crea
Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria

Genetics, Genomics, and Biotechnology of poplar

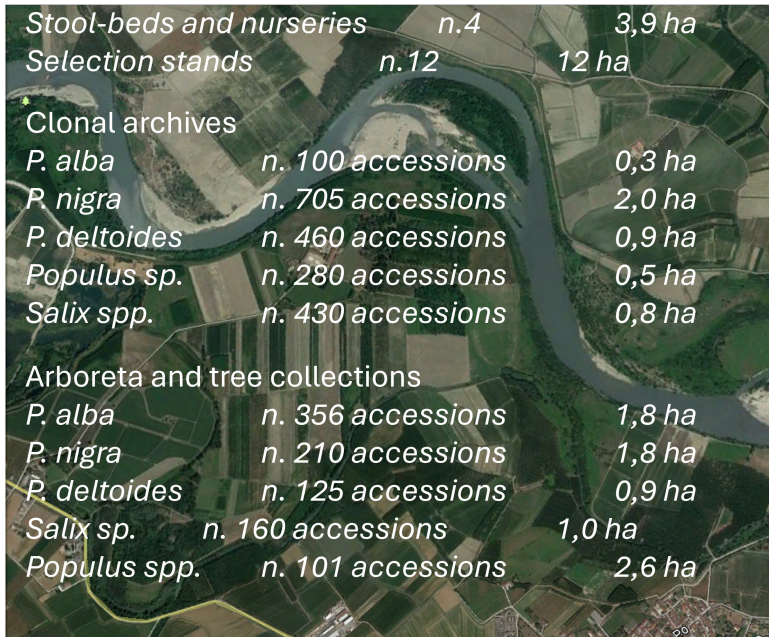
Chiara Biselli

RISORSE GENETICHE FORESTALI

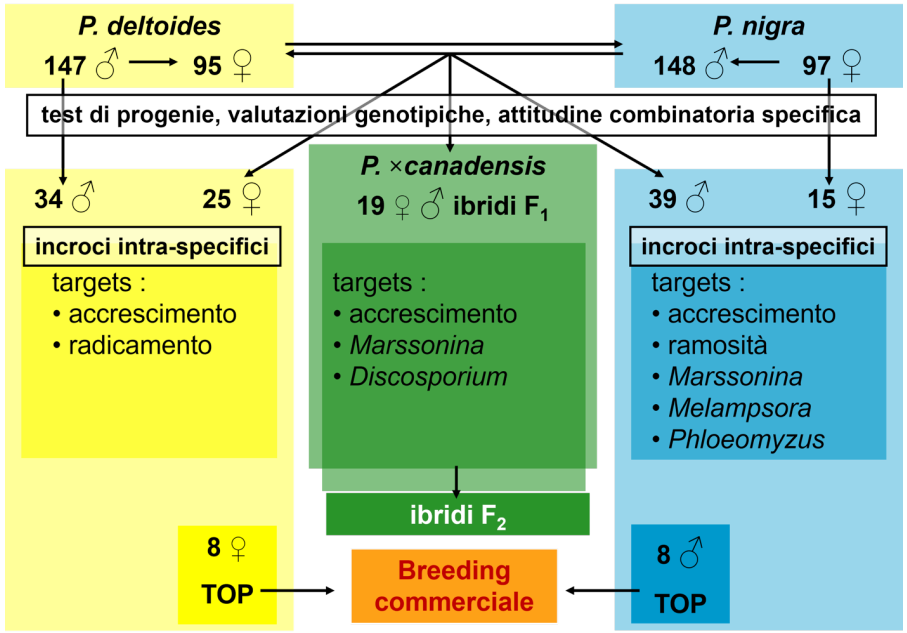


Poplar breeding at CREA-Forestry and Wood (Casale Monferrato)

Azienda Mezzi



Conventional breeding program



2025





9 *P. xcanadensis* CLONES REGISTERED TO THE N.R.F.M. AND COMMERCIALIZED IN ITALY AND EUROPE

The woolly poplar aphid *Phloeomyzus passerinii*

Woolly poplar aphid (wpa), *Phloeomyzus passerinii*, starts the colonization in bark crevices of old poplar plants, often at the insertion of the lowest branches 5-6 meters above the ground.



