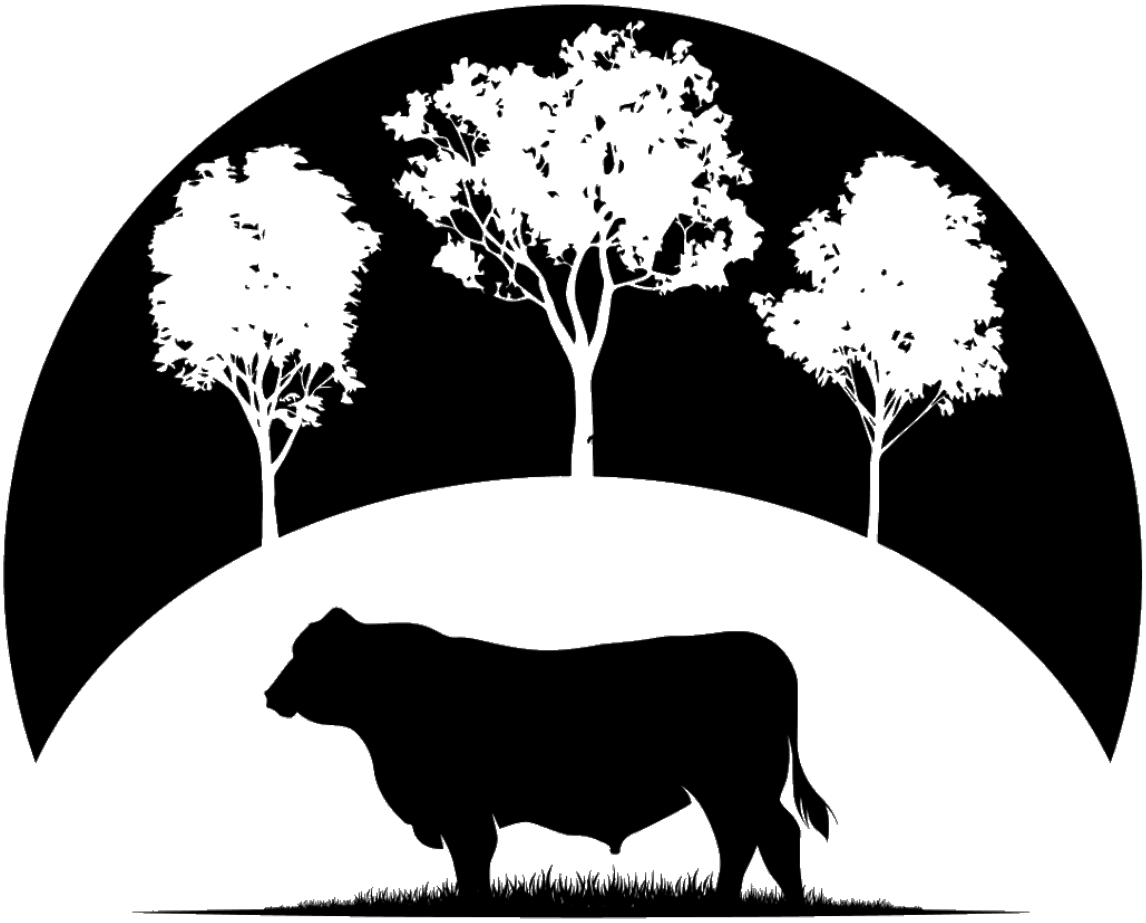

Trees For Graziers

Silvopasture Tree Species Profiles

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, through the Northeast Sustainable Agriculture Research and Education program under subaward number ENE23-187.

NORTHEAST SARE
Sustainable Agriculture Research & Education

Introduction

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, through the Northeast Sustainable Agriculture Research and Education program under subaward number ENE23-187. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

We at TFG hope that you will find it a helpful guide to some of our favorite silvopasture trees and that our knowledge of trees will grow together.

Trees For Graziers is a full service silvopasture company which works with farmers from their initial interest in silvopasture to planning, design, funding, implementing, and maintaining silvopasture, as well as growing silvopasture-specific trees. In short, our mission is to make it easy for busy farmers to say “Yes!” to silvopasture. Our involvement in every step of the process means we get feedback on everything that happens in a silvopasture setting and are thus able to add to the vast knowledge base that will need to be gained to take grazing to new heights all around the country. We consider this to be a living document that will change over time as we learn more and hear from you what you have learned.

The following tree species profiles give a silvopasture-focused summary of species showing the most promise in silvopasture systems—particularly in the eastern half of the US—many of which are already providing shade for cattle, grass, and graziers and offering ecosystem benefits to the farms who have embraced farming in nature’s image.

If you have questions about this document or would like more information about trees in the context of developing silvopasture, we have a growing library of resources at our website: **treesforgraziers.com**

Honey Locust

Scientific Name: *Gleditsia triacanthos*

Family: Fabaceae (the legume, bean, or pea family)

USDA Hardiness Zone: Zone 3-9

Size: 50-100 feet tall and wide; some specimens can be larger

Roots: All will have a fibrous component to them, but they also have a deep tap-root. Some honey locusts may have a number of thick, deep roots instead of a single tap root.

Growth Rate: Medium to fast

Light: Prefers full sun

Moisture: Dry to wet soils. Can tolerate a very wide variety of soil moisture. Does not grow well on heavy clay or gravel soils where the taproot will have trouble establishing itself.

pH: Prefers neutral soils, but tolerates a wide range of soil conditions

Description: This native is regaining popularity in the silvopasture world due to its many uses, especially for ruminant livestock. It fixes nitrogen in the soil, grows pretty fast, has edible pods commonly used as livestock fodder, creates high quality lumber which resists rot, and can be used in barren, droughty, or polluted soils**.**

Main Silvopasture Uses:

- Animal fodder. In a silvopasture, this is our #1 use. Pods are high in sugar, which is our main objective. Pods also contain solid protein, but most of that protein is locked away in hard-to-digest seeds. Primarily feed for ruminants, though pigs will gladly eat them as well. Drops pods late fall through winter, at a time when forages are dormant and livestock need access to more feed energy to put them in good condition before winter. Leaf fodder is also useful for ruminants and high in protein.
- Shade. Honey locust has one of the best shade profiles of any pasture species, which is another main reason we like it for silvopasture. The shade is very dappled, allowing a lot of light to come through the canopy to the forages beneath. See Greg Judy discuss honey locust

shade during a drought here. It also grows to be a fairly tall tree and prunes up easily, thus allowing the shade cast from the canopy to move a lot throughout the day.

Other Uses:

- Lumber. Creates a high quality, hard, durable wood used in construction, furniture. Also fairly rot resistant and can be used for fence posts, but note that it is not as rot resistant as black locust. Coppices well.
- Nitrogen fixation. Known to fix nitrogen, though not as heavily as other legumes like black locust.
- Sweet Pods. The mature pods have a sweet pulp, which can be made into sugar. Previous generations have researched the use of honey locust as a perennial feedstock for biofuels.
- General insect (especially bees) nectar plant. (Note: black locust is more important for honey production than honey locust due to its abundant flowers. The 'honey' in the name "honey locust" refers to the sweet pulp inside its pods, not to the production of honey by bees.)
- Wildlife Food Source. Especially attractive to deer (just as to livestock) as a high-energy feed in winter.

Special Considerations:

- The thorns on this tree can be quite large! This is a major issue, as anyone living in an area where wild honey locusts thrive will know very well. This will require careful genetic selection of trees to create trees that will reliably, consistently be thornless, and whose offspring will also be reliably thornless. Be aware though that even if you order seedlings that are supposed to be thornless, oftentimes nurseries will still send trees with thorns. This is because while the trees those seeds were collected from may have been thornless, the resulting seedlings won't necessarily be thornless. And even if thornless as a little 24" seedling, they may still develop thorns as they grow. TFG is working on selecting and clonally propagating thornless varieties. Grafted trees will be thornless, though they may still produce thorny seedlings. For more details on the work of TFG to select for and propagate high-quality, thornless trees, see this link.

- Some people consider this tree to be invasive to certain areas of the US, so be careful if you are introducing it outside of its natural range (though that natural range is very large in the Eastern US). What's definitely true is that in the right context, honey locust can spread aggressively, especially if there's a lot of thorny trees coming up that withstand browse. This makes it all the more important to carefully select for thornless traits when choosing stock.
- Honey locust seedlings are generally either male or female (there are some instances where there are male and female flowers on the same tree). This is another reason for clonal propagation, to ensure all trees planted are female and contribute pods. It may be that without a male tree nearby, trees would yield pods without seed, which would be ideal, since the seed has little value since it's mostly indigestible, and a lack of seeds would mean no new seedlings sprouting in unwanted places. There is a report that some trees produce seeds without the strong protective coating, which are hence more digestible, which may be an interesting factor to select for. All of this needs more research.
- Selections seem to have masting tendencies, and produce high in some years and low or not at all in other years. Thankfully, it seems that different varieties don't sync up so that planting a bunch of varieties (or seedlings) can provide consistent yield.

