

FACT SHEET

Demonstrating Yield of Shrub Willow Bioenergy Crops - Willsboro Research Farm



Planting willow with an Egedal planter in Geneva, NY

Shrub willow is a sustainable bioenergy crop

Shrub willow, a new perennial crop that can be harvested on a three-year cycle, has the ability to provide wood chips as a source of heat, energy, bioproducts, and biofuels. These energy crops grow quickly, produce large numbers of small stems, require low inputs of fertilizer or pesticides, and vigorously resprout after every harvest for more than 20 years. Shrub willows grow well on marginal agricultural land in the Northeast and upper Midwest and could potentially return over 1 million acres of underutilized farmland in New York to productive cultivation. Other environmental benefits include a reduction in greenhouse gas emissions, because the CO₂ emitted by the conversion of willow biomass was captured by the plant during its growth. The use of natural gas, gasoline and coal releases significant amounts of CO₂, which is resulting in global climate change.



Third year growth of a yield trial in Big Flats, NY

Shrub willow can be harvested for 20 years

Shrub willow is grown from dormant unrooted cuttings or “whips”, which are planted mechanically in the spring, and the first harvest occurs 3-4 years later. Shrub willows can be harvested for over 20 years with no reduced yield. Weed control is critical during the first two years of growth, but after closing canopy, little additional maintenance is required. Shrub willow is best harvested during the winter months when the ground is frozen and the plants are dormant. New Holland and Claas have developed cutting headers designed to harvest and chip willow stems with a forage harvester. The chips are then blown into a trailer for transport to market. The wood chips are burned to generate renewable power and heat; the technology is also being developed to convert willow wood chips into transportation biofuels.



Controlled pollination of willow flowers

Breeding shrub willow for improved yield

As an emerging bioenergy crop that has only a very short history of agricultural cultivation, there is tremendous potential to generate new varieties of shrub willow (species of *Salix*) with improved yield, pest and disease resistance, and water and nutrient use efficiency through conventional breeding. The NYS Agricultural Experiment Station in Geneva is the focal point for willow breeding in North America. Cornell University researchers annually perform controlled pollinations involving elite parental lines chosen from a collection of over 500 willow accessions. Varieties with as high as 40% greater yield have been identified in replicated selection trials and are being tested in yield trials across a wide range of sites.

Willow trials at Willsboro

The 2013 Willsboro Yield Trial contains 24 cultivars in a replicated experimental design. The material used includes both commercially available and newly selected cultivars from the Cornell willow breeding program at the NYS Agricultural Experiment Station in Geneva. The trial was planted on wet, untilled marginal land previously in hay production. There are 96 research plots at a density of 6,000 cuttings per acre, all of



Dwarf white clover planted as a cover crop between rows of shrub willow.

which were treated with a pre-emergence herbicide cap to reduce weed competition. At the end of the first growing season, all stems will be cut to just above ground level to promote coppice regrowth of multiple stems. At the end of the second and third years, each plot will be measured for height and diameter growth. After the fourth year (third growing season post-coppice), each plot will be harvested and the resulting biomass from each cultivars weighed to calculate yields across the three-year rotation.

Funding for the 2013 willow yield trial comes

from NEWBio, the Northeast Woody/Warm-season Biomass Consortium. Additional work at Willsboro will be funded by a grant from the Northern New York Agricultural Development Program. This research will explore the use of cover crop systems during willow establishment in order to lessen the need for herbicides, cut back on soil erosion, and improve soil health and nutrition. Tests for the establishment of late summer legumes such as subclover (*Trifolium subterraneum*) and fall annuals such as cereal rye (*Secale cereale*) will be conducted.

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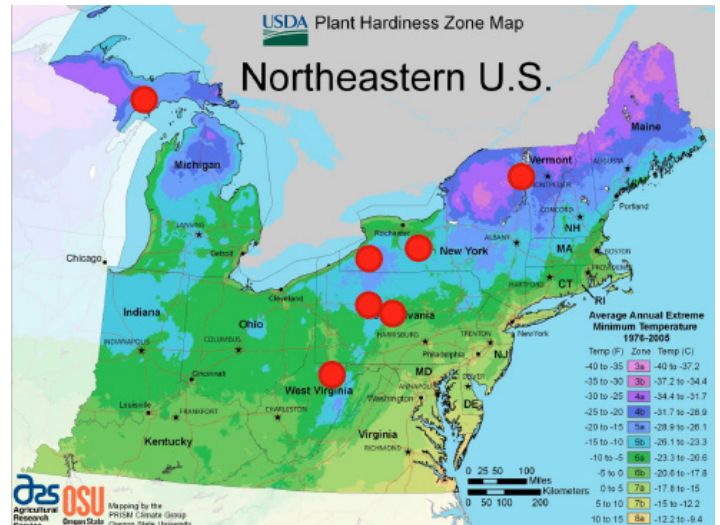
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NEWBio willow yield trials

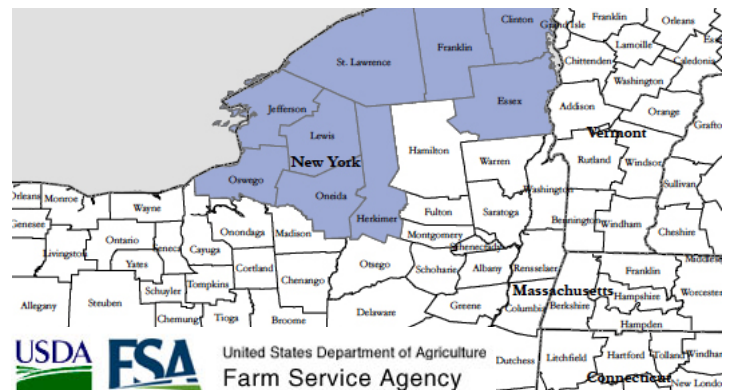
NEWBio currently has seven yield trials across NY, PA and WV, with the intent of determining differences in yield in different environments. Four of the trials were planted in 2012, and three planted in 2013. These trials are funded by the USDA NEWBio and USDA Northeast Sun Grant projects.



Source: <http://planthardiness.ars.usda.gov/PHZMWeb/>

BCAP project area

Further support for the future production of biomass crops comes from the USDA Biomass Crop Assistance Program, which provides financial incentives from the FSA for farmers to plant and harvest bioenergy crops for heat, power, biobased products or advanced biofuels. The FSA has recently established its tenth new project area, which encompasses much of northern New York State (below), for the production of shrub willow.



Source: http://www.fsa.usda.gov/Internet/FSA_File/bcap_ny10.pdf



Cornell University
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