Aphid colonies cause abundant waxy flocks, woolly, and whitish in colour. Feeding activity involves the injection of a toxic saliva determining bark suberization and, during haviest attacks, cracks and necrosis.
The death of the bark causes interruption of water and nutrients circulation.

Impact on yield and wood quality with up to 12% reduction of potential production.

Very harmful in several European and American countries where the majority of cultivated clones are susceptible.

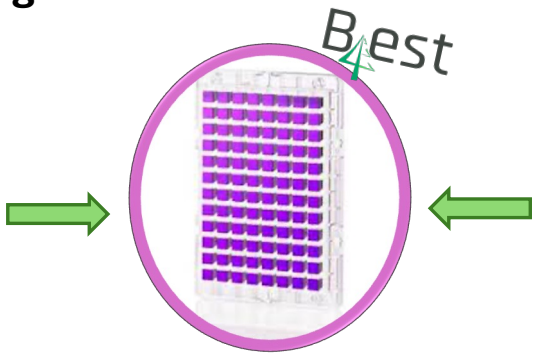
Identification of new molecular tools to sustain poplar breeding for wpa resistance

APPROACHES

1. Identification of QTLs/loci associated to wpa resistance by linkage mapping

Two F_1 segregating populations:

- **DxN** – D066 (resistant *P. deltoides*) x N074 (susceptible *P. nigra*) 179 individuals
- **NxN** – N355 (resistant *P. nigra*) x N385 (susceptible *P. nigra*) 265 individuals



High-throughput genotyping – 4TREE array covering 13,409 poplar specific loci

2. GWAS and Genomic prediction for new poplar wpa resistant clones

Two F_1 segregating populations

Poplar collections:

- 289 *P. nigra* clones
- 91 *P. deltoides* clones

Total genotypes: 380

Phenotyping for wpa resistance

FOREST GENETICS 3(1):23–26, 1996

SUSCEPTIBILITY OF *POPULUS NIGRA* L. TO THE WOOLLY POPLAR APHID (*PHLOEOMYZUS PASSERINII* SIGN.)

Gianni Allegro & Luisa Cagelli

Istituto di Sperimentazione per la Pioppicoltura – SAF/ENCC, P.O. Box 116, I–15033 Casale Monferrato (AL), Italy

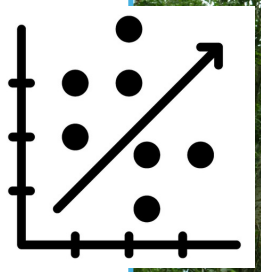
Received February 15, 1996; accepted May 15, 1996

Resistance scale	
Highly susceptible	1
Susceptible	2
Averagely resistant	3
Resistant	4
Highly resistant	5

