

# Agroforestry Notes

USDA Forest Service, Rocky Mountain Research Station • USDA Natural Resources Conservation Service

AF Note 10

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## Opportunities for Growing Short-Rotation Woody Crops in Agroforestry Practices

### Introduction

Technologies are readily available for growing hybrid poplars and willows in block plantings as short-rotation woody crops (SRWC) for fuel and fiber. SRWC species and technologies can also be incorporated into agricultural systems as agroforestry practices. Examples are windbreaks, living snowfences, “timberbelts”, riparian buffer strips, and wastewater treatment plantings. Fast growth, convenient propagation (see AF Note - 11), and compatibility with conventional farming methods make SRWC suitable for use in agroforestry practices to provide multiple benefits such as solid wood and wood fiber products, water quality improvement, crop and soil protection, wildlife habitat, and buffers for agricultural/community interfaces.

### Plant Materials

Poplar is the general term for trees in the genus *Populus*, which includes species of cottonwoods and aspens. Cottonwoods are selected for a variety of attributes (growth, form, adaptation to soil and climate conditions, disease/insect resistance, and intended use) and are “crossed” to produce “hybrid” individuals. For example, *P. trichocarpa* (black cottonwood), native to the Pacific Northwest, crossed with *P. deltoides* (eastern cottonwood), native to the Eastern and Midwestern U.S., produces a hybrid that is commonly grown for fiber production in the Pacific Northwest. Crosses of *Populus nigra* (European black cottonwood) and *Populus deltoides* (eastern cottonwood), produce hybrids that are commonly used in Minnesota and the upper Midwest. Within a hybrid, selected clones such as “robusta” and “raverdeau” are vegetatively propagated using “cuttings” or “whips” to establish trees in the field. Hybrid willows are a similar situation; more than 300 clones are being screened in the Northeast for their suitability for SRWC.

### Opportunities in Agroforestry Practices

Opportunities for income-generation from SRWC exist where both of the following conditions exist: (1) soils and climate are favorable to produce at least 4 to 8 dry tons/acre/year, and (2) a market exists within a reasonable distance.

Although block plantings are the most efficient way to grow SRWC to maximize economic gains, environmental benefits are maximized by incorporating SRWC as strip plantings into production agriculture systems known as timber belts. These strip plantings serve as conservation buffers in the farming system, and at the same time provide additional income for the landowner. The productivity of strip-planted SRWC can be equal to or greater than block plantings, but the enterprise will be more spread out. At present prices, at least 30 acres of harvestable biomass must be available on a section of farmland within 100 miles of a market in order to be economically viable.



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The rotation length for SRWC is 3 to 12 years, depending on hybrid and clone, spacing, growing conditions, and tree size desired. In many states, fiber farming is considered agriculture and is not subject to forest practice regulations if rotations are kept under 10 to 12 years. Growing and harvesting SRWC is similar to agricultural crops in many ways, and conventional farming equipment can be used to culture and harvest SRWC, especially if a short rotation is used. If coppicing is to be done, then harvesting is done in the dormant season, which is a convenient time for farmers. The trees can regenerate by “coppicing”, i.e., sprouting from the cut stumps. The original trees can usually withstand 3 to 4 coppice cycles, (approximately 30 years), before replanting is necessary.

Where market economics do not exist, incorporation of poplars and willows into agroforestry practices is mostly for conservation purposes. Poplars and willows are well-suited to many types of conservation plantings because of their fast growth, so they provide benefits sooner. Natural Resources Conservation Service (NRCS) Plant Materials Centers and other agencies have selected varieties for most regions of the U.S. based on their adaptability, suitability for purpose, and lack of unwanted characteristics such as sprouting or spreading. Following are some promising opportunities for incorporating SRWC into agroforestry systems and other special applications.

### **Windbreaks, Living Snowfences, and Timberbelts**

Cultivated varieties (cultivars) of poplars and willows have been used for many years to protect soil, crops, and livestock. Poplar varieties like “lombardy” grow well in the Northwest, “robusta” does well in the eastern Great Plains and Lake States, and “carolina” is well suited to North-central and Northeast conditions.

