

# Evolution of *LAR3*



-A disease resistance candidate in conifers

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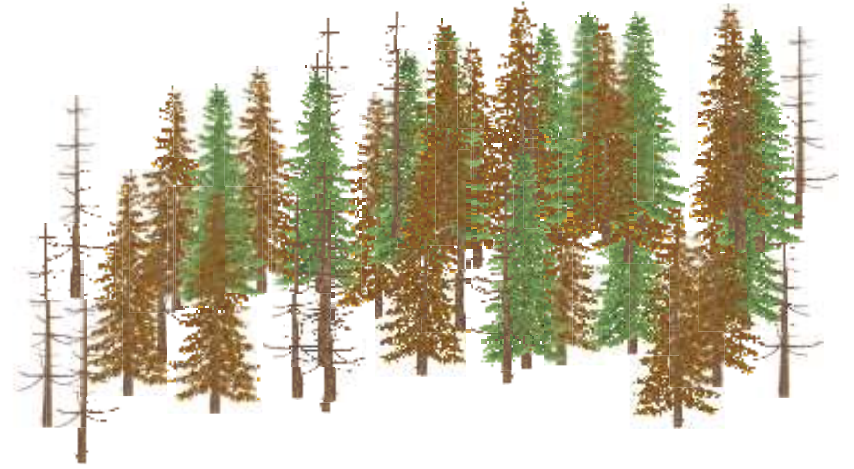
@capadorr



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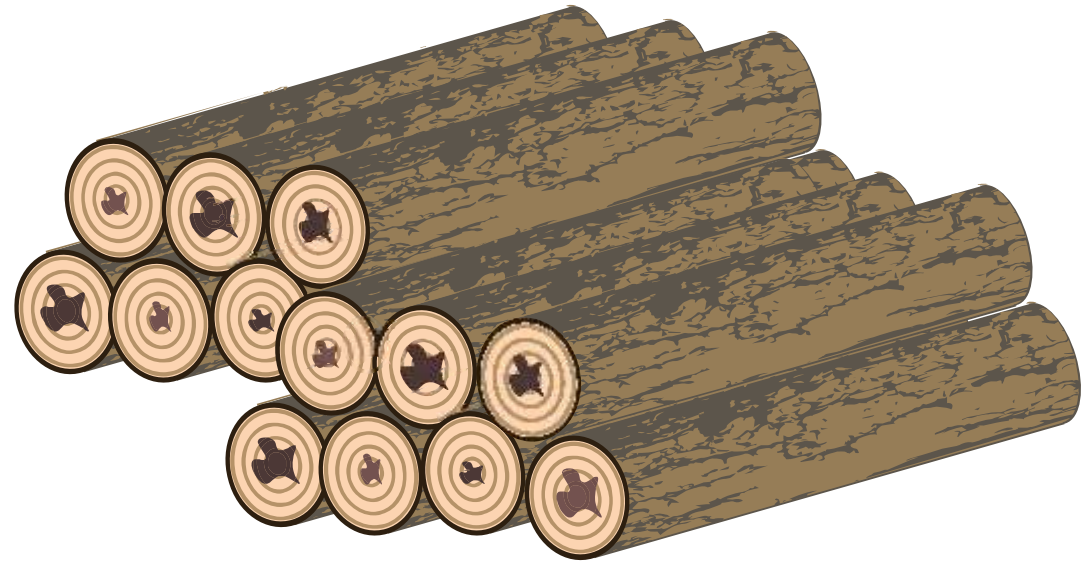
# Outline

- Overview
- LAR3 is a disease resistance candidate
- LAR3 is an outlier in conifers
- Is LAR3 under balancing selection?
- Concluding remarks

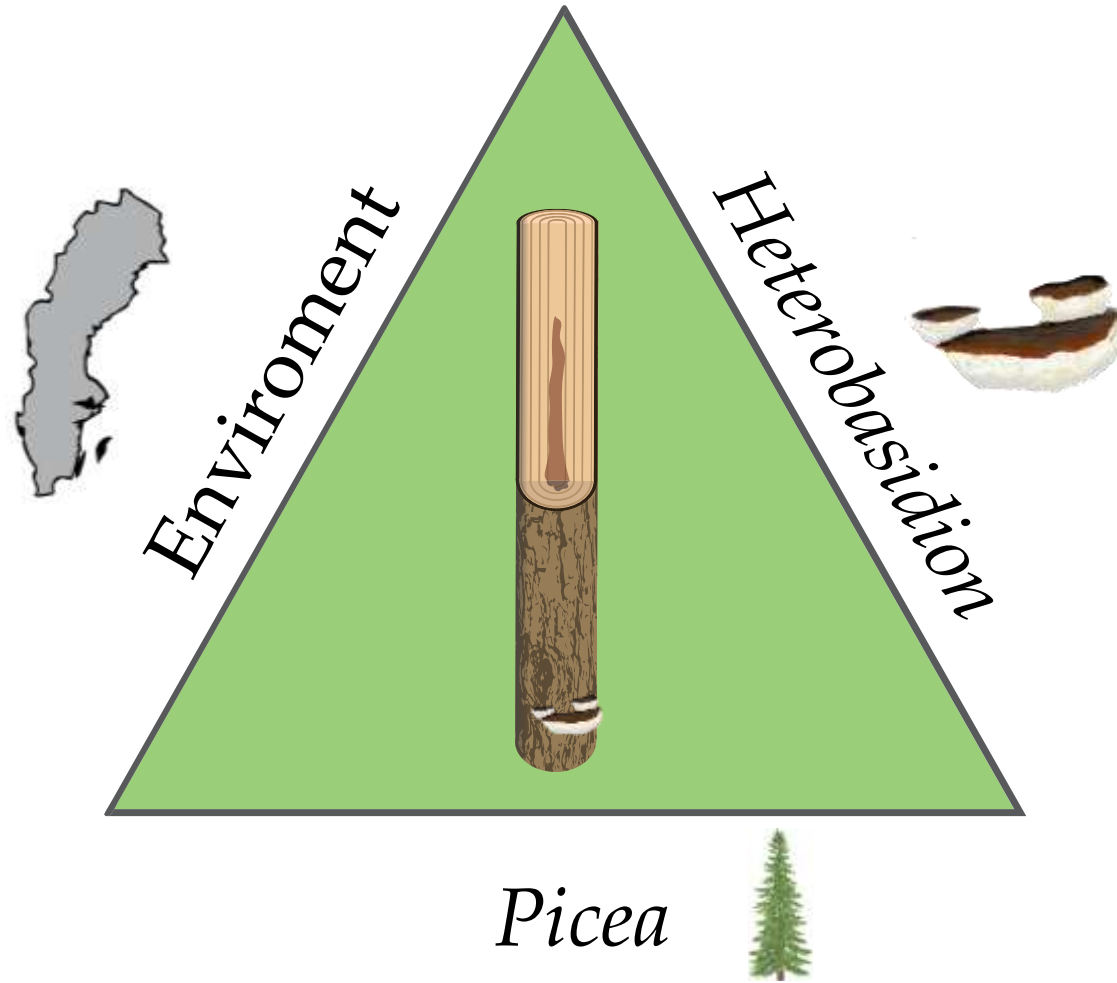


*Heterobasidion annosum* s.l. causes root and stem rot in Norway spruce..