Resistance index with reference to I-214

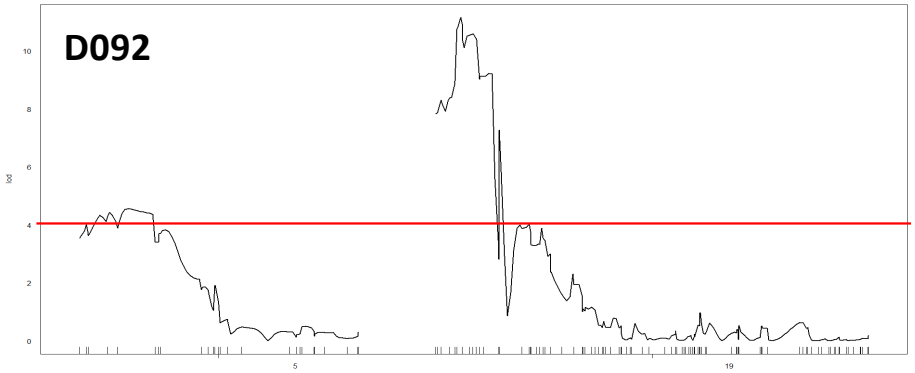
I-214 inoculum

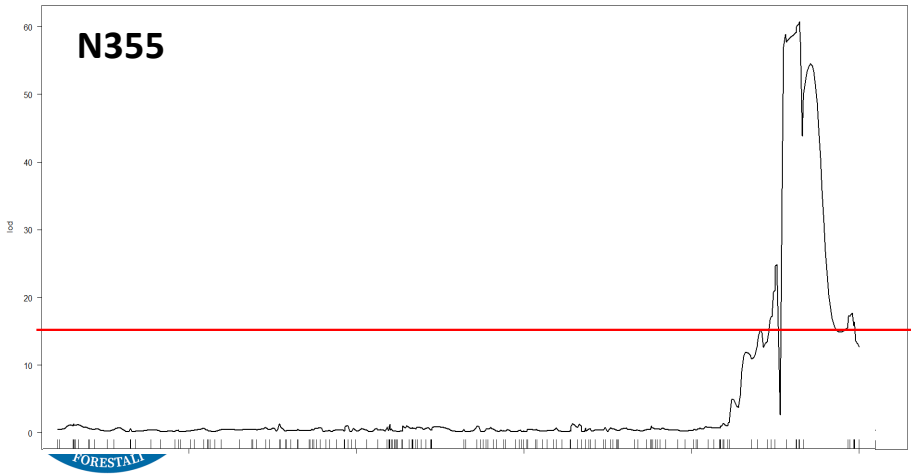




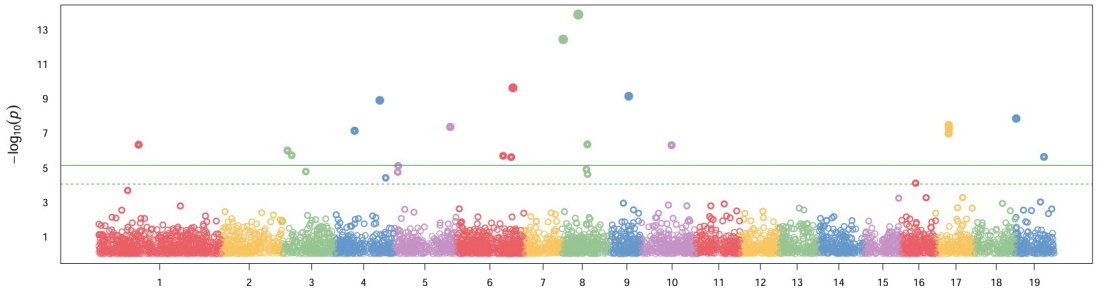
Identification of loci associated to wpa resistance

