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Agroforestry Demonstration Planting

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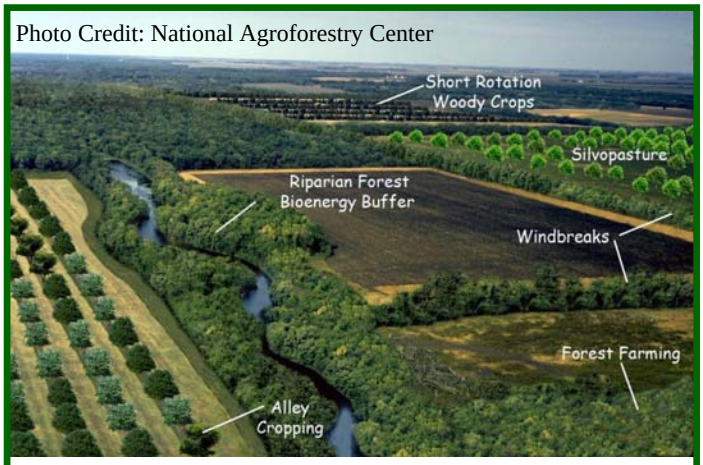
A New Kind of Agriculture

Agricultural researchers and policy-makers are currently facing the daunting task of figuring out how to feed the world's population, which is expected to grow to 9 billion by 2050. One piece of the puzzle will be figuring out how to increase yields from a limited land base while also protecting soil and water quality, wildlife habitat, and all the other ecosystems services we get from healthy landscapes.

One option being explored is agroforestry, which is a form of agriculture that mixes woody perennials (trees and shrubs), perennial and annual herbaceous crops (grasses, forbs, vegetables, etc.), and, sometimes, livestock in carefully planned systems. In theory, such systems could potentially be more productive than single-species annual crop systems due to the important ecological concept of niche space utilization. Furthermore, such mixed species plantings could potentially have higher productivity with fewer inputs and improved ecosystem services.

Photo Credit: National Agroforestry Center



Agroforestry has the potential to increase the productivity of our agricultural lands while doing a better job protecting soil and water quality. Shown here is a computer-generated graphic showing how different agroforestry practices could be deployed on the landscape.

A field of annual crops is typically only green and capturing the sun's energy for a few short months during the summer. The rest of the year there is nothing growing and the sun's energy is wasted. A forest or perennial grassland, however, is green from bud-break in the spring well into November. Furthermore, with a diversity of species, a forest or grassland has plants with different rooting depths and canopy heights meaning more of the available growing space is being utilized. The challenge, going forward, is to integrate the productivity and ecosystem function of a natural forest or grassland into agricultural systems that produce the food and energy we need. Agroforestry practices attempt to do just that.

The Agroforestry Demonstration Planting established in 2013 at the Northern Great Lakes Visitor Center in Ashland, WI is a modified windbreak design that uses improved cultivars of native species to provide economically valuable food and biomass. Deployed on a larger scale, such a planting could offer improved soil and water quality while generating food and energy for consumers and revenue for producers.

Over the coming years the planting will be used to generate performance data on the food and biomass species included in the planting as well as an opportunity for growers and the public to see agroforestry first hand.

A computer simulation of what the Agroforestry Demonstration Planting will look like in 2018.

Windbreaks: New Life for an Old Practice

Windbreaks are an old practice with many useful functions. By slowing wind speeds, a windbreak can reduce heating costs in buildings, shelter livestock to reduce feed costs, reduce wind-driven soil erosion, and reduce moisture loss from cropland. Windbreaks can also manage snow deposition to keep it off parking lots and roadways. Windbreaks can also act as a noise or visual screen and provide wildlife habitat. Unfortunately, windbreaks have fallen out of favor as farm equipment has gotten bigger and because many of the early windbreaks were planted with species with limited economic value. With the right species and design, however, a windbreak can not only save money but generate revenue through sale of products such as biomass, fruits, nuts, or decorative floral products.

There are many variations to windbreaks, but generally a windbreak is oriented lengthwise perpendicular to the prevailing winds and includes a mix of shrubs and trees to break the wind. Snow will drop in areas where wind speeds fall. Typically, this occurs on the leeward side of the windbreak, but by adding shrubs to the windward side (as is done with the Agroforestry Demonstration Planting), snow will be deposited in this area first, leaving the leeward side relatively free of snow.

