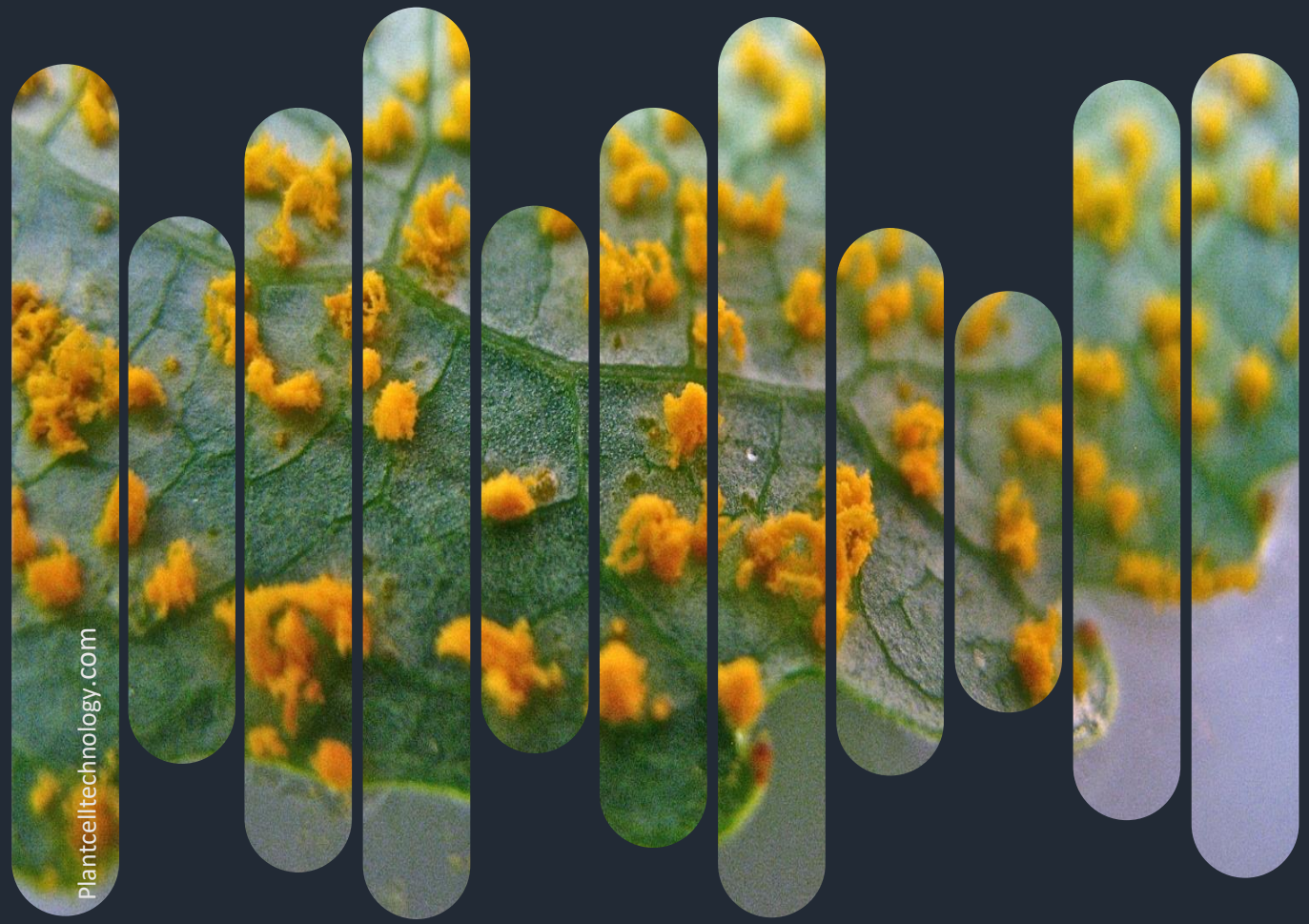

Genetic control of resistance in the interaction between black poplar and rust fungus

