ALLIANCES FORGED AT THE 1997 BIOLOGICAL SCIENCES SYMPOSIUM

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CURRENT RESEARCH ON CLONAL PROPAGATION OF TREES is fast approaching commercial reality. This is timely considering the challenges faced by the pulp and paper industry: a shrinking fiber supply, competition from fast crop rotation in equatorial regions, and the shift to ecosystem-based social policy have placed stringent demands on the industry.

On this premise, the 2nd Biological Sciences Symposium convened jointly with the annual TAPPI Pulping Conference at the San Francisco Marriott Hotel from Oct. 20-23 bringing together an international gathering of 145-plus Symposium participants and some 896 Pulping conferees.

Keynote speakers Richard Barker and Jim Ferris set the scene, recounting progress and successes, putting in context the challenges of biological sciences for industry and academia. In the ensuing days, presentations of technical papers and posters covered activity in genetic engineering, tree cultivation, bioprocessing, and microbiology. The Closing Panel addressed the perennial question,"Where do we go from here?"



Biological Sciences Symposium Chairman Bob Lazar invited members of the Pulping Conference to attend the Symposium

BUILDING BRIDGES

To encourage the synergy, Symposium Chairman BobLazar invited Pulping conferees at their Opening Session to attend the Biological Sciences Symposium. Indeed they did, with Pulping Chairman Jean-Claude Corbi setting the example.

To a capacity audience Lazar set the scene, proudly describing the triumph of collaboration between industry and academia, producing 97 papers and posters of significant research. This productivity emphasized the progress made since the 1st Biological Sciences Symposium in 1994 at Minneapolis, MN.

In the first keynote address, Richard G. Barker of Union Camp provided an industrial perspective, stating that the future depended on the use of advanced bioscience, particularly enzymes in bioprocessing and clonal propagation of wood sources, in order for the industry to remain competitive.

Using the forest biology program at Union Camp as an example, Barker described the current level of technology available for industrial clonal propagation of sweetgum and loblolly pine. He outlined continuing research needs for hardwoods and softwoods, including large scale vegetative propagation, genetic transformation of loblolly pine, identification of genetic constructs for sterility and vegetative growth rate, inducement of early flowering, and identification of molecular markers for growth rate, independent of genotype.

Barker illustrated successful bioscience applications, including the use of fungi and enzymes in chemical and mechanical pulping for removing extractives, reducing chemical requirements and producing cleaner effluent. In papermaking, enzymes improve paper machine drainage and sheet quality, and aid in the deinking process. For closed mill operations, enzymes could potentially reduce heat build-up and control the accumulation of dissolved organic and inorganic compounds.

Barker identified mill-related research needs in the following areas: a better understanding of the effect of the present mill conditions on enzymes in bleaching; better



Pulping Conference Chairman Jean-Claude Corbi presided over the opening of the Symposium and moderated the Closing Panel.



At the Opening Session, Karl-Erik Eriksson of the University of Georgia asked the critical question about direct funding for research.



Roberta Farrell of the University of Waikato pointed out that innovation encouraged the breakdown of barriers between research groups.



Bob Lazar (right) introduced the keynote speakers Richard Barker (left) of Union Camp and Jim Ferris (center) of the Institute of Paper Science of Technology.

methods to identify and monitor enzyme effects in bleaching; finding an inexpensive, non-toxic mediator; and understanding of the kinetics and mechanisms of enzymes.

In the second keynote, Jim Ferris of the Institute of Paper Science of Technology addressed academia issues. He felt that rethinking the research effort would pose the most critical challenge to the effective transfer of biotechnology into the mills. He projected, that just as airflight superseded steamships in efficiency, bioprocessing methods have the potential to surpass chemical-based processing in pulp and paper.

Ferris placed responsibility on the scientists and the engineers to bring the new technology to the attention of industry and management. Academia faces the challenge of weaving the new language into our culture and advancing bioprocessing to industrial companies.

Ferris declared that the chief priorities of academia shall be to network, involve commercial users, translate new skills, produce biomanufacturing engineers, and demonstrate capability of academic systems to transfer technology. He strongly advocated that academia, industry, and government share the risks and costs to develop bioprocessing technology. Ultimately, the commercial user must be willing to use bioprocessing.

