A Basket of Options: Strategies and Opportunities for Integrating Willow into Diversified Farming Operations

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Introduction

Agroforestry, the strategic and synergistic integration of trees and shrubs with crop or livestock operations, is increasingly viewed as a way to enhance the long term viability and resilience of farms (McRae, 2024). For example, it can be a means for diversifying crop production while reducing vulnerability to flood and drought. The main types of agroforestry practices include (*Agroforestry Practices*, 2025):

- **Alley Cropping**: agricultural crops grown simultaneously with long-term tree crops.
- **Forest Farming**: cultivation of high-value crops under the protection of a managed forest canopy.
- **Riparian Forest Buffers**: natural or re-established streamside forests made up of tree, shrub, and grass plantings.
- **Silvopasture**: combines trees with forage and livestock production.
- **Windbreaks**: linear plantings of trees and shrubs to enhance, protect, and benefit people, livestock, and soil and water conservation.

More broadly agroforestry is promoted as a "climate smart" practice (*Climate-Smart Agriculture*, 2025), helping reduce or at least mitigate agriculture's significant contributions toward global climate change (*Climate Change Data | Agriculture*, 2025), e.g. through carbon sequestration. Yet many barriers to successful adoption of agroforestry practices exist. This is especially true for operations producing new types of "tree crops" lacking the knowledge base, support systems, and markets existing commodities enjoy.

Common challenges faced by farmers include a lack of well-established guidelines for selecting from a wildly diverse range of potential species and genotypes/cultivars, and best practices for successfully integrating those into an equally diverse range of (often changing) contexts. Existing agroforestry research is largely concentrated on specific regions/contexts and a narrow range of tree-crop combinations (Choden et al., 2026).

Efforts to simplify this "decision matrix" are frequently focused on identifying ways tree crop cultivar/clone products can be most efficiently grown and exported via commodity markets and supply chains. These systems can end up looking a lot like the extractive, large-scale, capital intensive, monocrop systems they were originally intended to replace, undermining the broader range of potential benefits agroforestry offers to farms and farmers themselves.

One example is the relatively recent focus on the commercialization of shrub willow as a renewable energy feedstock. That includes work led by researchers at Cornell and the SUNY College of Environmental Science and Forestry (ESF) (*Willow Woody Biomass Projects*, 2025). With relatively rapid regrowth these "short rotation coppice" (SRC) crops can produce four to five dry tons (8-10 green tons) of harvestable biomass per acre annually, and can be harvested as often as seven or more times on a three-year cycle using specialized heavy equipment (Heavey & Volk, 2017). Successfully implementing such practices may however require new supportive policies and subsidies to make economic sense for the farmer (Asamoah et al., 2025; Montes et al., 2021), though it may work in some cases where the farmer is able to direct this biomass to on farm energy needs, eliminating off-site transportation costs (Lantz et al., 2014)

Drawing on historical records and traditions, current models, agroecological frameworks, and concurrent field work, this guide is intended to offer something potentially more relevant (or at least complementary) to small and medium scale producers: rather than optimizing for simplicity and efficiency by "scaling up", we suggest an "option by context" (OxC) approach which optimizes for complexity. This method explicitly acknowledges the variedness and changeability of small and medium scale operations, looking at how agroforestry practices can leverage and/or complement their inherent strengths and limitations. More specifically (building off the above example), we look at how and why farmers might select from the "basket of options" offered by a particularly diverse and multi-functional genus, willow (Salix sp.), and integrate them into their own diversified farming operations.

General Characteristics of Willow

Many consider willow to be one of the most versatile and multi-functional plants. Given its fast growth and relative ease of establishment, willow is sometimes mischaracterized as a "weedy" tree. We believe this is an unfortunate misrepresentation of this plant's ability to thrive in diverse and productive agroforestry systems. Most willow species thrive in relatively wet areas and are more tolerant of nutrient poor and polluted soils compared to traditional annual crops. They may even be used to help remediate and regenerate soils and waterways. Willow also has several potentially beneficial nutritional, medicinal, and other biochemical properties.