Black Locust

Scientific Name: *Robinia pseudoacacia*

Family: *Fabaceae* (the legume, pea, or bean family)

USDA Hardiness Zone: Zone 3-9

Size: 50-80 feet tall and 35-50 feet wide with trunk diameter of 30 inches.

Roots: Fibrous with suckers (sends up new plants from underground runners)

Growth Rate: Fast

Light: Prefers full sun

Moisture: Grows well in dry to moderate moisture soils. Does not like wet feet at all.

pH: 5.1-8.5 (tolerates a wide range of soil conditions)

Description: Black Locust is native to the southeastern United States (its range is in debate and should be considered adaptable with climate change), and is a great overstory tree as it allows a lot of light through to the understory. Black Locust provides valuable, highly durable and rot resistant wood as a timber tree, makes excellent firewood, and is a honey plant (bees love them!). It is also well-known for fixing nitrogen into the soil. Black Locust leaves provide a high protein fodder for livestock.

Main Silvopasture Uses:

- Shade. Fast growing, high canopy with dappled shade. In well-drained sites, it's our most recommended species for fast shade. It also can last longer than willows and poplars, our other fast-growing shade species.
- Nitrogen fixer. Known to be one of the most prolific plants to fix atmospheric nitrogen into the soil

Other Uses:

- Wood. Even though it grows fast, the very rot resistant wood is a great option for poles and posts. Burns really well and long, but also sparks, so watch where you burn it. Often doesn't get to the size

needed for a real timber tree, given attacks by locust borers. Coppices and pollards well, but is more likely to sucker then.

- Fodder/Forage Plant. Leaves contain an average of 20% crude protein and are comparable to alfalfa. Used around the world as a browse forage in silvopastures. However, it is considered toxic to horses by contemporary vet medicine. We typically don't consider it to be a main species to plant for fodder use. The fact that you'll get a lot of thorns on the ground, and thorns to handle when pollarding, makes it less attractive than poplars or willows, or even species like mulberry and basswood that are primarily used for fodder. Nonetheless, black locust has high quality leaf fodder, and should be considered a solid option, in moderation, in the right context.
- General insect (especially bees) nectar plant. Tree is well-loved by beekeepers.

Special Considerations:

- The Locust Borer (*Megacyllene robiniae*) is a beetle which is native to the southeastern U.S. where the Black Locust originates. The larvae riddle the trunk and branches with tunnels making the wood unfit for timber. This pest was responsible for reducing the Black Locust's significance as a commercial timber tree in the United States. Black Locust will grow well for many years, but rarely get large enough for timber due to this pest's activity in certain areas and climate. Maintaining healthy, vigorous trees and promoting Locust Borer predators seem to significantly minimize borer damage. Some clonal selections have been made that are more resistant to borer damage, which TFG is exploring.
- Expansive. Black Locust can form a thicket from shoots arising from roots. Will need to manage suckers, especially if the Black Locust is being coppiced. Suckers do give the opportunity for 'free trees' that can be managed for timber, especially in a context where trees are randomly spaced (as opposed to rows you need to maintain) like in a woodland. Brett Chedzoy, a NY forester and grazier, has had good success spreading his black locust across his farm through simply managing sprouts that come up naturally.

- Considered an “invasive species” in some states. Check with your state to see if black locusts are allowed in plantings, and plan accordingly.
- Thorny. Not as thorny as the Honey Locust (a distant relative). Thorns are on young branches only. Once the branches or trunk get a few inches thick, the thorns disappear
- Branches can be brittle and easily broken in strong winds. Even though the wood is famously strong and durable, the living tree is not particularly durable.
- Toxicity. Black Locust is also known to be poisonous to horses by contemporary veterinary medicine, although it is considered an excellent pasture livestock feed globally, and valuable for many livestock when used in moderation. Care should be taken by the planner and land steward to avoid scenarios where livestock might overfeed, such as if they don’t have access to other quality feed and all of a sudden get access to a lot of black locust.

Poplar

Scientific Name: *Populus* species

Family: Salicaceae (the willow family)

USDA Hardiness Zone: 3-9

Size: 50-80 feet tall

Roots: fibrous, expansive

Growth Rate: very fast

Light: Prefer full sun

Moisture: moist, thrive in flood plains and riparian zones

pH: 4-8

Description: Poplars are a great silvopasture tree selection as they are fast growing, cheaply propagated, and their foliage is highly digestible for livestock. Choosing a proper species depends on what your goals are and the area in which you are designing for. Think of them in categories of columnar (windbreaks), aspens (slopes and ridges) and cottonwoods (wet). There are also hybrid varieties to choose from that typically incorporate cottonwood and European genetics. These are known for vigorous growth and producing a harder wood than natives. We typically choose hybrid poplars for fast shade in our plantings.

Main Silvopasture Uses:

- Shade. Quick growing shade, especially when established from tall live stakes. You can use live stakes that are 10’ or more for really fast shade.
- Fodder. Because of low tannins poplars can be considered a staple food for livestock. Abundant and drought-resilient. Willows generally provide more leaf mass, but are higher in tannins, which means their leaves cannot typically be fed at as high of rates.

Other Uses:

- Wood. Biomass, biofuel, paneling, furniture, charcoal. Poplar and willows are often used as fast-growing shade trees in silvopasture, but poplars offer better timber. It's not high-value hardwood, but can be used for a variety of purposes. For more on this and other topics related to poplars and willows, see the New Zealand Poplar & Willow Trust.
- Erosion control. Fibrous root systems hold the soil together well; extensively used in New Zealand to prevent 'soil slips' (mass wasting).
- Logs for forest mushroom cultivation, particularly oyster mushrooms

Special Considerations:

- Native insects do not eat hybrid poplar leaves and therefore do not support biodiversity as the native species do. Avoid using hybrids for monocultural plantation purposes. Instead use within a diverse planting. If you want native species, consider planting cottonwoods or aspens, depending on your context. Tulip tree, also known as tulip poplar but not an actual poplar, also does well as a native species providing quick shade and higher value timber, though it's not as cheap to propagate.
- Given how easy and cheap it is to establish poplars, consider using them early on in a silvopasture, so that you can then grow all your own propagation material for your farm and those nearby. Same applies to willows.

Willow

Scientific Name: *Salix* species

Family: Salicaceae (the willow family)

USDA Hardiness Zone: 2-9 depending on type

Size: 80 feet tall

Roots: aggressive, fibrous

Growth Rate: fast

Light: Prefer full sun

Moisture: moist, thrive in flood plains and riparian zones

pH: 4-8

Description: Willows are fast growing, extremely easy to propagate, provide a lot of biomass, and are a natural anti-parasitic medicine. The *Salix* genus has over 400 species within the temperate region, with hundreds of cultivars all having various uses. Willows are generally fast growing, have dense fibrous roots, and prefer wet conditions with loamy floodplain soils, though some are more adaptable than others. Choose the right variety based on your site conditions, desired form and availability. Willows can be divided into three types: Tree, Osier (basket), and Sallow (shrub). For silvopasture, you'll want to use tree-form species if your goal is fast shade, and shrub-form species if you want to create low windbreaks or coppiced browse.

Main Silvopasture Uses:

- Fast shade and shelter. In wet soils, nothing will provide shade quicker. Unless you are going to control the size through regular pollarding, consider this a short-term tree providing quick shade until your slower-growing species provide the shade you need. TFG currently uses mostly Austree willow (a hybrid) for fast shade.
- Fodder. Prolific grower, putting out lots of leaf mass that can be used even in the middle of droughts when forages have stopped growing. High in tannins, it is great to offer as a free choice browse feed that livestock can browse as much as needed. Especially value in the diet

of sheep and goats, and in contexts where tannins can be used to offset the effects of toxic fescue. The amount of tannins in willow leaves varies by species, and likely is influenced by other factors as well which deserve examination. Leaves also have pain-relieving properties (aspirin was originally formulated from willow).

Other Uses:

- Wood. Generally less useful for wood than poplars. Willows are widely used for biomass plantings, but those would only infrequently interact with silvopasture usage.
- Erosion control and restoration. Similar to poplars above. Have long, intertwining root systems that hold soil together very well.

