

# Planting and Growing Chestnuts

## *Best Management Practices for Reintroducing American Chestnuts to Your Property*



Planting and growing chestnut trees is a rewarding and challenging experience. As with growing anything, there are some “rules of the road” that will help with the successful establishment and survival of your chestnut trees.

The American Chestnut Foundation (TACF) is working to restore the American chestnut (*Castanea dentata*) to its original range. To do this, we must plant a lot of trees! To date, we have planted over 500,000 trees as part of our mission.

Restoring the American chestnut to its native hardwood forests is not a single event, but a process that will take multiple generations of people and trees to complete. Along the way, a blight-resistant American chestnut will face the same challenges that today limit regeneration for many species in the eastern hardwood forests. Key among these challenges is competition with other plants, dispersal, and wildlife predation.

What we understand about these challenges and how the chestnut grows in response to them is vital to restoring this foundational species.

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If you plan to join our efforts, please take a few minutes to review the following information so that you might get the most out of your chestnut planting. We hope that by following these recommendations you will realize the successful establishment and growth of your new chestnut trees, and in turn, improve the value of your property.

### **I. THE TACF RESTORATION PROGRAM**

As stated above, the goal of TACF is to restore the American chestnut to its original range. TACF works towards this goal with a program that includes breeding, testing, and reintroduction.

There are several efforts underway to restore the American chestnut involving traditional breeding methods, simple conservation strategies, methods that would reduce the virulence of the blight fungus, as well as modern genetic transformation and editing techniques. The combination of these three broad methodologies is referred to as the “3BUR” approach: **B**reeding, **B**iocontrol, and **B**iotchnology United for **R**estoration

While the broadest goal is to restore the American chestnut species, TACF focuses on two major objectives: (1) introducing genetic material—responsible for the disease-resistance into the American chestnut; and (2) preserving the genetic heritage of the American chestnut species by a) planting and grafting native germplasm before it disappears and b) incorporating those materials upon resistant populations as part of diversification and regionalization efforts.

Since 2008, TACF and its many partners have been deploying potentially disease-resistant materials across the eastern US. The results of these outplantings will be most useful after 15-20 years. By measuring growth, morphological and phenological traits, along with response to disease pressure, better selections in seed orchards can be made so that only the best trees and their progeny are used for landscape scale reintroductions.

Regardless, we can’t stop with the first material developed through any of the 3BUR efforts. Volunteer and partner growers install testing, conservation, breeding, and demonstration orchards every year. Restoration of



a species is the goal and that will take decades to achieve if not centuries. As restoration efforts progress, the long-term, sustainability of restored American chestnut populations will depend upon the incorporation of additional diversity from wild American chestnut trees, along with the integration of new tree improvement technologies which are sure to be developed in that same timespan.

 **PARTICIPATING IN TACF'S PROGENY TESTING**

At the time of this writing, TACF currently has several testing lines of advanced backcross American chestnut material available for planting, and additional transgenic materials awaiting federal deregulation. As “testing lines,” they need to be put to the test! This means they need to be put out in the field under several varieties of conditions, including forested sites, non-forested sites, various soil and climate conditions, as well as different silvicultural treatments.

Remember that TACF has only just begun releasing TESTING lines of mostly American chestnuts which may have some blight-resistance. Even though some may have blight-resistance, there is no guarantee that the trees will perform as well as we hope. In addition, one can be assured that at least some percentage will get the blight\*.

Now that you are ready to help TACF achieve the goal of American chestnut restoration, there are a few decisions to be made that may help ensure a well-established and maintained planting of American chestnuts.

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## II. SITE SELECTION

The first decision that you are going to need to make when planting chestnuts is WHERE to plant your chestnuts. Typically, chestnuts are a hardy species, but they do have some general requirements.

\* This is because the focus used in breeding is one of RESISTANCE and not IMMUNITY. Immunity to the blight is currently an impossibility. Even Chinese chestnuts get the blight to varying degrees.



