Introduction of tolerance to barley yellow dwarf (BYD) in wheat from exotic genetic resources

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Clermont-Ferrand

Introduction

- Barley Yellow Dwarf (BYD)
  - Viral disease: BYDV
  - Transmission through aphids
    - *Rhopalosiphum padi*
    - *Sitobion avenae*
- Irreversible damages:
  - Yield loss 5-100%
    - Average 3t/ha in barley
  - Affects quality of barley

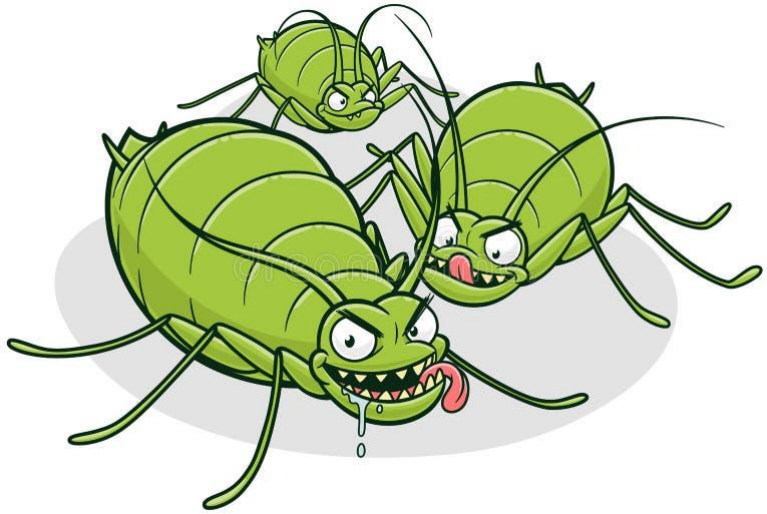
Introduction

- Current solutions
  - No treatment against virus but against aphids
  - Seed treatment
    - Efficient until 5-leave stage
  - Treatment during vegetative phase
    - Three weeks of persistency
    - Efficient through contact only = not efficient on new leave

➔ **Constant survey especially for early sowing**

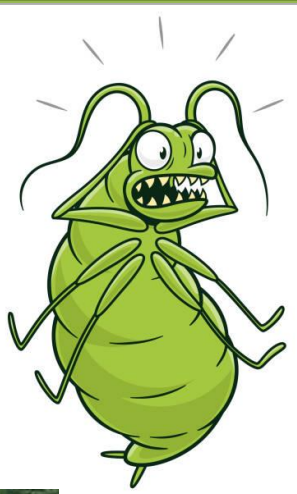
Introduction

- Problems
  - Reduction of the use of pesticides (EcoPhyto plan)
  - Global warming ➔ longer period of aphid survival



Introduction

- Solutions
  - Destruction of aphids' reservoirs
  - Modification of sowing dates
  - Development of tolerant varieties



Introduction

- Sources of tolerance = related species
  - *Thinopyrum intermedium*
    - Diploid ➔ Decaploid
  - *Agropyron cristatum*
    - Diploid or Tetraploid
  - Introgressed lines exist

Introduction

- Problems…
  - Exotic varieties / European varieties
    - China, Australia
  - Addition / substitution / translocation
    - Large fragments ➔ linkage drag
- Need to develop a material better adapted
  - Reduction of the size of fragments
  - In European elite lines

Introduction

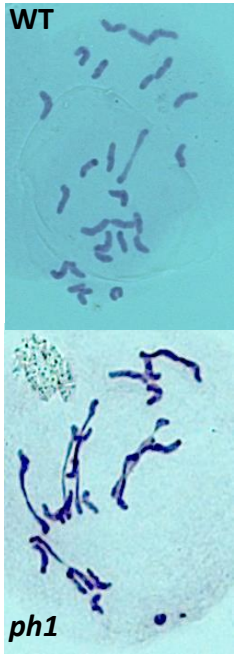
- To achieve these two objectives…
  - Pairing between homoeologous chromosomes from relatives
  - Efficient homoeologous recombination
- Control of pairing & homoeologous recombination in wheat
  - *Ph1* & *Ph2* ➔ mutants
    - Increase homoeologous recombination 1 ➔ 7 COs
    - In Cadenza (JIC)

