

Yale Forest Forum Webinar Series – Spring 2023

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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Biographic notes



Stefano
BISOFFI

Short descriptive biography:

- Consultant on International Agricultural Research (2018-)
- Scientific and Technical Director of CREA (Council for Agricultural Research and Economics, Public Research Organisation in Italy) 2004–2007, 2013-2017.
- 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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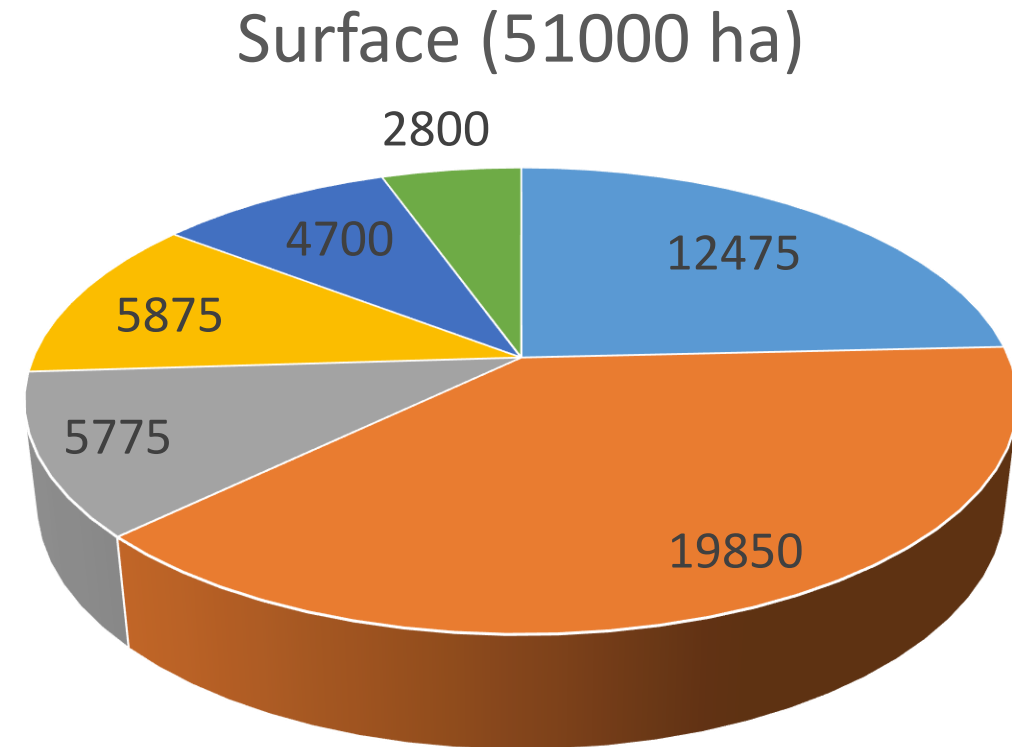
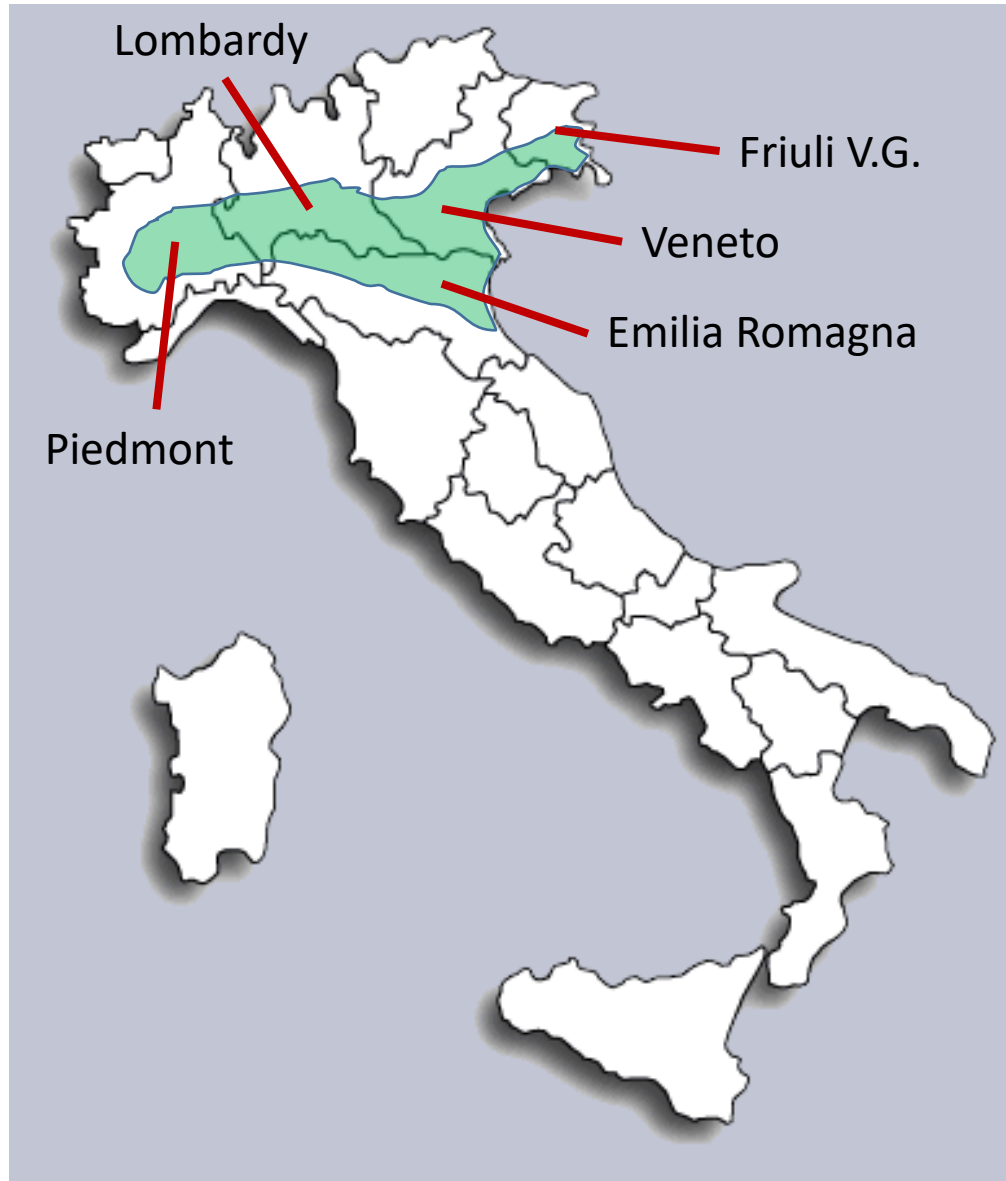
Poplar stands, common features of N.Italian landscape