Willows also offer a wide variety of ecological benefits. Their flowers provide one of the earliest spring sources of nectar and pollen for insects; birds eat the catkins and buds; leaves are a larval host for hundreds of butterfly and moth species; deer, muskrats, beavers, rabbits, and other animals eat the twigs; and several species nest in the trees' soft trunks.

The willow genus (Salix) is incredibly diverse and multi-functional as it contains 450 recognized species worldwide with over 100 in North America alone. (Argus, 1997). Willows also exhibit a great deal of genetic and phenotypic diversity within each species. Further enhancing this diversity (and adaptability), willows are dioecious (separate male and female plants/flowers) and obligate outcrossers (it must cross-pollinate with another individual), with a tendency toward polyploidy (having more than two complete sets of chromosomes). This all leads to willows readily hybridizing with other willow species, with offspring often exhibiting greater "hybrid vigor" and growth than their parental lines (a focus of many biomass breeding projects). This inter, intra, and cross-specific variability presents both challenges and opportunities for farmers and those who support them.

Historical Uses of Willow

Historically willows (Salix sp.) have been some of the most valuable plants for humankind due to their multiple uses. Their use has been well documented throughout history (Kuzovkina et al., 2007).

Willow extracts were used as analgesics (substances that relieve pain) and a variety of other medicinal purposes (for human and non-humans) well before the synthetic production of aspirin. Readily available with desirable properties like flexibility, durability, and low weight, willow has been used to craft a variety of necessities including furniture, snowshoes, arrow shafts, fish traps, whistles, nets, cordage, fences, and even shelters. The unique ornamental characteristics of willow has found its way into cultural expressions around the world, represented in paintings, pottery, legends, and poetry.

One the most artistic and functional uses of willow have been for creating baskets. The use of willows for containers, probably among the first handicrafts, played a major role in the advance of early human culture (Li, 1963).

In *Medicinal and other uses of North American plants: a historical survey with special reference to the eastern Indian tribes* (Erichsen-Brown, 1989), Charlotte Erichsen-Brown provides a highly detailed chronological compilation of historical references to the many ways willow was used by Native American tribes and early white settlers, as far back as the fourteenth century. Species identified include Salix nigra, S. interior, S. lucida, S. bebbiana, S. discolor, S. humilis, S. exigua, and S. petiolaris. Branches of willow were used to make a variety of items, including snowshoes, baskets, fishing nets, bows, and cordage.

In their study of the “worthful willow” in the Himalayan regions of Kashmir and Ladakh, (Malik et al., 2020) document the many current and historical uses of at least 18 different species of willow in an area with a relatively high diversity of willow species. Their study was “designed with the sole purpose of eliciting the precious wealth of information on the uses of Salix plants practiced by the indigenous people of the study area.” What they found was a wide array of practical and medicinal uses, with demand (and loss) outstripping replacement. And while there was still some familiarity with the methods and practices associated with these uses, there was no guarantee those would be passed on and practiced by future generations without a concerted effort focused on commercial propagation and regeneration of existing stands.

In his paper *Willows in the farming landscape: a forgotten eco-cultural icon* (referring to the British countryside), Ian Rotherham (Rotherham, 2022) writes:

> *Recent studies have revealed a largely forgotten rural landscape in which Salix (willow) species were a characteristic, iconic, and utilitarian feature...*
>
> *Remnant upland willow woods (now present as ‘shadow woods’) exist as isolated remnants in small wet habitats in an often desiccated landscape fragmented and drained. In the lowlands, especially former fenland areas, willows were present in extensive wet (carr) woodlands and in cultivated beds of withies or osier holts, and as coppices and pollards on boundaries and in field edges across the countryside… Today these once extensive and important landscapes are mostly forgotten and derelict; and furthermore, the eco-cultural resource of the willows is currently under threat with unrecorded veteran trees being actively removed by farmers.*