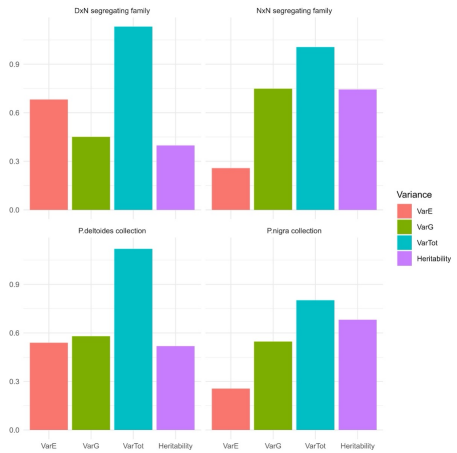
QTL mapping





GWAS by GBLUP



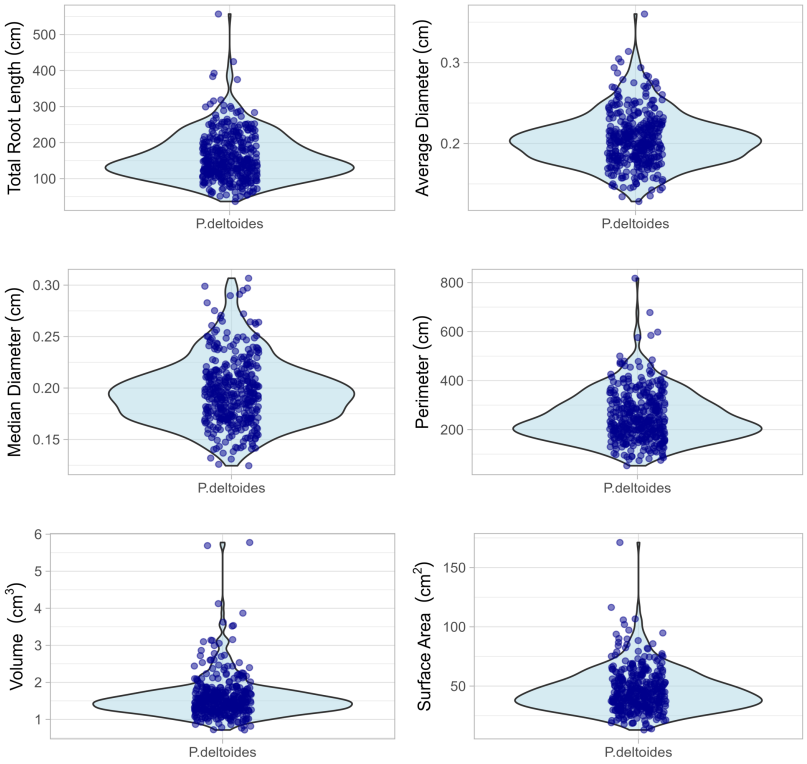


Genomic prediction

Population	Accuracy of GP models
DxN	0.64
NxN	0.70
P. deltoides	0.54
P. nigra	0.86

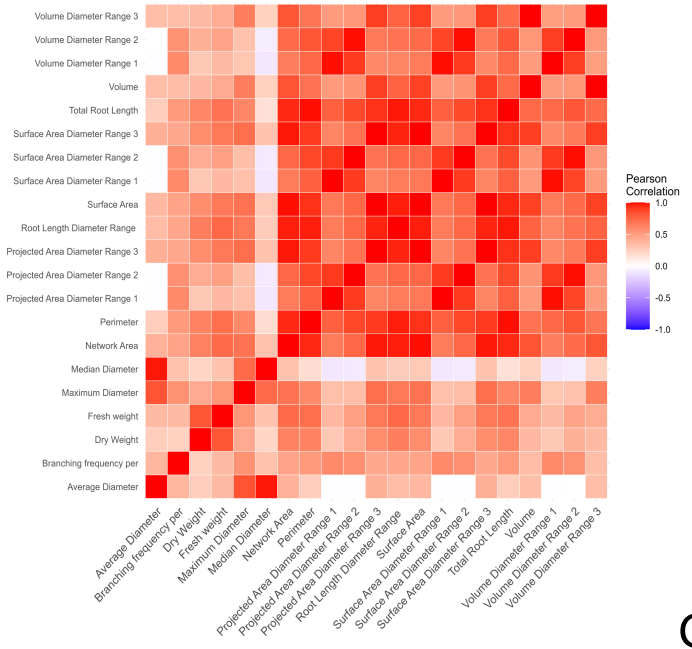
Analysis of rooting ability in *P. deltoides*

382 clones phenotyped for different root traits









INNOGEN
Innovazioni genetiche per l'agricoltura

VIB
science meets life

Dr Lieven De Veylder

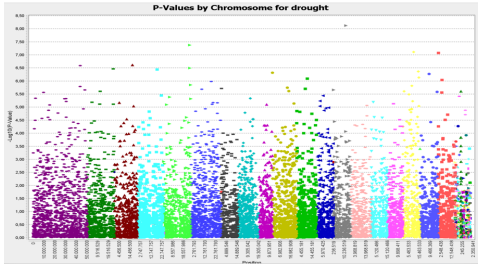
120 clones already sequenced

↓

Genomic prediction

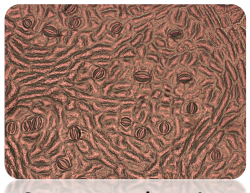
Searching for new alleles as target for genome editing in *P. nigra* – drought tolerance and wpa resistance

