Short Rotation Crops in the United States

Lynn Wright, Deputy Manager
Bioenergy Feedstock Development Program'
P.O. Box 2008
Oak Ridge National Laboratory
Oak Ridge, TN 3783 l-6422

with substantial input from
Bill Berguson, Natural Resources Research Institute, University of Minnesota
Jim Cooper, Chariton Valley Resource Conservation and Development District
Sam Land, Mississippi State University
Timothy Volk, State University of New York - Syracuse

Abstract

The report is based primarily on the results of survey questions sent to approximately 60 woody and 20 herbaceous crop researchers in the United States and on information from the U.S. Department of Energy's Bioenergy Feedstock Development Program. Responses were received from 13 individuals involved in woody crops research or industrial commercialization (with 5 of the responses coming from industry). Responses were received from 11 individuals involved in herbaceous crop research. Opinions on market incentives, technical and non-technical barriers, and highest priority research and development areas are summarized in the text. Details on research activities of the survey responders are provided as appendices to the paper. Woody crops grown as single-stem systems (primarily *Populus* and *Eucalyptus* species) are perceived to have strong pulp fiber and oriented strand board markets, and the survey responders anticipated that energy will comprise 25% or less of the utilization of single-stem short-rotation woody crops between now and 2010. The only exception was a response from California where a substantial biomass energy market does currently exist. Willows (*Salix* species) are only being developed for energy and only in one part of the United States at present. Responses from herbaceous crop researchers suggested frustration that markets (including biomass energy markets) do not currently exist for the crop, and it was the perception of many that federal incentives will be needed to create such markets, In all crops, responses indicate that a wide variety of research and development activities are needed to enhance the yields and profitability of the crops. Ongoing research activities funded by the US. Department of Energy's Bioenergy Feedstock Development Program are described in an appendix to the paper.

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The Department of Energy (DOE) of the United States initiated a national program of research on short-rotation woody crops research 20 years ago (1978) in response to oil supply disruptions and concerns about rising fossil fuel prices. Some work had been done previously by the U.S. Forest Service. Herbaceous crops research was added to the Department of Energy's program about 1984. DOE's Oak Ridge National Laboratory (ORNL) has provided management oversight and technical leadership over that period of time. United States Department of Agriculture (USDA) research units have been collaborators in both woody and herbaceous crops research over the past 20 years. The Department of Energy's investment in energy crops research has fluctuated between $6 million in the mid-1980s to a current level of only $3.5 million in 1998. The focus of the national program has changed with considerably more emphasis on economic, environmental, and policy research and analysis with the actual crop development work diminishing to a level of effort of only about $2.0 million. However, significant progress in hybrid poplar improvement together with market demand by the fiber industry has resulted in substantial commercialization of short-rotation woody crop (SRWC) technology for production of fiber. That in turn has promoted additional investment in woody crop development research by the forest products industry, and increased participation and support of the USDA Forest Service. The herbaceous crops research has progressed from a species screening activity in the late 1980s to a focus on switchgrass improvement in the 1990s. Commercial markets have not yet arisen for switchgrass, although it is currently being viewed as the favored feedstock for both biomass-derived liquid fuels and biomass power on the basis of cost of production.

The substantive portions of this paper were derived from the input of 13 woody crop researchers and 11 herbaceous crops researchers in the United States who responded to survey questions distributed to about 60 woody crop researchers and 20 herbaceous crop researchers via electronic mail. The survey questions are provided in the appendices A and B, together with the names, addresses and research interests of US. researchers interested in the International Energy Agency activities. All responses were used to summarize opinions on energy markets, technical barriers, and non-technical barriers.

