

# *Searching needles in haystacks* *genomics- and phenomics-based exploitation of wheat* *genetic resources for disease resistance breeding*



# GeneBank2.0: Potential and limits of genomics-informed pre-breeding

## 1. Yield and yield stability

- **Grain yield**
- Yield components
- Winter hardiness
- Lodging resistance
- **Nutrient use efficiency**

## 2. Hybrid seed production

- **Pollination capability**
- Restorer genes

## 3. Disease resistance

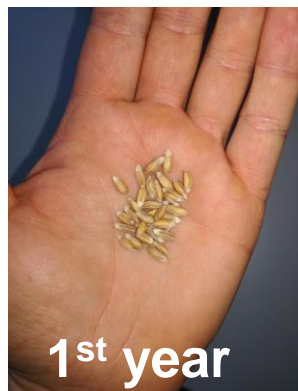
- Septoria tritici blotch
- Fusarium head blight
- **Leaf rust**
- **Powdery mildew**
- **Yellow rust**
- Tan spot
- Eyespot
- Septoria nodorum
- Soil-borne mosaic virus

## 4. Quality

- Ash content
- Flour yield
- Endosperm texture
- Protein content
- Zeleny sedimentation
- Hagberg falling number
- Water absorption
- Dough quality
- Baking volume

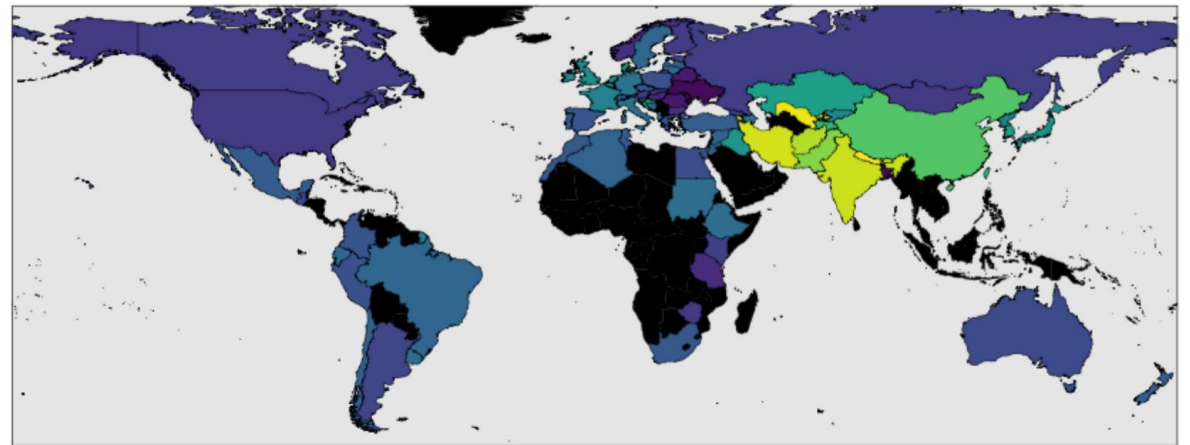
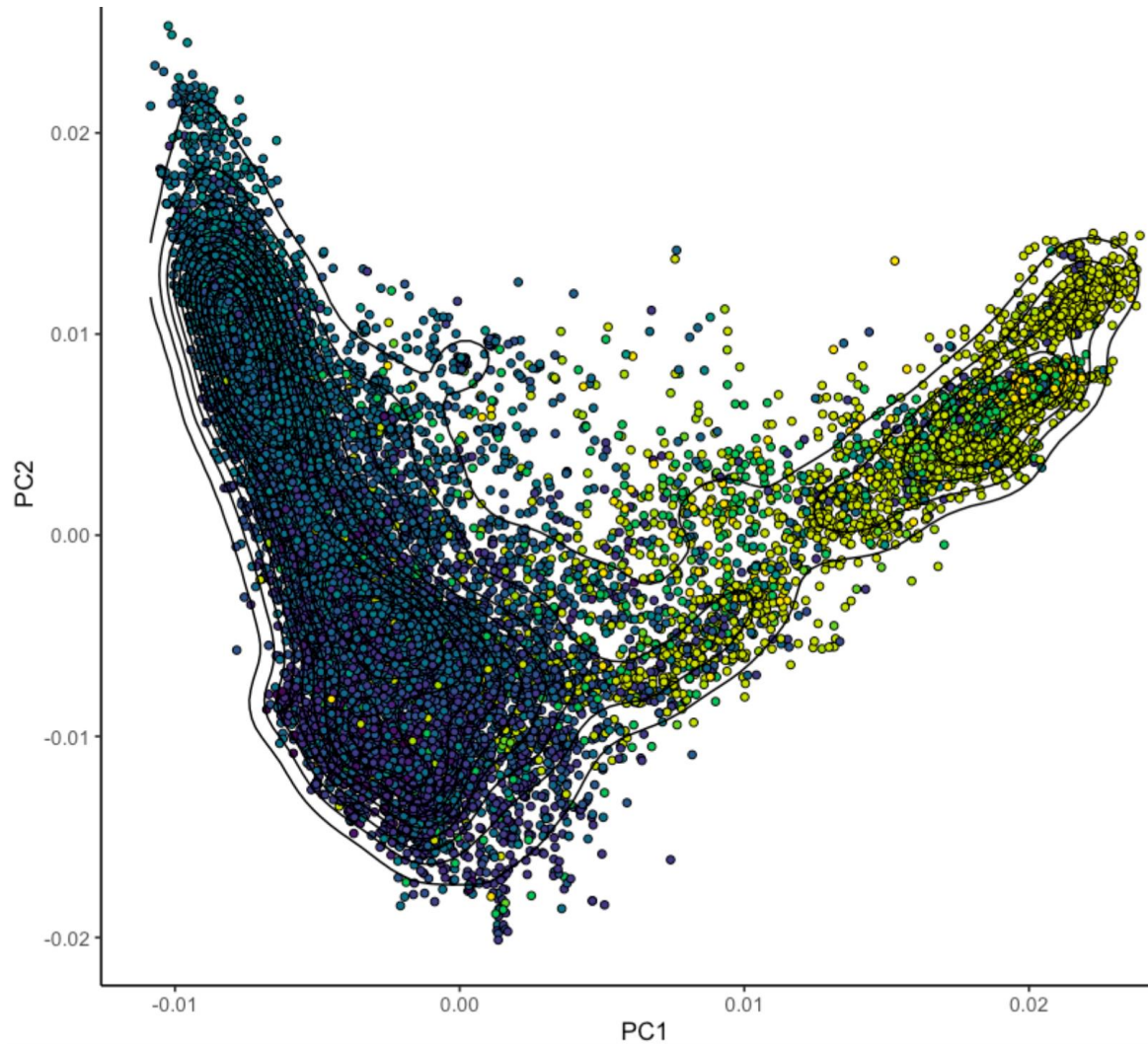


