Research and innovation
A review of the key success factors of smallholder poplar cultivation in Italy, from technical innovation of the research and industry to supportive legislation and public policies

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January 31, 2023
Biographic notes

Short descriptive biography:

- Consultant on International Agricultural Research (2018-)
- President, Permanent Executive Committee, International Poplar Commission, Statutory Body of FAO (2000-2012);
- National Representative (alternate) in the Horizon 2020 Programme Committee for Societal Challenge 2 “Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy” (2013-2020);
- Scientist (Poplar genetics and breeding) 1980-2004

Education:
MsSc (Forestry): University of Padua

Hobbies:
Rose & peony breeding
Orienteering
Cross-country ski

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Topics of the webinar

• Poplar culture in Italy
• What is so special about poplars?
• Uses of poplar wood
• Research (genetics and breeding)
• Poplars, environment, climate change
• The effects of policies
• Perspectives
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Poplar stands, common features of N. Italian landscape

Poplar culture is intimately mixed with the rural landscape and with rural life.

Latin: *arbore populi* = tree of the people
The alluvial plains of Northern Italy: 95% of poplar stands

Surface (51000 ha)

- Piedmont: 12475 ha
- Lombardy: 19850 ha
- Veneto: 5775 ha
- Friuli V.G.: 5875 ha
- FVG: 4700 ha
- Emilia R.: 2800 ha
- Rest of Italy: 51000 - (12475 + 19850 + 5775 + 5875 + 4700 + 2800) = 2125 ha

Regions:
- Piedmont
- Lombardy
- Veneto
- Friuli V.G.
- Emilia Romagna
- Rest of Italy

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The Po Valley, “cradle” of the Italian poplar culture

Catchment of the river Po: 70 000 km² (= 27 000 ml²)
*Salicaceae* a relevant component of the original flora
Agriculture since the Roman age
Poplar: the “farmers’ tree”
Cultivation for the paper industry since the mid-19th century
Poplars, typical features of the rural landscape

...A MASTERPIECE...

The Tree of Wooden Clogs

...A MASTERPIECE...

Poplars, typical features of the rural landscape
Poplar culture today
Industrial roundwood production in Italy

Poplars
1.2% of surface

Forests
Industrial roundwood production in Italy

Poplars
1.2% of surface
45% of production

Forests
Number of farms with poplars and surface of poplar stands

Classes of farm dimension

Number of farms (ha)

Poplar surface

<1 1-2 2-5 5-10 10-20 20-50 50-100 >100
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Pioneer species: poor, mineral soils, if water is available

- Salix alba
- Populus nigra
- Populus alba
Fast growth: 30-35 cm (12-14”) DBH in 9-10 years

‘I-214’ (Italy)
Breeding by controlled pollination is straightforward.

Dioecious species

Anemophilous

Abundant seed

High (but transient) viability
Easy vegetative propagation

20 cm cuttings from 1-year-old shoots

- New shoots
- New roots
6 m sets in two years, pruned and planted as ‘whips’
High uniformity of size and wood quality

Pruning up to 6-8 m in order to obtain knot-free logs for plywood production
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Plywood

Poplar wood
White
Uniform structure
Easy to work (especially peeling)
Light weight
Wood panel: plywood, particle board, blockboard panel

Usually “ennobled” by a layer of high quality veneer
Packaging
Industrial innovation

Product innovation often driven by furniture designers
Pulp and paper (minor importance in Italy)

- Short fibre
- Poor mechanical qualities
- White, high opacity, bright
- High cellulose, low lignin

Short-rotation high-density coppice for biomass

- Bioenergy (up to 10-20 MW)
- Woody pellets (home heating)
- Particle board (too much bark!)
- Dubious profitability
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Many *P. deltoides* specimens were brought to Europe, and especially to France, as ornamentals during the 17th and 18th century ...

The fundamental role of *P. deltoides* (Eastern Cottonwood) from N. America

Spontaneous hybrids between *P. deltoides* and the native *P. nigra* were propagated and introduced into cultivation during the 18th and early 19th century
Epidemic outbursts of Spring defoliation (*Venturia populina*) in the late twenties suggested a dedicated breeding programme to select resistant cultivars.

**Jacometti** collected *P.deltoides* from parks in Piedmont and crossed them with *P.nigra* and DxN hybrids.

Cultivars produced by Giovanni JACOMETTI

- I-214
- I-154
- I-476
- I-488
1935: Italy was sanctioned for its aggression to Ethiopia

The National Agency for Pulp and Paper (ENCC) was founded. Its mission: to increase domestic wood production.