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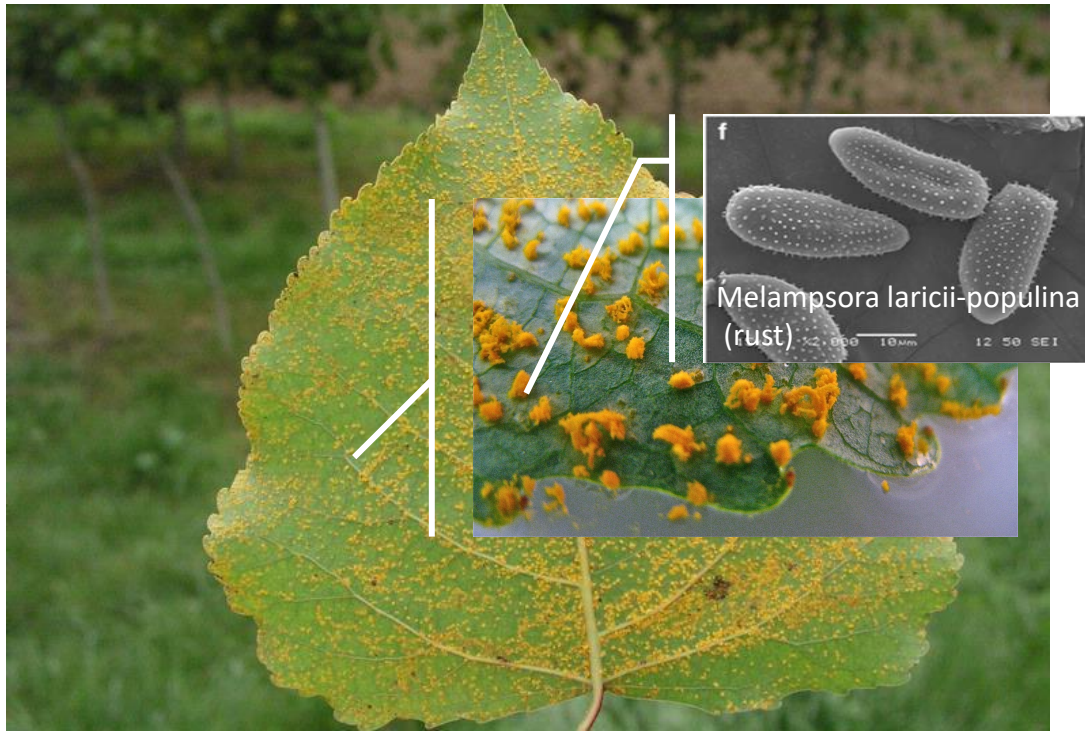
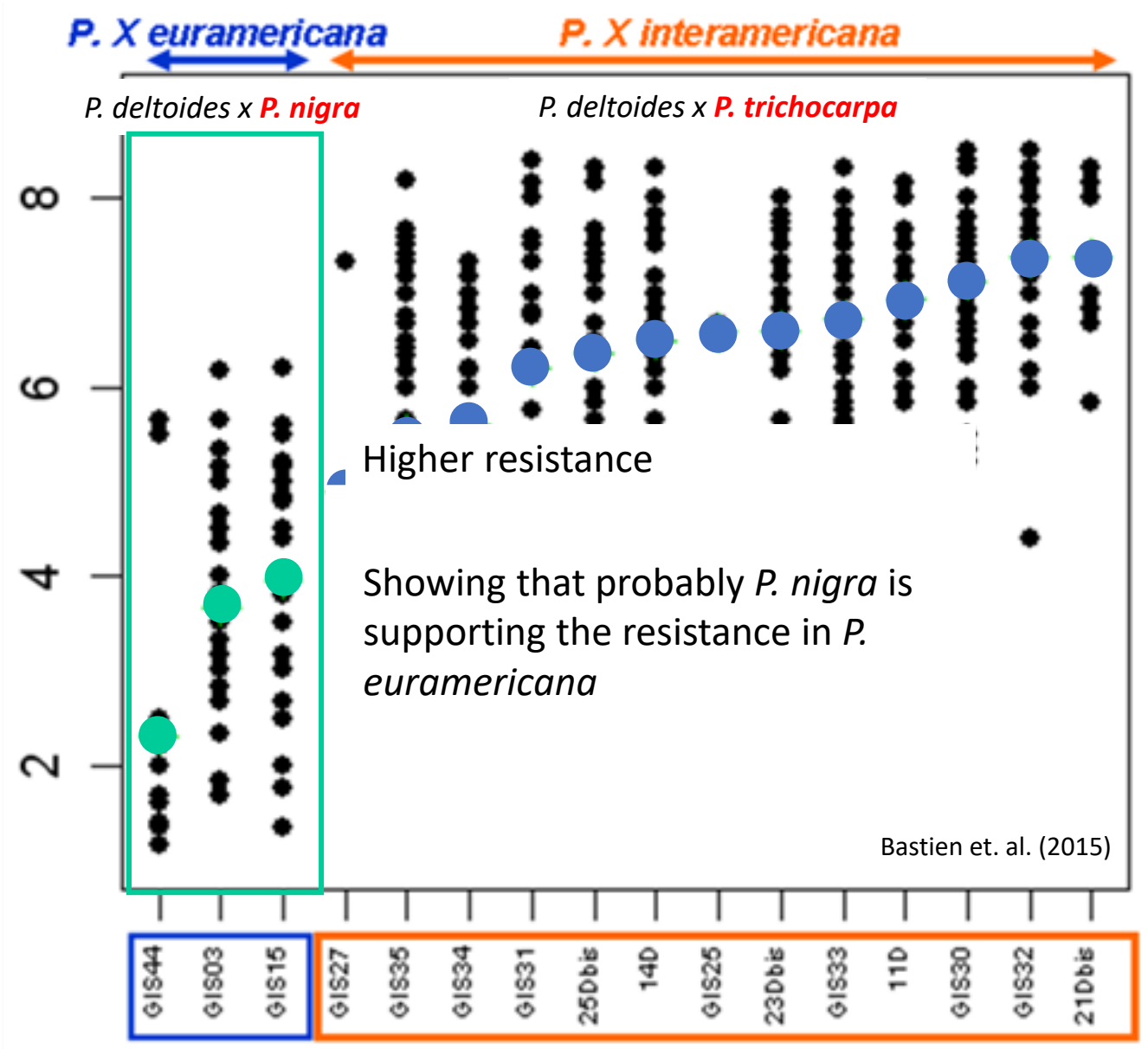
THE SEARCH FOR DURABLE RESISTANCE



- Management of hybrid poplars with resistance does not stop the rust from overcoming their resistance;
- Lead to more infection in *Populus* spp. and to economic losses



Introduction

OBJECTIVES OF THE STUDY

Observing the resistance in *Populus nigra*

- ❑ Data collection from laboratory trials.
- ❑ Exploratory data analysis (EDA).

