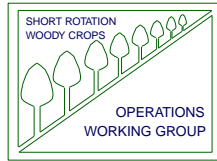

Short-Rotation Woody Crops

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resources, bioenergy system sustainability, and willow harvesting systems.

Spotlight on Timothy Volk

Timothy Volk, the new chair of the Short Rotation Woody Crops Operations Working Group, is very deserving of this leadership position. He is clearly a leader in the field of short-rotation woody crop research as evidenced by the fact that he was a lead or co-author on more conference presentations/posters (8) than any other individual at the meeting. Tim has published more than 23 peer-reviewed journal publications on willows, many reports and newspaper articles, and currently is a co-author on five journal papers in press.

Tim has been working on willows and agroforestry for the past 20 years in Canada and the Northeastern U.S. (attaining his Ph.D. in 2002). He is currently a Research Associate within the State University of New York's College of Environmental Science and Forestry and Director of the Short-rotation Woody Crops Program enabling productive collaborations with a great team of professional short-rotation forestry researchers and graduate students.

Willow is the key species involved in Tim's research on living snow fences, stream bank stabilization, phytoremediation of brownfield or contaminated sites, biomass



Photo by Lynn Wright August 21, 2008

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<http://www.esf.edu/willow/default.htm>

2008 Short-rotation Crops International Conference, August 18-21, 2008 in MN.

Credits:

Many, many people were involved in making this conference a great success. The steering committee for the conference included 38 people, but the lion's share of the credit for spear heading this stimulating meeting goes to Bryce Stokes, the Conference Chair, and Marilyn Buford, Conference Co-Chair and past President of the Short-Rotation Woody Crops Operations Working Group (both staff with US Forest Service Headquarters Research and Development). The time consuming job of reviewing and producing a publication of the abstracts was handled by Ron Zalesny, researcher at the US Forest Service Station; Rob Mitchell researcher at the USDA-ARS in Lincoln, Nebraska; and Jim Richardson with the Poplar Council of Canada. The University of Minnesota's Center for Integrated Natural Resources and Agricultural Management (CINRAM) contributed greatly by providing the registration and conference reporting website and assisting in local arrangements. Many government and private organizations were involved in sponsoring the meeting.

Meeting Summary Introduction:

Since most abstracts of meeting presentations are published in US Forest Service Technical Report NRS-P-31 and are available along with presentations at <http://www.cinram.umn.edu/srwc> the following contributions are an attempt to capture just one or two bits of interesting information from each presentation. I absorbed a great deal more about the current status of short-rotation crop technology by re-reading all abstracts and presentations. The notes that were assembled from the meeting and during this review are available on the www.woodycrops.org website. For this newsletter, the information is organized differently than from the meeting to hopefully give a fresh perspective on the information. Data are reported in the units used by speakers (either English or metric), but a table at the end, summarizes the yield data presented in both metric and English units,

together with the source. Since only the presenters are mentioned in the notes below to save space, apologies are made to the co-authors who also deserve a lot of credit.

Plenary Speakers and Messages:

John Ferrell, Manager of DOE Office of Biomass Program.

The Department of Energy remains very involved in supporting feedstock development and sustainability and integrated biorefinery options through interagency efforts. Key information resources brought to the attention of conference attendees was (1) The Biomass Crop Assistance Program (BCAP) in Section 9003 of the Food, Conservation, and Energy Act of 2008 (Farm Bill) and The National Biofuels Action Plan now available at <http://www1.eere.energy.gov/biomass/pdfs/nbap.pdf>

Ann Bartuska, Deputy Chief, Forest Service R&D

The Forest Service is continuing and enhancing research efforts relevant to bioenergy that have been underway for many years. There were hopeful indicators that more attention may be paid to short-rotation woody crops. The Forest Service website www.fs.fed.us/research contains a paper entitled "Why biomass is important – The Role of the USDA Forest Service in Managing and Using Biomass for Energy and Other Uses".

Gale Buchanan, USDA Chief Scientist and Under Secretary for Research, Education and Economics (USDA-REE)

USDA-REE is working to further awareness and research on bioenergy. Dr. Buchanan provided strong arguments regarding the wisdom of moving to a bioeconomy. He challenged conference attendees to devote their talents to helping secure the world's energy future.

New Stuff:

A new woody crop economic analysis model (for high-density willow plantings) can be downloaded for free from the SUNY-ESF website www.esf.edu/willow.

