



Pre-breeding strategies for obtaining new resilient and added value berries

Marker-assisted selection in raspberry: challenges and opportunities in the -omics era

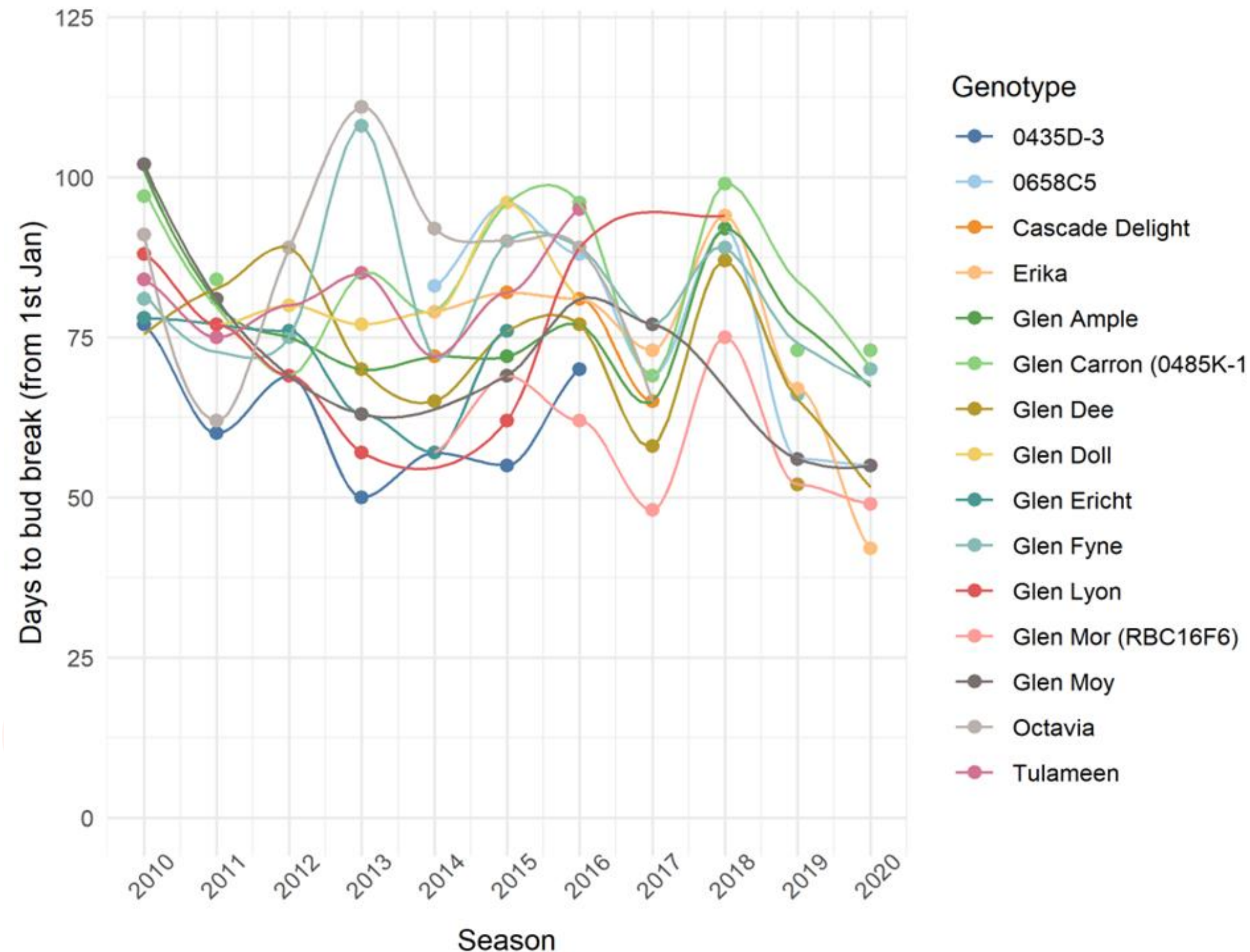
Brezo Mateos (JHI)

Advancing Berry Breeding: From Phenotyping to Genomic Innovation

Ancona 3/4/25



Arising challenges of the raspberry industry



- **Economics of production**
(183% inflation in UK data, yield reductions, loss of actives, inputs, substrates, labour cost currently 50%)

- **Climate change**
(Abiotic stress, biotic stress, increasing production costs, new policies)

Need for cultivars that help deliver food security while better protecting the environment.

The association mapping population

315 genotypes including

- 50 cultivars
- 150 families

Covers historic and active biparental populations, 'Glen Moy' x 'Latham', 'Autumn Treasure' x 'Glen Fyne', 'Glen Ample' x 'Glen Dee'.

Genotyping completed in 2022 through LGC 5K SNP array



Case study: identifying QTL associated with of winter phenology

Dormancy = 'plant hibernation'. Growth arrest until cold requirements are met.

Climate change is decoupling its main environmental signals.

Causes shifts in phenology, uneven bud break, and frost damage (**Economic loss**)

Need for an alternative to forcing artificial chilling (production costs, net zero objectives)

Aim: Identifying loci associated with key aspects of winter phenology.



Developing linkage maps for 'Glen Ample' x 'Glen Dee' population

Development of F1 mapping population 'Glen Ample' x 'Glen Dee' (N= 237)

Genotyping: LGC 5K SNP array.