Short-Rotation Woody Crop Survey Responses

The thirteen survey responses received on SRWC research provided a good sample of the types of woody crop research being performed in the United States, even though several institutions which perform woody crops research did not respond. The twelve responses, which focused on poplars or other single stem woody crops, included a good mix of university and private sector researchers. Willow research is the focus of attention only in the Northeast with a very recent expansion of clonal trials to the north central region of the United States. While the U.S. Department of Energy's Bioenergy Feedstock Development Program is still very connected to most of the SRWC being pursued in the United States, the private sector has a much higher level of investment in developing the technology than the U.S. government. Private sector investment is occurring both through internal research programs and cooperatives. Westvaco, Union Camp, Potlatch, and Boise Cascade are examples of companies with significant internal research programs. More than twelve fiber companies and a utility research institute are supporting the Tree Genetic Engineering Research Cooperative, and the Poplar Molecular Genetics Cooperative. The Minnesota Hybrid Poplar Research Cooperative, and the Willow Consortium and examples of cooperatives with mostly regional support. Most of the research cooperatives have developed over the past 5-6 years and were greatly facilitated by the efforts of Gerald Tuskan, the woody crops task manager for the Bioenergy Feedstock Development Program.

The survey results show that the dominant market for single-stem woody crops is pulp fiber, but biomass energy was deemed to be a secondary market by several private sector as well as university researchers.

Willow is being targeted for a biomass energy market, although commercial crops are only beginning to be established this year (with federal support). Several survey responders included other possible markets or necessary incentives for production. Possible markets for SRWC identified by the13 survey responses included the following: pulp fiber (12), biomass energy(S), carbon sequestration (7), fiber board (6), soil remediation (6), lumber (4), buffer strips (4), shelterbelts (3), and salmon habitat restoration (1).

The response by Bill Berguson of the Natural Resource Research Institute of the University of Minnesota -Natural Resources Research Institute provides some insight into the current market situation for hybrid poplars in the North central part of the United States. He says,

> "The primary driving force in our region (Minnesota, specifically) is timber availability for production of paper and oriented strand board (OSB) sheathing. Wood markets for these products have grown and prices have increased. I don't know what you arc meaning specifically by fiberboard, but I would put OSB in the fiber board category although there are many permutations of fiber board such as low-density fiber board (insulation and sheathing), medium density fiberboard (used in the furniture industry) as well as high-density fiberboard (in automotive and furniture). At this time, delivered prices for aspen range from $55.00 to $70.00 per oven dry ton. Prices in this range make hybrid poplar a reasonable alternative to natural stands. Biomass for energy would likely be a by-product of harvesting of hybrid poplar for wood products. I could see the tops and limbs being used for energy. I hate to be too negative but, based on our discussions with those in the energy industry, wood has to be so cheap in order to compete with coal for base load power that we can't grow it in our region and still return a profit to landowners. I've heard that deregulation of the energy industry is causing some to shy away from many higher-priced options because competition is getting so fierce in the energy industry."

A similar situation is observed by Sam Land in the South. He says,

> "Pulp fiber and fiber board (oriented strand board) will be the greatest reasons for expanded SRWC production in the lower Mississippi River Valley. Soil remediation of farm fields may provide some incentive for SRWC."

Timothy Volk of the State University of New York sees a very different picture for willow. He says,

> "The major market will be for energy. There is some ongoing work looking at willow for fiber board but situations will probably have to be fairly specific to make it work at this point. Being able to integrate dedicated willow biomass crops with biomass from low grade hardwoods and thinning material will be a boost to both segments. There is growing potential for that kind of integration because of the weakening demands for low grade hardwood as (pulp and paper) mills in New York and the surrounding region close. Growing pressure to reduce non-point source pollution is pushing the USDA to implement programs on riparian buffer strips. Willow biomass crops have already been identified as a beneficial component of buffer strips in New York State. Growing interest in phytoremediation of contaminated sites has presented another opportunity to obtain multiple benefits from willow biomass crops. In addition to the enhanced degradation or uptake of contaminants on some sites, willow provides attractive visual cover and acts as a physical barrier."

The responses to the question on energy use for SRWC indicated that strong drivers for using SRWC

wood for energy are not perceived to exist at this time. The most common response for single stem SRWC was that by 2010 energy usage would be 10% or less, with one 50% estimate, one 25% estimate, and two 20% responses, The 50% estimate for usage SRWC for energy was from a researcher reporting on production of Eucalyptus in California. Since California is the only place in the United States with a significant amount of biomass power being produced (outside of the fiber industry itself), it may be an indicator that if more energy markets are created, the amount of SRWC wood that will be used for energy will increase. While the willow being planted in the Northeast (on very limited acres) is 100% targeted for energy now, it was predicted that other uses would reduce that to 90% by 2010.

