25th Session of the International Poplar Commission

Theme: "Poplars and Other Fast-Growing Trees - Renewable Resources for Future Green Economies", Berlin, Germany, 13-16 September, 2016

Take Home Messages

This summary includes take home messages from plenary and concurrent sessions not reported in the formal report of the 25th Session of the International Poplar Commission.[1] The messages were delivered by the presenters to the session moderators and compiled by the IPC-Secretariat. Only in a few cases no take home messages were available. Thus, this compilation is not an exhaustive summary of all presentations made, but it may be useful for particularly those who were not present at the 25th Session or who were not able to spread themselves across concurrent sessions of interest.
The summary is presented in accordance with i) Technical Plenary Sessions I-IV and ii) 6 Concurrent Sessions of 6 Sub-themes, in chronological order.

I PLENARY SESSIONS

Plenary Session I, 11:00-12:30, Tuesday 13 September 2016

Poplars and other fast-growing trees - renewable resources for future green economies;
Matthias Dieter, Johann Heinrich von Thünen Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries, Germany

1. Demand for wood is one cause for deforestation and forest degradation;
2. Planting forests withdraws pressure from natural forests and helps to restore degraded forests;
3. Rising future demand requires additional or improved planted forests;
4. Green economy still is rather a political slogan than a reality, impact on demand (when and how much) not yet foreseeable;
5. IPC activities prepare for green economy;
6. Open IPC for more fast growing tree species, minding always regionally different natural conditions and future demand.

The reform of the International Poplar Commission (IPC) in light of modern forest policy requirements; Walter Kollert, Secretary of the International Poplar Commission, FAO, Italy

1. Expansion of the thematic scope to include "other" fast-growing species;
2. New title of the Commission: "International Commission on Poplars and Other Fast-Growing Trees Sustaining People and the Environment" (IPC);
3. Thematic restructuring of the working parties:
    a. Taxonomy, Nomenclature and Registration
    b. Domestication and Conservation of Genetic Resources
    c. Plant Health, Resilience to Threats and Climate Change
    d. Sustainable Livelihoods, Land-use, Products and Bioenergy
    e. Environmental and Ecosystem Services
    f. Policy, Communication and Outreach;
4. Strengthening and expanding national poplar commissions; and
5. Increased funding of IPC-Secretariat.

[1] http://www.fao.org/forestry/ipc/69644/en/

Plant remodelling in trees – breeding perspectives in poplar;
Mathias Fladung, Thünen Institute of Forest Genetics, Germany

1. Classical tree breeding is slow due to tree characteristics longevity and extended vegetative periods;
2. Compared to crops, trees are poorly domesticated, genetic gain could still be very large;
3. Tree breeding can be accelerated by genetic engineering, new breeding techniques (CRISPR/Cas9; High-Speed-Breeding) as well by genomic and marker approaches;
4. Tree remodelling traits comprise tree form and growth, wood characteristics, and developmental features;
5. Phenotypes of natural and transgenic mutants/variants could be similar

Advances in a willow (*Salix* spp.) breeding program in Argentina for different wood applications; Teresa Cerrillo, Instituto Nacional de Tecnología Agropecuaria, Campana, Argentina

1. Newly released clones (last four years) with high productivity and high survival rates were selected for Delta del Paraná
    a) Broader diversity of cultivars
    b) New tool to improve the yield and quality of willow plantations, with some clones with "double purpose" status.
2. There are experimental genotypes in advanced stage of selection which will provide new commercial clones to release or Delta Paraná River Delta and other regions in the future;
3. New clones could have accepted role in:
    a) Sustainable wood production
    b) Phytoremediation of contaminated sites
    c) Silvo-pastoral systems
    d) Biomass production

Plenary Session II, 14:00-15:30, Tuesday 13 September 2016

Sweden's quest for renewable resources – an opportunity for growing Poplars and Willows?;
Martin Weih, Dept. of Crop Production Ecology, Swedish University of Agricultural Sciences, Sweden

1. Poplars and Willows could contribute more significantly to Sweden's quest for renewable resources in the future, provided that climate-adapted and quality tailored plant material is made available (e.g. through plant breeding), and processing technologies develop as predicted;
2. If new plant material becomes available for cultivation in larger areas in the Nordic-Baltic region, Poplar has the potential to become an interesting feedstock in the development of a poplar-based business;
3. R&D project "Climate-Adapted Poplar through more efficient breeding and better tools for matching genotype and site – developing the poplar bio-economy market in Sweden and the Baltic (CLAP)"
    a. Phenotyping & screening across various sites between 53° and 60° N;
    b. Matching plant traits to climate (modelling with climate & physiological data);
    c. Develop genetic markers for breeding of climate-adapted poplar material;
    d. Develop a feasible breeding strategy for a commercial business; and
    e. Develop an economically sound business plan for Sweden

Bio-energy from Poplar biomass under short rotations: full greenhouse gas balance, energy balance and environmental life cycle analysis; Reinhart Ceulemans, University of Antwerp, Department of Biology, Belgium

1. Hard data that bio-energy from short rotation coppice (SRC) has environmental and energetic potential (in comparison with non-renewable energy sources)
2. Overall GHG balance slightly positive; other stronger greenhouse gases counteract carbon uptake
3. 10 times less GHG emissions than non-renewable energy sources
4. Beneficial energy balance: output/input = 29 (farm gate) and electricity/input = 8.6; and
5. Economically definitely not a success story (in Florence).

Short-rotation coppice (SRC) as a fuel hedge; Jan Grundmann, Energy Crops GmbH, Germany

1. For many investors the commercial performance of short rotation coppice (SRC) is still unattractive and has several risks;
2. More effort in breeding for yield increase in combination with good drought-resistance is required; and
3. Higher profitability in SRC operation opens further opportunities in nature protection within the plantation; thus would increase public acceptance for SRC and bio fuels in general.

The role of the private sector in promoting the culturing of poplar and other fast growing tree species in India; Ramesh C. Dhiman, Wimco Seedlings unit of ITC PSPD, India

1. Produce and supply quality plants;
2. Create demand for farm grown tree produce;
3. Conduct R&D on forest trees, afforestation and efficient wood usage;
4. Promote capacity building and skills development for self-employment;
5. Share knowledge with all stakeholders; and
6. Support private sector transforming rural economies through farm supported plantations and marketing.

Plenary Session III, 16:00-17:30, Tuesday 13 September 2016

Introduction of the European Poplar Association (ProPopulus); Pedro Garnica and Bernard Mourlan, European Poplar Association (ProPopulus)

1. The Goals of ProPopulus:
    a. Position poplar as a strategic raw material;
    b. Gather, promote, defend and represent the production and use of poplar;
    c. Present a platform for the exchange of information;
    d. Study questions of interest to the poplar sector;
2. Monitoring European issues for consistency and transparency in law and regulations;
3. Meeting and exchange forum for consistency in information;
    a. Provide reliable and permanent statistics;
    b. Promote poplar cultivation and use;
    c. Advise politicians and policy makers of issues relating to Poplar cultivation, use and products;
4. Membership Information to create a stable network between European actors;
5. Representation at events; and
6. Promote the poplar image as "The tree of the 21st century".

Importance of the plant microbiome for growth, health, and stress tolerance; Sharon L. Doty, School of Environmental and Forest Sciences, University of Washington, USA

1. Endophytes have multiple beneficial traits: phytohormone production; phosphate solubilization; siderophore production; anti-fungal properties; reduction of ROS;
2. Genetic evidence for: –Osmolytetrehalose –VOCs Acetoin and 2,3-butanediol;
3. Implications of this endophyte research:
    a. Sustainable Agriculture, Forestry, and Biomass Production; and
    b. Climate change mitigation (promote plant growth naturally through improved nutrient acquisition, phytohormone production, and stress tolerance).

Pharmaceuticals and Personal Care Products: *Populus alba* phenotyping and uptake; Erika Pierattini, Institute of Life Sciences - Scuola Superiore Sant'Anna, Italy

1. P. alba shows good health when treated with erythromycin;
2. Erythromycin enters the plant and undergoes plant metabolism => EPIMERS;
3. Main damage caused by Sodium Dodecyl Sulphate (SDS) exposure was due to Na toxicity;
4. SDS is mainly accumulated in roots; and
5. Zn seems to have a protection role against SDS stress.

The poplar in the urban environment - experiences with its use and usability in The Netherlands; Jitze Kopinga, Wageningen University and Research Centre, Netherlands

1. Poplar is a 'grateful' urban tree species;
2. It rapidly provides a green setting of (and shadow within) new urban developments to create a Heat Island Effect;
3. Its ecological value is comparable with, or even higher than, many other urban tree species;
4. Inconvenient qualities (e.q. root damage to road paving and intrusion into sewer pipes) are not specific for poplar but these aspects must always be taken into account when choosing the adequate tree species or planting site when technical solutions or adjustments are no realistic option;
5. The species does not suffer from disastrous pests and diseases – a Dutch list of recommended species and varieties prevents 'disappointments'; and
6. Variation between species on tolerance for de-icing salt is rather broad - flexibility in choosing the proper species on locations with an increased salt contamination of the soil.

Plenary Session IV, 09:00-10:30, Friday 16 September, 2016

Engineered wood products based on poplar and willow wood; Joris van Acker, Ghent University, Belgium

Poplars and Willows are increasingly being used for a wide range of forest products

1. Sawnwood lumber (timber);
2. Veneers;
3. Engineered wood products (EWP): lumber, veneers, strand softwood, or smallwood bound with structural resins to form lumber-like structural products:
    a. Laminated Veneer Lumber;
    b. Cross Laminated Timber;
    c. Nail Laminated Timber;
    d. Parallel Strand Lumber;
    e. Laminated Strand Lumber;
    f. Glue Laminated Lumber;
    g. Oriented Strand Board;
    h. Prefabricated Wood I-Joists;
    i. Plywood
    j. Particle Board;
    k. Fibreboard;

4. Sustainability of Poplar and Willow wood supply is critical to take advantage of these opportunities (raw material supply issues face some European countries).