Filtering

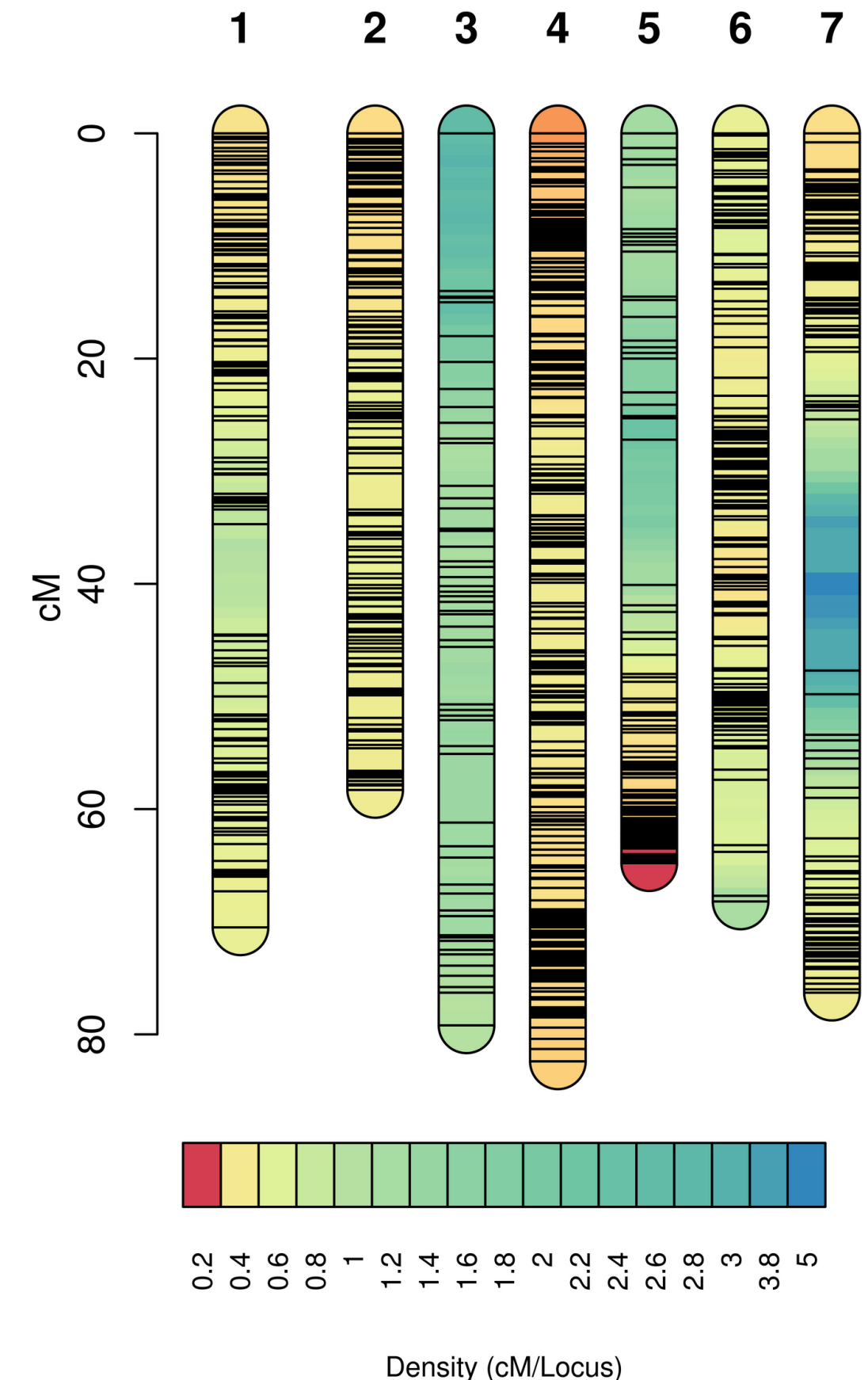
R: >10 NA, missing or inconsistent in parents

JoinMap v4.1: self pollination individuals,
identical markers, distorted segregations.

1092 loci in 231 F1 individuals

Mapping: linear regression (JoinMap v 4.1)

- 7LGs, total 499.7 cM
- Coverage ~ 2 markers/cM



Phenotyping winter phenology

9 traits measuring winter phenology, flowering time, and spring vigour.
Scored 2022-2024.

- 50% Senescence (days)
- 100% Senescence (days)
- Spring vigour (1-5)
- Bud break (days)
- Leaf out (days)
- Flowering time (days)
- Leaf development (days)
- Dormancy (days)

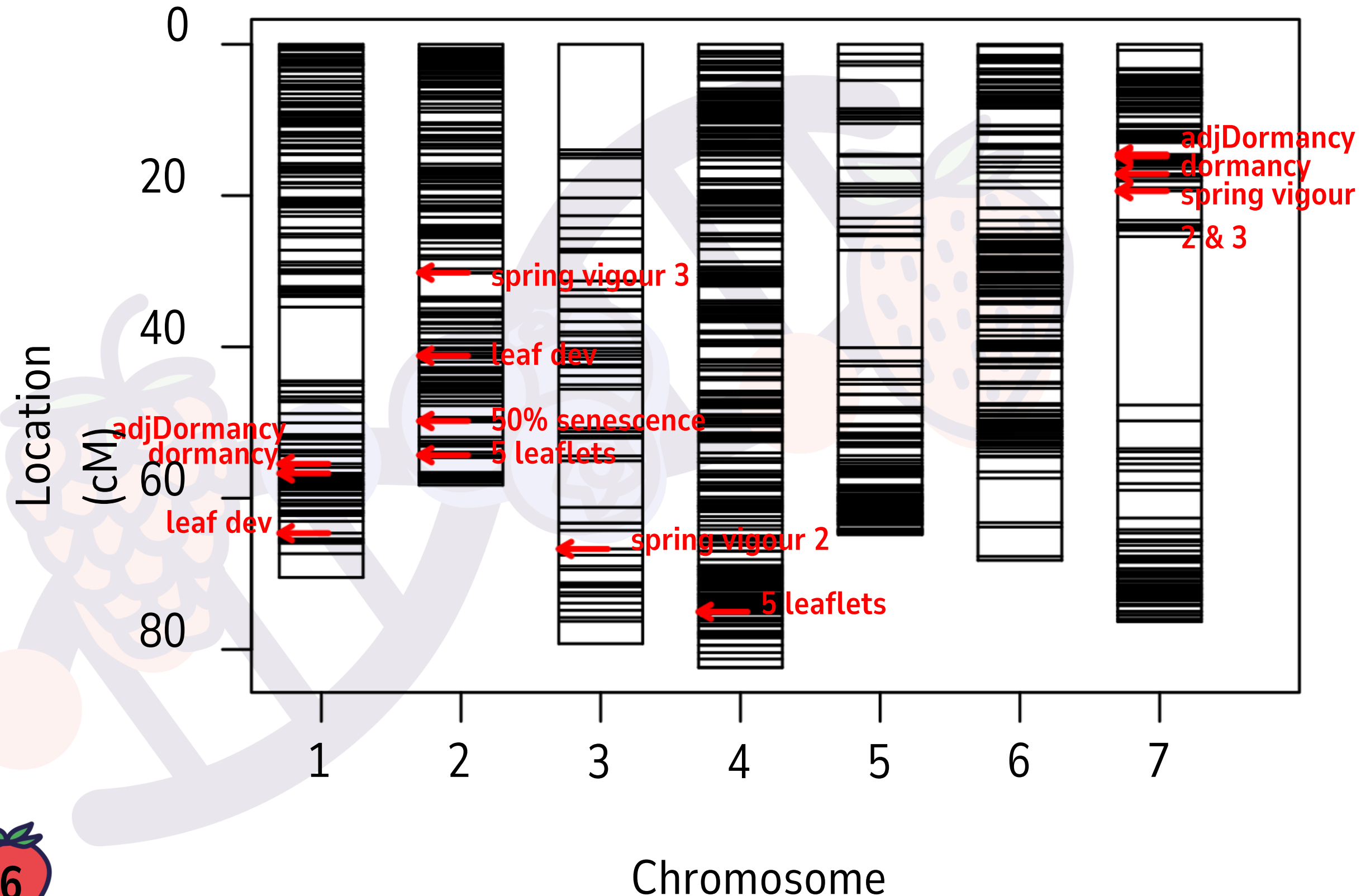
Effect of the position in the field estimated through GLMs