Special Considerations:

- One of the most easy to propagate from live-stakes. Start with dormant cuttings at least 10” long with half of the cutting underground, growing best in loose soils. TFG has successfully established live stakes as long as 20’ tall (and only planted 2’ deep because of hitting rock!). Once established growth is rapid, recovering quickly from browsing, coppicing or pollarding.

Mulberry

Scientific name: White Mulberry (*Morus alba*), Red or American Mulberry (*Morus rubra*), Black Mulberry (*Morus nigra*)

Family: *Moraceae* (the mulberry or fig family)

Roots: taproot or heart-shaped root pattern

Growth Rate: Fast

Years to Begin Fruiting: 3-5 years for seedlings. Grafted trees will start to yield right away

Lifespan: *M. rubra* (less than 75 years), *M. alba* (150+ years), *M. nigra* (300+ years)

Description: Mulberry is one of the most researched tree crops for use as animal feed around the world, mostly because it's been the sole feed of silk worms for millennia. It's a great food source for ruminants as well as pigs, chickens and other fowl. The nutritional value of both berries and leaf fodder are very high. Different varieties have differing fruit timing. Knowing your goals and site location should guide your species and variety selection. Below are the most common species to North America. Note that the common names (white, red, black) don't consistently correlate to the color of the fruit. Many "white mulberry" trees and their hybrids will have red, purple or black fruit.

Main Silvopasture Uses:

- Fruit. Great for poultry and hogs, likely the single most important tree crop for those species. Generally drops fruit from about June through August, depending on cultivar, some reported to drop later. Main fruit drop period usually happens over the course of a few weeks. Consider planting multiple cultivars to spread fruit drop over a longer period, and specifically select late-dropping varieties that will cover the late season when most others have petered out.
- Leaf forage. Highly digestible and high in proteins. Likely the best tree for leaf fodder. So digestible that even humans can eat it. If fruit is not a priority, consider planting male clonal varieties for only fodder.

Other Uses:

- Wood. Fence posts, craft lumber, fire wood. Not as rot resistant as black locust, but a very durable and beautiful wood nonetheless. Also high in BTUs.
- Shade. Medium size tree that typically wants to grow low and wide. For best shade, prune the tree up so the shade moves more throughout the day. Typically not used in silvopasture specifically as a shade tree.
- Fruit. For human consumption, whether fresh, dried, in jams, etc. Dried mulberry has been a staple crop in Middle Eastern cultures for centuries.
- Wildlife habitat. All kinds of birds and mammals love the fruit.

Propagation Considerations:

- Seedling trees are best used for leaf fodder, not for fruit production, since male seedlings will not produce fruit, and many seedling females will fruit only poorly.
- Cuttings from hardwood, softwood, and even the roots can all work well with the right care. Grafting works for cloning good genetic female varieties, but can be difficult for even experienced grafters. At scale, tissue culture is a useful strategy.

Special Considerations:

- Perhaps the most valuable tree for feeding monogastric livestock (poultry and pigs), and definitely fills a very important seasonal feed niche. Generously drops fruit during a long period of the summer, while most mast species drop their fruit in the fall.
- Note that mulberries present a challenge to make full use of in a rotationally grazed context. Because they are ‘soft mast’ or fruit that readily spoils, and drop in the summer when temperatures are high and decay happens quicker, you have to assume that most of your fruit will not be available for livestock if the livestock only have access to that area every 30+ days. Most of your fallen fruit will have rotten or been eaten by other wildlife before your livestock come around. For that reason, livestock systems will need to be built such that livestock can make optimal use of the fruit by having regular access to the fruit during the dropping season.

- Should be considered a prime option for poultry yards for a couple of reasons. First, because of the fruit that it drops. Depending on the planting density of the trees, and the number of birds that have access to them, mulberries could substitute a significant portion of the bird's feed. Second, it can handle the nutrient overload and abuse that generally occurs in poultry yards, better than most species. And it can take that nutrition and turn it into durable pole wood for use as fence posts, etc. Note that mulberries can grow in many different forms, and if pole wood is a goal, choose a selection that grows straight ('Oscar' is one such selection), as many prefer to heavily branch, making them unsuited for pole wood.

Species to consider for silvopastures:

White Mulberry (*Morus alba*)

USDA Hardiness Zone: 4-8 (reportedly some down to 3)

Size: 40-60 ft tall, and grows wide

Moisture: Moderate soils. Extremely drought tolerant once established

Special Considerations:

- Native to Asia and readily hybridizes with others, including *Morus rubra*. If fruit production is your goal, use clonal female stock. If fodder production is your goal, consider clonal male stock that's selected for large leaves and no fruit, so you don't increase your population of volunteer mulberries.
- Very tough tree that will grow almost anywhere except for wetlands. Can take a lot of abuse. You'll notice it persists in pastures despite heavy browse. Pollards and coppices very well.

Red or American Mulberry (*Morus rubra*)

USDA Hardiness Zone: 5-9

Size: 40-70 ft tall and wide

Moisture: Medium

Special Considerations:

- Native to eastern U.S. pure *Morus rubra* is becoming increasingly rare due to hybridization and a lot of nurseries misidentify what they have to offer. Planting verified *Morus rubra* in a silvopasture is a valuable conservation practice.
- *Morus rubra* tolerates more shade than *Morus alba* and is at home in a woodland setting.

Black Mulberry (*Morus nigra*)

USDA Hardiness Zone: 7-9

Size: 40-60 ft tall

Light: Full sun to shade

Moisture: Moist

Special Considerations: Most cultivated mulberry around the world. Native to central Asia. Reported to have the tastiest fruit.

American Persimmon

Scientific name: *Diospyros virginiana*

Family: *Ebenaceae*

USDA Hardiness Zone: 5-9

Size: 50-75 ft tall and 25-50 ft wide

Roots: Taproot, which makes it more subject to transplant shock

Growth Rate: Slow to Medium

Lifespan: 50-300 years

Light: Full sun to moderate shade

Moisture: Can thrive in a very wide range of soils, including poor, sandy soils.

Description: A slow-growing but long-lived tree, persimmons are primarily planted in silvopastures as a late season feed source. The persimmon fruit can range from yellowish-orange to dark reddish-orange. The fruit size can range from the smaller American Persimmons (about 1/2 inch diameter, about the size of a cherry tomato) to the larger Asian Persimmons (up to 4 inches diameter, about the size of a medium tomato). The texture of a ripe persimmon can range from jelly-like and almost dripping from the cut fruit to much dryer but still soft, almost like a firm melon or a soft apple. When not quite ripe, some persimmons have a lot of tannins and can be very bitter or dry, but when ripe, the persimmon is rich and honey-sweet with a spicy apricot flavor.

Silvopasture Uses:

- Fall-Winter feed for livestock (ruminants, hogs, poultry). Persimmons are universally loved by livestock as high-sugar treats late in the season when the extra energy is much appreciated. Depending on the selection, trees can drop fruit as early as August, or as late as February
- Shade. Slow-growing but long-lived, this tree will provide quality shade at a very manageable size for generations. Also, maintains a very narrow canopy and can be readily pruned up.

Other Uses:

hickory and pecan

- Human consumption (only ripe fruits!): whether fresh, dried, in baked goods, etc.
- General insect (including bees) nectar source
- Wildlife habitat
- Wood is very hard with a number of speciality, small-scale uses, like for the head of golf clubs or weaving shuttles. Not a tree grown for timber.

Special Considerations:

- Slow grower and does not transplant well. Special care should be taken to prep soil and protect the tap root when transplanting. Give persimmons extra care when planting, such as through extra mulch to preserve soil moisture while the roots recover
- It's not uncommon for transplanted persimmons, especially small seedlings, to die back to the roots. Thankfully, if the conditions are decent, they will usually sprout back vigorously. This does pose a real challenge to grafted trees, since anything that dies back to the roots, even if it re-sprouts, will have lost the graft.
- The persimmon fruit has been known by modern veterinary medicine to cause foaling with pregnant horses, although historical anecdotal publications suggest that horses and mules were pastured with them as feed. Care should be taken by planners and land stewards.
- Note that for silvopasture we are generally looking at American persimmon (*Diospyros virginiana*), not Asian persimmon. Asian persimmons have long been bred for human consumption, and are significantly larger than American persimmons, but lack the cold-hardiness needed for much of the northern United States, and generally cling to the branch rather than falling to the ground for livestock to consume. There are quite a few hybrids that could prove useful.
- The problem of seedling propagation is that male seedlings will not produce fruit, which is our main goal in silvopasture. Grafting is a standard option to obtain guaranteed female trees, though cost-prohibitive in many cases. TFG is evaluating the usefulness of clonal propagation by root cuttings, which will likely bring costs down

compared to grafting, and eliminate the concern about graft failures. Oak

Scientific Name: *Quercus* species

Family: *Fagaceae* (the beech family)

Common Species: northern red oak, white oak, pin oak, chestnut oak

Size:

- Northern Red Oak (*Quercus rubrum)*: 75-100+ feet tall and 50-75 feet wide. Medium-fast grower.
- White Oak (*Quercus alba*): 6-26 feet tall and wide. Medium growth rate
- Pin Oak (*Quercus* -): 25-65 feet tall and wide. Slow-medium grower

USDA Hardiness Zone:

Roots:

Light:

Moisture:

pH:

Description: The oaks are a large family of about 600 acorn-producing tree and shrub species. For silvopasture, their acorns produce an excellent feed to finish hogs on and can even be eaten by ruminants in small quantities as a supplement to grass pasture. Oak wood is highly valued for everything from timber buildings and furniture to wine/whiskey barrels and shiitake mushroom logs. The trees themselves are beautiful, majestic, and long-lived.. Each species has its own growing rates, dimensions, soil and light preferences, so research which oaks suit your area and needs.

