provided good protection in a number of recent trials. Other useful combinations are still to be discovered as we seek even better ways to protect garden plantings.

Hinder™ is the only product labeled for direct application to bearing trees and vegetable gardens. *Hinder™* is a soap–based deer repellent, and is one of the few products registered for use on edible crops. While it has been widely applied, research findings reveal moderate effectiveness in comparison to some other repellents. *Hinder™* does not weather well, and requires reapplication after rainfall. Four gallons of liquid costs about $50, and as a dilute spray, will cover about one acre of garden and ornamentals.

BGR™ , an odor– based agent, is comprised mostly of putrescent egg solids. *BGR™* can be applied as a spray, and retains a hint of hydrogen sulfide odor for up to 40 days. This repellent does persist on the vegetation after rainfall and offers reasonable protection for up to a month. A gallon of *BGR™* costs $20 and will cover about 75 to 100 evergreen shrubs.

Taste–based repellents must be eaten or at least tasted by deer in order for aversive behavior to be learned. If deer have been feeding in an area prior to use of these repellents, it is often difficult to modify deer feeding behavior. **All repellents and fencing measures work best if they can be put in place *before* the damage problem begins**.

Chew-Not™ and *Bonide Rabbit-Deer Repellent™* contain thiram (tetramethylthiuram disulfide), a fungicide that is distasteful

to mammals and acts as a contact repellent through its irritability of mucous membranes around the mouth and nostrils. It can only be applied to dormant trees and shrubs. It costs about $50 for finished spray to cover about one acre of trees and shrubs.

Hot Sauce Animal Repellent™ contains capsaicin as its active ingredient, which is the active compound in hot peppers. It is labeled for use as a spray on shrubbery, Christmas trees, fruit trees, and vegetable crops if applied before fruit set and prior to vegetable development. Its effectiveness in repelling deer is variable due in part to the continued growth of new, unprotected plant parts. *Hot Sauce™* costs about $175 per gallon, however 8 ounces of concentrate is enough to cover one acre of garden and ornamentals.

Ro–Pel™ (benzyl diethyl [2,6 xylylcarbamoyl] methyl ammonium saccharide and thymol) is a bitter tasting material that is incorporated into plant parts after spray application. The active ingredients are weather–proof and remain with the plant through the growing season. It can be used to protect nursery stock, Christmas trees, annuals, perennials, and shrubbery. However, this material has not performed well in research trials. One gallon costs $25 and covers about one acre of small trees or shrubs.

Other Measures

The use of dogs as frightening agents is another alternative that merits attention. A dog of sufficient size and temperament may be kept on a leash near the garden and allowed to stay outdoors overnight. A number of deer-damage problems have been alleviated with this simple system.

An alternative that has shown great promise in recent experiments is the use of a dog contained by a buried electrical ("invisible") fence. Such an invisible fence has great utility in keeping the dog at home, which can repel deer from the property. More research is needed before we can determine the most effective breed of dog, and estimate how much area a single dog can protect.

Noise–making and visual scare devices (i.e., exploders, sirens, lights, whistles, etc.) are not recommended for the home garden because of the disturbance to neighbors and lack of effectiveness. Deer readily acclimate to the noise or light, and are little disturbed after a few days of exposure.

Choice of Landscape Plantings

Homeowners are often faced with the dual problem of preventing deer from damaging a vegetable garden and/or a few fruit trees, while also protecting foundation shrubs and landscaped planting beds. In the first instance, the choice of garden plants is dictated by the owners desire for specific food products, so little compromise is possible. With ornamental plants, however, the homeowner has some additional latitude in choice of species and variety. Future problems and expenses may be diminished by selecting landscape materials from a list of plants considered less desirable to deer. Publications describing the most– and least–preferred food plants for deer are available (see selected references). Such lists may vary somewhat across broad geographic regions, but are generally reliable. Homeowners east of the Mississippi River may use the following tables as a guide for selecting woody ornamental plants. This information can be useful both for choosing plants that are unlikely to be damaged by deer, and identifying those ornamentals that almost certainly will require protection from deer, even in areas where populations are low and feeding patterns are selective. Check with a local horticulturist or your County Cooperative Extension Office before planting the species listed below to ensure they are adapted for your climatic and soil conditions.

As a final note, we encourage homeowners to be tolerant of losses caused by wildlife, and understanding in making management choices. This includes not only a personal choice to tolerate some damage in return for the significant aesthetic benefits derived from viewing wildlife, but also one should be understanding of choices made by neighbors and farmers who may perceive a real economic threat from wildlife damage.

Table 1. Deer-damage resistance of woody ornamental plants.

Rarely Damaged	*Seldom Severely Damaged*
Common Barberry	European White Birch
Paper Birch	American Bittersweet
Common Boxwood	Red Osier Dogwood
Russian Olive	Kousa Dogwood
American Holly	English Hawthorn
Drooping Leucothoe	Redvein Enkianthus
Colorado Blue Spruce	European Beech
Japanese Pieris	Forsythia
	Honey Locust
	Chinese Holly
	Inkberry
	Chinese Junipers
	Mountain Laurel
	Beautybush
	Norway Spruce
	White Spruce
	Austrian Pine
	Pitch Pine
	Mugo Pine
	Red Pine
	Scots Pine
	Japanese Flowering Cherry
	Corkscrew Willow
	Common Sassafras
	Common Lilac
	Japanese Wisteria

Table 1. Deer-damage resistance of woody plants (*continued*).

Occasionally Severely Damaged

White Fir	Eastern White Pine
Paperbark Maple	Bush Cinquefoil
Red Maple	Sweet Cherry
Silver Maple	Douglas Fir
Sugar Maple	Firethorn
Common Horsechestnut	Bradford Callery Pear
Downy Serviceberry	Common Pear
Allegheny Serviceberry	White Oak
Trumpet Creeper	Chestnut Oak
Japanese Flowering Quince	Northern Red Oak
Panicled Dogwood	Deciduous Azaleas
Smokebush	Carolina Rhododendron
Cranberry Cotoneaster	Rosebay Rhododendron
Rockspray Cotoneaster	Staghorn Sumac
Japanese Cedar	Multiflora Rose
Border Forsythia	Rugosa Rose
Rose of Sharon	Willows
Common Witchhazel	Anthony Water Spirea
Smooth Hydrangea	Bridalwreath Spirea
Climbing Hydrangea	Persian Lilac
Panicled Hydrangea	Japanese Tree Lilac
Japanese Holly	Late Lilac
China Girl/Boy Holly	Greenspire Littleleaf Linden
Eastern Red Cedar	Basswood
European Larch	Eastern Hemlock
Goldflame Honeysuckle	Carolina Hemlock
Privet	Judd Viburnum
Saucer Magnolia	Leatherleaf Viburnum
Dawn Redwood	Doublefile Viburnum
Virginia Creeper	Koreanspice Viburnum
Sweet Mock Orange	Oldfashion Weigelia

Table 1. Deer-damage resistance of woody plants (*continued*).

Frequently Severely Damaged

Balsam Fir	Plums
Fraser Fir	Rhododendrons
Norway Maple	Evergreen Azaleas
Eastern Redbud	Catawba Rhododendron
Atlantic White Cedar	Pinxterbloom Azalea
Clematis	Hybrid Tea Rose
Cornelian Dogwood	European Mountain Ash
Winged Euonymus	English Yew
Wintercreeper	Western Yew
English Ivy	Japanese Yew
Apples	English/Japanese Hybrid Yew
Cherries	American Arborvitae

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