Depicting the genetic control of resistance

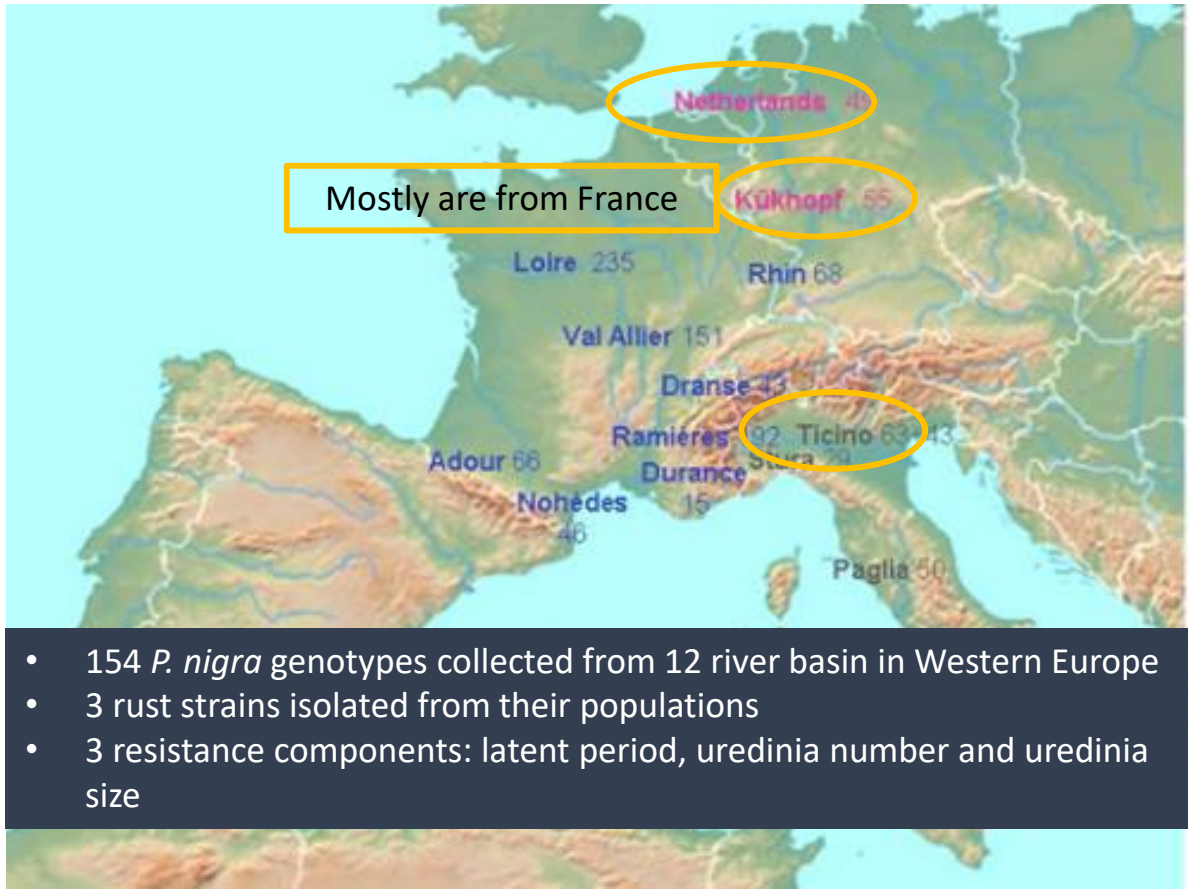
- ❑ Checking the variables needed for GWAS
- ❑ Running GWAS
- ❑ Results interpretation

Evaluating the interaction between *P. nigra* and several rust strains

- ❑ Preparing the variables needed for mixed-effects model
- ❑ Running mixed-effects model
- ❑ Results interpretation