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

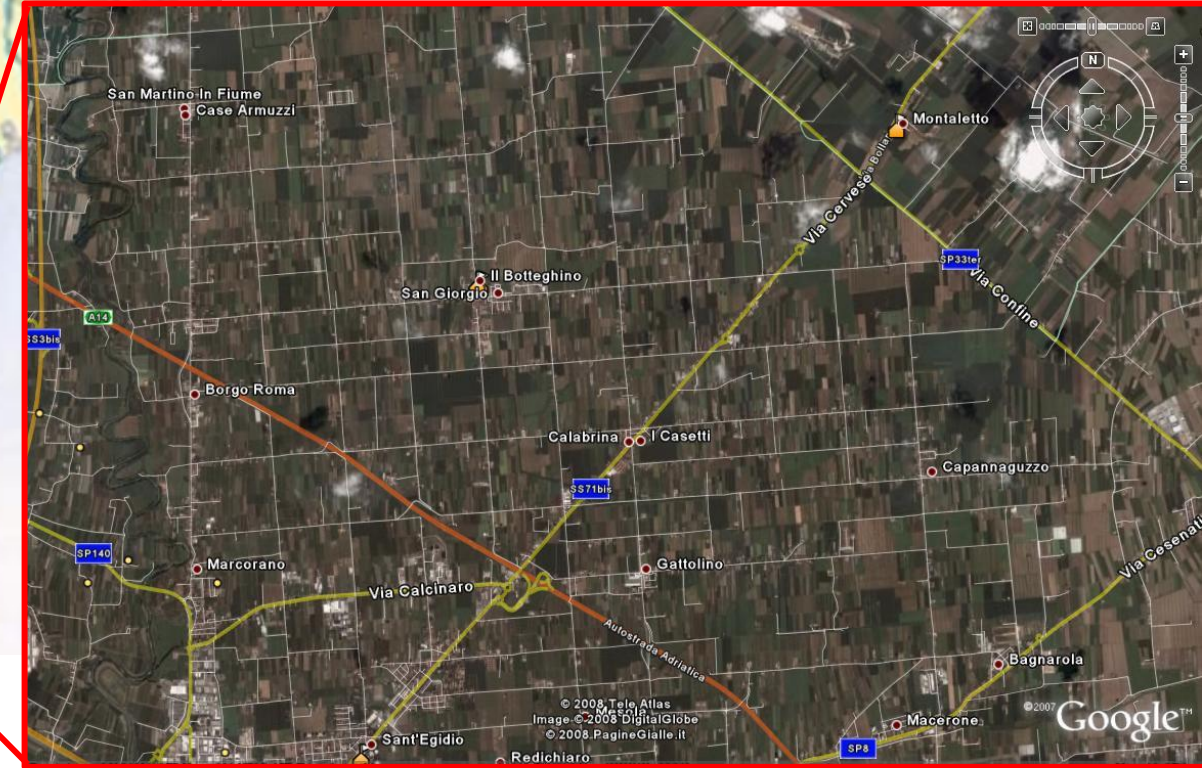
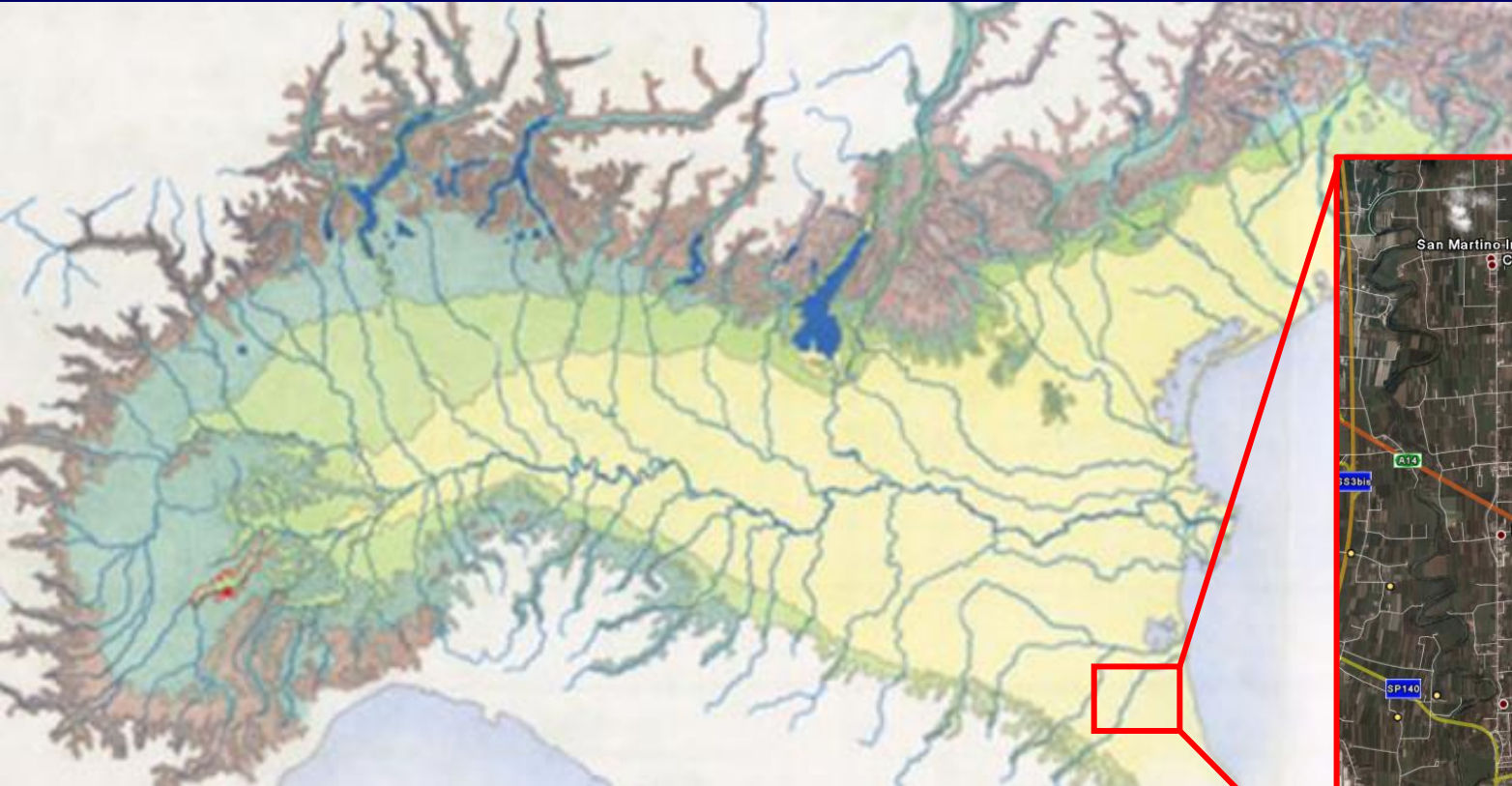
Latin: *arbor populi* = tree of the people

The alluvial plains of Northern Italy: 95% of poplar stands



- Piedmont
- Veneto
- Emilia R.
- Lombardy
- FVG
- Rest of Italy

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



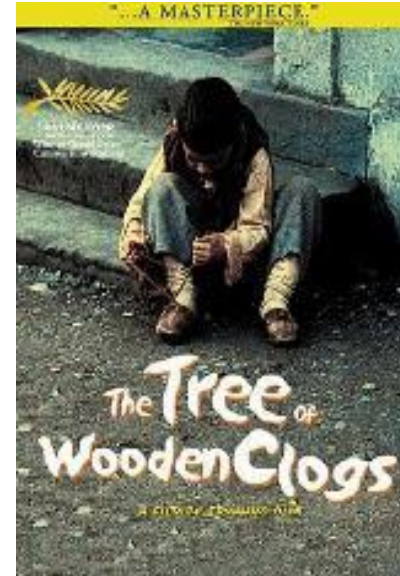
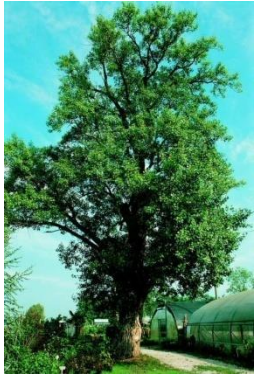
Catchment of the river Po: 70 000 km² (= 27 000 ml²)
Salicaceae a relevant component of the original flora

