ADDENDUM OF ABSTRACTS

for

Biofuels, Bioenergy, and Bioproducts from Sustainable Agricultural and Forest Crops

Short Rotation Crops International Conference

August 19 – 21, 2008, Bloomington, Minnesota, USA

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Predicting Hybrid Poplar Growth with a Simple Process-Based Model (3PG)

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Establishment of short rotation tree plantations for biomass production for fuel or fiber on agricultural lands (abandoned farmland) could provide significant environmental and economic benefits for rural communities, and society as a whole. Walker (*Populus deltoides* × *Populus petrowskyana*) variety of hybrid poplar is one of the most vigorous among other clones cultivated in Saskatchewan. There are no existing hybrid poplar tree growth models in the literature. The aim of this work was to parameterize the 3PG (Physiological Principles in Predicting Growth) stand growth model to predict Walker hybrid poplar growth in Saskatchewan. We used data for *P.deltoides* hybrids from the literature to estimate basic allometric variables used by 3PG. We systematically modified the rest of the input variables to fit model output results to empirical observations (tree height and diameter at breast height (DBH)) from a 9-year old Walker plantation established at Birch Hills, Saskatchewan. Using the final parameter settings that resulted in the best model fit, we evaluated a different set of 3PG model predictions against empirical data from an 11-year old Walker plantation established at Henribourg, Saskatchewan. The R-squares of regressions of predicted versus observed values for height and DBH at Birch Hills were 0.86 and 0.90, respectively, while they were 0.46 and 0.35 at the Henribourg site. The bias, Sum (predicted minus observed) divided by number of observations, was less than 0.7 m and 1 cm for height and DBH, respectively, at both sites. Our preliminary analysis indicated that, once parameterized for a specific hybrid, the 3PG model can be used to predict hybrid poplar growth with desirable accuracy for agricultural land in Saskatchewan by only utilizing commonly available soil and climate data. Additional work is being done to further improve the performance of 3PG for hybrid poplar growth modeling.

Keywords: farmland afforestation, *Populus* plantations, Walker hybrid poplar, stand growth model, Canadian Prairies

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Rapid Biomass Estimation of Short Rotation Woody Crops Via Optical Stem Density: A Trial Using Willow (*Salix* spp.)

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Quick and accurate biomass estimation of short rotation crops, such as willow (*Salix* spp.), is essential for carbon accounting and management decisions. Currently, most estimates of tree biomass, including willow, rely on measurement of stem diameter. This method works well for single-stem species but accurate measurement of multi-stem species, using this method, requires larger investments of time and effort as well as site, clone and age specific information for unsatisfactory returns in accuracy. Therefore, we developed a new method which assesses "optical stem density" from digital photographs taken at predetermined locations and angles within a plantation using a standard, commercially available digital camera. Photographed plots were destructively sampled for fresh weight which was then converted to dry weight. We then constructed an equation to relate the measurements of optical stem density to measured biomass. The relationship between optical stem density and biomass was very strong ($r^2 \leq 0.97$) thereby displaying good promise that the method can be used for quick and accurate biomass estimation.

Keywords: biomass estimation, willow, *Salix*, optical stem density, prediction equations

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New Poplar Clones Selected for Short Rotation Coppice in Italy