Trends & Perspectives in Poplar & Willow Cultivation: Global Synthesis of Country Progress Reports; Jim Carle, FAO/IPC Consultant, Mount Maunganui, New Zealand

1. Synthesis of Country Progress Reports, Working Paper IPOC/15:http://www.fao.org/forestry/45094-08e1e5bf441bc41bb139e66da0915f2c.pdf
2. Publications in Country Progress Reports, Working Paper IPC/16: http://www.fao.org/forestry/45093-07f2bbc0a28ee0e53499c75b5b56e56e.pdf
3. A powerpoint presentation is available on the 25th Session Portal of the IPC website

Global and regional market trends for poplar products; Arvydas Lebedys, Forestry Officer (Statistics), FAO, Rome Italy presented by Walter Kollert, Secretary of the International Poplar Commission, FAO, Italy

1. Poplar production and trade globally:
    a. 110 million m^3/yr log removals (mostly consumed locally for making wood-based panels);
    b. 4 million m^3 logs and 1 million m^3 sawnwood traded internationally (increasing trend);
    c. Value of log and sawnwood imports is > US$ 300 million/yr;
2. Better data in future:
    a. 2017+, World Customs Organization's Harmonized System (HS, used by all countries) will have a publicly available 6-digit code to document the international trade of poplar/aspen logs and sawnwood;
    b. Official export/import data from customs records will become available for all countries trading poplar wood.

Poplars and willows: a photo library; Jim Richardson, Poplar and Willow Council of Canada, Canada and Jud Isebrands, Environmental Forestry Consultants LLC, USA

1. Rich Repositories of Photos in institutes and organizations around the world;
2. Sharing of the most important and relevant to reflect the IPC;
3. Gallery location – FAO-IPC website, linked to The IPC Book;
4. Gallery organization –by Book chapter –plus other photo collections; and
5. Target date - upload by end of 2016.

II CONCURRENT SESSIONS

Sessions 1: Tree Improvement (Brunsen Hall)

Session 1A, Tree Improvement, 09:00-10:30, Wednesday 14 September 2016

Sources of variation in hybrid poplar biomass production throughout Michigan, USA; R. Miller, Michigan State University, Forest Biomass Innovation Centre, Escanaba, Michigan, USA

1. Strong within clone variation (significant genotype & environmental interaction) = 50% of all variation;
2. Variation over time at the same sites in growth performance (temporal variation);
3. Important to select specific clones for each site; and
4. Still in general 25% unexplained phenotypic variation – Where does it come from?

Genetic improvement of poplar and prospects for poplar cultivation in Germany; M. Hofmann, Nordwestdeutsche Forstliche Versuchsanstalt, Abt. Genressourcen, Hann. Münden, Germany

1. 9 genotypes submitted for certification, 2 submitted for plant variety rights at the German plant registration office;
2. Within Trial series 604 and 605 new hybrids from controlled crossed are being tested under field conditions;
3. In further pre-selections many hybrids were significantly superior to the control group;
4. Analysis of further measurement data and trial results (Leaf Rust resistance, drought tolerance etc.);
5. Linking outcome to the results of other projects (within FastWood, CF, ProLoc).

Establishment of poplar plantations in Scandinavia and the Baltic Sea region; A. Karacic, Swedish University of Agricultural Sciences, Sweden

1. Use popular clones from Swedish breeding program from the 1990 years;
2. 12,000 ha of short rotation in Sweden and 13,000 ha in the Baltic states;
3. Big differences in bud set among clones (climate adaptation);
4. Tests with different type of plant material of each clone (cuttings, rooted plants);
5. Climate-adapted poplars for the forestry sector in the Baltic Sea Region;
    a) Establishment trials, which plant material on different types of soils;
    b) Production of plant material;
    c) Candidate clones, registration;

Session 1B, Tree Improvement, 11:00-12:30, Wednesday 14 September 2016

Survival and growth analysis of aspen hybrid families in the Central Chernozem area of Russia R. Tsareva, All-Russian Scientific Research Institute of Forest Genetics, Tree Breeding and Biotechnology, Voronezh, Russia

1. Work with aspen hybrids from crosses of different white popular species from the Soviet time => most important for the selection of clones was the drought resistance in very dry years like 2003 and 2010;
2. Hybrid aspen families and trees good enough good for the environmental conditions;
    a. Half-sibling of local *P. tremula;*
    b. Age of 35 years. Height 20 m, diameter 36.6 cm, trunk volume 0.95 m³;
    c. Forest nursery Semiluksky. Voronezh region. 24.06.2016;
3. The best drought resistant and fast-growing genotypes may be used for science and practical needs to establish productive and resistant aspen plantations;
    a. *P. 'Yablokovy' x P. tremula* local;
    b. Age 32 years. Average height - 22 m, average diameter - 35.7 cm, average trunk volume – 1.06 m³;
    c. Collection of V. Petrukhnov aspen hybrids;
    d. Forest nursery Semiluksky. Voronezh region. 26.08.2013.

Next generation tree biotechnology for biofuels and biomaterials; M. R. Ahuja, Zobel Forest Associates, New Paltz, NY, USA, presented by Georg von Wühlisch

1. Populus GMOs with up to 50% reduced lignin content => more sugar => more lignin content.

Two *Salix* genotypes differ in their productivity when grown in monoculture and mixture; S. Hoeber, Swedish University of Agricultural Sciences, Sweden

1. Mixtures of salix clones have an advantage only under low fertilisation conditions => in total more growths at high fertilisation conditions no advantage;
2. Genotypes with different functional traits perform different when cultured in mixture compared to monoculture; and
3. Differences are apparent in young plants but no prediction can be made for long term and mature stands.

Improvement on poplars of the section *Populus* in Germany; M. Liesebach, Thünen-Institute of Forest Genetics, Grosshansdorf, Germany

1. More than 300 new controlled crosses => aiming to find better clones /progenies in dryer soil conditions;
2. Progenies are preferred instead of clones because of higher diversity (resistance);
3. Trembling Poplar
    a) Pros:
        i) wide site amplitude;
        ii) higher diversity using progenies;
        iii) high stress tolerance (e.g. against spring drought);
        iv) wood quality for material und energy utilisation;
    b) Cons:
        i) reproductive material (plants) more expensive than cuttings of poplars other sections;
        ii) slow growing after planting;
        iii) only little reproductive material on the market available.

Session 1C, Tree Improvement, 14:00-15:30, Wednesday 14 September 2016

Reproduction of *Populus* intersectional hybrid by means of ovule micro-cultures; A. Ghamari Zare, Research Institute of Forests and Rangelands, Tehran, Iran

1. Work with hybrids of *Populus euphratica* and *Populus alba;*
2. Need to have breeding of *Populus* in Iran to enlarge the planting region of *Populus* towards the dry and continental climate areas;
3. Embryo rescue and ovule micro-culture applied to get viable hybrid plants;
4. Hybrids are more tolerant against salt in the soil; and
5. Biotechnology techniques could overcome mating barriers between taxa in *Populus* species.

Session 1D, Tree Improvement, 16:00-17:30, Wednesday 14 September 2016

Geo-climatic gradient shapes functional trait variations in *Salix eriocephala*; R. Soolanayakanahally, Saskatoon Research and Development Centre, Saskatoon, Canada

1. Large genetic diversity exists with Canadian native willow species;
2. Potential for further exploitation in willow improvement for biomass, bioenergy and environmental applications; and
3. Traits of interest are enhanced carbon sequestration, high nitrogen use efficiency and tolerance of cold and salinity.

Evaluation of improved willow in north Patagonia, Argentina; E. R. Thomas, Instituto Nacional de Tecnología Agropecuaria, Río Negro, Argentina

1. The evaluation of growth at 5 years old shows the supremacy of *S. matsudana x S. alba* hybrids, standing out the clones LOS ARROYOS INTA-CIEF and AGRONALES INTA-CIEF, and a series of genotypes in final selection phase (96.01.12, 98.07.71, 94.08.74, 94.08.43 and 94.13.06 are the best);
2. This assessment of new clones provides valuable information to make a first preselection of adapted genotypes to the region;
3. These hybrid clones have shown a good performance, with suitable tree form (few branches and apical dominance); and
4. The yield evaluation of the better clones began to be carried out through field testing productivity.

Testing of native willows for SRC on agricultural land; J. Weger, Silva Tarouca Research Institute for Landscape and Ornamental Gardening, Průhonice, Czech Republic

1. Spontaneous hybrids of native willows (*S.*×*smithiana*, *S.*×*fragilis*) showed good potential for use in short rotation coppice (SRC), but they can also be used for further improvement;
2. Variety testing of best clones started in 2014 and new varieties should be available 2016-17:
    a. Rokyta (S-218) for woodchips SRC;
    b. Stvola (S-195) for firewood SRC;
3. Next goals: to improve specific traits of native willows for short rotation coppice - shape of tree, yield for energy and also for phytoremediation

Production of New Clones of Cricket Bat Willow (*Salix alba*) for fast growth and quality of timber; Prof. S. A. Gangoo, Faculty of Forestry, SK University of Agricultural Sciences and Technology of Kashmir.