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

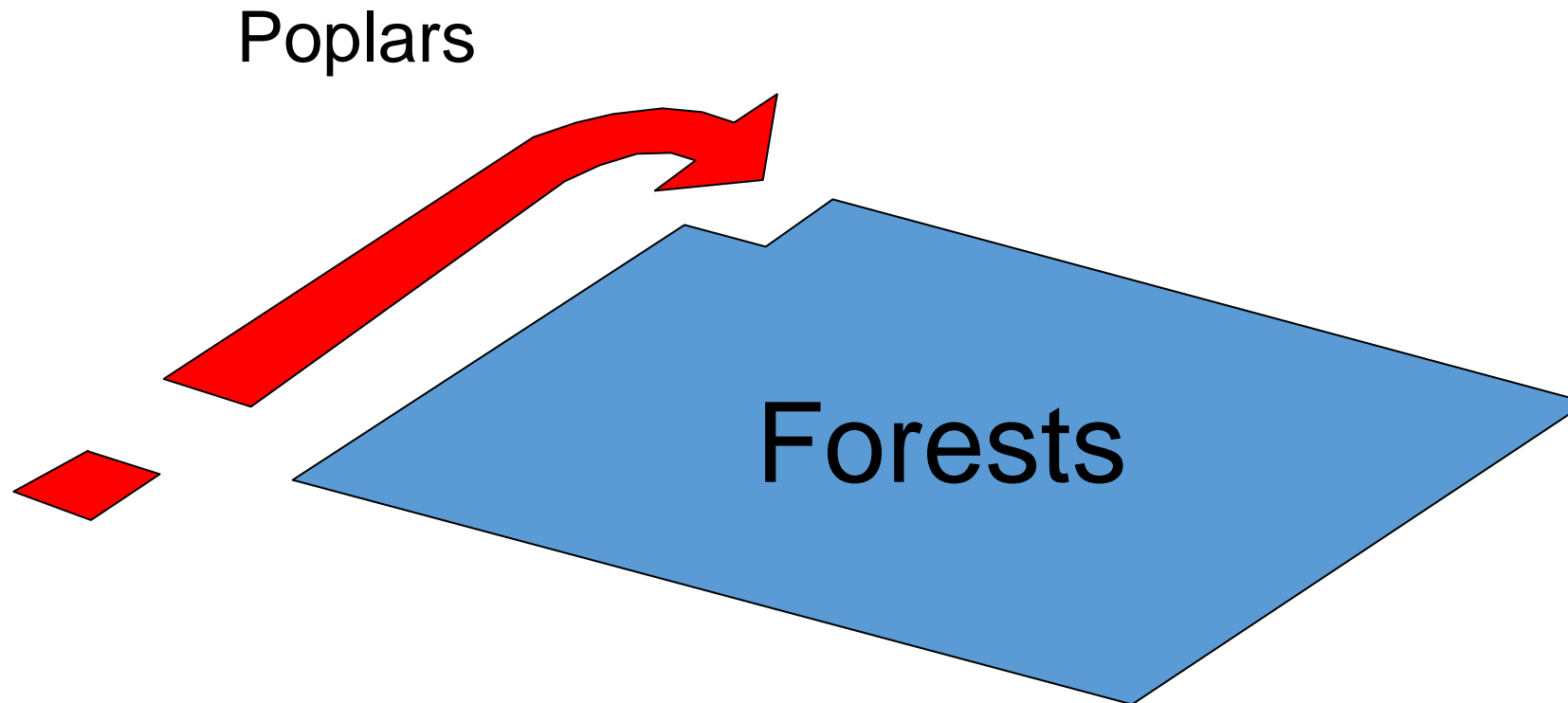


Poplar culture today

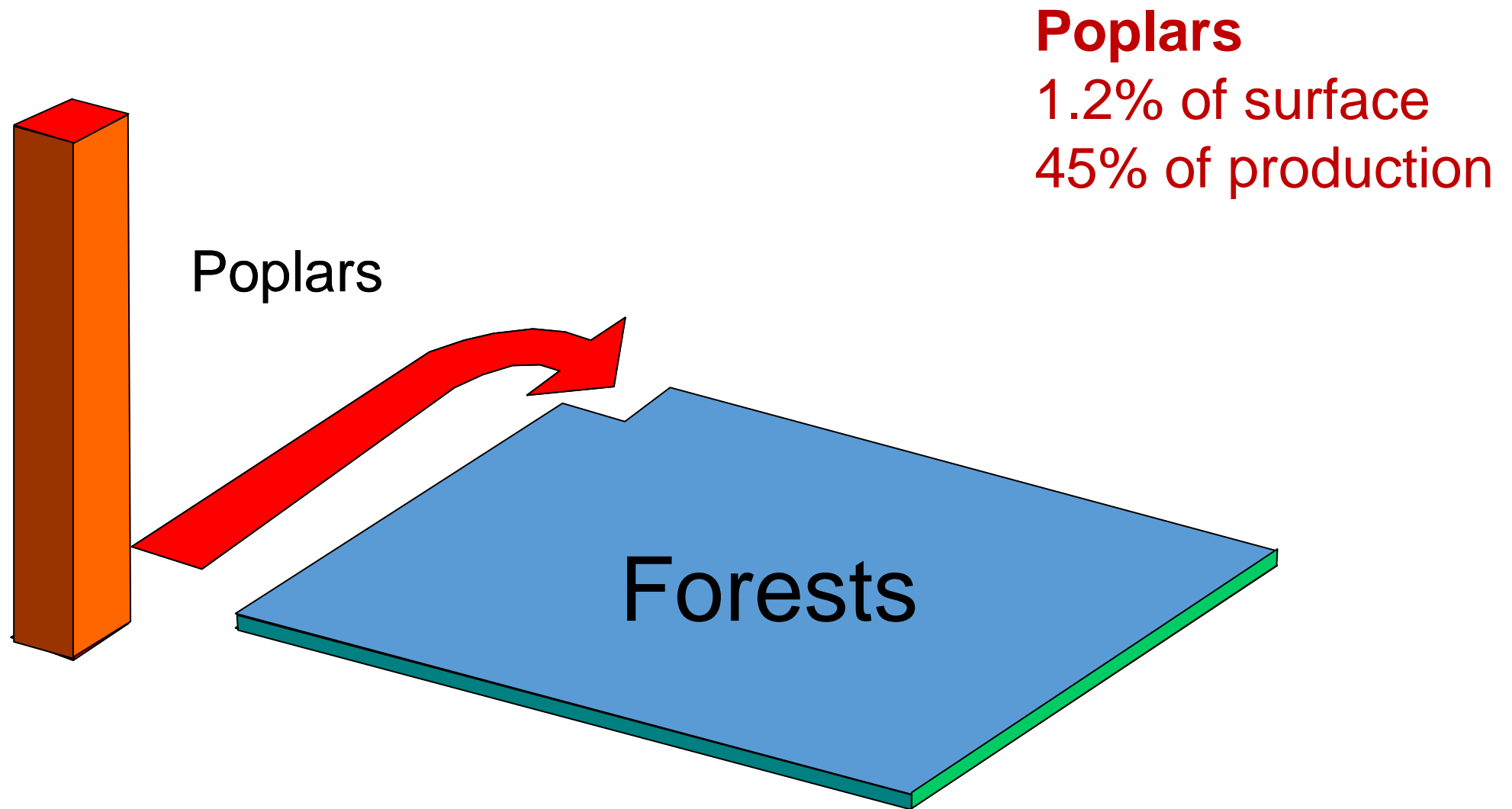


Industrial roundwood production in Italy

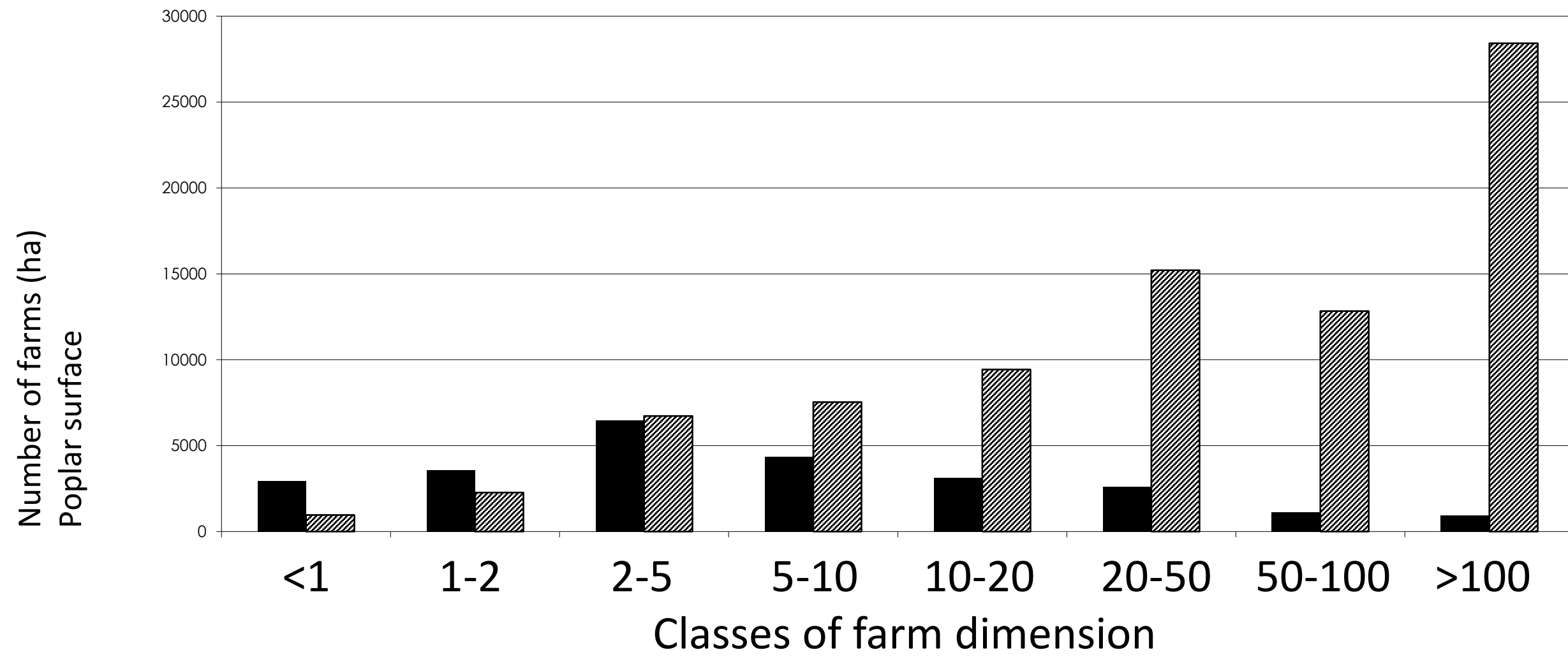
Poplars
1.2% of surface



Industrial roundwood production in Italy



Number of farms with poplars and surface of poplar stands



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Pioneer species: poor, mineral soils, if water is available



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



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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

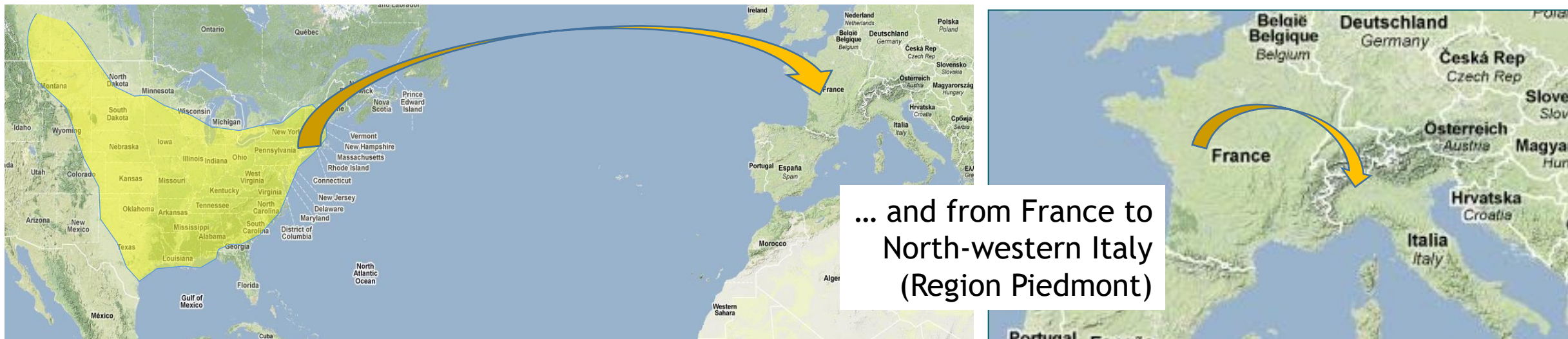
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Topics of the webinar