The new book – “Poplars and Willows in the World: meeting the needs of society and the environment” written by **J.G. Isebrands and J. Richardson** should now be available online. It is being published by FAO/IPC. The book provides a worldwide overview on poplars and willows.

A new group, the Council on Sustainable Biomass Production (CSBP), is developing sustainability standards. CSBP is supported by USDA and industry members. Field testing of consensus sustainability standards will occur in 2009. Information was presented by CSBP leader, John Heissenbutel.

An activity initiated in 2006, the Roundtable on Sustainable Biofuels (RSB) was brought to the attention of conference attendees by **Brenden George** of Australia. The RSB is a web-based international collaborative effort that has developed a list of principles for sustainable development and facilitates discussion of sustainability issues. These can be found at www.bioenergywiki.net a site hosted by the National Wildlife Federation and supported by wide range of international organizations including Petroleum and auto companies, the United Nations, government agencies from several countries. The RSB group invites participation from all individuals and organizations interested in sustainable biofuels development.

A new group called “Rural Advantage” is focusing on coming up with some interesting ideas and specific mechanisms for paying farmers for the ecological services that are provided when energy crops are grown. Check out the presentation by **Linda Meschke** in the Social and Policy Factors Session.

A new USDA-NRI program, the Coordinated Agricultural Project (CAP), will promote genomic approaches to U.S. Agriculture. **Brian Stanton** reported that a *Populus* CAP program is currently being organized by the USFS, Institute of Forest Genetics.

Organization Updates:

The 25' x 25' coalition, which believes America can provide 25% of its energy from bioenergy in 2025, has now increased its support base to over 900 individual and industry partners. Information presented by Bruce Arnold.

The joint DOE and Sun Grant Regional Feedstock Partnership currently consisting of 36 institutions has defined research needs and begun implementation of collaborative work on six feedstock types. Talk presented by Tim Rials, Sun Grant leader at the University of Tennessee.

DOE Biomass Program Biorefinery Investments were nicely summarized in a slide in the presentation made by Mark Downing of Oak Ridge National Laboratory.

The International Energy Agencies, Bioenergy Task 31 (Biomass Production for Energy from Sustainable Forestry), which is supported by 7 Northern European Countries as well as Canada and the US, was represented at the meeting by Jim Richardson, who described issues being addressed by the group (such as sustainable harvesting) and how to best utilize trees being destroyed by natural events such as hurricanes and insect damage. He noted that 60% of all forest wood removals are for energy.

The Poplar Council of Canada (www.poplar.ca) continues to be very active in conducting annual meetings, producing newsletters, sharing reports and forming working groups – based on the report by Jim Richardson.

Michigan Tech University has developed a “Wood to Wheels” (W2W) multidisciplinary approach to developing fuels and products from wood. Elements of the W2W were presented by **David Shonnard** and more information can be found on the Sustainable Futures Institute website; www.sfi.mtu/w2w.

University of Minnesota’s Center for Integrated Natural Resources and Agricultural Management did an excellent job of hosting the registration process for the Short Rotation Crops International Meeting and posting the presentations after the meeting which can be found at www.cinram.umn.edu/srwc/index.html.

International or Multi-regional Scope

Goran Berndes utilized maps and model results to show that only the US, Canada, Argentina, Russia, Brazil and Indonesia are in no- water stress areas especially with predicted climate changes. He believes bioenergy production worldwide can be integrated into agriculture in ways that will improve water productivity, and productive use of “blue/green” water flows without consuming more water. See more information in notes.

Hazen Kazaks reported that 7 of 11 Brazilian farmers in Parana, Brazil were not meeting the Brazilian mandate to dedicate 20% of farmland to natural vegetation. Of 11 Iowa farmers, most were participating at some level in USDA conservations programs, but several were testing corn on corn rotations, eliminating soybeans and increasing N inputs. In both countries about 25% of the farmers had a progressive worldview of farmland management.

Rob Mitchell, Ken Van Rees, Rick Hall, Ron Zalesny, and Mark Downing all discussed (in a panel format) the fact that there are still challenges facing the commercialization of herbaceous and wood energy crops in the US and Canada, but there are also opportunities.