Figure 1. An open field (A) can be an ideal place to start your chestnut trees. Be sure to manage the sod cover. A recently clearcut area (B) can also be a fine place to start an orchard. The soils are often fertile and the site will have less weed/grass competition than a field.



1. **Site selection: Well-drained, acidic soil type. This is**

**\*the\* most important consideration when planting chestnuts.** Choose wisely. Sandy (25% - 75% sand composition) or rocky, well-drained, highly permeable, and somewhat acidic soils (pH 4.5-6.5) on gently sloping, land is best. **Avoid heavy clay soils or planting in swales.** Review your property’s location on county soil maps from the Natural Resources Conservation Services (NRCS). Many of these are available on-line through Web Soil Survey (<http://websoilsurvey.nrcs.usda.gov/app/>), but you may also find them in your local library.

2. **Test for *Phytophthora cinnamomi* root rot in the south.** See subsequent section on Pests and Pathogens.
3. **Exposure.** Full sun is often best for growth, vigor and seed production. A sheltered north-facing slope that provides protection from drying winds and the low sun of winter may be better for cold or windy sites. Planting on a slope may also help alleviate some drainage issues. *See page 4 for more info.*
4. **How many trees / how much area to plant.** How many trees and/or how much area to plant really depends on several factors. What type of trees you’ll be planting, how long you want to have them on your land, and the amount of land you have available, which could be the most important

limiting factor. (*Will you plan on inter-planting chestnuts with other species? Please see the last section of this BMP for some tips.*)

Remember that you will need to plant at least 2 chestnuts to get nut production. Account for upwards of 50% or greater mortality over time, and plant at least 5. If you just want to plant a few trees, a good amount would be between 10 to 50. For those who want to plant 100s or 1000s of trees, the economies of scale will set in, of course!

**TACF often recommends that new growers start by testing their growing methods and land by planting 10 - 50 wild-type American chestnuts before planting many and/or implementing large-scale planting projects. This “trial run” can be a very valuable exercise to learn the finer points of growing chestnuts.**



Figure 2. Chestnut growth in response to release. This cookie, taken from a tree in western PA, shows very little growth for the first 32 years. Following a thinning, the tree grew almost 1" diameter per year for the next 8 years.

closely with ARRI, the Appalachian Regional Reforestation Initiative, to plant on AMLs in the most appropriate fashion. One of the most important things to keep in mind is that drainage is key, and some heavy land manipulation may be required on these lands. More information on reclaiming these areas can be received by contacting TACF and/or ARRI.

### **FORESTED SITES**

Forested sites typically have proper mycorrhizal associations for trees and may maximize growth potential because of their fertility. There are several ways to prepare forested sites for reforestation plantings.

### **OBTAIN A FOREST MANAGEMENT PLAN**

Before moving forward with any forest clearing projects, TACF recommends consulting with a professional forester and creating a forest management plan. Forests are complicated entities, and certain actions can swing value - either economic or ecological - either up or down. Professional foresters can help manage those decisions by a) establishing baseline information about stands on your property; b) implementing different management units and plans based on stocking, regeneration potential, and landowner goals; and c) making landowners aware of cost-share and other opportunities that can assist them in executing their management plan.

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## III. SITE PREPARATION

Site preparation needed will depend on the condition of the site. If the site is uncultivated, trees and brush should be removed, the field mowed, and re-growth controlled.

Assuming you want maximum growth and nut production, you will be choosing a relatively open site. One of the easiest ways to do this might be to plant in an open field.

### **OPEN FIELD**

Old fields can be easier to maintain, but they often contain hardier weeds that require persistence in management to control. They can also harbor different kinds of pests and vermin. For example, meadow voles are more highly populated in field sites. In addition, in earlier years, pests such as aphids and leafhoppers tend to also be in higher abundance in old fields.

### **ABANDONED MINELANDS**

Many areas within the native range of American chestnut may be defined as an abandoned mine land (AML). Depending on the way the site was reclaimed, reforestation may be more or less difficult. TACF works



Many state forestry bureaus offer some amount of free consulting by their service foresters. Typically, initial consults are free, but the creation of the plan may require a fee. If your state is not one of those that offers those services, there are many well-qualified, certified and/or consulting foresters from which to choose to create your forest management plan.