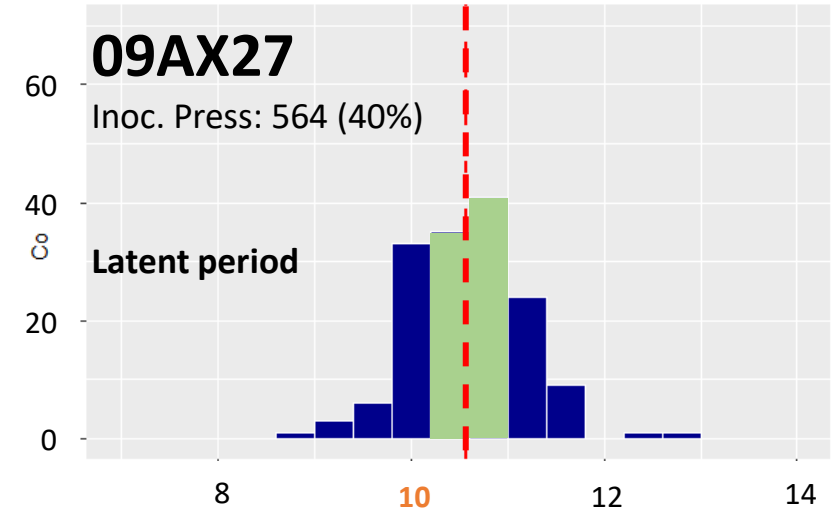
Materials and method

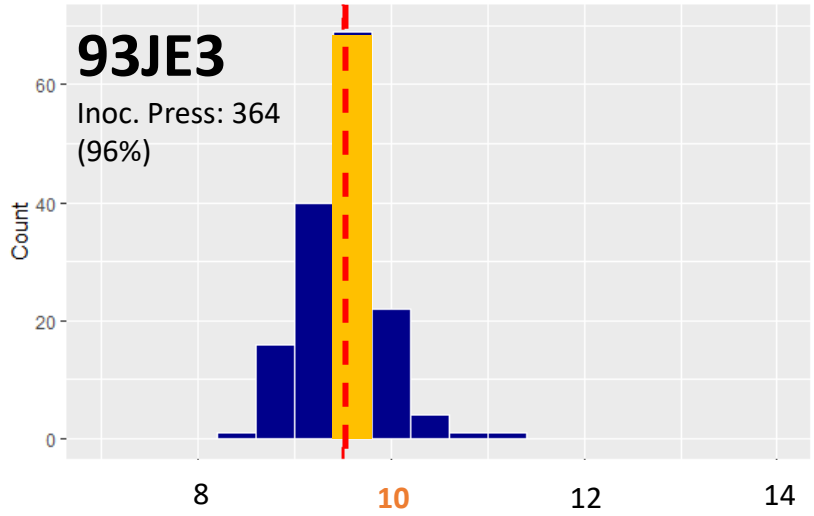
MATERIALS

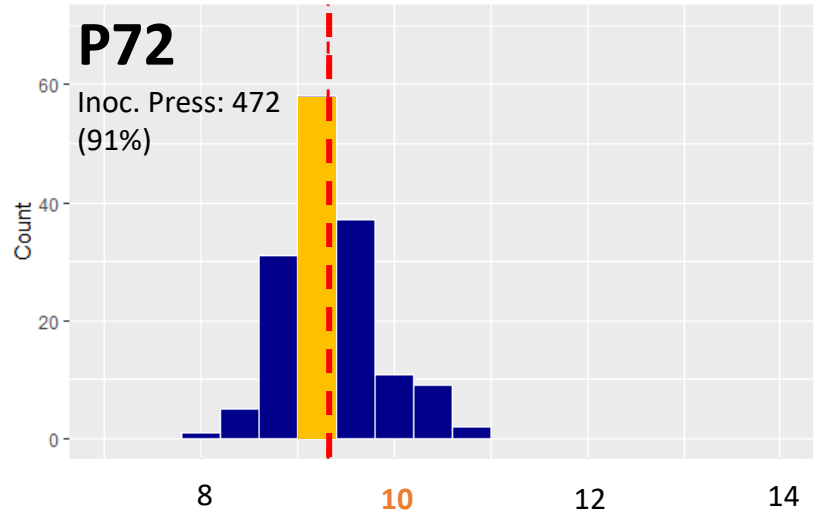


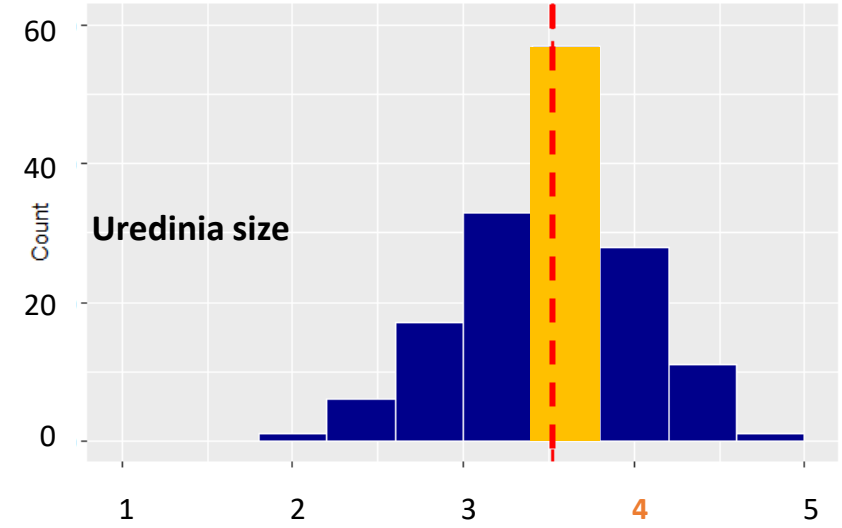
- 154 *P. nigra* genotypes collected from 12 river basin in Western Europe
- 3 rust strains isolated from their populations
- 3 resistance components: latent period, uredinia number and uredinia size