Steps are suggested for stopping and ideally reversing this trend, building off the region's biocultural heritage while addressing shared concerns around flood risk, biodiversity loss, erosion control, and climate change resilience. That includes:

- Engaging local communities and raising awareness amongst stakeholders
- Conducting a census of veteran or ancient willows in the area
- Locating “lapsed” pollarded and coppiced willows, and suggesting possible management options to reinvigorate these trees and bring them back into productive use

Despite its well established use over many centuries, cultivation of willow as a cash crop didn’t really begin until around 1800 (Kuzovkina et al., 2007) perhaps partly because of sufficient native sources. As demand for baskets grew, the need for husbandry practices that produced reliable quantities and qualities resulted in the development of novel cultivation practices in Europe. European immigrants soon brought these practices to the eastern United States by the 1840's (Hubbard & Chittenden, 1904).

The Second Industrial Revolution and growing importance of agricultural commodities resulted in an even greater need for willow baskets, further driving science-based innovations related to the breeding and cultivation of willow. World War I added to this demand, where willow baskets were used for carrying food, medical supplies and even artillery shells. However, by the 1930s this demand rapidly declined and was replaced by plastic alternatives (Li, 1963).

Today, interest in willow and other renewable non-petroleum based material stocks is again growing. Historical and ethnographic studies like those referred to above offer some insight into the social, economic, and cultural aspects required for this transition, including the development of complex processing and supply chains.

Some of this interest is again being driven by commodity markets, e.g., identifying, breeding, and cultivating fast growing shrub willows as a renewable source of biomass for energy and carbon markets. Initiatives like the previously mentioned Cornell University / SUNY ESF (*Willow Woody Biomass Projects*, 2025) provide a wealth of information for those interested in pursuing these more industrial scale approaches. With that said, large scale industrial and commercial production should be approached with caution given the past boom and bust cycles as well as the historic corporate capture of agricultural commodity markets. This is especially important to consider when management decisions involve long term commitments of land and other resources to perennial cropping systems.

Though still relatively new from a scientific standpoint, there is also growing interest in how willows might (once again?) become an integral and multi-functional part of farming landscapes, supporting their long term health and resilience. In the next section we introduce approaches for helping decide how, when, and where willow might be incorporated into farm operations.

A Basket of Options - Matching Willows Gifts (and Challenges) with Your Needs and Context

There are a great number of factors to consider when deciding why, if, and how one might incorporate willow into their farming operations. The answers to these questions are always context dependent. A few questions to consider include: What assets does a farmer have to draw on, whether they be financial, intellectual, labor/time, equipment, or from the land itself? Are there areas of your farm which are currently underutilized or underperforming? Are there areas which might benefit from regenerative practices, like those associated with agroforestry (Elevitch et al., 2018)? Are there opportunities for linking and leveraging a farm's combined assets or those of multiple individuals and enterprises within a region, for mutual and collective benefit? Gaining clarity around these types of assessments can help a farmer decide whether willow might be a net gain or burden on their farm, (perhaps avoiding the solution in search of a problem trap).

Willows have many traits that make them particularly useful as agroecological technologies. As an ally species with a broad genetic base and high stress tolerance, willows are able to establish and rapidly grow in a broad range of climates and site conditions, including harsh sites. They are easy to vegetatively propagate (see below), have a long vegetative season and are tolerant of high planting densities, with the ability to regenerate from stools after multiple harvests. Their diffuse fibrous root systems and high tolerance of saturated soils make them a valuable flood and erosion control technology..

Ecosystem Services

One way of assessing the potential benefits of a plant or practice is the concept of "ecosystem services". Beginning in the late 20th century the focus of willow plantings has shifted toward an emphasis on these kinds of services (Isebrands & Richardson, 2014).