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Biomass, such as forestry and agricultural crops residues and waste, is the largest renewable source for energy production and represents a substantial opportunity not only to reduce greenhouse gasses (GHG) but also to increase the internal energy supply. In the short term, the use of biomass residues will allow to increase the bioenergy production in Italy up to 8-10 Mtoe per year without reducing food production and maintaining soil fertility. In the long term, biomass would contribute 15-20% of the total energy production according to the target of the European Union (EU). To obtain this result it will be necessary to implement energy crops that are characterized by high production per hectare and low environmental pressure. Among dedicated woody crops grown on short rotation, good results are obtained by *Salicaceae*: poplar and willow clones. In this paper are showed performances (survival and biomass production) of new poplar clones, selected by Intensive Wood Production Research Unit at Casale Monferrato (AL), Italy. The trials are carried out in six different sites all over Italy. New poplar clones of *Populus deltoides* and *P.* ×*canadensis* are grown in a short rotation coppice (SRC) system (density of 8.000 to 10,000 plants per hectare, harvest every two-three years). These clones are characterized by good rooting capacity, fast growth, resistance to diseases and good re-sprouting capacity after harvesting. Dry biomass production can arrive to 22.6 Odt per ha per year in fertile soil with good water availability (North Italy). The clones *P.* ×*canadensis* 'Orion' and *P. deltoides* 'Baldo', are able to produce from 30 to 60% more than old clones utilized in traditional poplar stand (ten year rotation) as *P.* ×*canadensis* 'I-214'; they are also partially resistant to drought. Utilizing new clones will be possible to reduce economic and energetic cost of SRC, making cultivations more profitable.

Keywords: hybrid poplar clones, short rotation coppice, productivity

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Integrating Energy, Agriculture and Environmental Issues:
Some Considerations for Successful Implementation of Short Rotation Crops

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As the supply of energy to meet increasing demand continues to evolve to more diverse systems there are some clear issues developing that need to be addressed to improve the knowledge and confidence of consumers to understand these supply alternatives.

Discussion regarding 'sustainabilty' of feedstock production underpins arguments generated in the day-to-day press regarding competition for land, water and nutrients. What is the balance between food and energy production? How is this confused with food distribution? What are 'good' energy sources? What are 'bad'? What are the limitations of the alternative energy sources? How do we develop a strategy to allow for integration of different energy supplies that are competitive whilst meeting the challenges of a 'carbon constrained' economy? How can consumers determine what energy supplies lead to reduced greenhouse gas emissions? Some of these questions are inherent in the discussion and development of emissions trading schemes around the world. And sustainability principles and criteria are being considered through groups including the 'Roundtable on sustainable biofuels'.

Biomass energy supply is one of many options available. A key benefit of biomass material is the plethora of options for production allowing for localised adaptation and best management of the supply systems. But what are some of the key issues and considerations specific to short rotation crops (SRC)? What are the common problems to be addressed in developing robust supply of biomass material from SRC across different regions?

Scale is a significant component determining the reference point for evaluating the environmental credentials of production. At a large scale issues such as the balance of food and energy and competition for the land resource can to be addressed through land use planning instruments. Small scale limitations to production can be managed on-site and these include: nutrient management and soil health, water use and quality, optimisation of genetic selection for production and diversity. To assist with policy development at regional, state and federal scales there is a need to clearly define and communicate frameworks that allows for industry development with consideration of the need to communicate production standards across a range of scales.

Keywords: sustainability, market confidence, short rotation crops, SRC, energy supply

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The Capacity to Provide Feedstock Material to Energy Markets in South-eastern Australia: The Potential for Short Rotation Crops

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What is the potential production capacity of energy crops in Australia? As market opportunities develop for alternative energy systems it is important to understand the potential and current capacity to supply feedstock material to the bioprocessing industry (whether that be for stationary energy or transport fuels). There are two significant sources of woody biomass material: (*i*) residues and wastes from existing forest industries or, (*ii*) biomass from dedicated energy crops. We are investigating the potential for the development of new industries in supplying biomass material to meet potential demands. Specifically, *what is the capacity of new dedicated short rotation woody crops in south-eastern Australia*? To understand what potential can be realised we are investigating the suitability of native species in lower rainfall zones, estimating their productivity (accounting for soil and climate), and combining this yield information with data regarding electricity supply options within the current grids. To this information we overlay the estimated economic costs and required returns for biomass material to determine an *annual equivalent return*. This allows a comparison between farming options. We are doing this at a regional level.

This poster will display some of the key outputs from the Regional Industry Planning Analysis model in evaluating potential species for bioenergy production and refining our new industry evaluation methods.

