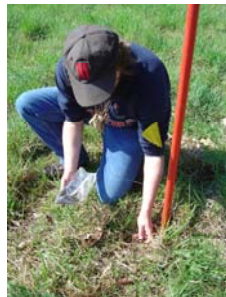
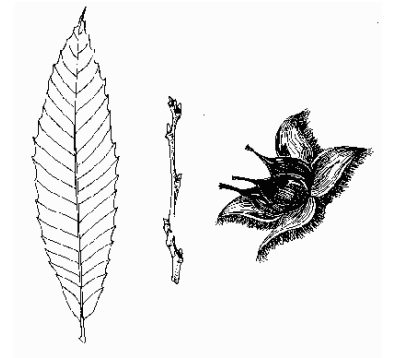


Planting and growing chestnut trees



The Pennsylvania Chapter of the
American Chestnut Foundation



Planting and growing chestnut trees is a rewarding challenge. As with growing anything, there are some tips and tricks to growing chestnut trees. The goal of the Pennsylvania Chapter of the American Chestnut Foundation (PA-TACF) is to restore the American chestnut (*Castanea dentata*) to the forests of the mid-Atlantic. To do this, we must plant a lot of trees! To date, we have planted over 22,000 trees as part of our mission. 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 the recommendations contained within, that you will realize the growth potential necessary for timely inoculation and nut production.

1. Site selection
2. How many trees?
3. Seed vs. seedling
4. Spacing
5. Maintenance

Now that you've decided to plant some chestnuts, there are five major decisions that you will be facing.

SITE SELECTION



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



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.

- 1) **Well-drained, acidic soil type. This is *the* most important consideration when planting chestnuts. Choose wisely.** Sandy, loamy, well

drained and somewhat acidic soil (pH 4.5-6.5) on gently sloping fertile land is best. Avoid heavy clay soils. Review your property's location on county soil maps from the Natural Resources Conservation Services (NRCS). Many of these are available on-line (<http://websoilsurvey.nrcs.usda.gov/app/>), but you may also find them in your local library.

- 2) **Avoid planting in swales.**
- 3) **Exposure.** Full sun is best for growth, vigor and seed production. A sheltered north-facing slope protected from drying winds and low sun of winter may be better for cold windy sites. Planting on a slope may also help alleviate some drainage issues.
- 4) **Site preparation** 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. Within planting rows, spray herbicide 2 weeks prior to planting, or otherwise remove sod and competing vegetation.
- 5) **Clearcuts vs. fields.** Assuming you want maximum growth and nut production, you will be choosing an open site. Clearcuts typically have proper mycorrhizal associations for trees and may maximize growth potential because of their fertility. Old fields can often be easier to maintain, but they often have hardier weeds that take persistence in management.
- 6) **How many trees?** A final consideration that will need to be made is how many trees you'll want to plant. This can determine the size of the area on which you'll be starting your orchard. Of course, the opposite could be true, so our next question is

HOW MANY TREES?

The next question you'll need to answer is how many trees you're going to want. This 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.

Remember that you will need to plant at least 2 chestnuts to get nut production. Account for some mortality over the years, and plant at least 5. If you

just want to plant a few trees, a good amount would be between 10 to 50.

For the purposes of establishing a planting of chestnuts for PA-TACF, we typically ask for a plot of land larger than 0.5 acres, but no more than 3 acres. An individual grower usually cannot take on more than 900 trees of any backcross generation***

Once you have established how much land is available, the type of trees you will plant will be determined after consultation with your Chapter's breeding coordinator. **All growers** should start by testing their growing methods and land by planting open pollinated American chestnuts, which are available each year from the Chapter.

Depending on the year's supply, the Chapter will have needs for different orchard types. Currently, the Chapter promotes the following types of orchards, which, to date, increase in complexity from 1 to 4. The theory behind the breeding and establishment of these orchards have been covered extensively in the TACF Journal; however, the following briefly covers what is involved in each type.

- 1. The Backyard Breeder.** This type has a grower establish a couple of American chestnuts near a couple of Chinese or hybrid chestnuts. Although 5-10 trees will be planted, no more than 4 should be kept. When the time comes, and with more than 2 trees, the excess trees will need to be emasculated, the catkins removed, to facilitate collection of proper seed type. The trees should be given ample room. Plant on 20' centers.
- 2. Demonstration and education orchards.** These are a great way to get your organization involved. These orchards typically take very little land, offer a great opportunity for learning the differences in chestnut species, and also offer a great visual representation of how breeding works. Planting usually involves 5-10 trees each of:

***For later generations, such as the B3F2 or higher generation, different rules apply. A single individual grower can potentially grow thousands. But, we hope that you might practice on a few using these methods before you plant large amounts of highly advanced material.

American, Chinese, Japanese, European, and hybrids chestnuts, as available.