According to the USDA (*Ecosystem Services | USDA Climate Hubs*, 2025):

> *Ecosystem services are the direct and indirect benefits that ecosystems provide humans. Agroecosystems, rangelands, and forests provide suites of ecosystem services that support and sustain human livelihoods. These services are typically broken down into four categories:*
>
> ***Provisioning services**: the material or energy outputs from an ecosystem, including food, forage, fiber, fresh water, and other resources*
>
> ***Regulating services**: benefits obtained through moderation or control of ecosystem processes, including regulation of local climate, air, or soil quality; carbon sequestration; flood, erosion, or disease control; and pollination*
>
> ***Supporting services**: services that maintain fundamental ecosystem processes, such as habitat for plants and wildlife, or the maintenance of genetic and biological diversity*
>
> ***Cultural services**: the non-material benefits that ecosystems provide to human societies and culture, including opportunities for recreation, tourism, aesthetic or artistic appreciation, and spirituality*

Agroforestry is increasingly recognized as a practice that can provide a wide variety of ecosystem services. The book *Agroforestry and Ecosystem Services* (Udawatta & Jose, 2021) provides a detailed compilation and synthesis of information from experts around the world. That includes highlighting several temperate **ecosystem services potentially provided by willow: erosion control, silvopasture/fodder, windbreaks, early spring pollinator support, runoff filtration/sequestration/evapotranspiration, and riparian buffer.**

Payments for Ecosystem Services (PES)

Various attempts are now being made to monetize these benefits through what is sometimes called Payments for Ecosystem Services (PES) ("Payment for Ecosystem Services," 2025a). These can come in the form of incentives offered to farmers or landowners in exchange for managing their land to provide some sort of ecological service. While there may be some tradeoffs in terms of productivity, in some cases government payments for ecosystem services might result in minimal impact on the rates of return from farm land (Livingstone et al., 2023).

Many existing PES programs, mostly focused on carbon (see Carbon Credits below), are primarily focused on large farms, charging verification fees while not ensuring the participation of BIPOC or beginning farmers. The Finger Lakes PES Pilot Program run by Cornell Cooperative Extension of Tompkins County is one example of a program which seeks to make this form of support available to a greater diversity of farmers (*Payment for Ecosystem Services*, 2025b).

Ecological Engineering

One way of categorizing willow's potential uses is as an "ecological engineering" tool. Ecological engineering "applies ecology and engineering to predict, design, construct or restore, and manage ecosystems that integrate human society with its natural environment for the benefit of both" ("Ecological Engineering," 2025). Kuzovkina & Volk (2009) describe some of the essential characteristics of Salix varieties related to ecological engineering and particular applications. They identify "thirty six agronomical, physiological, and ecological attributes of willow that provide a framework for species selection and assist in the identification of site-specific functional types of willows for land reclamation, phytoremediation (removal of pollutants), bioengineering, and agroforestry." Some of these applications are highlighted below.

Hedgerow/Windbreak

Willow can be well suited for windbreaks, living snow fences, hedgerows, or shelterbelts, given its ability to form tall and dense stands quickly. Varieties used should be able to attain heights needed for protection, produce high shoot and branch density, have high wildlife and ornamental value, and have some potential for value-added products (Kuzovkina & Volk, 2009). Properly constructed and oriented such structures can provide some level of protection from wind erosion.

Erosion Control

Willows are also well suited to protect slopes, streambanks and shorelines against water erosion. Willow's ability to readily resprout from nodes along the length of a branch allow horizontal application of stems or woven mats. Varieties suitable for these projects should have extensive root systems, allow clonal propagation, be tolerant of drought and heat (as well as flooding), and have low palatability.

Runoff filtration

Willow's ability to affect the movement and uptake of water offers other potential ecosystem services as well. Most Salix species have high water and evapotranspiration demands, though those rates vary between genotypes. This corresponds with willow's ability to move water back into the atmosphere which is valuable in flood zones. Combined with high nutrient uptake and nitrogen, varieties with these characteristics can help filter and sequester pollutants (Kuzovkina & Volk, 2009). There may be some tradeoffs between erosion control and pollutant uptake for low nutrient/degraded sites.