$$\text{Trait} \sim \text{Pos } X + \text{Pos } Y + \text{Pos } X:\text{Pos } Y$$

When significant, adjusted scores were calculated through model residuals.



QTL mapping



R:qtl (Broman, 2003)

Genomic-wide 5% upper LOD threshold for each trait and algorithm calculated with 1000 permutations.

14 QTL linked to 6 traits.

8-16% variance explained.

Co-location of traits, + known QTL.

Legacy: integrating genetic and genomic data

From quantitative genetics...

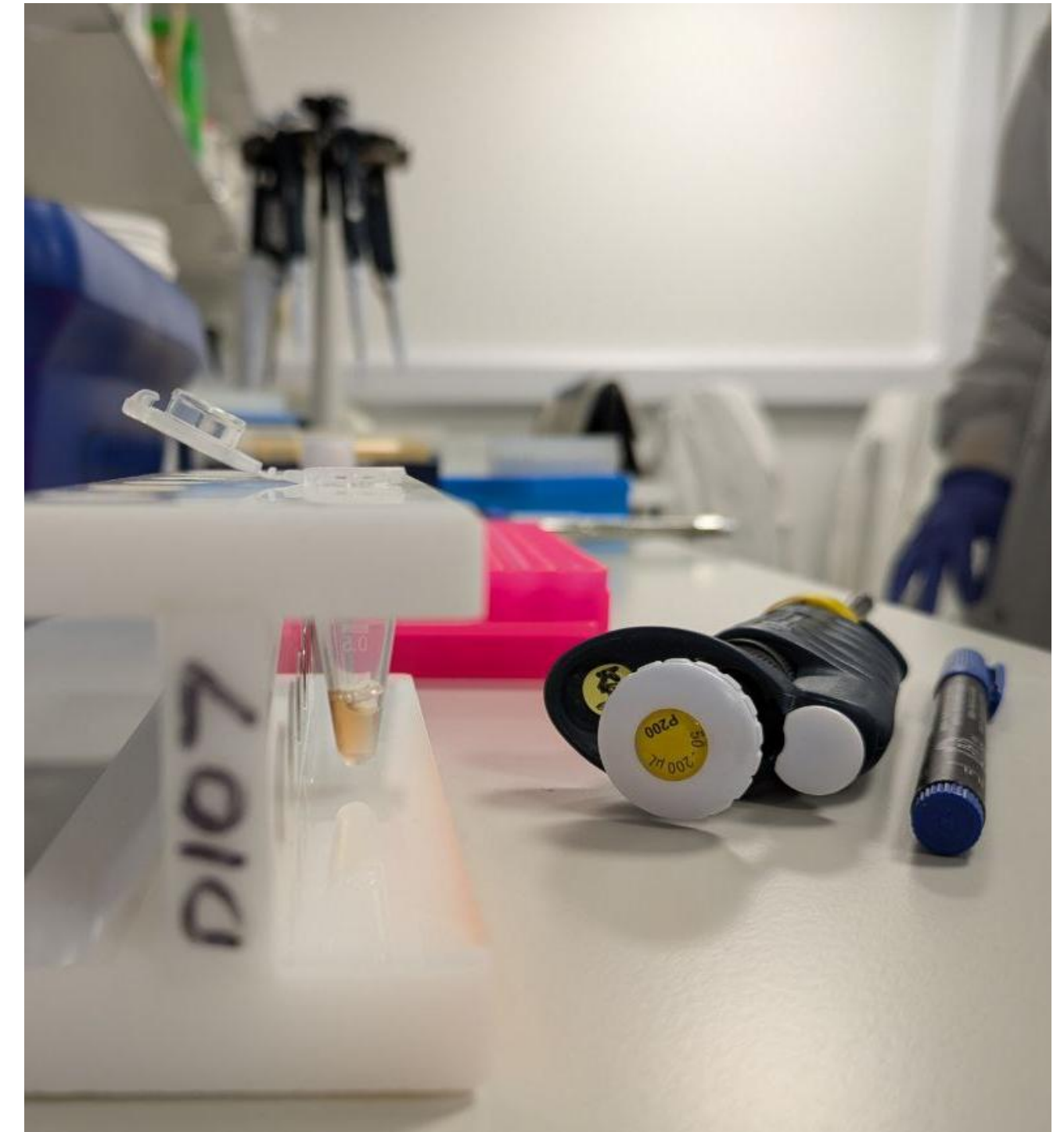
14 Putative QTL & regions of interest (GWAS)

... to genomics ...

- 4 genomes ('Glen Moy', 'Glen Mor', 'Glen Ample', 'Glen Dee') (w/ Linda Milne, JHI).

... and transcriptomics.

- Reference Transcriptome Database (RTD) for *R. idaeus*. (w/ Linda Milne, Micha Bayer, Craig Simpson, JHI).
- V5 coming soon!