1. Candidate plus trees (CPTs) were selected in Kashmir and tested in a common garden;
2. Seed progeny of 20 CPTs was raised in RBD design;
3. Traits like leaf length and width, length/width ratio, petiole length, position of maximum width, leaf angle no of leaves/plant, shape of leaf blade base, leaf margin and colour of petiole;
4. Genetic characteristics like heritability, genetic advance and genetic gain for all the traits were calculated; and
5. Dendrogram showing 5 different clusters of genotypes was observed in *Salix alba*

Session 1E, Tree Improvement, 09:00-10:30, Thursday 15 September 2016

Breeding of fast-growing tree species for changing environments in Saxony, Germany; H. Wolf, Staatsbetrieb Sachsenforst, Pirna, Germany

1. There is immense potential for forest tree breeding to cope with the challenges of environmental changes; and
2. Forestry tree breeding has not only to do with trees, but also with people to convince society of its benefits.

Poplar genetic transformation for sustainable growth in short rotation plantation; N. Rashydov, Institute of Cell Biology and Genetic Engineering, Kiev, Ukraine

1. Three transgenic line of P. nigra x P. deltoides cv Gredizka with agrobacterial transformation were obtained for short rotation coppice; and
2. The advanced method for genetic transformation will be used to receive resistant lines of Poplar against stress factors (drought, radioactivity, contaminated soils and extreme temperature events.

Fast breeding of Poplars and other tree species: future prospects and biosafety concerns; H. Hönicka, Thünen-Institute of Forest Genetics, Grosshansdorf, Germany

1. A reliable system for inducing the reproductive phase in Poplar is now available;
2. Poplar plants produce first flowers, even after 6 months, instead of more than 7 years;
3. Crossings between early flowering and wild Poplars confirmed that 50% of offspring were completely transgenic free; and
4. This new breeding method can allow overcoming ongoing biosafety problems caused by the increasing spread of pests and diseases worldwide.

Breeding of multipurpose Willows on the basis of *Salix daphnoides, S. purpurea* and *S. pentandra*; B. Bubner, Thünen-Institute of Forest Genetics, Waldsieversdorf, Germany

1. *Salix daphnoides*, *Salix pentandra* and *Salix purpurea* were tested in field trials for biomass production and salicytic acids;
2. *Salix daphnoides* performed best in biomass and calicytic acids (best species choice); and
3. Crossings of *Salix daphnoides* may be planted for providing bark that can be used as a complement to synthetic salicytic acid in medicine.

Sessions 2: Tree Improvement/Genomics (Room Pasteur)

Session 2A, Tree Improvement, 09:00-10:30, Wednesday 14 September 2016

Case Study of Hybrid aspen, Poplar and Willow yields in five-year rotation; D. Lazdina, LSFRI 'Silava', Salaspils, Latvia

1. *Salix* spp have reasonable yields for 5 year rotation period - 5 years old roots and 5 (no harvest), 4 (harvest after first year), 3 (harvest at second year) have similar yields 15-20 t dry mass/ha;
2. Yield 1-6 t dry mass/ha is too low to cultivate *Populus* spp. at 5 year rotation cycle despite of CAP for 5 year rotation restrictions; and
3. One of most productive clones was Tora which had significantly lower moisture than others «-»6%.

Poplar breeding program in Argentina: 2013 comparative clonal trial network status; S. Monteverde, Instituto Nacional de Tecnología Agropecuaria, Campana, Argentina

1. Even though this trial network is in its first stages of evaluation, promising clones displaying good performance, growth and stability were detected;
2. These clones, will allow the diversification of the clonal offer for the cultivation of poplar trees in the region, improving their response when facing conditions derived from the global climatic changes, as well as, to the appearance of new pathogenic races; and
3. These clones were also selected with the participation of leader farmers and some representatives of the leading companies of the region, with whom there is an agreement of technological cooperation.

Flowering time genes influence biomass production in poplars; T. Brügmann, Thünen-Institute of Forest Genetics, Grosshansdorf, Germany

1. Beyond *SOC1* and *FUL* , selected candidate genes with an expression in poplar flower AND developing xylem. Overexpression and knockdown approaches were executed;
2. The analyses are still ongoing but regenerated lines were identified with an significantly increased growth;
3. *PCBER1* were knocked down by RNAi. The knockdown was approved with qRT-PCR; and
4. 6 out of 9 transgenic lines were significantly higher after 17 month of cultivation.

Session 2B, Tree Improvement, 11:00-12:30, Wednesday 14 September 2016

Towards a high and sustainable biomass production: the *Salix* Molecular Breeding Activities program (SAMBA); A. C. Rönnberg-Wästljung, Swedish University of Agricultural Sciences, Uppsala, Sweden

1. QTL studies → genetic markers for *Salix schwerinii* alleles;
2. QTL studies → breeding for separate climates; and
3. Association mapping → genetic markers of more general use for *S. viminalis.*

Production of diploid pollen in *Populus* by heat-induced depolymerisation of meiotic microtubule cytoskeletons; J. Wang, Forestry University, Beijing, China

1. High temperature treatment is effective for production of unreduced gametes in *Populus pseudo-simonii*;
2. The effect of 2n gamete induction with high temperature depends on meiotic stage, duration and temperature for treatment; and
3. High temperature-induced depolymerization and restoration of meiotic microtubular cytoskeletons are important mechanisms for production of unreduced gametes.

Triploid poplars as a potential for breeding fast growing trees; H. Liesebach, Thünen-Institute of Forest Genetics, Grosshansdorf, Germany

Current results:

1. Several procedures to breed triploid poplar clones were tested.
    a. Most effective method is the enrichment of spontaneously formed 2n pollen followed by conventional controlled pollination;
2. Sexual polyploidisation was successfully applied to produce 44 triploid clones derived from intra- and intersectional crosses, several of them with a very good growth performance;
3. SSR genotyping of parents and offspring clarified cellular mechanisms of 2n gamete formation:
    a. Because of low sample sizes no significant relationship between treatments to induce 2n gametes and FDR resp. SDR mechanisms as well as no relationship to seedling growth; and
4. A number of selected diploid and triploid clones were propagated to establish a field trial.
5. Tetraploid lines from ~ 10 fast-growing diploid clones were produced (details not shown).

Further work:

6. Establishment of a field trial with selected diploid and triploid clones in spring 2017
    a. Basis for the approval of new varieties; and
7. Inclusion of tetraploid clones into the breeding stock for further crossing experiments.

Session 2C, Genomics, 14:00-15:30, Wednesday 14 September 2016

The SWEET gene family in *Populus*: evolution, expression patterns, and contribution to secondary growth; Meng-Zhu Lu, Research Institute of Forestry, Chinese Academy of Forestry, China

1. 27 SWEETs in poplar;
2. PtSWEETs exhibit diverse sub-cellular localizations;
3. Some PtSWEETs are strongly expressed in cambium
4. PtSWEET7 and PtSWEET17a enhance secondary growth; and
5. PtSWEET5 stimulates sugar transportation to stem.

The analysis of gene expression profile in *Salix* under salt stress; J. Zhou, Department of Tree Genetics and Breeding, Jiangsu Academy of Forestry, China

1. 318, 1560, 808, 514, 2091 DEGs were identified under the salt stress at 2, 6, 12, 24h, 48h, respectively;
2. The percentage of DEGs upregulated at 12h was higher than other time points; and
3. The upregulated DEGs related to plant hormone transduction pathway were significantly involved in the response to salt stress.

ISAP (Inter-Sine Amplified Polymorphism) – a retrotransposon-based marker system for identification of varieties, clones and accessions of Poplar; A. Kögler, Technische Universität Dresden, Faculty of Science, Institute of Botany, Germany
Molecular markers

1. Fast, cheap, and robust differentiation between different varieties and clones;
2. Independent from environmental conditions and age of the plants;
3. Genotyping and evaluation of genetic diversity of populations; and
4. Ensuring product identity (certified reproductive material).

Intra-specific variation in poplar drought responses; A. Polle, Georg-August Universität Göttingen, Germany

1. Higher water availability in native habitat correlates with higher biomass productivity under control and moderate drought;
2. Moderate, gradually increasing drought: conserved programm of acclimatization;
3. Local adaptation does not restrict phenotypic plasticity of drought responses;
4. Gene correlation network analysis as a tool extract candidate genes underlying variation in biomass; and
5. Functional validation required!

Session 2D, Genomics, 16:00-17:30, Wednesday 14 September 2016

SSR based DNA fingerprinting and genetic diversity analysis of 92 poplar cultivars in China; J. Hu, Research Institute of Forestry, Chinese Academy of Forestry, China

1. Fingerprint of 91 cultivars were constructed based on 18 SSR markers and five core markers were selected;
2. Seven cultivars were identified as triploid using SSR analysis and FCM detection;
3. Polygenetic analysis showed 91 cultivars were divided into six groups that were basically coincident with the section classification of *Populus* genus*;* and
4. This study provides valuable genetic information for the identification of Poplar cultivars and intellectual property rights protection of breeders. Meanwhile, the genetic relationships of these cultivars could be used in design of poplar breeding program.

Metabolomic responses of down-regulated p-coumaroyl quinate/shikimate 3'-hydrolase (C3'H) and cinnamate 4hydrolase (C4H) genes in the lignin biosynthetic pathway of Eucalyptus urophylla x E. grandis with reduced recalcitrance; T. Tschaplinski, Oak Ridge National Laboratory, USA

1. Genes in the lignin pathway of *E. urophylla x E. grandis* hybrid has been knockdown, which resulted in reduced recalcitrance of cell walls of stem wood;
2. To understand the effect of knocking down these genes metabolomic studies have been conducted on transgenic plant;
3. Many metabolites were up-regulated as expected but few metabolites down-regulated; and
4. Interesting results in connection to conversion of biomass to biofuels.