- 3. The MSR/CMS and American germplasm reserve orchard.** In 2001, PA-TACF began a program that aims to increase the Chapter's inclusion of diversity of resistance sources while, at the same time, incorporating a method to ease the difficulties of controlled pollination. MSR (Multiple Sources of Resistance) and CMS (Cytoplasmic Male Sterility) are covered elsewhere, but, briefly, the inclusion of these methods are merely offshoots of the standard backcross orchard most often established as part of TACF's efforts. Some additional record keeping is required. To date, a minimum of 40-80 trees planted is necessary. As later generations are bred, this number will increase. This orchard types is a great way for the new grower to become involved with our breeding program.
- 4. The Backcross Orchard** is not for the faint of heart. Most often, a minimum of 350 trees is required. The amount of labor and input required can be high, and we often require fencing of a site to protect from deer. Advanced backcross seed are difficult to make (see our section on Pollination), so we want to be assured of receiving the most from those efforts. With very few exceptions, we will not plant more than 900 trees with any one grower because of the amount of input required.

We generally ask that growers who want to establish an orchard work closely with our breeding coordinator to identify the orchard that will best fit their needs, as well as the needs of the Chapter. In Pennsylvania and New Jersey, we ask that you contact our Leffel Research Center at Penn State University, the contact information for which may be found at the back of this document.

DIRECT SEEDING VS. PLANTING SEEDLINGS

Once you get your seed, the next decision that will need to be made is whether to plant seeds or to plant seedlings. Before planting, be sure to keep your seed in cold storage (a refrigerator) away from apples and

pears until you are ready to plant. The colder the storage, but above freezing, the longer the seed will keep.

Typically, planting seeds is easier and less labor intensive than planting seedlings. Germination of “pure” chestnut species, as well as advanced hybrids, is often very high, often eclipsing 90%. For early hybrid generations, F1 and BC1 generations especially, incompatibilities occur that often decrease germination significantly. When planting those generations, it may make more sense to test germination in the greenhouse and outplant using seedlings.

****Before planting**** be certain to read the section on maintenance and make the decisions on how to properly maintain your chestnut orchard well into the future.

DIRECT SEEDING CHESTNUTS

If you have decided to direct seed chestnuts, there are a few things to keep in mind.

- 1) **Plant early in the spring.** In the spring, plant as soon as you can work the soil. In Pennsylvania, this is usually about mid-March. Try to plant as soon as you can work the soil.
- 2) **Planting the seed.** Most chestnuts will have sprouted by this time. Be sure to plant with the radical facing down. If the radical is not present, then plant with the flat side of the seed facing down. Plant radical down (Figure below).
- 3) **Clip the radical?** Often, the radical will be very long. One may clip the radical to ease planting, but clip as little as possible, and be certain not to break the cotyledonal junction between the radical and the nut.



- 4) **Proper planting medium.** When

planting, use a 1:1:1 peat, perlite and vermiculite (PPV) mix. Some planters find this mixture too light. It is often good procedure to mix native soil into this mixture so that you have a final mix of 50% PPV and 50% native soil. Mix water in



When planting chestnuts indoors, be sure to use pots that are deep enough. Be sure to label the pots well.

with this mixture so that it is wet, but not soaking wet.

- 5) **Don't plant the seed too deep.** Make a planting hole about 3-6 inches deep. Backfill the hole with the planting mixture. About 1/2 to 1 inch from the surface, place the chestnut, and then cover with the mixture. When placing the chestnut in the backfill, make a hole with your finger in the dirt to allow for placement of the radical.
- 6) **Make a good home.** Make a hole using a bulb planter, auger, shovel, or what you have available.
- 7) **Record what you do.** Be certain the planting position is well marked with identification elements. Usually, this is a position number within a grid and a Seed Lot number and/or Cross Code (See page 13)

PLANTING SEEDLINGS

Starting seeds indoors is a very reliable method of propagating chestnuts. It can be easier to protect your stock from would-be seed predators. Still, starting your chestnuts indoors carries with it its own pitfalls. Be sure to keep these things in mind when planting your seed inside.

- 1) **Large enough pots.** Deep containers are necessary to grow seedlings well. It is recommended that pots of about 12” in depth and 4” in diameter are used. Of course, the longer you plan on keeping the material, the larger the pot should be.
- 2) **Type of pot.** Pots can be made from one or two-quart milk or juice cartons. Provide drainage by

punching holes in their bottoms, or by removing the bottoms altogether (the open bottom “air prunes” the roots, reducing coiling (J-rooting) and often stimulating the production of rootlets). Commercial options are available. D40 cells and 1 to 5 gallon tree pots are most often used.