TECHNICAL SESSION FOCUS

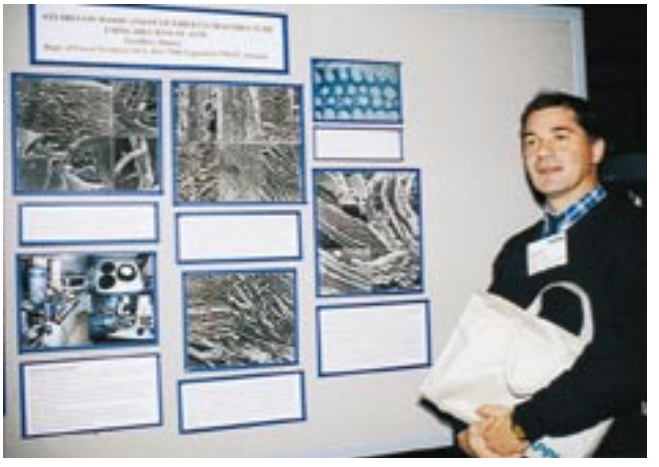
Papers presented at the 13 technical sessions covered a broad range of research areas. Sessions on enzymatic systems for lignocellulose modification drew crowded houses. Forest biotechnology, enzymes, biopulping, microbiology, and water quality sessions received the attention of both biologists and industry people. Of equal significance was work presented in tissue culture, gene expression/mapping, gene transformation, and fiber modification sessions.

Papers presented at the Tissue Culture session covered issues such as water potential in embryos, activated charcoal on nutrient medium, a culture technique for fertilization of Douglas fir, and transformation and regeneration techniques using bacterium species for cloning Eucalyptus.

The session on gene expression and gene mapping documented significant strides in identification of xylem-specific genes and genetic expression for fusiform rust in loblolly pine. Further work on tools such as differential display for tracking embryo development and simple sequence repeat markers for mapping Douglas fir and western hemlock was also presented.

Progress in genetic transformation by hormonal manipulations, bombardment and bacterium infection were discussed during the Transformation sessions. Also covered were isolation of genes for lignin biosynthesis and male clone development, and site-specific recombination systems for greater control over gene expression in transgenic trees.

The Forest Biotechnology session focussed on obstacles to the development of commercial programs for



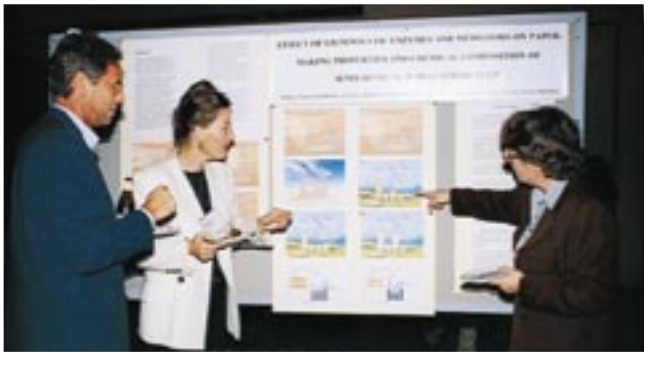
Geoffrey Daniel of the Swedish University of Agricultural Science presented his technique for imaging ultrastructure of wood and pulp fiber.



John Cairney (left) and Gerry Pullman (middle) of the Institute of Paper Science and Technology discussed gene expression of developing embryos, with Sarah Covert (right) of the University of Georgia.



Gary Scott (right) of the USDA Forest Products Laboratory discussed the feasibility of large-scale biopulping trials with Jordan Kopanidis (left) of Brown and Root, Inc., a Pulping Conference attendee.



Tamara Vares (center) and Annele Hatakka (right) of the University of Helsinki described their work on "Effect of Lignolytic enzymes and mediators on paper-making properties and chemical composition of semichemical wheat straw pulp" to Kurt Messner (left) of the University of Technology, Vienna.

Douglas-fir, loblolly pine, Sitka spruce, eucalyptus, and western white pine. Evaluation of operational production by somatic embryogenesis, herbicide resistance response of transgenic cottonwoods, and modelling of flowering for sterility were also given.

The Biopulping session reported on mechanisms for fungal lignolytic enzymes and the effects of fungal pretreatment on kraft and mechanical biopulping The results from a scaled-up biopulping operation were also discussed.

For conventional biobleaching, mill experience with xylanase for elemental chlorine-free (ECF) and totally chlorine-free (TCF) bleaching, and cloning of thermophilic xylanases and their performance on softwood and hardwood kraft pulps for ECF and TCF were discussed. Also presented were papers on laccase/mediator systems concerning reactivity, mechanisms, performance of new systems, and a new screening technique. A mediator-free manganese peroxidase was also discussed.