### **FOREST PREPARATION OPTIONS**

Even-age forests are created using regeneration cuts that include clearcutting, seed tree and shelterwood. While most of us understand the term “clearcut,” “seed tree” and “shelterwood” may be unfamiliar concepts. Simply put, a seed tree harvest is a regeneration cut where some mature trees are left on the site to provide seed to regenerate the stand. A shelterwood, on the other hand, gradually removes all the mature trees through a series of cuts. This technique provides both a seed source for regeneration and protects the developing understory. All of these systems mimic large natural disturbances. Tree species that respond best to even-aged management include oaks, eastern white pine, black cherry, and tulip-poplar.

Uneven-aged forest management produces a forest or stand of diverse ages and sizes. This type of regeneration cut is generally employed to regenerate species that are more tolerant of shade than those regenerated through even-aged management. Sugar maple, American beech, black and yellow birch, eastern hemlock, basswood, and pignut hickory benefit from uneven-aged management. Uneven-aged management mimics small natural disturbances by selecting individual or small groups of trees for harvest.

Therefore, based on what you plan on having in your forest, you and your professional forester may discuss the following options for chestnut reintroduction:

**Clearcuts:** In some cases, a clearcut of a site may be required. Chestnuts and other forest species may do well in a clearcut, but there are some considerations to keep in mind. Clearcuts may allow for the introduction or proliferation of high light-loving invasive species. With a good management plan,

and well-implemented harvesting and post-harvesting strategies, these can be controlled.

**Shelterwoods:** If a full clearcut is not required, some shelterwoods can often be more beneficial to chestnut reintroduction than full clearcuts. Because chestnuts are somewhat shade-tolerant, they can often out-compete more vigorous species in a shelterwood than they can in a clearcut.

**Gaps:** Gaps in forested areas may also be used for single tree plantings. These can be created either through natural occurrences such as blow-downs or lightning strikes, or through deliberate removal of specific trees. With at least 40% removal of canopy over a planted chestnut tree, and with proper follow-up maintenance, this strategy can successfully reintroduce the species in your woodlands.

### **PLANTING ESTABLISHMENT**

Once you have determined the site prep necessary for your planting, the next decision that will need to be made is whether to plant seeds or seedlings. Before planting, be sure to keep your seed in cold storage, such as in a refrigerator, until you are ready to plant. The colder the storage (but above freezing), the longer the seed will keep. **DO NOT FREEZE** the nuts.

Chestnuts may be directly sown into the ground, but seedlings may also be available for large-scale planting. In either case, the best time for planting is often the spring. Bare-root seedlings can be planted in the fall, but these are most often recommended for more southern areas.

In most cases, landowners planting advanced material from TACF will be planting bare-root seedlings. Be certain to follow proper planting protocol when doing so, including proper planting time, creating a large enough hole, and sufficient watering during and after plantings. Many cooperative extension programs have very well-written documents on proper bare-root planting. Please contact TACF, or your professional forester, for more specific instructions.

You may also start seeds indoors for your own use.

TACF has documentation on any of these methods. Simply e-mail for specific instructions if you plan on using a method other than bare-root establishment.

Be sure to record everything you ~~do~~ **do** ~~die!~~ Especially note any changes made to a planting plan, if one was made.

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#### IV. MAINTENANCE

Before you plant, you'll need to determine what sort of maintenance regimen you'll be employing. Maintenance considerations include fertilization, watering, deer and other pest control, and weed control. As with anything, a decision you make in one section of maintenance will affect and/or limit the choices you have in another area of maintenance. Choose wisely!

The next few sections will cover some of the choices you will have in maintaining your chestnut orchard. Recommendations are made, some more highly than others. While TACF encourages and thrives on experimentation by their growers and cooperators, there are a few things that we have learned along the way. There are mistakes that have been made, ones we hope you will not have to face in your chestnut growing career. Please look over this section carefully and work closely with your forester and/or TACF Staff to choose the right methodologies for your land and lifestyle.