- 3) **Proper planting medium.** The growing medium should contain plenty of fibrous materials to help preserve the root ball at transplanting time and should contain other amendments to provide for lots of aeration. Soilless potting mixes are better than potting soils. A mix containing lots of composted bark is a good option.
- 4) **Start seed early.** Start seed as soon as possible after receiving them in a greenhouse or sunny window. Generally, one can start their seed in January or February. Make sure you don’t over-water the containers: keep the soil moist but not wet. Fertilize occasionally but with a dilute solution of a complete fertilizer.



Scorched growing tip of a BC3F2 hybrid which occurred due to improper hardening off between greenhouse and field planting. The tree eventually grew well, but some amount of growth was lost.

- 5) **Harden Properly.** Seedlings started indoors will be ready for transplanting after the final frost of the season has past. At that time, begin to expose your plants to sun and brisk winds gradually. Introduce them to the outdoors by placing them under a shady tree or on a protected sunny porch. If you have a shadehouse available, try using 30-50% shade cloth for at least 2 weeks. Move them out into harsher environments slowly so they’ll have time to acclimate.
- 6) **Carefully pluck the nut.** When outplanting the seedlings within the first few months of planting, be certain to remove the remaining nut from the seedling. Rodents will dig up the seedling in order to eat the nut.

- 7) **Prepare a good home.** When planting the seedling, make a hole at least 1.5-2 times as large as the root ball of the seedling you are to plant. Chainsaw or tractor mounted augers can make quick work of planting holes. — Depending on the soil type, augers can “glaze” a planting hole, creating a hardpan like property in the hole. When planting the seedling, be sure to aerate the sides of the planting hole with a hand-held cultivator or plow.
- 8) **Water properly.** After transplanting, seedlings need lots of water. Water thoroughly for at least the first month after planting. For best success, water with about 1 gallon per tree every week.
- 9) **Documentation.** Record everything you did! Especially note any changes made to a planting plan, if one was made. Label the planting hole properly (see page 13).

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. Some recommendations are made, some more highly recommended than others. While PA-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 the

breeding program coordinator 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, <http://chestnut.cas.psu.edu>, has a section devoted to case studies from growers on their experiences in growing chestnuts. The site is continually updated, so it is recommended that any grower keep eye on the site for updates, and join the TACF and PA-TACF mailing lists to stay up-to-date on the newest technologies related to chestnut growing.



Continued deer browse of sprouts from an American chestnut stump.

DEER CONTROL

In Pennsylvania and New Jersey, the most common setback in chestnut growing is browse by deer. In many areas of both states, especially urban areas, deer populations are out of control.

TREE SHELTERS

One of the first places many growers turn when trying to protect their trees from deer is to plastic tree shelters. After several years of using them to grow chestnut trees, PA-TACF has determined that the use of tall, narrow-diameter tree shelters is highly detrimental to tree health. For many varied reasons, the Chapter has discontinued use those shelters.

Do not use narrow tree shelters taller than 3 feet high.

Tall tree shelters encourage continued tip die back, create a flimsy tree that cannot support itself (leading to a condition we affectionately call “tree flop), and

retard proper root growth. In addition, blue birds will fly into these tubes, get stuck, and perish.

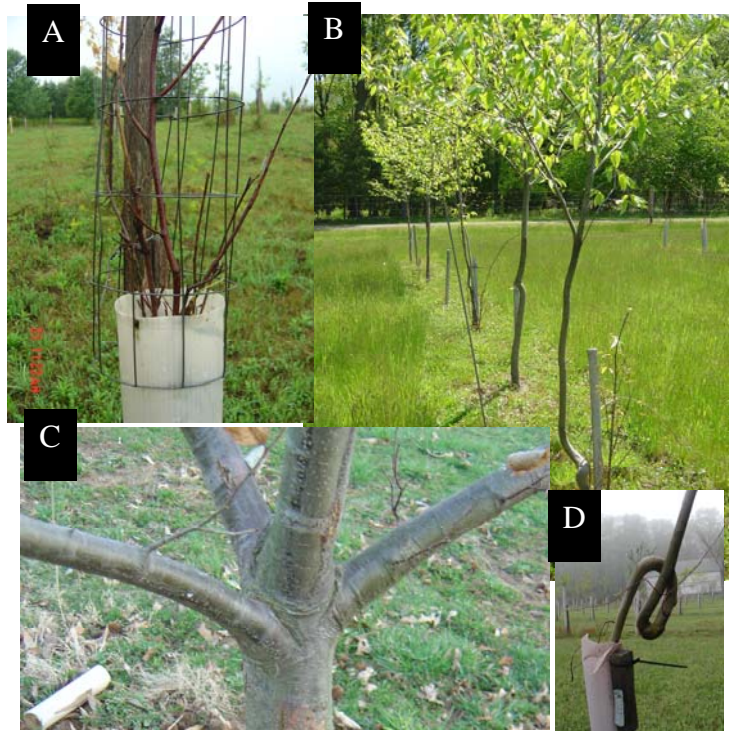
The Chapter endorses use of shelters of about only 1-2 feet in height, depending on the type of weed control that you will plan on employing.