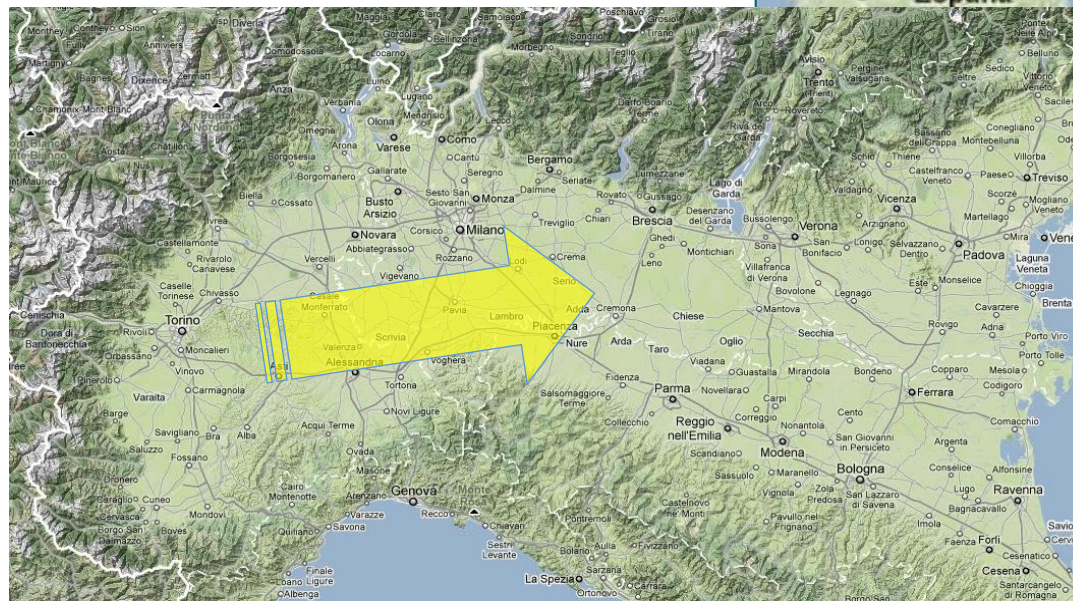
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The early introductions of *P. deltoides* from N. America



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

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Poplar breeding starts in the 1920's



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

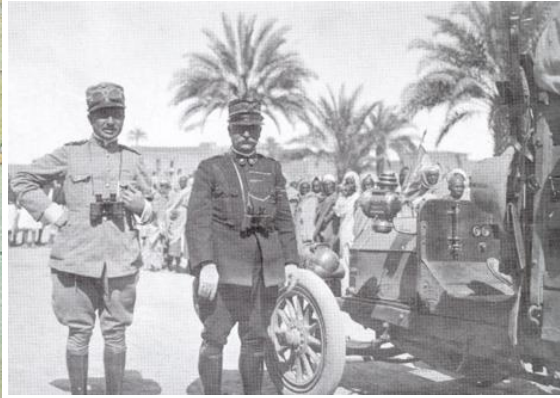
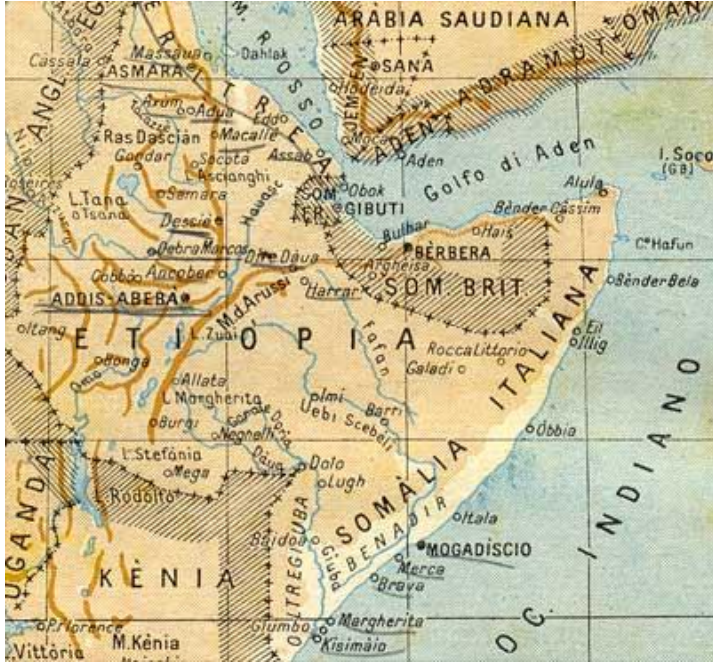
I-214

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



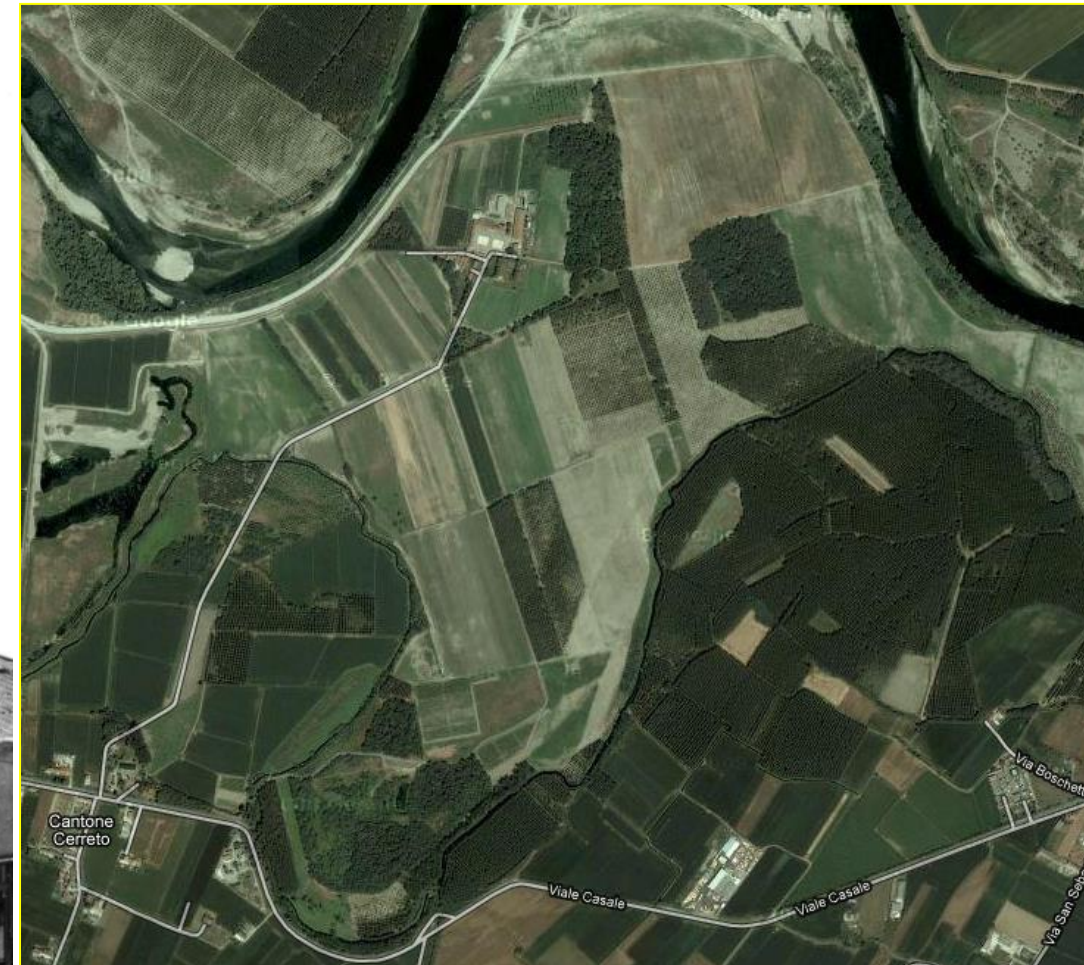
RIPRODUZIONE FOTO ADAMINI

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The Poplar Research Institute of Casale Monferrato (1937)

Experimental farm: 207 ha



Poplar breeding, the “core business”

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

Production of huge quantities of
seedlings followed by stepwise
clonal selection

Harvard (I-63/51)

Lux (I-69/55)