..leading to losses equalling to 2 million SEK every day..

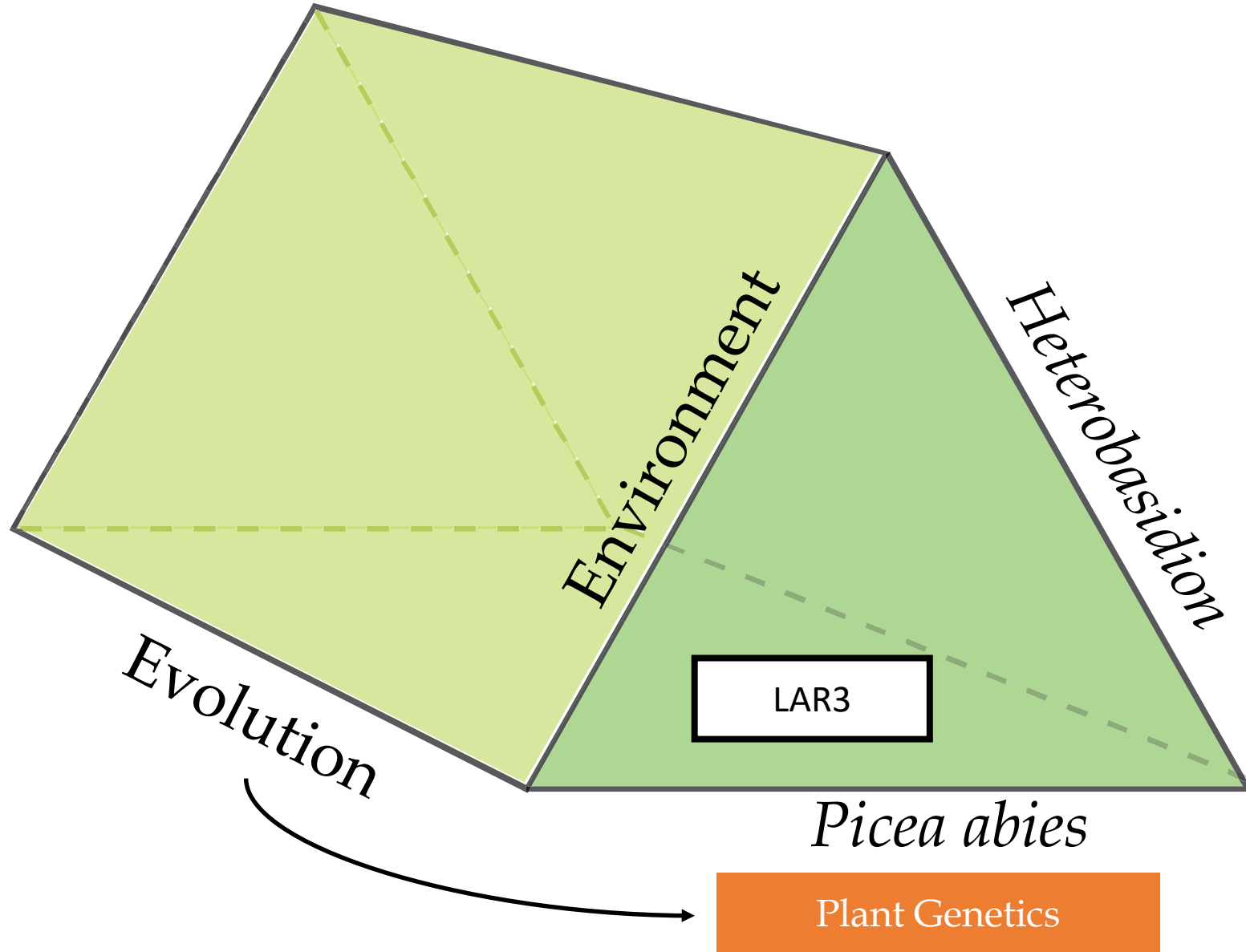


# “Disease triangle”

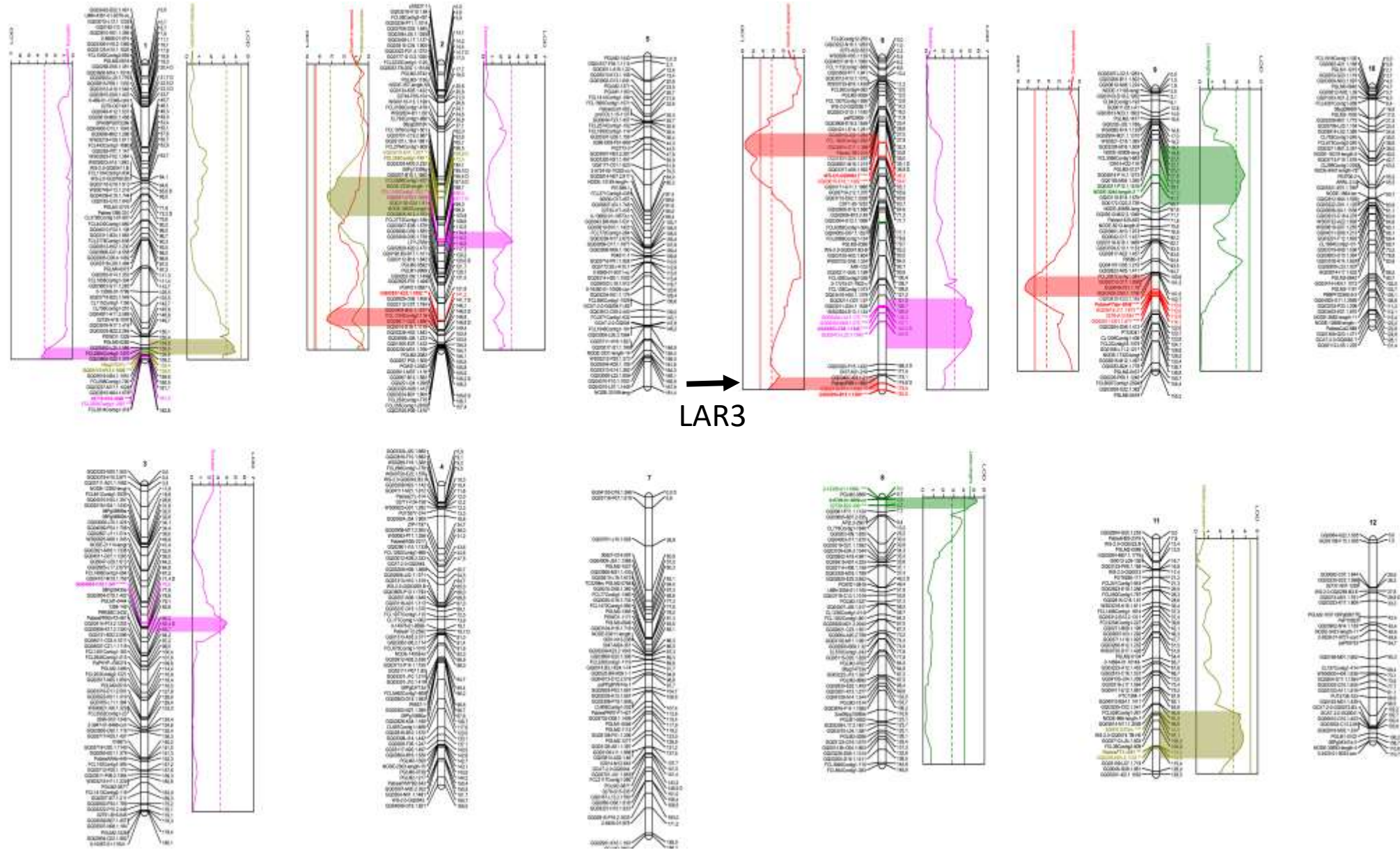


Plant Genetics

# “Disease tent”



# LAR3 is a disease resistance candidate



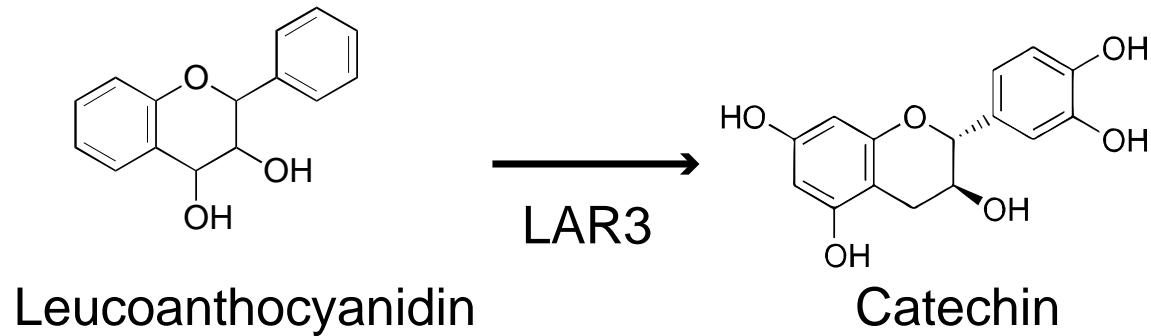
LAR3

(♀S21K7622162 x ♂S21K7621678)

