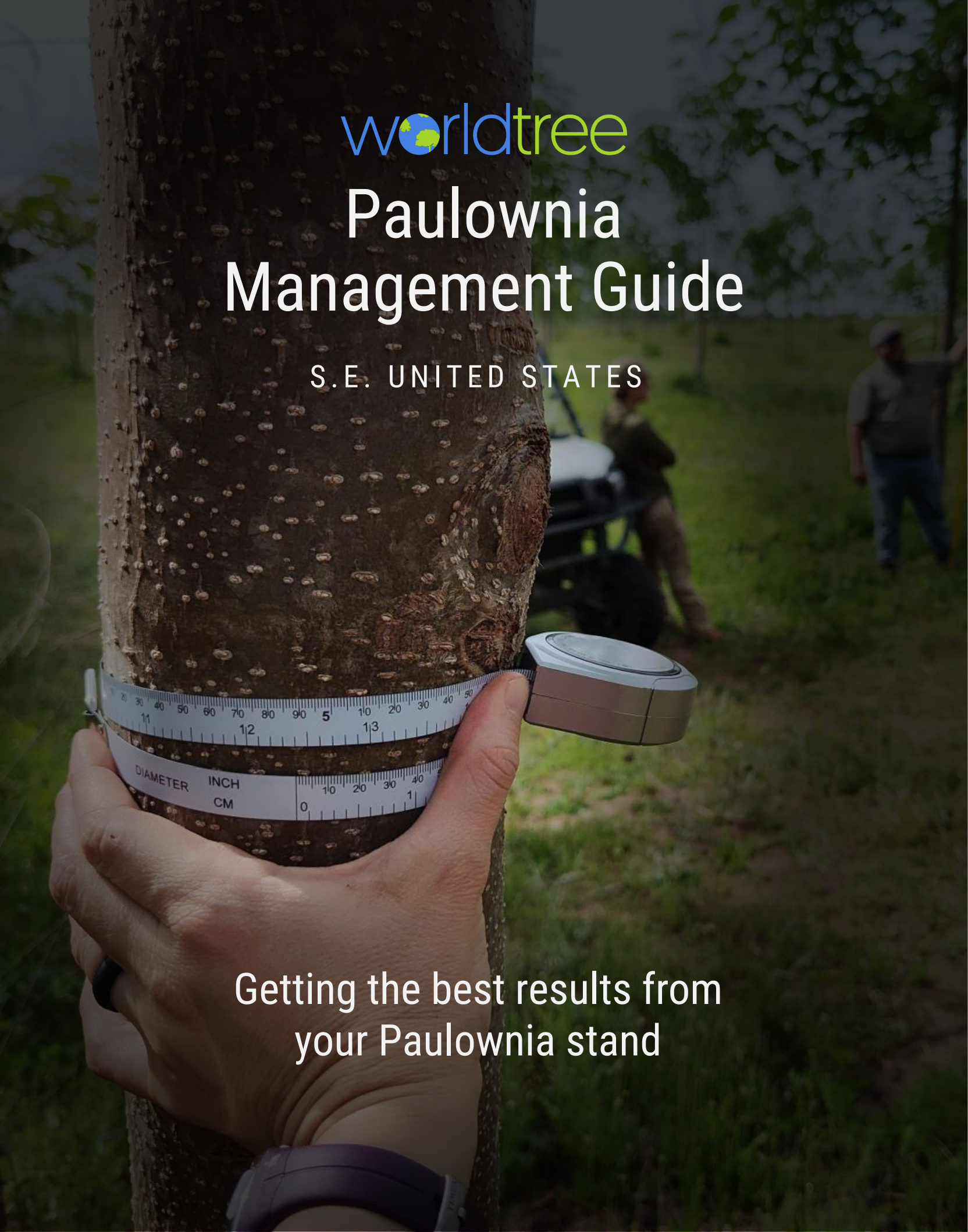
worldtree

Paulownia Management Guide

S.E. UNITED STATES



Getting the best results from your Paulownia stand

Introduction

Welcome



Welcome to the rewarding journey of cultivating Empress Splendor Trees, renowned for their rapid growth and ecological benefits. This guide introduces you to the basics of managing your stand of these majestic trees. Inside, you'll find a comprehensive management plan covering all essential cultivation aspects—from planting to pruning.

Recognizing that each location has unique challenges and opportunities, our experienced forestry team is committed to customizing a plan that best suits the local conditions of your site.

As you embark on this venture, success hinges on the critical first four years, where proper care and management are paramount. To support you through this formative period, World Tree Representatives will not only make periodic on-site visits but will also be readily available via phone and email to answer any queries you might have.

This hands-on approach ensures that you have all the tools and advice necessary to achieve a thriving, profitable stand of Empress Splendor Trees.

Let’s grow together in creating a sustainable future.

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Site Evaluation

Initial site evaluation

The key to a successful Empress Splendor stand is to ensure your site is conducive to growing these trees. Empress trees prefer well-drained, sandy/sandy-loam soils. While they can grow in a wide range of climates and/or soils, several limiting factors can inhibit the growth of high-quality, merchantable timber.

Limiting factors

- High clay content (> 60% clay)
- Compaction
- Excessively low pH (< 5)
- Poor drainage
- High water table
- Bedrock, fragipan, or other restrictive features
- Drought or low rainfall
- Excessively rocky or stony soil

How the evaluation process works

Following your initial contact with a World Tree Representative, we will begin our online land-checking process. To do this, we will need the GPS coordinates or an address for your property. Any survey, parcel information, or stand delineations in your records would expedite our process.

Depending on your location and the timing, you may be requested to collect and submit soil samples for testing. Alternatively, a World Tree Representative will visit your site to conduct an evaluation and guide you through the soil sampling process.



The ideal well-drained, sandy-loam soils will equip the Empress trees to absorb nutrients and grow vigorously, as shown above.