Unlocking The Potential of Native Species

Increasing agricultural productivity while reducing inputs and enhancing ecosystem services could be realized through development of new crops, particularly new crops from species native to a given region. Native species are typically adapted to the climate, soils, and pests of the region, and thus, may not require the same level of fertilizer or pesticide inputs. Blueberries, raspberries, and cranberries are all native to the Lake Superior region and all have become important crops. There are a number of other species native to the Lake Superior region with potential, but like the berry crops, will require breeding and possibly crossing with related, but non-native species, to reach their full potential. Some emerging new crops native to the Upper Midwest featured in the Agroforestry Demonstration Planting include hazelnuts, willow, and aronia.

Hazelnuts

There are two species of hazelnut native to the Lake Superior region: American hazelnut (*Corylus americana*) and Beaked hazelnut (*Corylus cornuta*). American is typically found on the lighter soils in full or partial sun, while beaked hazelnut is more often found on heavier soils in the understory of a mature forest. Although both species can produce large nut crops, the nuts are typically small with very thick shells and small kernels. Nearly all commercial hazelnut production is from European hazelnut (*Corylus avellana*), which doesn't survive the harsh winters of the region and is lethally susceptible to a native fungal disease called Eastern filbert blight (EFB).

The Upper Midwest Hazelnut Development Initiative is a collaboration of researchers and growers working to develop a commercial hazelnut industry in the Upper Midwest. The Agroforestry Demonstration Planting includes a germplasm trial to evaluate advanced selections of hazelnuts.

Researchers with the Upper Midwest Hazelnut Development Initiative (www.midwesthazelnuts.org) are working to develop commercially-viable hazelnut cultivars for growers in the Upper Midwest by: 1) Screening wild populations of American hazelnut for high-yielding and large-nut plants, and 2) Evaluating progeny from crosses between European and American hazelnut selections (hybrids). The Agroforestry Demonstration Planting includes promising early selections to determine which ones are worthy of further evaluation in on-farm trials. Hazelnut is a particularly exciting new crop, as the oil is heart-healthy and makes a superior feedstock for biodiesel. As such, hazelnut could be the first perennial oilseed crop for the Upper Midwest.

Willow

Both tree and shrub willow (*Salix spp*.) are found throughout the Lake Superior region, especially on the heavy wet clay soils. Willow is fast-growing and tolerates frequent harvest. University researchers in New York have been breeding willow for many years with the goal to develop willow into a biomass crop that farmers and landowners can grow to produce and sell wood chips for wood boilers. Known as "willow grass" the willow is grown for three years and harvested with a modified corn chopper or bio-baler. Because it re-sprouts vigorously, harvests can continue every three years for at least 30 years. The idea is to deploy willow in windbreaks, living snow fences, or riparian buffers on agricultural lands as a way to improve soil and water quality.

Willow is a perennial woody plant with potential as an energy crop that also improves soils and water quality when strategically deployed on agricultural lands.

The Lake Superior Woody Biomass Trials were established in 2010 by UW-Extension at three sites in the region including at the Agriculture and Energy Resource Center a few miles from the Northern Great Lakes Visitor Center. The purpose of the trials is to evaluate various cultivars of woody biomass crops and to demonstrate their production to growers. As part of that effort, three improved cultivars and two native species of willow are included in the Agroforestry Demonstration Planting. As part of the windbreak they will collect snow on the windward side of the planting.

Aronia

Black chokeberry (*Aronia melanocarpa*) is a fairly large shrub typically found on wetter soils in the Lake Superior region. It produces large clusters of black berries. With very high levels of antioxidants and flavonoids, it is catching on as a healthy new berry crop. It has a strong flavor and is typically not eaten fresh, but instead is used to make juices, jams, and baked goods. Early-adopter growers are using the name Aronia (who wants to eat a black chokeberry?) as they put in plantings and market the berries. The Midwest Aronia Association (www.midwestaronia.org) is a good source of information about this emerging crop. One of the challenges of developing new crops is building market acceptance. To generate the kinds of new crops needed to improve agricultural ecosystems, it will be necessary for consumers to be willing to try new things and learn to use fruits such as aronia in their daily meals.

Aronia has significant potential, but will require perfecting the production systems and building the market.

The Agroforestry Demonstration Planting includes two released cultivars, Nero and Viking. As with the other fruit-producing shrubs, they are planted on the leeward side of the windbreak and are mixed with fruit trees. As such, they provide the shrub layer to the windbreak and should generate an economically viable crop for producers. The project coordinators will be measuring yields over the coming years while also evaluating compatibility and function in the windbreak.

