This idyllic orchard has benefited from good soil and irrigation. Photo by Tom Saielli

Chestnut Growers' Guide to Site Selection and Environmental Stress

By Elsa Youngsteadt

American chestnuts are tough, efficient trees that can reward their growers with several feet of growth per year. They'll survive and even thrive under a range of conditions, but there are a few deal breakers that guarantee sickly, slow-growing trees. This guide, intended for backyard and small-orchard growers, will help you avoid these fatal mistakes and choose planting sites that will support strong, healthy trees. You'll know you've done well when your chestnuts are still thriving a few years after planting. By then, they'll be strong enough to withstand many stresses, from drought to a caterpillar outbreak, with much less human help.

The two-foot-long taproot on this four-year-old root system could not have developed in shallow soils, suggesting that chestnut can grow better in deep soils. Taproot courtesy of Blair and Mary Carbaugh. Photo by Sara Fitzsimmons

Soil

Soil type is the absolute, number-one consideration when deciding where—or whether—to plant American chestnuts. These trees demand well-drained, acidic soil with a sandy to loamy texture. Permanently wet, basic, or clay soils are out of the question. So spend some time getting to know your dirt before launching a chestnut project. Dig it up, roll it between your fingers, and send in a sample for a soil test. Free tests are available through most state extension programs, and anyone can send a sample to the Penn State Agricultural Analytical Services Lab (which TACF uses) for a small fee. More information can be found at http://agsci.psu.edu/aasl/soil-testing. There are several key factors to look for.

Acidity

The ideal pH for American chestnut is 5.5, with an acceptable range from about 4.5 to 6.5. Outside this range, the roots absorb too much of some nutrients or too little of others, and the leaves begin to turn chlorotic (light green to yellow), indicating poor health. Fortunately, this problem

is easy to avoid. Your soil test results will indicate the soil pH and provide advice about how to amend it to reach the target acidity. Some labs may offer recommendations for chestnut specifically; if yours does not, simply indicate on the soil test paperwork that your target pH is 5.5. Get your suggested amendments worked into the ground *before* you plant.

Trees are stunted or dead at the top of this slope, but thriving at the bottom; the difference is associated with bedrock near the soil surface at the top of the slope but not the bottom. Photo by Kendra Gurney

Texture and Depth

Loose, airy, sandy soils are ideal, while dense, fine-textured clays are to be avoided at all costs. The latter stunt root growth and hold on to too much water, leading to weak, slow-growing trees. Soil survey maps (such as those available at http://websoilsurvey.nrcs.usda.gov) can help you find promising sites on your property. Use the maps to locate sandy or sandy loam soils in hydrological groups A or B, which are well drained. Also look for soils with high permeability, or high saturated hydraulic conductivity (K_{sat}). To accommodate chestnut's substantial taproot, prioritize sites with at least four feet of good soil above impermeable layers such as bedrock or fragipan.

Once the maps guide you to a promising site, check out the soil in person. When you pinch some moistened earth between your fingers, it should crumble. If it forms a ribbony strip, it contains too much clay. For another texture test, mix up a few shovels full of soil and scoop a cup of it into a quart jar. Add water until the jar is three-quarters full, and then shake it up. Sand, silt, and clay will settle into layers, with sand on the bottom and clay on top. (Tiny clay particles can take more than a day to settle out, so be patient!) In the ideal soil, the sand layer will make up half to three-quarters of the total, and clay less than a third. When performing these tests, dig deep! If you run into a hard clay layer just a foot or two down, keep looking. Finally, remember that even a nice, sandy loam can be ruined by erosion or compaction, so avoid areas recently subjected to intensive grazing, logging, or other compacting activities.

This seedling succumbed to too much watering, leaving tell-tale dark brown splotches along the leaf edges and between the veins. Photo by Sara Fitzsimmons

Excess Water

Even with perfect, well-drained soil, it is possible to overwater. Chestnuts aren't cut out for saturated soil, and trees subjected to too much moisture will develop dark brown or black patches on their leaves. Soggy chestnuts are also more susceptible to diseases such as root rot.

There's no set watering schedule to keep you on track; your trees' needs will vary with the soil or potting medium, temperature, and humidity. For seeds started directly in the ground, don't water at all for at least a month after planting—doing so only encourages the nut to rot. Seedlings in pots will need more water than those started in the ground. A

good rule of thumb is to let the pot dry out almost completely (so it feels light when you lift it) and then give it a thorough soaking. When transplanting potted seedlings into the ground, try giving each tree about a half a gallon of water per week for the first month after planting, then let rain take over. Then adjust as needed for your soil and weather.