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Soil testing

In most of our regions, your local County Extension Office will offer low-cost, routine soil analysis. Be sure to work with the office in your corresponding county, as they are the most familiar with your local soil types.

AL: https://www.aces.edu/blog/topics/crop-production/routine-soil-analysis/

GA: http://aesl.ces.uga.edu/soil.html

FL: https://sfyl.ifas.ufl.edu/agriculture/soil-testing/

MS: http://extension.msstate.edu/content/soil-testing

LA: https://www.lsuagcenter.com/portals/our_offices/departments/spess/servicelabs/soil_testing_lab

TN: https://soillab.tennessee.edu/soil-testing-and-fertilizer-recommendations/

When taking soil samples, keep in mind

- Collect a range of samples across the different physiographic regions of your stand.
  - We would like at least one sample per 5 acres.
- Soils will vary across any given area depending on slope, drainage, land use history, parent material, and many other factors. It is important to take samples that are representative of the variation present.

Typically, the parameters we are looking to evaluate are

- pH (ideally 5.7-6.5)
- Nutrient availability
- Soil texture (less than 60% clay)
  - In most cases, texture can be evaluated in the field.

This information allows us to create a map of your plantable footprint and gives us a better idea of how to develop a personalized approach to the site preparation process.





Pictured right

A handheld auger, post - hole digger, or shovel can be used to obtain soil samples.

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Site Preparation

Methods of site preparation

Site preparation is not just a step in the process, it's a crucial factor in the success of your tree growth. The appropriate methods will vary depending on the condition of your site. Typically, it consists of making necessary soil amendments, establishing ground cover, and, in general, preparing your land for planting.

- The site preparation process for someone with old agricultural land will be more straightforward than it would be for land with several years of natural regeneration.
- It's important not to underestimate the timing of site preparation. Rushing through it too close to planting can lead to issues down the road, potentially causing additional labor and headaches. Completing site preparation within the proper time frame ensures a successful planting and saves you from unnecessary stress and work in the future.
- Soil amendments are not a quick fix. They can take months to fully effect, so it's crucial to determine and implement necessary amendments as soon as possible. Our goal for site preparation is to set each farmer up for long-term success before planting. The more energy and effort you invest in the site preparation process, the better results you'll see with your trees in the long run.



Pelletized lime. It's also available in powdered form by the truckload.

Soil Amendments

Necessary soil amendments will be determined from your soil tests.

- The ideal soil pH is 5.7 – 6.5, so if your soil pH is below 5.7, you should apply lime as soon as possible.
- If you have acidic soils, you will need to supply calcium (Ca) and magnesium (Mg) in the form of calcitic lime or dolomitic lime. Calcitic lime is faster-acting and more commonly used to neutralize the soil unless there is a magnesium deficiency. Soils deficient in Mg should use dolomitic lime.
- Applying lime before the growing season is important if your soil is acidic. Lime works by neutralizing the acid in the soil, but it takes time to do its job. Scatter the lime around the intended root zone at the recommended rates for your soil type. Based on your soil tests for the following year, this process will most likely need to be repeated as necessary. By following these steps, you can effectively manage the acidity of your soil and create a favorable environment for your trees.

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Site Preparation

Weed Removal

- Weeds should be eliminated before planting as they can compete with the tree for nutrients, moisture, and light.
- We don't recommend the use of herbicide because of the potential damage to the young trees and overall soil health, but many non-residual systemic types are suitable if used well before planting.
- Avoid using any pre-emergent chemicals 1-2 weeks before planting because there may be residual effects on your trees.
- Planting cover crops is an excellent method to suppress weeds, and this will have numerous other benefits for your trees, as outlined below.

Establishing Cover Crops

We cannot emphasize enough the importance of cover crops for your stand's long-term health and success. Whether the cover is your natural regeneration in the understory or a tailored mix of spring and fall perennials from your local co-op, cover crops will provide innumerable benefits to your plantation. Your planting site's conditions will dictate whether your cover crops should be established before or after planting your trees. Consult your World Tree Rep for the best option for your site.

Cover crops serve your trees by

- Providing soil structure and preventing erosion.
- Fixing nutrients back into your soil.
- Helping your soil retain moisture.
- Breaking up compaction to allow for better water infiltration.
- Suppressing weeds.
- Adding organic matter.
- Attracting beneficial insects





Clearing the land to make space for planting.



Sun hemp seeded the year before Empress planting to fix nitrogen and build soil organic matter.

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Site Preparation

Options:

Pre-planting annuals

- If time allows, in the year prior to planting, it is recommended to plant a bean crop, such as soy, hairy vetch, or field peas, to fix nitrogen into the soil.
- Keeping living roots in your soil prior to planting will greatly benefit your trees.
- The key is to mow or crimp these crops before they become too large to manage.

Perennials

- Reduces the cost of planting cover crops year after year.
- Have a more extensive and efficient root system than annuals.
- If you'd like to try a calculator that will give cover crop recommendations for your location, visit https://smartmix.greencoverseed.com/

EQIP – Environmental Quality Incentives Program

- EQIP is a conservation program through the NRCS that provides technical and financial assistance to landowners to address natural resource concerns.
- EQIP can help landowners cover the cost of site preparation by establishing program-approved cover crops (available practices and standards vary by state).
- Landowners should contact their local NRCS office and set up a visit to discuss available options for their area and property.
- More information can be found here: https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives





Pictured right

Cover crop of Austrian winter peas, white clover, and various legumes as preferable deer browse to discourage tree predation.