Other groups of growers are experimenting with several types of mesh tubes, hardware cloth enclosures, and any number of other things.

There is a brand of “Superwide” grow-tube available for those who cannot erect any type of fencing. These are expensive and laborious to install. Please consult with the breeding coordinator to discuss options for your new planting if you choose not to erect fencing or plan to be persistent in deer repellent application as described below. With almost any tree shelter use, the additional application of repellents and or fencing will be required and continued vigilance in shelter re-erection will be necessary.

FENCING

The most proven method of deer protection is an 8-



The horrors that can occur with the use of narrow tree shelters. A) consistent tip dieback; B) poor ability to support crown; C) form break; D) caught leading tip

foot, woven wire fence (with 2 foot tubes inside the fence). In some areas, a multi-strand baited electric fence can be effective. Some growers have used 8-foot tall plastic fencing with some success.

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 5 feet tall and 2 feet in diameter.

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.

Deer Repellents

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 on-line, and these are summarized at <http://chestnut.cas.psu.edu/fencing.htm>

Numerous growers have sung the praises of egg-based repellents. It works well -- AS LONG AS YOU PERSERVERE IN ITS APPLICATION. One slip-up and *ding ding ding* it's dinnertime. During the summer, you should apply the mixture once every two weeks, as well as after any rainfall event. The method is described in detail by PA-TACF member Chandis Klinger in his article titled,

"Protecting Young Plants with Brush and Eggs". The article is in volume 7, issue 1 of the journal (Fall/Winter 1992), and is available for download from TACF's website: <http://www.acf.org/journal.htm>, or by contacting the Leffel Center or TACF for a copy.

When using deer repellents, fencing is not a requirements. 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.

Buck Rub

Male deer will rub their antlers on the trunks of chestnut trees in the fall. Fencing will help prevent this as well as browse. If fencing or wire cages cannot be erected, the installation of two tall stakes on opposite sides of the tree may help prevent buck rub, as the deer cannot reach the stem with his antlers.



This chestnut tree in Philadelphia has experienced successive years of buck rub.

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. 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.

In general, PA-TACF employs the use of 1.5-2 foot tall plastic tree shelters. These tree shelters may be of any diameter, although the larger they are, the easier within which they are to weed.

When erecting tree shelters, you will need to keep a



Even when planting seedlings, proper tree shelter application is necessary for protection from rodents and herbicide damage.

couple of things in mind:

- 1) **Keep the tube in place.** Most shelters ship with wooden tree stakes. These rot fairly quickly, usually within about 2 years. PA-TACF usually makes fiberglass rods available for growers. The fiberglass rods are 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) **Cut shelters.** To save money, one may cut down taller shelters into short shelters. Keep in mind that the resulting cut end will be very sharp, and will rub against the tree, producing an area perfect for blight infection. Cover cut ends with plastic tubing or old garden hose that has been cut in half. Duct tape will only last about one season.
- 4) **Sink shelters in the ground.** After planting the nut in the hole (see “Direct Seeding Chestnuts” on page 4), 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 below show damage by rodents to improperly protected trees.



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 sign 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.

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.



Japanese beetles and their damage to leaves of an American chestnut

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 breeding program coordinator to properly identify the pest and the proper control methods.

As of now, the most common and easiest to control pest is the Japanese beetle. Control this pest as soon as they start to attack (mid summer) with the application of the pesticide Sevin.

Aphids and leaf hoppers typically attack orchards in old fields. Their presence looks bad, as toward the end of the growing season, leaves will curl and become chlorotic; however, their infestations are rarely damaging to the trees and, unless the trees are severely damaged in multiple years, do not require active control

PATHOGENS

PA-TACF exists because of the attack of chestnut trees by the chestnut blight fungus (*Cryphonectria parasitica*). Rest assured that your orchard will eventually get attacked by natural infections of the blight. Typically, infection on backcross trees should be left untreated as our major goal in these breeding orchards is to weed out those with poor resistance.

For American and other trees that are not to be inoculated, one may prolong the lifespan through the process of mudpacking, a process that is described in detail on the Chestnut Growers site.

Particularly in the warmer climates of the south, chestnut trees fall prey to another fungus known as ink rot disease or *Phytophthora* root rot. Currently, the Asiatic species of chestnut are generally resistant, but many of our backcross and pure American stock remain susceptible. There is no cure, but our friends in the Chapters across the Mason-Dixon line are breeding stock for resistance to this disease.

To date, no confirmed attacks of TACF breeding stock by *Phytophthora cinnamomi* have been made in Pennsylvania or New Jersey.

