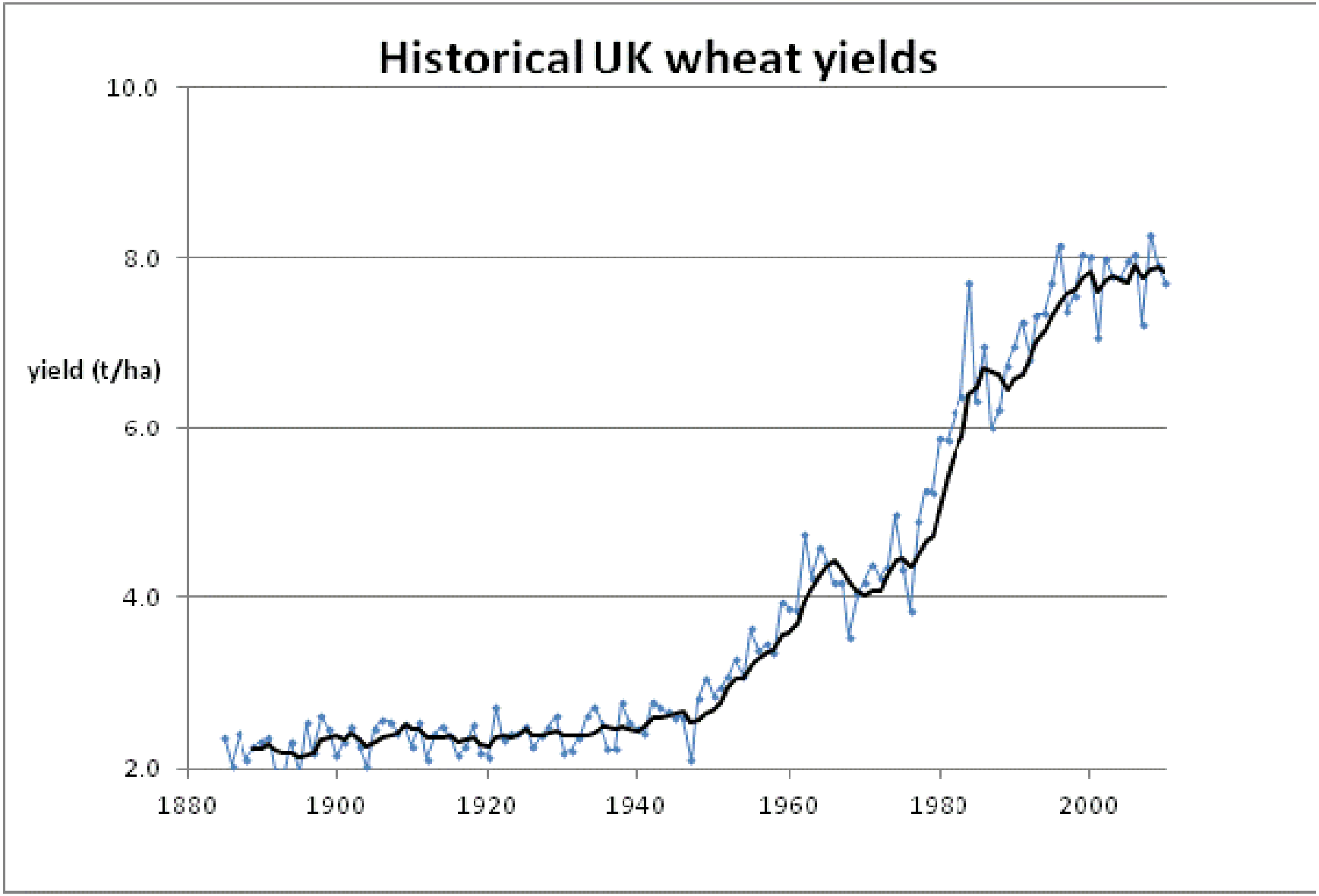
MAGIC wheat in the UK: not just for mapping