For those with a scientific bent, a soil moisture meter can be a good guide to optimal water levels. Chestnut grows best when a soil is wet to field capacity, but not wetter. This translates into a soil-moisture tension of -10 to -20 centibars. Higher tension, 0 to -10 centibars, is too moist, while lower than -30 centibars is too dry. Especially with young plants that are not using much water, levels closer to -20 are preferred over levels closer to -10.

Drought can be fatal for young trees, and this one is unlikely to recover. The dry, light-brown patches start around the edges of the leaves and, in severe cases, spread inward. Photo by Tom Saielli

Drought

Compared to other eastern hardwoods, chestnuts are relatively drought tolerant, and some growers succeed without ever watering their trees. It's still a good idea to be prepared with a watering plan in case of a severe dry spell, especially during the first two seasons of establishment. Drought-stressed trees will wilt or develop light brown to white crispy patches around the edges of their leaves. For young trees in their first few years, these conditions can be fatal; older trees probably won't die, but will still appreciate some extra moisture.

If it's hot, the soil is dry, and there's no rain in the forecast, don't wait for symptoms to appear; get out there and give your trees a drink. For the backyard grower, this probably means a short walk with the garden hose. In a small orchard, it could mean having an irrigation system or a way to haul around a tank of water. Absent this infrastructure, TACF scientist Tom Saielli suggests making friends with your local fire department. Saielli, a former volunteer fire fighter, suspects that most fire departments would be delighted to learn more about chestnut restoration and help you out of a pinch with a tank of water.

Light

For nut production, chestnuts need full sun. Period. The trees will grow faster, however, with about 30 percent shade. Under these conditions, chestnuts can grow four to seven feet per year—about twice as much as those in full sun. Saplings can survive indefinitely in shadier sites, but they won't grow much, so aim for zero to 30 percent shade depending on your goals of nut production versus growth.

One pitfall to avoid is transplanting trees directly from protected or indoor settings to full sun, causing leaves to be "sunburned" and die back. This problem is easily avoided by "hardening off" indoor-grown trees for a few weeks before transplanting them into full sun. Simply place the pots in deep shade for a week or so, then lessen the shade for another week before transplanting. Freshly transplanted trees also can be protected by sprinkling a few bits of straw over the leaves to break up the direct sun.

Don't let this happen! These grasses and weeds will slow the seedling's growth, or even kill it, by competing fiercely for nutrients and releasing chemicals toxic to the tree. Keep a two- to three-foot weed-free zone around small trees. Photo by Matt Brinkman

Weed Control

If trees could have nightmares, grass would surely haunt them. Grass and weed roots dominate the same top few inches of soil that most tree roots also use. They suck up the moisture and nutrients that you want the tree to get, and some grasses ooze chemicals that are toxic to other plants. Trees that have to fight it out with grass may grow several times more slowly than unhindered trees or even be killed outright. So give your chestnuts their much-needed weed-free zone, starting with a two- to three-foot-diameter ring for small trees and expanding it as they grow.

In a back yard, this likely means piling a mulch ring around each tree; in an orchard, it could also mean black plastic strips or landscape fabric that suppress weeds. In either setting, an herbicide such as glyphosate (Round-Up) can also work, but be cautious during application. Apply glyphosate in a manner to avoid getting any on the leaves or stem and avoid applying in windy conditions. Tree shelters are a good protection against this potential accident. If spraying is still required after trees outgrow their shelters, use a sprayer with a shield on it.

Mulch and landscape fabric have the drawback of harboring voles, which can be especially damaging to trees during winter months. Trees can be protected from voles by metal or plastic collars that extend two to three inches under the soil. Alternatively, the mulch ring can be pulled back from the trunk about a foot during winter months.

The black regions between veins are due to excessive amounts of fertilizer, primarily nitrogen. To avoid this fate for your trees, follow package dosage instructions and choose a water-soluble liquid fertilizer for potted saplings. Photo by Sara Fitzsimmons

Nutrients

Fertilizer is no substitute for good soil, light, and weed control, but well-situated trees will grow even stronger when properly fed. Potted trees, because of their small volume of soil, are most susceptible to over-fertilization. To avoid this problem, use a liquid fertilizer diluted in water for fine dosage control. Most general-purpose fertilizers will do; the exact N-P-K (nitrogen-potassium-phosphorus) ratio isn't that important. For potted trees, look for a formulation that includes micronutrients (sometimes also listed as "trace elements," such as iron and manganese). Fertilize every week or two according to package directions. In-ground trees can take a liquid or a granular fertilizer; the latter only needs to be applied twice per year. Again, look for a general-purpose fertilizer that contains N, P, and K.