# Challenging logistics to activate an entire collection

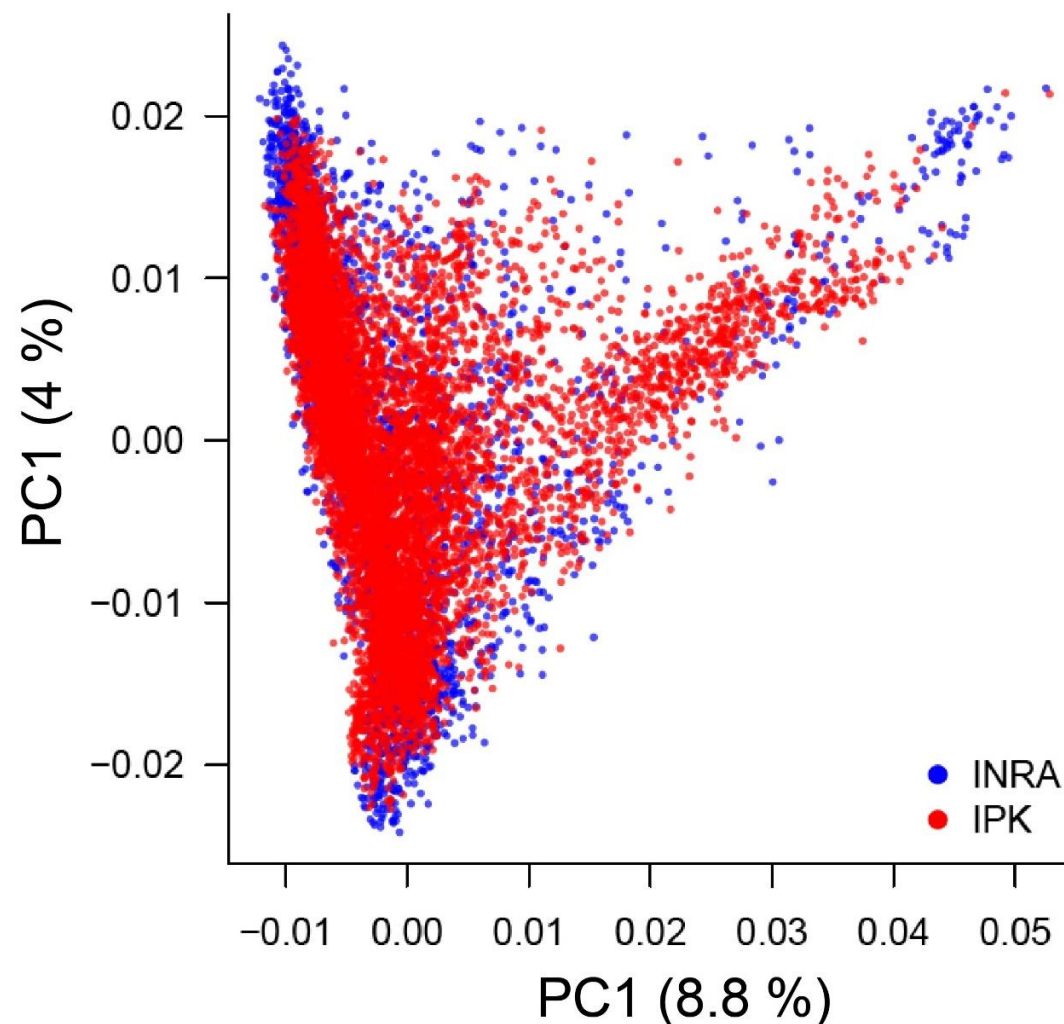




# Genotype atlas for 8,762 winter and 5,861 spring wheat accessions



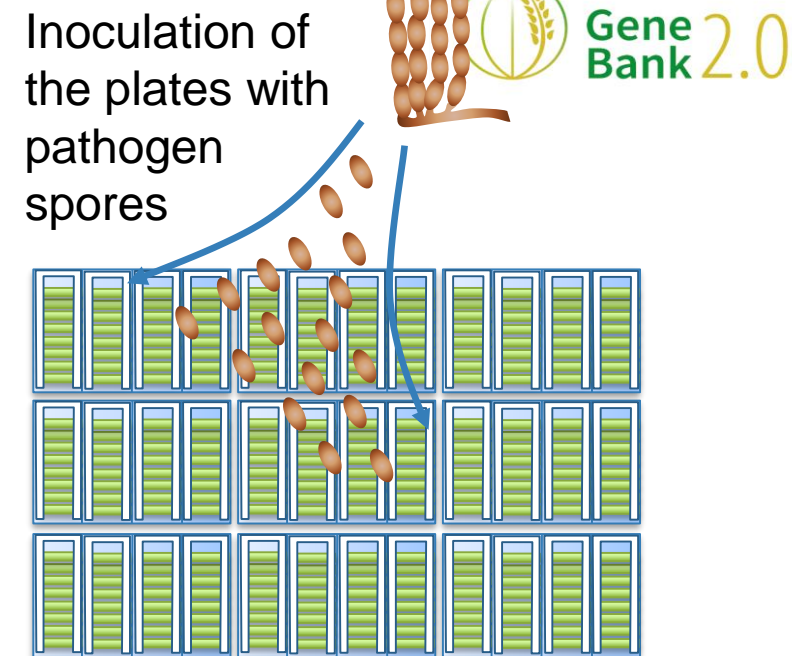
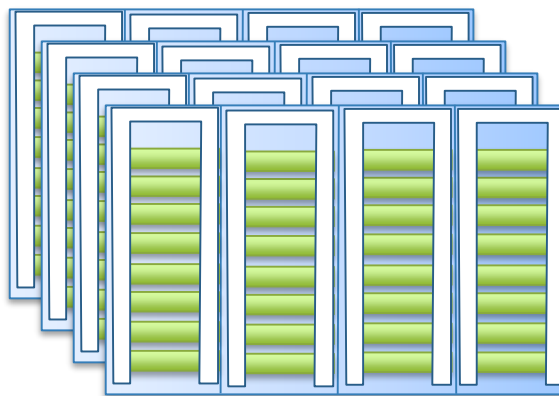
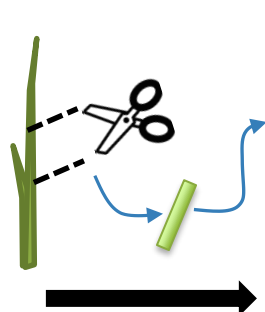
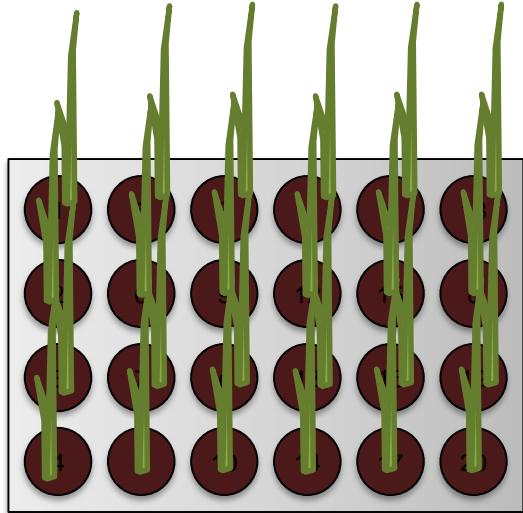