Agricultural context
Construction
Derivation of inbred lines
Genetic diversity and LD
Novel phenotypic variation
Selection and breeding

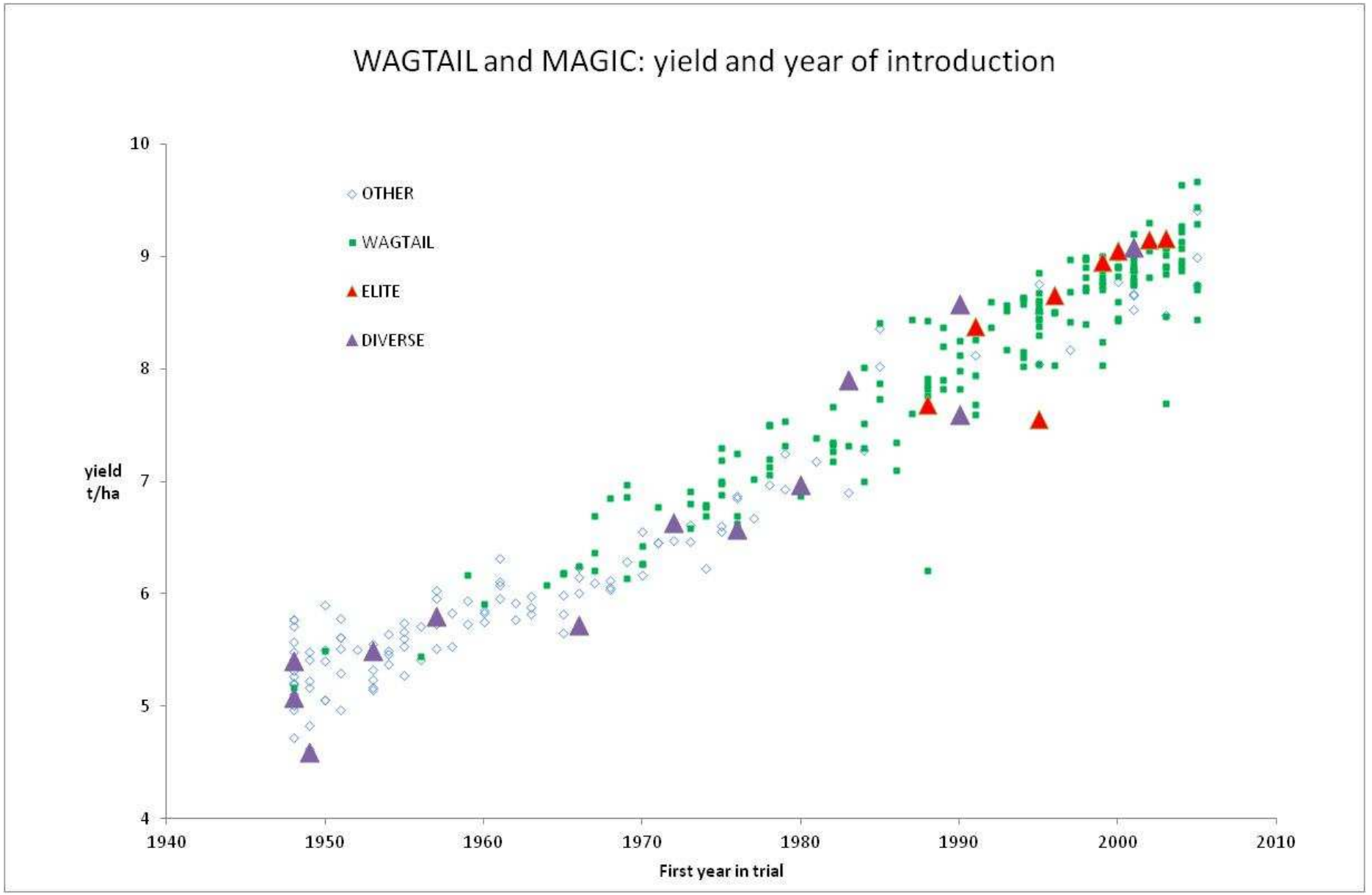
Plant Science into Practice

Ian Mackay



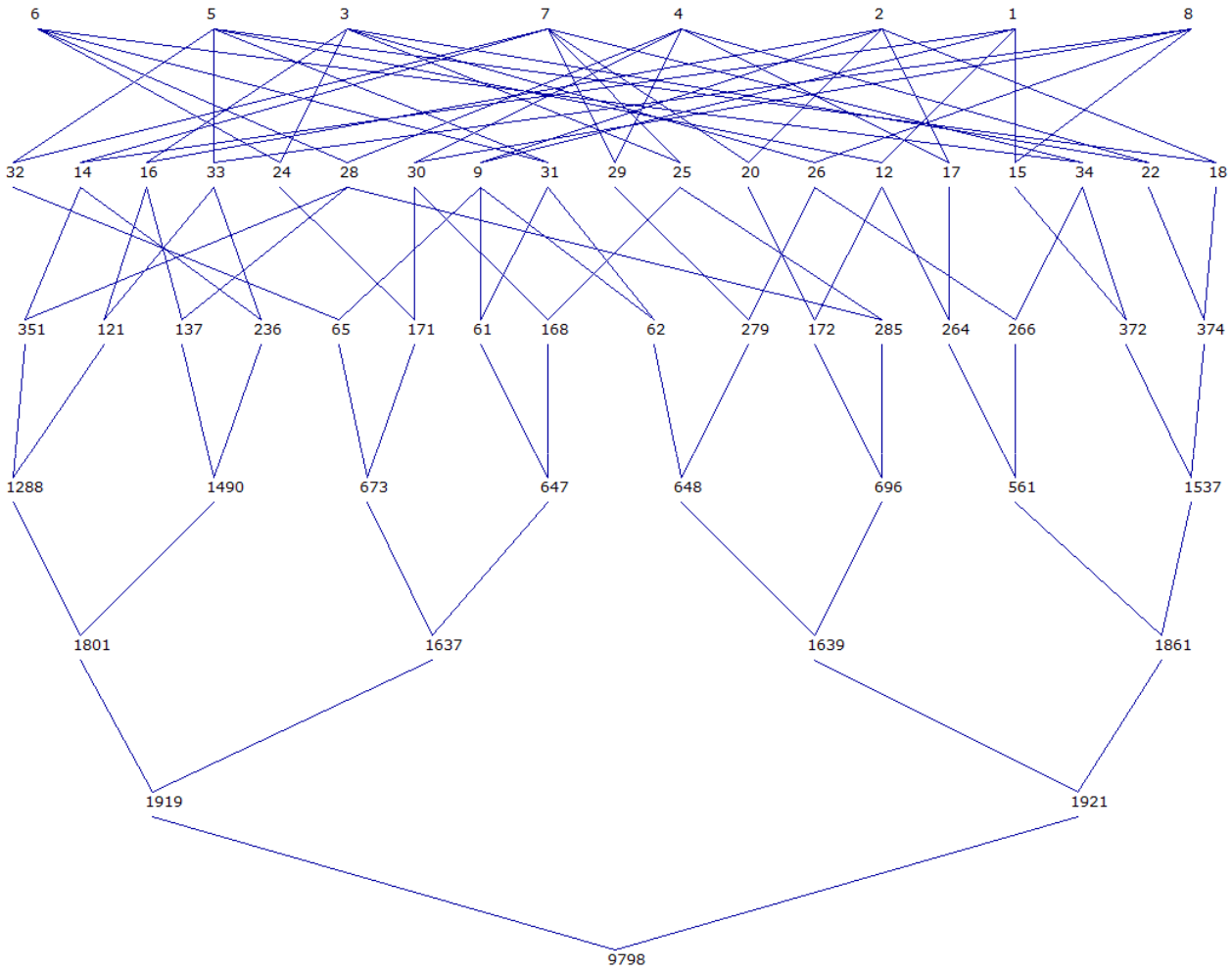
Plant Science into Practice

Ian Mackay



Plant Science into Practice

Ian Mackay



Founders 8

F1s 28

4-ways 210

8-ways 210

IC1 210

IC2 210

IC3 210

IC4 210

Production of inbred lines by RABID

Doubled haploids	too expensive
Bulk breeding	uncontrolled relationships
Single seed descent	current best