Estimates of hectares of commercial plantations in 1998, 2005, and 2010 showed an anticipation of a doubling in the Pacific Northwest by 2010, a tripling in the North Central region and a multi-fold increase in the Southeast. While the exact number of SRWC hectares currently in the United States is not known, it is likely to be in the range of 30,000 to 50,000 hectares depending on whether one includes unsuccessful plantations established in the South during the early 1980s. By 2010, it is estimated that about 200,000 hectares may be planted. Policy changes associated with reducing greenhouse gas emissions could result in more land converting to SRWC.

Survey responses on technical and non-technical barriers to expanded utilization of single stem woody crops for energy included the following:

> "High cost for establishment and culture of SRWC, and low market value of energy wood." (Sam Land)
>
> "Subsidized petroleum products in the United States." (Steve Strauss)
> "Lack of cost-effective conversion technologies for converting wood to liquid fuels." (Toby Bradshaw).
>
> "Price of fuel, harvesting technology, transportation infrastructure (in some cases)." (Bruce Hartsough)
>
> "Cost/ton of dry fiber." (Ken Munson)
>
> "There really are no technical barriers ... utilization will be dependent on economic returns to landowners and end-users, which is heavily dependent on yield. (Bill Berguson)
>
> "There are always challenges in improving energy conversion technologies and woody crop production, however the primary barrier is that the crops are far too expensive for use as fuel and far too valuable for use as forest products." (Tom Houghtaling)
>
> "SRWC used mainly as a source of raw material for pulp production" (Randy Rousseau)
>
> " The largest barrier to use by mills is the lack of a continuous supply of logs" (Jon Johnson)
>
> "none" (Bob Kellison)

Tim Volk of the State University of New York in Syracuse, NY provided a lengthy comment on technical and non-technical barriers associated with willow. The following is a paraphrased version of his comments.

Non-Technical barriers include: lack of a reliable and solid market for willow biomass crops, need for economic valuation of the environmental and rural development benefits associated with willow biomass crops, need for policy and economic incentives that would reduce the burden for, establishment costs that currently would be born entirely by the producer, need for policy commitment to renewable energy portfolios in the region. Technical barriers include: questions about use of biosolids and manures on willow biomass crops as a replacement for commercial fertilizer, need for quantified information on environmental benefits, need for improved understanding of potential insect and disease problems, need for genetically improved clones with higher yield potential, increased pest and disease resistance and improved form, need to optimize harvesting equipment for local conditions, and need to optimize chemical and mechanical weed control.

With respect to the most important research and infrastructure development issues needed to expand commercialization, the researchers tended to list whatever area they were most interested in and currently working on. However, most if not all of those areas were also listed by one or more of the survey responders from industry. Recommendations from university researchers working on poplars and eucalyptus are quoted below:

"Cold tolerance (for eucalyptus) in some areas" (Bruce Hartsough)

"Breeding for improved yield, control of pests and pathogens by breeding and silviculture, improved coordination among regional breeding centers" (Toby Bradshaw)

"Improved gene transfer methods for commercial genetic engineering, means for engineering sterile trees for biosafety/public acceptance, development of more high value products with stable markets" (Steve Strauss)

"Breeding of genotypes that are adapted to a wider variety of site types, ways of reducing establishment costs- especially through use of safe herbicides, marketing of the product, and, more effective pest management methods" (Sam Land)

Industry researchers/managers identified the following as the most important R&D issues for poplars and eucalyptus.

