

Silviculture and Harvesting Abstracts

Technologies for Harvesting Short Rotation Woody Crops

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A study is being conducted to research the energy budget associated with the establishment, maintenance and harvest costs of plantations of short rotation woody crops. The study includes tree species that are native to the lower Mississippi alluvial valley (LMAV). The project, located near Bosco, LA, is still in the planting phase and a variety of harvest regimes are planned. We are currently exploring the technologies available to harvest short rotation woody crops. The study site is flat, but the area is very wet, which may restrict the selection of harvesting systems. Technologies available include understory harvesting equipment that mulches the stems and captures them in a towable trailer, similar to an agricultural system. More recent technologies include baling the mulched stems in a single-pass, with a bale collection step completing the harvesting system. The International Poplar Commission, one of the FAO technical statutory bodies on forestry, indicates that feller-bunchers and grapple skidders are still the most productive systems. On flat ground with a high water table, another system worth considering is a swing-to-tree feller-buncher. This machine could be preferred over drive-to-tree feller-bunchers because the boom reach of the machine can extend across several rows without moving the machine, resulting in less trafficking of the wet soils. We are exploring technologies that can be implemented on the LMAV site as background to harvest implementation. This paper presents the considerations for technology selection.

Keywords: harvest systems, SRWC, logging, equipment

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Crops Based on a New Holland Forage Harvester and Specially Designed Willow Cutting Head

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Despite the projected increase in demand for woody biomass from short rotation woody crops (SRWC) and the wide array of benefits associated with their production and use, the expansion and rapid deployment of these systems has been restricted by their high cost of production and in some situations a lack of market acceptance because of poor quality chips from first generation harvesting systems. For willow and hybrid poplar SRWC, harvesting accounts for about 1/3 of the delivered cost. Harvesting and chip transportation combined account for 45-60% of the delivered cost. Harvesting is also the second largest input of primary fossil energy in the system, after commercial N fertilizer, accounting for about 1/3 of the input. Improvements in harvesting efficiency would reduce the delivered cost, increase the net energy ratio and decrease greenhouse gas emissions associated with SRWC production systems.

Over the past four years SUNY-ESF and Case New Holland America have worked together to develop a single pass cut and chip harvester for SRWC based on a New Holland forage harvester. During that time the system has gone through a number of transformations and improvements that has allowed larger diameter material to be cut and improved the flow of woody biomass through the system. The current system consists of a New Holland forage harvester and a specially designed New Holland SRC Woody Crop Header. Project partners will build on existing collaborative efforts to improve the effectiveness of the harvester and design an efficient handling system for wood chips that are produced. Testing will be conducted in both short rotation willow and hybrid poplar biomass crops. Improvements in the harvesting and handling systems will reduce the SRWC production costs, provide consistent quality material to meet end users specifications, and accelerate the deployment of SRWC.

Keywords: SRWC, biomass crops, willow biomass crops, hybrid poplar, woody crop header, forage harvester.

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Effects of Planting Density on Growth, Mortality, and Yield of Short Rotation Willow Crops (*Salix* spp.)

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Shrub willow (*Salix* spp.) and other short rotation woody crops (SRWC) are expected to become essential to meet the future demand for biomass feedstocks in the U.S. and globally, but the development of complete production systems for these crops is still in its infancy. Significant improvements are needed to reduce the cost of production and improve the environmental attributes of the system. Establishment costs, which currently account for about 25% of the delivered feedstock price, are currently a major barrier to the deployment of willow biomass crops. Planting stock accounts for the majority of establishment costs, because of the currently recommended high planting density in these systems (15,400 plants ha⁻¹). These recommendations are based on research from Europe, largely based on the growth of *Salix viminalis*, and trials in the early 1990s in North America on a single variety, 'SV1' (*Salix dasyclados*). Lowering the planting density would reduce establishment costs but may have possible impacts on other important management decisions and costs associated with crop production.

This presentation will examine the results of two trials that are under way to assess the impact of reduced planting densities on SRWC production. The first, located in Canastota, NY, looks at growth and yield over two harvest cycles in a trial in which a range of density occurred in three shrub willow and one hybrid poplar variety as a result of variable mortality in the establishment year. The second trial, replicated in Tully, NY, and Waseca, MN, was designed to examine the effect of five different planting densities ranging from 5,833 to 17,498 plants ha⁻¹ on growth and yield for four shrub willow varieties. Cross sectional area, plant height and survival data will be presented from the first two years of coppice regrowth from these two trials.

Keywords: *Salix*, short rotation woody crops, long term production

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Four Years of Herbicide Trials for Shrub Willow Biomass Production Systems in the Upper Peninsula of Michigan

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Renewable, woody biomass is becoming a promising alternative to fossil fuels for the production of energy products around the world. Specialized energy crops and cropping systems are slowly developing to meet the increased demand for energy wood. One promising system for the Northeast and Lake States regions of the United States relies on shrub willows (*Salix* sp.) grown at high densities and harvested on short rotations. This type of production system has the potential to produce exceptional yields but is expensive to establish. Yields and establishment costs are both strongly effected by the methods and effectiveness of weed control during the plantation's first two years. Weed control in young, dense willow energy plantations is challenging because the crop is sensitive to most commercial herbicides and crop use labels are exceptionally rare. Herbicide screening research has been underway at the Forest Biomass Innovation Center for the past four years to find promising chemicals and application rates to facilitate the labeling of appropriate treatment methods for commercial willow energy plantations.

This presentation will provide a summary of five herbicide trials conducted in the Upper Peninsula of Michigan between 2007 and 2009. Six herbicides were tested on several taxa of willow with mixed results. This, together with data from other researchers, has led to a more comprehensive test of thirteen herbicides on three sites in both Michigan and New York during 2010. Preliminary results from the Michigan location of this comprehensive test will also be presented.

Keywords: weed control, herbicide, willow, energy crop, plantation

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Yield, Profitability, and Optimum Harvest Scheduling of *Eucalyptus* spp. in Florida

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Maximizing profitability of SRWC systems requires dual optimization of both the optimum time between harvests and the optimum number of harvests before replanting. A largely unknown variable in determining optimum harvest scheduling is the growth and yield of SRWCs. Yield data from two sites taken over 8 years is being used to develop site-specific growth and yield functions for *Eucalyptus grandis*, and *Eucalyptus amplifolia*. These functions are incorporated in an optimization model to evaluate profitability and perform a sensitivity analysis. We expect that *Eucalyptus grandis* will be most productive and profitable, and that profits are maximized with 3-4 harvests per rotation and 2-4 years between harvests.

Keywords: *Eucalyptus* spp., economic analysis, Faustmann

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