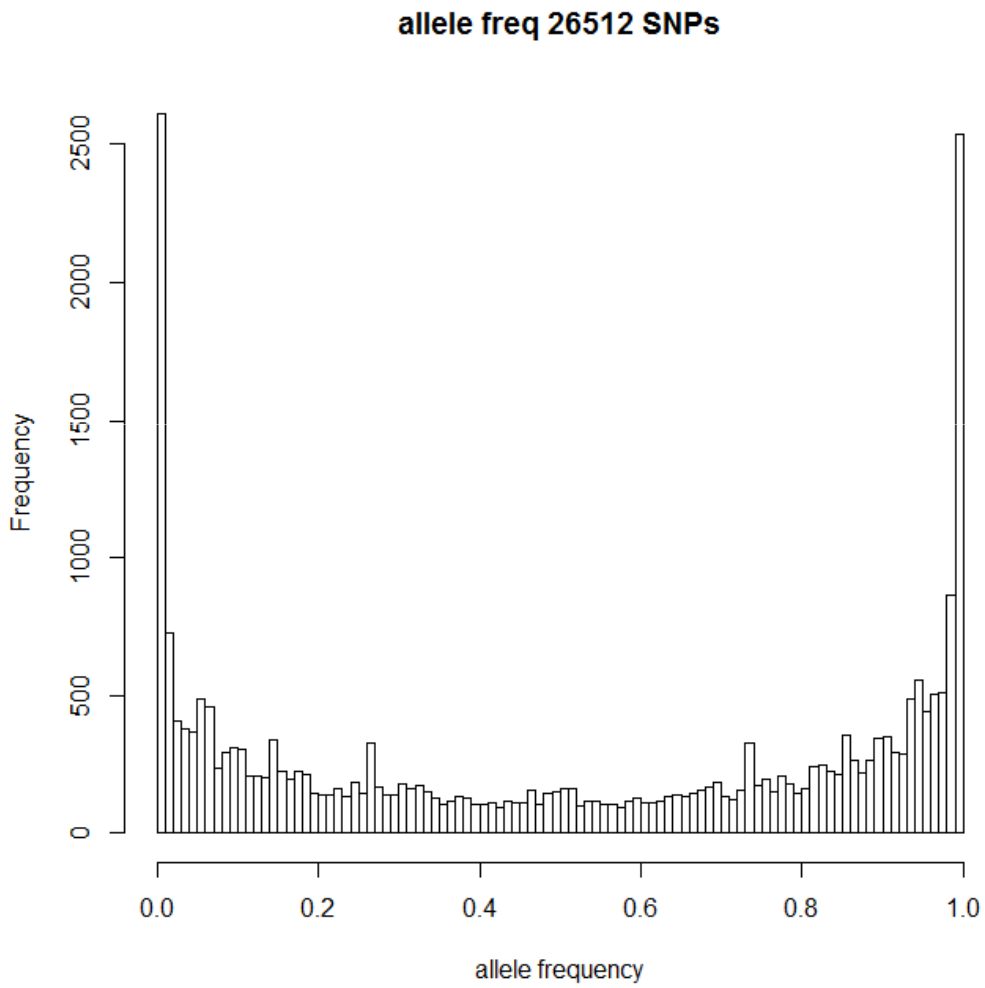
Rabid Bulk Inbreeding (RABID)