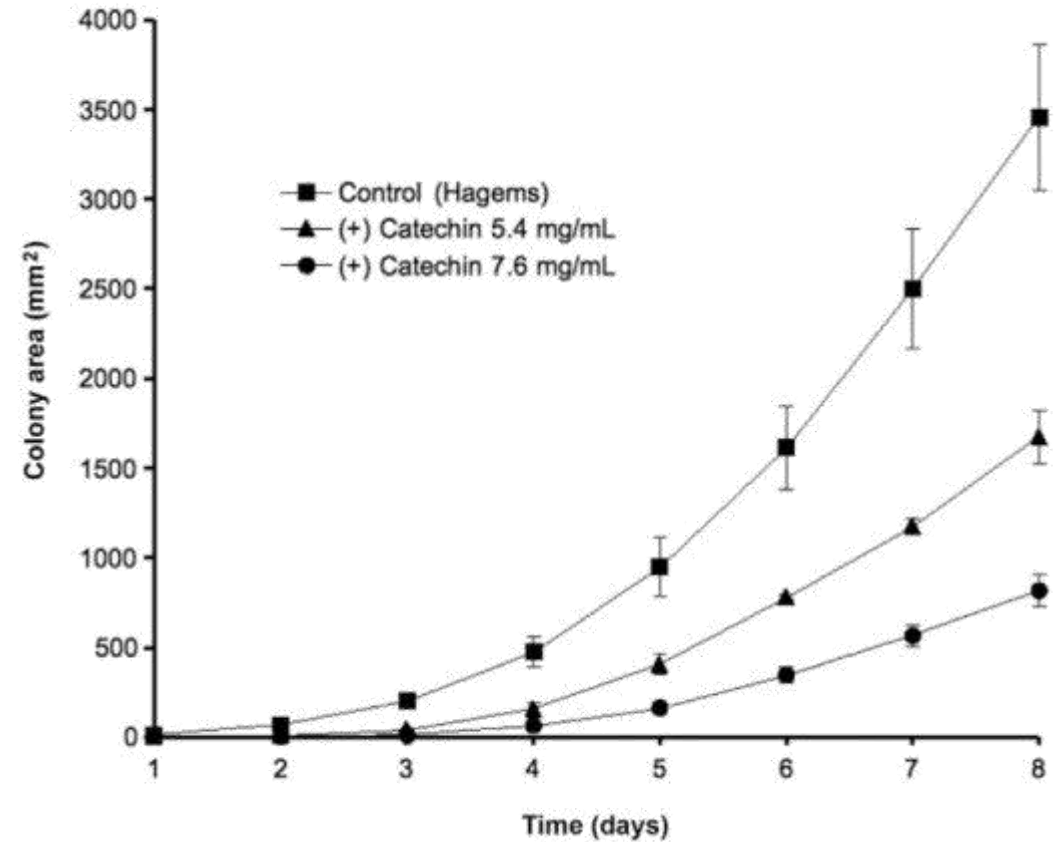
Lind et al. PLoS One 2014

# LAR3 is a disease resistance candidate

- Leucoanthocyanidin reductase