Other potentially relevant traits (also varying between varieties) include a resistance to chemical contaminants, resistance to carbon dioxide and methane in the root zone, tolerance of soil compaction. Oxygen transfer to the root zone may be another desired species specific trait (e.g., for poorly drained/waterlogged sites). Willows can be classified as alluvial, requiring well aerated substrate, and non-alluvial—tolerating stagnant water for prolonged periods of time (Skvortsov, 1999). For example, Salix nigra, S. amygdaloides, S. exigua, and S. eriocephala commonly occur in riparian habitats, while S. discolor is a non-riparian species with less exacting requirements for soil aeration (Argus, 1986).

Carbon Sequestration

Concerns about climate change and rising atmospheric carbon levels have raised interest in willow as a potential tool for removing and ideally sequestering carbon from the atmosphere. Decades of research related to the use of willow as an energy biomass crop are proving useful in this inquiry According to SUNY ESF researchers (*Research Summary: Sequestration of Carbon by Shrub Willow Offsets Greenhouse Gas Emissions – Farm Energy*, 2019), even when coppiced, shrub willow provides a large sink for sequestering carbon below ground, more than offsetting the GHG emissions in all eight management scenarios studied.

Carbon Credits

Similar to payment for ecosystem services, efforts are now being made to quantify, incentivize, and monetize those carbon sequestration services as "carbon credits" ("Carbon Offsets and Credits," 2025), though not without controversy (Mishra, 2024).

Building Soil Health

Currently, growing shrub willow in marginal areas is significantly more cost effective than growing on premium farmland suitable for cash crop production (*Perennial Bioenergy Crop Growing Guide - Shrub Willow*, 2025). Farmers interested in improving their farm's soil health function, water quality and overall productivity might consider growing shrub willow to improve those conditions on such land. Many of the ways willow can improve soil health have already been touched on, including phytoremediation (removal of pollutants), wind and water erosion prevention, building up of organic matter/carbon, aeration and decompaction.

Like the vast majority of other land-based plants, willows are able to form associations with mycorrhizal fungi. That includes beneficial associations with arbuscular mycorrhizal (AM) and ectomycorrhizal (EM) fungi (Parádi & Baar, 2006). These can be essential for successful restoration of degraded soils and ecosystems, providing essential and often limited nutrients to plants in exchange for carbon. This can provide a variety of immediate benefits to soil health as well as the stage for later tree succession by providing later crops with compatible fungal symbionts (Nara, 2006; Trowbridge & Jumpponen, 2004).

Trees which rely on AM and EM simultaneously can serve as what Michael Phillips has called "mycorrhizal bridge trees", acting as a conduit for nutrient exchange between different fungal species and other plants. According to Phillips (Phillips, 2017) pg. 152-154:

> *The root systems of fast-growing trees with relatively pliable wood make barter possible between AM and EM fungi. Alder, aspen, cottonwood, poplar, and willow are chief among the bridge trees that take orchard health to an entirely new level…*
>
> *Mycorrhizal bridge trees can be integrated into the orchard environs from relatively afar, given the reach of roots and the ectomycorrhizal half of the equation, perhaps as much as several hundred feet. The interconnecting mycelia shared among arbuscular understory plants between bridge trees and fruit trees are vital to making a more global connection possible.*

Mulch

In addition to serving as a biomass source, chips generated from short rotation coppice willow can also be used as a high quality regenerative source of "ramial chip" mulch. There is a well established body of evidence indicating the benefits of this material generated from small diameter (<3") branches, providing a more balanced C:N ratio and other essential nutrients (Caron et al., 1998; "Ramial Chips," 2003). Phillips refers to the many benefits of this material throughout his book Mycorrhizal Planet (Phillips, 2017), calling it an ideal mulch and compost input, helping build the fungal component of soils (especially important for woody perennials).