bulk breeding + markers
as quick as SSD
can automate

Is being used for second cycle inbreds

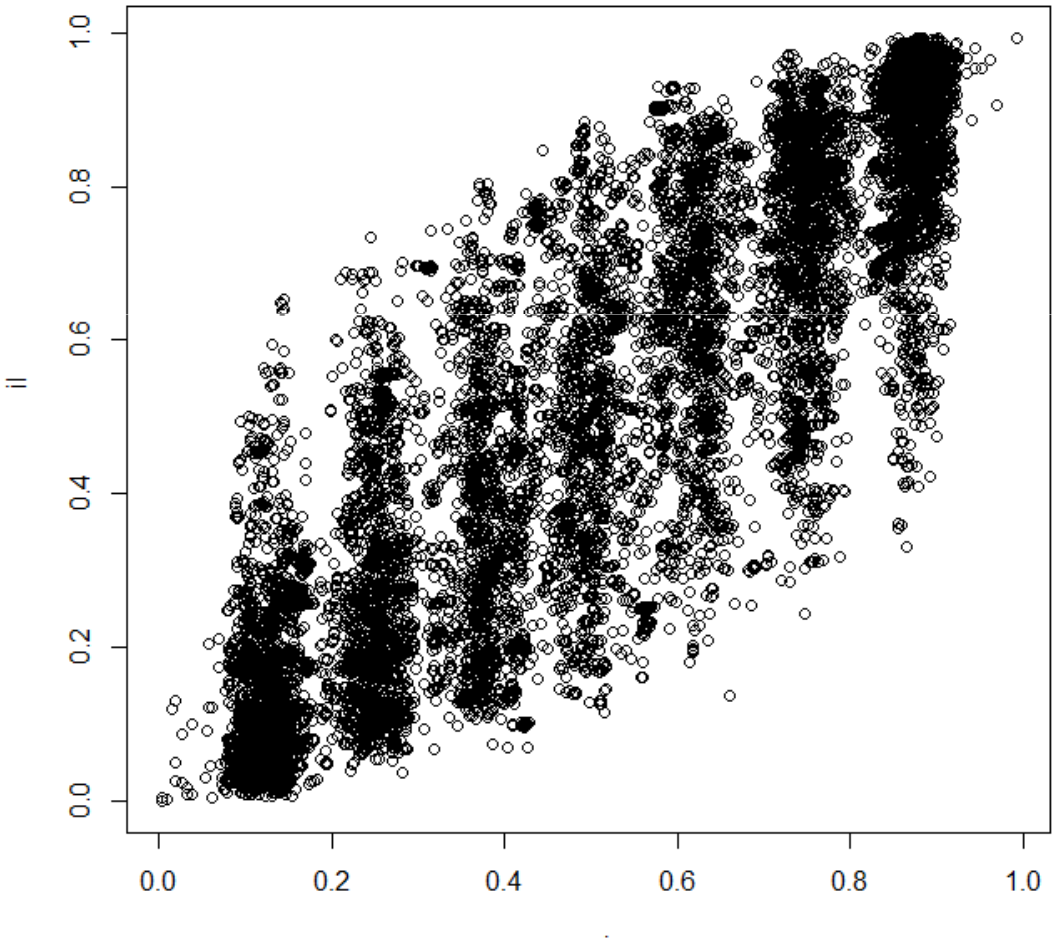
See poster.