Surely there are other 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 breeding program coordinator and/or your local extension agent.

WEED CONTROL

Soil and weeds will significantly and negatively affect the growth of young trees; grasses in old fields are especially tough competitors. 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, or spray with herbicide in order to manage within row vegetative competition. Some growers prefer to use organic options of weed control, while others do not have this constraint.

Between rows, PA-TACF encourages growers to control vegetation through mowing, as this will help control rodent populations within the orchard. Also, when tree shelters are employed, hand weeding within the tube will be necessary to control vegeta-

tion directly against young trees, at least for the first two years.

Organic Options

For a grower who strives to keep their land organically certified, the options for weed control include landscape fabric, black plastic mulch, cardboard, and even corn gluten. Generally, landscape fabric and plastic mulch are favored. Wood chip mulch may be applied over landscape fabric or cardboard to halt deterioration of the materials

- 1) **Be careful with wood chip and black plastic mulch**, particularly if you have not protected the stem with a tree shelter. Rodents, most often voles, like to live within or under mulch, just waiting for a vulnerable chestnut tree on which to munch.
- 2) **Black plastic mulch is not permeable.** Depending on the type of irrigation and fertilization method you choose, black plastic mulch may not be the way to go. Broadcasted granular herbicide will not be able to sink in through the plastic. You will need to water the trees individually with a liquid-based fertilizer, or use a drip-line irrigation system into which you inject a liquid-based fertilizer.
- 3) **Landscape fabric is permeable**, but often more expensive. Weigh the costs and benefits, and feel free to consult with the Chapter's tree breeding program coordinator.
- 4) **Organic herbicide?** Some gardener magazines suggest the application of a cocktail of lemon juice and vinegar to control offensive competing vegetation. Corn gluten is another option. The effects of these methods on chestnut culture have



Black plastic mulch is a good option for weed control for the organically certified grower.

not yet been fully evaluated by the Chapter. Use at your own risk!

NON-ORGANIC OPTIONS

The most often employed method of weed control by PA-TACF growers is through the use of commercially available herbicides. Although we do not officially endorse the use of any one herbicide, most growers use RoundUp or a similarly-formulated broad-spectrum herbicide. There are many generic brands of **glyphosate-based** herbicides — check around for different brands. In general, however, check the **concentration**, read the label well, and get a brand with an included **surfactant**, which will help the herbicide stick to the vegetation better.

1. Spray when the weather is clear and the target vegetation is actively growing.
2. Spray about 2 times per year, once in the early summer and once in the fall.
3. Keep an area 2-3 feet in diameter around your trees free of grass and weeds.
4. Be certain to protect the bark and leaves of the chestnut tree — 2 foot tall plastic tree shelters work very well for this.

There are other herbicides out there that work differently and have more specific targets than RoundUp. These include chemicals specific to woody-vegetation or preemergent herbicides. Typically, these chemicals require certification or extensive personal protective equipment (PPE) for application.

5. ***Always* read the label and follow instructions on the herbicide.** Unless you are fully certified and trained to work with herbicides, consult with your local extension agent and breeding coordinator before embarking on a killing spree with a potentially dangerous herbicide cocktail.

FERTILIZATION

There are several considerations that will go into selecting the proper fertilization regime for your or-

chard. The first step in planning a good fertilization regime is to analyze the soil of the location on which you intend to plant.

SOIL TESTING

Prior to planting your chestnut orchard you should have a soil test performed by an accredited soil analysis lab. Penn State University, through their Agriculture Analysis Labs (AAL) offers general soil analyses for about \$9 per sample. Each spring, PA-TACF offers growers kits which the Chapter receives at a reduced bulk price.

When you receive a soil sample kit from the Chapter, instructions on how to fill out the sample will be included. If you order one directly from PSU, contact the Leffel Center for a copy of the instructions, or, keep these several things in mind:

- 1) List the breeding coordinator (Sara Fitzsimmons) at the Leffel Center (address on the back of this manual, e-mail: sff3@psu.edu) as a contact so that she may assist in analysis of the soil sample
- 2) Crop Name: Use a 10-letter code closest to your Farm Name. Ask Sara if you want a Name defined for you.
- 3) There is no crop code for chestnut. Use one of these codes, depending on your situation:
Crop Code: 6100, **Crop Name:** Group I, Acid Soils, To Plant – if you haven't planted
Crop Code: 6200, **Crop Name:** Group I, Acid Soils, To Maintain – for older orchards
- 4) You may want to know more about your orchard location. There are other tests available through PSU's Ag Analysis Labs, some of which are interesting, but usually unnecessary. Please feel free to consult with Sara and/or the AASL for more information regarding these extra tests and what they will tell you.
- 5) In 2006, it cost approximately \$2.50 to mail the soil sample kit back to the AAS Labs for analysis.