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Site Preparation

Preparing Your Land

- Our stands are planted at a density of 110 trees per acre.
  - 20'x 20' grid: Preferred spacing for farmers only interested in growing timber.
  - 25' x 16' grid: Ideal for farms interested in alley cropping.
- Use machinery to loosen and fracture the soil to approximately 30-50 inches deep; this should be done at least one month before planting.
- Our preferred methods are to use either an auger (24-36") or subsoiling shanks.
  - The method you choose for your farm will entirely depend on your soil conditions, the machinery you have access to, and the land use history of your property.
  - Consider the pros and cons listed below and contact your World Tree representative to determine the best method for your site.
- Plan out your grid before using any machinery.
  - If your stand has a significant slope and/or contour, you should run your rows parallel with the contour of the stand to avoid erosion.
  - Using a subsoiling shank, you can rip perpendicular rows and plant each tree at the intersections.
  - Using an auger will require more intensive planning and measuring to ensure each hole is at the correct spacing.
  - After using the determined machinery, mark each hole or cross-section with flagging to easily find the correct spot when planting.





Top: *A planting hole drilled with a 24-inch auger*

Bottom: *Subsoiling shanks to rip rows.*

Pros and Cons of Mechanical Site Prep Methods

METHOD	PROS	CONS
Ripping (Subsoiling)	• Less time-consuming. • Preferred for sandy soil types.	• If done improperly, there is a higher risk of soil erosion. • Bedded rows can make the site harder to operate in. • There is also a higher risk of root suckering problems in alleys when soil is disturbed if the roots have grown superficially.
Auguring	• Less risk of disturbance & compaction across the site. • Less risk of soil erosion.	• Time-consuming. • More labor intensive. • It can inadvertently bring poor subsoil up to the immediate rooting zone and destroy organic matter.

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Planting the Seedlings

Planting

Following site preparation, the success of your Empress trees hinges on the care shown when planting them. Planting is one of the most labor-intensive and time-consuming tasks, and it should be finished within a week of delivery.

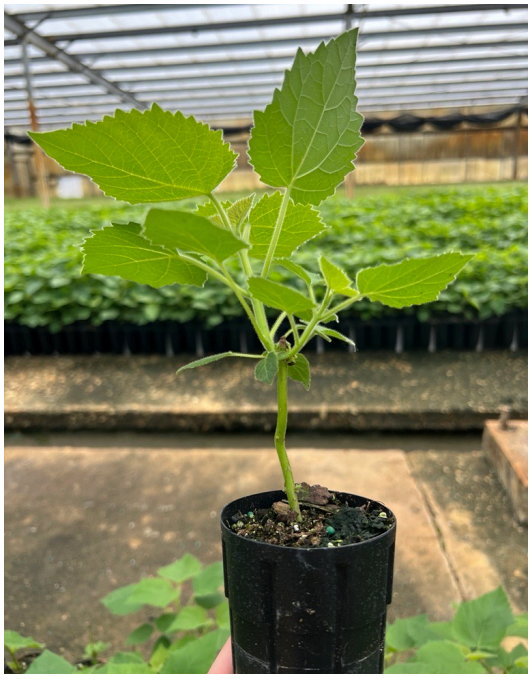
It is imperative that you plan well in advance for any additional help you may need. You should anticipate spending 1-3 days planting your trees; however, this largely depends on how many people are helping you and how many hours a day you are able to spend planting.

We will work with you to determine a seedling delivery date that will work with your schedule.

Tree Arrival and Handling

You will receive your seedlings in early spring. They may have more of a bush-like appearance than a tree form. This is normal and is caused by "top pruning" in the nursery. This practice creates field hardy stems, which promotes woody, secondary growth.

- Unload the trees and place them onto level ground in a semi-shaded position out of the wind.
  - Young trees from the nursery are vulnerable to the stress of shipping and moving, so to minimize mortality and stress, they will need to spend about three days in partial shade to acclimate to their new environment.
  - Do not place them in full shade; dappled shade is ideal.
  - Avoid placing them on concrete or tarmac, which gets hot in the sun.
- Confirm the number and quality of trees sent to you by counting, reviewing, and signing the proof of delivery (POD) document accompanying the trees, and return the POD (either directly or by sending a picture) to your World Tree Representative.
- Contact a World Tree Representative immediately if discrepancies or quality issues are present.
- Your seedlings will be in cell trays and will likely need immediate watering upon arrival.
- Avoid heavy splashes that will dislodge the soil from the cells, splash soil onto leaves, or push leaves down onto the soil.
- Over the next few days, water your seedlings in the early morning or mid-afternoon so that the leaves have time to dry before the evening to avoid the risk of leaf mold disease.



A startling growing in the nursery that has received top pruning to avoid overcrowding and encourage strong stem development.



Startlings receive water in a safe location after delivery.

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Planting the Seedlings

Planting



Timeline

- **The trees should be planted within 3-7 days of arrival.**
  Remember, the trees are growing rapidly at this stage. In just a week, the top will outgrow the pot-confined roots. So, if the growing conditions are not favorable, you can keep watering them in their cell trays for a few days, but they must be planted within 14 days of receiving them.
- **Because planting is both time and labor-intensive, we highly recommend planning for help with this ahead of time.**
- It will take a very efficient farmer planting without additional help the full 14 days to plant 1100 trees. If you do not have guaranteed help during the planting timeline, we recommend planting no more than 10 acres.
- **Please contact a World Tree Representative for advice if you cannot complete the planting within 14 days of receiving your seedlings.**
- Unless a World Tree manager gives explicit instructions not to plant, failing to do so may result in a fine. Communicating with a World Tree Representative is the best way to avoid penalties.

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Planting

Planting the Seedlings

- Prepare your workers by showing them the correct methods to use when planting.
- We recommend having team members do separate jobs: pre-water (if the soil is dry), plant the tree, and post-plant water. Quality control is important at every step to get a high success rate.

1. Plant into moist soil.
2. Dig a small hole a bit deeper than the cell plugs in the center of your prepared planting area.
3. Gently remove the tree from the container and position it upright with the stem/root junction (or slightly above, depending on the soil type) at the natural soil level.
4. Backfill around the plant with topsoil. Fill soil about ¼ inch es above the root/stem collar. Pack the soil around the tree so it is supported but not so compacted that the soil will not adequately absorb the water.
5. Your planted trees should end up sitting upright, level to the ground, in full sun, and not at the bottom of a slope where water can accumulate or pool.