Although planting and growing chestnuts can be very rewarding, there are many pitfalls, all of which may not be covered in a single publication such as this one. The Chestnut Growers website (<https://ecosystems.psu.edu/research/chestnut/>) has a section devoted to case studies from growers on their experiences in growing chestnuts. The site is often updated, so it is recommended that any grower keep an eye on the site for updates, and join the TACF mailing lists to stay up-to-date on the newest technologies related to chestnut growing.

#### DEER CONTROL

One of the most common setbacks in chestnut growing is browse by deer. Not only will deer eat many newly established forest trees, especially chestnuts, they

may also harm or even destroy them through buck rub. These issues may not be as problematic in some areas as others. And, in some cases, a landowner may have enough land where proper deer management programs can be implemented. As before, a good management plan, and/or consultation with a wildlife professional can be of great benefit for proper implementation.

#### **DEER MANAGEMENT TO ENHANCE PLANTING SUCCESS**

*by Kip Adams, Quality Deer Management Association (QDMA)*

For tree plantings to be most successful, the deer population should be managed concurrently with the habitat. Balancing the deer herd with what the habitat can support provides tremendous benefits to deer, the habitat and numerous other wildlife species.

The proper number of deer for an area depends on many variables including habitat quality, age structure of forested habitat, soil quality, climatic extremes, season, landowner's goals, and many others.

Balancing the deer herd with the habitat is achieved by annually removing antlerless deer. The appropriate antlerless harvest rate varies by region, but you can calculate a target antlerless harvest by using an estimate of the deer herd or of your habitat quality. Numerous population models suggest a harvest of 20 to 30 percent of the adult does (not fawns) in a population will stabilize the herd. If your goal is to increase the herd, harvest fewer than 20 to 30 percent of the does. If your goal is to decrease it, harvest more than this percentage. If you do not have an estimate of the number of deer in your area, you can use ballpark harvest ranges based on habitat quality. You can stabilize a deer herd by harvesting approximately one adult doe for



*Figure 3. Continued deer browse of sprouts from an American chestnut stump.*



every 25 to 100 acres of high-quality habitat, one adult doe for every 100 to 300 acres of moderate-quality habitat, and one adult doe for every 300 or more acres of low-quality habitat. As above, harvest above these rates to reduce the deer herd.

## **DEER EXCLUSION AND REPELLING**

Other landowners may not have the acreage, or enough neighboring, managed acreage, to properly manage deer populations themselves. In these cases, individual deer exclusion methods will need to be implemented.

**1) Tree Shelters.** One of the first places many growers turn when trying to protect their trees from deer is to plastic tree shelters. TACF typically does not recommend tall, narrow, plastic tree shelters, although this technology is starting to improve. Depending on other establishment methods employed, i.e. vegetation control, etc., there are other options including several types of mesh tubes, hardware cloth enclosures, “superwide” tubes, and others. Each come with their own advantages and disadvantages.

**2) Fencing.** The most proven method of deer protection is an 8-foot, woven wire fence (with 2 foot tubes inside the fence to protect from smaller critters). In some areas, a multi-strand baited electric fence can be effective. Some growers have used 8-foot tall plastic fencing with some success. Several growers have erected their own fencing, often proving more cost effective over professional installation. Several examples of these fences are available on the Chestnut Growers website.

**3) Caging.** For small amounts of trees (about 10-20 but no more than 50, as a general rule), wire cages made from 6’ lengths, hog rings, and electric fence rods may deter deer as well. Four foot tall chicken wire cages have proven effective as well.

The American Chestnut Cooperators Foundation has a website devoted to the construction of wire cages for chestnut trees (<http://www.accf-online.org/cages.htm>). The taller the cage, the smaller the diameter can be. As a general rule,

though, try to use a 6-foot-tall fence approximately 3 feet in diameter. We recommend a minimum of 4 feet tall and 3 feet in diameter.