It's worth being mindful of your soil pH when selecting a fertilizer. Some, such as those marketed for citrus and azalea, are intended to make soil more acidic, and this may be effective if you're

The yellowed leaves on these seedlings were likely caused by an iron nutrient deficiency; the plants recovered after treatment with a fertilizer containing micronutrients. Photo by Jeff Donahue

starting with a potting mix of unknown or neutral pH. But if you've already tested and amended your soil for correct acidity, further acidification could be harmful. Regular annual soil tests will help keep track of trends in acidity that may need to be adjusted with amendments or fertilizer choices.

Timing of fertilizer applications can also be important. If you fertilize too early in spring, you may push a tree to send out leaves before the danger of late spring frosts has passed. If you fertilize too heavily or too late in the growing season, the tree may not go dormant properly before the start of freezing weather in fall. Over-fertilized or late-fertilized trees also are more prone to winter injury. In general, liquid or solid fertilizers are applied in the spring a few weeks after leaves have sprouted, with the last application of solid fertilizer made by the beginning of July and liquid fertilizer by the beginning of August.

These trees all have kinks in their trunks where they got caught on their tall shelters and began to grow in the wrong direction. This is one of many reasons to avoid tree shelters more than two feet tall. Photo by Sara Fitzsimmons

Tree Shelters

Tree shelters can save young trees from an array of problems, from gnawing voles to the misdirected squirt of herbicide. But a poor shelter causes troubles of its own, so choose wisely. The ideal shelter is one to two feet tall, set about two inches deep into the ground, with no exposed sharp edges on the top that can injure the tree or its caregivers. Tall shelters alter the tree's environment too much, making it grow so fast that it becomes thin, floppy, and unable to support its own weight. Because air inside the shelter can be much warmer than the surroundings, trees also may get caught unprepared for winter, resulting in tip dieback. Finally, when the stem grows out of the top of a tall shelter, it suddenly branches out like an open umbrella—a weak and abnormal branching pattern. Hence, no shelters taller than two feet! A rolled or folded edge at the top of the shelter is important to keep the trunk from rubbing against a sharp edge.

In case you still haven't heard enough about this, a final word of caution: be sure to take off tree shelters before the trunk begins to grow around it, which can cause scars and deformity.

This 18-inch vented shelter by Tree Pro will protect saplings without causing problems. Also note the excellent weed control! Photo by Kendra Gurney

Mower Blight

Young trees are easily taken out by careless mowing. Even trees that aren't completely severed will send up resprouts from the base, which ruins the trees' form, and become more susceptible to disease. Tree shelters are the best protection against lawn-mower accidents—just be sure you're using the right kind of shelters, described above. Older trees should no longer have shelters, but with any luck they're also shading out the weeds so you won't have to mow near their trunks. On larger trees, small wounds from mowers or string trimmers should simply heal. Rings of mulch, in addition to suppressing weeds and reducing the need for mowing and trimming, can also help alert the mower operator to avoid a tree.

This tree shows signs of a harsh winter. The growing tip died back from cold exposure, but the rest of the tree leafed out and will recover. Photo by Kendra Gurney

Winter Injury

Although a harsh winter can do some damage, rarely will it dish out more than your trees can handle. The main symptom of winter injury is branch dieback; the killed stems or branches turn dark brown or deep red. In the spring, these trees will leaf out only below the killed portion, leading to a shrubbier growth form. These bushy tendencies can be corrected with careful pruning a few years later (once the tree has fully recovered and is established).

These blackened leaves were injured by frost. Patterns of injury vary depending on the developmental stage of the leaf and the temperature. Photo by Paula Murakami

Spring can also throw in a surprise freeze after trees have already leafed out. Even if a spring frost doesn't cause immediately visible damage, leaves will probably blacken within a couple of days and eventually fall off. Again, it's not a fatal problem, and trees usually recover. To minimize the effects of harsh winters, plant chestnuts in a protected area such as the edge of a field, where nearby forest can help moderate extreme temperatures. Keeping to the slopes and avoiding low, cold (and wet) spots is also a good idea.

Wind

Even though American chestnut once dominated rocky ridge tops in its historical range, this is not an ideal habitat for your own stand. Apart from having overly dry soil, rocky ridge tops have a harsh environment, with a combination of winter cold and wind that will likely damage your trees, especially in northern regions. Even without leaves, chestnuts are susceptible to desiccation, or over-drying, in winter. Desiccation causes slow growth and tip dieback in the spring. To avoid this problem, pick a more sheltered site, or plant near a wind-break. Greenhouse fans also make wind—so beware if you're keeping young, potted trees indoors over the winter. Make sure your pots are not directly beneath or in front of a greenhouse fan.

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