Session 2E, Genomics, 09:00-10:30, Thursday 15 September 2016

Improvement of the inducible activation tagging AC/DS transposon system by employing the positive selection marker TMS2; M. Fladung, Thünen Institute of Forest Genetics, Germany

1. The activation tagging system based on the maize transposon Ac is reliably working in Populus;
2. It seems applicable to other tree species (e.g. Eucalyptus, conifers) with low-efficient transformation but high regeneration capacity;
3. The rolC-system as a phenotypic selection marker for transposition is working but not highly reliable; and
4. The tms-system improves the selection (positive selection marker for transposition): only transposed poplar cells are able to regenerate into plants
    a. No PCR step to detect transposition necessary;
    b. In theory, only Ac-transposed cells regenerate into plants (exception outliers);
    c. Save of time and money.

Chloroplast and mitochondrial SNP-markers support holistic poplar breeding; H. Schröder, Thünen Institute of Forest Genetics, Germany

Comparison of mt and cp:

1. mt genome reveals low number of polymorphisms;
2. cp genome is highly polymorphic;
3. cp genome high number of species-specific SNPs and InDels; and
4. Nevertheless, for adaptive (non-neutral) markers, mt is to keep in mind.

InDel/SNP markers:

1. Combination of only four InDel markers allows differentiation of 12 species:
    a. Either in a procedure of exclusion (Agarosegel) or in a multiplex (Genetic Analyzer);
2. Eight species to be identified by single PCR-RFLPs;
3. More would be possible in multiplex analyses
    a. e.g. MassArray;
    b. A SNAP-Shot multiplex is under construction.

Sessions 3: Tree Health, Insects, Pathogens, Climate Change and Ecology (Room Curie)

Session 3A, Climate Impacts and Pathogens, 09:00-10:30, Wednesday 14 September 2016

Early climatic benefits of *Salicaceae* plantations on abandoned arable land; R. Rytter, Rytter Science, Röstånga, Sweden

5 years after planting of *Salicaceae* on former arable land:

1. SOC pools were generally unchanged;
2. Standing C stocks had increased by 15% in SRC willow;
3. Annual C accumulation rates were 2.6 Mg ha^{-1} in SRC Willow and 0.5 Mg ha^{-1} in hybrid aspen and Poplar plantations; and
4. *Salicaceae* plantations, in addition to future fossil fuel substitution, may provide an early climatic benefit when planted on newly abandoned arable land.

Session 3B, Pathogens, 11:00-12:30, Wednesday 14 September 2016

A histological and biochemical comparison of resistant and susceptible *Populus* genotypes inoculated with *Sphaerulina musiva*; N. Abraham, North Dakota State University, Plant pathology NDSU, Fargo, ND, USA

Summary:

1. No difference in pre-penetration process was observed;
2. Differences in post penetration events were seen after 96hours post inoculation;
3. Inter and Intracellular colonization was observed in both the genotypes; and
4. Resistance mechanism was clearly visible at 3weeks post inoculation in the resistant genotype.

Future Work:

1. Analysis of DAB staining, penetration rates, germination rates with SAS.

Testing pathogenicity of *Sclerotium rolfsii* causing leaf spot of poplar; S. Rawat, Forest Pathology Division, Forest Research Institute, Dehradun, India

1. Pathogenecity was proved by spraying method on all the clones but not by soil inoculation method. Leaving a gap between survival of pathogen (soil-borne) and plant organ affected (stem and leaf);
2. In spray method, symptoms were produced within third day of inoculation, with the initiation of brown spots;
3. These brown spots started to grow into concentric rings within 4-5 days on clone W-110;
4. Mycelial formation took place which led to the initiation of sclerotia within 6-7 days (W-110). Then, sclerotial maturation within 8-9 days after inoculation;
5. Defoliation started after 9-10 days of inoculation;
6. This is mainly a disease of poplar nurseries especially in humid and warm locations;
7. The pathogen manifests only during monsoon season under warm and humid conditions;
8. There appears to be clonal variation in respect of its infection; and
9. Further studies under consideration for studying its occurrence throughout the poplar growing region and its economic impact on nursery production.

Could pathogenicity be used as a determining factor to study isolate variation? K. Naharia, Genetics and Tree Propagation Division, Forest Research Institute, Dehradun, India

1. Differences were observed in respect of time of initiation and types of symptoms; and
2. Appearance of haloing in two isolates (no. B-87 and B-88) showed the possible role of toxin in symptom variation.

Session 3C, Pathogens/Insects, 14:00-15:30, Wednesday 14 September 2016

Poplar clones in Latvia: Juvenile growth and fall frost damages; S. Senhofa, LSFRI 'Silava', Salaspils, Latvia

1. Clone had significant (all $P < 0.01$) effect on the phenological stage, leaf and stem frost damage, height and biomass;
2. Clones (cuttings) which are introduced in the 1960s were less frost damaged than those introduced recently;
3. Latter introduced clones were superior in height and above ground biomass production (in the leafless stage);
4. Significant ($P < 0.05$) trend of more stem damage for more productive clones was found;
5. Frost damage of leaves had no effect on tree height and biomass (both $P > 0.05$); and
6. Results suggest that fast growing and frost tolerant clones at the particular age could be selected.

Plant decline etiology in Poplar short-rotation coppices; N. Anselmi, DIBAF University of Tuscia, Viterbo, Italy

1. Identify the species of the pathogen;
2. Define the predisposing factors; and
3. Trace possible control measures.

Poplar clones differ in their resistance against insect feeding; H. Schröder, Thünen Institute of Forest Genetics, Germany

Beetles:

1. The Poplar leaf beetle was the most frequent insect on all but two clones;
    a. This beetle is known to be the main defoliator of poplar all over Europe; and
2. Willow beetles and leaf rollers have been found in a smaller number.

Clones:

1. It is interesting that the clones of the group "MAX" differ in their resistance level; and
2. No beetles found on "Rochester" – other insects responsible for LAL of 10%.

Resistance:

1. There is a clear ranking of clones, possibly due to their resistance level against insect feeding; and
2. This result will be used to perform transcriptome analysis of the most susceptible and most resistant clones (candidate genes).

Importance and management of the Red Poplar Leaf Beetle (*Chrysomela populi* L.) in short-rotation coppices (SRC): an overview; R. Georgi, TU Dresden, Faculty of Environmental Sciences, Germany

1. *Chrysomela populi* rank among the most important pests in SRC with poplar, especially with short rotation cycles;
2. Natural enemies are known for all development stages of *C. populi*, some are highly specialized; and
3. Promotion of natural enemies through habitat manipulation, especially flowering plants, is a key factor to supress damage of *C. populi* below the economic injury level.

Session 3D, Insects, 16:00-17:30, Wednesday 14 September 2016

The power of Poplar odour- how we can help Poplars to fight back; M. Kazic, Georg-August-Universität Göttingen, Forstzoologie und Waldschutz, Germany

1. The power of Poplar odor is considerable, but not fully explored yet!

Olfactory navigation of sawflies (*Nematus* spp.) as a device for hazard analysis of different practically relevant poplar varieties in short rotation coppice; K. Manthe, Universitiy of Applied Sciences Erfurt, Faculty of Landscape Architecture, Horticulure and Forestry, Germany

Results:

1. Differences between scent pattern of practice-relevant varieties of poplar as possibility for hazard analysis (*Nematus* spp. e.g.);
2. Using feeding preferences and orientation-relevant pattern of different varieties shows that Max 3 is the most attractive poplar variety for *Nematus* spec; and
3. Varieties of the section Tacamahaca were at least accepted.

Future Work:

1. Laboratory and field trials to repel *Nematus* spp.; and
2. Establish a mixed-variety short rotation crops.

Management of poplar defoliator: *Clostera cupreata* through herbal approach; R. Sehrawat, Forest Research Institute, Indian Council of Forestry Research and Education, India

1. Present study clearly indicates that *C. procera* leaves were quite effective as larvicide for providing a better non-polluting alternative for the control of Poplar defoliator.

Session 3E, Ecology, 09:00-10:30, Thursday 15 September 2016

Methods for diagnosis of aspen sustainability; O. Chernyshenko, State Forest University, Moscow, Russia

1. Useful selection methods have been developed for selection and diagnosis of Aspen in Russia.
2. Traits selected include stem form, bark colour, radial growth, resistance to stem rot and dendro-chronological approaches

Full LCA of Poplar SRC considering environmental impacts on a marginal SITE in Southwest Germany - (presented by J.-P- Schnitzler); J. Schweier, Albert-Ludwigs-University Freiburg, Germany

1. Results showed that the main factor controlling the biomass production and the environmental impact was the rotation cycle length.
2. It was highest in 7-year rotation cycles, conversely to the impacts on GWP, which decrease by increasing the rotation cycle length.
3. Fertilization treatments affect the SRC biomass production while negatively impacts the environment.

Quantifying environmental impacts of poplar short rotation-coppice on marginal land - summary results from the PROBIOPA experiment; R. Grote, Karlsruhe Institute of Technology, Germany

1. Short rotation coppice bioenergy does not have a neutral global warming potential, but is far less emitting of greenhouse gases compared to other energy sources or land-uses
2. The use of Poplar wood chips for bioenergy is more favourable than fossil fuels (gas, charcoal and oil).