**4) Deer Repellents** have proven effective to a certain extent. They **must** be re-applied biweekly and after any rainfall. You can purchase commercially available repellents based on beef blood or coyote urine or make your own (although collecting coyote urine may prove to be a difficult task). Several reviews of repellents are available online.

When using deer repellents, fencing is not a requirement. Short tree shelters may still be used to protect from rodents and from herbicide damage. Be certain to apply the repellent on a regular basis. Again, fencing is the most effective deer control method.

## **VARMINT CONTROL**

Chestnuts are a prized food of many species, humans not being the least of them. Blue jays, turkeys, bears, deer, voles, mice, squirrels, chipmunks, raccoons — just about everything will eat chestnuts. And they won’t just eat the nuts themselves, but also the stems.



*Figure 4. Improperly protected chestnut stems are open to attack by various creatures. The tree on the left shows sign of groundhog attack. The tree on the right shows signs of vole attack. Protect the young saplings from a number of hungry vegetarians with the use of plastic tree shelters. The stems are almost completely girdled and also now have wounds that are open to significant blight infection. Also remember that vole attacks tend to be worse in field situations vs. forested ones.*

Or, in the case of bear, can break the trees in half.

In order to protect your planting from would-be marauders, both at the nut stage and beyond, it is important to employ the right hardware. TACF employs

the use of several types of protection including several brands of short tree shelters and aluminum flashing. No matter what method you choose, they should always be properly established and maintained.

- 1) **Keep the tube in place.** Most shelters ship with wooden tree stakes. These rot fairly quickly, usually within about 2 years. Fiberglass rods are often perfect for the job, but if they are unavailable, rebar may be used, or, of course, the wooden stakes as a last resort.
- 2) **Erect the shelter “right side up.”** When shelters are shipped, one lip is curved outward — that is the top of the shelter, related to #3 below.
- 3) **Sink shelters in the ground.** After planting the nut in the hole be sure to sink the shelter into the ground about 2 inches. This will serve to protect from voles both at planting time and beyond. The pictures on page 6 show damage by rodents to improperly protected trees (Figure 4).

## OTHER PESTS

### INSECTS

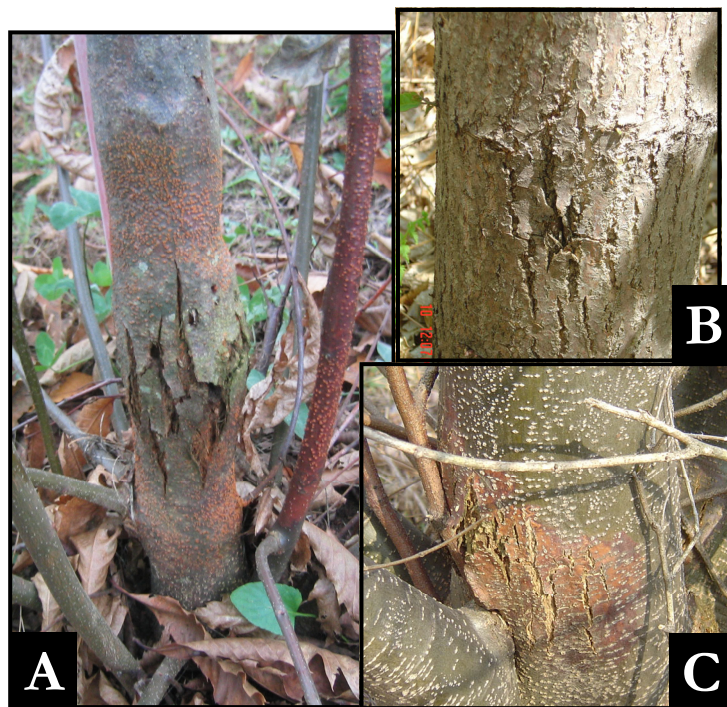
Besides mammalian predators, there are many insects who will jump at the chance to attack your chestnut trees, not the least of which are Japanese beetles.