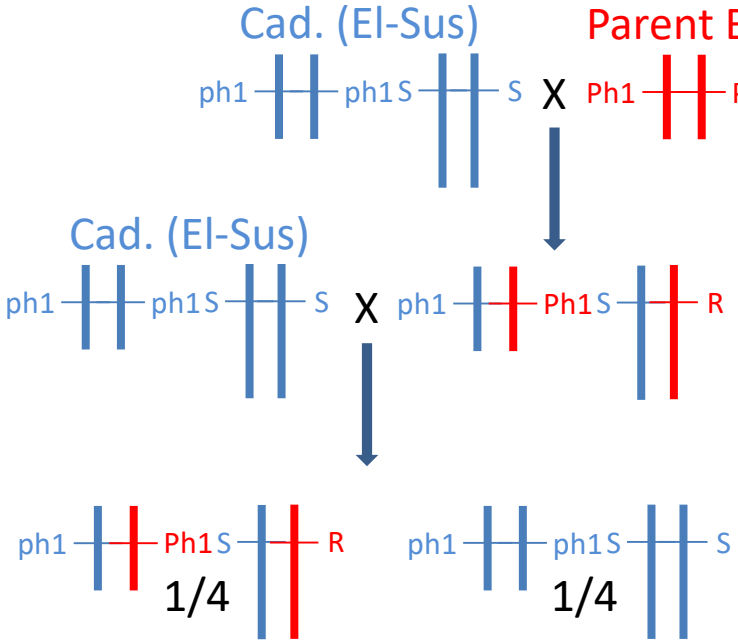
Genetic material

- *Ph1* mutants
  - Cadenza0348 & Cadenza1691 (JIC)
- Tolerant varieties
  - Mackellar, Glover (BDV2)
    - Crosses OK
  - P961341, P29 (BDV3)
    - Crosses OK
  - Zhong4, Zhong5 (BDV4)
    - Hybrid necrosis = eliminated
  - OK7211542 (?)
    - Octoploid = eliminated

Genetic material

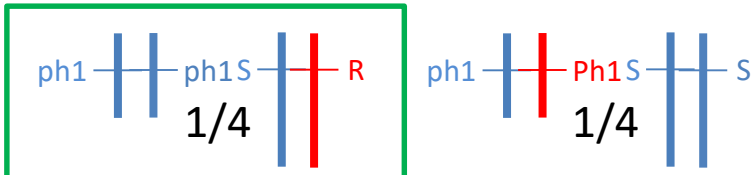
- Development of segregating populations