## ... towards a Pan-European genotype atlas





# Disease resistance phenotyping





# Macrophenotyping platform for disease resistance

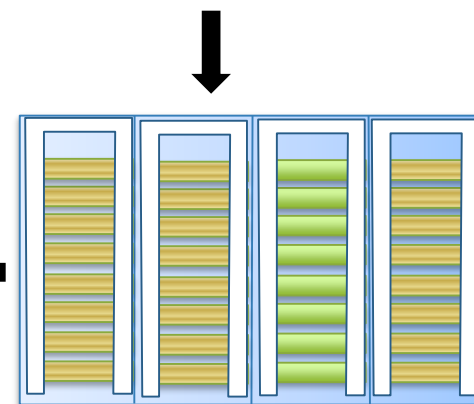
High-throughput genomics



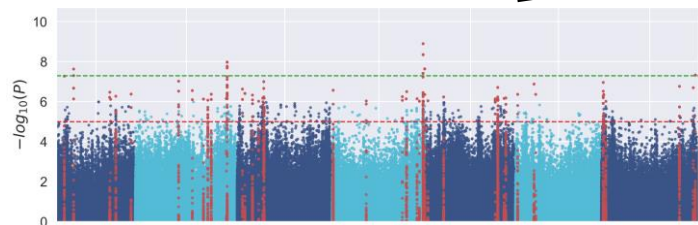
Image analysis server



BluVision Macro  
Macrobot 2.0

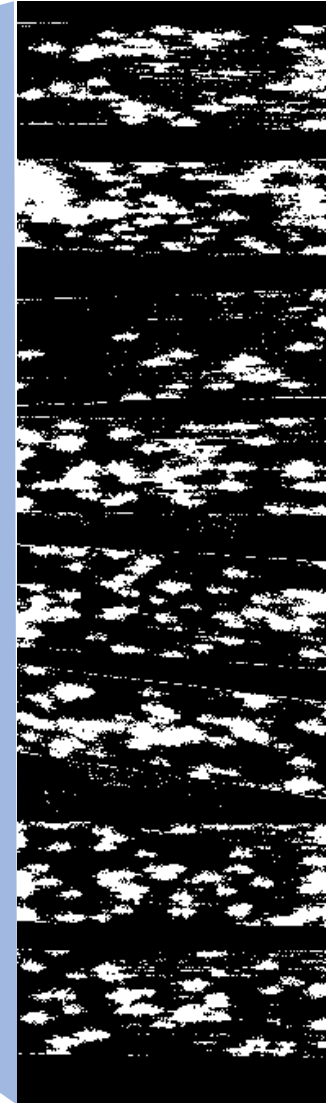
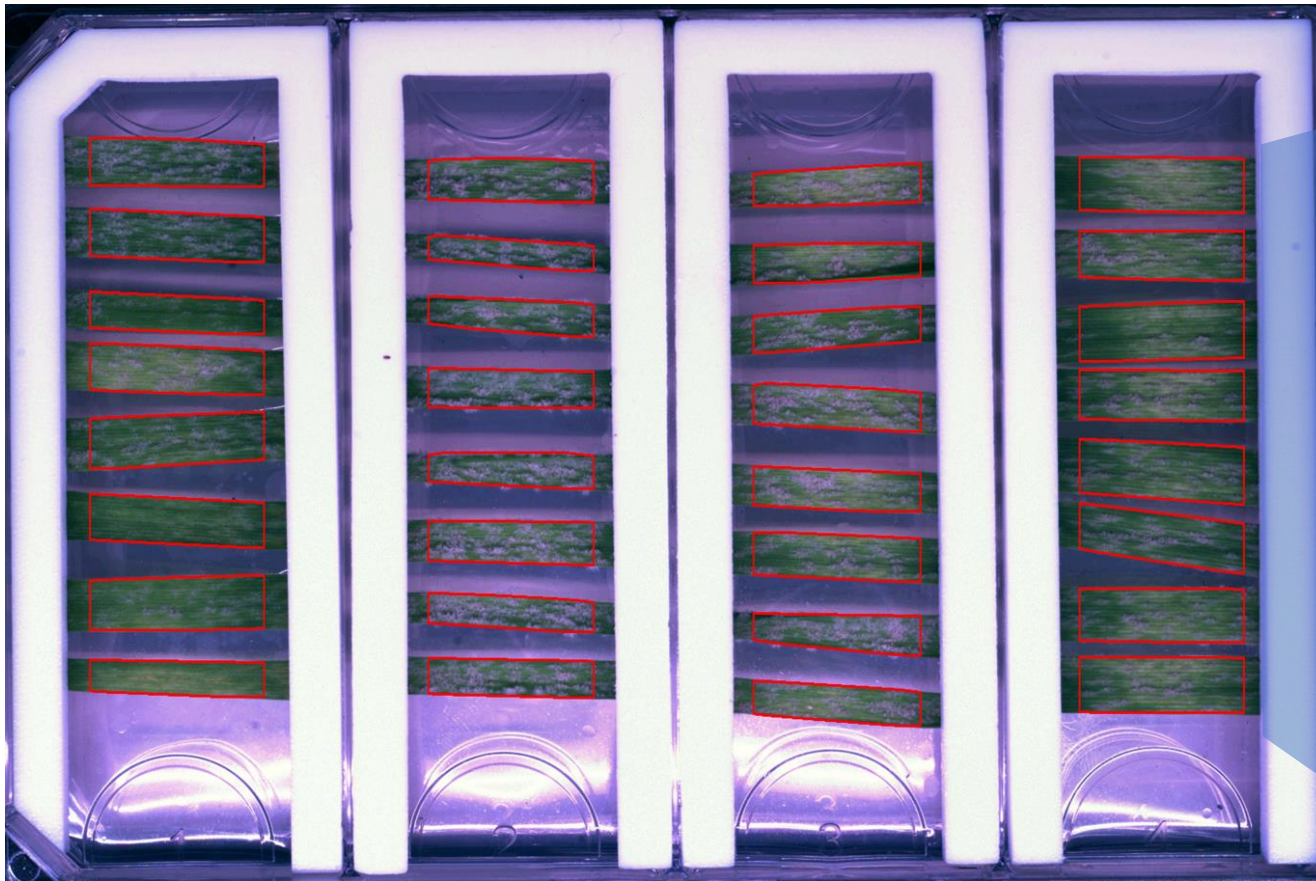