Natural regeneration of black, hybrid and balsam poplars in the landscape; H. Liesebach, Thünen-Institute of Forest Genetics, Germany

Genotyping and parentage analyses in wild poplar collections indicate that:

1. A large number of natural regeneration has no other detectable species contributions than *P. nigra.* However, offspring from the widely planted clone 'Italica' is partially included;
2. Backcrosses between commercial Euramerican poplars (*P.* × *canadensis*) and native black poplars are existing, both as female and male parents. They also can propagate by root suckers;
3. Commercial cultivars (balsam poplars and intersectional hybrids) jointly produce generative offspring families;
4. New inter-sectional hybrids are generated from crossbreeding of Euramerican Black Poplars and Balsam Poplar cultivars: (*P. deltoides* × *P. nigra*) × (*P. maximowiczii* × *P. trichocarpa*);
    a. A process of genetic introgression has started in Germany forming a species swarm around the native black poplar;
    b. The within species mating for *P. nigra* is preferred, but it is sexual compatible with members of sections Aigeiros and Tacamahaca; and
    c. Generalised statements on this ongoing process of genetic introgression, on its spatial presence and dependence from flowering coincidence are not yet possible.

Sessions 4: Physiology, Agroforestry and Production Systems (Room Hertz)

Session 4A, Physiology, 09:00-10:30, Wednesday 14 September 2016

Growth and physiology of Salix clones in response to drought and re-watering; A. B. Guarnaschelli, Department of Vegetal Production, Faculty of Agronomy, University of Buenos Aires. Argentina; presented by S. Cortizo.

1. Results confirm the susceptibility of willow clones to water supply;
2. Plants exhibited physiological (g_s, K_s) and morphological adjustments (LA) n response to low water availability mainly in the first period;
3. Both *Salix matsudana* x *Salix alba* "Barrett 13-44 INTA" and *Salix matsudana* x *Salix nigra "*Lezama INTA-CIEF" clones were able to cope with drought conditions, as was observed in previous studies in clones cultivated in Argentina;
4. They had also the capacity to recover after re-watering, through g_s K_s, and LA adjustments;
5. Drought reduced growth were more severe after the first period;
6. Variability in the clone responses were found;
7. "Barrett 13-44 INTA" had taller plants, it showed higher growth efficiency and was less affected by drought than *"*Lezama INTA-CIEF" clone;
8. Plant phenotypic plasticity is a characteristic of remarkable importance in the present scenario of global climate change because it influences tolerance to environmental variability; and
9. Breeding for phenotypic plasticity in traits other than yield will potentially afford resilience under conditions of environment variability. In this case, breeding for plasticity in water use traits could lead to better survival and higher average yields.

Transpiration and water relations of four poplar genotypes under short rotation coppice (SRC) - (presented by S. Vanbeveren); Navarro, University of Antwerp, Belgium

1. Ongoing research continues
2. Fs ~ PAR + Temperature
3. No water stress yet ($-0.3 < \Psi_{stem} < -0.7$; RWC 90-95%)
4. Stomatal behaviour ~ PAR, g_s ~ temperature
5. Koster most suitable for warmer climates
    a. Low g_s
    b. Low Fs
    c. High Ψ_{stem}
    d. High RWC

Valuation of some growth and functional responses of *Salix* clones in response to flooding; F. D. Caccia, Department of Vegetal Production, Faculty of Agronomy, University of Buenos Aires, Argentina presented by S. Cortizo

1. Willows have a considerable capacity to tolerate flooding;
2. There are significant differences in the responses of Willow (species and clones) to flooding. willow clone *Salix matsudana* x *Salix nigra "*Lezama INTA-CIEF" was most tolerant to flooding;
3. Recommendations for future experiments on different water regimes:
    a. Monitor or measure soil temperature in the pots as soil temperature is very different for dry, or flooded, or control conditions.
    b. When studying the recovery from flooding, it is recommended to measure chlorophyll concentration of the leaves (e.g. by a non-destructive SPAD-instrument).
    c. During experiments with different water regimes, it is useful to monitor the rate of leaf abscission.

Session 4B, Physiology/Agroforestry, 11:00-12:30, Wednesday 14 September 2016

Introducing trees into cultivated fields to reduce the French shortage of poplar wood: agroforestry and wood quality; R. Marchal, CIRAD, RU BioWooEB, Montpellier, France
Conclusions:

1. Difficult to generalize results because of the small sampling and of the interaction silviculture/distance to the river;
2. Trends of very small degradations (statistically not significant) of material properties in AFS (MFA, Lignin, MoE);
3. Access to water is a very important factor to explain variabilities; and
4. But, roughly, intrinsic poplar wood quality coming from agroforestry seems equivalent to the quality of wood produced into "forest" conditions.

In Progress:

1. Measurement of tension wood on disks; and
2. Confirmation of these results on a larger sample, other localities, other cultivars.

Poplar and black locust yields from short rotation coppice hedgerows in an alley cropping system; J. Mirck, Department of Soil Protection and Re-cultivation, Brandenburg University of Technology, Cottbus, Germany
Allometrics:

1. First rotation: no difference between inside and outside rows; and
2. Second rotation (1st year): poplar significant difference between inside and outside rows, black locust no differences.

Yields:

1. Poplar didn't establish well in 2010, possibly because the trees were planted in April, which was very dry that year;
2. First rotation:
    a. Poplar: 5.5 Mg/ha/yr;
    b. Black Locust: 6.9 Mg/ha/yr;
3. Black locust may show a higher annual yield, because the first rotation covered 5 growing seasons for black locust and 4 for poplar;
4. Poplar hasn't reached max annual growth yet, greatest growth in 2014; wet in May;
5. Black locust reached max annual growth of 11 Mg/ha/yr in 2012; wet in June and July;
6. Second rotation (1st year):
    a. Poplar: 3.9 Mg/ha/yr;
    b. Black Locust: 4.2 Mg/ha/yr; and
7. Black locust greater growth because 2015 was very dry.

Survival:

1. Poplar: 70% end first rotation, not affected by harvest; and
2. Black locust: 80% end first rotation, 70% 1st year 2nd rotation.

Biomass production in an improved sustainable mixed short-rotation woody cropping of *Populus*-hybrids and *Robinia pseudoacacia*; J. Rebola-Lichtenberg, Georg-AugustUniversität Göttingen, Germany

1. Biomass growth in short rotation coppice (SRC) with mixed cropping of 8-year-old Poplar genotypes and three Black Locust genotypes;
2. The hypothesis is that Poplar may possess traits that are advantageous if planted with N-fixing Black Locust (*Robinia psuedoacacia)*; and
3. The research is on-going, with limited results to date.

Proposed Management for Willow Agrosilvopastoral Systems in the Parana River Delta (Argentina); Edgardo Casaubon, Teresa Cerrillo, Laura Gurini, Mauro Fernandez, Estacion Experimental Agropecuaria Delta del Paraná, INTA, Ministerio de Agroindustria

1. In recent years the quantity of beef cattle in the region has led to the move from a traditional plantation system to a more intensive production system with the aim to achieve a comprehensive production of wood, grasses, beef and bee products;
2. The new willow silviculture is designed to produce a higher percentage of wood for solid uses (sawn wood and veneers), in addition to crushed wood, wood pulp and/or wood for energy uses;
3. In the case of plantations under agrosilvopastoral systems particularly, it is designed to produce high-quality beef, forage and/or bee products (honey, bee polen, propolis) according to the demands from both the domestic and the international markets;
4. Intensive nursery management to produce one and two-year-old, 3.5- to 7-m long, rooted and unrooted pole cuttings, especially in *S. babylonica x S. alba* "Ragonese 131/25" and "Ragonese 131/27", and *S. matsudana x S. alba* "Barrett 13/44" willow cultivars;
5. Livestock introduced at the first, second or third year of plantation, facilitating natural grass fodder and the simultaneous production of beef, bee products and wood for various uses.
6. Matching sites with specific species/ clones to achieve high performance critical;
7. Water management through drainage networks important;
8. Less weed competition; lower fire risks (dry grass fuels low) and water present in drainage networks and available for livestock; and
9. Willow leaves are additionally very palatable and nutritious for livestock, and thus a good complement to livestock feed.

Session 4C, Agroforestry, 14:00-15:30, Wednesday 14 September 2016

Poplar in southern European agroforestry; M. R. Mosquera Losada, Univesidad de Santiago de Compostela, Lugo, Spain

Fast-growing tree culture outside forest: experiences from India; Dinesh Kumar, Silviculture Division, Forest Research Institute, Dehradun, India

1. Adoption of technology depends on a complex array of socio-economic factors besides scientific merit;
2. Poplar does not give fuel, fodder, food, fibre, timber, yet it is one of the three most popular agroforestry trees (Money is important too);
3. Industrial utility (composite wood products, pulp, matches etc) rather than grower's own consumption of utility;
4. Yamunanagar has a major concentration of buyers in one market;
5. Narrow spectrum of produce usage implies greater price fluctuations (boom and bust);
6. Trees Outside Forests for production function, forests for conservation;
7. Environmental audit is inevitable;
8. Keep evolving, else others may take over;
9. Need for extension cannot be overemphasized;
10. Government should act as facilitator, not controller, for agroforestry to thrive;
11. Small quick returns may be more important than large late returns for smallholders;
12. Farmers are excellent innovators; and
13. International cooperation is vital.