Silvopasture Uses:

- Livestock feed (especially for hogs)—acorns. When selecting trees for this use, focus generally on trees in the white oak group, as they tend to produce the most favorable and lower-tannin acorns. In our area, TFG looks at white oak, swamp white oak, chestnut oak, swamp chestnut oak (which interestingly is also called cow oak), burr oak and hybrids between these trees. Hybrids are particularly interesting, as they are likely to show hybrid vigor, growing faster

while yielding sooner and heavier than their parents. Much work needs to be done here in the silvopasture realm.

- Wood. Highly prized for finish carpentry, furniture and barrels, as well as posts, fencing, stakes, wedges, roof shingles, firewood, and charcoal. Coppices well.
- Shade. Tall, long-lived trees can provide quality shade for generations to come. Will need to prune lower branches heavily, as open-grown oaks love to grow wide.

Other Uses:

- Wood can be used for forest mushroom production, particularly for shiitakes.
- Wildlife food and shelter. Oaks are particularly important for native insects, especially moths and butterflies, which form the bulk of food for young birds. Hence, oaks are closely correlated to the success of many bird species.
- Human consumption—acorn flour. Traditionally used as a staple crop around the world, including in the U.S.

Special Considerations:

- Oaks are generally slower growing and take a while to start growing again after transplanting
- Over-ingestion of acorns, especially green acorns, can be a real problem for ruminants. As is typically the case, problems usually happen when cattle have access to too many acorns and not enough other forage, and hence over-feed on acorns. In moderation, they can be perfectly fine, as exemplified by the Spanish *dehesa*, where cattle and sheep have grazed for centuries around oaks.
- Oaks tend to produce their acorns on an irregular, cyclical ‘masting’ schedule, and cannot be relied upon to yield consistently year after year.
- Much work needs to be done to select for high-yielding, consistently-bearing, low-tannin oaks, and then to clonally propagate those as top-notch feed & timber silvopasture trees.

hickory and pecan

Chestnut

Scientific Name: *Castanea* species

Family: *Fagaceae* (the beech family)

USDA Hardiness Zone:

- American Chestnut (*Castanea dentata*) Zones 4-7
- Allegheny Chinquapin/Dwarf Chestnut (*Castanea pumila*) Zones 5-9
- Chinese Chestnut (*Castanea mollissima*) Zones 4-8

Size:

- American Chestnut (*Castanea dentata)*: 75-100+ feet tall and 50-75 feet wide. Medium-fast grower.
- American Chinquapin (*Castanea pumila*): 6-26 feet tall and wide. Medium growth rate
- Chinese Chestnut (*Castanea mollissima*): 25-65 feet tall and wide. Slow-medium grower

Roots: Taproot

Light: Prefers full sun

Moisture: Dry to medium moisture soils. Does not tolerate wet soils.

pH:

- American Chinquapin (*Castanea pumila*): 5.1-6.5
- American Chestnut (*Castanea dentata*): 3.5-6.0
- Chinese Chestnut (*Castanea mollissima*): 5.1-7.5

Pollination: Requires cross-pollination from at least one other seedling or cultivar, and both will typically produce a nut crop. Some cultivars are better for nut production, and others are better for pollination. Wind pollinated, and flowers in June/July.

Description: A large beautiful tree that gregariously produces a sweet nut crop for all animals and humans alike. Blight-resistant trees can live for thousands of years and produce an annual crop. There are 8-10 species of chestnuts native to the temperate northern hemisphere, 3 native to North America along with 3 commonly cultivated species. In this profile we highlight the native chestnut and chinquapin, and the Chinese chestnut

(the most commonly used non-native chestnut). Before 1930, the American chestnut was one of the most important trees in the forest. Then the chestnut blight, a fungal disease brought from Japan to New York, swept through the continent. Though it has disappeared as a large tree, one can still find re-sprouts in the wild. Efforts to develop a resistant strain of American chestnut have taken three paths: through hybridization with Asian varieties, finding and crossing resistant native mother trees, and genetic modification through the introduction of a wheat gene.

Each of these species has its own unique strengths and weaknesses.

Silvopasture Uses:

- Nut crop (livestock). Hogs and turkeys are the primary livestock you would grow chestnuts for, though others will gladly eat them as well. Unlike many other nuts that are high in oils, chestnuts are starchy—similar to corn.
- Timber and carpentry wood. American chestnut is particularly valued for timber production, one of the most valuable and multi-use timbers in the US. As American chestnut trees become more available, expect it to be grown widely with timber in mind. Coppices well.
- Shade. The American chestnut offers a really good shade profile because of how tall it can get, offering the chance of a majestic native hardwood tree that will provide nice shade for generations to come. Chinese chestnut and chinquapin, with their shorter sizes, make less valuable shade trees.

Other Uses:

- Nut crop (human use). Raw, cooked, dried, oil, flour. Throughout much of the country, chestnuts are the most dependable tree crops for human consumption, and hence offer significant upside for sales. Note that when growing chestnuts for human consumption, you'll need to closely consider the increased investment needed in management, harvesting, processing and marketing to successfully get the product to market. The upside with chestnuts is that if the trees begin to yield, it's not yet practical or profitable to sell for human consumption, livestock can eat the nuts.. Look to the Savanna Institute for resources that explore in-depth growing chestnuts for human consumption. (Note: If growing in a silvopasture,

you'll need to be very aware of food safety regulations and adjust your livestock management accordingly.)

- Wildlife food source. Great for deer and wild turkeys
- Logs for forest mushroom cultivation

Yields: In an open setting with good care, seedlings should start to yield within 5-8 years with grafted trees bearing sooner. Yields will steadily increase as the tree grows to maturity and can continue yielding for hundreds of years. Yields vary greatly between species, cultivar, and age of the plant. 1,000-2,000+ lbs per acre are common in commercial orchards. Nuts fall September-November.

Special Considerations for Growing:

- Chestnut weevils, ambrosia beetles, Asian gall wasp, blight, and ink disease are all pests and diseases to possibly contend with depending on species chosen and planting context. Plant into well drained, acidic soil with plenty of organic matter.
- Though grafting is sometimes used for commercial orchards, there can be an issue with delayed graft failures. For silvopasture, where a robust, resilient and cost-effective tree is the aim, seedlings are the best option.

Hickory and Pecan

Scientific Name: *Carya* species

Family: Juglandaceae (the walnut family)

USDA Hardiness Zone:

- Shellbark Hickory (*Carya laciniosa*) — zone 5-8
- Shagbark Hickory (*Carya* — zones 4-8
- Yellowbud/oilnut/bitternut Hickory (*Carya cordiformis)* — zones 4-8
- **Pecan** (Carya illinoinensis) — zones 6-9
- **Hican** (Carya x hybrids) — zone 5

Size:

- **Pecan** (*Carya illinoinensis*) — 75-120 feet tall and wide
- **Shellbark Hickory (***Carya laciniosa*) — 70-90 feet tall and 30-50 feet wide
- **Shagbark Hickory** (*Carya ovata*) — 70-90 feet tall and 30-50 feet wide
- **Yellowbud** *(Carya cordiformis)* — 60-80 feet x 20-50 wide
- **Hican** (*Carya x hybrids*) — 75 feet tall and 50 feet wide

Light: All prefer full sun. The Shagbark Hickory (*C. ovata*) can tolerate a bit more shade than the other species.