Once a soil analysis has been made, and a copy is sent to the breeding coordinator, steps will be made to tailor an amendment and fertilization regime specific for your site. Once you start growing chestnut



trees and applying various products to help maintain the planting, the soil chemistry will change. Try to get a soil test performed bi-annually or, at the very least, the year prior to inoculation.

If you do not use PSU's AAL, tell the soil analysis labs you use that you would like recommendations on blueberries or rhododendrons: most labs do not have recommendations for chestnut trees.

ORGANIC VS. NON-ORGANIC AND LIQUID VS. GRANULAR

There are many fertilizer choices out there. Some growers prefer to stay organic, while others do not have such a constraint.

- 1) **Use high nitrogen formulations** like 30-10-10 or 20-10-10. As inoculation year approaches, use a high phosphorous fertilizer such as 0-46-0.
- 2) **Pay attention to all labels on any fertilizer you get.** Work with either your cooperative extension agent or Chapter breeding coordinator to establish an effective fertilization regimen. The Chapter will also assist in the purchase of materials when possible.
- 3) **Do not fertilize past August 15, particularly in high latitude areas.** This leads to tip-die back and will significantly cut growth potential of your trees in any given year.

INORGANIC

If an easily accessible source of water is available, or, even better, an irrigation system is installed, the use of liquid fertilizer may be the best. For liquid fertilizer, we most often recommend continued application of 30-10-10 Miracid. In the 1st and 2nd growing seasons, use 30-10-10 Miracid at 1.5 TBSP / Gallon of water. Fertilize with 0.5—1 gallon of the mixture per tree. Fertilize at least once per month with this formulation.

Broadcast application of granular and slow-release

fertilizers is another option, and one of the best for the grower with little time. Keep in mind, though, that little rainfall over a season will require watering of the orchard. Be certain to review the watering methods below.

ORGANIC

Products such as fish emulsion fertilizers and products by Espoma such as Tree Tone are available for the organic grower. These products are typically less effective than synthetic alternatives, but are better than nothing.

WATERING METHODS

Be sure to establish your orchard near an easily accessible and utilized water source. Drought will come one day, or you will need to utilize the water source for proper fertigation or dilution of granular fertilizers.

During the discussion of weed control methods, irrigation methods were discussed. If you decide to use a non-porous weed control method such as black plastic, a drip-line irrigation system should be employed underneath the plastic.

Hi-tech, mechanized irrigation systems can be difficult, expensive, and frustrating to maintain. In many cases, however, installation of an irrigation system can save the "life" of an orchard.

Typically, it is recommended to purchase a large tank, 300-400 gallons, to hold water. The choice of tank will be determined by the truck bed or tractor cart with which you plan to tow the tank around, and how the tank will fit into the scheme. Gravity can be employed to run water from the tank onto the trees as you drive along the rows.

Low-tech irrigation systems have been installed by several growers at relatively cheap cost. By installing collecting tanks (about 300-400 gallon tanks) at a higher elevation than the orchard, PA-TACF member

Tom Pugel runs drip line from the tanks into his orchard. By simply using rain water and gravity, Tom has kept his orchard well-watered.



Long-time chestnut grower and PA-TACF member Tom Pugel's Riegelsville orchard was established on a 7 x 15 foot spacing. In this picture, the trees are in their fifth growing season, and Tom notes he wished he would have established a wider spacing.

ALTERNATIVE METHODOLOGIES

Chestnut growers are typically energetic and inventive. Through the expansion of the volunteer growing community of TACF, growers have tried a number of methods by which to plant and grow their trees. Many new growers ask about methods other than those described in this manual. Yes, there are other methods available, but these described have proven the most effective for those in PA-TACF. If you have a new idea of a method you'd like to employ, please contact your breeding coordinator at the PSU Leffel Center to discuss the potential. Again, while we encourage experimentation, some methods that have been tried have proven detrimental. By consulting with the coordinator, you can get some more ideas on how to best implement your idea. Also, once the method proves successful, the coordinator will be able to further spread the utility of your ingenuity!

"The Meadowview Method"

At TACF's main research farms in Meadowview, VA, slightly different methods than what are described herein are employed. While the use of aluminum collars, an update to the "tin can method", around seed can be employed in PA, the method employs significant input into an irrigation system. Additionally, at the time of this writing, deer control was not a significant issue at the Farms (although it appears as though deer are becoming more of a problem).