- We also recommend creating soil berms or bowls around the trees so that water runs inward to the stem. The base of the stem should be at or slightly above ground level, not sunken into the hole.
  - Supplement sunken soil with OM-rich soil.
- Carefully consider how your choice of compost and soil will affect:
  - pH
  - Water retention
  - Ammonia Levels

- Once planted, apply water slowly in the area (½ gallon or more per tree, depending on soil moisture). Give it time to infiltrate around the tree and tamp gently to remove any underground air pockets. Wash any soil off the leaves and stems while watering, and make sure all leaves are clear of soil when finished.
- An option to enhance your soil health at the time of planting is to add an organic soil conditioner containing beneficial bacteria. These soil microbes have been shown to stimulate the growth of root hairs, which help with nutrient uptake. A product we recommend for this is called Fish Shit, which can be ordered at Fishheadfarms.com.



Startlings being driven from their acclimating location to the field for planting.



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Watering, Weed Control, Soil Amendments

In this first year, we are trying to establish a strong root system that will sprout a new, fast-growing stem the following year. Keeping the tree fed and watered is our priority.

Watering

- **Your Empress stand will require supplemental watering, especially during the first two years.**

  This is a crucial task that should not be overlooked.

- You will need a watering rig or irrigation system if you don't already have one. There are many options, such as putting a water tank with a pump on a trailer pulled by an ATV. Others have put a tank in the bed of a pick-up truck or capable golf cart. Your Representative can walk you through your options as well as put you in contact with other farmers who have experience assembling and operating their watering rigs. In most cases, it's best to have 2 people available to operate the rig: one driving and one watering.



There is a 55-gallon drum watering rig above and a watering setup with a 3,000-gallon tank for on-site water storage below.



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Watering, Weed Control, Soil Amendments

Watering (cont.)

- Water every other day or 2 days per week to get the trees well-established if the soil is dry or you have had low rainfall (about 5 gallons/tree per week). Your young trees will benefit from less water more frequently. This will train the roots to grow deep into the soil. Vigilance will be required throughout the summer to ensure the soil does not dry out. It's much easier to under water than over water.
- Generally, we recommend watering each tree with about 1-2 gallons of water every few days; however, there are a few factors to consider when determining when to water and how much to water:
- Consider your soil type. Sandy soils will drain much faster, so they will need more water than other soil types that take longer to drain.
- Watering each individual tree takes time. Don't wait until the soil completely dries out to start watering again. If you do, the soil under some of your trees will dry out before you finish watering.
- Monitor your trees daily, if possible. If even a couple of your trees have wilted, that is an indication to water your entire stand as soon as possible. If you don't, all your trees will wilt in the next few days.
- Consider using an irrigation system, like drip irrigation, if you are in a low-rainfall area or don't have the time to water manually.
- If you can, pump lake or pond water into your watering rig. This will be far more beneficial to your trees than city water.
- Things not to do:
  - Don't spray water on the leaves in hot weather.
  - Don't make the soil around the roots constantly wet. Stagnant water can cause root rot.
  - Don't panic if the leaves droop during the heat of the day (this is different from wilting). If the roots are healthy, the leaves typically perk up by morning.



Watering rigs made of liquid storage totes.



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Watering, Weed Control, Soil Amendments

Weed Control

Weed control is integral throughout the first growing season. If you have established cover crops, they can inhibit weed growth, but some weed control will still be necessary. The goal is to ensure weeds do not outcompete and overtake the young trees. Keep the area 2-3 feet around the tree free of weeds. Maintaining a balance between controlling competition and covering the ground is important. We have found that farms with sufficient ground cover have had better initial survival and growth. There are many methods to control weeds, such as manual and/or mechanical removal, mulch, herbicides, etc. You should use manual or mechanical removal first, but if you are having persistent issues, some non-systemic herbicides can be used as well.

Please consult a World Tree Representative before using any herbicides not listed below.

Methods

- **Manual and Mechanical Removal**
  - Clearing the taller, green weeds and grasses close to the tree stem is best done manually or mechanically (e.g., pulling, mowing, crimping, slashing, or weed whacking) to avoid the risk of herbicide contact with the tree.
- **Mulch**
  - Putting mulch around the base of your trees can suppress weeds by acting as a barrier between them and the sunlight they need to grow.
  - Remove weeds around the base of the tree before putting down mulch.
  - Mulch can also help your trees by retaining moisture in the soil and insulating the soil during extreme temperatures.
  - To reduce the risk of trunk rot, ensure the mulch is not in direct contact with the tree trunk.



Mulch around a newly planted tree.



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Watering, Weed Control, Soil Amendments

Weed Control Methods

- **Non-systemic Herbicides**
  - After the weeds are cut and show signs of re-shooting, non-systemic herbicides can be used around the new Empress Tree shoots if you are very careful to avoid drift or vaporization contact.
  - Herbicides are effective only if the weeds have actively growing shoots and bark thus semi-dormant weeds may not be effectively controlled.
  - Use Glufosinate (Basta, Interline, Liberty, and others)
  - Glufosinate is a non-systemic, foliar-active herbicide suitable for weed control of grasses and small broadleaves.
  - Use according to directions and avoid any contact with the Empress Tree roots, stems, or leaves.
  - Use extreme caution when applying herbicides to avoid any contact with the Empress trees
  - Contact with small amounts of Glufosinate will not kill an Empress tree.

- **AVOID GLYPHOSATE! (Roundup)**
  - Use products other than Roundup. Even if the tree is still dormant, Roundup can be taken up through the bark of young Empress Tree stems.
  - Contact with small amounts of glyphosate will kill an Empress tree.
  - Avoid pre-emergent, broadleaf herbicides.
  - When considering using any other herbicide, read the labels carefully and consult with your World Tree Representative before purchasing or applying.