Australia & New Zealand

Brendan George reports that arguments regarding competition for land, water, and nutrients (sustainability issues) are addressed frequently in the Australian press. While bioenergy is one of the options being address in Australia, it is having difficulty garnering strong support due to its complexity. There is no “silver bullet” bioenergy technology. George and others are involved in research on variety of native species that might have potential for short-rotation production in south-eastern Australia. **Ian Nicholas** reports that Scion, a government research organization in New Zealand, is evaluating the use of several different shrub willow species for bioenergy production and water quality improvement, in plantings established in 2005.

Brazil

Gerd Sparovek explained that 91% of expansion of sugarcane production for ethanol has

occurred in south central Brazil with no loss of forest due to the expansion but beef cattle density and production area was reduced. Limited sugar cane expansion in Amazon region has resulted in forest reduction but no affect on beef cattle production. Continued sugar cane expansion in Brazil will likely occur on current livestock areas. This could have negative economic and social consequences. An alternative is to intensify cattle production using sugar cane industry residuals. Also sugarcane and food production could occur on the same fields.

Canada

Lawrence Townley-Smith of Agriculture and Agri-Food Canada, described an analysis tool that has been developed to assist policy makers, industry and financiers understand Canadian biomass resource potential. The tool called the Biomass Inventory Mapping & Analysis Tool (BIMAT) is now available online (and can be found by searching on the name).

Sylvain Masse and his team used focus groups in Quebec and the Canadian Prairies to identify the issues of concern to farmers and to evaluate mechanisms that are effective in transmitting information to farmers. The need for documentation on clones and location/situation specific crop plans were the highest of about 8-10 very important issues. This presentation is highly recommended reading for those involved in implementation.

Canada – West

Cees van Oosten’s invited presentation provided a broad overview of the 10,750 ha of commercial and research plantings of poplars, aspens, and willows in western Canada. He informed us that a major driver for new plantations is the fact that while aspens predominate on 28.3 million ha most trees are over 40 years old, leaving a serious shortage of replacement stock.

Alberta Pacific representative, **Dave Kamelchuk**, described the companies 20 year leasing program with farmers within 200 kilometers of mills. Annual payments are being made plus farmers get a “finders” fee for signing up other farmers. “There would be no poplars in Alberta if

Alberta Pacific had not initiated the program”.

The Western Saskatchewan Forest Centre has recently installed a new (2008) demonstration planting (20 ac) of willows (reported by **Shannon Poppy**) and a trial investigating effluent and canal water irrigation on woody crops (reported by **Larry White**). A Canadian FS 3-row planter put the trees in the 20 acre planting in the ground at a rate of 7000 trees/ hr at a cost of 3 to 5 cents per tree.

William Schroeder reports that a “bio-baler” can be used to harvest natural (or planted) willow rings around wetland depressions in **Saskatchewan** however ruggedness of the machine needs improvement.

Canada – East

Michel Labrecque reported excellent results in several locations in **Eastern Canada** with wastewater sludge fertilization of willow over 4 rotations (15-22 dt/ha/yr). Abandoned clayed sites further north appear well suited for willow production.

Andrew Gordon makes the case for agroforestry as a viable energy crop production approach worldwide, including **Ontario**.

Europe

George von Wuehlisch reported that there are 1400 ha of experimental trials in **Germany**. NM clone (OP 388) is doing well on poor soils. The EU roadmap lays out a goal of 18% of energy from renewable by 2020.

Nils-Erik Nordh reported that about 15,000 commercial acres of willow currently exist in **Sweden**, but that only 200 new acres were planted in 2008. Tests demonstrated the planting season could not be extended beyond April – June.

Ioannis Dimitriou described advantages and hazards of using willows for phytoremediation. Eighty % of the short-rotation plantations in **Sweden** are fertilized after harvest with sludge mixed with wood ash.

Fabrizio Nardin described activities of the company **Alasia New Clones** in **Italy**. One approach to growing poplars is a two-year rotation production strategy. The tree density is 5500 to 6600 cuttings/ha (2227 to 2673 cuttings/ac) with 3m

(10 ft) between rows and 60 or 50 cm (24 or 20 inches) within rows.

Terenzio Zenone reported that there are 66,270 ha of conventional poplar and ~ 5000 ha of short-rotation poplars in **Italy** and that both types of forests are good carbon sinks. Lots of detailed data on carbon flux was provided.

Nele Witters of Belgium Presented results of modeling of multifunctional biomass systems showing that woody crops only are competitive economically when phytoremediation capabilities are valued in addition to biomass resources.