Biochar

Another potential use of willow chips as a contributor to soil health is biochar. Biochar is a charcoal-like substance made by pyrolysis, a process of heating biomass with limited to no oxygen. As a stable carbon-based compound that takes thousands of years to decompose, it can provide climate benefits by sequestering carbon in the soil (*Digging into Biochar | USDA Climate Hubs*, 2025).It has been used in agriculture for more than 2,500 years, and shown to improve a variety of soil physical, chemical and biological properties (e.g., bulk density (BD), cation exchange capacity (CEC), pH, microbial diversity and activity, etc.), enhancing agronomic productivity. (Hangs et al., 2016) document these, with their own study showing that "a willow biochar soil amendment improved several physical, chemical and biological properties, while decreasing net N2O (nitrous oxide) emissions and increasing CH4 (methane) consumption, along with mitigating the effects of fertilizer N addition on different soil properties".

Propagation Medium and Aid

In addition to several contributions to soil health, willow also holds promise as a potting medium and propagation aid. There is increasing interest in substituting (or reducing) mined peat moss with renewable and sustainable alternatives. Research shows that willow compost may be a viable alternative for some contexts. One study of vegetable transplants (Adamczewska-Sowińska et al., 2022) showed that 25 - 50% of peat mass can be replaced by willow composts without having an adverse impact on seedling growth. Another study (Adamczewska-Sowińska et al., 2021) found that adding wood-decaying mycelium to compost further enhanced results.

Willow extracts are also known to contain many bioactive compounds, including salicylates, phenolics, and Indolebutyric acid (IBA). The latter is known to promote rooting. Though some have found the results inconsistent (Dirr & Heuser, 2006), a "willow water" extract made from willow twigs steeped in boiling water (sometimes mixed with honey and/or cinnamon) can help in rooting some types of vegetative cuttings. In another study, (Mutlu-Durak & Yildiz Kutman, 2021) seed treatment with salicylic acid and willow extract increased the shoot fresh weight of maize seedlings 130% and 225%, respectively. Root areas were enhanced by 43% with SA and 87% with willow extract applications. These extracts also increased leaf protein concentration and reduced the negative effects of salinity during early growth.

Successional Planting

As a pioneer species, willow is well suited as a successional planting tool. The initial protection from wind and sun, along with its soil holding and building capacities, can provide the conditions needed for higher economic value, longer term crops to establish, including other tree crops. Shrub willow varieties bred for bioenergy use are sterile and do not spread naturally, so they may be particularly well suited as a successional crop (*Perennial Bioenergy Crop Growing Guide - Shrub Willow*, 2025).

Potential Agroforestry Practice Applications

Alley Cropping

Alley cropping, growing crops between rows of trees or shrubs, works best when there are complementarities between the two. For example, trees or shrubs might help reduce wind or solar intensity for crops needing protection from either. There may also be additional complementary benefits regarding resource partioning (e.g., non-overlapping needs in terms of soil nutrients or strata). That said, Willow can present some challenges when attempting to grow it within such a system, given its fast growth, spreading root systems, and high nutrient and water use. This can lead to greater competition for resources compared to other trees or shrubs.

One alley cropping agroforestry trial (Koch et al., 2025) compared yields within three different alley cropping agroforestry systems (willow short-rotation coppice, walnut trees, and diverse hedgerows) growing five winter crops (winter wheat, triticale, winter barley, winter pea, and rapeseed). The willow short rotation coppice plots had yield levels significantly lower closest to the tree rows, similar to other studies cited. Increasing yields farther away was attributed to reduced competition for light, nutrients, and water, with crops still benefiting from some sheltering effects.

Silvopasture

The USDA (USDA Forest Service, 2025) defines silvopasture as

> *The deliberate integration of trees and grazing livestock operations on the same land. These systems are intensively managed for both forest products and forage, providing both short- and long-term income sources…*
>
> *Silvopasture systems are created by introducing forage into a woodland or tree plantation or by introducing trees into a pasture. Rotational grazing is a key management activity when using silvopasture in order to minimize damage to trees.*

Fodder

The concept of tree fodder is an intriguing and exciting aspect of a holistic grazing system that can both benefit livestock grazing systems as well as meet environmental goals for small farms in the Northeast. Tree fodder blocks are dense plantings of trees that provide a strategic reserve of fodder for excessively dry, drought, or even overly wet conditions. Many species can be utilized, but Willow (Salix spp.) and Poplar (Populus spp.) are common staples.