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Watering, Weed Control, Soil Amendments

Soil Amendments

Lime and Fertilizer in the First Year

- It's recommended that soil tests be processed at your local extension office for at least the first few years at the beginning of the dormant season. This will help you plan your soil amendment and fertilization needs for the coming year.
- Like water, fertility in the first year of growth determines growth later in life. Soil tests are critical for determining what type of fertilizer to use and how much you need to apply.
- Fertilize twice:
    - 3-4 weeks after planting
      Use the dose recommended by your soil test results. Use a narrow spade to make deep slits in the soil about 5-6 inches from the stem of the tree (on either side) and drop in the fertilizer. Don't put any fertilizer in the planting hole upon planting, as it can burn the tree roots. Be careful not to wash the fertilizer into contact with the tree stem when you water after planting.
- When possible, composted chicken manure or manure pellets are our recommended type, and they help promote deep green foliage. If chicken manure is not available, synthetic fertilizers may be appropriate*.

  *Slow-release granular fertilizers may be applied sooner after planting.
  Contact your World Tree Representative for help planning your first fertilizer application.
- 12 weeks after the first application (or when the trees reach 24" high)
    - The recommended second application is urea, which is concentrated and highly soluble N (46:00:00). Fast-growing crowns will benefit from the application in the early midseason. Remember to apply when the urea is washed in with good rains, as it is very soluble in water. It will dissolve easily sitting on the surface of moist soil or grass. If not washed into the soil by rain, the nitrogen can be completely lost within 24 hours by turning into gas or volatilization. The alternatives are to use a slow-release form of nitrogen (most are more expensive than urea), get the fertilizer under the soil where it won't volatilize and escape to the air, or dissolve in water and spray the solution on the soil around the trees.
- The N-P-K numbers indicate:
    - Nitrogen – boosts leafy growth and a deep green color.
    - Phosphorus – helps boost root growth and flower blooms.
    - Potassium – help plants regulate water use and withstand stress.
- If the leaves are dark green, the trees are getting adequate fertilizer. Pale green leaves mean that they are not getting enough nutrition. The older leaves' yellowing towards the stem's bottom is normal.



Photo showcasing 6 months of growth due to proper fertilizer application.

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Watering, Weed Control, Soil Amendments

Soil Amendments

Lime and Fertilizer in Future Years

Continuing routine soil tests at the beginning of the dormant season for the first few years will help to ensure proper nutrition for your trees.

- If your pH is still low, it's best to get lime in the ground around December, so it has a few months to infiltrate the soil and neutralize the acidity. You'll want to apply the lime before a rain event so it gets dissolved into the soil. Pulverized lime has the potential to be blown away in the wind if not timed correctly. Scatter the lime broadly around the root zone at the recommended rates for your soil type.
- The first dose of fertilizer should be spread around late winter to early spring so it has time to soak in. When the trees begin to bud in the spring, we want the nutrients readily available to the roots. If you're using a quick-release synthetic fertilizer, you can wait until closer to bud break.
- The expanding leafy canopy needs a timely nutrient supply to achieve the most rapid growth. If you are in a dry summer zone, you may need to supply some fertilizer before the winter rains stop. Otherwise, the fertilizer will sit on the surface and unavailable to the tree roots.
- Determine the amount to supply based on your soil analysis; scatter fertilizer evenly on the ground surface. Apply in a circle with a radius about one-third of the tree's height (i.e., a 3 ft. radius around the trunk for a 10 ft. tree; for a 15 ft. tall tree, apply in a 5 ft. radius). Don't apply fertilizer within 1 foot of the trunk; there are few feeder roots there.
    - A more labor-intensive option is to make deep slits in the ground with a spade and insert the fertilizer into these holes. This helps it get deeper into the soil to feed the tree roots rather than the cover crops.



Preparing fertilizer for easy dispersal.

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Coppicing

Why coppice?

The most beneficial action for a thriving Empress tree is initiating the coppicing process, which involves cutting it down. In the initial year of planting, our primary focus was on fostering a robust root system, with little regard for stem shape or straightness. These roots now serve as a reservoir of stored energy, propelling your trees to regenerate rapidly after being cut to ground level.

In the current coppice year, our attention shifts to managing the regrowth and channeling the tree's energy into a single, straight, fast-growing stem. This strategic approach is key to maximizing the merchantability of your stand.



A new sprout is seen growing from the old stump and root system. The previous year's stem is still on the ground nearby.

When to Coppice

Ideally, empress trees should be coppiced at the beginning of spring. In more southern climates, you will look to coppice as soon as the trees start showing buds and springing to life. This is a crucial year for the long-term merchantability of your stand. You will want to work closely with our team to decide if you should coppice your stand after the first growing season or wait until the second growing season. Generally, your stand should be coppiced after the average root collar diameter of the stand exceeds 2 inches across.

- Make the coppice cut in late winter or early spring or as soon as the tree shows small green buds towards the top of the stem.
- Do the coppice when you see buds like the ones in the left or center picture. It will only take 1-2 days for them to reach the size in the right-hand picture.
- The Empress Trees will break buds when the stem temperatures get above about 65°F for more than a few hours each day, and root growth (and coppice shoots) will activate when the soil, at 2-3" deep, has warmed to stay above 55°F for most of the day. Do not let the above-ground shoots/buds get more than 1" long before doing the coppice; the new shoots are a sign that sap flow has commenced, and the stored energy reserves (starch etc.) in the roots are being mobilized upwards. The aim is to coppice before that energy has left the underground store.
- The reason for doing a last-minute coppice, which involves waiting until the tree is ready to shoot rather than cutting it off in mid-winter, is to minimize the period during which an exposed cut stump is exposed. This approach helps to prevent drying out and invasion by fungi and also reduces the risk of early shoots being burned off by mild ground-level frosts. Within a few weeks, a healthy tree will re-shoot and compensate for most of the lost growth by the end of the season.

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Do I coppice everything?

