

Cream of the Coppice

Hybrid poplar, willow and eucalyptus are highly adaptable, fast-growing and easy to regenerate, but will landowners grow them if they can't reap instant rewards?

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A healthy, harvest-ready stand of hybrid poplar can yield four to 10 tons of biomass per acre annually. Each tree is capable of growing more than 60 feet in six seasons, with little maintenance beyond the first planting year. Though short-rotation trees such as poplar, willow and eucalyptus already possess impressive growth characteristics, researchers are working to optimize them as the potential for their use as bioenergy feedstock materializes.

Timothy Volk, who leads State University of New York's short-rotation woody crops program, and his team are concentrating their efforts on willow, mainly because disease issues associated with poplar in the Northeast have limited its use there. Research at SUNY has included breeding, optimum plant spacing, nutrient requirements, rotation lengths and other crop management issues in and beyond the region, in order to test the trees across a broad range of conditions.

Growing Willow

The main impetus behind willow research is to determine how to economically grow the trees on marginal land, Volk says. "Much of our region tends to have a high clay content and poor drainage," he says, adding that this is land that traditional row crops would not typically grow well on.

"The first step in the planting process is to control existing vegetation—if it's an old field you need to kill it off and plow it in a fairly traditional fashion." If that's done in the fall, Volk recommends planting a winter cover crop to control soil erosion. "The following spring we'd plant in late April and early June, putting in just under 6,000 unrooted dormant plant cuttings per acre, which is done with a planting machine pulled by a tractor," he says.

Volk says his team has relied on equipment designed in Europe, where willow trees are more commonly grown as a bioenergy feedstock. "There are probably about 30,000 to 40,000 acres, largely in Sweden and the U.K. right now," he says. The imported equipment is modified to work more effectively for growing conditions in the Northeast. The problem is that shipping the machines is expensive, and getting new parts or supplies in a timely fashion can cause problems. "If something breaks and it takes a while to get here, the planting season is half gone," Volk says. Fortunately, an upstate New York firm has recently obtained a license to manufacture one of the European planters for the North American market, which should help, he adds.

After the seedlings are in, the focus of the first year is on weed control. "Typically after the first year, the leaves drop and then we cut them down," Volk says. "We work with willow's ability to resprout effectively. In the first year you might have two to four stems per plant per year, and after coppicing it during the dormant season it'll sprout back the next spring and you'll get a lot more stems coming back, anywhere from six to 15 stems per plant." At that point, the trees look like bushes or shrubs.

Harvest should occur after three or four growing seasons. "The only thing you do during the next rotation is put a little fertilizer on in the spring as it's sprouting, cut it again and let it grow for another three or four years," Volk says. "If you run on a three-year cycle for example, you'll put it

in the ground once and harvest seven times.”

Currently, researchers are harvesting 4 to 5 dry tons per acre each year, but new varieties in SUNY’s breeding program are showing yield increases of 20 to 25 percent. “That’s very initial work, but I think we’ll be able to increase that steadily over time,” Volk says.

Across the U.S. in the Pacific West, Greenwood Resources Inc. is also selecting and breeding short-rotation woody crops, zeroing in on hybrid poplar.

Planting Poplar

Greenwood manages 35,000 acres of poplar in Oregon and Washington, which are being used for biomass energy and saw and pulp logs. Jake Eaton, Greenwood’s managing director of acquisitions and resource planning, says the company believes poplar and woody crops such as eucalyptus will become the feedstock choice for biomass energy, whether for heat and power generation, gasification or advanced liquid biofuels.

Greenwood’s business model is to partner with an energy or technology company, identify a growing area, analyze the potential investment, take the project to investors to get funding for plantation development, and then sell the feedstock to the customers.

As poplar is the most widely adapted tree species in the world, Greenwood has extended its reach into China, Europe and South America, including operations in Chile to provide feedstock to power stations, Eaton says.

Ideal locations for poplar plantations are in temperate regions of the globe. “Good conditions for poplar are deep, well-drained soils, moderate heat and sunshine, and access to water either through ground water or adequate precipitation,” he says, adding that they are grown intensively with timely weed and pest control, and fertilizer if necessary. “The production systems for biomass require 12- to 15-year rotations within which we have four to five coppice cycles where the tree is harvested,” he says.