Incubation and pathogen development





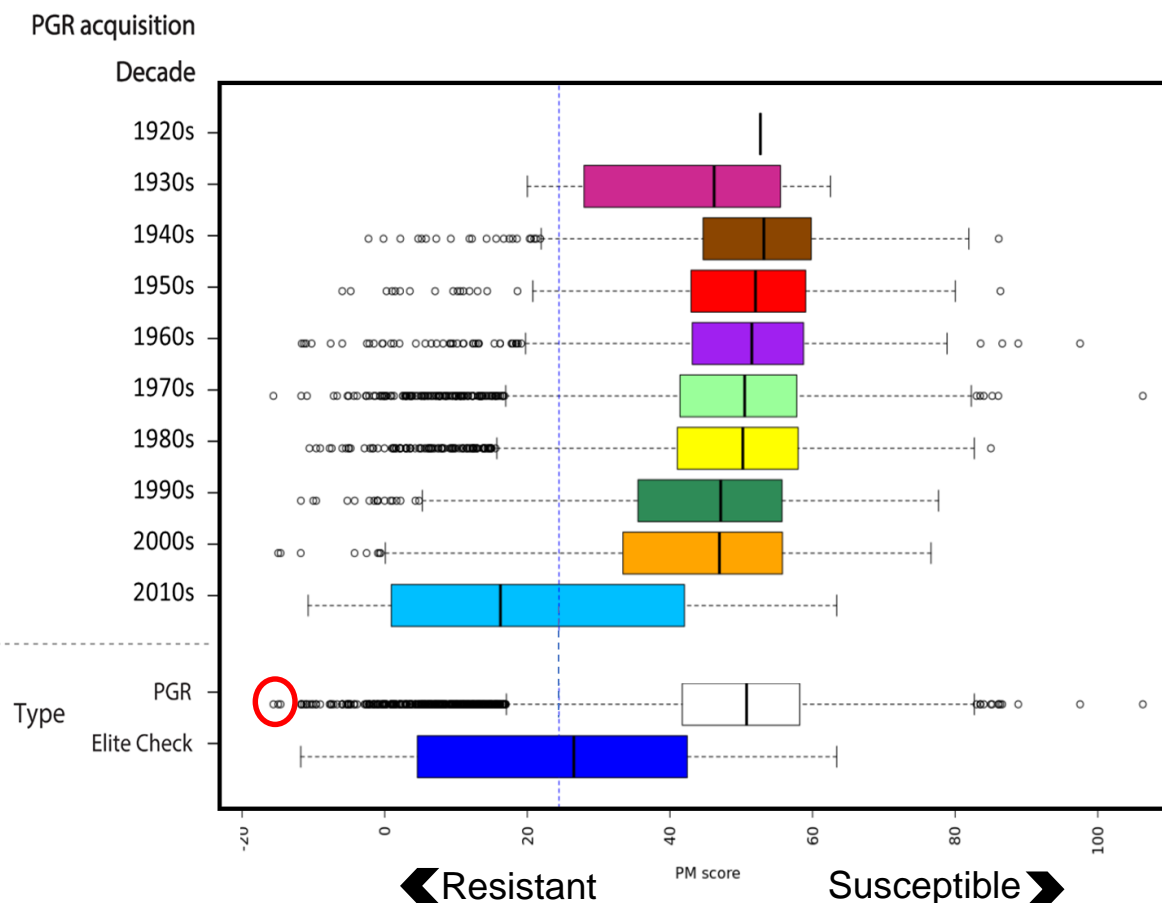
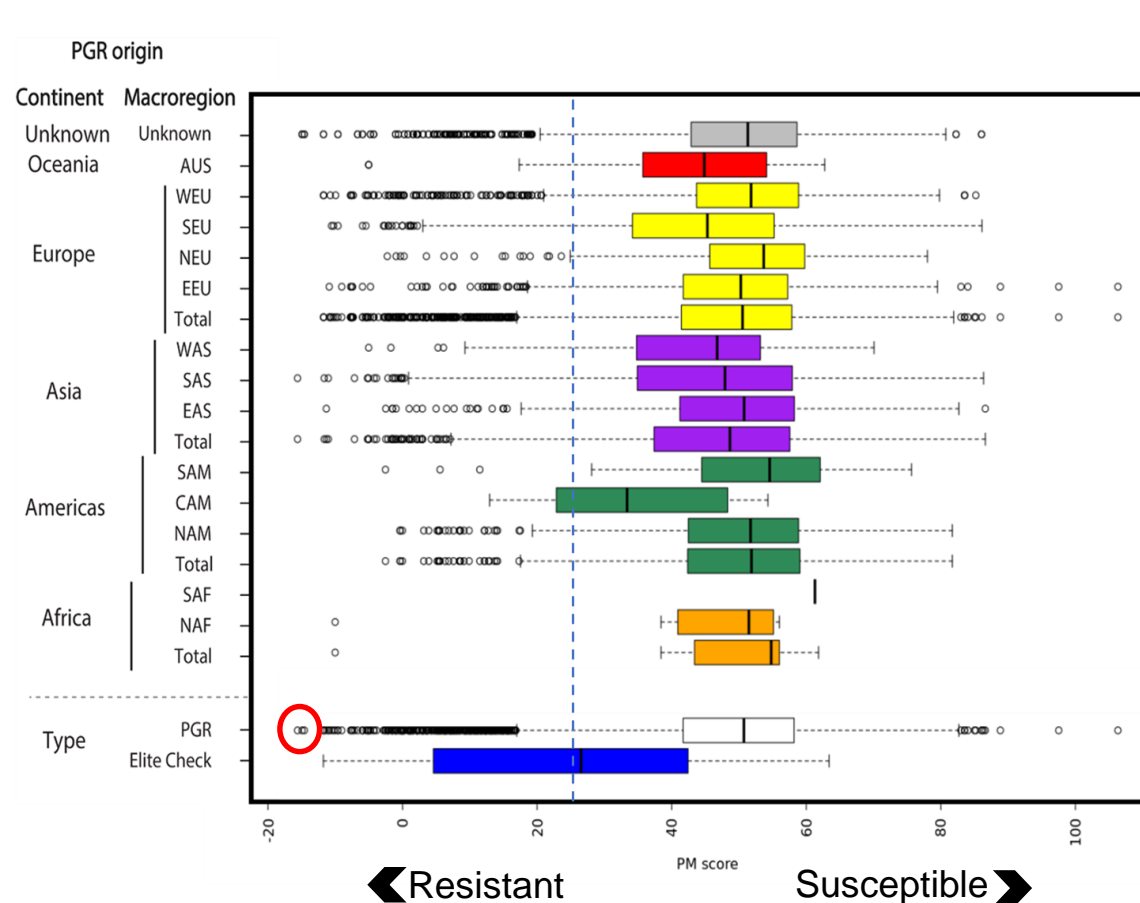
# Precise phenotyping for disease resistance (powdery mildew)