26512 markers segregating in WAGTAIL



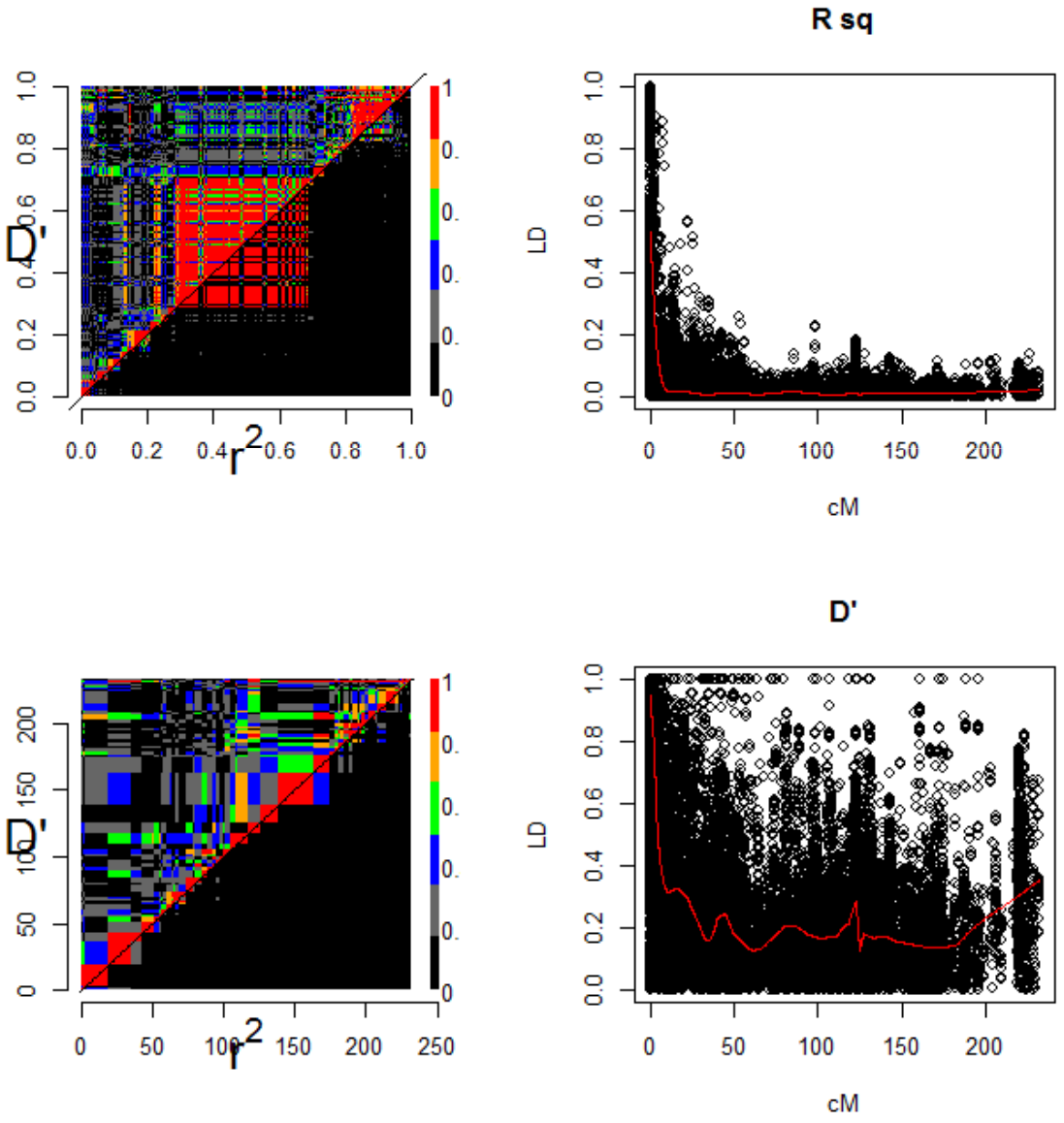
15968 markers segregating in MAGIC

WAGTAIL

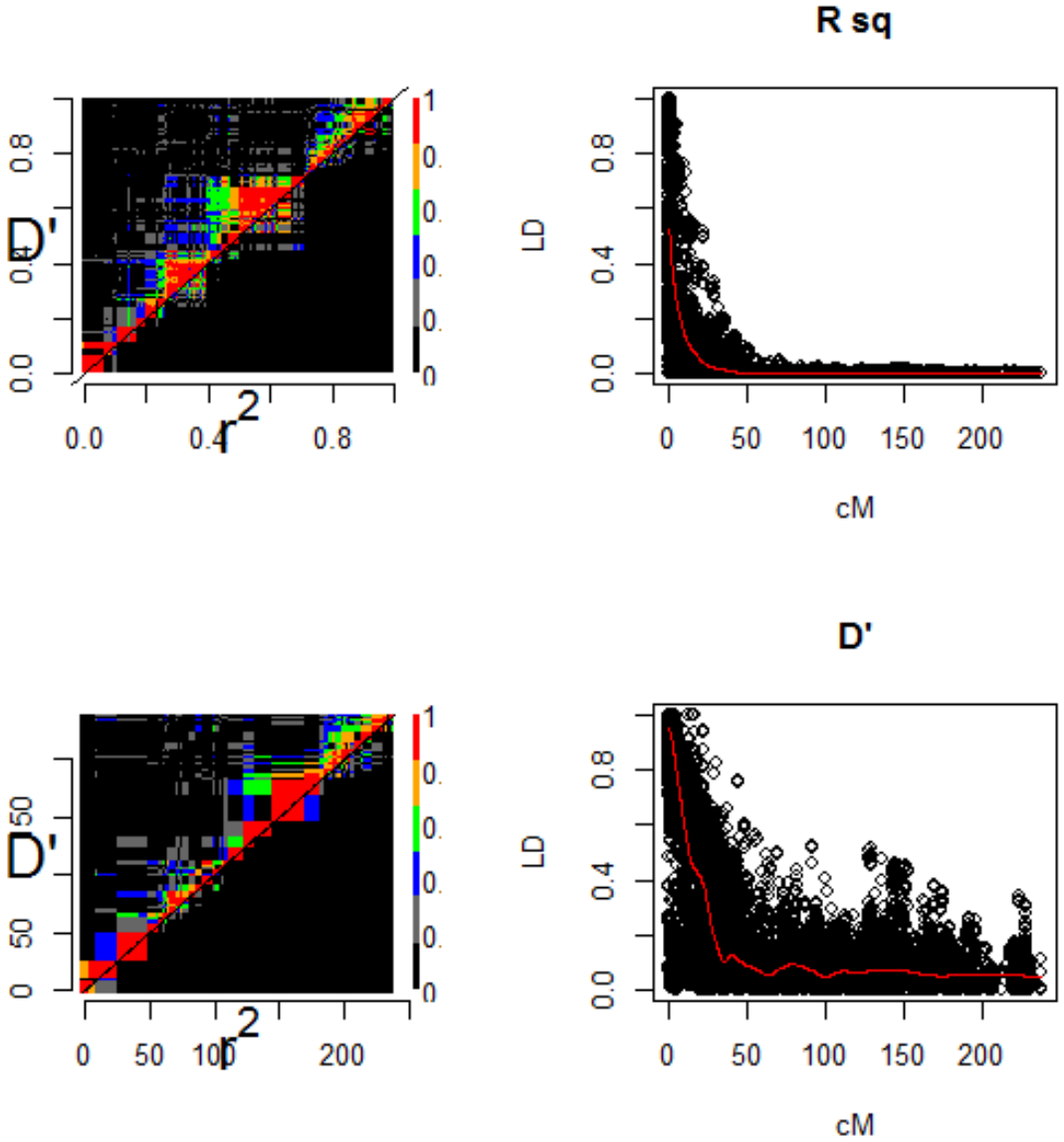