"Development of a herbicide that can be applied over trees during the growing season" (Randy Rousseau)

"Improvement of weed management techniques that are feasible and reliable on a large scale, genetic selection for consistent growth and low-risk, nutritional needs, returns from fertilization" (Tom Nichols)

"Biotechnology - creating new trees with value-added traits" (Ken Munson)

"Improved yields, better pest resistance, lower cost cultural practices, and new (lower-cost) harvesting technology (compared to available technologies)" (Thomas Houghtaling)

"Improved economic returns" (Chuck Wierman)

"Genetic transformation for herbicide, insect, and disease and gene sterility" (Bob Kellison)

Timothy Volk suggested the following high priority R&D areas for willows:

-Optimization of the production system including weed control,
-Reducing erosion during establishment,
-Modification of machinery for North American conditions,
-Effective use of waste products such as biosolids and manure,
-Development of a breeding and testing program for new clones, and
-Quantification of environmental benefits so that a value can be placed on these attributes.

Herbaceous Energy Crop Survey Results

More than half of the institutions involved in switchgrass (*Panicum virgatum*) research in the United States responded to the survey questions. The survey asked for input on any non-food, non-feed crops being evaluated in the United States. The majority of the responders focused on switchgrass (since the survey was sent to switchgrass researchers), but some other herbaceous crops were included, such as bahiagrass (*Paspalum notatum)* and Reed Canary grass (*Phalaris arundinacea* L.). Research on switchgrass and other energy grass candidates is being done almost exclusively by universities and U.S. Department of Agriculture research stations and Plant Materials Centers, though some farmers are becoming involved through publically supported biomass energy projects. The recent connection of the USDA Plant Materials Centers with the research of the U.S. Department of Energy's Bioenergy Feedstock Development Program is resulting in testing of switchgrass over an expanded range and engages the participation of units with a long-standing history of effective technology transfer of crop information to the farm community. Names, addresses and research interests of researchers responding to this survey are provided in Appendix B

There are two projects in the United States involved in demonstrating the use of herbaceous crops as feedstocks for energy. One exists in southern Iowa under the leadership of Jim Cooper of the Chariton Valley Resource Conservation and Development District, Incorporated. This project is one of the 'Biomass Power for Rural Development" projects that was initiated in 1997 by the US. Biomass Power Program. Over 4000 acres of switchgrass established on Conservation Reserve Program land will be harvested and supplied to a local utility for co-firing testing applications. Numerous farmers are involved in the Iowa project. Research support is being provided by Iowa State University to advance the breeding and selection of switchgrass for that region, to evaluate the economics and to study the environmental consequences of switchgrass production on erosion, biodiversity and soil carbon sequestration. A second project is just getting started in Alabama on 300 acres of land with the participation of a single farmer in association with the research participation of Auburn University. The harvested switchgrass will most likely be supplied to a local utility owned by Southern Company to also test co-firing applications although formal arrangements are not in place as of this writing.

Biomass energy was deemed to be only moderately important as a market for non-food, non-feed herbaceous crops over the next 10 years. Many of the responders felt that soil conservation, soil remediation, buffer strip protection, and soil carbon sequestration would be the more important drivers for planting of crops like switchgrass in the near term.

Most of the survey responders did not address the question about current and anticipated hectares of non-food, non-feed herbaceous crops in the United States largely because they were not convinced that markets will exist. Of those who did respond to that question, mention was made of the significantly

increasing amounts of land dedicated to cotton production and the production of grass for turf. Switchgrass was planted on several thousand hectares for erosion reduction and soil improvement as a result of the Conservation Reserve Program (CRP) initiated about 10 years ago in the United States. However, CRP lands cannot be harvested except under special permission from the U.S. Department of Agriculture. There is a desire to change that policy so that grasses grown on CRP land could become a partially subsidized feedstock for biomass energy applications, but nothing beyond talk has occurred in that regard. Analysis currently being conducted by Oak Ridge National Laboratory staff in collaboration with USDA and University of Tennessee staff indicate that several millions of acres of switchgrass would be profitable under energy and environmental policies that would support prices for switchgrass in the $30 to $40/dry ton range.