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Detecting Local Adaptation in European raspberry cultivars

Valeria Montano (BioSS)

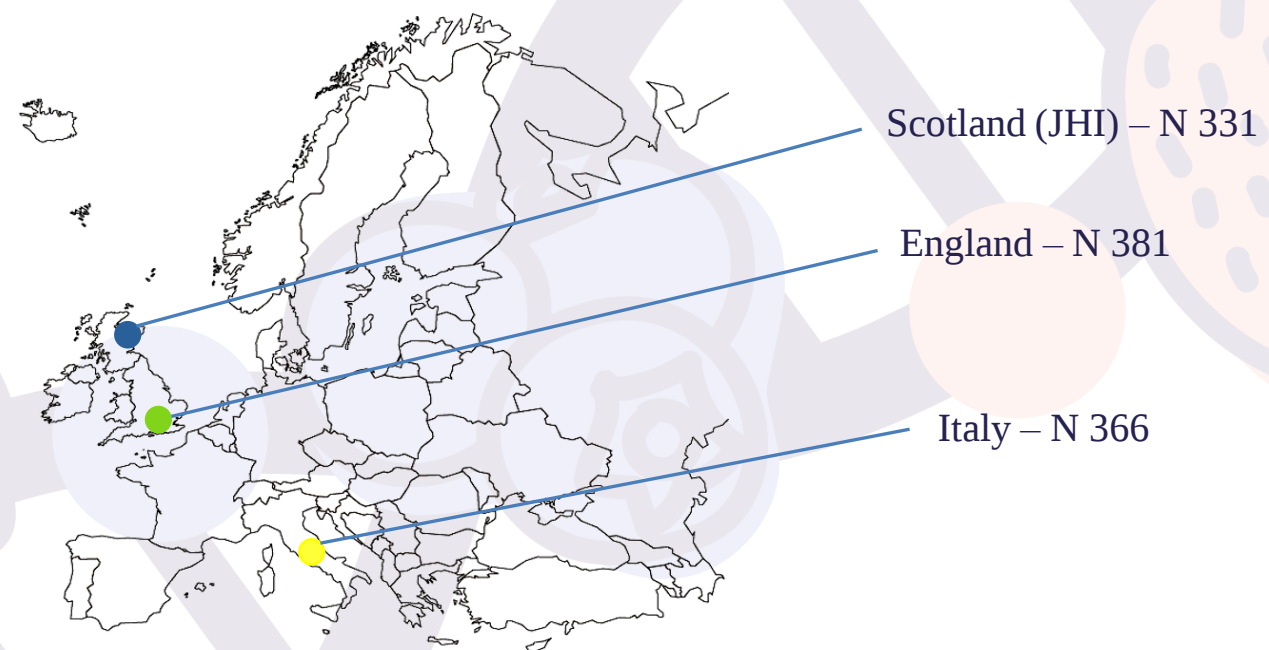
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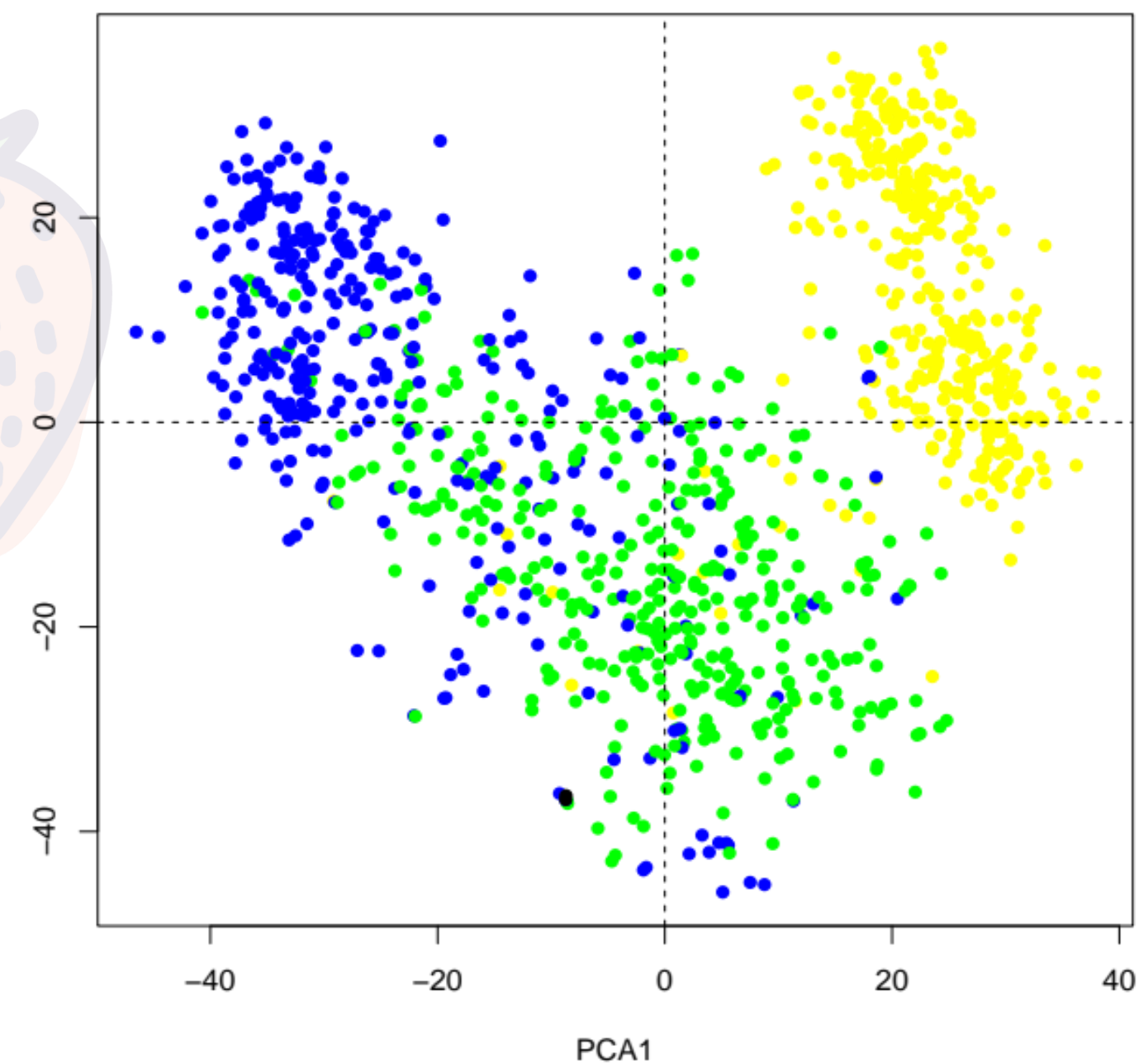