In the Southern U.S., South Carolina-based Arborgen Inc. is developing high-yielding, short-rotation crop seedlings including poplar, but its highest yielding crop is its freeze-tolerant eucalyptus, which was approved for field testing by the USDA last summer.

Quantifying Eucalyptus

Field testing of Arborgen’s freeze-tolerant eucalyptus has shown the trees can survive temperatures as low as 15 degrees Fahrenheit and can therefore be planted in Florida, southern Alabama, Mississippi, Georgia, Louisiana and southern Texas.

Arborgen Product Development Manager Jeff Wright says an average 25-megawatt (MW) power plant would require about 137,700 bone dry short tons (BDT) per year, assuming a heat rate of 11,000 Btu per kilowatt hour, 90 percent capacity factor and a heat content of 8,000 Btu per pound. “Most woody biomass is delivered shortly following harvest, and the 25-MW power facility would require 250,400 green short tons at a moisture content of 45 percent,” he says. “To supply 100 percent of the woody biomass requirements in southern Georgia would require approximately 19,600 acres of plantation eucalypts on seven-year rotations (7 BDT per acre per year, planting and harvesting 2,800 acres annually).”

To supply all of the woody biomass requirements in south Florida would require 11,500 acres of plantation eucalypts on five-year rotations (yielding 12 BDT per acre per year, planting and harvesting 2,300 acres annually). “However, at present, it is unlikely that a 25-MW power facility

would be supplied solely by purpose-grown trees given availability of harvest, mill and urban biomass sources not presently utilized," Wright adds.

Challenges and the Future

The system for growing willow trees at a meaningful or commercial scale for bioenergy needs to be further optimized, Volk says. "But it's at a stage where it can start being deployed and, as long as we learn as we go, we can improve it over time," he says.

Brad Hunter, Greenwood business development analyst, says the company is seeing increased demand for commercial applications in Europe, and while there is interest from utilities and others in the U.S., regulatory uncertainty is weighing on the biomass market. "In the areas where these wood pellet, cellulosic ethanol and electricity companies are operating, there's increasing demand for purpose-grown trees and management systems," Hunter says. The demand for these trees in the U.S., however, will largely depend on permitting and engineering developments in bioenergy facilities, Wright says, and also continued financing.

Another challenge is the upfront establishment cost of tree farms. "If we're putting in or near 6,000 [willow] plants per acre, we're probably spending \$800 to \$1,000 an acre to get the crop established," Volk says. "Landowners look at that and see it as a big outlay, not getting any money back for four years until the first harvest."

To help alleviate these costs, Arborgen will provide landowners an opportunity to grow both pine biomass for bioenergy and a higher value pine for saw timber. "The analysis undertaken would suggest that financial returns to the landowner will be higher for the flex stand than either biomass or saw timber in separate plantations," Wright says.

SUNY has done some economic modeling of the willow production system, which, using seven three-year rotations, predicts a return of 5 to 5.5 percent. "That doesn't sound so bad for an ag crop, but that's over 21 years," he says. "When you run a cash-flow analysis, the upfront establishment investment doesn't get paid back until about year 12 or so, about mid-way through the rotation. The last three or four harvests is when you're making your money."

The Biomass Crop Assistance Program should reduce establishment cost, making it much more attractive for landowners, according to Volk. When SUNY's model is run with BCAP incentives plugged in—cost share and annual rental payments—the upfront establishment costs are recovered at first harvest and cash flow is positive after that. "The return on investment then is about 35 percent, so it makes it attractive," Volk says. "I'm actually a little concerned that it'll be overly attractive. In Sweden in the early '90s, they over-incentivized willow and in a couple years they planted 20,000 or 30,000 acres but much of it was poorly established and had poor yields. There was this initial boost with the incentives, but it stalled out the program longer term."

Hunter says Greenwood is working with several conversion facilities to apply for the BCAP. "We think it is a good opportunity to share the establishment risk, but we're still waiting for more clarity from local [Farm Service Agency] staff on how it will be implemented," he says.

Right now, Volk believes the cropping system is ready for deployment if a package can be put together. "That's the way to make it work—to link those pieces together and share the risk," he says.