United States

US – Northeast

Tim Volk’s overview of the Northeast willow program highlighted an incredibly focused and successful program that began in 1986. The first totally private willow nursery (100 acres) was established in 2006. The “people factor” is seen as the biggest challenge to successful market penetration. Continued R&D support is needed during the early commercialization phase since 10 successes are needed to offset the negative effects of 1 failure. Small-scale heating is a big market opportunity for willow in the northeast and biorefinery processes allowing multiple products will lead to enhanced value of the willow crops.

Larry Smart is making new willow collections and breeding for yield, potato leaf hopper resistance, and other goals. Fifteen clones are exceeding SV1 yields. Seven clonal field trials are established across New York.

Thomas Buchholz described the beta version of new economic model (EcoWillow v. 1.0) developed at SUNY-ESF and provided graphs of several analysis runs.

Larry Abrahamson reported results from the new willow economic model showing that harvesting and establishment are the largest cost components. Willow harvesting trials with many machines has lead to a partnership with Case New Holland. CNH first refined the CRL cutting head for use on a CNH harvester and demonstrated harvest rates of 3.5 acres/hr. CNH has also built a new cutting head that looks very good in recent tests.

Jaconette Mirck found that the highest experimental dosage level of Solvay wastebed water caused signs of stress in three willow clones tested, but that significant differences existed among the clones. Results will facilitate designs for using willows to remediate Solvay wastebeds and similar industrial wastebed problems in the Northeast.

Amos Quaye reported on an experiment studying the impacts of paper sludge, manure and fertilizer applications. Lack of effects could have been related to low summer rainfall levels.

US North Central – Herbaceous

Jane Johnson reported results of the multi-state USDA Renewable Energy Assessment Project (REAP) which suggests that as much as 5.3 to 12.5 Mg/ha of residues need to be left on the ground to maintain soil carbon levels (more than is required for erosion control).

Ken Vogel reported that 10 farmers contracted to grow 6-8 ha fields of switchgrass were able to produce the crop on average at about \$50/dry Mg; the most experienced produced the crop as low as \$43.20/dry Mg. Net energy yields were very high. F1 hybrids in breeding trials are showing yields of 9.5 dt/ac/yr but it will take 10 years to get the new varieties available commercially.

Rob Mitchell analyzed the opportunity for using existing low-intensity, high-diversity native grasslands as an environmentally desirable bioenergy feedstock, but showed that no grouping of any 4 contiguous counties (or about a 25 mile radius) in **Nebraska** could supply a 50 million gallon ethanol plant. Experimental plantings of monoculture and polyculture grasses established in 2004 and 2005 produced much higher yield/acre. Monoculture switchgrass produced 5 dt/ac, but best yields to date have been a mixture of 3 grasses producing an annual yield of 6.7 dt/ac. He noted that at these yields, supplying a 50 million gallon ethanol plant would require only 7% of the land base in a 25 mile radius. A high-yield crop (10 dt/ac/yr) could supply that size biorefinery by just using the pivot corners of irrigated crops.

Margaret Mangan reported yields and chemical composition data from polyculture and monoculture herbaceous plantings established in 2006 at four locations in **Minnesota**. Yields varied

with locations and maturity at harvest (Nov 2007). While a 4-grass mixture had the highest yield at Lamberton, MN, switchgrass had the greatest overall potential ethanol yield. All native grasses had greater lignin and total carbohydrate concentration than the legumes or forbs. This is a very interesting presentation with lots of detail but also very large (130 MB).

Tom Voight reported exceptionally high yields with the sterile *Miscanthus giganteus* production in Illinois (22 to 35 dt/ha). It's very early leaf out and late senescence contribute to high yields, but also leads to crop damage where warm temperatures in early spring or late fall are followed by very cold temperatures. Photosynthesis can occur at temperatures as low as 8⁰ C, and it has survived temperatures as low as -26⁰ C during senescent periods. Cost of planting rhizomes is \$1500 to \$2000/ha.

Ken Moore described new approaches to management of herbaceous crops, such as 3 yr corn-3 yr switchgrass rotations or planting perennial cover crops between corn rows. He argues that sorghum and *Miscanthus* deserve further attention due to very high yield potential. Indiangrass was the highest producer of 4 perennial warm season grasses tested in Iowa. Fertilizer requirements for switchgrass and big bluestem optimize at between 90 and 120 kg/ha/yr.