In the biobleaching session on novel systems, papers were presented on mechanisms for fungi activity, a free radical system, screening techniques, and fungi activity on non-phenolic lignin structures.

Papers presented at the Fiber Modification session discussed the effects of cellulase drainage aids on fiber characteristics. Fiber-pore accessibility, imaging of modified fibers, enzyme mechanisms and effects on paper properties, and a new cellulase were evaluated.

Microbiological applications in papermaking focussed on biocides. Techniques for evaluating efficacy, treatment, and control were discussed. Other topics included microbial resistance to biocides and the impact of loop closure on microbial populations.

Solutions for improving receiving water quality for pulp mill effluents were discussed in terms of mill modifications and methodology for toxicity assessment. This prefaced the EPA explanation of their watershed approach for determining water quality compliance.

BIODIVERSITY AT THE POSTER SESSION

By displaying the 36 posters in the conference foyer, the organizers encouraged greater interaction between



At the Closing Panel Discussion moderated by Jean-Claude Corbi, Steve Strauss (right) of Oregon State University, Bob Lazar (center), and David Boron (left) of the National Science Foundation evaluated the needs of forest biology to successfully develop and transfer research efforts to commercial application.

Biological and Pulping participants. The posters reflected the international scale and diversity in tree biological research.

Most of the reports covered work on different enzymes on wheat straw, kraft, mechanical, and sulfite pulps. Other posters discussed performance and effects of new fungi and enzymes in bioprocessing, effluent treatment strategies, and the cost for a commercial biopulping operation.

Several posters highlighted new developments in biotechnology, including genetic mapping for rooting, application of differential display, and identification of genetic features for sterility and stress in pine.

FORMULATING FUTURE SUCCESSES

As moderator of the closing session, Corbi encouraged all who attended to "keep the research momentum going." The panel itself assessed the different sectors involved in the biological research effort in order to formulate goals for the future. Steve Strauss of Oregon State University represented academia. Lazar, of Union Camp, spoke for industry. David Boron of the National Science Foundation represented the federal government. The panel strongly endorsed pooling of resources to surmount challenges in research.

Strauss evaluated academic research in the United States. He challenged researchers to draw upon the wealth of basic science now available for forestry instead of continuing to graft techniques. He felt the greatest obstacle to be identifying specific traits in different species. The automation of handling techniques would be crucial to advance research. He indicated that the hot areas for future research would be sterility and disease resistance.

According to Strauss, the chief problems for academics have been dependable funding, a critical mass of skilled labor, interdisciplinary participation, rights to intellectual property, scale-up field testing, and maintaining a breadth of perspective within investigative groups. He praised forestry research efforts for innovation, cost sharing, and strategic targeting of key research areas, giving credit to the industry for its high level of participation.

Though proud of the level of activity in industry, Lazar criticized industrial research on bioprocessing as too narrowly focussed on applications, ignoring understanding of underlying mechanisms. He pointed out that cutbacks in the forest industry, loss of talented biologists to other fields due to limited career advancement, and the weakening of the effort in forestry due to the channeling of federal money into agronomic molecular biology have contributed to the present state of affairs: the depletion of forest resources without a reasonable alternative.

Lazar proposed a thorough solution: to provide the public with realistic calculations of the harvest value of cloned elite trees. That could be done by assessing the value of trees genetically engineered, determining the impact of imported trees on our trade balance, and quantifying the environmental impact biopulping and biobleaching may have; to provide financial support for university research in forestry; and to encourage industry participation in government-funded research projects.

Lazar marked out future targets for major lines of industrial research including intensive cultivation, clonal forestry, genetic engineering of trees for crucial genes, forest entomology, internal alteration of fiber structure, and application of biobleaching. He called on industry to be more proactive by increasing internal funding of forestry programs, by developing research partnerships with government laboratories, by awarding grants to support university efforts, and by writing letters of support for government and university programs. Finally, Lazar expressed that the federal government should provide governance for external research efforts, encourage the adoption of state research initiatives, and support national research efforts.

Boron outlined the NSF resources available, and discussed their key aspects for funding forest biological research. Projects funded for academic collaboration with industry must show demonstrable cost-sharing and detailed divisions of research. Projects funded for technological innovation must be multidisciplinary, develop new concepts, innovate, and guide integration to commercial use. In response to the chief concern of the audience, Lazar announced he will meet with Boron to discuss federal funding for forest research.

All in all, this second symposium marked a milestone. For the first time the biological sciences community worked with industry people to target future research. The message delivered throughout the symposium urged progress through collaboration and cooperation. TJ

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