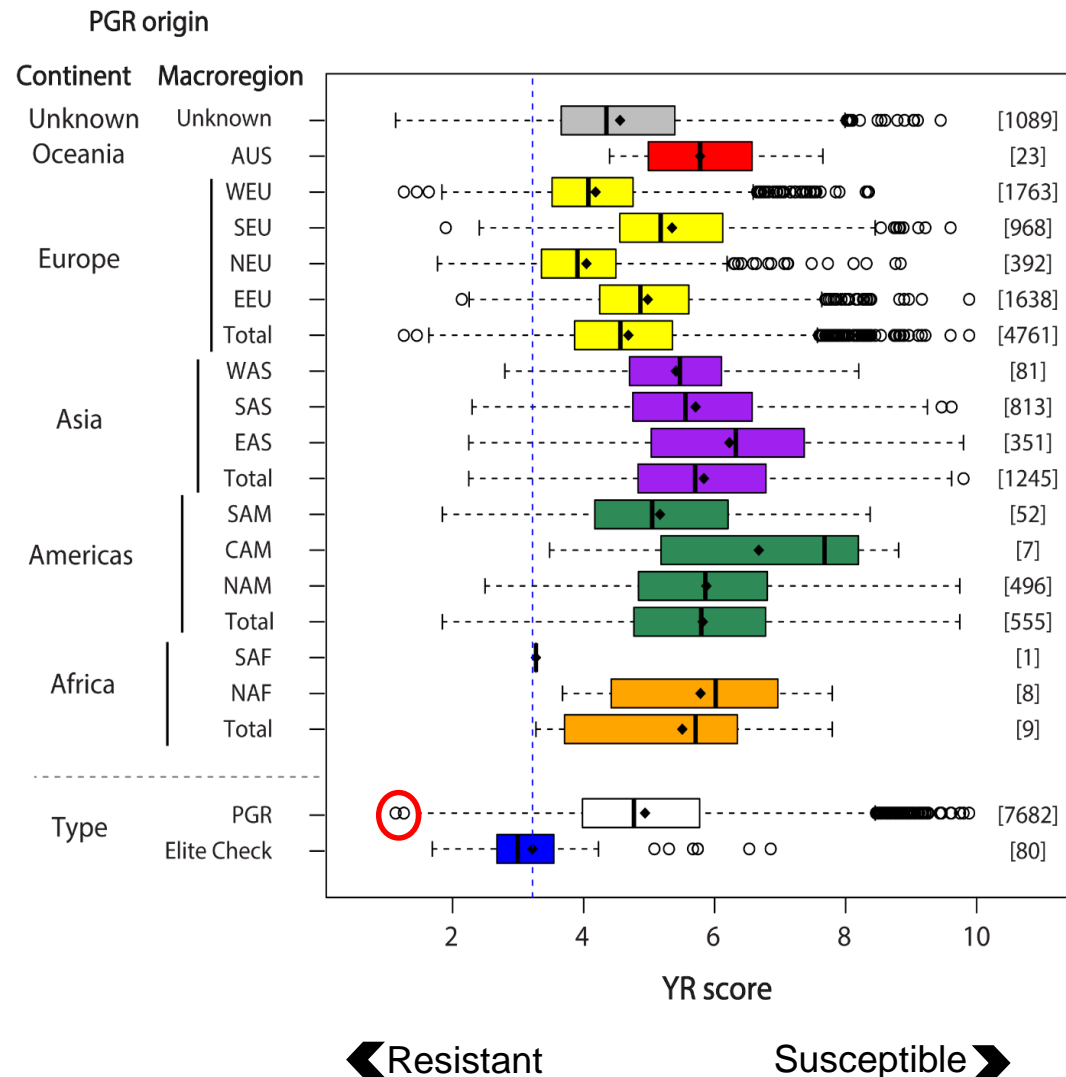
# Searching needles in a haystack

## Spatial and temporal distributions of powdery mildew resistance



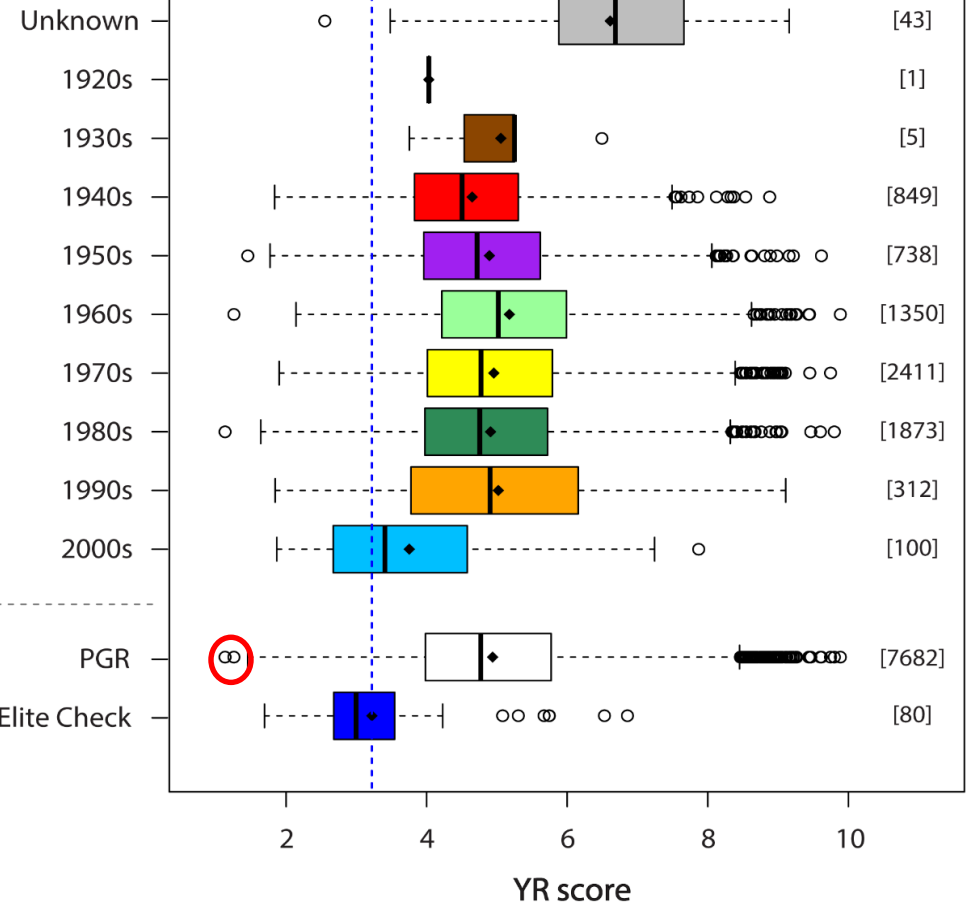
# Searching needles in a haystack

## Spatial and temporal