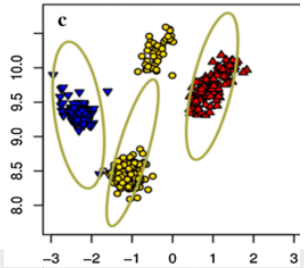
Selfing and speed-breeding
Up to BC1F5

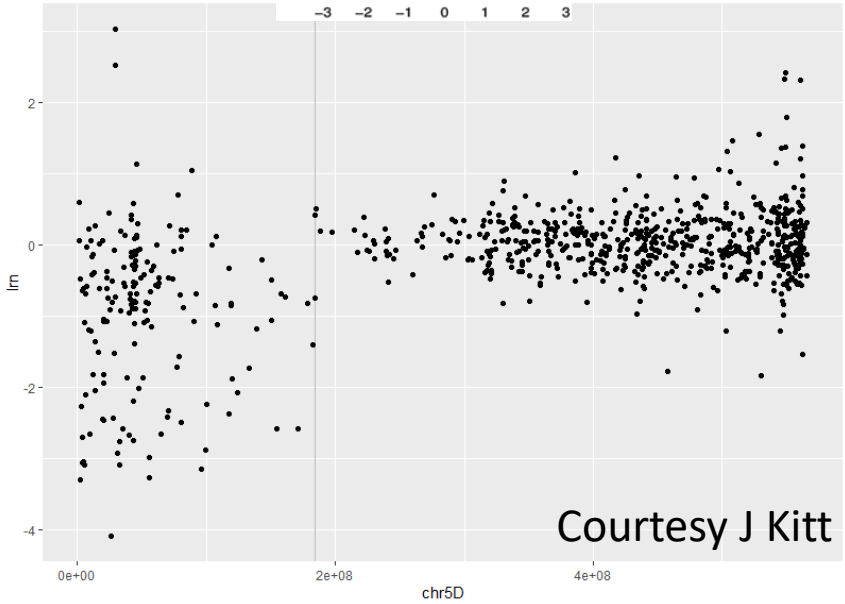
Screening with markers



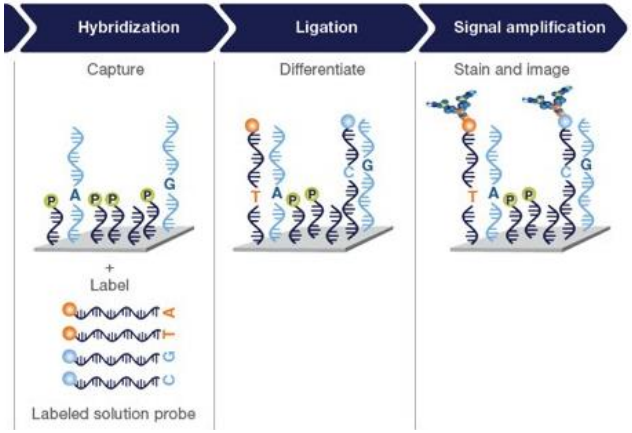
Genotyping of parents and populations using the BW35K AXIOM Array

- Analysis based on Off-Target Variants (OTVs)





Courtesy J Kitt



Applied Biosystems™ Axiom™
384-array layout

Applied Biosystems™ GeneTitan™
Multi-Channel (MC) Instrument

Genotyping of parents and populations using the BW35K AXIOM Array

- Screening of the parents with 35K SNP array

	1	2	3	4	5	6	7