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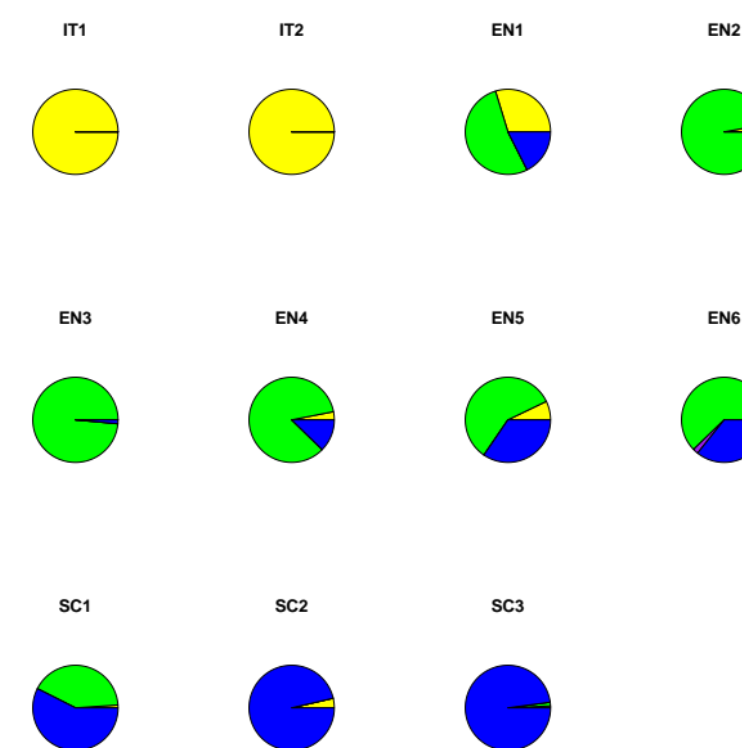
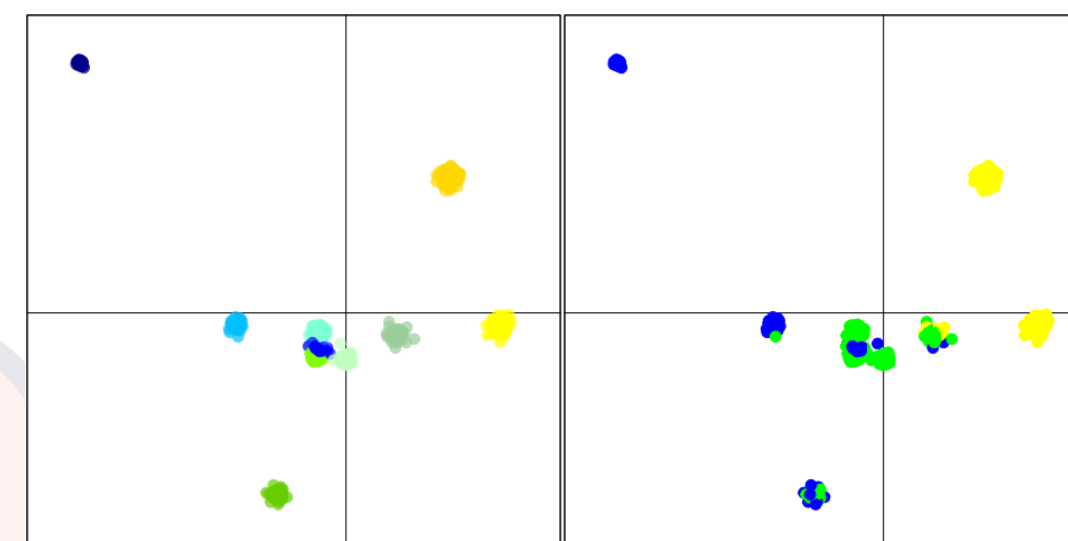
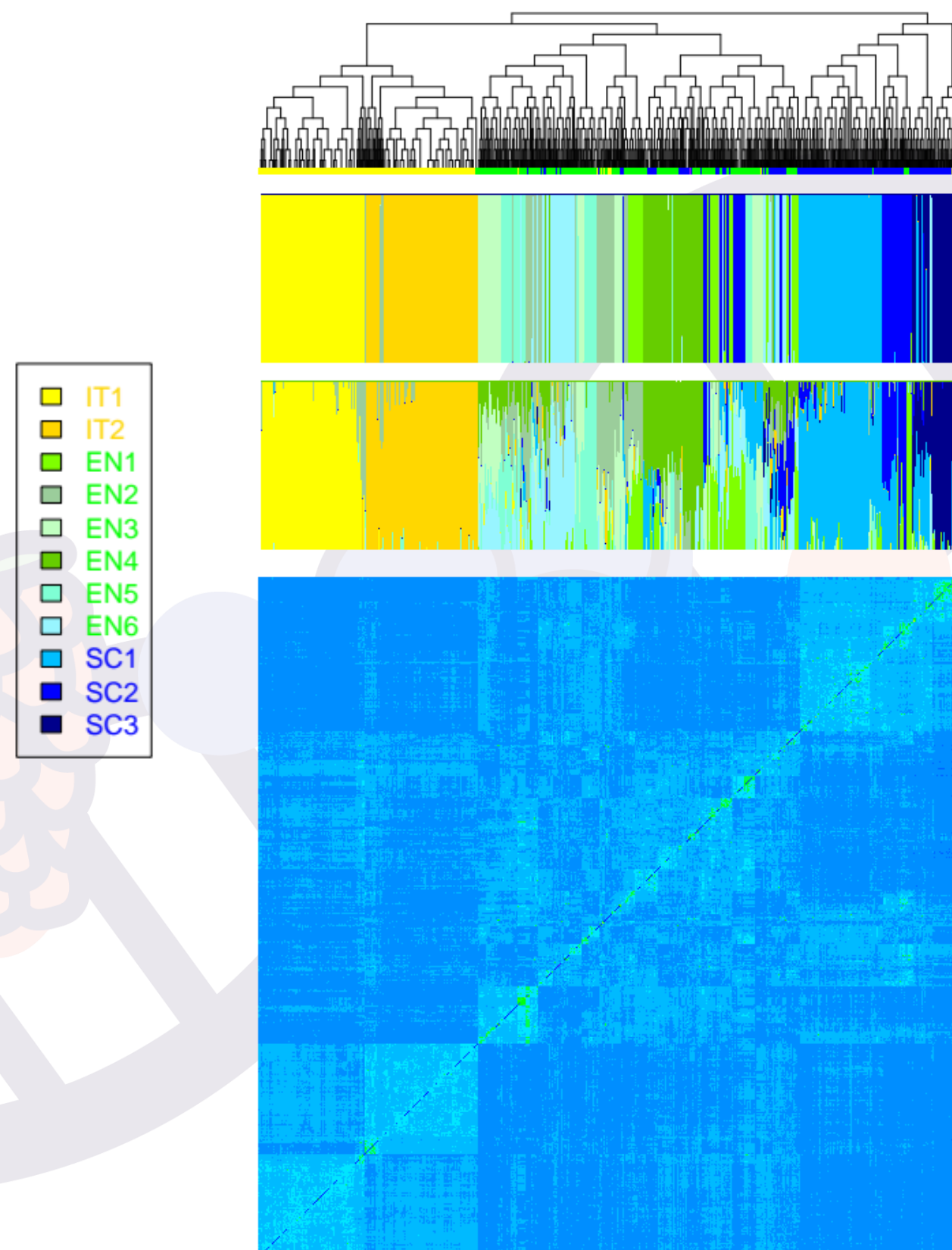
Geographic locations of our samples