With climate change emerging as a central challenge to maintaining good grazing forages for livestock, trees offer a critical solution to a future climate that is more and more unpredictable. One season may be excessively dry, and the next excessively wet. This leads to a lack of quality forage from traditional grass/legume/forb stocks, and unmanaged waterways (riparian zones) that can flood pastures with excess water, sediments, and lead to erosion of these valuable pasturelands. Adding trees to grazing systems (silvopasture) can provide shade, shelter, an alternative food source as well as buffer many of the water issues present in farms throughout the Northeast.

Growing tree fodder is already an established strategy in varying climates around the world (such as New Zealand and parts of Asia and Africa) that experience more challenging (excessively wet and dry) environments when compared to the historic trends in the Northeast. They are a clear strategy for increasing the stock of reliable food sources for animals in both wet and dry seasons, as woody plants and trees tend to be better adapted to these variable conditions.

For more details regarding use of willow as fodder see the SARE project reports from our earlier work (*Establishing Willow and Poplar Tree Fodder Blocks for Resilient Livestock Feed and Flood Mitigation in a Silvopasture Riparian Buffer - SARE Grant Management System*, 2025).

Shade and Shelter

Another potential benefit of willow plantings for livestock is the shade and shelter they can provide. These benefits are increasingly important to their well-being and farmers' bottom line (Unruh, 2022) as the climate warms and the frequency of extreme weather events increases. This requires optimizing the species, shade canopy and orientation of such plantings for specific contexts, timings, and production systems.

Trees for Graziers (https://treesforgraziers.com) is an excellent source of information related to this topic and silvopasture more broadly. As part of their SARE funded *SilvoPro: A Training Program for Silvopasture Professionals* project (*SilvoPro: A Training Program for Silvopasture Professionals - SARE Grant Management System*, 2025) they've developed a *Silvopasture Tree Species Profiles* fact sheet offering recommendations related to willow and many other species. For silvopasture, they suggest tree-form willow species for fast shade, and shrub-form species if you want to create low windbreaks or coppiced browse.

There are also several examples of tools intended to support decision making related to this, including the Shade Tree Advice tool (Wolf et al., 2017), Tree Advisor (Bentrup & Dosskey, 2022), and AgroforesTreeAdvice (Gosme et al., 2025).

Riparian Buffers

Many farms have neglected and/or ignored riparian (water) pathways that would benefit from buffer plantings. Utilizing willow in these riparian zones has the potential for a variety of win-win scenarios that benefit the farm, larger farm ecosystem, and the global climate.

For livestock operations, riparian buffers can also serve as tree fodder blocks, providing productive vegetation for livestock while also protecting the water way. These areas often border pasture lands and if strategically developed, can provide an easily accessible source of fodder just outside the fence line. In these cases, palatability and nutritional quality would play a more important role in variety selection.

Willow Propagation, Establishment, and Management

While many of the values of willow itself are well documented in research, processes for effectively establishing meaningful plantings on Northeast farms is relatively unknown. Questions remain about cultivar selection, seedling development, layout design, soil prep, planting, and protection of young seedlings, including those intended to provide reliable tree fodder for the farm.

Even while agroforestry practices like silvopasture are well documented as providing benefits to farm ecosystems and the productivity of livestock, adoption remains low. This is in part due to farmer unfamiliarity with tree planting and establishment, and alsobecause there is too much risk in experimenting with strategies to ensure an investment in trees pays off. Moreover, while techniques are well established for individual tree planting, there are not well-articulated but flexible processes for establishing tree plantings for specific needs and contexts. The Northeast needs “turnkey” solutions for tree establishment that can work in many farm contexts, leveraging available labor and materials most efficiently.