A	P29 (L 10.6)	Glo/P29 (S 2-5) Glo (L 2.8)	P29 (S 18.4)	Glo (S 2.5) P29 (L 31.1)	Mac (S 0.5)	Glo (S 1; L1.8)	P29 (S 3.6)
B	**P96 (S 238.2)**	**P96 (683)**	P29 (S 10.6) P96 (L 3.2)		Glo/Mac (L 13-21)	Glo (L 0.2)	
D	Glo/Mac (L 9.2)	Mac (L 16) **P29 (L 189.5)**		P29 (L 78.7)		P96 (L 28.7)	**P96 (S 51.6)** **Glo (L 477.5)** **Mac (L297.6)** **P96 (L107.6)**

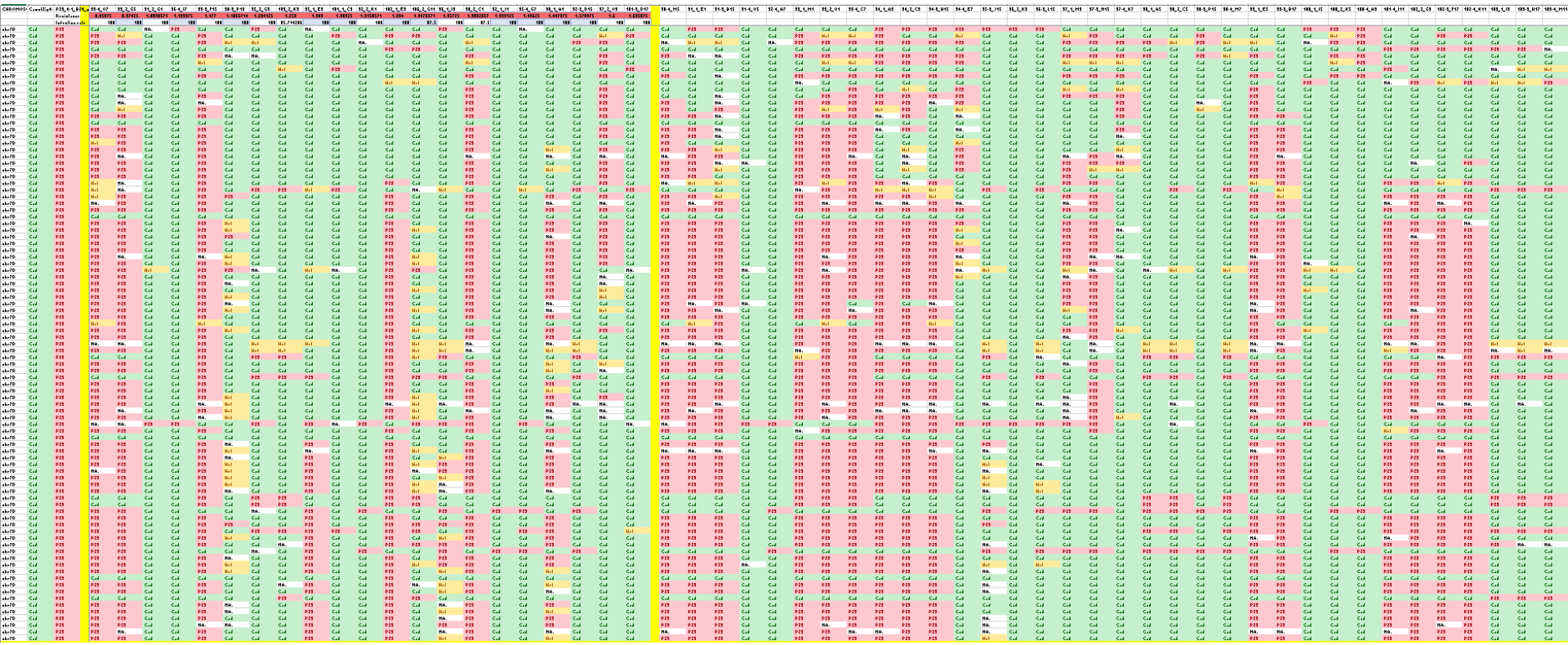
	1	2	3	4	5	6	7
A	Twe (S 5.4)	Twe/Wol (S 24.1)		TC14/Twe (L 18.8)		TC14/Twe (S 4.5)	TC14 (L 11.6)
B	Wol (S 2.8)					**TC14 (678.9)**	
D							**TC14 (L 70.0)** **Wol (L 70.0)** **Twe (L 70.0))**