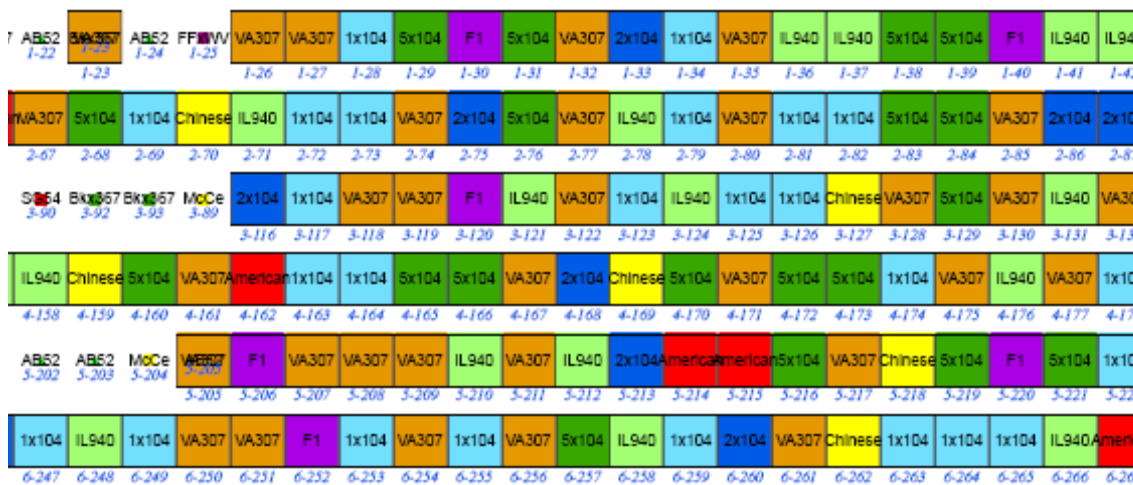


"The Meadowview Method" of planting chestnuts.

- At our farms in southern Virginia, we direct-sow most nuts, at orchard spacing, in black plastic-covered rows we've already plowed, disked and fertilized.
- To prepare each planting hole, we remove a plug of soil with a bulb planter and replace the soil with lightly packed, moist peat moss.
- We cover the nut with a half-inch of peat.
- We protect the nuts from rodents by placing a three-inch diameter, slightly cone-shaped cylinder of ten-inch aluminum flashing around each of them. (The top is about a half-inch smaller than the bottom to reduce internal reflection of sunlight onto the developing leaves.)
- We sink the cylinder into the ground an inch or two deep, then mound soil around it to keep it in place in tough weather.
- To exclude rain and to keep the nuts warm, we then cover the top with an eight ounce paper or Styrofoam cup with a hole punched in the side for air.
- The cup is removed shortly after the seedling emerges. As the season progresses we water as needed.
- We fertilize every other week through early August, simply filling the aluminum cylinder with a solution of Mir-Acid.

SPACING

Now that you have determined the types of maintenance you will employ, and the type of seed you are going to plant, and how many you are going to plant, you can determine the spacing.



This is an excerpt from the most recent Foxhaven orchard planting plan. The blue numbers are the row and position locations within the orchard. The various different genotypes are described by different colored blocks, as well as by codes that relate back to the cross from which the trees are derived. The more trees that are planted in an orchard, the greater the complexity of the map, and the more necessary proper planting record keeping becomes.

Typically when establishing a demonstration, MSR/CMS, or backcross orchard for PA-TACF, the breeding coordinator will work closely with you to establish a spacing and planting plan for you.

However, keep these things in mind when consulting with the coordinator.

- 1) **Farmers often have large tractors** that require a lot of room to maneuver. As the trees grow larger, you will have less room to maneuver. Although it seems like a lot of room now, you may thank us for larger spacing recommendations later. Typically, this means a 10 x 20 spacing, with 10 feet between trees and 20 feet between rows.
- 2) **If you have fenced a site**, be certain to leave enough area between the fence and the planting to turn your equipment around. You'll often need at least 20-30 feet from the fence to do this.
- 3) **Non-mechanized orchards** have seen good growth and maintenance with orchard spacings of 8 x 8 (8 feet between rows and 8 feet between trees).
- 4) ****Never**, please never**, go below a spacing of 8 x 8. The lowest ever recommended is 7 x 15. Again, it may seem like you are taking up too much room now, but wait until the trees grow up!

PLANTING DAY

If you are establishing a breeding or demonstration

orchard, you most likely have received a planting plan that outlines the planting positions where certain seed go.

Numbering orchard positions and tree locations

Work closely with the tree breeding program coordinator to

choose a numbering scheme that makes the most sense to you. You may be tempted to alter the numbering scheme after a year or two of growth, but this makes the life of the tree breeding program coordinator *very* difficult. The tree breeding program coordinator urges you to keep a single system of numbering, and stick with it.

Labeling tree positions

Forestry Suppliers has aluminum tags that work really well for labeling individual tree positions.

Find them on-line at <http://www.forestry->



Proper record keeping is essential. Thanks to Dave Armstrong and Livy Eck for keeping everything straight at the Reed Run Orchard. Photo courtesy PA-TACF grower Tim Eck.

suppliers.com. One only needs a ballpoint pen and some time to write out the tree position (row and number) and the cross or seed lot code for the tree to be planted.