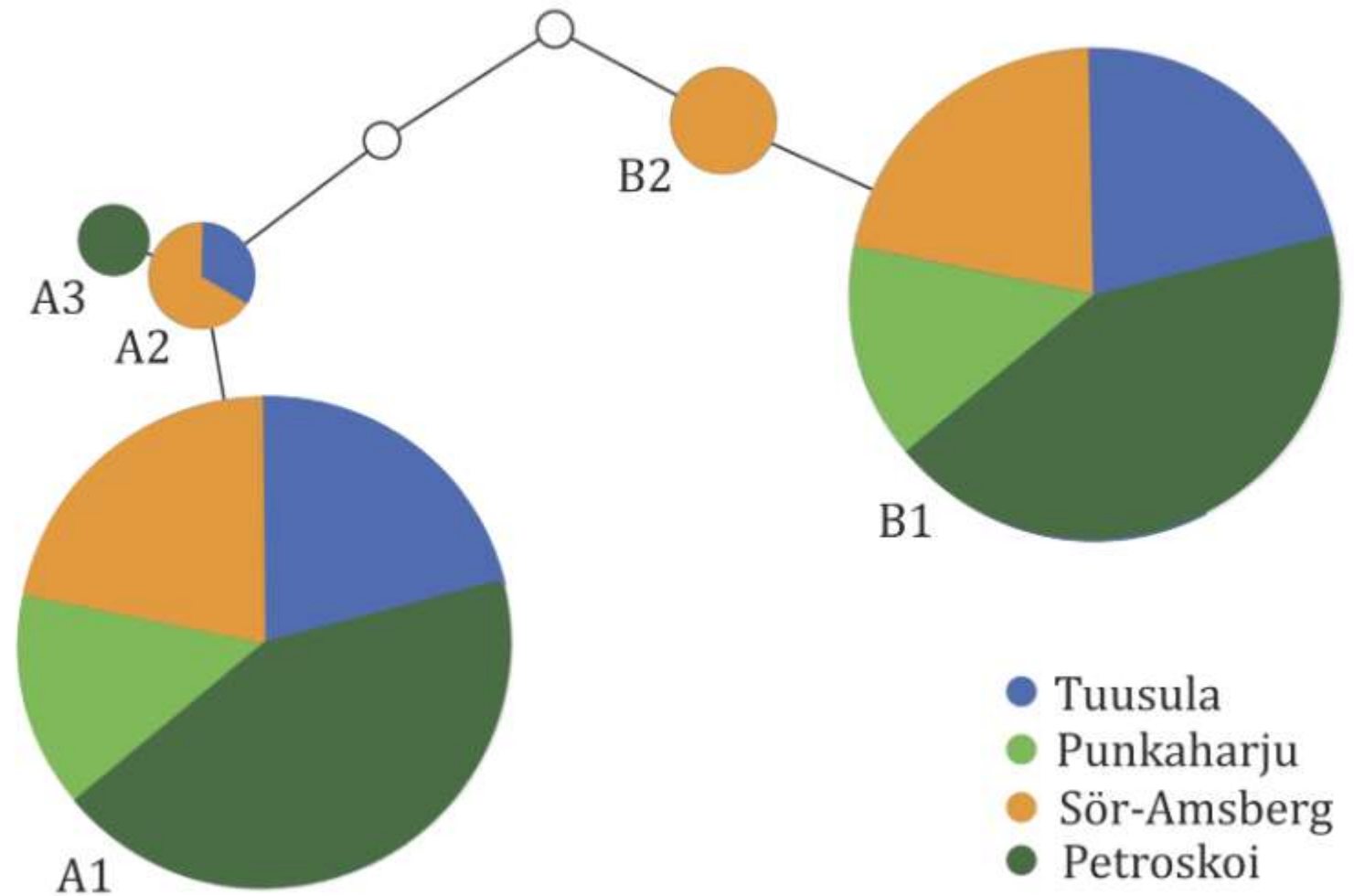


- Growth of *H. parviporum* on catechin



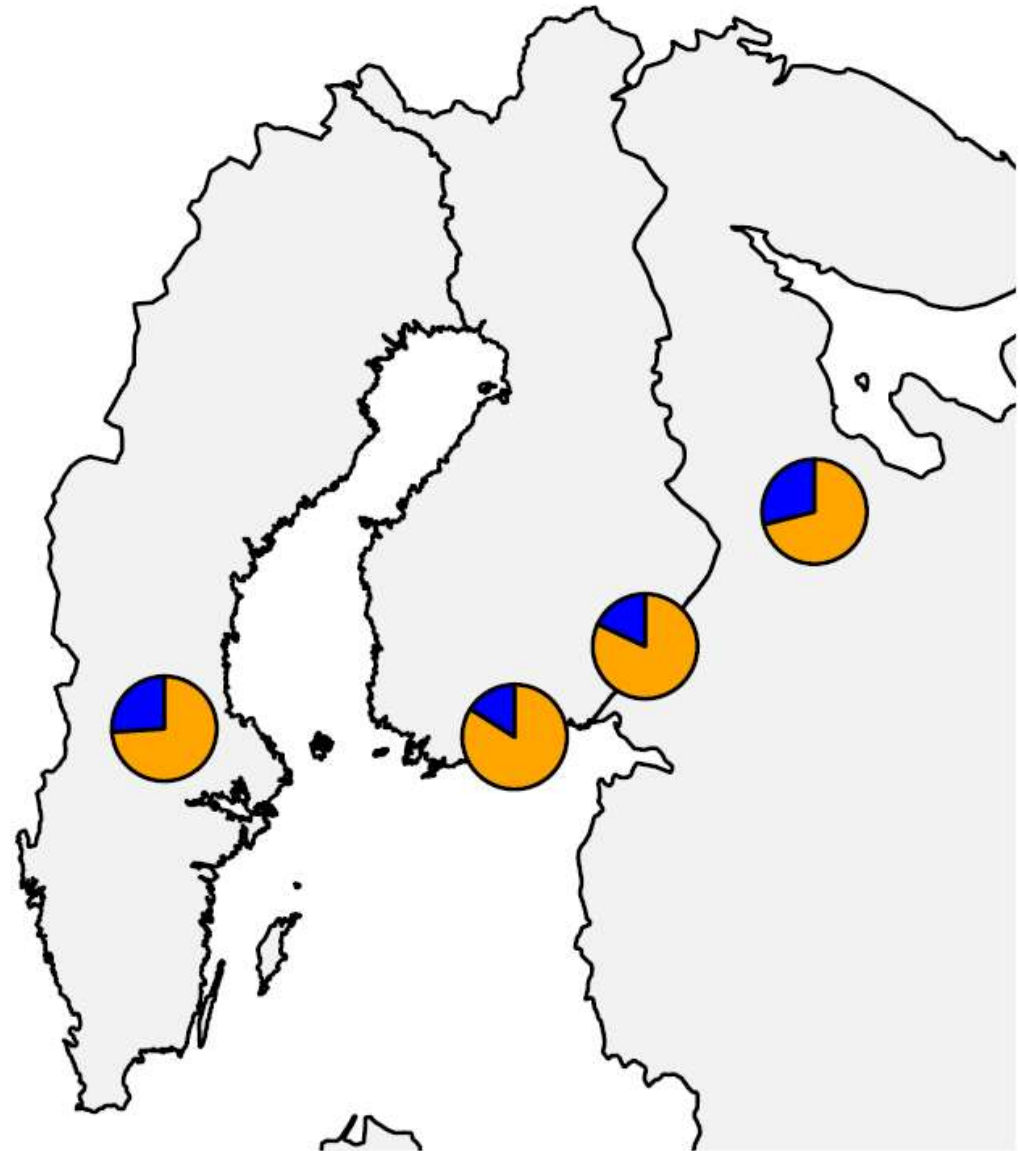
# LAR3 is a disease resistance candidate