In most cases, you will coppice the whole stand. However, in some scenarios, it will be better to wait another year to coppice everything or coppice only those trees with a ground-level diameter greater than 2”. Your World Tree representative will help you make the best decision.

Many farmers assert that the best flush of growth you will get is from a coppiced stem. Coppicing all trees means you may have the risk of needing to re-coppice some again the following year if the height of the new stem is still not desirable.

Waiting another year to coppice those trees with a smaller diameter will give the trees another year to grow their root systems but may leave you a more difficult job the following year. You’ll have a thicker stem to cut through and more material to dispose of if it puts on a lot of growth during that year.

How to Coppice

- First, remove all weeds close to the stem for better access to making a clean cut. Keep the more distant weeds at a short height, as they will compete for sunlight, nutrients, and water while the tree is in a state of urgency.
- Follow-up weed control may be needed in the 3-4 weeks after the coppice before you apply fertilizer to the tree (don’t fertilize the weeds). In this period, the new coppice shoot can grow to be about 2 ft. tall. It will have soft new leaves and green bark at low height, so be especially careful that these are not contacted by the herbicide. Similarly, cutting or killing weeds again before the second dose of fertilizer later in the season will be beneficial.
- Cut as near to ground level as possible without damaging your cutting tools. Even on larger stems (>4” diameter), you should be able to leave a stump of less than 1-2” above ground. On small stems, aim to make the stump less than 1⁄2” tall. In some cases, a strong shoot may arise from underground near the stump; these are preferred to others if they are of equal or better vigor as they will be well anchored. Low-cut stumps will form new shoots near the ground, and these will be more wind-firm as they develop compared to shoots originating 2” or higher on the stump.
- What NOT to do: The stumps shown below are cut too high. High stumps will encourage multiple shootings and weakly anchored stems. (Page 8 of grower's guide: coppicing has the photos to show)
- What to do: The pictures below show stumps of trees that were cut at the right time and very close to the ground.





New buds are seen emerging from the coppiced stem.

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Coppicing

Tools

- Use a sharp, sanitized tool that can cut cleanly through the stem without too much effort.
- A long-handled lopper with bypass cutting action is suitable for stems slightly more than 1” ground diameter. A curved, long-toothed pruning saw works well for stems larger than 1” ground diameter. The pruning saw will also be useful for removing branches later in the season.
- Avoid using manual or hydraulic shears that have a crushing action. They will mash or lift bark on the stump, create deep cracks in the stump, or cause torn-out or remnant protruding wood fibers. Stump cracks and fiber tears increase the loss of moisture from the cut surface in dry climates or harbor fungi and insects in wetter climates. The aim should always be to make a clean cut with minimal damage to the remaining bark on the stump.
- With all tools, try to avoid contact with the soil's cutting edge. Soil particles and rock fragments will quickly dull your tool.



Appropriate hand saws to use for coppice and pruning.

Thin The Shoots to One Leading Stem

- Thinning must be done just before the tallest shoot is 18” high. Don’t wait any later - otherwise, you will end up with a leaning trunk and lower-value timber.
- Often, there will be multiple coppice shoots from one stump; 2, 3 or 4 are common. Usually, the first shoot is the most vigorous, but sometimes, one of the secondary shoots will spring from a lower or better-anchored spot on the stem. When the tallest shoot is close to 18” high (i.e. a week or so before first fertilizing), it is time to select the strongest, best-anchored coppice shoot and cull out the rest.
- It’s essential to do this culling reasonably early in the season. If the shoot culling is left to just a few weeks later, when the shoots are 3-4 feet high, they will already be leaning away from each other, looking to maximize their light. In this case, bending in the lower stem will be a permanent feature of the future tree’s shape. **Leaning trees have tension wood in their stem, which reduces timber quality and can cause sawn wood to bend.**
- Don’t thin too early... let the dominant shoot clearly express its dominance before choosing which one to keep.
- This tree was harvested in year 5, and the non-thinned coppice regrowth from the stump is shown 2 and 3 years later.

Full site preparation and timely coppice will produce a healthy stand of vigorous trees, growing strongly upward to generate valuable tall, straight logs. With the right conditions and your diligent care, your Empress Trees will amaze and delight you. By the end of the season, you will be enjoying the cool, leafy shade of a tree much taller than you.





Sprout regrowth after coppicing.

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Applying Fertilizer following coppice

- Once the excess shoots have been culled and the new coppice shoot reaches about 2-3' tall, a fertilizer containing N, P, and K should be applied. The ideal fertilizer for your trees should be chosen according to your soil test recommendations.
- The trees will respond best if they receive at least two doses of fertilizer during the growing season.
- The recommended second application is urea, which is concentrated highly soluble N (NPK ratio of 46-0-0).
- For the second application, it's best to use urea, a highly concentrated and soluble N (NPK ratio of 46-0-0).
- Apply the urea when the tree height reaches about 6 feet, but no later than the last week of July. This timing maximizes the trees' response to the fertilizer and minimizes the risk of nutrient loss.
- Note that urea is also very easily volatilized once it absorbs moisture from the air or the ground. If it doesn't rain shortly after the urea is applied, much of it might be wasted because it converts to gas. You should always aim to fertilize just before rain or water the fertilizer during or shortly after application. If you can smell ammonia in a day or so after applying urea, you are losing some of the nitrogen to the air.
- For alternatives to urea application, you can consider using a slow-release form of nitrogen or dissolving the fertilizer in water and spraying the solution on the soil around the trees. These options provide more flexibility in your fertilization practices.
- Scatter the fertilizer evenly on the ground surface in a circle about 2-3 feet in radius, starting about 6" away from the stump and new stem. Don't leave fertilizer particles directly touching the bark or in a concentration near the stump.
- Unlike the first year, the fertilizer is now scattered, not clumped, and there is no need to dig the fertilizer in. Ideally, try to choose a time when rain is likely to dissolve the fertilizer and wash it into the soil within 48 hours, or try to water it indirectly as part of the early season water supplements.