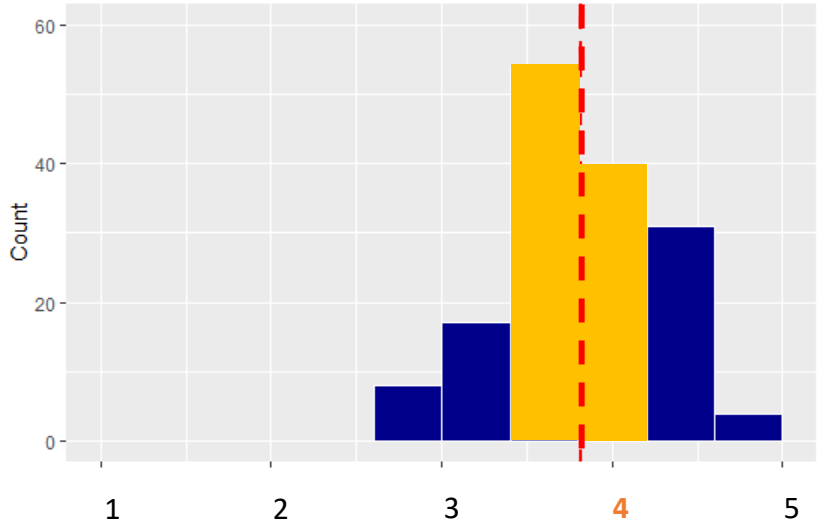
OBSERVING THE RESISTANCE IN BLACK POPLARS FROM EDA

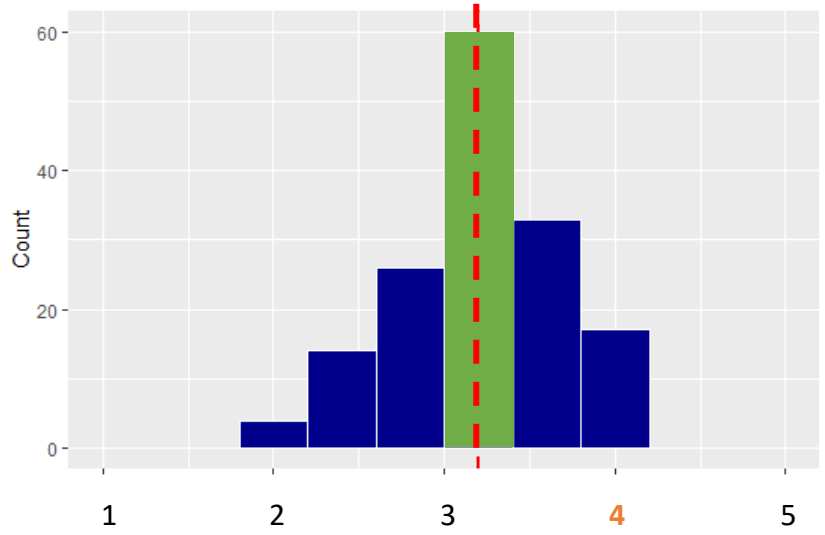




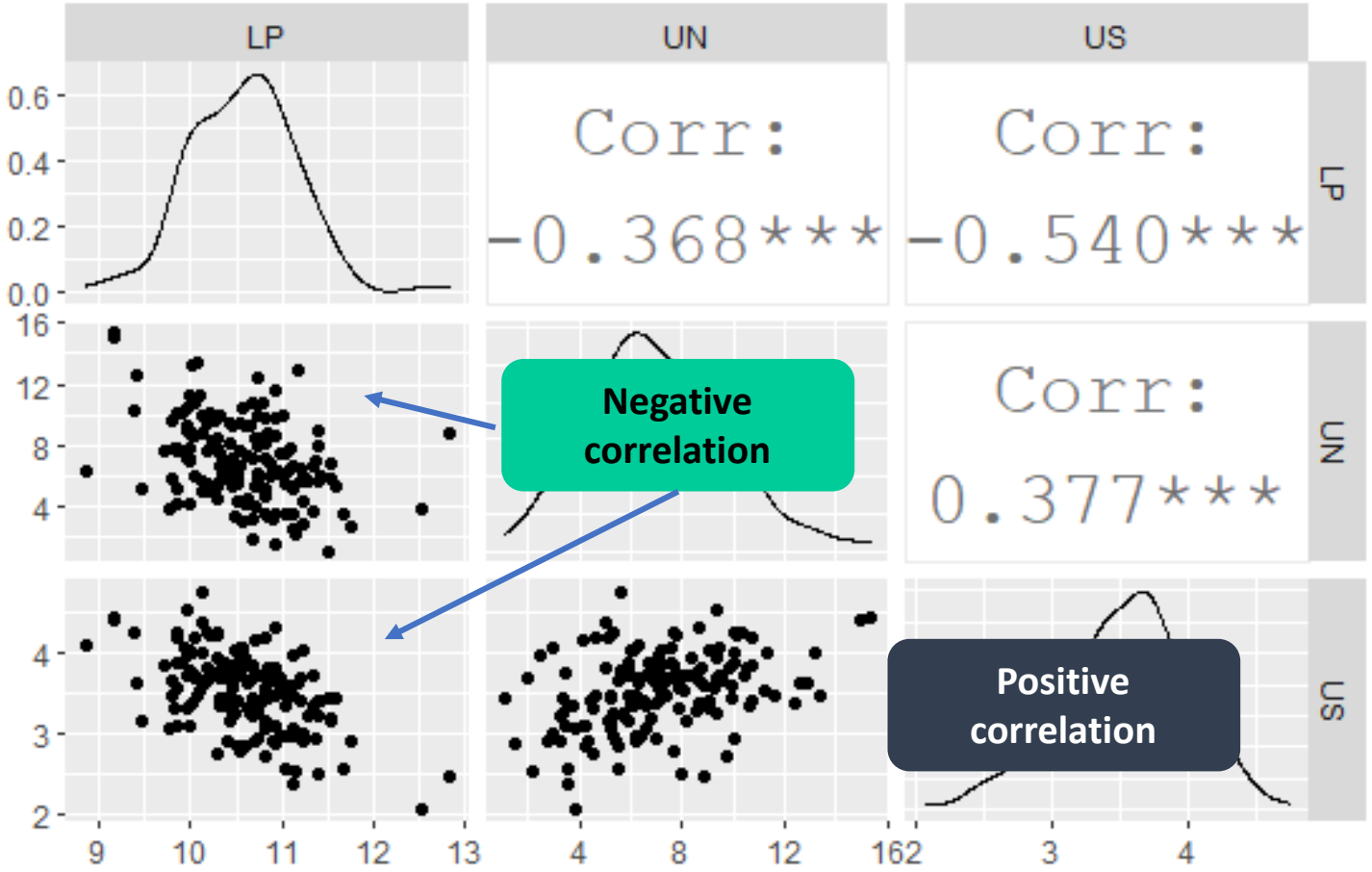








OBSERVING THE RESISTANCE IN BLACK POPLARS FROM EDA



Observing the correlations between the resistance components