GWAS

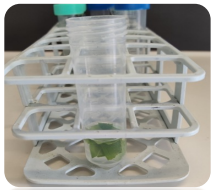


Whole Genome Sequencing of 200 clones

Allele mining

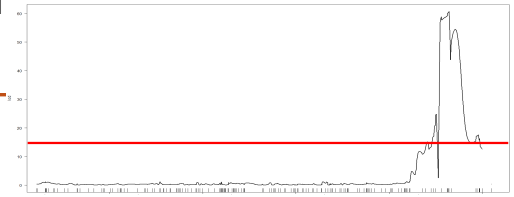


Stomata density



Leaf wax content

PacBio Whole Genome Sequencing and Assembly of clone N355



Waterpiopp

7 clones under evaluation for drought response

RNA-Seq of 2 clones

Integration with Whole Genome Sequencing data

Genome editing and cisgenesis for the improvement of biomass quality and plant architecture in poplar

Genome editing for lignin biosynthesis



- **TARGETS:** the lignin biosynthetic genes *CAD1* (cinnamyl alcohol dehydrogenase 1) and *C3H* (p-coumarate 3-hydroxylase)
- **CLONE:** *P. alba* clone Villafranca
- **RESULTS:** 82 independent lines were obtained and screened by sequencing. Four lines carrying mutations within the coding region of *C3H* were obtained and are currently under study for molecular characterization and phenotypic evaluation.

Cisgenesis for cellulose biosynthesis and plant architecture

- **TARGETS:** overexpression of *P. trichocarpa DUF266A* (Domain of unknown function 266A), a gene associated with cellulose biosynthesis, and *GA20ox7*, encoding a key oxidase enzyme of gibberellin biosynthesis.
- **CLONE:** *P. nigra* clone Jean Pourtet.
- **RESULTS:** 41 transformed lines. 13 marker-free cisgenic lines carrying *DUF266A* and 4 marker-free cisgenic lines carrying *GA20ox7.* Plants are currently under study for molecular and phenotypic characterizations.





Commong garden – phenotypic plasticity - GxE

First nursery including 400 *P. nigra* clones from CREA-FL and INRAE germplasm collections

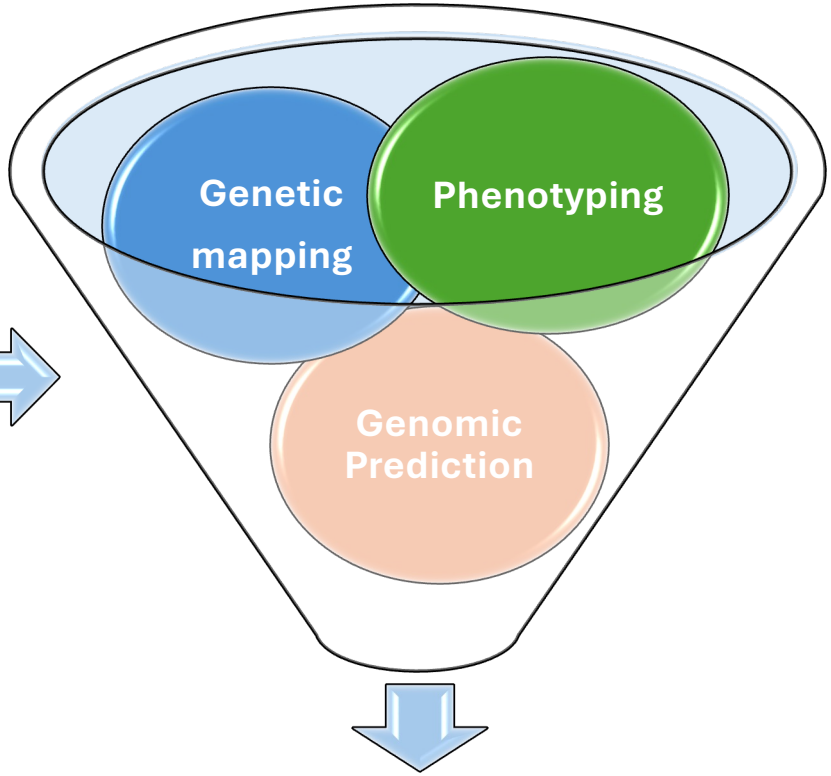




….. tests in other countries (project under submission)

In conclusion





High resolution
POPLAR GENETIC SYSTEM

Acknowledgements

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THANK YOU!