distributions of yellow rust resistance (field data)

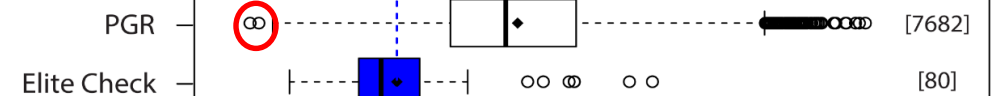


### PGR acquisition

#### Decade

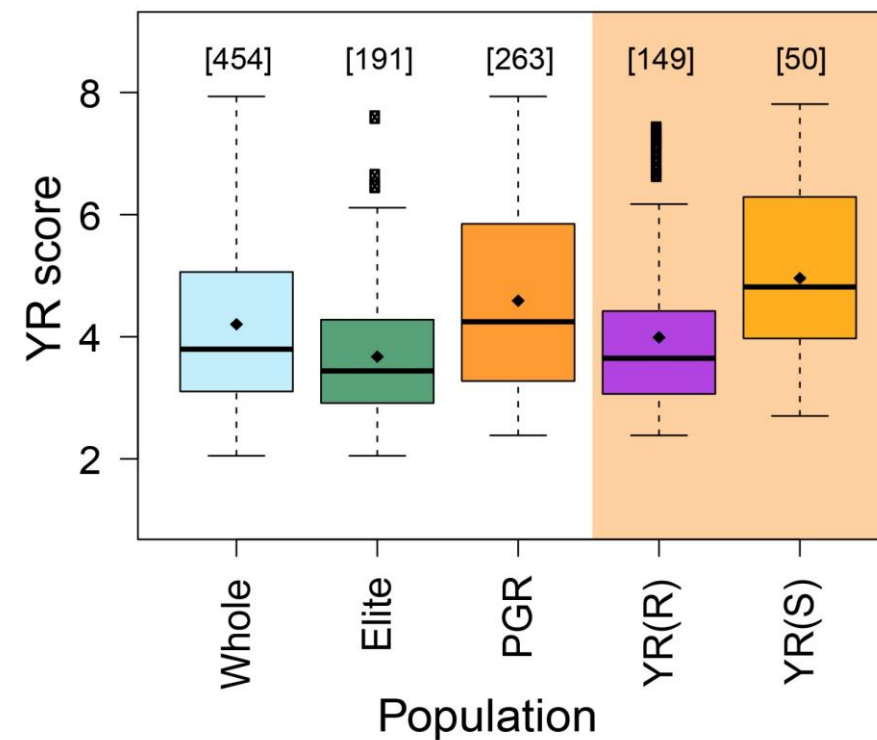
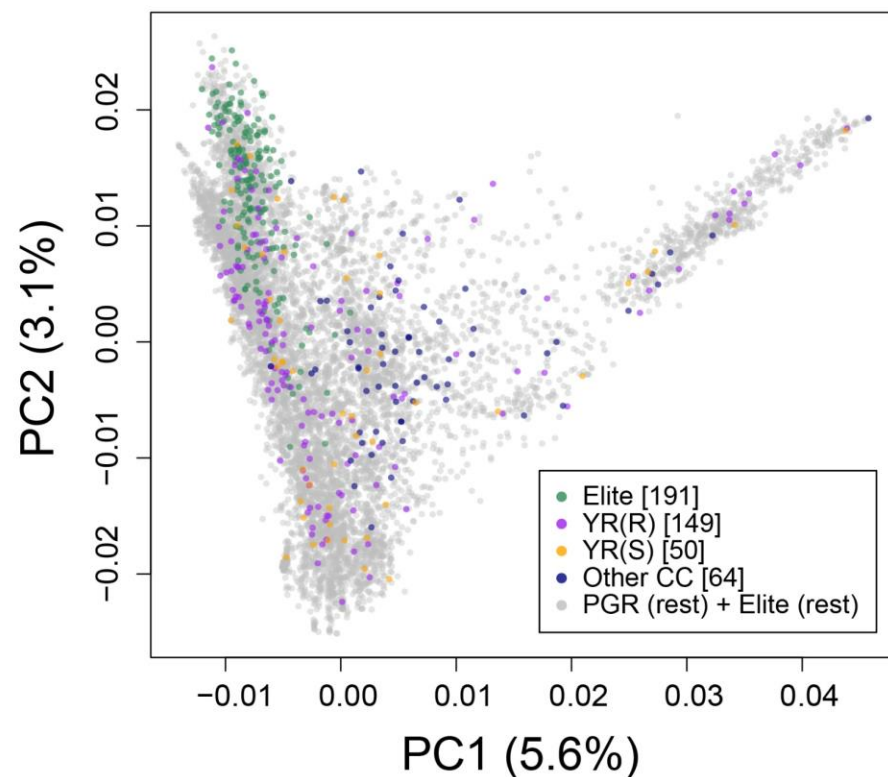


#### Type



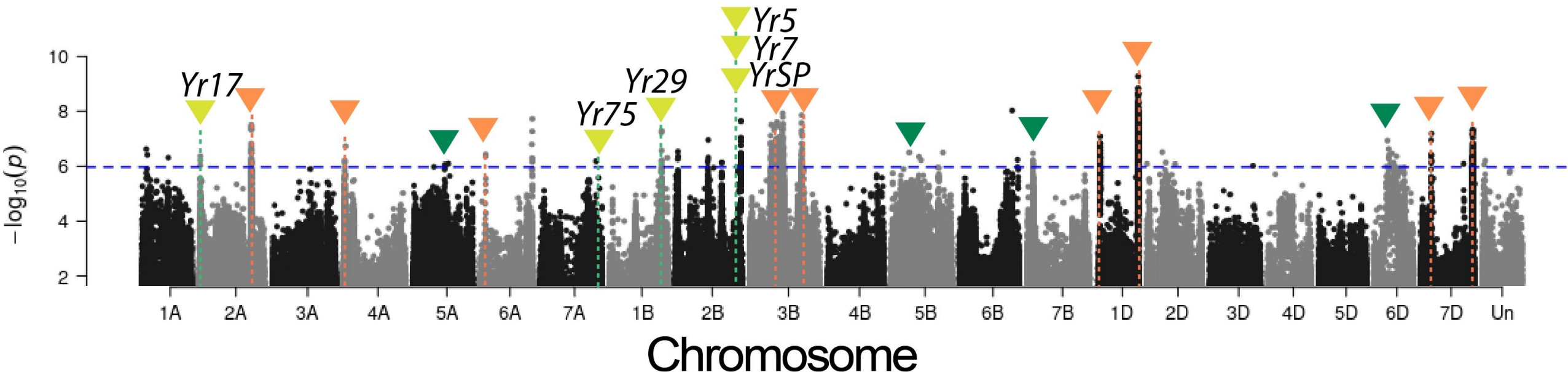


# Designing a trait-customized core collection



# Mining for novel resistance genes




- ▼ Known YR resistance loci
- ▼ Resistance alleles are lost in elite pools
- ▼ Resistant alleles are almost fixed in elites