Triple 13 is the most commonly used, widely available synthetic fertilizer used by our farmers.

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Prune to increase the value of your trees

Our goal when pruning is to increase the value of your trees by producing clear, knot-free lumber. Your empress trees have a natural growth habit of extending limbs out wide, demonstrating a more decurrent, "bushy" form. We want to train our trees to grow tall and straight rather than wide, giving us a higher yield of marketable timber. This process will be a delicate balance of pruning off lower limbs while leaving enough upper limbs with leaves for the tree to support itself through the rest of the year.

After coppicing, you will want to allot time to prune lower lateral limbs in the first few months. Due to the empress tree's incredible rate of growth, we recommend doing monthly flushes of branch pruning each growing season within the first few years. This will help keep your trees in balance with knot-free stem wood and productive leaf area. Keeping enough productive leaf area on your trees will help you grow a strong and healthy tree with a robust diameter.

Pruning Post Coppice

Your newly coppiced stem will produce leaves directly from the trunk. Each leaf produces a bud directly above it that has the potential to become a woody branch. It's best to go through your trees and remove these buds before they get the chance to become a branch and create a knot. Removing the branch buds will encourage the tree to keep pushing for upward growth. The leaves growing from the stem should not be removed, as they are producing food for the growing tree. It's very easy to accidentally knock off the leaf while pruning the branches, so you'll want to be mindful of them. These leaves will fall off by themselves at the end of the season. It's recommended to do this pruning monthly, or more often if time allows, during their first year of growth.

Near the end of the growing season, it is important to leave several pairs of branches intact so the tree can continue to produce leaves and food in the following spring.



The trees above display the appropriate balance of leaf area to retain and branches to remove in order to produce knot-free lumber.

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The Spring following coppicing

What you do the following year will depend on the size of the tree. Individual trees will vary throughout the stand, so do not be discouraged if some trees are performing better than others. It's common for trees to be in different stages of growth.

- Small trees less than 10 feet tall (or with a significant bend in the trunk)
  - Re-coppice
  - Our minimum commercial milling length is 8'6". If the existing stem is not straight or if it is less than 10 ft tall, repeating the coppice will produce a taller, straighter base log.
  - Note that minor kinks are OK. However, a sweep, bend, or lean will significantly lower the quality of the lumber because we need to mill around the pith (hollow center).
- Trees greater than 10 feet tall
  - Leader pruning followed by branch pruning.
  - Leader pruning will add another section of straight stem with few or no side branches. This action itself is very simple, but getting the timing right in early spring is crucial for success.

Branch Pruning Specifics

Prune the lower branches off, working your way up the tree but leaving at least 30-40% canopy in the upper part of the tree.

It's best to make these cuts while the limbs are smaller, generally less than 1 inch in diameter, to leave less of a scar on the trunk. If the branches become too large before pruning, it can form a knot, "well", or other deformations on the trunk.

If a branch has reached a relatively large size, 2-3 inches in diameter, that does not necessarily mean that the log is wasted. It simply means that the area could be a lower grade of lumber, and the tree will have a harder time healing the large branch scar.



The ideal proportion of clear lumber to leaf canopy.



If pruning is postponed too long, the knots and well above can start forming. This will drastically reduce the quality and length of the lumber produced.

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Pruning

Making the cut

- The photos illustrate the two-step method for pruning branches with minimal harm to the tree. This method is key to preventing the bark from tearing down the trunk, which can lead to larger wounds, diseases, pests, and defects in the lumber.
- Our aim is to make a clean, fast-healing cut. The angle of the cut, perpendicular to the branch rather than parallel to the trunk, minimizes the surface area of the wound. Preserving the branch collar, which houses cambium growth tissue, is crucial. This tissue aids in the quick closure of the wound, preventing disease.
- As the tree diameter grows outward, the bark at the edge of the pruning scar grows inward.
- New wood is generated under the bark, and this closes over the wound. These cuts are visible when milling lumber, so it's best to make them as early as possible to decrease their size.
- After pruning, you may see new shoots emerging above the branch scars. Rub these off with your thumb or snip with pruning shears flush to the stem while they are still green and soft (i.e. before becoming woody). These shoots also grow remarkably fast and outcompete the tree's main trunk if left unattended.
- If more than 30% of the leaf area is removed at one time, the tree's daily surplus of photosynthetically manufactured energy will be greatly reduced, leading to a negative feedback cycle of reduced root activity and/or reduced wood formation (i.e., less diameter growth). This is one reason it's beneficial to go through your trees monthly to keep up with branch pruning rather than doing it all in one go.
- Even healthy trees can have adverse effects if they are over-pruned.

Tools

The best tools to prune branches within reach are small, sharp hand pruning shears for buds and small branches and a hand-held pruning saw for larger limbs. A pole saw is recommended for branches that are out of reach. To avoid injury, we do not recommend using a hand saw while standing on a ladder.



The first cut removes the majority of weight from the limb.



The second finishing cut along the branch collar will result in a clean cut with no bark peeled down the stem.

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Leader Pruning

Most of the tree's value at harvest time is in the bottom 10 feet. This section should be straight and knot free. Leader pruning creates a trunk extension of straight-stem wood with few or no side branches. This will help form a secondary log for milling at harvest time. The trees must be vigorous and healthy for leader-pruning to be effective. Above 12 ft, leader pruning is more difficult to reach, and the buds will usually not have the vigor to produce a long, straight extension.

Note: Leader pruning is highly recommended, if possible because it adds value to your trees; however, it is not required, and extreme caution should be used when leader pruning.