The herbaceous crops researchers at the Plant Materials Centers had many opinions about non-technical barriers to the commercialization of herbaceous crops for energy, as listed below:

> "Lack of local market outlets for producers, need for guaranteed pricing" (Tony Bush)
>
> "No established market, no demonstrated demand, establishment of perennial warn-season grasses such as switchgrass is uncertain." (Roger Gates)
>
> "A strong, consistent market demand for a herbaceous crop is needed as well as alterations in the guidelines in current Farm Bill regulations to utilize certain programs in the production of herbaceous crops for energy purposes." (Martin Van der Grinten)
>
> "Comparative costs between energy sources. Need for tax incentives for promotion of product. Marketing and distribution of product." (Jerry Kaiser)
>
> "Markets - Producers will learn how to grow any product if a market exists. We have sufficient knowledge to begin production. Most of these crops don't require a degree of specialization." (Lance Tharel)

The university and USDA researchers also had a few thoughts on the topic of non-technical barriers,

> "Non-technical issues include the need to define and quantify the economic/political "value" of using these materials as a sustainable resource." (Jim Cooper)
>
> "There are essentially no technical barriers. It is not profitable at this time so it is not being done." (John Cundiff)
>
> "Infrastructure (markets, commodity support programs, commodity interest groups, Conversion technologies (biomass to liquid fuels), Inherent conservatism of agriculture" (David Parrish)
>
> "Sufficient acreage in a small enough area to keep trucking cost down. Cost of production/ price paid for the product. Getting a stand of switchgrass!! !! !! Developing management programs to keep the plant alive and productive." (William Ocumpaugh)
>
> "Risk abatement: For the farmer, assurance that the market is (1) dependable and has some probability of being profitable and (2) is long-term, i.e. the program won't disappear next year or the year after the farmer establishes his stand. Absence of infrastructure for transporting and storing biomass." (Dennis Rowe)

Only a few researchers identified technical barriers to the commercialization of herbaceous crops for energy. The responses appeared to be specific to their parts of the country and/or the stage of research and development. From Texas and Georgia, there is concern about the ability to achieve successful stand establishment on a consistent basis. In Iowa, where substantial acreage already exists, the concern focuses more on technical improvement needed in harvest and handling methods. Concern about the technical readiness of conversion technology especially for converting biomass to liquid fuels was expressed. The need to increase yields was identified as being related to profitability issues but another responder emphasized that producers have sufficient knowledge to begin production. While non-technical barriers to commercialization are perceived to be more important than technical barriers, a variety of high priority research topics were provided by survey responders,

Similar to the woody crop researchers, herbaceous crop researchers had a wide range of suggestions on the highest priority research and development needs for expanding commercialization of non-food, non-feed herbaceous crops, These are quoted below.

> "Establishment problems and then utilization issues." (William Ocumpaugh)
>
> "Demonstration of power and liquid fuel production from biomass at competitive costs," (Roger Gates)
>
> "Breeding and evaluation for preferred biomass energy traits; harvesting (timing, mechanics); storage; transportation; and economic analysis." (Jim Cooper - paraphrased)
>
> "Basic biotechnology on important species (for the long term)."(Bob Conger)
>
> "Development of extension guidelines for energy crops." (Dennis Rowe)
>
> "Infrastructure and federally-funded incentives to get a biofuels programoff the ground. More information on carbon sequestration potential for biofuels crops. Long-term studies on the agronomic viability of switchgrass stands." (David Parrish)
>
> "Public policy mandating use of renewable resources for some percentage of energy." (John Cundiff)
>
> "Practicality, efficiency." (Tony Bush)

Summary

Many of the research and development issues listed by the survey responders are under investigation by the Bioenergy Feedstock Development Program funded by the U.S. Department of Energy. Brief descriptions of those activities, contact information for program staff, and lists of current subcontractors and collaborators with the program can be obtained by visiting the Web site
http://www.esd.ornl.gov/bfdp

Appendix A

Survey Questions on

Short-Rotation Woody Crops in the United States

with

list and addresses of researchers responding

Survey on Short-rotation Woody Crop (SRWC) Research & Development

Name, address, phone, fax & e-mail

Region: Pacific Northwest, North Central/lake States, Northeast, Southeast, Mississippi Valley, South Central/southern Plains, Mid-west, Mid-Atlantic (circle region of your activity)

Estimate of total commercial hectares of short-rotation woody crops per region circled above: in 1998 (), possible by 2005 (___), possible by 2010 ( ).