Unfortunately, many growers attach these labels to the tree, promising that they will keep an eye on the label. Those promises are rarely kept. Be certain to attach your label to something other than the tree. Attaching them to the cable tie that binds the tree shelter and the fiberglass stake is a great method.

Another method of labeling tree positions is to write on a “permanent” stake or tree shelter. **Sharpies are not permanent.** Unless you want to annually re-write the tree’s information, try another method. Forestry Suppliers sales a product called a “paint valve marker”, which, in black, stands up to weathering very well.

Label every position at planting time. This will save you time in the long run, and can help both yourself and visitors from getting lost out in the orchard.

GOOD LUCK!!

There are other resources available that may help one in establishing an orchard and for further growing:

1. TACF Handbook to Growing American Chestnuts Available from TACF
2. Other TACF growers::
Join the TACF Growers lists
<http://chestnut.cas.psu.edu/maillinglist.htm>
3. The Chestnut Growers Website
<http://chestnut.cas.psu.edu/breeding.html>
4. The Northern Nut Growers Association
<http://www.nutgrowing.org>



Well manicured orchard of PA-TACF member Blair Carbaugh showing all preferred methods of maintenance at a chestnut breeding orchard.

- 1) The site has been fenced and tree shelters protect from herbicide damage.
- 2) Tree shelters are held in place with Chapter-donated fiberglass stakes.
- 3) The area between the rows is kept well mowed to reduce rodent populations.
- 4) Within their third growing season, the trees exceed 6-7 feet in height and have sturdy caliper growth because of consistent and proper fertilizer application and watering regimens.

Contact the Leffel Chestnut Center
at Penn State University
for more information at any time.

Sara Fitzsimmons
PA-TACF Tree Breeding Program Coordinator
sff3@psu.edu

Sue Oram
PA-TACF Administrative Assistant
sko2@psu.edu

Penn State University
206 Forest Resource Laboratory
University Park, PA 16802

PHONE: 814-863-7192 or 814-863-3600
FAX: 814-863-7193
e-mail: pachapter@patacf.org
Website: <http://www.patacf.org>

MAINTENANCE SCHEDULE

Name of Orchard:
Orchard Manager:

Manager e-mail:
Manager phone:

<u>PROCEDURE</u>	<u>SCHEDULE DATE</u>	<u>DATE COMPLETE</u>	<u>BY WHOM</u>
1. Plant nuts, as early as you can work the soil.	March 15 - April 15		
2. Take Soil Samples and have them processed through Penn State University. Information is available at http://www.aasl.psu.edu/SSFT.HTM or by calling the Analysis Lab at 814-863-0841. Tell them you are growing blueberries or Rhododendrons, or some other acid-loving species (pH 5.5).	Before or shortly after planting. Perform again on a yearly basis, or, at the very least, the year prior to scheduled inoculation.		
3. Fertilize – Tailor fertilization regime according to recommendations from soil sample test. There are many options available. Consult your local extension specialist, or contact Sara for more information.	Depends on formulation. Granular may take 1. Liquid as many as 5-6. Use at least a 30-10-10 formulation, but tailor to soil sample. In general, DO NOT fertilize after August 15.		
4. *Weed Control - Spray with Roundup (systemic) when grass is actively growing, before leaves emerge weather is clear, and wind is still. Or control by hand and/or with use of landscape fabric. Clear 2 ft. diameter around newly planted seed/trees and 1 ft. beyond drip line on older trees.	Herbicide: Twice per year. Once in the spring and once in the fall Hand weeding: As needed; At least 3x or more per year.		
5. Monitor flowering, both male & female.	June		
6. Monitor for Jap beetles and seed germination Control beetles with Sevin	Mid July		
Sevin (available at most hardware stores) will control Japanese beetles.			
7. Protect trunks from deer browse and rubs	Late August		
8. In colder areas, elevate tubes off ground about 1" to harden off for winter. Watch for mouse damage.	Late August to cold nights		
9. Yearly report of orchard activities; include for each planted position: survival (yes/no) and height (taken in feet, inches). Older orchards will take flowering data and diameter measurements.	October - February		

Please record the dates that you complete a maintenance procedure. Not every procedure will be required for every orchard. Return the completed maintenance schedule and final data worksheets between October 15 and January 15 to:::

Sara Fitzsimmons
206 Forest Resource Laboratory
University Park, PA 16802
or e-mail your results to: sff3@psu.edu

* **Weed Control** - Use of herbicides requires protection of trees, including bark of trunks from, the spray. Chestnut trees are quite susceptible to damage by herbicides. Short (2') tree shelters protect trunks well from herbicide damage.