Katie Peterson educated the audience on the benefits of using alfalfa as a bioenergy crop such as the ability to rotate the crop with corn, nitrogen fixing capability, and high value protein by-products. She also showed that feedstock quality varies due to environment.

US North central - Woody

Bill Berguson described the many accomplishments in poplar research in the North Central region since the last 1970's but noted that the research accelerated with the formation in 1997 of the Minnesota Hybrid Poplar Research Cooperative. Industry interest was driven by rising aspen stumpage prices. Now Verso Paper has 23,000 commercial acres of hybrid poplars planted for fiber and are a vital collaborator in the breeding program. Fertilizer studies show N to be the limiting element but that application should not occur till

basal area equals at least 20 sq ft per acre.

Bernie McMahon explained that the extensive North Central poplar breeding program, now in its 12th year has recently added N x M and N x Other crosses. Ten new clones (of previous crosses) are exceeding the yields of NM6 (current standard) in clone field trials at ages 3 to 5 yrs at levels of 1.8 to 2.6 x depending on site.

Ron Zalesny showed that poplar hybrids are performing best further north, while in Iowa, the pure *P. deltoides* are the best performers. Generalist clones, such as NM6 (and some new clones), look very good at several locations. Many older stands are suffering from Septoria canker.

Jill Zalesny reported that high salinity leachate and similar wastewaters are viable irrigation and fertilization sources for poplars in the North Central region.

Grant Domke presented evidence to show that shearing is an effective management tool for increasing stand stocking and growth rates of planted hybrid aspen in **Minnesota**. Yields of hybrid aspen are twice that of native aspen (but both are low – LW comment).

Raymond Miller found that currently commercial poplar and willow clones grown in the sandy loam soils of the upper Peninsula of **Michigan** reach a maximum yield of about 3.5 dt/ac/yr whether grown at low 680 trees/ac or high 7260 trees/ac density.

US – West

Jake Eaton reported that GreenWood Resources (GWR) is collaborating with cellulosic ethanol developer ZeaChem and projecting a potential ethanol yield per acre of 1500 gallons. This requires near maximum possible ethanol yield per dry ton and at least 10 dt/ac/year of biomass delivered to the biorefinery. Biomass production strategy involves 5 coppice rotations of 2 to 5 years using 2200 stems per acre planted at ~ 8 ft x 2 ft, and harvested with a heavy forage harvester.

Brian Stanton explained that the top four clones in current trials are showing a 20% improvement over standard clones with the best clone producing 29% higher yields. Improvement of composition for biofuels processing is currently a major push. NIR technologies look promising to

help with quickly screening clone composition.

John Brown had a memorable message, “If you plant it, they will infest!” He described several insect pests on western poplars and advised that it is important to know your pests, develop multiple monitoring strategies, and invest in research to determine economic injury levels.

Marcia Patton-Mallory presented a multi-institutional assessment of western US biomass supplies, both current and potential. Energy crops were a large component of potential supplies. Well placed biorefineries could supply 5 to 10% of the transportation fuel used in the western US at \$2.19 to \$3.00 per gallon of gasoline equivalent.

US – Southeast

Ed Richard described sugarcane as being an energy crop with “two pots of gold”, the sugars and the lignocelluloses. New varieties obtained by hybridization with *Miscanthus* and *Erianthus* are showing fantastic cold tolerance. Combinations of thick-stemmed grasses have the potential of providing nearly a year-round biorefinery feedstock supply without storage in the southern US.

Kelly Tiller reported that 723 acres of switchgrass are growing in Tennessee to provide a cellulosic supply for an ethanol fuel pilot plant that is being constructed. Plans are to expand to 6000 acres and John Deere is helping develop improved feedstock harvesting equipment.

Michael Cunningham claims that ArborGen bred eucalyptus have growth rates in southern Florida that are similar to those in Brazil, and have freeze resistance. ArborGen pines and sweetgum varieties are producing 6-9 dt/ac/year, and selected aspens are yielding 15 dt/ac/yr. He noted that one of the unique benefits of producing short-rotation wood for bioenergy is that the transportation infrastructure requirements can be as much as 15 times less than that needed for harvesting annual crops that have a short harvest window.