- 773 genotyped individuals
- Two clear haplotype groups
- SNPs segregating together



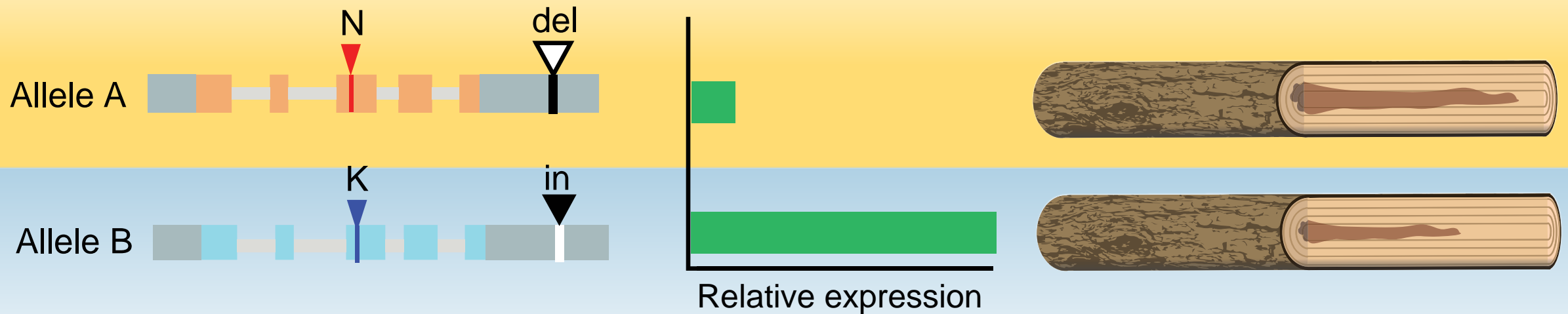
# Allele frequencies of LAR3 in genotyped populations

- Similar allelic frequencies
- LAR3A = 0.78
- LAR3B = 0.22

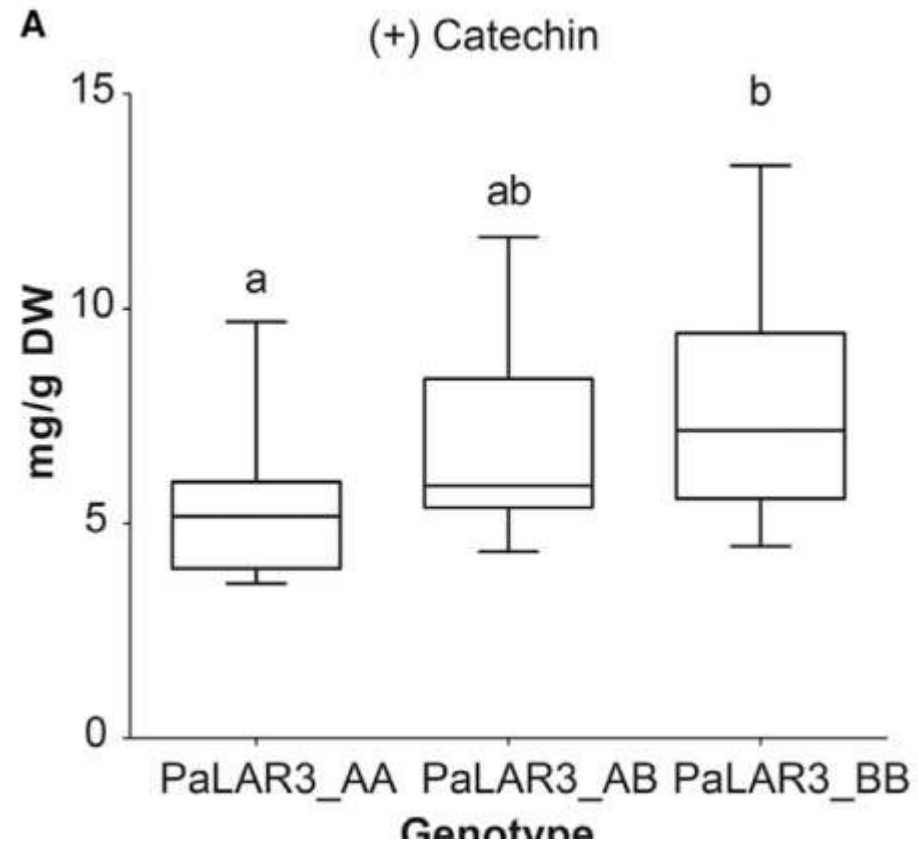
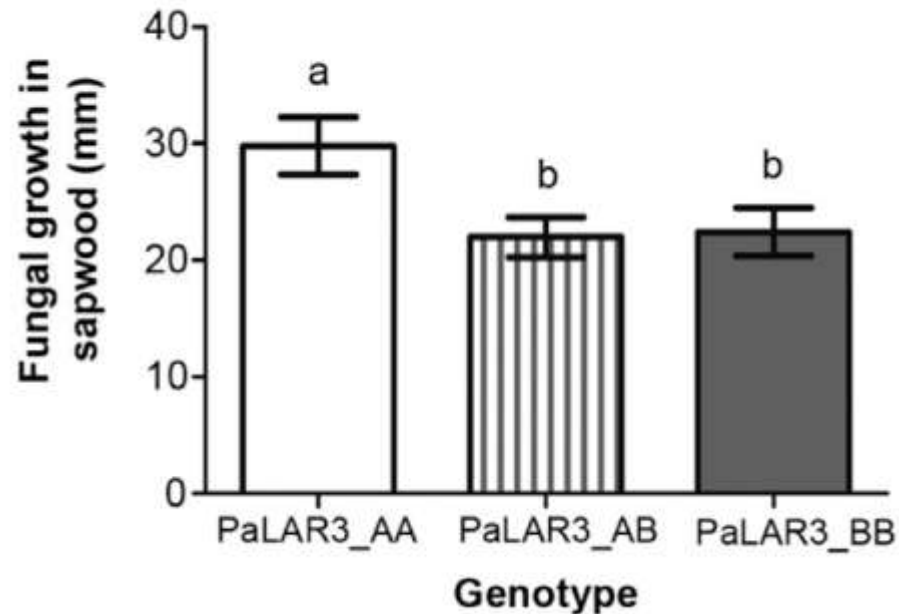


# There are two alleles for LAR3

They are defined by one aminoacid change (**Asparagine** to **Lysine**), one **indel** in the 3UTR region and differential **expression**