- To give an idea about their synergy for poplar's overall resistance
- Preliminary analysis to explore the genetic correlation between the components using multivariate analysis

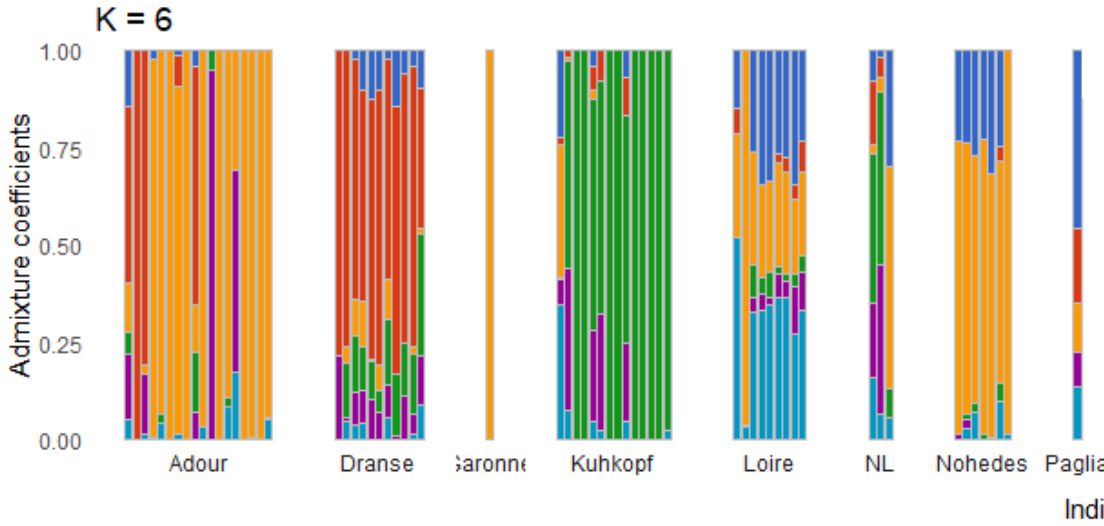
DEPICTING THE GENETICS OF RESISTANCE USING GWAS