1080 IND (tot + 2 industrial samples)
8239 SNPs loci

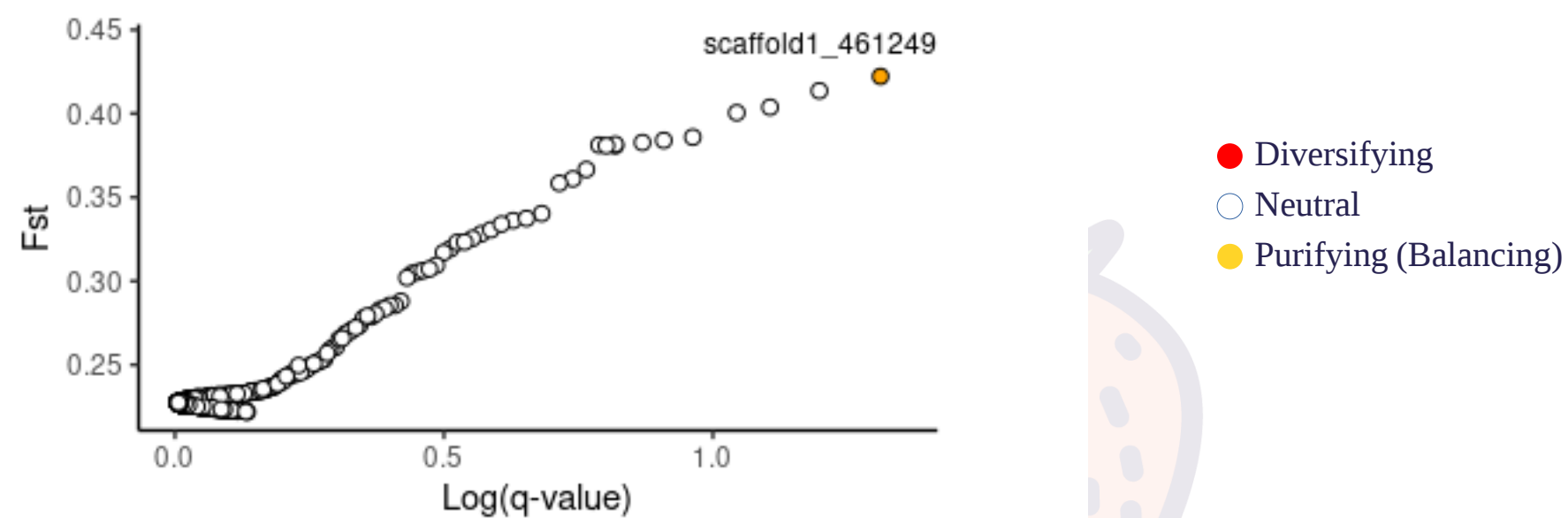


Genetic Structure

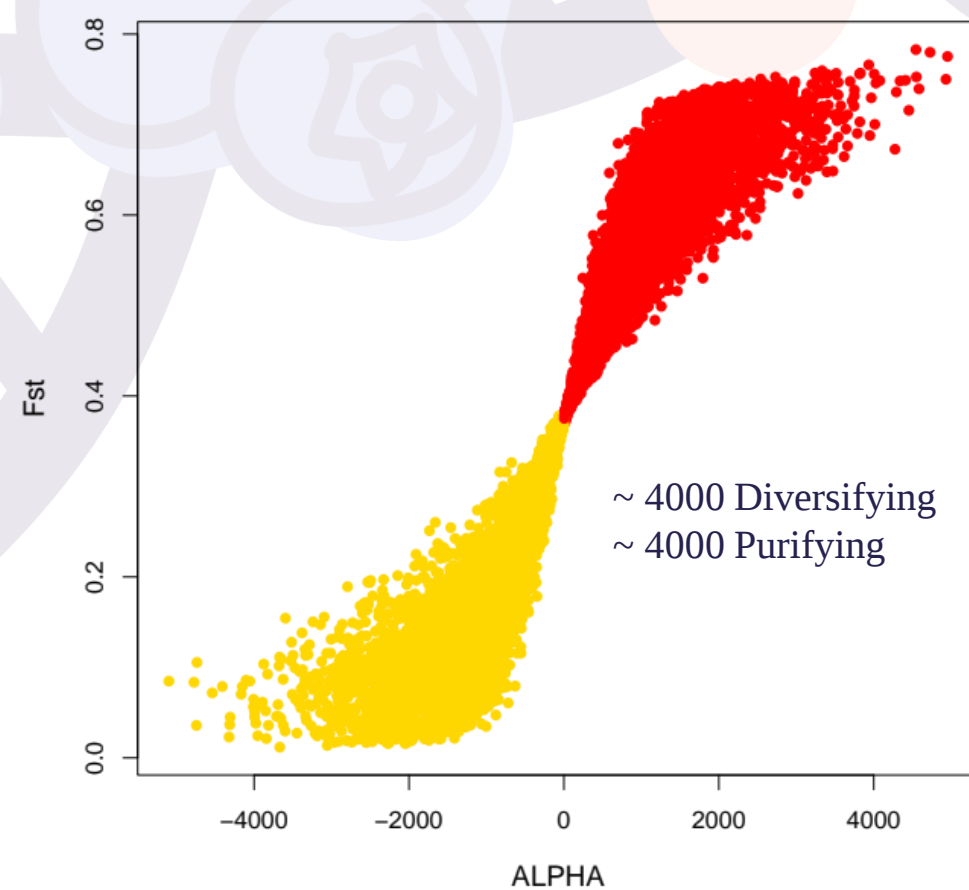


Signatures of local adaptation

Geography

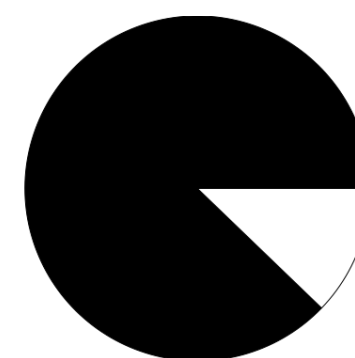


Structure

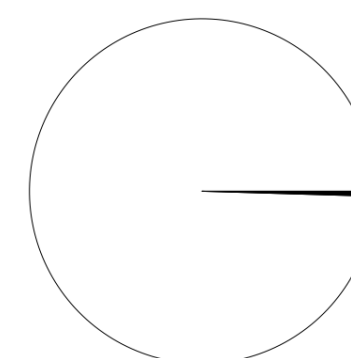