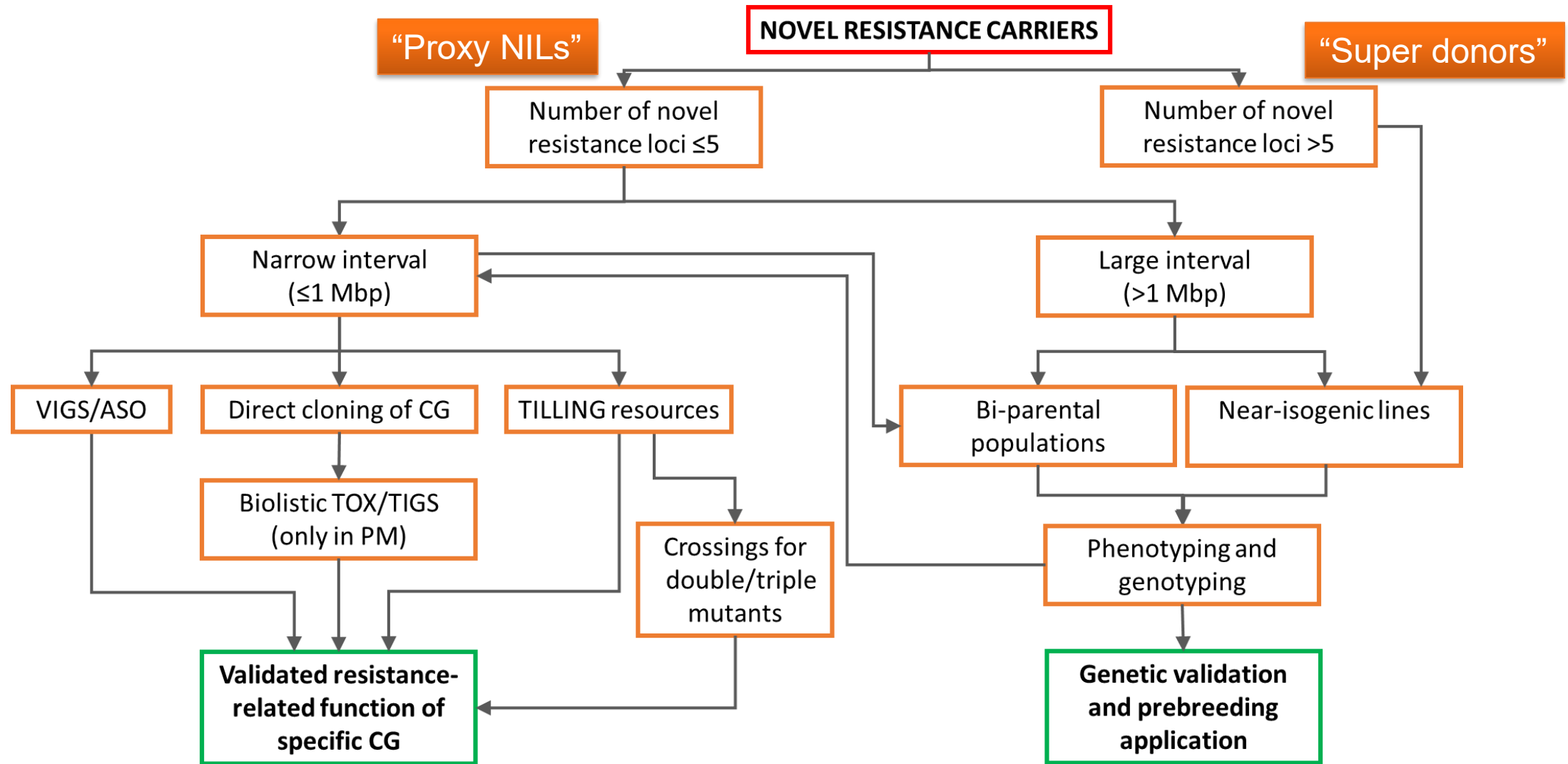


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In publication

## Comparison of chromosomal regions in near-isogenic lines (NILs) harboring known and novel YR genes and loci

-  Introgressions from known resistance donors into the susceptible genetic background.
-  Novel resistance-conferring haplotypes
-  Already cloned *Yr* genes

# Outlook: Resistance gene candidates validation







<https://wheat-dw.ipk-gatersleben.de/>

Test account  
Username: **demo**  
Password: **demo**

For registration  
please contact  
Stefanie Lück  
(lueck@ipk-gatersleben.de)



Home

Shopping cart

Geolocation

Diversity map

Partners

Project details

Impressum

Select Dataset Version: 2019-07-01

Manage shopping cart

Filtered number of accessions: 4049    Number of accessions in shopping cart: 0

Search specific passport fields

Genus: Triticum

Species: aestivum, durum, macha, monococcum

(Part of) subtaxon: convar. macha var. subletshchumicum, subsp. durum convar. durum subconvar. durum var. africanum, subsp. durum convar. durum subconvar. durum var. melanopus, subsp. durum convar. durum subconvar. durum var. murciense

(Part of) the accession name:

(Part of) the accession number:

Country of origin: AFG, ALB, ARG, ARM, AUS

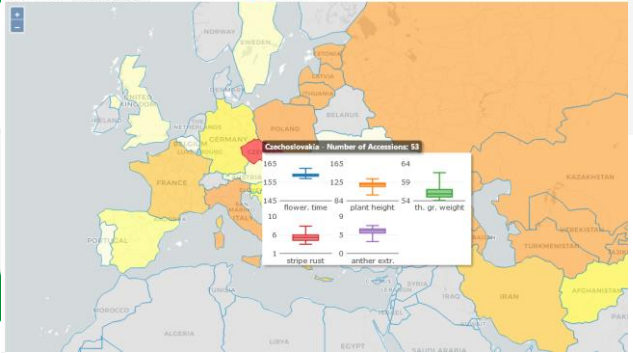
Sample status: Advanced/improved cultivar, Breeder's line, Breeding/research material, Hybrid

Currently visualised number of accessions: 297

Select Mode (Shift + Click): Multi

Select Plot Mode: Box-Whisker-Plot

Activate former countries: Union of Soviet Socialist Republics, Yugoslavia, Czechoslovakia



Czechoslovakia: Number of Accessions: 53

flower time: 165, 155, 125, 64

plant height: 145, 64, 59, 54

th. gr. weight: 10, 8, 3, 0

stripe rust: 1, 0, 0, 0

anther extr.: 1, 0, 0, 0

SNP matrix: Imputed

Color-blind mode

Pos: 21,098,868    180,001,866

Zoom level: 100%

SNP View

Chr: 1A

Reference Genome

Features

Stand

No features found in this area

TR\_1, TR\_2, TR\_3, TR\_4, TR\_5, TR\_6, TR\_7, TR\_8, TR\_9, TR\_10, TR\_11, TR\_12, TR\_13, TR\_14, TR\_15, TR\_16, TR\_17, TR\_18, TR\_19, TR\_20, TR\_21, TR\_22, TR\_23, TR\_24

TRI\_366

TRI\_4668

TRI\_255

# Thank you very much!

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GEFÖRDERT VOM



Bundesministerium  
für Bildung  
und Forschung



**Plant Breeding Research for the Bioeconomy**