The materials

- Genomic matrix: 154 genotypes x 7 800 SNPs

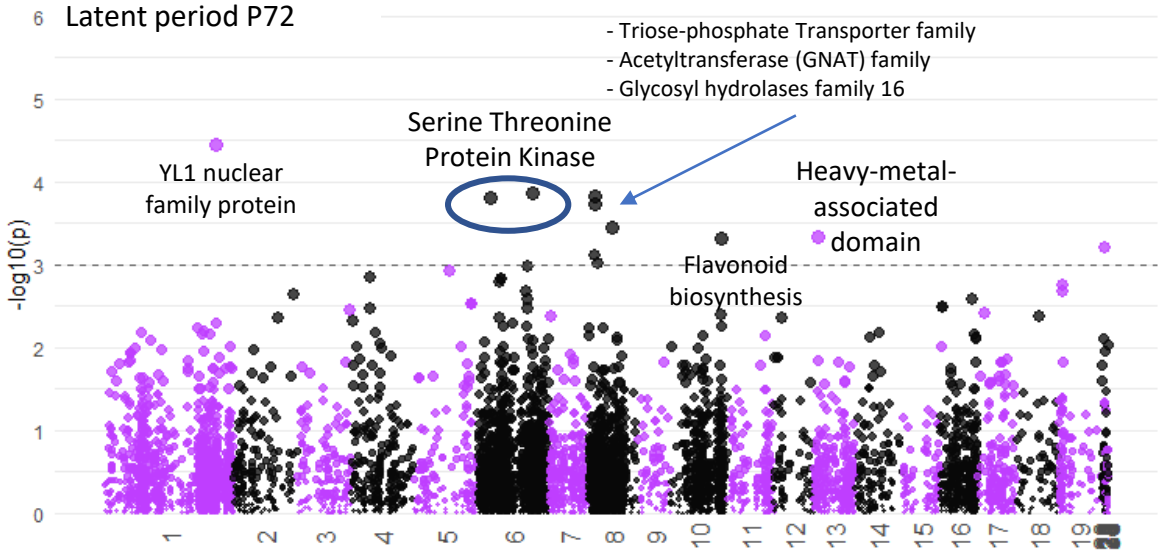
The model

- Generalized linear model method
- $Y = Z\beta_1 + X\beta_2 + \varepsilon$
- Evaluation of candidate genes: using P-values
- Correcting noise variation using kinship matrix and population admixture (K = 6)



The results

- Cut-off P-value: 0.001, marker R^2 = 8 – 13%
- Found 80 candidate genes in total for all the resistance components and rust strains



EVALUATING THE INTERACTION EFFECTS

The materials

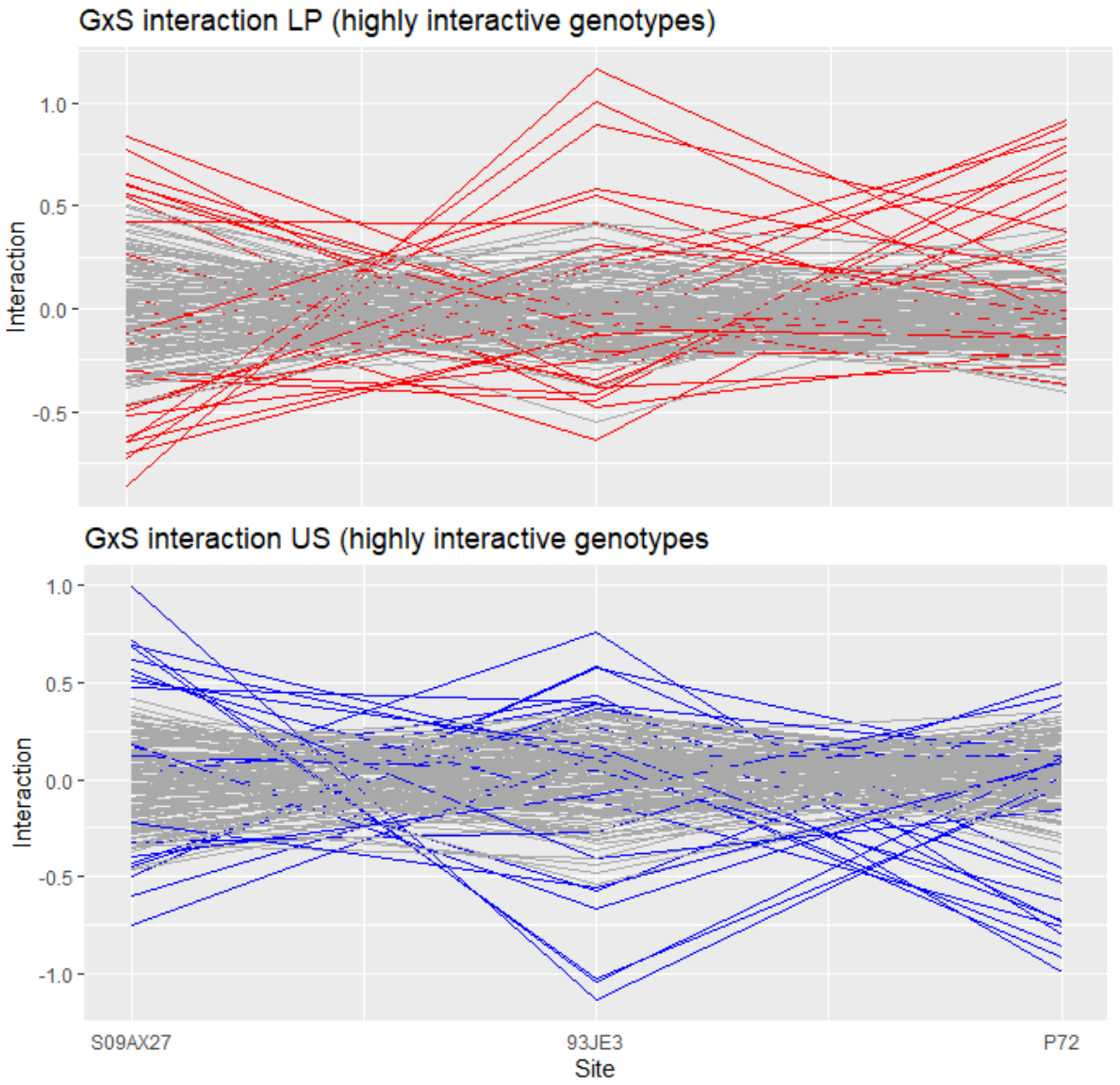
- 154 black poplar genotypes inoculated with 3 rust strains
- 3 resistance components: latent period, uredinia number and uredinia size

The model

- Linear mixed-effects model
- $Y_{ijk} = \mu + S_k + G_j + B_i + (GS)_{jk} + \varepsilon_{ijk}$
- Evaluation of interaction effects: paired X^2 of the log-likelihood of mixed-effects model and null model

The results

- Interaction effects were significant, explaining 20% of variation in latent period and uredinia size
- Indication of strain-specificity of the resistance components



Future Perspectives

THE IMPACTS OF THE STUDY FOR POPLAR'S BREEDING PROGRAM

Confirming the candidate genes for marker-assisted selection

Through further research on the genes' regulation pathways and functions

Selecting a group of poplars with various resistance across the strains

A group of poplars with stable resistance across the strains but with various strain-specificity to reduce the possibility of exerting selection pressure on the rust.