Moisture: Medium soil moisture preferred. The Shellbark Hickory (*C. laciniosa*) can tolerate more wet soils. The Shagbark Hickory (*C. ovata*) can tolerate some fairly dry periods and doesn't like wet soils or flooding.

pH: Most species prefer fairly neutral to alkaline soil (6.5-8.0)

Description: The Hickories and Pecans are large, slow-growing, tap-rooted trees that can take many years to begin bearing. As a nut crop there is a lot of promising commercial potential for both dried nuts as well as a high quality pressed oil from yellow bud hickory (has the highest fat content of the various species, as well as a thin shell). There are several species of hickory and much variation within them. Many hybridize in the wild and under cultivation. They all have strong hardwood and are long lived.

Silvopasture Uses:

- Nuts (human consumption). Raw, cooked, dried, nut milk. This is a rare tree that we'd use in silvopasture where the main goal is human consumption. It surely has opportunities for consumption by livestock, but its human consumption opportunities are great. It also should be exempt from many Food Safety regulations, as it needs to be shelled in order to be consumed. This makes it an easier fit into an active silvopasture system than chestnuts or apples, where regulations can be strict. There is already a rich and widespread culture of raising cattle under pecan orchards.
- Shade. A tall, majestic, long-lived tree that will provide shade for generations. Fairly dense, but can readily be pruned up, which you'll want to do for timber production anyway.

Other Uses:

- Nuts for livestock consumption. Hogs of course will eat almost any nut, but others, like cattle, have been reported to eat yellowbud hickories as well. Most folks will likely plant these for human consumption first and foremost, and the fact that they provide quality livestock feed is a useful fallback option.
- Nut oil (yellow bud hickory: has 75-80% fat content). Yellowbud hickory is an intriguing crop for much of the country where pecans can't compete with existing commercial production. The market for hickory oil is so incredibly tiny and niche right now that we can't say with any certainty whether this market will scale profitably. But the opportunity of a domestic olive-oil substitute is certainly intriguing. Thankfully if you do plant a bunch of trees for oil consumption, and the market does not prove to be profitable when yield starts, these will still be beautiful trees providing shade, timber and livestock feed for generations to come.
- Wood. Good timber, great for fuel, with a high BTU. Also extensively used for smoking meats.
- General insect pollen plant. Attracts beneficial insects which feed on the pollen of these trees
- Wildlife food and shelter

Yield: Highly variable on species and size of the tree. Hickories produce less than Pecans. Improved varieties often produce more than unimproved and wild species, although the hybrid Hican will produce less (but larger) nuts than the Pecan. 50 lb. is not uncommon for a 10-20 year old tree. Pecans can produce up to 100 lbs when they are 20-25 years old. Yellowbud nuts can produce ¾ gallon of oil per 5 gallon bucket of nuts.

Special Considerations for Growing:

- Almost all of these trees are slow growing during their first few years.
- Bitternut hickory develops a dense root system and can be transplanted more successfully than other hickories
- Get the seedlings into their permanent spots as soon as possible to avoid damaging or stunting that taproot. Ideally, if you can protect the seeds from rodents, the seeds would be planted where you want the trees to grow. Named varieties are available from grafting, although grafting hickories is tricky and hence expensive.

Walnut

Scientific Name: *Juglans nigra* (Black Walnut)

Family: *Juglandaceae*

USDA Hardiness Zone: 4-7

Size: 75-130 feet tall

Roots: Taproot, which makes it hard to transplant well

Growth Rate: Fast, especially when direct-seeded, without transplanting. Transplanted trees usually take a few years to get back up to speed, a problem trees planted by squirrels don't experience

Light: Prefers full sun

Moisture: Medium

pH: 6.1-7.5 (Neutral to slightly alkaline)

Description: This large deciduous tree is a popular nut and lumber tree. In the United States, the Eastern Black Walnut is a very common nut tree. The nut meat is difficult to extract yet prized for its strong flavor. However, walnut is most valued for its high quality wood from a relatively fast growing tree. Walnuts are great shade trees, great nut producers, and may be considered a wise investment for your children or grandchildren. One of the often cited concerns about walnuts is a toxic compound exuded from their roots and contained in leaves and nuts called juglone. This compound inhibits the growth of certain plant species (especially nightshades) and seems to be toxic to horses. While some forages will be stunted by the toxicity, there are plenty of great forages that are juglone resistant and will thrive in the light shade produced by the canopy, resulting in no net loss of forage production in most cases. Walnuts should be strongly considered for silvopasture and alley cropping systems for its combination of light shade and valuable timber.

Silvopasture Uses:

- Shade. Has a nice shade profile, since it's a tall tree with leaves that come on late in the spring and drop early in the fall, allowing more sunlight to come through to the pasture below.

- High quality timber. This is the leading reason most would plant walnuts in a silvopasture. The value of high-quality walnut timber is hard to match. Wood is very hard and very attractive, so it is used for flooring, furniture, and things like gunstocks, paddles, and tools

Other Uses:

- Human consumption (nut)- fresh raw, roasted, dried, oil. For more resources on human consumption use, look to resources developed by the Savanna Institute. In general we should note that walnuts are fairly marginal at this point as crops for human consumption, and growing them for human consumption is likely not a great option for most large-scale silvopasture systems, whereas timber can provide a much better silvopasture fit. If you do want to grow walnuts for human consumption, look for selected cultivars that crack out better and have a higher percentage of nut meat. Walnuts can be tapped like a maple tree to make syrup.
- Nuts can be eaten by hogs, and if crushed can be eaten by poultry, as was regularly done for poultry feed way back in the day. Nuts may give a distinct flavor to pork, which could be marketed as a premium product.
- Extracts from the green husks of walnuts have insecticidal properties, and shells are ground of for a variety of products

Special Considerations for Growing:

- Walnut roots and leaves produce juglone, a chemical that inhibits the growth of certain plants. Make sure that surrounding trees and underplanted plants can tolerate juglone.
- Black Walnuts can be difficult to shell. Make sure you have a heavy-duty nut cracker.
- Be sure to prune to a central leader if growing for timber.

American Basswood

Scientific Name: *Tilia americana*

Family: *Malvaceae* (the linden family)

USDA Hardiness Zone: 2-8

Size: 75-100 feet tall and 40-75 feet wide

Roots: Flat with some taproot

Growth Rate: medium - fast

Light: Prefers full sun. Will tolerate shade, but grow slower the more shade there is.

Moisture: Prefers moist, well-drained soils, but tolerates dry sandy soils as well

pH: Most species prefer fairly neutral to alkaline soil (4.5-7.5)

Description: The *Tilia* species are common in temperate climates of the northern hemisphere. In North America, *Tilia* are called "Basswood" or "Linden". These large trees have edible leaves, flowers that host many beneficial pollinators, and wood with a tremendous variety of uses. There are a couple other native species to North America that are region specific with small differences, Carolina Basswood and White Basswood. There is not much research on using Tilia species in silvopasture, but due to its highly digestible leaves, good pollarding/coppice, fast growing and shade, and tremendous wood production, we believe it is an excellent addition to work with.

Silvopasture Uses:

- Fodder. Because the leaves are highly palatable and digestible, and the tree grows well after pollarding or coppicing, it makes for a great fodder tree, likely rivaling mulberry as the most useful fodder tree.
- Shade. Has a deep shade, but can be pruned up to create the form we want (which would negate use for fodder, instead creating a timber form)

Other Uses:

- Bee plant. Valuable tree for pollinators, given that it flowers in the middle of summer after many other trees are done flowering. Hence it is much appreciated by beekeepers.
- Wood. Multi-purpose wood species, particularly used for carving. Coppices and pollards very well
- Leaves for human consumption. Young leaves and leaf buds are used as a base for salads, can be used for pesto and in sandwiches. The leaves are mild and slightly mucilaginous (in a good way).

Special Considerations for Growing:

- Coppiced or pollarded trees rarely flower, so consider keeping a few basswood for leaf production, and grow a few full-sized, non-coppiced trees for timber and pollinators
- Does not tolerate juglone
- These are large trees that produce deep shade if left unmanaged, so plan (and prune) accordingly.

Tulip Poplar

Scientific Name: *Liriodendron tulipifera*

Family: *Magnoliaceae*

USDA Hardiness Zone: 4-9

Size: 70-90 ft tall (or higher) 40 ft wide

Roots: shallow with juvenile taproot

Growth Rate: fast

Light: prefers full sun, tolerates some shade

Moisture: Prefers moist, well drained (although is drought tolerant once established)

Flowering: mid to late spring

Life Span: 200-300 years

Description: One of the largest hardwood trees in North America, with a clear straight trunk. It is a common native in young east coast mixed deciduous forests and is one of the most attractive and tallest of eastern hardwoods. It may reach 300 years of age on deep, rich, well-drained soils of forest coves and lower mountain slopes. It is fast-growing, produces good shade, and lots of biomass. The wood has reliable commercial value because of its versatility in furniture and framing construction. Yellow poplar is also valued as a honey tree, a source of wildlife food, and a shade tree for large areas.