Biomass estimation models and allometry changes in a short rotation coppice poplar plantation in the North of Spain; J. Valbuena-Castro, Sustainable Forest Management Research Institute, Madrid, Spain

1. Considerable differences in biomass prediction have been observed in a SRC plantation depending on the factors studied, such as the predictor variables used in the models, the model formulation or the age;
2. It seems that there is a notable influence of age on allometry in the years after harvest;
3. The implicit inclusion of age in the model as a dummy variable, expanding the exponent of basal diameter, reduces the variability in parameter estimations; and
4. It is evident that different options may be employed depending on the purpose of the model, so it is advisable to carefully consider the aim of the model in order to select the most appropriate time of sampling.

A pilot study of Poplar plantations optimal rotation period and its growth dynamics under different planting densities; B. Hjelm, Dept. of Crop Production Ecology, Swedish Univ. of Agriculture Science, Uppsala, Sweden

1. Clone ”OP 42” (*P. maximowiczii x P. trichocarpa*), 12 stands in southern and middle Sweden; Age range 5-23 yrs, Planting density 900 -1 500 stems/hectares;
2. Project I assessing gow many years to break even point CAI /MAI?; What impact has the planting density on the rotation?; and What is one general rotation model?
3. Project 2 Study the growth dynamics between the planting densities in which assessment of:
    a. Diameter development;
    b. Volume and biomass development; and
4. The pilot study will be evaluated until autumn 2018.

Session 4D, Production Systems, 16:00-17:30, Wednesday 14 September 2016

Results from six years of the joint research project PROLOC – clone-site interaction and yield dynamics after two rotation cycles; C. Stiehm, Northwest German Forest Research Institute, Germany

Outlook:

1. Model calibration and validation
2. Implementation of growth simulator
3. Integration of results from analysis of AP2a and AP2b trials (10a rotation cycle, varying spacings)
4. Including new clones/cultivars into growth simulation
5. Integration of results from other projects with ProLoc outcome (FastWood, CF)
6. Reduced data acquisition for third rotation cycle within AP1

Development of Poplar clones for SRC in an EU-wide trial; D. Glas, Bavarian Institute for Forest Seeding and Planting (ASP), Germany

Interim Results to:

1. Determine SRC-suitable clones
2. Analyze productivity on different site conditions
3. Consolidate expert knowledge
4. Avoid costly breeding programs
5. Develop regional clone recommendations as precondition for EU-wide marketing of clones

Influence of two contrasting planting systems and weeding regimes on willow performance under field conditions; M. Welc, Swedish University of Agricultural Sciences, Sweden
Preliminary Conclusions:

1. The type of propagation unit (cutting vs. billet) and weeding regime (weeded vs. unweeds) had the highest impact on survival rate and biomass accumulation of willows in this experiment,
2. Survival rate and biomass accumulation:
    a. was higher for cuttings than billets (H1.1),
    b. did not significantly differ for stored or fresh propagation units (H1.2),
    c. was significantly reduced under weed pressure (H1.3),
    d. differed between willow genotypes (H1.4)
3. Dry weight-diameter relations depend on weed pressure (H2).

Continuation:

1. Destructive harvest - complete biomass dataset
2. Weed inventory data

Success factors for short rotation plantation projects - framework conditions, business models and case studies in Europe; M. Weitz, Lignovis GmbH, Hamburg, Germany
Short Rotation Plantations:

1. Account for < 0.1% of EU crop land only;
2. Economic break-even in comparison to wood from forestry;
3. Mainly "strategically" orientated stake-holder are involved and first professionally managed commercial sized projects are developing; and
4. Discriminated by exclusion from agricultural climate and environment subsidy programs (at least in Germany).

Benefits:

1. Sustainable land use (low input agriculture & benefits for biodiversity);
2. Ground water protection and erosion control;
3. 3-times higher CO_2 reduction potential vs. 1st generation energy crops is not sufficiently appreciated in current support schemes; and
    a. Fair valuation of environmental and climate benefits would immediately make SRP production systems economically attractive.

Session 4E, Production Systems, 09:00-10:30, Thursday 15 September 2016

Resource potential of aspen in Russia; A. Tsarev, Petrozavodsk State University, Russian Federation

1. Results show that selection and hybridization may give fast-growing hybrids stem volume wood faster than development of the disease;
2. Rapid growth of plants or any other factors contributing to their resistance to fungal diseases can produce economically valuable Beach Aspen plantations resistant to heart rot;
3. Overall, Aspen is a valuable wood resource and provides ecosystem services; and
4. Rational use of Aspen can potentially make an important contribution to the transformation of forestry in a highly profitable industry.

Growth potential of first generation hybrid aspen plantations in southern Finland; E. Beuker, Natural Resources Institute Finland, Finland

1. Growth and yield trials were established and evaluated at 3 sites: Trial 1, Lohjansaari (1997); Trial 2, Lapinjärvi (1999); Trial 3, Lohja (1998);
2. Three hybrid aspen clones tested : A = E10476 (in trial 1); B = E10467 (in trial 1); and C = E10490 (in trials 2 and 3)

3. Four planting densities: 2,5 x 2,5 m (~1600 trees/ha); 3,0 x 3,0 m (~1200 trees/ha); 3,5 x 3,5 m (~800 trees/ha); and 5,0 x 5,0 m (~400 trees/ha);
4. Interim results are showing some growth differences in diameter, volume and volume/tree after 12 years monitoring.
5. The choice of site as well as clone is also very important for the production.
6. Hybrid aspens are expected to become more important as a resource of biomass in the Finnish bio-economy.

Biomass productivity and mutual relations between tree growth and soil nutrient status in short-rotation hybrid aspen plantations in hemi-boreal Estonia; R. Lutter, Institute of Forestry and Rural Engineering, Estonian University of Life Sciences, Estonia

1. Hybrid aspen shows great growth potential for SRF practise on former arable soils after 15 years of growth in Estonia;
2. First generation hybrid aspen plantations planted on former arable lands had significantly altered soil reaction (pHKCl) but did not show significant depletion of primary macronutrients (N, P, K);
3. Former arable lands provide sufficient supply of nutrients even after 15 years of growth in hybrid aspen plantations. Available water content (AWC) in soil (different layers to 75 cm) was limiting growth of the trees;
4. Former SOC-exhausted croplands have a higher ability to sequestrate new C to the below-ground pool than already SOC-rich grasslands;
5. Hybrid aspen plantations already showed during the first 15 years a great potential to sequestrate C and N at the ecosystem level; and
6. Future monitoring is needed to detect possible nutrients limitations and growth potential during the whole rotation period (25 year).

New clones will let farmers to increase variability and sustainability of poplar plantation in Argentina; S. Cortizo, Instituto Nacional de Tecnología Agropecuaria, Campana, Argentina

Background

1. The 14,508 hectares of poplar plantations in the Paraná River Delta area are a significant economic resource for the region;
2. Maintaining the quality and health of commercial plantations depends on the continuous supply of genetically improved clones and a suitable silvicultural management to produce wood of adequate industrial quality;
3. To meet this requirement, the National Agricultural Technology Institute (INTA) has led a poplar-breeding program since 1960;
4. The main objective of the work has been the selection of superior genotypes based on the concept of overall quality of the tree to improve industrial performance;
5. *Populus deltoides* has been introduced into Argentina as a base in the breeding program since no native *Populus* species were available; and
6. Recently four new clones with similar or better performance compared to commercial control clones have been introduced.

To encourage the multiplication and the adoption of the new clones:

1. Agreement of propagation with leading growers was signed
2. Certified cuttings were provided to the nurseries of the region
3. Different tools were generated and made available to the authorities
4. Workshops and training courses were organized

Sessions 5: Production Systems, Livelihood, Economics and Energy (Hans Grade Hall)

Session 5A, Production Systems/Livelihoods, 09:00-10:30, Wednesday 14 September 2016

Mixed strategies for willow defence - resistance and tolerance to herbivory under varying nutrient regimes; C. Glynn, Department of Crop Production Ecology, Swedish University of Agricultural Sciences, Uppsala, Sweden

1. No evidence was found of a trade-off between tolerance (biomass recovery after herbivory) and defence as measured by condensed tannins, flavonoids, chlorogenic acids or by total phenolics.

Process based modelling to select optimal regional phenotypes for SRC willow to maximize resource use efficiency; B. Richard, Rothamsted Research, Harpenden, United Kingdom

1. LUCASS
    a. Powerful tool to simulate yield, canopy development and above and below ground biomass
2. Scenarios simulation:
    a. Q1: Endurance (high LAI) remains better in « dry » south-east England
    b. Q2: Less low yields in « wet » west England
    c. Q3: Less risk of low yields, and better WUE with a 3-year rotation, and with Tora
3. Future work
    a. More weather stations with local soils
    b. Future climate scenarios with more water stress

A *Salix* spp. short rotation coppice system in Buenos Aires, Argentina: Effects of clonal composition, planting density and drip irrigation on biomass production; F. Achinelli, Comisión de Investigaciones Científicas de Buenos Aires (CIC), Argentina

1. Productivity of Willows in this agricultural soil is highly dependent on irrigation, and also probably of rainfall. "Yaguareté" clone more sensitive to drought than "Barrett"
2. We hope subsequent harvests could help define yield tendencies: is yield related to rainfall or yield declines reveal nutrient depletion?
3. Nutrient export determinations and aerial biomass partitioning (by size class of shoots) are underway.