Keywords: short rotation crops, SRC, production, energy supply

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Farmer Perceptions of Easements for Energy Crop Production in Minnesota: What it takes to get landowners to sign up for easements

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In 2007, the Minnesota Board of Water and Soil Resources (BWSR) was charged with establishing an clean energy easement program under the auspices of an already established conservation program, Reinvest in Minnesota (RIM). The overarching goal of the program was to support native perennial biofuels production with secondary environmental benefits such as water quality, soil health, reduction of chemical inputs, soil carbon storage, biodiversity and wildlife habitat. Therefore, RIM-clean energy was not to be a traditional conservation easement program, rather it was intended to be a new and innovative "working lands" easement program. The University of Minnesota Center for Integrated and Natural Resource Management (CINRAM) in the Department of Forest Resources was charged with conducting focus groups around the state with farmers and landowners in order to better understand the constraints and opportunities farmers and landowners immediately perceived with such a program. Questions ranged from farmer familiarity with current easements and their enrollment status, to perceived constraints of easements; necessary compensation per acre; and the perceived benefits of the proposed easement. Participants were solicited from lists of potential participants provided by farmer advocacy groups, Extension offices and Soil, Water and Conservation District Offices, as well as snowball techniques. Turnout and willingness to participate was quite high given the time of year, immediately prior to winter holidays and the end of harvesting season. Participants were straightforward with their opinions and did not hesitate to engage in a hearty discussion. From these focus groups, key needs were determined and constraints better understood.

This poster will display the key findings are presented from the five focus groups held with farmers and landowners around the State of Minnesota regarding the perceived constraints and opportunities of the proposed easement program, as well as the payments necessary to obtain farmer participation in such a program.

Keywords: conservation easement, qualitative research, focus groups, payments

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Land Size and Tenure and Conservation Activities on Farms in Paraná and Iowa

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Brazil and the United States are the top ethanol producers, but their agricultural systems differ in terms of land tenure and land size distribution. Do these factors result in a divergence of conservation practices and biodiversity management? In this study, I interviewed 11 farmers in the state of Paraná and 11 farmers in the state of Iowa on issues of land tenure, land size, and dedication to biodiversity and conservation management. In Paraná, the Forestry Code requires at least 20% of the property to be in a "native state" as well as dedicating "Areas of Permanent Protection." Seven of the smaller farms, with less than 900 hectares, definitely had more than 80% of their land in production. That left less than the minimum for natural vegetation and wildlife habitat. These farmers might be operating closer to the margin than their larger counterparts, and therefore cannot afford to follow this law. In Iowa, where conservation practices are voluntary, the smallest operation did not participate in any USDA programs, but neither did a farmer with a larger farm. More data is needed to conclusively tease out any relationship between conservation practices and land size there. There is an additional distinction between farming in Iowa and Paraná: land rental. Most Iowans said they rented some of the land they farmed, the Brazilians I interviewed not at all, perhaps to diminish the risk of unwanted, outside occupation. As a result, many farmers in Iowa discussed how they needed to work their conservation practices and conservation program enrollment decisions around the rental contracts and in consultation with their renters, whereas farmers in Paraná would be able to plan for the long-term from the outset.

Keywords: ethanol production, conservation, land size, land tenure

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Production of Short Rotation Willow Biomass With and Without Irrigation Using Treated Effluent Water from a Municipal Sewage Treatment Plant