Allele B is associated with higher resistance and higher Catechin production

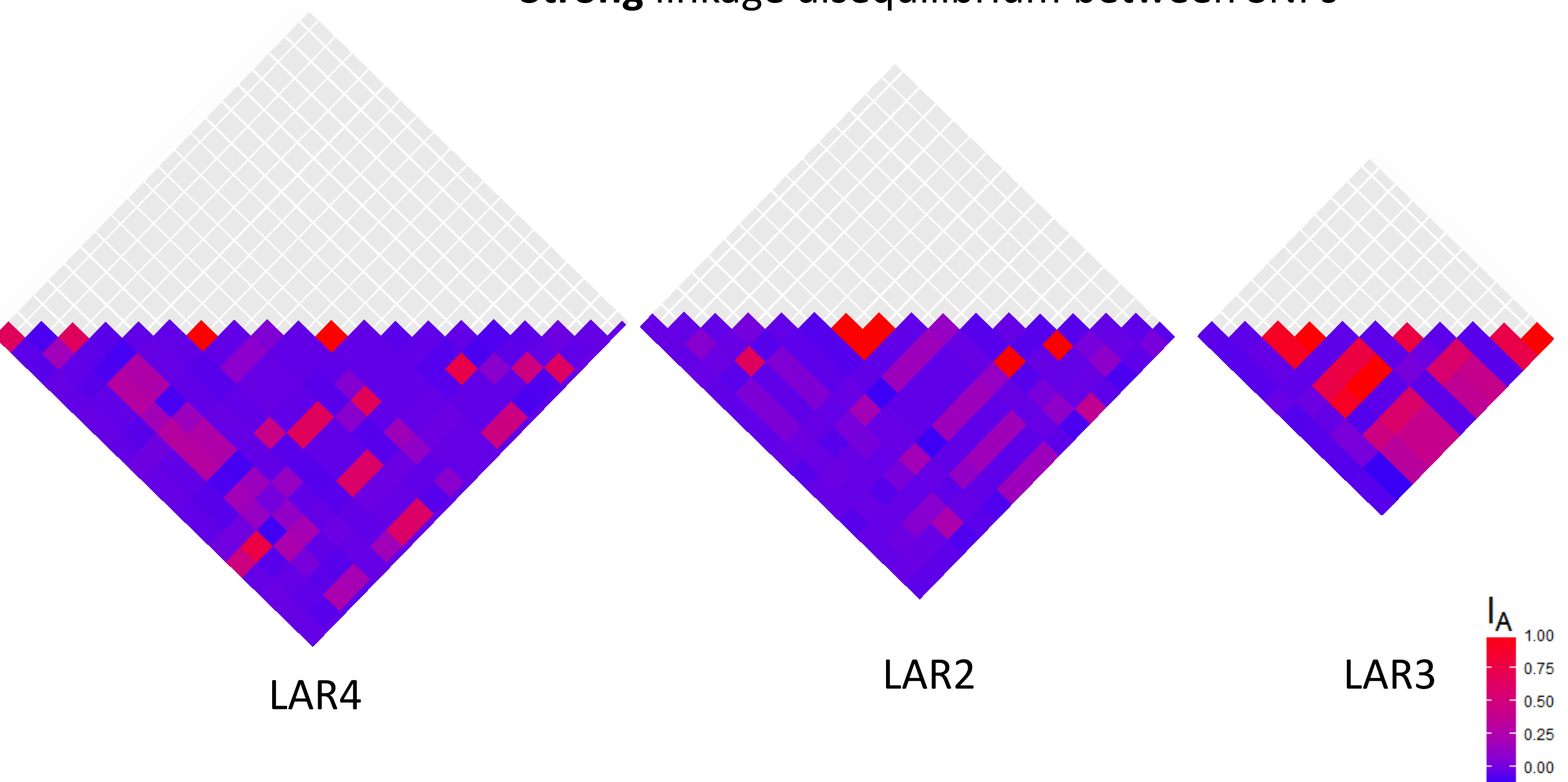


# Is LAR3 an outlier?

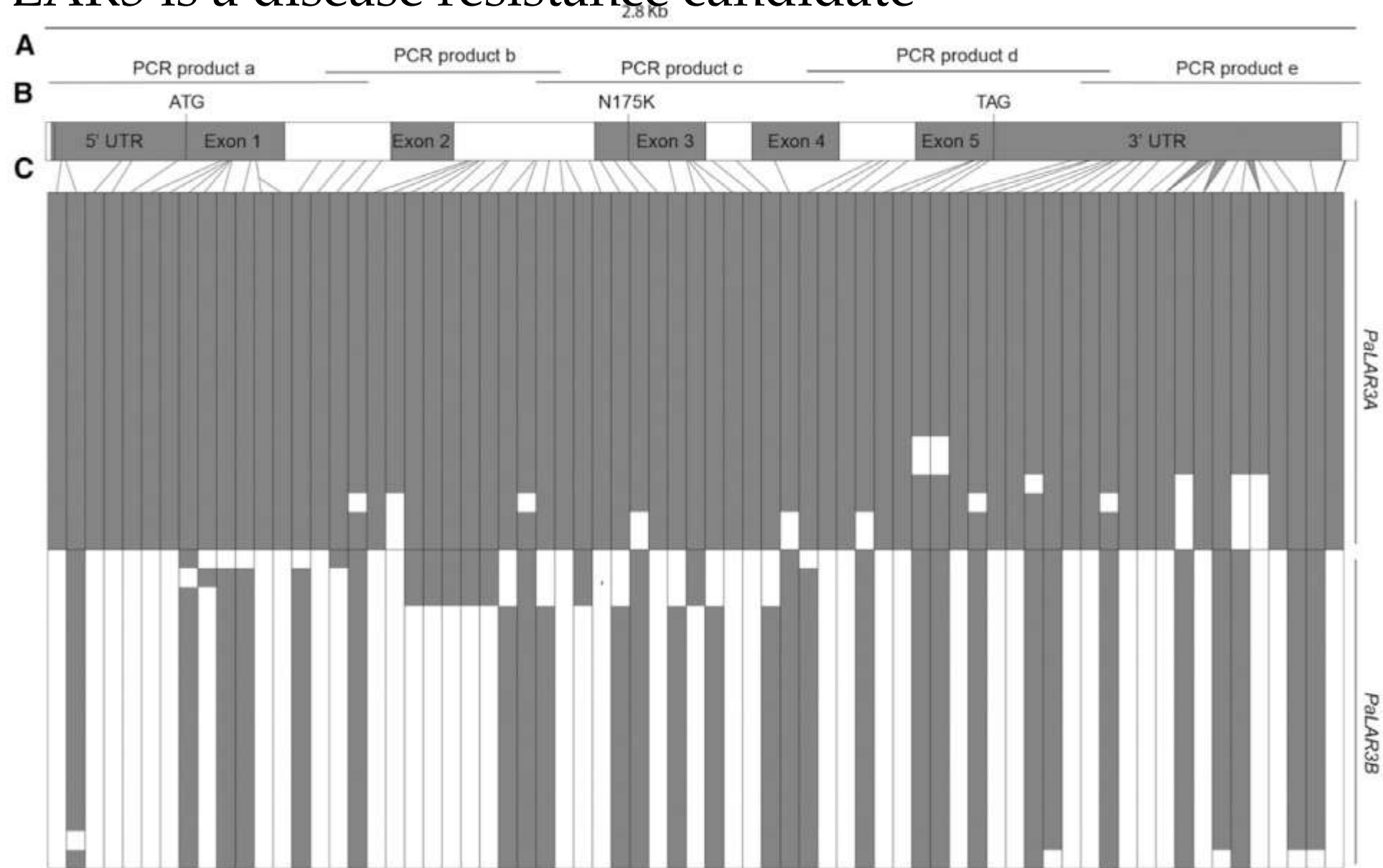
## Genes in conifers generally...