Genotyping of parents and populations using the BW35K AXIOM Array

- Screening of the parents with 35K SNP array
  - Glover & Mackellar: introgression on 7DL like Wolverine but larger
  - P29 & P961341 retained for further screening

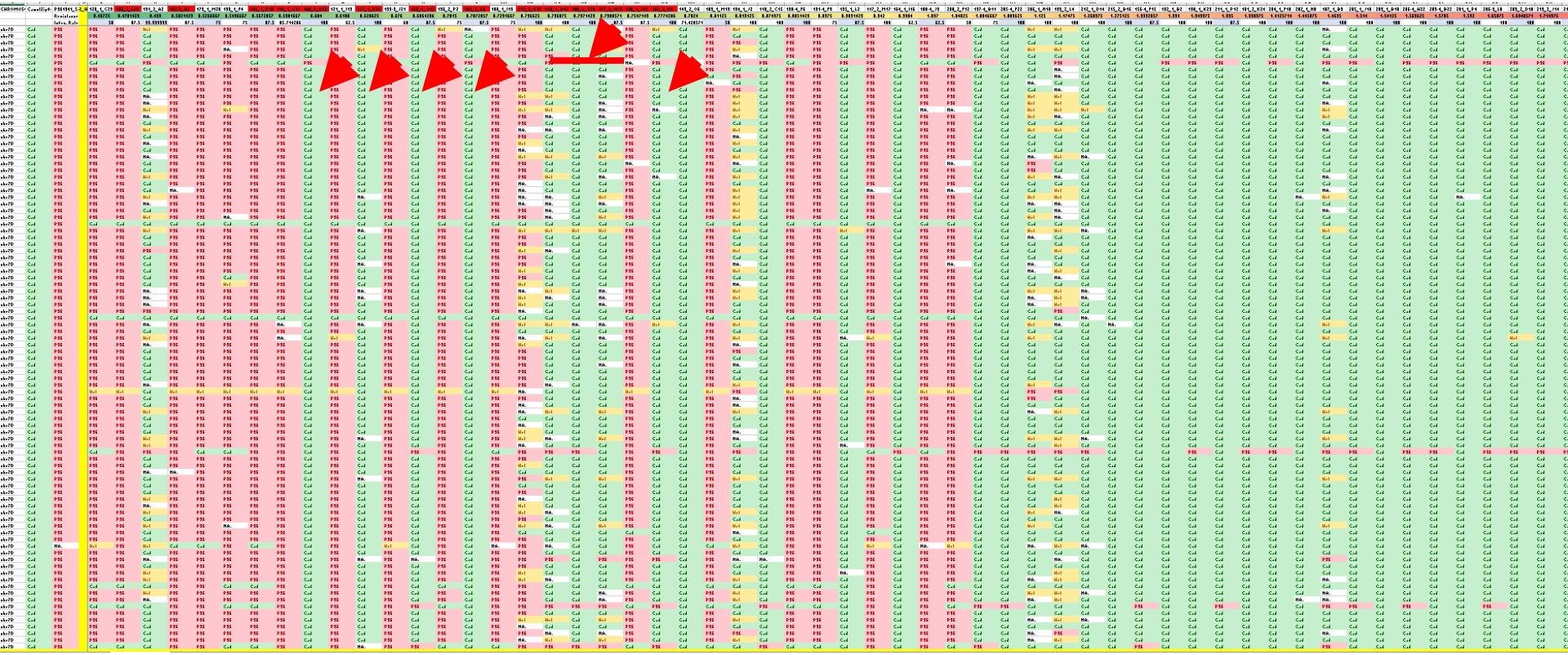
Cadenza x P29, 65 individuals

- P29 population: Chr7DL (BYDV2)



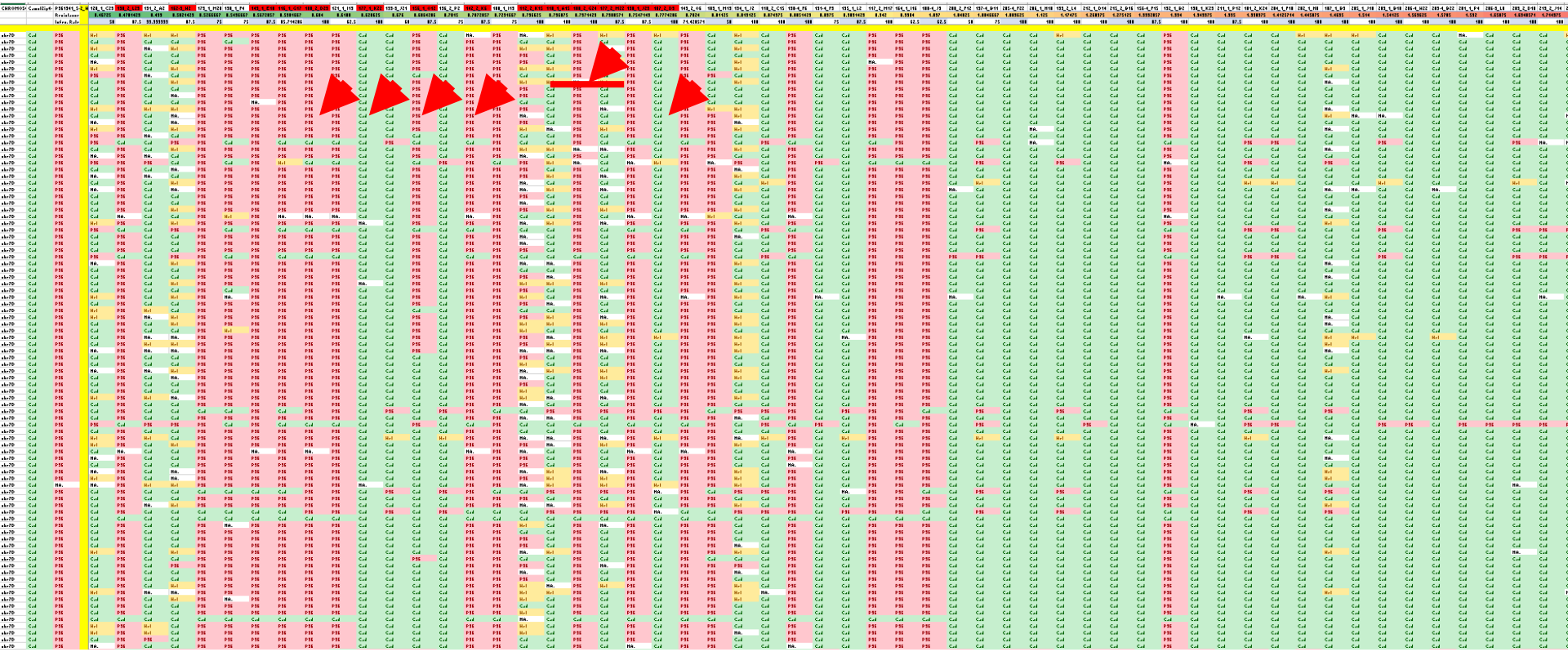
Cadenza x P961341, 695 individuals

- P961341 population: Chr7DL (BYDV2)