Steve McKeand presents compelling arguments for why pines (especially Loblolly) should be used for biofuels production in the southeastern US. They include breeding programs and nurseries in place, and excellent yield results of selected Loblolly pine genotypes.

Tim Rials provided information suggesting that among the various spectroscopy techniques available, that NIR spectroscopy appears to be very valuable for evaluating wood or grass properties when combined with MVA statistical analysis, and that it can be used in the laboratory, field and biorefinery.

Mark Eisenbies estimated that between 10 and 40 million metric tons of harvest residues are available in the southeast, but the economics is uncertain and the ecological feasibility is site dependent.

Hal Liechty described a new production system under evaluation in the Western Gulf region of the US that includes grass and tree combinations, such as switchgrass grown with cottonwoods or pines.

Selected Herbaceous and Woody Total Biomass Yield Numbers Presented at the August 2008 International Conference. Yields in bold are the units reported by the presenters.

CROP	LOCATION	YIELD: DT/AC/YR	YIELD: DT/HA/YR	SOURCE¹
Switchgrass, New F1 hybrids	Nebraska	9.5	21.3	K. Vogel, presentation
Switchgrass – Standard varieties	Nebraska	5.0	11.2	R. Mitchell, presentation
Switchgrass – new varieties	Nebraska	~10.0	22.4	R. Mitchell, presentation
3 perennial grasses	Nebraska	6.7	15.0	R. Mitchell, pre
Switchgrass	Minnesota – 4 sites	0.1 to 3.8	0.2 to 8.5	M. Mangan, slides
Canadian Wild Rye	Minnesota – 4 sites	0.36 to 3.9	0.8 to 8.8	M. Mangan, slides
Grass polyculture	Minnesota – 4 sites	0.89 to 4.1	2.0 to 9.1	M. Mangan, slides
Legume polyculture	Minnesota – 4 sites	0.05 to 2.0	0.1 to 4.5	M. Mangan, slides
Forb Polyculture	Minnesota – 4 sites	0.22 to 2.9	0.5 to 6.5	M. Mangan, slides
High Diversity	Minnesota – 4 sites	0.58 to 2.1	1.3 to 4.7	M. Mangan, slides
Miscanthus Avg of yrs 3-5	Illinois north	9.8	22	T. Voight, abstract, p. 65
Miscanthus Avg of yrs 3-5	Illinois central	15.5	34.7	T. Voight, abstract; p. 65
Miscanthus Avg of yrs 3-5	Illinois south	15.8	35.4	T. Voight, abstract; p. 65
Corn – total plant	Iowa	6.2 to 7.6	14 to 17	K. Moore, pre
Sorghum	Iowa	16.1	36	K. Moore, pre
Miscanthus	Iowa	19.6	44 (max)	K. Moore, pre
Sugarcane, high fiber; new varieties	Louisiana	10.2 to 13.9	22.8 – 31.3	E. Richard, pre
Sugarcane-Sugar Sugarcane-Fiber	Louisiana	4.7 to 6.6 5.8 to 9.3	10.5 – 14.8 13.0 – 20.8	E. Richard, abstract p. 47