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At Whitecourt, Alberta, a short rotation coppice (SRC) willow plantation is being grown with and without irrigation using treated municipal sewage wastewater. This project is part of a nation-wide Canadian Biomass Innovation Network study, led by Natural Resources Canada, Canadian Forest Service, that is investigating growing of SRC willow as a bioenergy feedstock. The Whitecourt site was chosen because of its accessibility for demonstration purposes, its proximity to a wastewater treatment facility, and the fact that a potential end user of the wood fibre produced (a waste-wood fired power plant) is located in the community. Five willow clones are being monitored for their performance with and without irrigation. Growth, survival, biomass yield, insect and disease issues, heavy metal uptake by the willow, and accumulation of heavy metals in the soil are being monitored. The use of wastewater for irrigation offers the opportunity to increase yields of willow biomass by augmenting low rainfall in western Canada, to reduce environmental impacts of waste water disposal and to decrease the need for manufactured fertilizers. This has the potential to reduce operating costs and improve the net carbon budget of plantations. Other uses of SRC willow include site reclamation, riparian buffers, phytoremediation, and nutrient cycling and management. The poster will outline the project purpose and objectives and will present the status of the project to-date.

Keywords: short rotation coppice, willow, *Salix*, irrigation, sewage wastewater, biomass

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RootViz FS: A New Tool for Non-Invasive Imaging of Rhizosphere Dynamics

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RootViz FS is a system that enables non-destructive and non-invasive imaging of rhizosphere dynamics. Based on digital x-ray imaging, RootViz FS allows analysis of developing root systems of greenhouse stage plants and is suitable for a variety of genomics and breeding applications involving root system interactions with the rhizosphere. Plants or cuttings are grown in a low-density soil-less rooting medium in a controlled environment. Whole plants in the growth containers are placed into the RootViz FS system and digital images are automatically acquired by assembling composite images of the entire rhizosphere volume. Both two-dimensional and stereo representations of the rhizosphere can be acquired. Analysis of the composite images is carried out using standard image analysis software such as ImageJ. From these images several metric descriptors of root systems can be extracted such as: total root biomass, root length, number of roots, root thickness, and ratio of primary to secondary roots. RootViz FS is capable of high resolution images (100 microns) which allows for fine root analysis. The throughput of the system is dependent on the volume of the rhizosphere being analyzed and can be adapted for high-throughput analysis applications. Software for analysis of root system metrics allows characterization that may not be obvious to casual visual analysis. RootViz FS has been used to measure the growth rate of root systems and to characterize their morphology based on primary to lateral root ratio. Root systems of different genetic varieties of the same species can be separated into distinct classes based on image analysis results. More in-depth analysis has been carried out using Cytoscape software to make associations between the phenotypic data acquired and the genetic background of the root systems being analyzed. Because the entire local rhizosphere can be imaged, RootViz FS has distinct advantage over existing systems such as rhizotrons for root system analysis. The dynamic nature of the system also allows direct visualization of root responses to environment as well as differences in root architecture and morphology due to genetic variation. RootViz FS has been successfully applied to root system analysis of a variety of species including: poplars, willows, pine, switchgrass, rice, corn, tomato, and soybean.

Keywords: non-destructive analysis, non-invasive analysis, rhizosphere imaging, root imaging, rooting development, root morphology,

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Loblolly Pine: A Clear Choice for Biomass Production in the Southeastern U.S.

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Moving from fossil fuels to biofuels is an important objective, and there are different ways to tackle the problem. One way is to develop new kinds of raw material that will be easy to convert to biofuels, then develop the infrastructure needed to produce and process the new material. An alternative approach that we advocate is to start with the biomass currently available in large quantities and develop methods to convert it to biofuels. The southeastern US has over 36 million acres of loblolly pine forests, representing over 28% of the entire forested area (US Forest Service inventory data). Loblolly pine is adaptable to a wide variety of sites, including degraded land that is not suited for crop production, and production and harvesting infrastructure already exist. Biomass yields from pine can be readily increased by planting the most productive genetic material. Across a wide range of sites, high-yielding varieties are projected to produce about 40% more than average planting material, and more specialized combinations of genetic material and management regimes are projected to increase yields up to about 65%. We additionally believe that there may be planting and management strategies for loblolly pine that will allow co-production of biofuels and high-value traditional forest products. As the market for pine biomass develops, we will be working to provide landowners in North Carolina and across the southeastern US with high-quality pine seedlings to plant and cost-effective, sustainable management systems to allow landowners to achieve the best productivity.