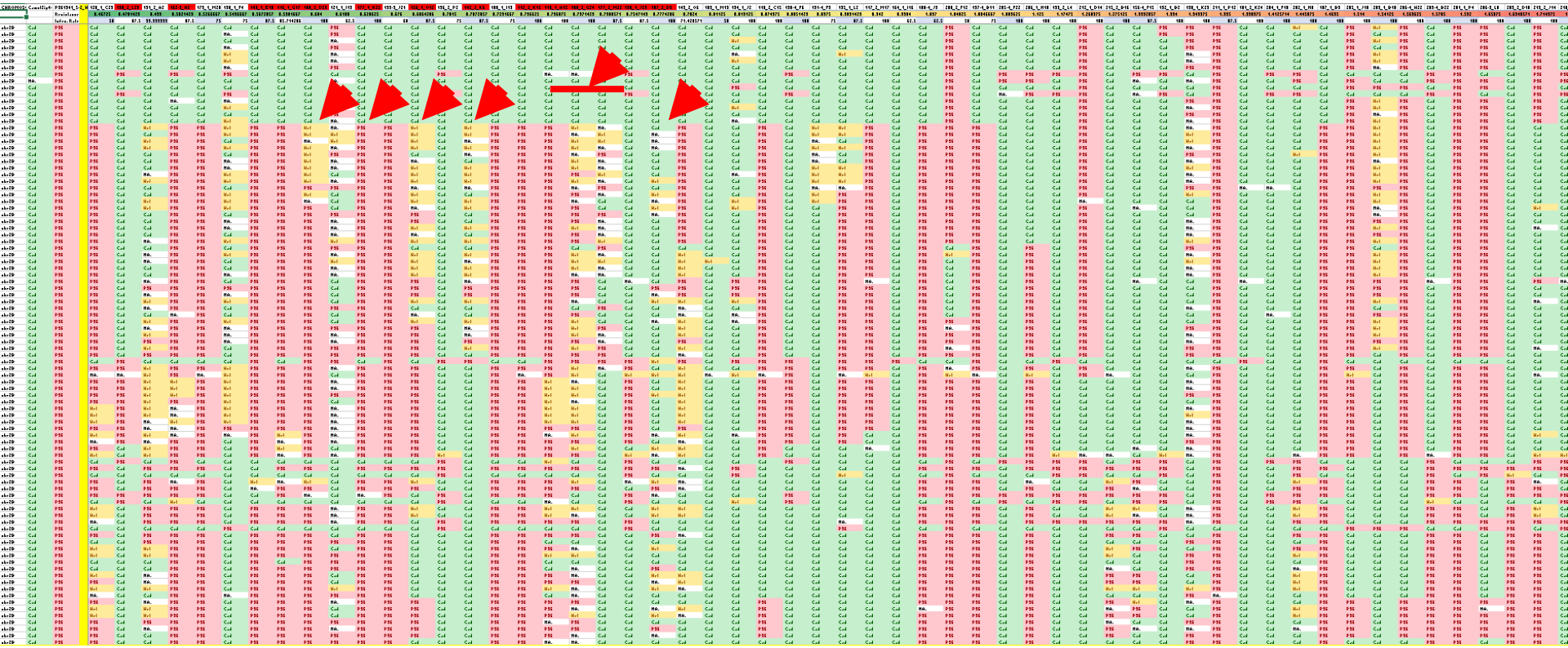
Cadenza x P961341, 695 individuals

- P961341 population: Chr7DS (BYDV3)?