Grey alder (*Alnus incana* (L.) MOENCH.) – a complement to other fast-growing tree species in northern Europe; L. Rytter, Forestry Research Institute of Sweden, Svalöv, Sweden

1. Grey Alder has many good qualities that are favorable for cultivation in northern latitudes
2. The biomass production is high, although not on the *Populus* or *Salix* level
3. There is a large potential for breeding improvement within the species
4. Grey Alder may significantly contribute to reduce the climate change effects by biomass production and C capture in northern latitudes

Session 5B, Livelihoods/Economics, 11:00-12:30, Wednesday 14 September 2016

Poplar in the Kyrgyz Republic; N. Chyngozhoev, Forest Research Institute of the National Academy of Science, Kyrgysztan

1. Poplar species dominate as the main forest-forming species in river valleys and broad flood plains and habitats with sufficient moisture or in terraces with close groundwater occurrence. Distributed from 1200-2300 metres altitude;
2. Local wild-growing poplar species include: Downy Poplar – *Populus diversifolia* Schrenk.; Blue Poplar – *P. Pruinosa* Schrenk.; Bolle's Poplar – *P. bolleana* Lauche.; Uzbek Poplar – *P.*

usbekistanica Naz.; Tien-Shan Poplar – *P. tianschanica* V. Tkatsch.; Densely-leaved Poplar – *P. densa* Kom.; Talas Poplar – *P. talassica* Kom; and Trembling Poplar – *P. tremula* L.;
3. Good opportunities for planting fast-growing poplar species for wood production;
4. Local species of poplar preferred to avoid possible genetic infestation; and
5. Protective measures to preserve species diversity and regulate cattle grazing is needed.

How poplar (*Populus deltoides*) based agroforestry transformed weak rural economy to prosperous green economy in North India; M. S. Haque, National Bank for Agriculture and Rural Development, India

1. Development of Poplar plantations in agroforestry systems as a public-private partnership has been a great success story in the Northern States of India providing wood products and social and agricultural benefits.

The journey of Poplar cultivation under agro-forestry in India - responding to drivers of change; Gulshan Kumar, Indian Forest Service, Haryana State, India

1. Opportunities to all stakeholders in meeting the socio-economic needs, environmental development and preservation of gene pool & bio-diversity.
2. Supply of Poplar wood grown under agroforestry system has taken off pressure from natural forests.
3. To a considerable extent Industries are able to meet their raw material requirements from locally available farm based wood products.
4. Agroforestry has provided an opportunity to meet the challenges of social issues viz; poverty, hunger, health and environmental sustainability.
5. Multiplier effect on economy through overall socio-economic development.
6. Ecological restoration through increase in tree cover.
7. Carbon sequestration, carbon credits climate change mitigation.
8. Poplar Agro Forestry has proved to be a land management system for Integrated rural & industrial development

Session 5C, Economics 1400-1530 Wednesday 14 September 2016

Social Poplar plantations of Balykoty Forest Service in Kyrgystan; K. M. Zhantaev, State Agency for Environment Protection and Forestry, Kyrgyzstan

1. Poplars and grown to reduce pressure on natural forests for solid wood and firewood bringing social and economic benefits;
2. High elevations and poor soils cause longer rotation lengths but these plantations bring jobs to rural areas; and
3. Glacier water irrigation of plantations is very unique.

Poplar plantation - a boon to rural livelihoods and ecological restoration in north India; S. K. Sharma, Geography and Environmental Science Department, India

1. Due to acceptable risk and high profits in Poplar cultivation, farmers in Northern India prefer to plant Poplar on their lands in agroforestry systems rather than other agriculture or agroforestry options;
2. This labour-intensive and large-scale adoption of Poplar cultivation has helped farmers earn good profits;
3. The activity of raising Poplars and their marketing, has given economic benefits to the farmers and employment to the very poor formerly unemployed;
4. Poplars and fast growing and renewable resources for green economies; and
5. Poplars offer the environmental benefits such as the capture of CO2 to mitigate climate change.

***Populus deltoides* financial maturity (case study: Kurdistan province, western Iran);** K. Adeli, Forestry Department, Faculty of Agriculture, University of Lorestan, Iran

1. In the present study, Faustmann model considered the lost opportunity cost by cutting earlier and calculated the optimal age of harvest;
2. Although the financial maturity of poplar in the study area was 12 years, the farmers cut these trees by the age of 6 or 7 years taking into account the risks of the market;
3. Earlier harvesting incurred a high lost opportunity costs since these trees began to grow quickly at this age to rich financial maturity; and
4. Economic analyses showed that 12-14-year financial rotation age for Poplar hybrids for solid wood products was optimal.

Economic analysis tool for SRWC-based feedstock production in the South-eastern U.S.A. - (presented by D. Hazel); S. Ghezehei, Department of Forestry and Environmental Resources at North Carolina State University, USA

1. Planting in marginal sites raises challenges to the financial success of the enterprise - yields need to be increased, operational costs need to be reduced, varietal selection and silvicultural systems must be optimized; and
2. Grower decision support tools help to identify optimal species and production systems and identify potential problems before you plant.

Session 5D, Energy, 16:00-17:30, Wednesday 14 September 2016

Evaluation of growth and bio-energetic potential of fast growing trees (*Populus* and *Salix*) for short rotation plantation; N. Kutsokon, Institute of Cell Biology and Genetic Engineering, NASU, Ukraine

1. Collection of fast growing trees including 21 *Populus* and 10 *Salix* clones was established. They were differed by growth and energetic parameters;
2. Average height of the best clones reached more than 2 m while the lowest were around 1 m height and less. Diameter variations ranged in 4–19 mm, by numbers of branches per plant clones varied between 1,0 and 2,2 and by fresh weight – between 23–341 g;
3. By the caloric value of firing the biomass of different clones varied between 17,9–19,4 kJ/g;
4. During the first planting season willow clone Zhytomyrska-1 was the most intensively growing. Perspective clones of poplar and willows were also determined; and
5. Preliminary results for the second planting season demonstrating more intensive growth for poplars comparing to willows.

Woodfuels as alternative source of energy in rural and urban areas in the Philippines; R. Aggangan, Forest Products Research and Development Institute, Philippines

1. Wood energy (in the form of process heat for cooking fuel) consumes a large portion of production (more than half);
2. Emphasis is now on obtaining inventory data and developing short rotation wood crop silviculture systems
3. Production will probably focus on agroforestry systems; and
4. Outreach and demonstration programmes will be developed and introduced.

How to run a biomass group-heating on short rotation coppice basis; H.-G. von Engelbrechten, Agraligna GmbH, Germany

1. In Beuchte approx. 160,000 litre heating oil are replaced by biomass from woodchips
2. This reduces pollution of around 416 tonnes CO^2 per year
3. Due to biomass production, 120,000€ (0,75€/litre heating oil (average)) remains in the region, in 2016 with Oil-prices of 0,50€/l →80,000€

4. Short Rotation Coppices are outstandingly suited to cover the demand for raw materials
5. Feasibility of small, regional projects is viable
6. Despite substantial investments, heat supplied by biomass can be distributed to the customer at a cheaper price than current gas and oil

Subsurface drip irrigation in poplar bioenergy systems: biomass production and economic evaluation in Mediterranean climate; P. Paris, CNR-Istituto di Biologia Agroambientale e Forestale (IBAF), Italy

1. Surface drip irrigation (SDI) on poplar short rotation coppice (SRC) was tested in 2 sites with dry summer-subtropical climate;
2. Sub-optimal irrigation increased significantly shoot growth, biomass allocation pattern and yield (woody biomass);
3. Monitoring soil moisture at 30 cm soil depth is sufficient for scheduling irrigation; and
4. Doubling yield with SDI is enough to make it profitable.

Session 5E, Energy, 09:00-10:30, Thursday 15 September 2016

Efficient harvest and storage of wood chips from poplar in practice; R. Pecenka, Leibniz Institute for Agricultural Engineering Potsdam-Bornim (ATB), Germany

1. Efficient harvest and storage techniques are essential for economic production of woodchips from short roation coppice (SRC);
2. Forage harvesters and mower chippers are the best harvest systems a available at present; and
3. Dry matter losses during storage reach up to 25% dependent upon the wood chip site.

Post-harvesting emissions of CO^2 and biogenic hydrocarbons from woodchips produced by a poplar short rotation coppice; A. Ghirardo, Helmholtz Zentrum München, Research Unit Environmental Simulation, Germany

1. A consistent release of CO_2 and several VOCs with different time gradients was recorded during the desiccation process of the wood-chips;
2. CO_2 and methanol were emitted at high rates during the initial heat of the heap possibly due to degradation of plant material;
3. Temperature is an economically important factor to consider when storing the biomass for drying purposes, because it significantly influences the C-loss which can be 13-18% of overall biomass loss after 6 weeks;
4. During the drying and storage phase, microbial activities increased, leading to increasing microbial VOCs emissions, whereas plant-related VOC emissions decreased steadily; and
5. Freshly harvested woody biomass is a significant source of GHG and VOCs, which might impact local air quality.

New Poplar genotypes for short rotation biomass plantations in the Mediterranean environment: productivity and quality of biomass for bio-refinery - (presented by P. Paris); M. Sabatti, CNR-Istituto di Biologia Agroambientale e Forestale (IBAF), Italy

1. The low site fertility depressed yield without significant differences amongst the compared clones;
2. The experiment has not evidenced so far clone/s more adapted to Mediterranean conditions; and
3. Significant differences amongst clones in terms of biomass quality (s.s. density, moisture, chemical composition) with evident practical consequences for bio-refinery.

Sessions 6: Production Systems, Reclamation, Phytoremediation and Special Applications (Room Melli Besse)

Session 6A, Production Systems, 09:00-10:30, Wednesday 14 September 2016

Poplar and willow wood as a multi-use, local, raw material for a broad spectrum of green construction products within the European forestry wood chain; L. de Boever, WOOD.BE, Brussels, Belgium

1. It is important to assess the distribution of density and tension wood when assessing potential of new Poplar clones; and
2. Innovative wood products e.g. laminated window frames based on thermally modified wood shows potential of Poplars for engineered wood products.