Bootstrapping

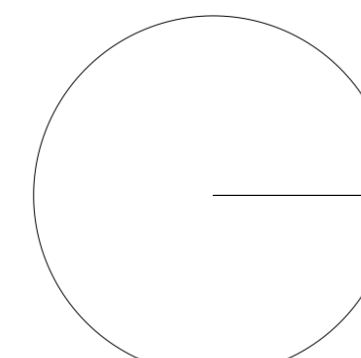
Diversifying



Neutral



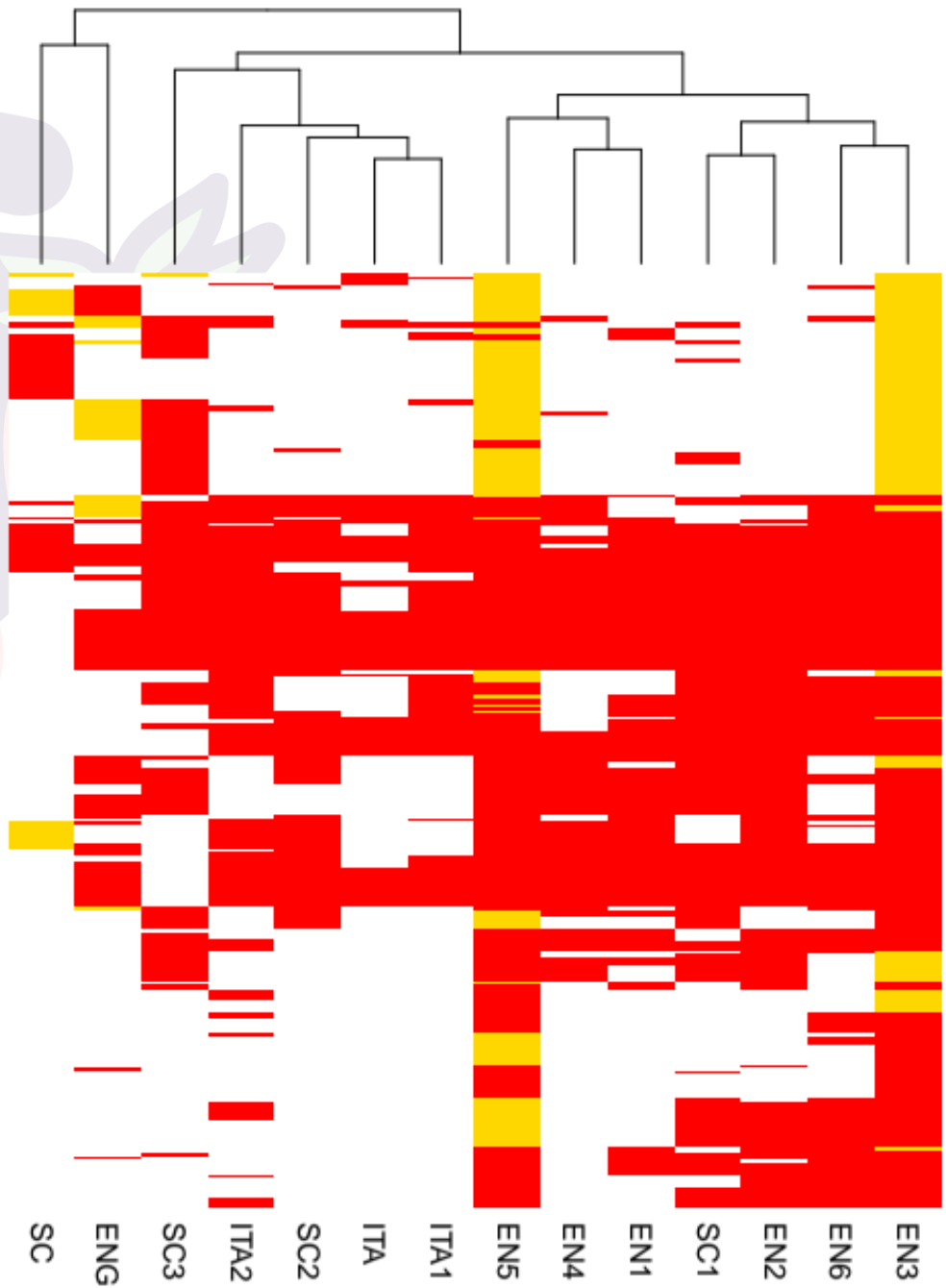
Purifying



- Assigned more than 0.001 times
- Assigned less than 0.001 times

Signatures of local adaptation

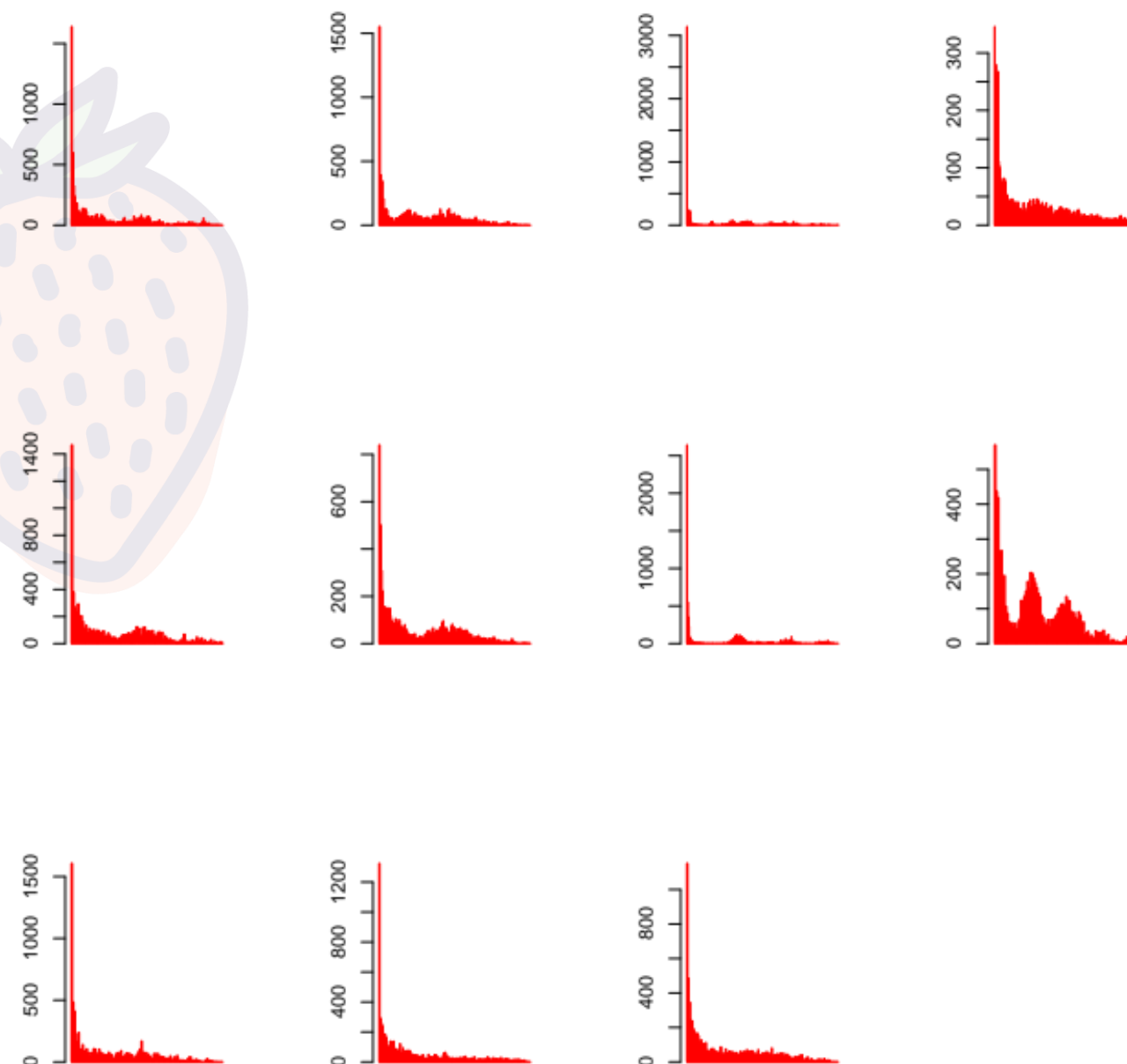