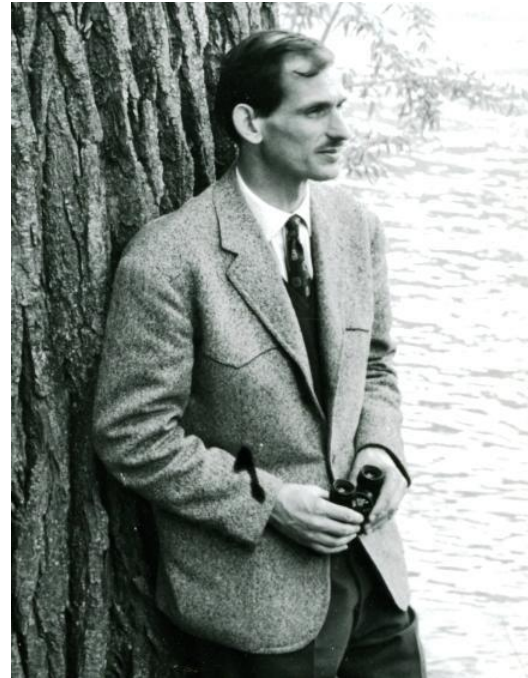
Onda (I-72/51)

San Martino (I-72/58)

Triplo (I-37/61) (a triploid clone)

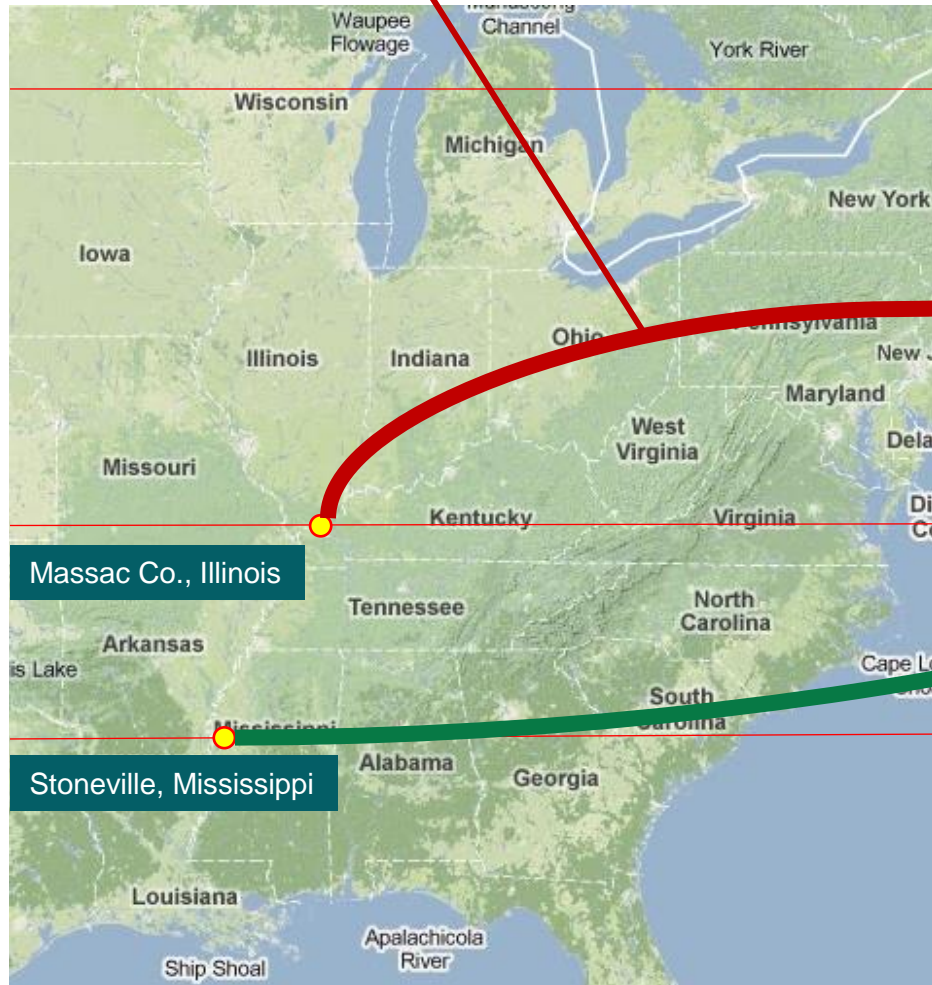
Main attention on
Populus deltoides
(North America)
both as individual
cultivars and as
female parents of
hybrids

**Michele
SEKAWIN
(1917-2015)**



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

New "blood" from seed collections in N.America



Populus trichocarpa
collections carried out by
the US Forest Service
(1973-1974-1975)

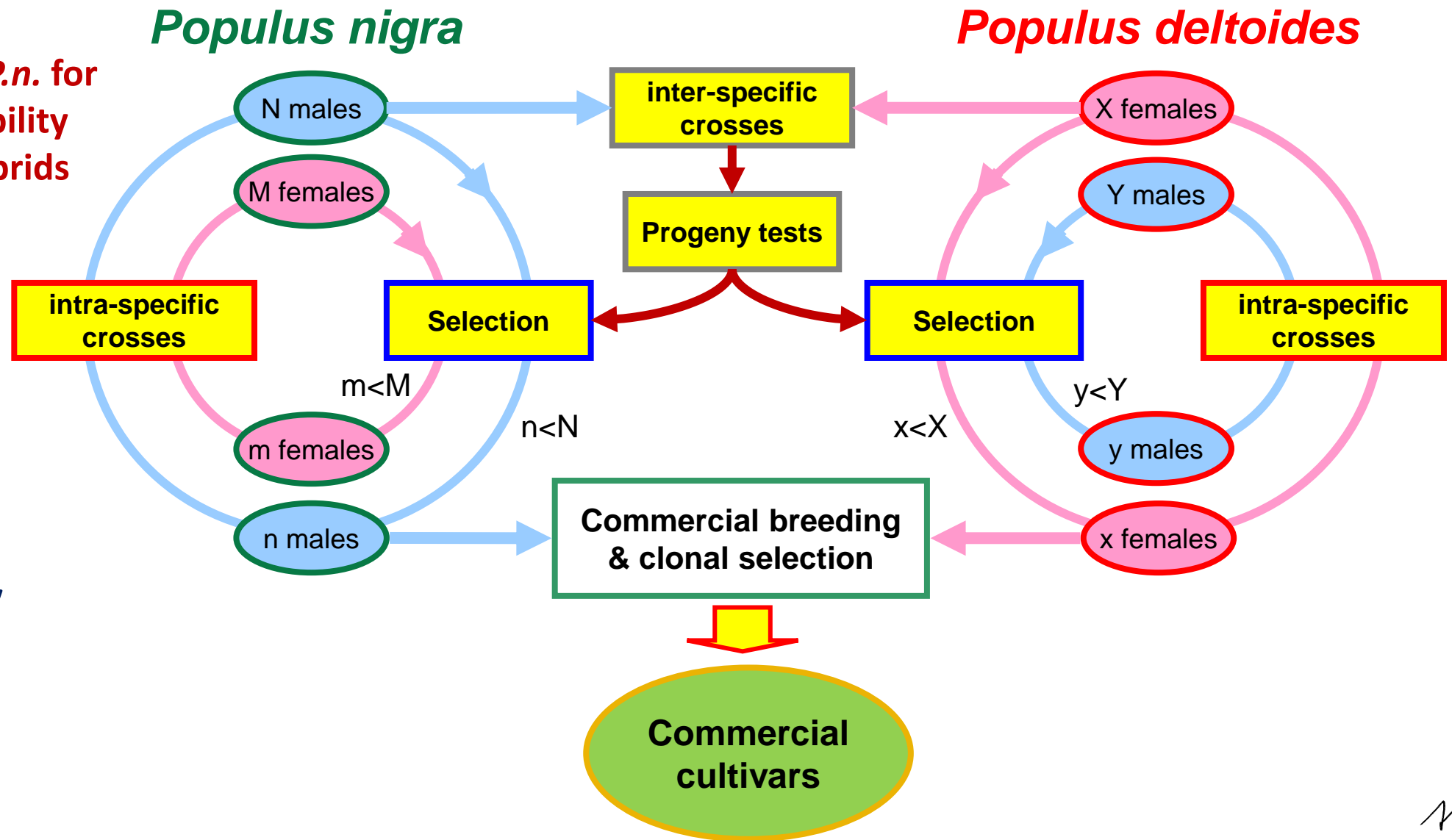
Populus deltoides collections
carried out by the N.A. Poplar
Council (1967-1973-1974)



Reciprocal recurrent selection of D & N since 1982

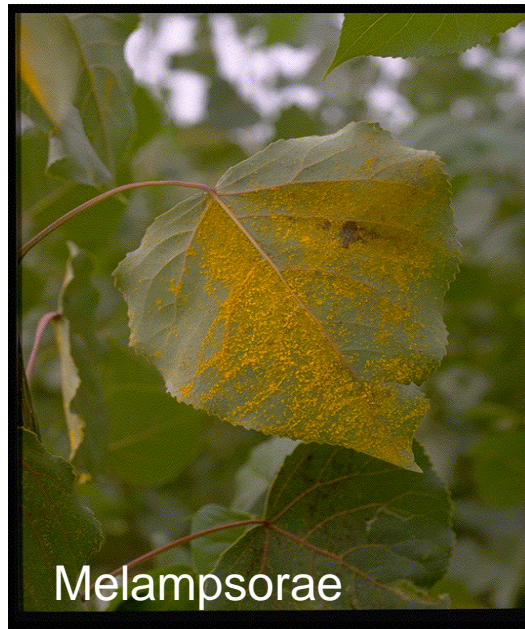
Objectives:

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



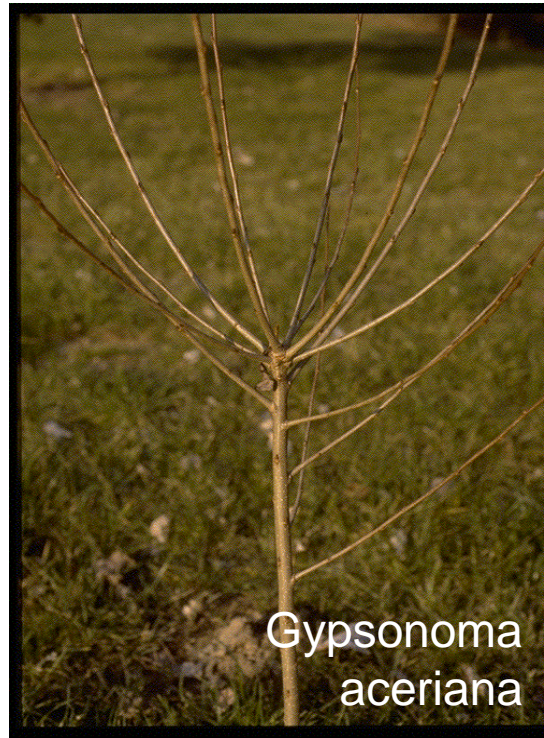
Genetic selection only for the Poplar Woolly Aphid



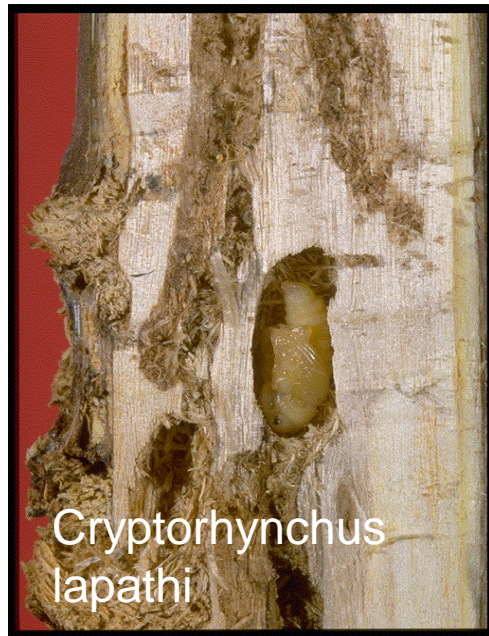
Saperda



carcharias



Gypsonoma
aceriana



Cryptorhynchus
lapathi



Cossus cossus

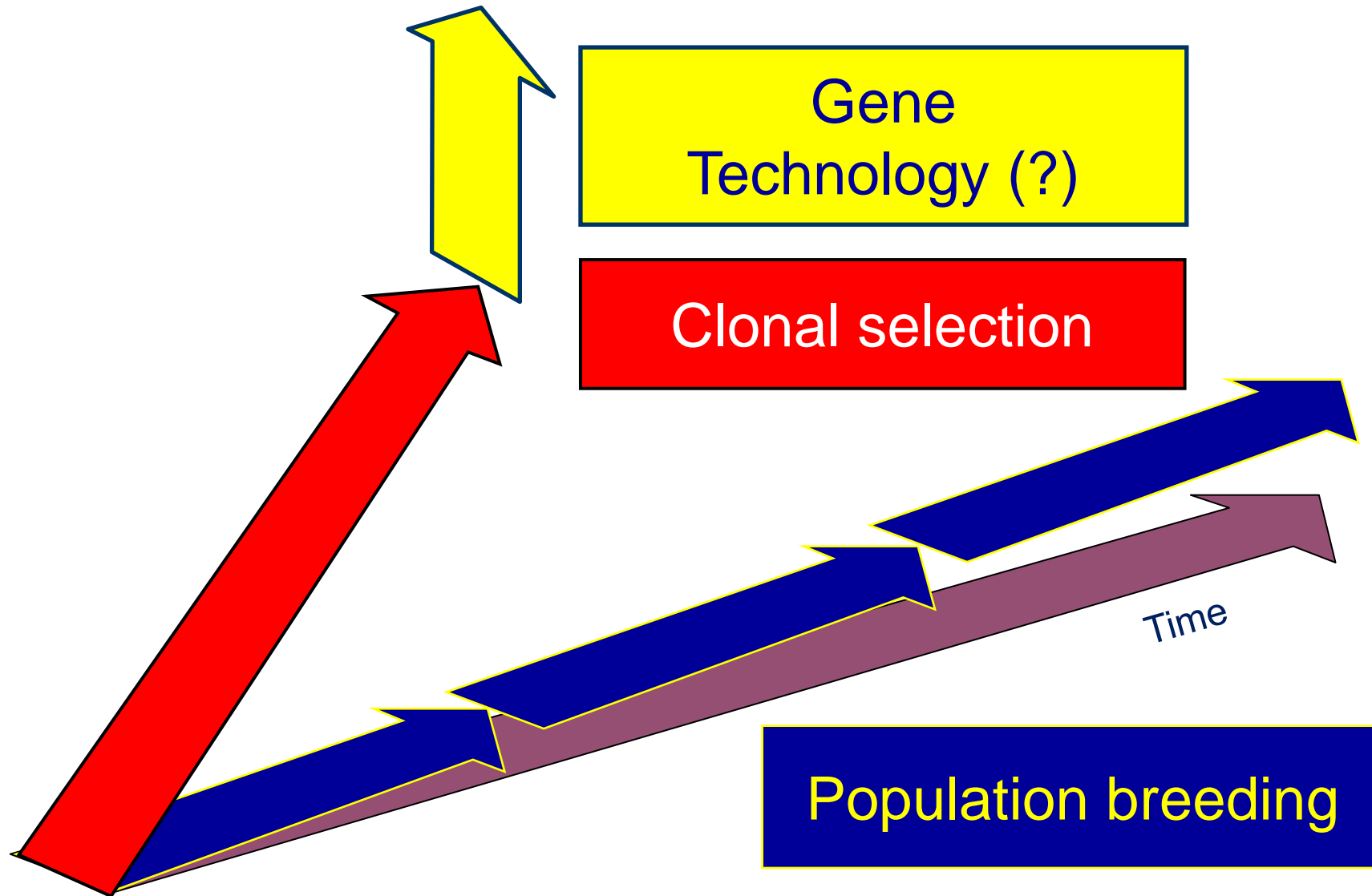


Brown marmorated stink bug: *Halyomorpha halys*



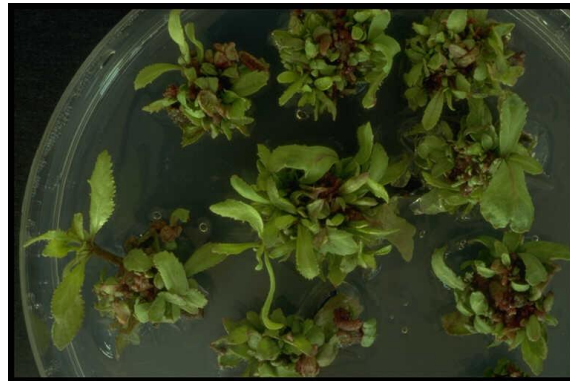
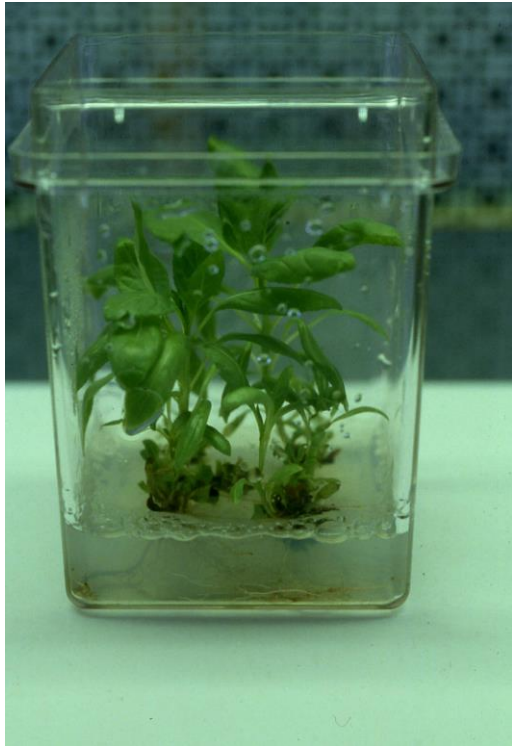
Phloeomyzus
passerinii

Multiple breeding pathways



Gene technology

Poplars are very easily propagated *in vitro*
Poplars can be easily modified genetically



Resistance to insects
(Protease inhibitors)