What markets or incentives are likely to promote expanded SRWC production in your region by 2010? Circle as many as apply: pulp fiber,carbon sequestration, fiber board, shelterbelts, lumber, buffer strips, other fiber products, soil remediation, biomass energy, other or combination.

What % of SRWC production is likely to be used for energy production in 1998 (___), by 2010 (___)?

What are the technical and non-technical barriers to expanded utilization of all or portions of SRWC for energy?

List areas of woody crop research, development, or implementation that you would be interested in learning about from IEA Bioenergy Short Rotation Crop Task Participants.

Are there any research, development, or implementation issues on which you would like to be involved as a collaborator with other IEA Bioenergy Short Rotation Crop Task participants.

Species which is the focus of your research activities _____

Primary types of research activity ongoing? (List general catagories only)
(1) by your institution or company, (2) by other groups in your region

If breeding, how many seed sources, families, or genotypes are included in your breeding population?

If field testing newly bred materials (outside of the nursery); how many families or clones are currently being tested? How many places are the same materials being tested? What clone is being used as a check?

Approximately how many clones/full-sib families/half-sib families are being used operationally in your region?

List any key research papers or publications that IEA Bioenergy Task Participants might be able to request in order to learn more about your research activities.

What do you believe to be the most important research or development issues that need to be addressed to promote expanded commercialization of this species?

A. 1. University/Forest Service Researchers Responding to Short-rotation Woody Crops survey

Name and Address	Comments
Bill Berguson University of Minnesota Natural Resources Research Institute 5013 Miller Trunk Highway Duluth, MN 55811 Ph: 218-720-4296, Fax: 218-720-4219 e-mail: bberguso@sage.nrri.umn.edu	This organization is involved in breeding and clonal testing of hybrid poplars, nutrition and fertilization studies, cultural practices, and large-block yield studies. Detailed descriptions were provided for this report but cannot be included. "We are very interested in participation in activities similar to ours"
Toby Bradshaw University of Washington Seattle, Washington Ph: 206-616-1796, Fax: 206-685-2692 e-mail: toby@u.washington.edu	He leads the Poplar Molecular Genetics Cooperative. He is interested in collaboration on genetics and breeding of hybrid poplars.
Bruce Hartsough Biological & Agricultural Engineering University of California One Shields Avenue Davis, CA 95616 Ph: 530-752-8331, Fax: 530 752-2640 e-mail: brhartsough@ucdavis.edu	Work involves harvesting and utilization issues and he would be interested in collaborations in this area.
Jon D. Johnson Washington State University -Puyallup 7612 Pioneeer Way E. Puyallup, WA 98371 ph: 253-445-4522, fax: 253-445-4569 e-mail: poplar@wsu.edu	Work involved production physiology, disease resistance, breeding and progeny testing, application of hybrid poplars in waste management issues and for riparian buffers. He has a general interest in knowing what other IEA participants are doing.
Dr. Samuel B. Land, Jr. Mississippi State University Department of Forestry Box 9681 Mississippi State, MS 39762 Ph: 601-325-2786, Fax: 601-325-8726 e-mail: sland@cfr.msstate.edu	Work involves the collection, testing, and crossing of *Populus deltoides* clones from the southeastern United States for genetic improvement of SRWC materials. He is interested in collaboration on *Populus* breeding methods and SRWC culture approaches.
Steve Strauss, Forest Science Oregon State University Corvallis, OR 9733 1 Ph: 541-737-6578, Fax: 541-737-1393 e-mail: Strauss@fsl.orst.edu	He is leader of the Tree Genetic Engineering Research Cooperative. He would be interested in collaborating on work on genetic transformation of hybrid poplars.

Timothy Volk SUNY-ESF, 133 Illick Hall 1 Forestry Drive Syracuse, NY 13210 Ph: 315-470-6774, Fax: 315-470-6934 e-mail: tavolk@mailbox.syr.edu	Work on willows at SUNY-ESF includes the following: Site preparation methods to reduce erosion. Root production and turnover & C sequestration, Use of organic amendments to willow soils. Testing of clonal materials across many sites. Genetic improvement of willow biomass crops. Optimization of willow crop production. Assessment of impact on soil sustainability. Characterization of differences among clones. Disease and insect problems of willow crops Potential of willow for phytoremediation He would like to learn from other I EA participants the following information: Pitfalls to avoid in commercializing willow biomass crops. Optimization and improvement of different aspects of the willow biomass production systems. New developing uses for willow for multiple products and benefits.