Willow	Germany	Avg. 4.5, Range 1.8 to 11.1	Average 10, Range 4-25	G. Von Wuehlisch, presentation
Poplar	Germany	5.35 to 7.1	12 – 16	G. Von Wuehlisch, abstract, p. 17
Willow-SV1	New York	4 to 5	8.9 to 11.2	L. Smart, abstract; p. 54
Willow-new clones	New York	40% higher than SV1 in small plots		L. Smart, abstract; p. 54
Willow	Quebec, several climate zones	6.7	15-22	M. Labrecque et al abstract; p. 28
Willow	Upper Michigan	2.5	5.6	R. Miller, abstract; p. 36
Poplar-NM6	Upper Michigan	3.7	8.3	R. Miller, abstract; p 36
Poplar-NE222	Upper Michigan	2.6	5.8	R. Miller, abstract
Poplar - standards	Washington	5.3 (merchantable) ~6.4 (biomass) ²	12 (merchantable) ~ 14.4 (biomass) ²	B. Stanton, presentation
Poplar – new top 4	Washington	6.5 (merchantable) ~7.8 (biomass) ²	14.5 (merchantable) ~ 17.4 (biomass) ²	B. Stanton, presentation
Poplar - current	Minnesota	3.5 to 5.5	20.4	B. Berguson, abstract
Poplar - current	Minnesota-North	3-4	6.7 to 8.9	B. Berguson, pre
Poplar - current	Minnesota-South	4-5	8.9 to 11.2	B. Berguson, pre
Poplar - new clones	Minnesota-South	6 or more	13.4 or more	B. Berguson, pre
Poplar – new (best 6 clones in trials)	Minnesota-West	4-5 (age 10)	8.9 to 11.2	R. Zalesny, abstract; p. 72
Poplar – new (best 6 clones in trials)	Minnesota-South	4.6 to 6 (age 7)	10.3 to 13.4	R. Zalesny, abstract: p. 72
Poplar – new (best 6 clones in trials)	Wisconsin- Southwest	7.2 to 9.4 (age 8)	16.1 to 21.0	R. Zalesny, abstract; p.72
Poplar – new (best 6 clones in trials)	Iowa-Central	6.4-10.9 (age 9)	14.3 to 24.4	R. Zalesny, abstract; p.72
Plantation yields, species not noted	Southeast US	12-14	26.9	M. Cunningham, presentation
Sweetgum	Southeast US	8	17.9	M. Cunningham, pre
Eucalyptus	Southern Florida	20-24	44.8 to 53.8	M. Cunningham, pre
Loblolly	Southeast US	6-9	13.4 to 20.2	M. Cunningham, pre
Aspen (new clones)	Northern US	15	33.6	M. Cunningham, pre
Aspen (age 10)	Iowa	9.8	22	R. Hall, presentation
Eastern Cottonwood irrigated & bedded	Arkansas; Delta region	1.9	4.3	H. C. Stuhlinger, poster abstract; p. 57
Eastern Cottonwood un-irrigated & sub- soiled	Arkansas; Delta region	0.93	2.1	H. C. Stuhlinger, poster abstract; p.57

¹ Where the source is given as “presentation or pre”, it is information provided during the verbal presentation of the person named, but not verifiable in either the abstract or presentation hardcopy (referred to as slides).

² Presenter provided only merchantable yields, biomass yields were assumed to be 20% greater.

CONFERENCE TOUR - AUGUST 21, 2008
UNIVERSITY OF MINNESOTA SOUTHERN RESEARCH AND OUTREACH CENTER (SROC)
WASECA, MINNESOTA



Figure 1. Lynn Wright in a 9 yr old clone trial at the SROC

The site has 200 acres of land well-suited for agronomic, wetland and water management studies. High quality agricultural soils at the SROC provide an opportunity to realize rapid growth of biomass plants and thus very quickly see the results of clone and variety comparisons. Evaluations of management approaches for corn and soybeans, such as precision farming technologies, occupy much of the acreage. The SROC is also involved in swine, dairy, and dairy-beef research. The study of biomass crops was first added to the mix of research on the site in the year 2000 with the establishment of a hybrid poplar variety trial at 6 ft x 6 ft spacing. While these trees were not discussed during the tour, I had a personal interest in checking them out since I had played a small role in helping to get the project established. I was surprised that these 9 year old trees still looked very healthy and little mortality was evident (Fig. 1).

In the last 10 years several additional variety trials of both poplars and willows have been added, as well as a multiple herbaceous species comparison trial, and an evaluation of landscape position on the growth of eight of the faster growing biomass species. The tour actually started next to a willow variety trial planted in 2005. Since the clones in the trials were from the willow program at the State University of New York, the originator of the materials, Larry Smart and Tim Volk provided information about the trial to an interested group of tour participants.



Figure 2. Larry Smart talking about the willow trial as Tim Volk watches.



Figure 3. A portion of the conference tour group learning about the willow trial. The 10 yr old poplars are on the left.

Survival of all but one variety, SV1 has been greater than 90%, with most close to 100%. A comparison of cross-sectional areas shows all of the varieties growing at a faster rate than SV1 and one clone had a cross-sectional area more than 3 times that of SV1.

Field studies were established at the SROC in 2006 and 2007 to evaluate the effects of landscape placement, as well as species differences in fiber and fermentable sugars. Even though the whole site appears to be almost flat to this writer, the investigators managed to find as much as 6 feet difference in elevation and were able to establish replicated plots in seven landscape positions. According to the description provided by Gregg Johnson, our tour guide for this study, each plot contained alfalfa, corn, two willow varieties, switchgrass, cottonwood, and poplar. My pictures and the diagram handed out also appear to show False Indigo as an eighth species, but perhaps it was eliminated from the study due to poor survival.