Improving GWAS

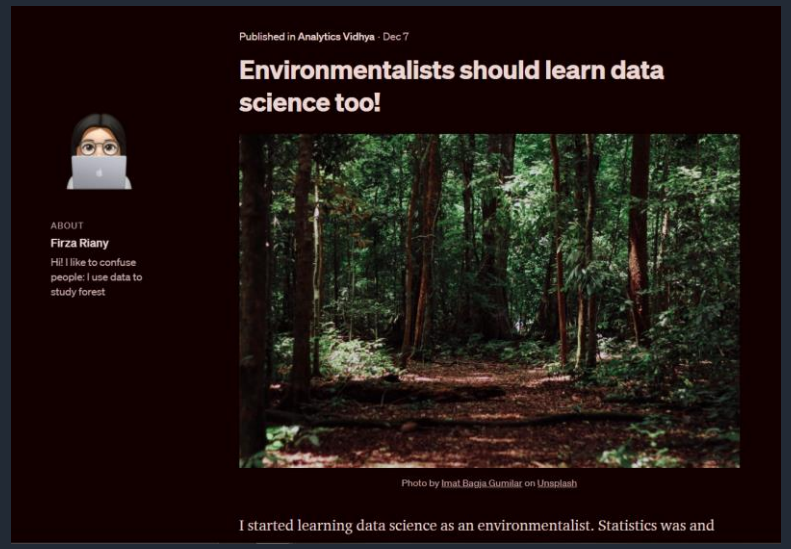
By testing more genotypes with more rust strains to increase the statistical power.

Confirming the genetic control of the resistance's strain-specificity

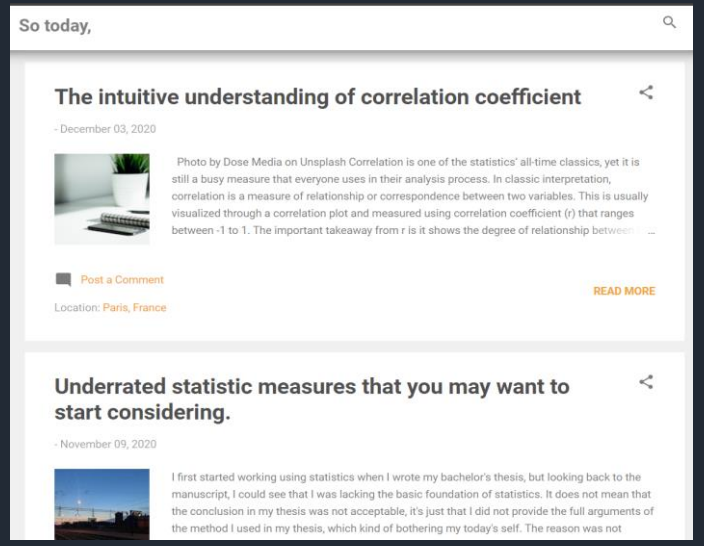
To see if the specificity is genetically controlled or not by modeling the association between interaction parameters and SNPs

More about me:

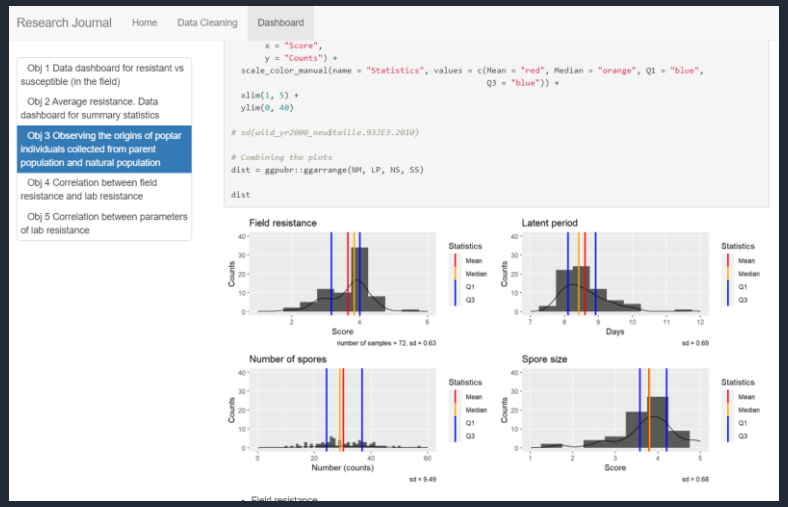
Medium page: explains-forestry.medium.com



Blogspot: firzariany.blogspot.com



GitHub: [firzaariany (Firza Riany) (github.com)]



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