A.2. Industry researchers or research managers Responding to Short-rotation Woody Crops Survey

Name and Address	Comments
Chuck Wierman Boise Cascade Corporation Fiber Farm P.O. Box 500 Wallulla, WA 99363 ph. 509-546-3445, fax 509-545-9964 e-mail: Chuck_Wierman@bc.com	Would like information on woody crop genetics
Tom Nichols Boise Cascade Corporation 8599 Yetka Lane Cloquet, MN 55720 ph. 218-244-3621 e-mail: Tom_Nichol@bc.com	Would like more information on, pathology (such as Septoria resistance), weed Control (such as levels needed, herbicides, etc.), and nutrition (such as site indexes and fertilization)
Kenneth Munson International Paper Company	Interested in yields and costs of short rotation woody crops.
Thomas W. Houghtaling Minnesota Power 30 West superior St. Duluth, MN 55802 ph. 218-722-264, fax 218-723-3916 e-mail: thoughtali@mnpower.com	Has interest in information on yields, harvesting technology, pest resistance, and cultural practices
Bob Kellison Champion International Corp. 13 16 Dixie Trail Raleigh, NC 27607 e-mail: kellib@champint.com	Work involves breeding and other activities. Has interest in genetic transformation of hybrid poplars on a commercial scale, and optimum nutrition of hybrid poplars
Randall J. Rousseau P.O. Box 458 Wickliffe, KY 42087 ph. 502-335-6274, fax 502-335-6231 e-mail: rjrouss@westvaco.com	Work involves genetics, physiology and biotechnology of *Populus*. He wants to see development of faster growing *Populus* clones for the Southeastern US.

Appendix B

Survey Questions for

Herbaceous Crop Research in the United States

with

list and addresses of researchers responding

SURVEY ON HERBACEOUS ENERGY CROP RESEARCH & DEVELOPMENT

Name, address, phone, fax & e-mail

Region: Pacific Northwest, North Central/lake States, Northeast, Southeast, Mississippi Valley, South Central/southern Plains, Mid-west, or Mid-Atlantic **(Circle as appropriate)**

Estimate of hectares of berbaceous crops used for non-food, non-feed products per region identified: in 1998 ().), possible by 2005 ( ), possible by 2010 (_____

Estimate of total hectares of conservation reserve program lands in same region: in 1998 (___).), possible by 2005 ( ) possible by 2010 (_____

What markets or other incentives are expected to promote expanded production of non-food, non-fiber berbaceous crop production by 2010? Circle as many as are applicable: biomass energy, soil conservation, forage, carbon sequestration, fiber, buffer strips, housing materials, soil remediation, animal bedding, other environmental services, other products, combination of products.

What are the perceived technical and non-technical barriers to commercialization of herbaceous crops for energy?

List areas of herbaceous energy crop research, development, or implementation that you would be interested in learning about from IEA Bioenergy Short Rotation Crop Task Participants.

Are there any research, development, or implementation issues on which you would like to be involved as a collaborator with other IEA Bioenergy Short Rotation Crop Task participants.

Species which is your research focus _____

Primary types of research activity ongoing? (List general catagories only)
(1) by your institution or company, (2) by other groups in your region

If breeding - bow many seed sources or accessions are included in the breeding population?

If field testing **newly bred materials (outside of the nursery); How many different varieties (or genotypes) are currently being tested? How many places are the same materials being tested? What variety is being used as a check?**

How many varieties are being used operationally in your region?

List any key research papers or publications that IEA Bioenergy Task participants might be able to request in order to learn more about your research activities.

What do you believe to be the most important research, technology development, or implementation issues that need to be addressed to promote commercialization of non-food, non-feed berbaceous crops in your region?