Acid-catalyzed organosolv processing of short rotation coppice "poplar with bark" - a parametric study on yield and structure of sulfur-free lignin; V. Rohde, Fraunhofer Institute for Chemical Technology, Germany

1. Lignocellulosic material of fast-growing Poplar with bark is used to produce sulfur-free lignin in an environmental way.

Growth patterns of several poplar clones for plywood production in Spain; P. Garnica, Bosques y Ríos SLU, Garnica Plywood, Spain

1. This is an ongoing effort, for conclusive results we still have to wait for a few years more;
2. B&R is a private company and research is a fundamental part of our philosophy but the main goal is achieving financial sustainability for these poplar plantations;
3. Timber quality for plywood production is the key factor;
4. Several clones, both relatively new and older could be good substitutes of I-214 from the growth perspective; and
5. It is essential the genetic pools of the plantations are widened, so far Spain has been lucky enough with forest pests and diseases on poplars (climate helps), but we don´t know what will happen in the future.

Properties and utilization of selected fast growing tree plantation species for wood-based industries in the Philippines; R. Aggangan, Forest Products Research and Development Institute (FPRDI), Department of Science and Technology (DOST), Laguna, Philippines

1. Some FGTPS-based industries in the Philippines, particularly the plywood and furniture manufacturers, are experiencing shortage of raw material supply;
2. Massive plantations of preferred FGTPS should be established under the National Greening Program (E.O. 24) and by private companies;
3. New processing systems must be continuously developed to optimize the use of plantation timbers;
4. Development of new, profitable wood products;
5. Encourage establishment of new plantations ensuring sustainable supply of raw materials.
6. Develop cost-effective technologies in harvesting, retrieval and utilization of logging and wood processing wastes; and
7. Intensify information, technology transfer, and marketing capability in terms of plantation forestry.

Session 6B, Reclamation/Phytoremediation, 11:00-12:30, Wednesday 14 September 2016

Poplar for environmental restoration: Physiological and molecular approaches for heavy metal and organic molecules; L. Sebastiani, Institute of Life Sciences - Scuola Superiore Sant'Anna, Pisa, Italy

1. Explore Poplar genetic variability;
2. Understand molecular system and transporters;
3. Understand epi-genomic effects; and
4. Undertake breeding for phytoremediation.

Using native balsam poplar (*Poplar balsamifera*) for reclamation in the oil sands region of north-eastern Alberta, Canada; B. Thomas, University of Alberta, Department of Renewable Resources, Alberta, Canada

1. Opportunity to use the forest industry expertise and material for energy sector reclamation in overlapping tenure regions;
2. Clonal screening for "salt" tolerance critical for exploration of using selected native clones of Balsam Poplar (*Populus balsamifera*) for operational use on public land in Alberta, Canada for reclamation of oil sand extractions sites; and
3. Pioneer species excellent for "new" reconstructed sites.

Establishment of hybrid poplar for surface mine reclamation in the southern coalfield of West Virginia, USA; R. Zalesny, USDA Forest Service, Northern Research Station, Rhinelander, WI, United States

1. Soil amendments incorporating biochar with post-mining soils were tested to see if they increased tree survival and growth
    a. Biochar treatments did not significantly influence tree survival or growth;
2. Sixty hybrid Poplar clones representing seven genomic groups were tested for early survival and growth:
    b. 32 clones performed well and were advanced to a 2nd cycle of selection that is now growing in field trials; and
3. After two growing seasons, this silvicultural system is working well and has potential as a post-mining land use alternative for the region.

Willow afforestation for quarry rehabilitation in Rio Negro Valley, Argentina; E. R. Thomas, Instituto Nacional de Tecnología Agropecuaria, Río Negro, Argentina

1. Planting unrooted Willow rods (3m length) by "deep-planting technique" into contact with the water table subsurface irrigation resulted in excellent survival without surface irrigation;
2. Results after one year showed survivals of for the clones: "Géminis INTA-CIEF", 100%; "Agronales INTA-CIEF", 97%; "Los Arroyos INTA-CIEF" 95%; and
3. Results provide useful information about rooting capacity and survival of Willow rods in this site conditions.

Session 6C, Reclamation/Phytoremediation, 14:00-15:30, Wednesday 14 September 2016

The effectiveness of Poplar and Willow trees in reducing erosion on pastoral slopes in New Zealand

I. McIvor, Plant & Food Research, New Zealand

1. Poplars and Willows are effective at stabilising pastoral hillslopes in NZ;
2. They are more effective when root systems of adjoining trees interlock; and
3. At DBH <20cm the effectiveness is reduced because the strength of the roots is insufficient for soil stabilization.

Study on growth parameters of poplar trees irrigated with municipal wastewater in south of Tehran-Iran; A. Salehi, Research Institute of Forests and Rangelands, Agricultural Research, Education and Extension Organization, Iran

1. Results of this study show that despite a lack of water resources in recent years, wastewater can be used as an important source for providing required water for wood farming especially from urban areas of Iran;
2. Factors to be considered include concentration of some elements may need to be reduced to a minimum level to avoid any toxic effect in a long-term application;
3. Use of wastewater for irrigation should be based on accurate management and chemical, physical and microbial properties of water and soil, according to international standards;
4. In this study, a small part of our 5-year project was presented. We will try to publish the results of every year (growth and phytoremediation of poplars) in international journals; and
5. Also we will try to select and introduce of suitable poplar clones for cultivation in contaminated soils.

Treated wastewater use in forest plantations in north Patagonia, Argentina; C. Tucat, Medanito S.A., Argentina

1. The great performance of Willow clones in this initial stage is evidence of very good potential for short rotation forestry (SRF) irrigated with urban wastewater; and
2. From the environmental point of view, the short rotation forestry is a complementary treatment to urban wastewater, and an opportunity to obtain biomass for energy.

Selection and use of native Willow clones for reclamation in forest ecosystems impacted by elevated salt levels; R. Krygier, Natural Resources Canada, Canadian Forest Service, Alberta, Canada

1. Native Willows are tolerant to OSPW (salt impacted water/soils) present in the wild and can be identified through greenhouse screening processes; and
2. Survival and growth screened Willow clones are not affected under field conditions when grown in OSPW impacted soils.
3. Salt tolerant Willows can be found in the wild population and can be identified by simple screening processes; and
4. Difference in salt tolerance exists between and within Willow species.

Session 6D, Phytoremediation, 16:00-17:30, Wednesday 14 September 2016

Phytoremediation of river sediments with the use of poplars and willows; A. Pilipovic, University of Novi Sad - Institute of Lowland Forestry and Environment, Russia

1. There was not effect of sediment application on growth parameters in the first year;
2. Above ground biomass of treated Poplars was greater than the control plants in the second year;
3. Gas exchange measurements showed no change in photosynthetic activity of the investigated plants but the water use efficiency (WUE) of treated Poplars was increased in the 2nd year;
4. The load of heavy metals on soil did not exceed allowed limits;
5. Applied amounts of sediment did not affect treated plants; and
6. Further investigation of maximal amounts of sediment for use with Poplars and Willows for use in phytoremediation of river sediments is needed.

Effects of heavy metals and mycorrhizal fungi on growth and nutrient status of *Populus alba x glandulosa*; N. Aggangan, University of the Philippines Los Baños, Philippines

1. The two transgenic hybrid clones of *Populus alba x P. glandulosa* differed in their responses to heavy metals and mycorrhizal inoculation;

2. Transgenic clone PCP301CGOR4 was more responsive to mycorrhizal inoculation than PABC21;
3. Effectiveness of arbuscular mycorrhizal fungi (AMF) and ecto-mycorrhizal fungi *Pisolithus tinctorius* in promoting growth of PCP301CGOR4 was not affected by heavy metals; and
4. Mixture of AMF from minte tailings was more effective in promoting plant growth and nutrient uptake than *Pisolithus* not collected from mine tailings areas.

Session 6E, Special Applications, 09:00-10:30, Thursday 15 September 2016

Lead tolerance of *Populus alba* and *Populus nigra* clones inoculated with arbuscular mycorrhizal fungi in relation to physiological parameters; A. Salehi, Poplar & Fast Growing Trees Research Group, Research Institute of Forests and Rangelands Tehran, Iran

1. *Populus nigra* clone 62/154 was more Pb-tolerant than *P. alba* clone 44/9;
2. At all Pb-treatments, mycorrhizal and non-mycorrhizal plants of *P. nigra* had greater photosynthesis and transpiration than *P. alba*;
3. Inoculation with mycorrhizal fungi improved the physiological parameters in *P. alba* but not in *P. nigra* suggesting that inoculation could improve the tolerance of plantes on Pb-polluted soils of *P. alba*; and
4. High levels of Pb (1000 ppm) significantly decreased the percent of mycorrhizal colonization of *P. alba* but not of *P. nigra*.

Study of transporters of HMA and NRAMP family in wild type and transgenic line (35S:aqua1) of *Populus alba* stressed with cadmium; A. Neri, Institute of Life Sciences – Scuola Superiore Sant'Anna, Italy

1. Genetic modification changed the physiology of the plant and the stress response;
2. Manganese and Cadmium have similar ways of uptake.
3. Target genes are influenced by cadmium treatment;
4. WT and line1 plants show different cadmium translocation dynamics; and
5. Probably cadmium is not recognized by the plant that mantains a costant manganese level in the leaves.

Future perspectives:

6. Modify a gene among the HMA and NRAMP families whose genetic modification, done with classic methods or Crisp-CAS9, would increase *P. alba* phytoremediation potential.