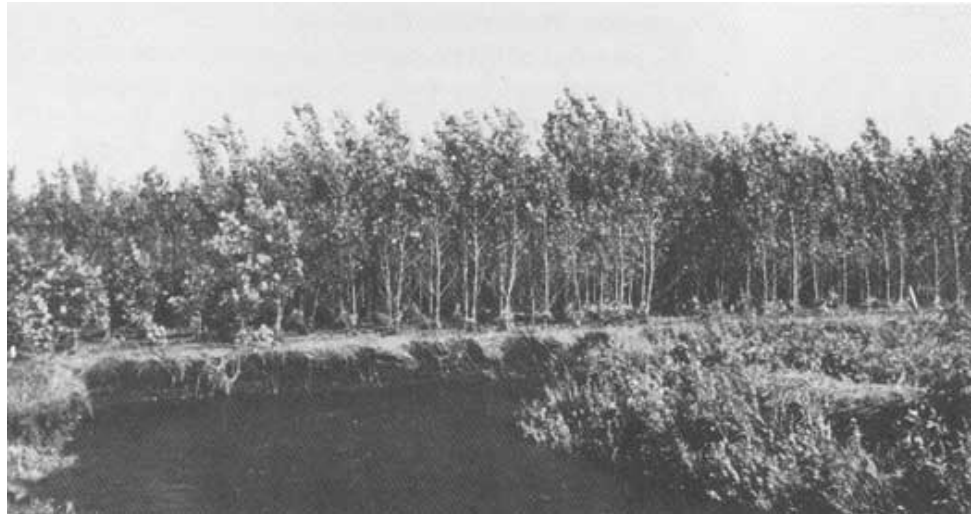
Hybrid poplars and willows may be grown as SRWC in strip plantings that also function as windbreaks. A system of multi-row field windbreaks can be designed to provide continuous protection for cropland and also allow harvesting on a 6 to 10 year rotation. For example, for a 4-row windbreak on a 6/7-year rotation, two rows can be harvested after six years and the remaining two rows after seven years when regrowth of the first two rows is sufficient to provide crop and soil protection. If one or two rows of these multi-row windbreaks are planted to evergreen species, the SRWC can be harvested at one time, wildlife habitat would be enhanced, and continuous protection would be provided. Distance between windbreaks would be determined by the average height of the trees at a specified age in the rotation. The short harvest intervals will help maintain healthy windbreaks, reducing the need for costly renovation or removal of aging windbreaks.

Living snowfences are specialized windbreaks to protect roads. Poplars and willows are well suited for the task because of their fast growth and ability to be hedged to maintain their size and density. If living snowfences are to be harvested, it should be done in late winter when their snow management job is mostly over.

Timberbelts are wide field windbreaks or field border plantings designed to increase the SRWC component of the system. One or more rows of conifers can be incorporated to enable harvesting of the timberbelt at one time and still provide continuous protection.

### **Riparian Buffer Strips**

Hybrid poplars and willows can enhance the functionality of riparian buffer strips (see AF Note - 3) and provide income for the landowner, providing a win-win situation for landowners and conservation. Riparian zones are “home” to poplars and willows, and these species are ideally suited to act as “biological sponges” to absorb sediments, nutrients, chemicals, and animal wastes from agricultural runoff. Riparian buffers also serve as “waterbreaks” to slow down flood waters and intercept debris.



**Poplar trees within a riparian zone that can be harvested.**

The width of riparian buffer strips containing SRWC can be tailored to attain landowner objectives and conservation needs. Narrow strips attain an acceptable level of SRWC production and conservation benefits, and minimize the amount of land taken out of conventional agriculture. Wider strips enhance the SRWC component with greater yield and market values likely, and are more effective in retarding flooding.