B1. University and U.S. Department of Agriculture researchers responding to Herbaceous Crops Survey questions

Name and Addresses	Comments
Jim Cooper Chariton Valley RC&D, Inc. RR3 Box 116A Centerville, IA 52544 Phone: 515-437-4376, Fax: 515-437-4638	Work involves leading a project on demonstrating viability of supplying switchgrass as a fuel for co-firing. He wants to learn what types of new markets may exist for grass and forage materials.
Bob V. Conger Dep, Plant & Soil Science University of Tennessee Knoxville, TN. 37901-1071 Phone: 423-974-8833, Fax: 423-974-7997 Email: congerbv@utk.edu	Work includes cell and tissue culture in grasses and development of gene transfer technology. He is interested in collaborating with others on biotechnological applications for crop improvement.
John S. Cundiff Biological Systems Engineering Dept. Virginia Tech Blacksburg, VA 24601-0303 Phone: 540-231-7603, fax: 540-23 1-3199 Email: jcundiff@vt.edu	Work involves systems research of issues related to the harvest, storage, and transport of herbaceous biomass. He believes public policy mandating the use of renewable resources for a percentage of our energy is needed.
David J. Parrish Crop and Soil Environmental Sciences Virginia Tech Blacksburg, VA 24061.0404 Phone: 540/23 l-9778 Fax: 540/231-3431 E-mail: dparrish@vt.edu	Work involves agronomics, establishment, variety screening, harvest management, seed physiology, whole-plant physiology, carbon sequestration. He would like to be involved as a collaborator on agronomic and physiological issues with other researchers.
William R. Ocumpaugh HCR-2 Box 43-C Beeville, TX Phone: 512 358 6390, Fax: 512 359 4930 Email: ocumpaug@fnbnet.net	Works on switchgrass establishment and management, soil quality, and carbon sequestration. Would like to collaborate with IEA participants on seedling establishment issues and use of legumes to reduce N-fertilizer costs.
Dermis E. Rowe USDA Agriculture Research Service Waste Management and Forage Research 810 Highway 12 East Mississippi State, MS 39762-5367	Works on several grasses and evaluates establishment methods and dates, mowing frequencies, biomass production using animal wastes as fertilizers. He would like to work with others on use of animal or municipal waste to fertilize the biomass crop to improve profitability and eliminate animal waste pollution problem.

B.2. U.S. Department of Agriculture Plant Materials Centers Responding to the Herbaceous Crops Survey

Names and Addresses	Comments
Tony Bush, Agronomist Rose Lake Plant Materials Center 7472 Stoll Road East Lansing, MI 48823-9420 Phone: 5 17-641-4982 Fax: 517-641-4397 Email: tbush@mi.nrcs.usda.gov	This center is currently testing 6 varieties of switchgrass and has gathered 24 accessions for future research. Indicates that his plant materials center is constantly looking for partnership opportunities.
Roger N. Gates Coastal Plain Experiment Station P.O. Box 748 Tifton, GA 3 1793 Phone: 912-386-3175 Fax: 912-391-3701 Email: rngates@tifton.cpes.peachnet.edu	Works on Bahiagrass to improve forage value, and best management practices for establishment. Believes most important activity to promote commercialization of herbaceous crops for energy is to demonstrate power generation at competitive costs.
Martin van der Grinten, Manager Big Flats Plant Materials Center Box 360A, RD #1, Route 352 Coming, NY 14830	Notes that Plant Materials Centers try to find vegetative solutions to natural resource conservation issues. His center has released over 300 grasses, legumes, forbs, shrubs, and trees for natural conservation use.
Jerry Kaiser, Plant Materials Specialist USDA-NRCS-Plant Materials Center 2803 North Highway 79 Elsberry, MO 63343 Phone: 573-898-2012 Fax: 573-898-5298	Notes that his center is evaluating 10 varieties of switchgrass for yields.
Dr. Lance M. Tharel, Assistant Manager USDA-NRCS-Plant Materials Center 6883 S. State Highway 23 Booneville, AR 72927-92 14 Phone: 501-875-5182 Fax: 501-675-5466	Center evaluates switchgrass and gamagrass for buffer strips and willow for bank erosion control. Believes most important way to promote commercialization of herbaceous crops for energy is to work on market development.