Figures 4 a&b. Gregg Johnson, pointing out the species comparison plot – shown on right – at the “summit” landscape position.

The Waseca site also included a comparison of many additional herbaceous and shrub species referred to as the “Big Study” according to my tour notes. I don’t have a complete listing of all species involved but based on notes and pictures, they included: Willow Sx67, False Indigo, Wild Artichoke, Late Lilac, *Miscanthus giganteus*, several switchgrass varieties, Bonilla Big Bluestem, Goldenrod, and Reed Canarygrass. I noted that a yield of the Artichoke was reported to be about 4 dry tons/acre aboveground. The *Miscanthus* was not a particularly good stand, due to winter kill.



Figure 5. Craig Sheaffer showing the Wild Artichoke with False Indigo in the background.



Figure 6. The tour group checking out the tall *Miscanthus*, just past the shorter Late Lilac.

There were several high potential grasses within the species comparison trial. Several are shown below.



Figure 7. A lovely variety of Big Bluestem (Bonilla).



Figure 9. Chieftain Reed Canarygrass



Figure 8. Cloud 9 Switchgrass.



Figure 10. Sunburst Switchgrass

The most unexpected species included in the trial, from my perspective, was Goldenrod, a common weed.



Figure 11. Goldenrod with pretty flowers, but less height than the surrounding grasses.

POST CONFERENCE TOUR – SEPTEMBER 22, 2008

VERSO PAPER COMPANY COMMERCIAL HYBRID POPLAR PRODUCTION

Verso Paper Company graciously invited conference attendees to visit an early progeny and provenance trial maintained by Verso Paper, the Verso nursery, and an early age commercial planting including yield blocks and new clone and family trials. The planting program being highlighted, was started in 1995 by Champion Paper Company with a goal of creating a wood resource closer to the Sartell Paper Mill, which makes light weight

coated paper. Since the initiation of the planting, the mill and wood supply was sold to International Paper, and then resold to Verso Paper. The planting program continued through the change of companies with approximately 2000 acres being planted per year since about 1997 with a goal of 25,000 acres and a total of 23,000 acres currently in the ground mostly in Douglas, Ottertail and Todd counties in the West Central portion of Minnesota.



Figure 12. Bill Berguson and Bernie McMahon explaining the early clonal, progeny and provenance trials established in 1999 at tour site # 1.

The first tour stop contained both an open pollination collection of 78 provenances of cottonwood (*P. deltoides*) collected in Minnesota and a control pollinated collection of 21 full-sib progeny of DxD (*P. deltoides* x *P. deltoides* crosses). These trials are providing materials being evaluated not only for growth, but also for rootability. Two smaller clonal comparison trials are providing very interesting material for further breeding. In particular several *P. deltoides* x *P. maximowiczii* hybrids are showing excellent growth.

Figure 13. Select female hybrid poplars (*P. deltoides* x *P. Maximowiczii*) are tagged with orange flags.



Figures 14 & 15. Bernie McMahon describing the various stages of the hybrid poplar breeding trials established at the Verso Paper Nursery at tour stop # 2



Figure 16. Tour participants in awe of the depth and breadth of the breeding and testing program being led by Bernie McMahon and his collaborators at the University of Minnesota's Natural Resources Research Institute.

The trees at Verso Paper Tour Stop # 3 were in their second growing season, having been established in spring of 2007. The site contained commercial fiber farm acres, and both clonal and family field trials.



Figure 17. Dan Langseth of Verso Paper is explaining the management approach to the tour group.

The trees are established at 10 x 10 ft spacing on cropland. Glyphosate is used to kill existing vegetation and the site is well cultivated prior to planting. Immediately after planting, the trees are oversprayed with a pre-emergent herbicide mix (such as Scepter and Pendulum). A second cultivation is usually done about 45 days after planting. Problem weeds such as thistle and grass are spot sprayed. After the first growth season,

a pre-emergent is applied in each fall until the site reaches crown closure, usually about year 3 or 4 at 10 x 10 spacing.



Figures 18 & 19. These photos show the rapid tree growth and the successful weed control regime of Verso Paper.

This very successful and informative tour ended as the windy conditions and storm began brewing in the west. Hopefully all carried enjoyable memories of the presentations and tours to their respective home and countries.