Hybrid poplars have been tested in narrow buffer strips next to drainage ditches within corn and soybean fields. Whips planted 4 to 5-feet deep effectively removed excess nitrogen and phosphorus in shallow groundwater coming from adjacent cropland. These dense plantings are winter-harvested on 1 to 3-year rotations to remove the excess nutrients from the site and to rejuvenate the buffer system. Regrowth from stump sprouting occurs rapidly, so the disturbance and recovery period are minimal.

Similarly, wider strip plantings including SRWC can be established adjacent to streams and rivers in agricultural landscapes. NRCS has utilized data from the Northeast, Southeast, and Midwest to establish a riparian forest buffer standard consisting of three vegetation zones. Zone 1 is a minimum 15-foot wide strip nearest the stream consisting of undisturbed native tree species. SRWC can be grown in Zone 2. It's width (20 feet minimum) is determined by the hydrologic characteristics of the site, buffering needs, and the amount of land the landowner wants to put into his SRWC enterprise. Zone 3, furthest from the stream, is a minimum 15' wide band of suitable grass species. Zone 3 is optional, depending on the need to intercept overland flow from adjacent cropland or pastureland.

Where markets exist, an alternative to SRWC is growing valuable hardwoods in riparian zones to produce high-quality logs for lumber or plywood.

**Agricultural Wastewater Treatment**

In irrigated agricultural areas, nutrient- and pesticide-laden excess irrigation water often finds its way into rivers and streams by way of drainage ditches. A wastewater treatment system will be tested in the Yakima Valley in the Columbia River Basin of Washington using sediment ponds, block plantings of hybrid poplar, and shallow wetlands to filter return flows before they reach the river. The poplars will be harvested for fiber, thus converting a waste into a resource.

## Community Wastewater Treatment

Block plantings of hybrid poplars can potentially be used to treat the discharge of summer effluent from a city sewage treatment plant. In Woodburn, Oregon a planned 300-acre system of grass, clover, and poplars will be used to treat wastewater. The poplar clones were selected from an 8-acre test planting. SRWC will be harvested on a 7 to 10 year rotation, and the income will offset a portion of the operation and maintenance costs.

Hybrid poplars are also being tested as a "landfill cap." In Western Oregon, a dense stand of fast-growing poplars established on top of completed landfills reduces the amount of rainfall that leaches through the landfill, thereby reducing the amount of leachate from the landfill that must be subjected to costly treatments. This approach replaces the need for expensive synthetic membranes which are ordinarily used to cap landfills. Poplar whips are deep-planted (2 to 4 feet) at high densities into the 5-foot deep landfill cover. The deep rooting and fast growth of the poplars uptake the water before it leaches into the groundwater. Poplars were found to uptake three times more water than grasses. The trees will be managed and harvested as a SRWC.

## Additional Information

- “Biology of Populus and its Implications for Management and Conservation.” 1996. Edited by R.F. Stettler, H.D. Bradshaw, Jr., P. E. Heilman, T. M. Hinckley.
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- “High Yield Hybrid Poplar Plantations in the Pacific Northwest.” by P.E. Heilman, R. F. Stettler, D. P. Hanley, and R. W. Carkner. 1995. Research Paper PNW 356. Available at Washington State University, University of Idaho, and Oregon State University Extension Offices.
- “Riparian Management Systems to Protect Water Quality.” by R.C. Schultz, R. Lowrance, W. Elmore, and Joseph P. Colletti. 1998. Chapter 7 In: Agroforestry - An Integrated Science and Practice. W.J. Rietveld, H.E. Garrett, and R.F. Fisher (eds). American Society of Agronomy Special Publication (In Press).
- “Windbreaks and Shelterbelts in Sustainable Agricultural Systems.” by James R. Brandle, Laurie Hodges, and Bruce Wight. 1998. Chapter 4 In: Agroforestry - An Integrated Science and Practice. W.J. Rietveld, H.E. Garrett, and R.F. Fisher (eds). American Society of Agronomy Special Publication (In Press).

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