Field work associated with this project aims to test several pathways to success and report back on the best practices for:

- Developing farm-based propagation facilities and capacities
- Establishing and maintaining farm plantings, including tree fodder blocks

Propagation Techniques

Vegetative Cuttings

As mentioned earlier, willow can be easy to propagate. With sufficient water and light, most cuttings readily root. A few varieties like Salix bebbiana (Bebb's willow) or Salix humulis (Prairie willow) may be more challenging to root cuttings. The easiest method is to harvest hardwood cuttings approximately 7-10” in length and ½-1” thick during the winter dormant season, then planting them directly in the ground (or pots) with at least 1 or 2 nodes above ground level. No rooting hormone is needed, but bottom heat can help if rooting in pots. It is important to maintain orientation when planting cuttings so that the leading/upper end of a branch is pointing up. Larger/longer stakes can also be planted to give plantings an even better head start. New plantings may need to be initially protected from grazing. Softwood cuttings can also be rooted under a moist peat/perlite mix.

Seed

Starting willow from seed may be desired for harder to root species like Bebb’s, or if genetic diversity is desired (rooted cuttings are clones of their parent). As one starting point, the Native Plant Network provides detailed protocols (*Propagation Protocols — Reforestation, Nurseries and Genetics Resources*, 2025) for both vegetative and seed propagation, including several native willows. Their recommendations for Bebb’s willow includes the following:

Propagule Collection: Identification of female plants, and frequent observation of catkin development. Harvest typically coincides with the appearance of cotton emerging from partially opened capsules. The female catkins are placed in paper sacks to capture seed as the capsules open during drying.

Propagule Processing: Salix seed can be cleaned using an air stream and a series of soil screens. A jet of compressed air is blown through the top screen in a swirling fashion; the seed is dislodged and separated from the cotton and empty catkins remaining.

Pre-Planting Treatments: No stratification needed. Sow cleaned seeds as soon as possible after collection.

Growing Practice: The very small size of Salix seed (about 1 mm in length and 0.3 to 0.5 mm in width) makes precise seed dispersal difficult (in trays, pots or plugs). The addition of diluent (e.g. grit, perlite) of similar size might be of some benefit in achieving more precise sowing by hand. The germination medium is a standard sphagnum peat moss and perlite mix of fairly coarse texture, allowing optimum aeration, moisture, and light. The surface must be kept continuously moist and germination of willow seed is often visible after one or two days. This can be observed by the swelling and separation of the cotyledons. During winter, maintain greenhouse temperatures of 70 F during the day and 55 F at night. Thinning of seedlings will be required and is usually performed at the time of transplanting into the next container size.

Sourcing Plant Propagules

If one has legal access to existing plants, cuttings can be taken (as described above). Note that willows are dioecious, with separate male and female plants. If you are harvesting your own cuttings it is useful to first identify the sex of your source materials (e.g., if future seed production is desired).

Known cultivars/clones may however be more desirable for greater predictability of performance (and sex). These can be in the form of cuttings (rooted or unrooted), rods, bare root plants, or potted plants.

Potential sources include:

Ramo, the largest willow producer in North America (https://ramo.eco/en/planting-and-supply/), Trees for Graziers (https://treesforgraziers.com/trees/)

Wellspring Forest Farm (https://wellspringforestfarm.com)

Vermont Willow Nursery (vermontwillownursery.com/)

Edible Acres (https://www.edibleacres.org/)

Twisted Tree (https://www.twisted-tree.net/scionscuttings-1/willow-and-poplar)

Cold Stream Farm (https://www.coldstreamfarm.net/product-category/deciduous-trees/willow/),

Fedco (https://fedcoseeds.com/trees-and-shrubs/willows).

We look forward to continuing this research and exploring the wonderful world of willow as it continues to be a benefit for farms, landscapes, and animal wellbeing.

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