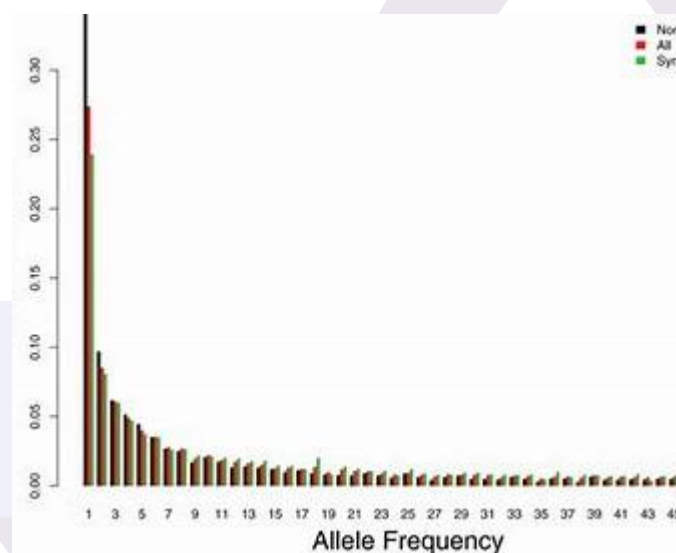
- Diversifying
- Neutral
- Purifying (Balancing)



Signatures of local adaptation

Cultivated Raspberry SFSs

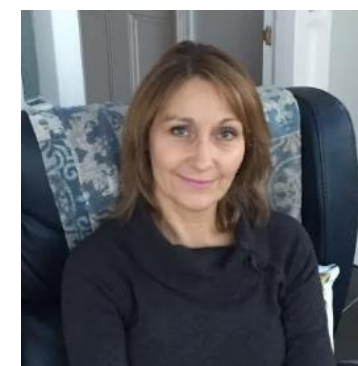
Neutral SFSs



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