A Learning Resource for All

The purpose of the Agroforestry Demonstration Planting is both to demonstrate agroforestry, and specifically the practice of windbreaks, but also to evaluate the production potential of a range of food and biomass species. A series of field days and workshops will be held over the coming years to share research data. In addition, Research Bulletins and other written publications will be available through the Bayfield County UW-Extension website: www.bayfield.uwex.edu.

Plants Included in the Agroforestry Demonstration Planting

Woody Biomass Species

Willow (Salix spp.) *is native to North America, but interspecifc crosses (hybrids) are used to produce faster growing plants for use as wood chips in bioenergy applications. The willow in the Agroforestry Demonstration Planting will catch snow on the windward side of the planting and be harvested as a biomass crop.*

Poplar (Populus spp.) *are native to North America, but interspecifc crosses (hybrids) are used to produce faster growing plants for use as wood chips in bioenergy applications. The cultivar NM6 is included in the Agroforestry Demonstration Planting as the tall tree species.*

Fruit Tree Species

Plums (Prunus domestica). *Plums are native to North America, but interspecific crosses (hybrids) are used to produce larger and better tasting plums.*

Apple (Malus domestica). *Apples are native to central Asia, but are naturalized throughout the United States. In the Agroforestry Demonstration Planting, apple will occupy an overstory canopy position within the fruit rows on the leeward side of the tall tree break.*

Fruit and Nut Shrub Species

Juneberries (Amelanchier spp.). *Juneberries, also known as Serviceberries are native to North America. The fruits are dark purple and similar in size and flavor to blueberries.*

Black Chokeberry (Aronia melanocarpa). *Chokeberries, or more commonly known as Aronia, are native to the Eastern United States. Their berries are tart but make excellent jams and jellies and can be used in value-added foods. In the Agroforestry Demonstration Planting, Aronia is used as a tall shrub in the fruit rows on the leeward side of the planting.*

Fruit and Nut Shrub Species, cont.

Hazelnut (Corylus spp.) *is native to the region and typically found on sandy soils. Although productive and hardy, American hazelnut typically produces small nuts with thick shells. Crosses with European hazelnut (Corylus avellena) are being trialed in this project to find genotypes that produce well on the heavy clay soils of the region.*

Currants (Ribes spp.). *Currants are native to our region and produce healthy and flavorful berries. The improved varieties included in these trials are immune to white pine blister rust, are tolerant of a wide range of soils, and are not preferred deer browse. In the planting they are included as the shrub layer in the fruit rows.*

Common Name	Varieties	Species Name
Biomass Species		
Hybrid Poplar	NM6	Populus nigra X Populus maximowiczii
Fantail Willow	SX 61	Salix sachalinensis
Basket Willow	Fish Creek	Salix purpurea
Hybrid willow	Canastota	Salix sachalinensis x Salix miyabeana
Pussy Willow	native	Salix discolor
Sandbar Willow	native	Salix exigua
Fruit and Nut Shrub Species		
Hybrid Hazelnut	experimental	Corylus americana x Corylus avellana
Aronia	Viking, Nero	Aronia melanocarpa
Juneberry	Northline, Smoky, Honeywood	Amelanchier alnifolia
Black Currant	Titania, Ben Sarek	Ribes nigrum
Red Currant	Rovada, Blanka	Ribes rubrum
Tree Fruit Species		
Plum	Black Ice	Prunus besseyi x Prunus salicina
Plum	Toka, Pipestone, Mount Royal	Prunus domestica
Apple	Honeycrisp, Sweet 16, Redfree, Spartan	Malus domestica

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USDA National Agroforestry Center

Upper Midwest Hazelnut Development Initiative

UW Extension

Northern Great Lakes Visitor Center

WEST

Agroforestry Demonstration Project

Planting Key

Pm = Plum 'Mt Royal'
Pp = Plum 'Pipestone'
Pt = Plum 'Toka'
Pb = Plum 'Black Ice'
As = Apple 'Sweet 16'
Ar = Apple 'Red Free'
Ah = Apple 'Honeygold'
Ah = Apple 'Honeycrisp'
P = Poplar 'NM6'
C4 = native conifers in 2014
O = open

H = hazelnut
Ht = Hazelnut trial
Av = Aronia 'Viking'
An = Aronia 'Nero'
Ss = Serviceberry 'Smoky'
Sh = Serviceberry 'Honeywood'
Sn = Serviceberry 'Northline'
Cb = Black Currant 'Ben Sarek'
Ct = Black Currant 'Titania'
Cr = Red Currant 'Rovada'