Keywords: *Pinus taeda*, high-density plantings, multiple-use, genetic improvement

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Loblolly Pine Ideotypes for Feedstock Production under Short Rotation

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Loblolly pine is a highly productive ligno-cellulosic species that is grown throughout the southeastern United States. Its primary industrial use is wood and paper products with a host of secondary products being produced under various production and manufacturing scenarios. Biomass as a primary product for biofuels feedstock production could be desirable in many areas, especially on land less suited for traditional forest product production. In a study of two distinct clonal varieties, we found that both were highly productive on control plots; however, only the variety with low leaf area was highly productive when soil C:N was experimentally increased. This suggests that ideotypes could be selected from productive loblolly pine families that are optimal for specific site conditions and biofuel feedstock production. A large set of sibling clones further shows the potential for selection of optimal ideotypes including those with different crown architecture. Crowns that allow close spacing while maintaining high individual tree productivity through short rotations on nitrogen limiting sites would be ideal for biofuels feedstock production. Methods to efficiently characterize phenotypes and genome-assisted approaches to further the effectiveness and efficiency of selecting such genotypes in tree improvement programs will be explored.

Keywords: loblolly pine, *Pinus taeda,* ideotypes, genomics, tree improvement

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Productivity of Three Willow Species at Taupo, New Zealand

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Water quality is the paramount issue for Lake Taupo, and new regional and national initiatives are required to protect the water quality and enable economic land use activities. One new initiative is farming biomass for energy and high value extractives. Lower fertiliser inputs and deeper rooted plants reduce N leaching. Less fuel-dependent activities required over a rotation reduce gaseous emissions to the air and improve the economics of biofuel production.

A biomass trial was established at Rotokawa in the Taupo district in the winter of 2005. The trial was designed to determine best current practice in establishing and growing the crop, giving attention to species choice, cutting length, ground preparation, fertilisation and weed control.

As an indication of biomass production after one year, for each stool the maximum leader height and the number of shoots >0.5 m were measured. The number of stool deaths were also recorded. After one year *Salix* species performing well were *S. matsudana* × *alba* 'Tangoio', *S. viminalis* 'Gigantea, *S schwerinii* 'Kinuyanagi', and *S. purpurea* 'Irette'. Mean leader height range was 1.00-1.43 m. Mean number of shoots per stool range was 2.60-3.28 and mean stocking rate (i.e. survival) was 8995-10068 per ha. On this site at age one year, there was no apparent benefit of ripping, although this should be tested on future significant planting areas. The cutting length of 25 cm appeared to provide adequate height growth, number of shoots and acceptable stocking on this site. Stool deaths were accounted for primarily by inadequate cutting size, poor cutting-soil contact, hare damage and in some cases accidental contact with weed spray. Weed control in the establishment year was the major management issue

Data on biomass yields of the shrub willows after three years (2008) will be presented together with key lessons learnt during the project on the suitability of particular *Salix* species and their optimum management options.

Keywords: willow, establishment, cuttings, site preparation, *Salix*

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Life Cycle Assessment of Wood Pellets and Ethanol from Wood Residues and Willow