Bagworms, orange-striped oak worms, cicadas, ambrosia beetles, and gypsy moths are just a few of the insects that have affected our orchards in the past. Be vigilant in keeping an eye out for insect invaders. Consult with your extension agent or TACF Staff and growers to properly identify the pest and the proper control methods.

### PATHOGENS

There are a variety of pathogens that can and have attacked orchards. As with insect attack, be vigilant and keen to sudden changes in survival or health of the trees in your orchard. Whenever possible, consult with the TACF Staff, growers, and/or your local extension agent for proper identification of diseases and their appropriate controls and/or prevention.

Figure 5. Chestnut blight cankers on an American chestnut (A) and a Chinese chestnut (B). In A, showing a tree with high blight-susceptibility, one can see the distinctive orange coloration of the blight fungus, on of the only fungi in the native range of American chestnut that looks like this. The Chinese chestnut in B is exhibiting a high amount of blight resistance; the canker is barely noticeable. That in C shows some moderate amount of susceptibility with the orange coloration showing through, though only in a mostly superficial way.



- 1) **Chestnut blight** (Figure 5). TACF exists because of the attack of chestnut trees by the chestnut blight fungus (*Cryphonectria parasitica*). Rest assured that some trees will eventually get attacked by natural infections of the blight. Even Chinese chestnut get the blight! The only question is to what degree it will affect them.
- 2) **Phytophthora root rot.** Particularly in the warmer climates of the south, chestnut trees fall prey to another pathogen known as ink disease or *Phytophthora* root rot. Currently, the Asiatic species of chestnut are generally resistant, but some lines of TACFs advanced material are not. TACF recommends testing in wetter areas and those south of central Pennsylvania, when possible, so as to avoid infected areas. To date, no confirmed attacks of chestnuts by *Phytophthora cinnamomi* have been in Pennsylvania or northward.

## VEGETATION MANAGEMENT, FERTILIZATION, AND WATERING



Depending on the size of the planting you've undertaken, and the type of maintenance plan involved, you may or may not want to include fertilization and watering in your plan.

**Vegetation management, however, is absolutely essential.** Weeds will significantly and negatively affect the growth of young trees; grasses in old fields are especially tough competitors. In any planting, vegetation must be controlled for at least the first 3-5 years following establishment. Growers with most success keep a weed-free area of at least 2-3 feet in diameter around their trees.

You can mow, mulch, use a tarp or other plastic wrap, mechanically remove, or spray with herbicide in order to manage vegetative competition. Some growers prefer to use organic options of weed control, while others do not have this constraint.

With a well-established forest management plan, and follow-through with trusted professionals, proper vegetation control can be implemented.

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## V. PLANTING PLANNING AND EXECUTION

### *INCLUDING OTHER SPECIES IN YOUR PLANTING*

Depending on the goals of your chestnut planting, you may consider including additional species. Goals such as habitat improvement, hardwood stand development, etc., would influence the species selected to plant alongside chestnut.

Typically, American chestnut can grow well with a number of native Appalachian species, but some of the best associates are white pine, red oak, white oak, chestnut oak, and tulip tree. As for the mid and understory, flowering dogwood, Rhododendron, mountain laurel, and blueberries often do well with chestnut plantings. This list, of course, is not all-inclusive. Simply look to your own forest or those around you for ideas of species that might work on a site that is also suitable for American chestnut reintroduction.

Here again is where a consulting forester and/or good planning can help when establishing a restoration

planting. Spacing and establishment protocols for each of these species may differ somewhat, so always follow species specific planting and site selection guidelines.

### *MEASUREMENTS*

American chestnut restoration will take decades to complete and is only in the nascent stages. As such, there is a need for landowners planting American chestnuts to report their findings.

The degree to which you might participate in the TACF testing plan can vary from a strict, scientifically laid-out progeny test, to simply sending in some pictures and quick write-up of your thoughts on the planting.

If you are interested in the former, please work ~~with~~ closely with TACF Staff to properly establish the planting and to institute a measurement program for your trees. TACF has training programs available for those who would like to participate, especially if you have a group of volunteers who can also help.

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### **For more information, please contact:**

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