Selecting the Leader Bud

- At the start of the season, there will typically be a few inches to a foot of tip dieback; below this, you will see leafy buds that will become new branches. Because of the tip dieback, there is no longer a terminal bud, so the tree will fork at that height. We can train the tree to grow one straight stem rather than forking by selecting one of the leafy buds as the dominant leader. The unwanted buds should be removed, allowing the tree to put its energy into the chosen leader.
- The strongest and earliest buds will often not be the pair at the first node. Commonly, the second or third node down will have the strongest, earliest shooting buds.
- One of these new-season shoots can become a near-vertical leader with careful selection, timing, and the correct cutting method. The stem will always have a small kink, but if done correctly, this will hardly be noticeable at the end of the season.
- Straightness is more important than strength. The strongest bud of a pair may be facing in the direction of lean. Therefore, if the first bud is weak, the next suitable bud facing the right direction may be two nodes down.





The photos above show how leader pruning can form an almost seamless trunk extension.



This photo shows the trees' natural inclination to fork into 2 codominant leaders.

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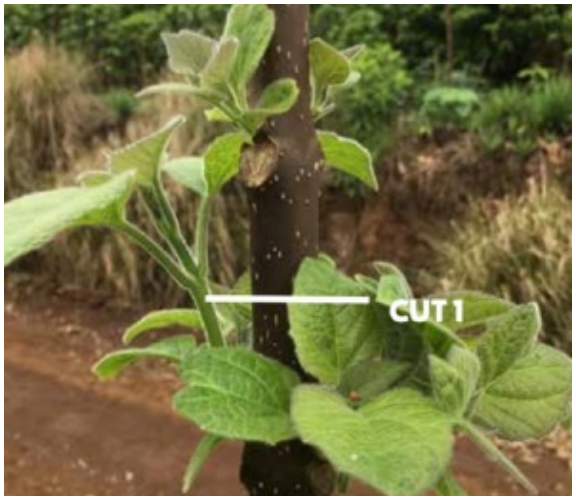
Pruning

Making the cuts

A hand-held, sharp, clean pair of secateurs is a suitable tool. Use bypass secateurs which have a blade on one arm and a bypass anvil on the other; don't use secateurs with blades on each side (i.e. a bolt cutter design), nor those with a central anvil as these types of tools will crush the stem or leave torn fibers behind.

First cut

- Make a clean, straight, horizontal cut about 3/8 to ½" an inch above the node to be retained.
- After this is done, snip off the weaker bud that is on the opposite side of the chosen leader bud. This will allow less interference during the second cut.



Second cut

- Hold the secateurs at a 30˚ angle to the stem to create a diagonal cut.
- Position the secateurs so that you can cut through the leaf scar below the already removed weaker bud. This will completely remove the bud tissue below the bark and above the leaf scar, which will prevent the bud from re-sprouting and competing with the leader.



When to cut

- Timing is crucial. Leader pruning must be done in early spring before the new bud shoots are more than 1" long. Usually, the first bud shoots usually appear a week or two after the flowers have opened and before all the flowers have fallen off. Watch carefully because the bud shoots can get too big over a matter of a few days. Once they are too big, leader pruning will still result in a single stem, but it will have a pronounced kink.
- Bud shoots will often arise on the stem's lower part before appearing on the terminal end. You may need to weaken these before leader pruning.
- If the emerging shoots on the nodes immediately below the retained leader shoot look like they're competing strongly with the leader, it may be necessary to weaken them to give time and space for the leader shoot to dominate. This decision should be made either during leader pruning or in the following few weeks.
- Once the leader is well established, allow the branches of the first 1 or 2 nodes below the leader to become fully developed lateral branches for the next year, or two, or more. They will help with overall wind stability in the plantation and add to diameter growth. Trim those branches only if they look like they are competing with the leader for light, vigor, and/or height. Retaining only those branches means that future knots will occur only on a short length (i.e. 1-2') of the upper part of the Year 1 log.



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Potential Issues

Pests & Diseases

Insects, grazing animals like deer, and other pests can cause significant damage when you coppice your trees. These pests often eat the terminal bud of the tree, forming an unmerchantable log. If the terminal bud is eaten, the tree will fork at that height, and you will have to coppice it again the following year.

Empress Tree leaves are a favorite food for grazing animals like deer and rabbits. If the browsing is light, homemade repellent mixes or commercial products like Deer Away, Des-EX, Petergenic-B, and Milorganite can be used. Repellents tend to be effective if used proactively rather than reactively. It's essential to re-apply the repellent every few days or after rain. However, if the deer problem persists, installing a physical barrier like tree tubes, tree cages, or electric fencing is the best solution.

A small, green caterpillar called Heliothis may also infest your trees. While light defoliation is not a huge concern if they eat the terminal bud, the tree will fork at that height, and you will have to coppice it again. For a light attack, physical removal is the best solution, while a severe infestation may require the use of biological control, such as DiPel (Bacillus thuringiensis). Please contact us before using any pesticides on your trees.

Insect pests like caterpillars or grasshoppers are rarely a problem once the butt log is fully formed on your tree.



Tree tube to protect from deer browse.

Silvopasture

Silvopasture, or grazing livestock within the trees, is an excellent way to utilize your property while the trees are growing. However, waiting until the trees have substantial height and diameter growth is essential before you introduce cows or other grazing animals. Remove all domestic grazing animals for at least 3 years, even in winter when there are no leaves, to prevent them from damaging the cambium or pushing the trees over.

When you introduce grazing animals to your stand, start with light, intermittent grazing, i.e., on/off every few days. Chickens and other birds are great for managing insect pests in the early years. If pasture birds are used, ensure the trees are at least 3 feet tall before the birds are introduced.



Cows introduced for grazing 3 years post coppice.

Sunscald

Sunscald is a common problem on southern-facing slopes in the northern parts of our planting region. The sun's rays heat the thin bark and sap at a faster rate than the tree can withstand, causing fissures in the bark that can permanently damage the trunk and result in the loss of the log. To prevent this, apply white paint to the bark on southern-facing slopes to deflect the sun's rays and slow the heating.

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World Tree Representatives make periodic on-site visits and are readily available by phone and email to answer any questions.