Poplar plantations strongly supported by the Government and instrument of propaganda.
The Poplar Research Institute of Casale Monferrato (1937)

Experimental farm: 207 ha
Breeding activities continued after World War II (main breeder until 1982: Michele SEKAWIN)

**Harvard** (I-63/51)
**Lux** (I-69/55)
**Onda** (I-72/51)
**San Martino** (I-72/58)
**Triplo** (I-37/61) *(a triploid clone)*

Main attention on *Populus deltoides* (North America) both as individual cultivars and as female parents of hybrids

Production of huge quantities of seedlings followed by stepwise clonal selection
Introduction of *P. deltoides* seed (from open pollination)

Seed of *P. deltoides* shipped in 1952

Seed of *P. deltoides* shipped by Prof. Scott Pauley in 1948

Massac Co., Illinois

Stoneville, Mississippi

Casale Monferrato

I-69/55 ‘Lux’

I-63/51 ‘Harvard’

45°08’N

37°09’N

33°24’N
New “blood” from seed collections in N. America

*Populus deltoides* collections carried out by the N.A. Poplar Council (1967-1973-1974)

*Populus trichocarpa* collections carried out by the US Forest Service (1973-1974-1975)
Objectives:
1. Improve *P.d.* and *P.n.* for their combining ability
2. Select the best hybrids for commercial plantations

Obstacle: Incompatibility between male *P.deltoides* and female *P.nigra*
Breeding goals: first, resistance to diseases

- Marssonina brunnea
- Venturia populina
- Melampsorae
- Discosporium populeum
- PMV
Genetic selection only for the Poplar Woolly Aphid

Saperda carcharias

Gypsonoma aceriana

Cryptorhynchus lapathi

Cossus cossus

Phloeomyzus passerinii

Brown marmorated stink bug: Halyomorpha halys
Multiple breeding pathways

- Gene Technology (?)
- Clonal selection
- Population breeding

Time
Gene technology

Poplars are very easily propagated \textit{in vitro}.

Poplars can be easily modified genetically.

Resistance to insects (Protease inhibitors)

Application will depend on future public acceptance.
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**Poplars, environment, climate change**

- The effects of policies
- Perspectives
Poplars in agroforestry systems

- Improve soil fertility and organic matter
- Absorb excess P and N
- Provide revenue in the early years of rotation

Corn

Winter wheat

Tobacco
Poplars and climate change mitigation

Role of poplar plantations in combating carbon enrichment of the atmosphere

Stocked in living trees (including roots and soil)

Fossil fuel substitution

Replacement of energy-intensive products
Carbon budget of a poplar stand

Life Cycle Assessment (LCA) was performed according to ISO 14040 standard

Two clones:

‘I-214’ (most common in poplar culture in Italy)
Production: 158 m³ ha⁻¹ = 84 t ha⁻¹ CO₂e
Emissions: 7.35 t CO₂e
Net balance: 76 t CO₂e

‘Senna’ (low environmental impact)
Production: 197 m³ ha⁻¹ = 119 ha⁻¹ CO₂e
Emissions: 7.22 t CO₂e
Net balance: 111 t of CO₂e
How artificial is a poplar stand as an ecosystem?

- Simplified ecosystems
- Periodic disturbance
- Genetically uniform
- Even aged
- Cultivated

- Persistent cover
- Less intensive cultivation
- Little soil disturbance
- Understorey
- Transition ecosystems
Breeders were the first conservationists.

Large *ex situ* collections of the main breeding species are preserved by Research Institutions.
A project promoted by the Council of Europe and coordinated by IPGRI (now Bioversity International)

The network was enlarged to other broadleaved species
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Environmental policies: a mixed, sometimes inconsistent, bunch

1923: By law, poplar stands were encouraged in floodplains for their favourable hydraulic behaviour (limited obstacles to water flow).

1980s and 90s: Strong environmental movements imposed restrictions on poplar culture in floodplains and supported re-naturalisation of riparian vegetation.

2000s: A compromise: poplar stands allowed when a management plan includes strong environmental prescriptions (e.g. avoidance of any chemical treatment: phytosanitary products or herbicides; no tillage after 4-5 years).
**Subsidy management policies: EC regulations**

**Agriculture** (but not Forestry) is a subject of **Common Policy** in the **European Union**: the Union (Commission, Parliament, Council) decide the framework; Member States or Regions negotiate **Rural Development Plans**.

**Reg. 2080/1992**: The priority was to reduce agricultural surplus (mainly cereals) and support wood production as “**renewable raw material**”. Unintended consequence: **death of agroforestry**.

**2000s-onwards**: Subsidies linked to environmental objectives. Poplars receive a **partial contribution to planting costs** subject to some conditions: e.g. choice of genetically resistant clones and/or FSC/PECF certification of SFM
Certification of propagation materials

- Research (public and private)
- Development of new cultivars
- Tests of cultural value:
  - Rooting ability
  - Growth
  - Resistance to diseases
  - Wood quality
- Registration as OECD «Tested Reproductive Materials»

A subject (usually the breeder) is in charge of maintenance of identity.

- Cuttings are bought by nurseries and may be multiplied in stool bed for a maximum of five years.
- Plants (one- or two-years old) are sold to poplar growers.

Optional Protection of Breeder’s Rights

Public control (Regional Authorities)

Private control

Public «third party» control

Private sector

Public «third party» control

- Public sector

- Optional control

- Private control

08/01/2023
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Research perspectives

- Breeding (to be continued)
- Genomics: Marker assisted selection
- New Breeding Technologies (?)
- Biological control of insect pests (hyperparasites, pheromones)
- Fingerprinting for clonal identification
- Agroforestry systems
- Mixed species plantations
- Carbon farming
- Mechanization of exploitation
- Improved use of small size logs
Uncertain economic perspectives

- Competition with foreign poplar wood producers (e.g. France, Hungary)
- Competition with foreign industries (e.g. Spain)
- Fragmented offer vs concentrated demand
- Fluctuations of investments according to the profitability of alternative crops