- Low linkage disequilibrium (Larsson et al. 2013; Nysted et al. 2013)
- Large introns (Nysted et al. 2013)
- Excess of rare alleles (Holliday et al., 2010; Larsson et al., 2013; Namroud et al., 2010b)
- Largely conserved in sequence variation and gene expression (Pavy et al. 2013; Yeaman et al. 2014a)

- **Strong** linkage disequilibrium between SNPs



# LAR3 is a disease resistance candidate



# *LAR3* is an outlier!

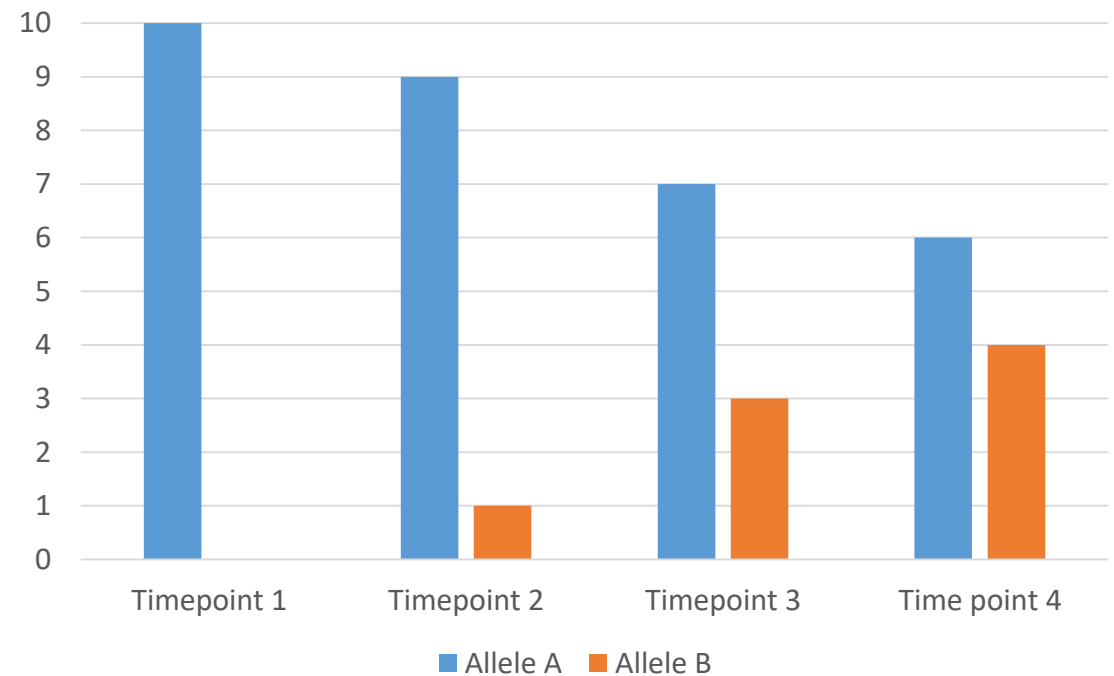
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and seems to be under **balancing selection**

# Is *LAR3* under balancing selection?

- Balancing selection maintains allele frequencies in populations
- It is very common in pathogen – host interactions
  - *MHC* in humans
  - *Rpm1, Rps2, Rps5* in *Arabidopsis* (LRRs)

- Frequency Dependent Selection



# Is *LAR3* under balancing selection?

## MOLECULAR ECOLOGY

Molecular Ecology (2015) 24, 3529–3545

doi: 10.1111/mec.13226

INVITED REVIEWS AND SYNTHESSES

### Detecting balancing selection in genomes: limits and prospects

ANNA FIJARCZYK and WIEŚLAW BABIK

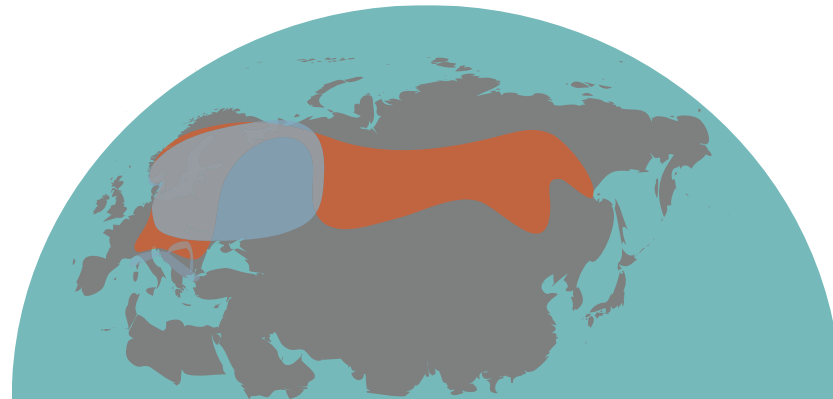
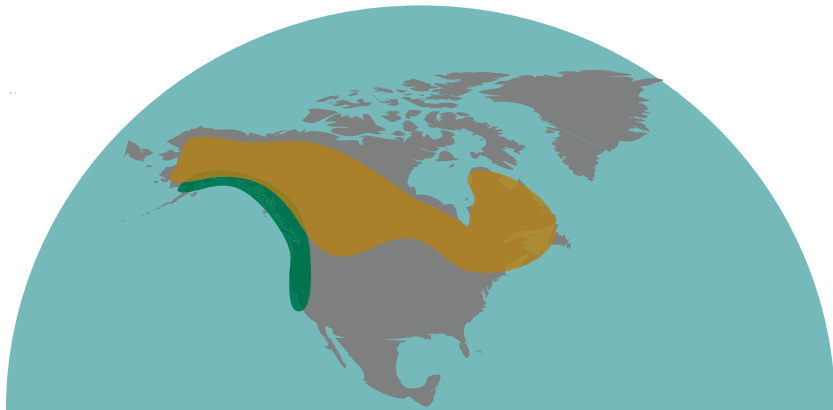
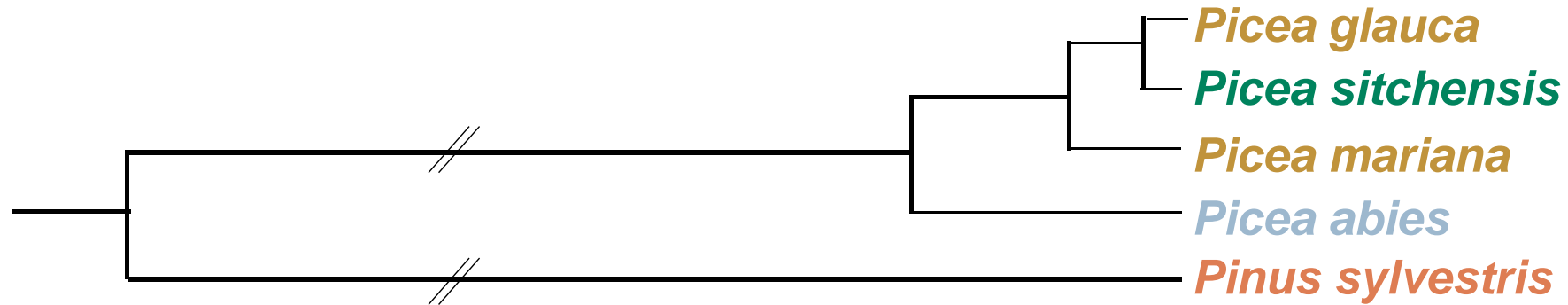
*Institute of Environmental Sciences, Jagiellonian University, Gronostajowa 7, 30-387 Kraków, Poland*