Application will depend on
future public acceptance

Survival

100

80

60

40

20

0

0

2

4

8

16

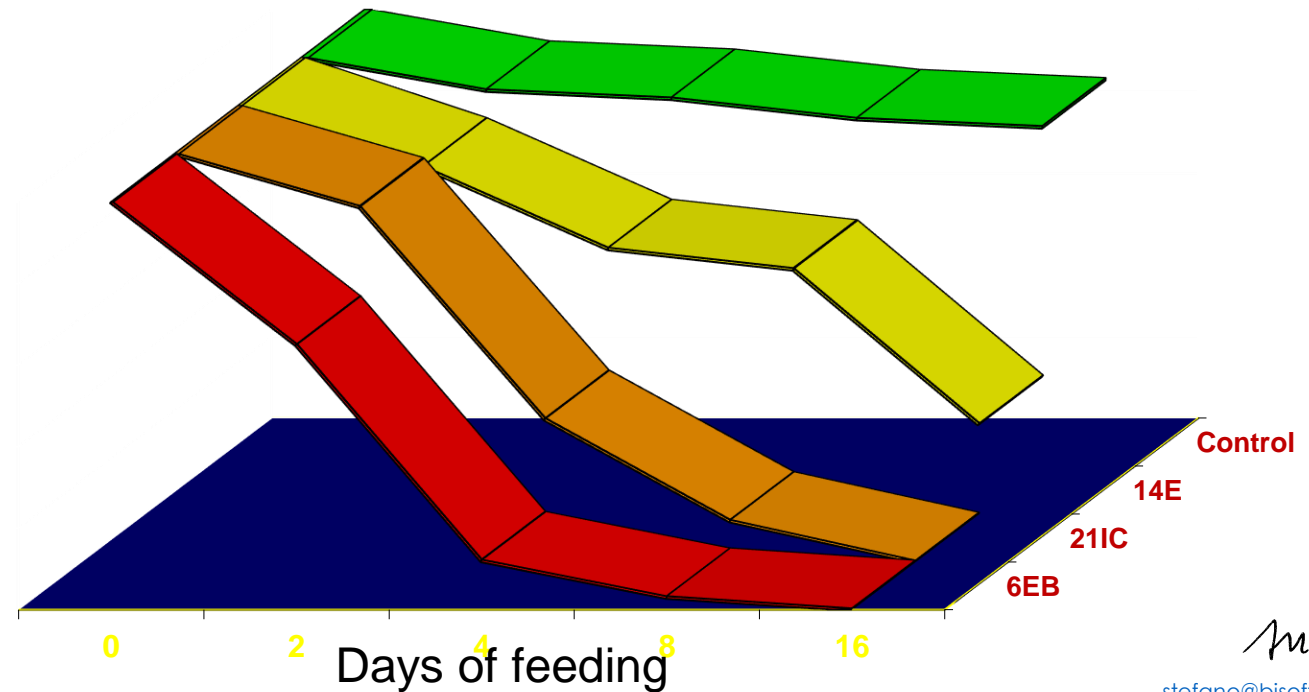
Days of feeding

Control

14E

21IC

6EB



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Poplars in agroforestry systems



Improve soil fertility
and organic matter

Absorb excess P and N

Provide revenue in the
early years of rotation

Poplars and climate change mitigation

Stocked in living trees
(including roots and soil)



Role of poplar plantations in combating carbon enrichment of the atmosphere



Replacement of energy-intensive products



Fossil fuel substitution



Carbon budget of a poplar stand

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



Stool bed: 1 year



Nursery: 2 years



Stand: 10 years. Spacing 6x6 m

Two clones:

'I-214' (most common in poplar culture in Italy)

Production: $158 \text{ m}^3 \text{ ha}^{-1} = 84 \text{ t ha}^{-1} \text{ CO}_2\text{e}$

Emissions: $7.35 \text{ t CO}_2\text{e}$

Net balance: 76 t CO₂e

'Senna' (low environmental impact)

Production: $197 \text{ m}^3 \text{ ha}^{-1} = 119 \text{ t ha}^{-1} \text{ CO}_2\text{e}$

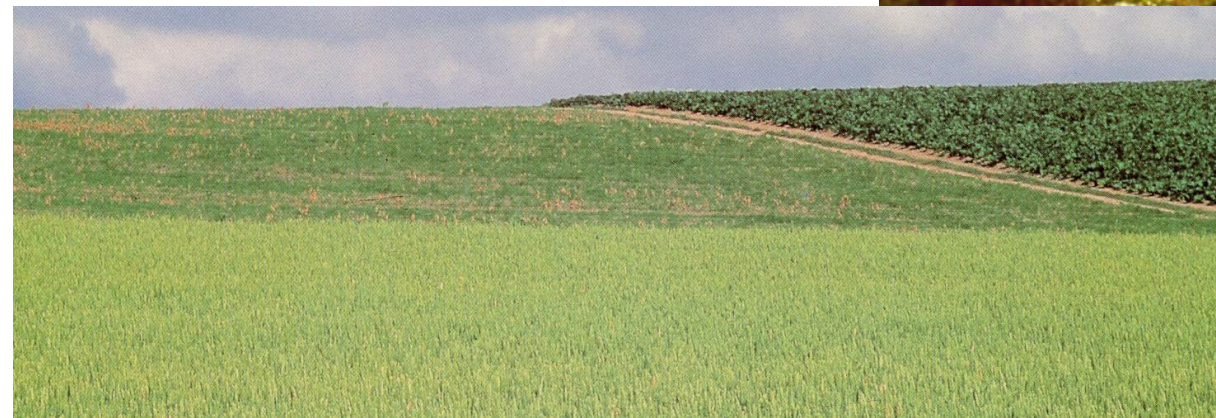
Emissions: $7.22 \text{ t CO}_2\text{e}$

Net balance: 111 t of CO₂e

How artificial is a poplar stand as an ecosystem?



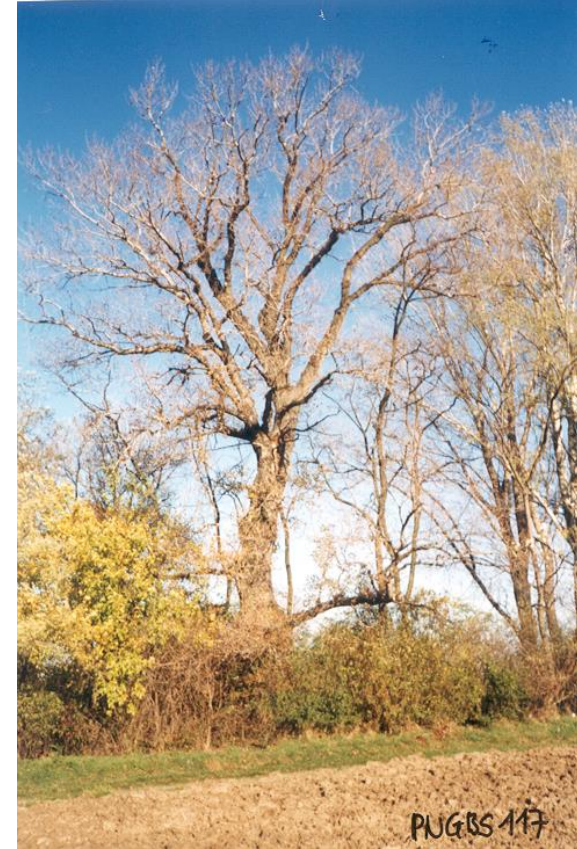
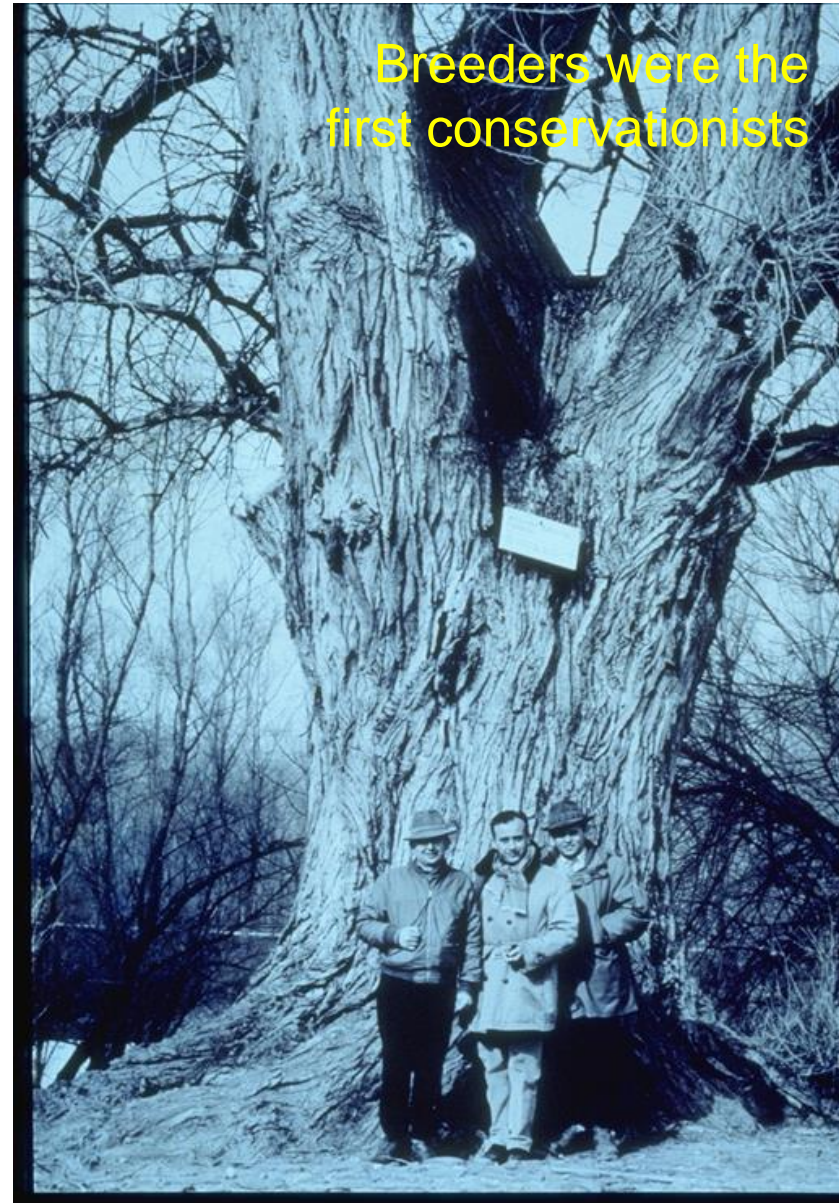
Simplified ecosystems
Periodic disturbance
Genetically uniform
Even aged
Cultivated