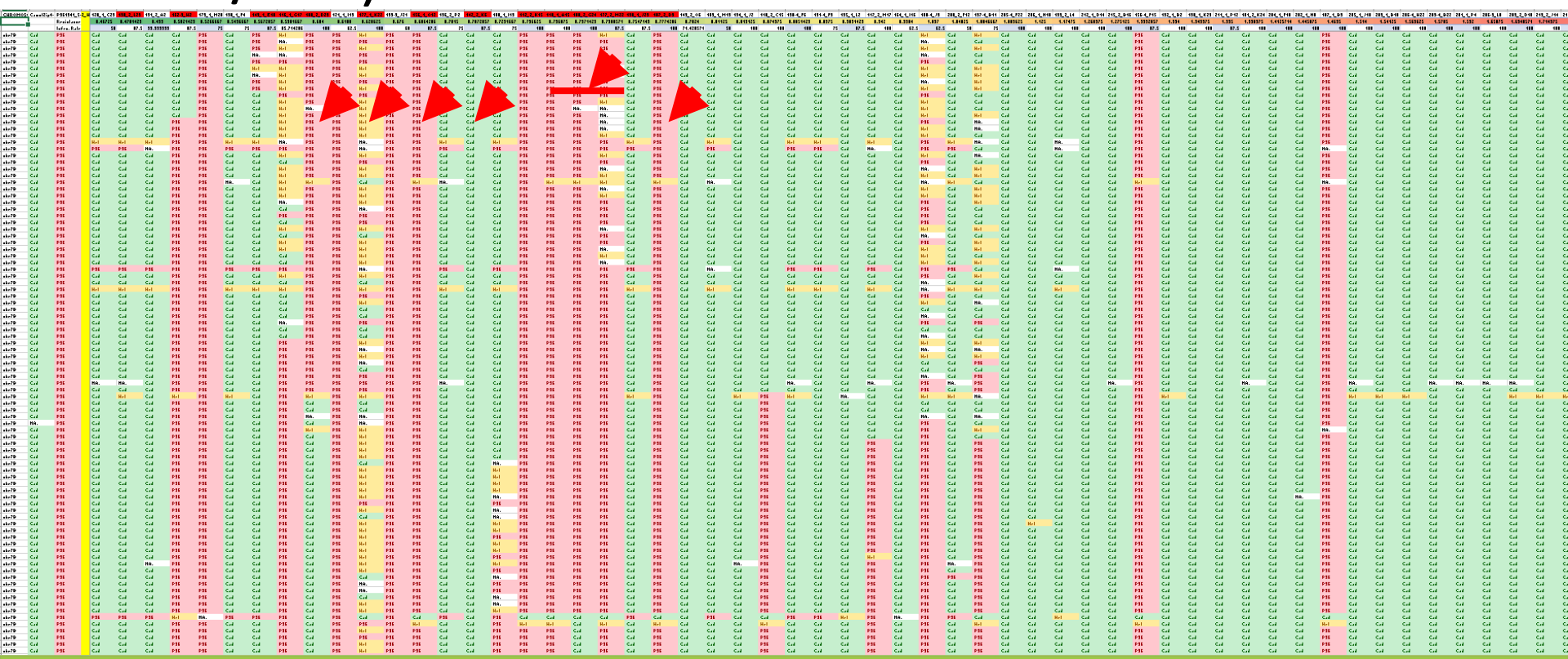
Cadenza x P961341, 695 individuals

- P961341 population: Chr2BL (BYDV4)?



Cadenza x P961341, 695 individuals

- P961341 population: Chr7BL (translocation of 7D/7E?)



Conclusions

- Recombination found between wheat and alien chromosomes → approach using *ph1* mutant is relevant to reduce the size of introgressions
- Population derived from P29
  - No highly-tolerant lines
  - Different sources of P29?
- Population derived from P961341
  - More lines with good tolerance
  - Several loci may affect BYDV tolerance
    - 7DL = BYDV2
    - 7DS = BYDV3?
    - 2BL = BYDV4?
    - 7BL = translocation from 7D/7E (BYDV2)?

Acknowledgements

FSOV

CETAC

ASUR plant. breeding

KWS

SEMENCES Lemaire Deffontaines SÉLECTIONNEUR OBTENTEUR

Lidea FRESH IDEAS FOR

DSV

SECOBRA recherches

Genetics & ReCOmbination

Institut Genech

JKI Julius Kühn-Institut

Thank you for your attention!

Co-immunolocalization of ZYP1 and ASY1 proteins onto *T. aestivum* chromosomes (B. Darrier (INRAE GDEC Clermont-Ferrand France) & I. Colas (JHI Dundee UK), unpublished results)