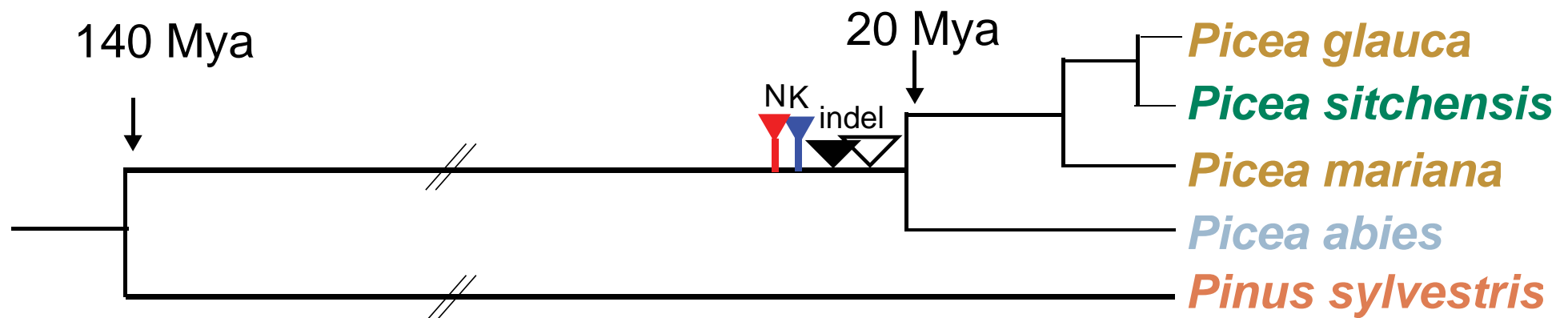
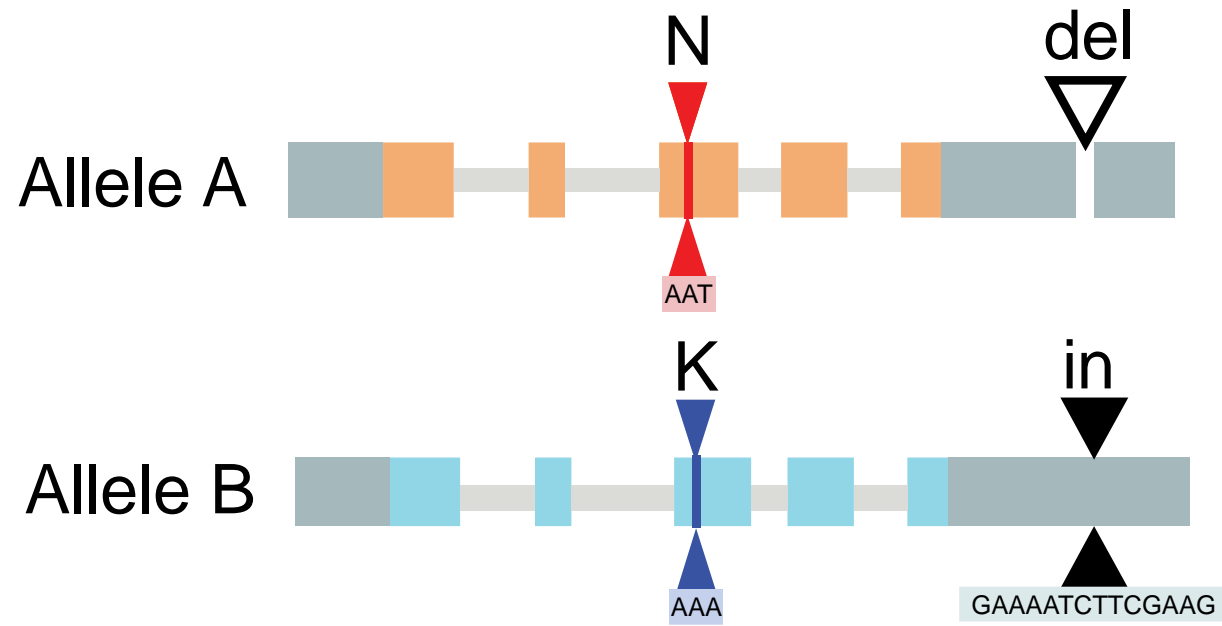
- Shared ancestral polymorphisms
- Fewer alleles at even frequencies
- Extended linkage disequilibrium
- Increased diversity around locus

# Is *LAR3* under balancing selection?



- Shared ancestral polymorphisms
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# Is *LAR3* under balancing selection?





# Is *LAR3* under balancing selection?

- Shared ancestral polymorphisms  Function?
- Fewer alleles at even frequencies
- Extended linkage disequilibrium
- Increased diversity around locus  Work on progress!!!

Is it the same in the other conifers?

# Acknowledgments

## Different Alleles of a Gene Encoding Leucoanthocyanidin Reductase (*PaLAR3*) Influence Resistance against the Fungus *Heterobasidion parviporum* in *Picea abies*<sup>1</sup>

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FORMAS



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Questions?