Silvopasture Uses:

- Fast growing, but also long-lived shade trees. Note that this is not a true poplar, and cannot be propagated via live stakes. For fast (but shorter-lived) shade alone, hybrid poplars are cheaper and faster to establish. However, tulip trees are native and produce more valuable timber, making them a better fit in some instances.
- Timber. Will grow nice and upright even in an open silvopasture, and produce a quality sawlog.

Other Uses:

- Pollinator habitat. Valued by beekeepers.

Osage Orange

Scientific Name: *Maclura pomifera*

Family: *Moraceae* (the mulberry or fig family)

USDA Hardiness Zone: 4-9

Size: 30-65 feet tall

Roots: Tap-rooted when established in place, more likely to have roots spread laterally when transplanted

Growth Rate: Fast

Light: Prefers full sun

Moisture: Very tolerant of a wide range of soils, especially dry soils

pH: Very tolerant of a range of soil pH, known particularly to be very adaptable to very alkaline soil

Pollination: Wind pollinated. Male and female flowers on different trees

Description: It is a small to medium size tree with deeply furrowed bark and thorny branches. You could say that osage has an extensive history of use in silvopasture in the US, given that it was used extensively in the mid 19th century as a hedge to fence livestock in and wildlife out, particularly on the Plains where wood and stones to build fences was absent. Though they were put out of service once the use of barbed wire spread, they may now have a second agroforestry life as a long-lasting, home-grown fence post material and fuel source.

Silvopasture Uses:

- Wood. The primary stand-out quality of osage is very rot resistant, durable wood that is known as the longest lasting fence posts anywhere. Tongue-in-cheek old timers will say that the post will outlast the hole. It is a great option as a means of growing your own fence posts, or for sale off-farm. Could be an especially good fit for poultry silvopasture, where osage can take up excess nutrients and lock them up/export in the form of the wood. Also makes great fire wood, burning longer and hotter than any other domestic species. Because the tree doesn't typically grow straight naturally, managers

should coppice or pollard trees to produce tall, straight shoots for posts.

- Living fence, hedgerow, windbreak. Osage long made a name for itself for being the go-to species for farm hedgerows. So much so that a common name is ‘hedge apple’ or simply ‘hedge’. A good row of osage was known to be ‘horse high, hog tight and bull strong’. For those interested in bringing back this practice, osage is the perfect candidate.

Other Uses:

- Poultry yards. Covered somewhat above, but worth mentioning as a stand-alone use. Many trees cannot take the heavy nutrient load put out by heavy use poultry areas, but osage should do well here, and use the excess nutrients to produce long new growth that can be used for poles, fence posts, etc. Suggest using this as a pollard to produce new pole wood year after year for generations.
- Fodder. Could be a valuable fodder tree as well, especially thornless selections. Livestock are known to browse on osage leaves, and it is a cousin to mulberry, one of the highest quality leaf fodder species. In fact, osage leaves were used as a quality replacement for silkworms when mulberry leaves weren’t available. This means they would likely be a great fit for livestock fodder as well, but will require more research (just like most of silvopasture).

Special considerations:

- Similar to black locust, osage has thorns on young stems that disappear as the stem matures. Hence, mature trees do not have thorns on the trunk. Thornless clones can be made by taking wood from high up on the tree, above the point that juvenile wood produces thorns, the same way that thornless honey locust can be obtained for grafting.
- Thorny seedlings would be the best option for hedges meant to function as a living fence. Meanwhile, if you’re going to grow osage for pole wood, you’d likely want a thornless selection, since those will be significantly easier to handle.
- Osage trees are either male or female. Females will yield fruit without males, though they’ll be seedless. I can’t say at this point whether

there’s any real advantage to having osage fruit in a silvopasture. The seeds inside would likely have some feed value, but it would be only a minimal contributor. You may want to consider male (hence, fruitless) selections so you don’t have to worry about seedlings where they aren’t wanted.

Catalpa

Scientific Name: *Catalpa speciosa* (northern catalpa) & *bignonioides* (southern catalpa)

Family: *Bignoniaceae*

USDA Hardiness Zone: 4-8 (northern) and 5-9 (southern)

Size: Typically short-medium. Most not above 40'. Grows wide.

Roots: Shallow, spreading

Growth Rate: Fast

Light: Full sun to partial shade.

Moisture: Prefers moist, well-drained soil, but adaptable to wet or dry conditions

pH: 5.5-7

Flowering: Late spring to early summer

Description: A medium-sized tree with very large leaves, catalpa trees offer an interesting niche function in silvopasture systems for producing rot-resistant wood. As a North American native, and the host of many native insects, they are an interesting addition for biodiversity as well.

Silvopasture Uses:

- Wood. Even though catalpa grows fast and produces light wood, the wood is known for being very rot-resistant in contact with the soil, and hence useful for fence posts, pole wood, etc. Given that catalpa grows fast and straight, it is an interesting option to grow specifically for the wood. Similar to osage, it can be an interesting species to integrate into poultry yards, where it can provide cover while taking up nutrients and converting them into pole wood that can be harvested every several years. Because the tree doesn't typically grow straight naturally, coppicing or pollarding trees to produce tall, straight shoots is how you would manage it for posts.

Other Uses:

- Insect and pollinator species. Loved by bees and moths, and sometimes planted in the south specifically to lure in catalpa worms,

the caterpillar of the Sphinx moth that is known to fishermen as “catfish candy”. Also good for honey production

- Fodder, potentially. Without testing, use of catalpa for fodder is purely speculation, but seems likely to be viable. Produces very large leaves, which are most similar to paulownia leaves, which are quickly eaten up by livestock when they drop in the fall. Testing is needed.

Special considerations:

- Note that there’s both a southern and northern catalpa, so select the variety that is going to thrive in your climate.

Apple

Scientific Name: *Malus domestica* or *pumila*

Family: *Rosaceae* (the rose family)

USDA Hardiness Zone:3-9

Size: Depends on root stock. For silvopasture, the larger the tree the better.

- Own root, Standard: 20-26’ (6-8m) high x 20’ (6m) wide → tall, not for fresh eating apples which should be picked from the tree, but can be used for juice/cider apples which can be picked up off the ground
- Semi-Dwarf: 13-16’ (4-5m) high and wide
- Dwarf: 8-13’ (2.5-4m) high x 12’ (3.5m) wide

Roots: Flat, mostly shallow roots

Growth Rate: Slow-medium

Light: Full sun preferred

Moisture: Medium

pH: 6.1-7.0 is what is aimed for in commercial nurseries, but can take a wider spread.

Pollination:

- Most require cross-pollination
- Note that not all species will cross-pollinate; review a chart before planting.

Flowering: May-June

Description: A moderate sized tree to small dwarf trees. There is more to apples than meets the eye. There are dozens of species around the world that grow in different climates and ecosystems, bearing fruit sizing from a pea to a large potato. There have been many varieties cultivated for fruit flavor and various uses, but most of these are subject to high pest and disease pressures, meaning they are extremely difficult to manage in an organic, low-input system, such as what’s needed for silvopasture. For this reason we suggest using wild seedling apples (sold commercially for wildlife plots) or grafted varieties that are selected for low-maintenance

systems, and most likely on full-sized understock, for silvopasture systems where livestock feed is the primary goal. If the goal of management is apples for human consumption, you'll need to consult other resources that specifically address the many factors that go into establishing a successful apple orchard, and thoughtfully integrate animals into that orchard to the (more limited) degree it makes sense.

Apples, and similarly pears, present a challenge to make full use of in a rotationally grazed context. Because they are 'soft mast' or fruit that readily spoils, and drop early in the season when temperatures are high and decay happens quicker, you have to assume that most of your fruit will not be available for livestock if the livestock only have access to that area every 30+ days. Most of your fallen fruit will have rotten or been eaten by other wildlife before your livestock come around.

There are a couple things you can consider to make the best use of your apples.