Persistent cover
Less intensive cultivation
Little soil disturbance
Understorey
Transition ecosystems

Conservation of genetic resources

Breeders were the first conservationists

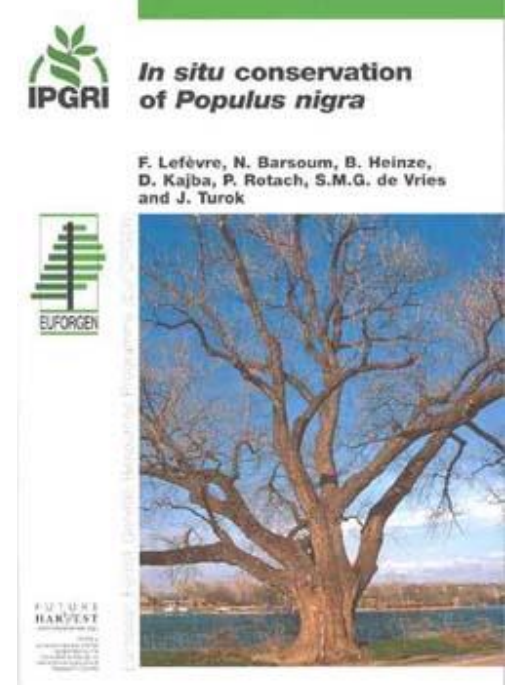
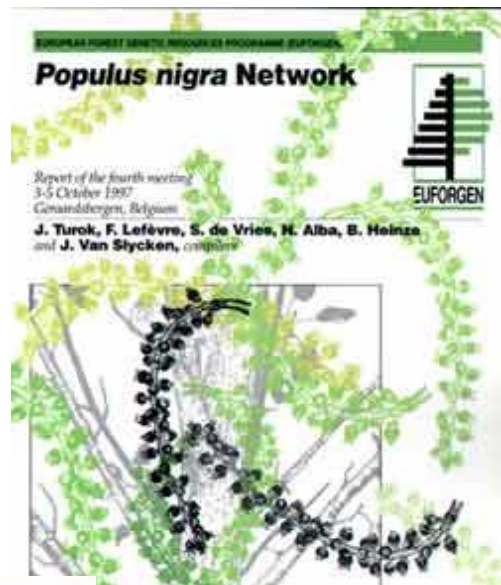
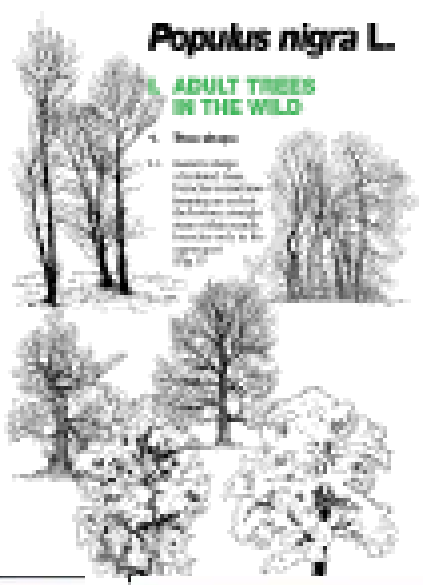
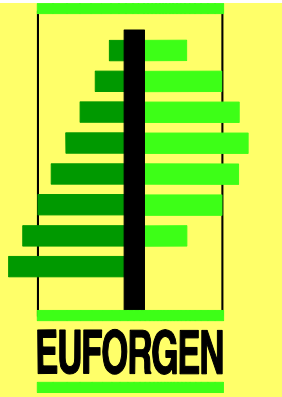


Large *ex situ* collections of the main breeding species are preserved by Research Institutions

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P. nigra preservation in Europe (EUFORGEN Network)



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

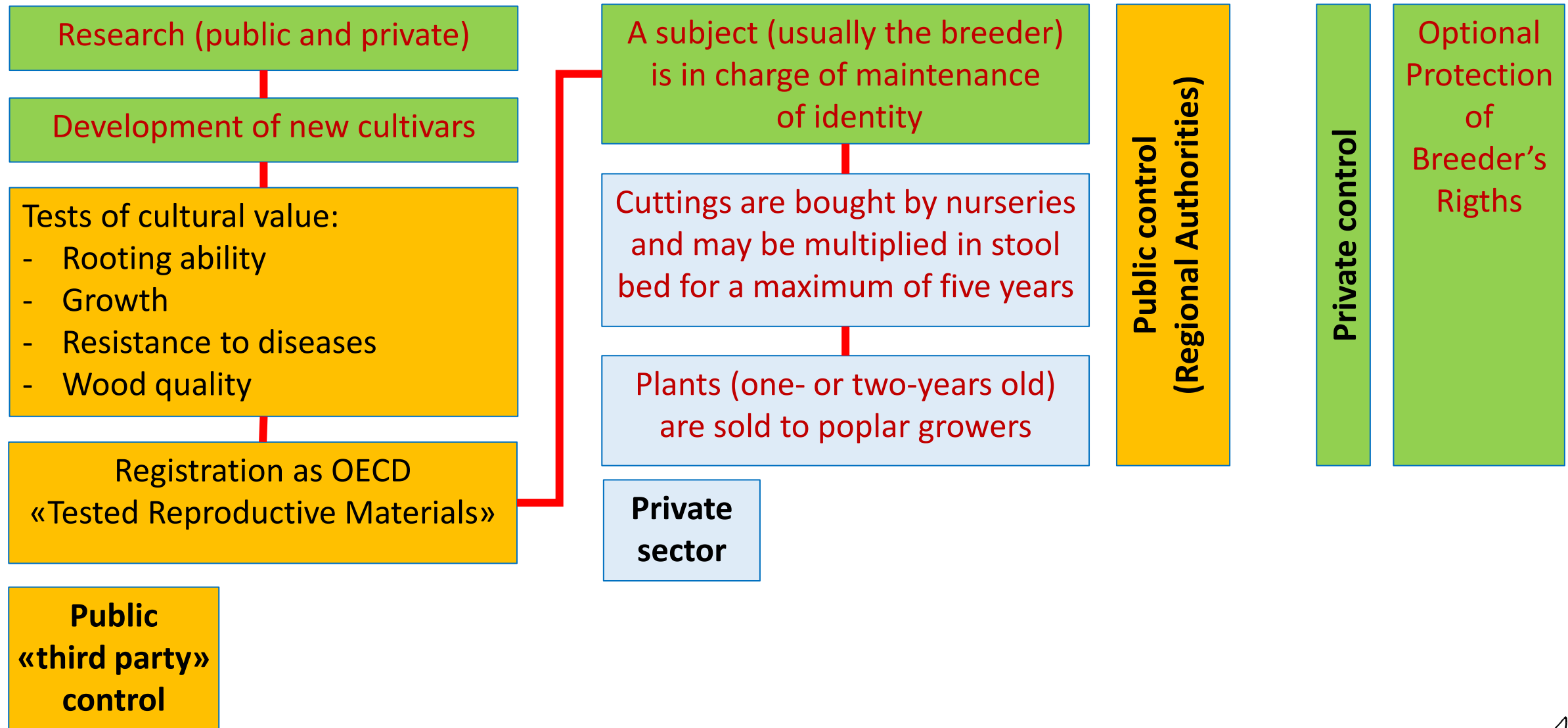
Agriculture (but not Forestry) is a subject of **Common Policy** in the **European Union**: the Union (Commission, Parliament, Council) decide the framework; Member States or Regions negotiate **Rural Development Plans**.

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



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- 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



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