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This poster documents the environmental impacts of heat from wood pellets and ethanol from forest residues and willow, over the whole wood pellet/ethanol life cycle. The wood pellet life cycle includes forestry, sawmill, boiler to dry timber, planing, wood pellet production and transportation, and wood pellet combustion ('cradle to grave'). The environmental impacts from heat from wood pellets are compared with the impacts of heat from a heat pump. The ethanol from wood life cycle includes forestry and forest residue production for ethanol from forest residues, and the production of wood from willow for ethanol from willow. The life cycle stages common to ethanol from forest residues and from willow are transport to hogger, hogging, ethanol production, ethanol purification, and the operation of a passenger car. The environmental impacts of a mix of 5% ethanol 95% petrol are compared with the impacts of pure petrol.
This life cycle assessment aims to determine if the production of heat from wood pellets and ethanol from wood is viable from an energy point of view, and identify the environmental 'hotspots' in the wood pellet/ethanol life cycle. For the wood pellet life cycle, all environmental impacts presented in the report are given in terms of 1MJ of heat from wood pellets (the 'functional unit'). For the ethanol from wood life cycle, all environmental impacts are in terms of 1km distance driven by a passenger car. Renewable and non-renewable energy use, and the following environmental impacts, were evaluated: 1) global warming (GWP), 2) ozone depletion (ODP), 3) acidification (AP), 4) eutrophication (EP), and 5) photochemical ozone creation (POCP).

The impact assessment shows that heat from wood pellets has a significantly lower global warming potential than heat from a heat pump. The fuel used in the boiler to dry timber in the wood pellet life cycle has a large impact on the environmental performance, as wood pellets using a boiler fuelled by biomass from sawmill or forest residues has a significantly lower non-renewable energy use and global warming potential. Wood pellets produced using a biomass-fuelled boiler have a significantly lower non-renewable energy use than a heat pump. Using ethanol from wood as a partial substitute for petrol lowers the global warming potential and non-renewable energy use of the fuel. The production of ethanol from willow has a lower acidification, eutrophication, global warming, photochemical ozone creation and non-renewable energy use than the production of ethanol from forest residues. This is due to differences in the production of wood from pine forests and from willow forests, and the higher efficiency of the hogger used to hogged wood from willow. The uptake of wood pellets in household heating and ethanol in transportation would lower the use of fossil fuels in heating and transportation in New Zealand.

Keywords: Life Cycle Assessment, willow, ethanol, wood residues, wood pellets

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Woody Biomass Harvest from Willow Rings

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The hummocky morainic regions of the Great Plains are covered by numerous small water bodies, colloquially referred to as sloughs. The vegetation surrounding these sloughs can vary, however they are generally surrounded by a dense ring of willows in the zone between high and low water levels. Sloughs are often considered agricultural wastelands, however they perform important ecological roles from snow trapping, local groundwater recharge and soil erosion control to provision of valuable habitat for wildlife. We considered that coppice harvesting of willows may represent a sustainable management option where the harvested woody biomass has some economic value and the ecological functions of the willow are preserved. The objective of this study was to mechanically harvest willow from typical willow rings in the aspen parkland and determine willow biomass yield on a per hectare basis, quantify yield loss during harvest and develop post harvest management strategies.

Willow yield varied according to site ranging from 6.9 to 27.0 dry tonnes (dt)/ha. Yield variation was related to willow stem diameter and the stand density. Individual bale weight at harvest ranged from 136 to 238 kg (dry weight). When yields for the four study sites were combined, 3.7 dt of biomass was harvested from 0.25 ha of willow ring. This is equivalent to an average field yield of 14.7 dt/ha.

Keywords: willow ring, *Salix*, coppice, harvest, biomass

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Breeding *Salix* for Bio-Energy and Agroforestry

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In Canada, there is increasing interest in growing willows for environmental and economic reasons. The objectives of the AAFC-PFRA breeding program are to enlarge the genetic pool of willow in order to select new clones with strong adaptation to harsh conditions and to develop high biomass producing willow clones suitable for agroforestry, and biomass/bio-energy applications. The AAFC-PFRA willow breeding program follows traditional strategies of selecting superior individuals from genetically diverse populations. Selection and collection of willow germplasm was initiated in 2005. Individual trees of *Salix amygdaloides, Salix bebbiana, Salix petiolaris, Salix interior, Salix discolor* and *Salix eriocephala* were selected from natural stands in New Brunswick, Quebec, Ontario, Quebec and Saskatchewan, vegetatively propagated and planted in common gardens. Inter- and intra- specific breeding using *Salix interior*, *Salix discolor* and *Salix eriocephala* was initiated in 2008. The program focuses on improvement of traits with high heritability and strong correlation with biomass accumulation that can be easily and efficiently screened early during growth. Initial screening of genotypes is based on height and diameter, leaf area, cold hardiness and carbon isotope discrimination.