- Consider selecting apples that drop really late and keep really well. If you're in a context where livestock winter on pasture and rotationally graze on stockpile or hay, then you're more likely to have good, usable apples when you come back around if your apples drop in November and are good keeping varieties with thick skins.
- For those who run pastured pigs, apples are one of the more interesting tree crops to consider. In this case, you'll need to figure out how to give the hogs access to the trees when the fruit is falling, but not for too long or in times when they are likely to cause damage. We are not in the place to make recommendations on particular layouts, but for those who can develop a system that provides both timely access to trees and controls damage, apples are a great tree option to form a large part of pigs diet during fall months
- Those who have goals of using silvopasture to benefit wildlife, especially deer, should closely consider apples. Given that wildlife have access to all parts of the farm, all the time, they can effectively use soft fruits that fall anytime, which includes apples, pears, but also plums, mulberries and more. That allows hunters to create perennial hunting plots that will draw animals in for decades.

Silvopasture Uses:

apple

- Late summer through winter feed supplement for livestock and wildlife

Other Uses:

- Human consumption. Fresh, cooked, cider, etc. Every farm can make use of a few apple trees.
- Nectar source for insects (especially bees)

Special Considerations for Growing:

- Anticipate significantly lower yields than commercial orchards when you're growing trees in a very low-input system for livestock feed.
- Grafted trees should start yielding in 5-8 years or so, and continue being productive for decades to come.
- Really good care of your trees in the establishment phase will go a long way. Apples have a lot of challenges under normal orchard conditions, and the integration of livestock and tall forages (which provide great vole habitat) doesn't make things any simpler
- Apples don't like high humidity, which could be an issue with tree shelters. TFG has tried loose mesh shelters, which allowed a lot of air flow to the trees, but found we had to replace all those mesh shelters because the tree leaves poked through, cattle would eat the tree leaves and get a liking for the mineral-rich leaves, and then damage the shelters to get access to the leaves. What we've settled on for now is using 6' Plantra shelters and cutting them open but leaving the tubes on even when the leaves are well out of browse height. With this technique, more air can flow through the tubes and around the tree trunk, while the tube remains in place to provide protection from rubbing until the tree has gained more size.
- Be very thoughtful of apple placement on a landscape. Avoid frost pockets, and prefer hills where cold air can escape.
- Note that special food safety regulations will apply if selling apples for food where livestock have access. Make sure to do your homework before integrating livestock into a commercial orchard.

Propagation: Typically by grafting. Seedlings are not true to type - meaning they produce apples that rarely taste anything close to the parent stock. Often they do not have a good fresh eating flavor, but could be

used for hard cider. This is not a major concern with silvopasture, given that livestock are not near as picky as humans, though using grafted stock allows you to closely choose trees that will yield during certain times of the year, and have certain blocks with trees that will drop their fruit together. If buying seedlings, look for “Antonovka” seedlings. If buying grafted trees, choose the tallest understock available, combined with low-maintenance, resilient fruit selections.

Maintenance:

Keep in mind that for apples to be profitable in a silvopasture setting means that much of what’s routinely done in an orchard setting for human use just cannot be justified for the sake of profitability. Regular pruning, fertilizers, pesticides, fungicides, etc. will all have to go out the door if your goal is livestock feed. So plan accordingly.

Pear

Scientific Name: *Pyrus communis*

Family: *Rosaceae* (the rose family)

USDA Hardiness Zone: 4-9; some varieties into Zone 3

Size: The size of the Pear tree is based on the rootstock used as almost all Pear trees are grafted. The interesting ones for silvopasture are below:

- *Standard*: 25-40 feet tall and 25 feet wide
- *Standard Perry Pear Tree*: 25-70 feet tall and 15-55 feet wide

Roots: Fibrous

Growth Rate: Medium

Light: Prefers full sun. Tolerates very little shade

Moisture: Medium-moisture soils are preferred.

pH: most varieties prefer fairly neutral soil (6.0-7.5)

Pollination: European Pears traditionally require cross-pollination, although a few varieties are self-fruitful. This requires two different varieties of European Pear. Some Asian Pears (*Pyrus pyrifolia, P. ussuriensis,* and *P. x bretschneideris*) will cross-pollinate European Pears. Because there is such a wide variety of pears and cross-pollination variations, it is best to get cross-pollination information from the nursery or catalog company you are purchasing your pears from. Pollinated by insects.

Flowering: Late Spring to early Summer (May-June); susceptible to late frosts

Years to Begin Bearing: 3-10+ years depending on the variety and rootstock

Years of Useful Life: 50-75 years. Dwarfing rootstocks live shorter lives

Description: The European Pear needs almost no description. It is one of the most well known, and loved, tree fruits in the world. While most people are familiar with the few varieties the local grocer stocks, there are over 3,000 other varieties in the world which few of us have ever tasted. And few have ever tasted Perry, the pear equivalent of apple cider. Pear trees also attract and feed beneficial insects and have wood that can be used

for a variety of purposes. For similar reasons as those listed for apples, we suggest using seedling wild pears commonly sold for wildlife plots, or ultra low-maintenance varieties grafted to standard rootstock in your silvopasture system if the primary intent is for animal use.

Note that there are many similarities between pears and apples in the way they are best utilized in silvopasture, namely:

- Both are challenging to use effectively because they will rot quickly in warmer months, before livestock have a chance to eat them
- Both are subject to a wide range of pests and disease, so selection for ultra low-input systems should emphasize very resilient stock
- Both should be planted as seedlings, or grafted trees on the tallest rootstock available. Taller trees are sturdier, less prone to disease and pest issues, grow older, and cast a shade that moves more throughout the day.

Silvopasture Uses:

- Livestock and wildlife feed. Fruit primarily, although livestock also like the leaves
- Shade. Select the tallest understock you can find when using grafted pears, and prune off lower branches to keep the canopy high off the ground.

Other Uses:

- Human consumption. Fresh, cooked, made into perry, etc.
- Wood. Has better qualities for making use of wood than apple does, especially perry pears, which can achieve real timber size. From wood-database.com: “It’s been said that Pear is used in Europe much in the same way that Black Cherry is used in the United States: as a popular and high-quality domestic hardwood.”
- General insect (especially bees) nectar plant

Special Considerations for Growing:

- See the special considerations for apples. Most apply to pears as well.
- Pears do not tolerate juglone (natural growth inhibitor produced by Black Walnut and its relatives).

- Pears are susceptible to Fire Blight, Pear Scab, and Canker, so try to choose varieties that are resistant to these diseases.
- Make sure to consider flowering times when planning which varieties you choose. You need to make sure that you have compatible varieties (i.e. ones that will pollinate each other) flowering at the same time. Having a diversity of varieties is recommended.

Propagation: Typically by grafting for standard orchard use, though silvopasture context should be a good fit for cheaper seedlings, which also bring a bit more genetic diversity. Seedlings are not true to type - meaning they produce fruit that rarely taste anything close to the parent stock. This is not a major concern with silvopasture, though using grafted stock allows you to closely choose trees that will yield during certain times of the year, and have certain blocks with trees that will drop their fruit together. If buying grafted trees, choose the tallest understock available, combined with low-maintenance, resilient fruit selections.

Maintenance:

Similar to apples, the standard maintenance protocols for pears will need to be thrown out in the service of profitability when producing feed for livestock. Very low-input trees will need to be selected that can handle the relative neglect.

False Indigo Bush

Scientific Name: *Amorpha fruticosa*

Family: *Fabaceae* (pea)

USDA Hardiness Zone: 3-10

Size: 6-12 ft high and wide

Roots: Flat, suckering

Growth Rate: Medium-fast. Grows back vigorously after cutting.

Light: Full sun to partial shade

Flowering: April-June (depending on area)

Moisture: Wet to dry. Quite adaptable. Often grows near streams. Adaptable to a wide range of soil pH, and to low-nutrient soils, where it can thrive due to ability to fix nitrogen.

Description: A multi-stemmed, nitrogen-fixing, suckering shrub, False Indigo Bush is a species TFG is closely evaluating for extensive use in riparian buffers (where it seems to be a very natural fit) and in silvopastures. In grazing systems the plant has value through a combination of nitrogen fixation, browse and chop-and-drop mulch. It seems to also propagate well from dormant cuttings, which would make it very easy to propagate.

Silvopasture Uses:

- Livestock browse in diverse silvopasture planting. Deserves to be evaluated more. Robert Marsh, featured in this video (5:08 to skip to the section on false indigo) uses it as a summer fodder plant. From personal communication, the livestock don't touch the plant in spring or fall, and do use it well in the summer. Seems to be quite high in tannins, which can restrict intake, but also bring value in moderation, especially when livestock are grazing on fescue.
- Nitrogen fixer

Other Uses:

- Great beneficial insect habitat
- Green mulch

false indigo bush

- Deer resistant

Propagation: Scarified seed and softwood or hardwood cuttings**.** TFG is currently testing how well it propagates via hardwood cuttings. Small tests so far have been positive. If it propagates well via hardwood cuttings, it'll be a very rare nitrogen fixing plant that does.