Keywords: willow, *Salix*, breeding, common garden, biomass, bio-energy, agroforestry

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Carbon Sequestration in Short Rotation Forestry and Traditional Poplar Plantations

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In recent years, the increasing funding of non-food crops provided by the Community Agricultural Policy (CAP) has brought about a series of changes in the traditional land use. In this light, considering that Short Rotation Forestry (SRF) could allow Italy to increase its quota of renewable energy production, several Italian Regions, where biomass thermoelectric power plants are under construction, have included in their Programme for Rural Development (PRD) a series of financial incentives to support the establishment and maintenance SRF plantations. For these reasons, SRF for energy purposes is rapidly expanding in Italy. In order to evaluate the carbon sequestration in traditional plantation and Short Rotation Forestry (SRF) of poplar, we measure the CO_2 exchange between atmosphere and canopy using eddy correlation (EC) technique during the years 2002-2005. EC allows to determinate the Net Ecosystem Production (NEP) in terms of carbon stored by the ecosystem. The areas of study are located in the northwest of Italy inside the Basin of Ticino river: the poplar plantation (*Populus* × *euramericana* clones I-214 spacing 6 × 6 m density 270 plants ha^{-1}) occupies an area of 120 ha. The SRF (*P. generosa* × *P. nigra* clone Pegaso) occupies an area of 80 ha: trees were planted in March 2004 using 1-year-old seedlings in a double row design with a spacing of 2.8 × 0.75 × 0.45 m corresponding to a density of 12.500 plants/ha. The three years observation in poplar plantations shows that the carbon uptake was stronger in 2003 than in 2002 for a period ranging from bud break up to around DOY 160 (early June). Afterwards, the 2003 Net Ecosystem exchange (NEE) was severely reduced. This trend may reflect the precipitation trends of the year 2003 that were comparable to year 2002 until April while, from May onwards, precipitation was much lower in 2003. The total annual sequestration of CO_2 was 22.9; 19.1 and 23.2 tons ha^{-1}, respectively, for the years 2002, 2003, and 2004. In SRF the annual carbon sequestration has been estimated as 11.2 and 27.5 t CO2 ha^{-1}, respectively, for the first and second growing season. In addition, in order to calculate an overall GHG budget for the examined SRF plantation, CO_2, CH_4 and N_2O emissions from agriculture machinery use (ploughing, harrowing, planting, harvest, irrigation, fertiliser and pesticides spearing) were estimated according to IPCC methodology. The resulting annual GHG emission, in terms of tons of CO_2 equivalent ha^{-1}, has been estimated in 1.03 and 0.59 for the first and second growing season, respectively. To further extend the GHG budget analysis, we modeled the GHG emissions/absorptions for 10 years in SRF and in a conventional, non-coppiced, poplar plantation. Based on data obtained from experimental experience and from literature, two level of productivity were hypothesized based on the level of potential productivity and intensity of the cultural practices: high (H) and low (L) inputs .The resulting CO_2 uptake has been calculated in 130 (L) – 183 (H) t CO_2 ha^{-1} for the poplar plantation and 134(L) – 235 (H) t CO_2 ha^{-1} for SRF. On the other hand, the CO_2, CH_4 and N_2O emissions from agricultural treatments and pesticide/fertilizer production resulted to 7.7 (L) – 11.5 (H) t of CO_2 equivalent for poplar plantation and 9.2 (L) – 23.4 (H) for SRF. Overall, these results indicate a very good GHG balance for both the cultivations and the different scenarios analyzed.

Keywords: carbon sequestration, greenhouses gas balance

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