Maintenance: Little. May want to cut back suckers, and brush hog every few years to reinvigorate the plant.

Concerns: Like black locust, this plant is known to be toxic to animals when fed in high quantities. Experiment with it on a small scale first and use it in moderation.

Bamboo

Scientific Name: *Bambuseae t*ribe

Family: *Poaceae* (the grass family)

Light: Prefers full sun, but some species tolerate medium to full shade

pH: 5.1-8.5 (varies on the species)

Description: A fast growing woody grass with many silvopasture uses, yet needs special attention when designing due to the spreading nature of some species, and a lack of information on how to establish it at scale in grazing systems. We believe that bamboo has a place in silvopastures since it's a grass that can be utilized as year-round fodder, a windbreak/ shelter, shade, erosion control and more.

Silvopasture Uses:

- Animal Fodder. Bamboo is a grass—the major component of ruminant diets. It is perhaps the only plant that can provide feed year-round (including in the depth of winter), while also serving as shade and windbreak. We highly recommend you check out this research out of West Virginia for more on this topic, including a breakdown of species they used.
- Livestock shade.
- Windbreak and shelter. Typically fast growing and very tolerant of wind. Also is able to take heavy traffic. Makes a great screen.

Other Uses:

- Wood products. Very multi-functional to have around for use on the farm.
- Edible shoots for human consumption.
- Wildlife Shelter. Especially for birds and small mammals
- Erosion Control & Bioremediation. Extensive root system helps stabilize soils prone to erosion. Used as a fast-growing plant to help clean and detoxify environments.

Special Considerations for Growing:

- Bamboo comes in two broad types: Running and clumping. Clumping bamboo is the most well-behaved and will stay where you put it, while running bamboo will spread. In a silvopasture setting, it'd very often be nice to have a spreading bamboo that will spread for you. It's a lot cheaper to fill an area that way.
- Do not put spreading bamboo in a place you cannot control. I wouldn't put it on the boundary with a neighbor who is picky about their yard. Thankfully, you can control the spread of bamboo through a variety of means, in particular mowing and grazing. As a grazier, your livestock are your best tool to control the spread of bamboo.
- Some reports have bamboo as invasive, and use the term lightly. They do not tend to 'jump' to a place far from where they were planted. They rarely spread from seed. Instead, they spread via rhizomes, which can be controlled through the methods mentioned above.
- Shorter bamboo species, such as 10-20' tall, are likely the best options for most silvopasture settings, unless you really want large bamboo canes for timber-type use (could be an interesting option for posts to protect trees that only need to last several years until the tree is established). Short, small-diameter bamboo will be much easier to remove with a brush hog, and the leaves will be in reach of livestock.
- Consider using the native river cane *Arundinaria gigantea,* a species that had been much more common in the United States, and formed the backbone of grazing in the south for generations until it was cleared for cotton and other crops.
- Read here about the bamboo experimentation being done at Cairncrest Farm in NY.

Eastern White Pine

Scientific Name: *Pinus strobus*

Family: *Pinaceae* (the pine family)

Description: White pines are tall and graceful evergreen trees that can achieve heights of 150 feet or more. White pines are monoecious with each tree bearing male and female cones. The needles of white pine come in clusters of 5 and are quite soft being about 3-5 inches long. White pine is native to the Eastern United States and has been a valuable source of lumber due to its straight growth habit and high strength to weight ratio.

USDA Hardiness Zone: 3-8

Size: 50-80 feet tall and 30 feet wide

Roots: wide, spreading and quite deep but without a taproot

Growth Rate: Fast at 2-4 feet per year.

Light: Prefers full sun, will tolerate some shade.

Moisture: Prefers well-drained soils and therefore slopes, hilltops and shoulders of hills. Often grows better than hardwoods on poorer (especially sandy) soils.

pH: 4.5 - 6.0

Silvopasture Uses:

- Windbreak and shelter. Potential as windbreak or living barn when young especially in dense plantings; older trees lose their lower needles and do not offer much wind protection

Other Uses:

- Timber. Used to create graded lumber for framing; used for flooring, siding, trim; often used for pulpwood as well. Prune lower limbs for better quality timber.
- Livestock shade. Potential to produce tall shade which “moves” around pastures

- Wildlife Shelter. Especially birds and small mammals
- Pine needles (“pine straw”) can be used for mulch

Special Considerations for Growing:

- Can be difficult to establish in a pasture setting. Doesn’t do well in tree tubes.
- Grows very slowly for 3+ years.

Eastern Red Cedar

Scientific Name: *Juniperus virginiana*

Family: *Cupressaceae* (the cypress family)

Description: Red cedar is the most widely distributed coniferous tree in the eastern U.S. and a dense slow-growing evergreen that often remains bushy on poor soils. The oldest tree reported, from West Virginia, was 940 years old. The juvenile leaves are like sharp short spikes while the adult trees have flattened scale-shaped leaves.. Red cedars produce small cones with one to four seeds each; cedar waxwings are fond of these "berries". On many cattle operations, red cedars encroach upon pastures as the animals avoid them. Tough and tolerant of rocky, sandy and clayey soils and drought and cold, red cedars thrive in adverse conditions.

USDA Hardiness Zone: 2-9

Size: 15- 60 feet

Roots: fibrous and tap

Growth Rate: slow

Light: Prefers full sun. Intolerant to shade.

Moisture: Grows best with moist but well-drained soils, but grows dry rock outcrops to wet swampy land

pH: 4.7-7.8

Silvopasture Uses:

- Windbreak and shelter. Potential as windbreak or living barn, especially in dense plantings; with a bush-like habit, red cedar has strong early presence as a windbreak

Other Uses:

- Timber. Very rot-resistant and therefore good for posts and outdoor projects; as an aromatic wood avoided by moths, it is used in cedar chests and cedar closets. The wood exhibits beauty, durability, and workability. Wood shavings are sold for animal bedding.

resources

- Wildlife shelter and food. Excellent shelter and nest tree for many birds. dense thickets provide good escape cover for deer, and the abundant foliage, although low in quality, provides emergency food for them during times of stress
- Erosion control. Excellent soil stabilization characteristics with a fibrous root system that holds soils in place. Used for soil conservation plantings during the Dust Bowl.

Special Considerations for Growing:

- This isn't a recommendation to plant red cedar. We know many graziers hate the tree. But if you have it, you might as well use it for what it does offer: good cover and windbreak potential.
- Host for cedar apple rust which can spread from cedar to apple. Should be 1,000 feet away from any *Malus* species.
- Bagworms often take up residence on cedars.
- Tends to spread by seeding since deer and domestic ruminants do not prefer to eat young seedlings.

Recommended Resources

Books

Silvopasture: A Guide to Managing Grazing Animals, Forage Crops, and Trees in a Temperate Farm Ecosystem by Steve Gabriel

The Grazier's Guide to Trees by Austin Unruh

Trees of Power: Ten Essential Arboreal Allies by Akiva Silver

Coppice Agroforestry: Tending Trees for Product, Profit, and Woodland Ecology by Mark Krawczyk

The Sibley Guide to Trees by David A. Sibley

Tree Crops: A Permanent Agriculture by J. Russell Smith

Timber Press Pocket Guide to Bamboos by Ted J. Meredith

Articles, PDFs & Webpages

"Temperate Climate Permaculture: plant index"
http://tcpermaculture.com/site/plant-index/

"Perennial Pathways: Planting Tree Crops" by Savanna Institute
https://www.savannainstitute.org/planting-tree-crops/

"Silvopasture Case Studies in North Carolina and Virginia" by Frey and Fike
https://www.srs.fs.usda.gov/pubs/gtr/gtr_srs236.pdf

"The Tree Selection Guide for Mid-Atlantic Silvopastures" by Dana Beegle et al
https://vtechworks.lib.vt.edu/bitstream/handle/10919/87405/Beegle_DK_T_2019.pdf?sequence=1&isAllowed=y

"USDA species profile: *Liriodendron tulipifera"*
https://www.srs.fs.usda.gov/pubs/misc/ag_654/volume_2/liriodendron/tulipifera.htm

"USDA species profile: Pinus strobus*"*
https://www.srs.fs.usda.gov/pubs/misc/ag_654/volume_1/pinus/strobus.htm

“USDA species profile: Juniperus virginiana”
https://www.srs.fs.usda.gov/pubs/misc/ag_654/volume_1/juniperus/virginiana.htm

“USDA species profile: Salix nigra”
https://www.srs.fs.usda.gov/pubs/misc/ag_654/volume_2/salix/nigra.htm

https://www.thespruce.com/eastern-red-cedar-care-guide-7152940