MAGIC

WAGTAIL LD pattern: 2A



MAGIC LD pattern: 2A



FARMERS WEEKLY

22nd August 2011

New wheat yellow rust race confirmed

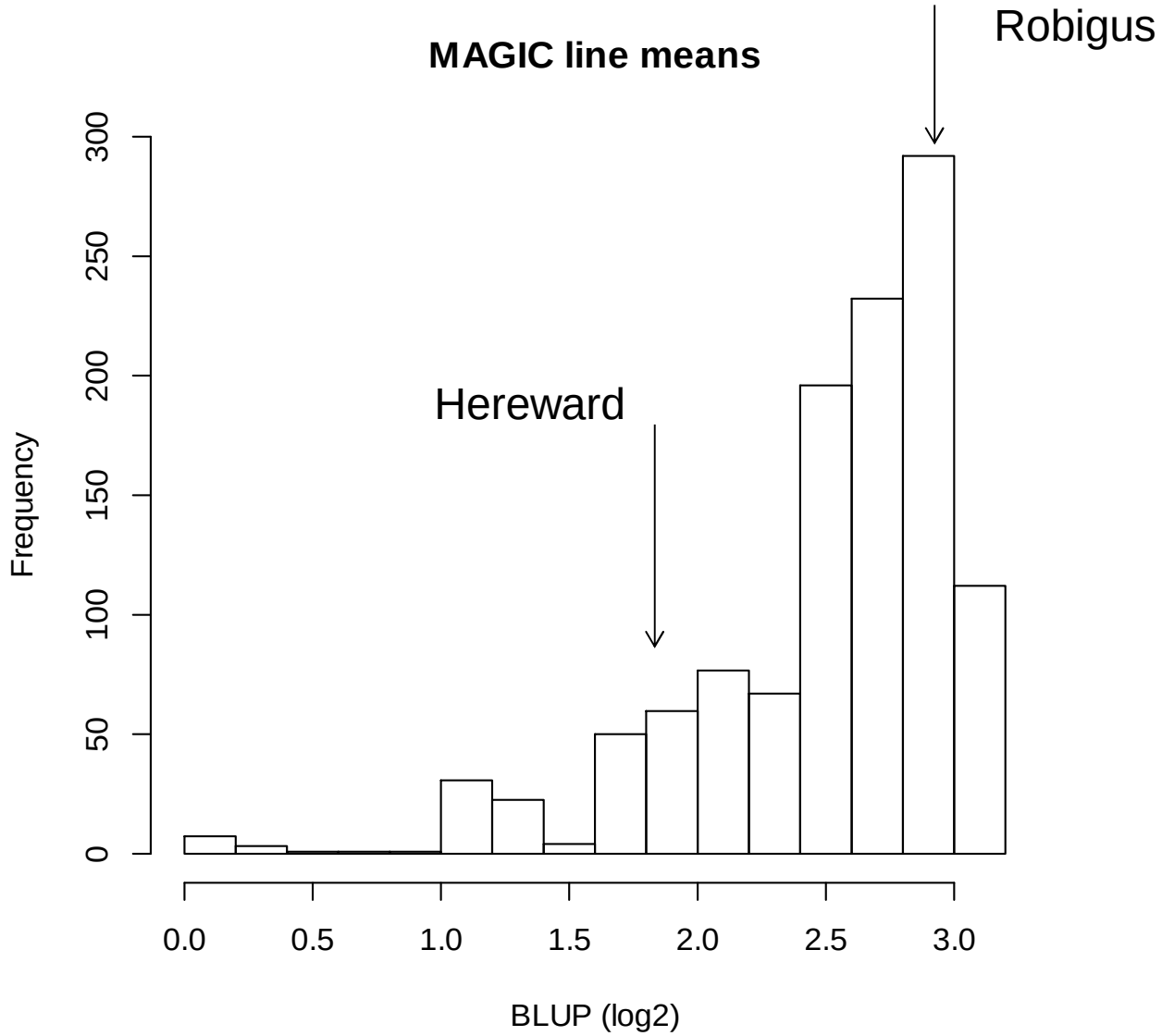
Mike Abram
Monday 22 August 2011 16:00

A new race of yellow rust in winter wheat has been confirmed by the UK Cereal Pathogen Virulence Survey (UKCPVS).

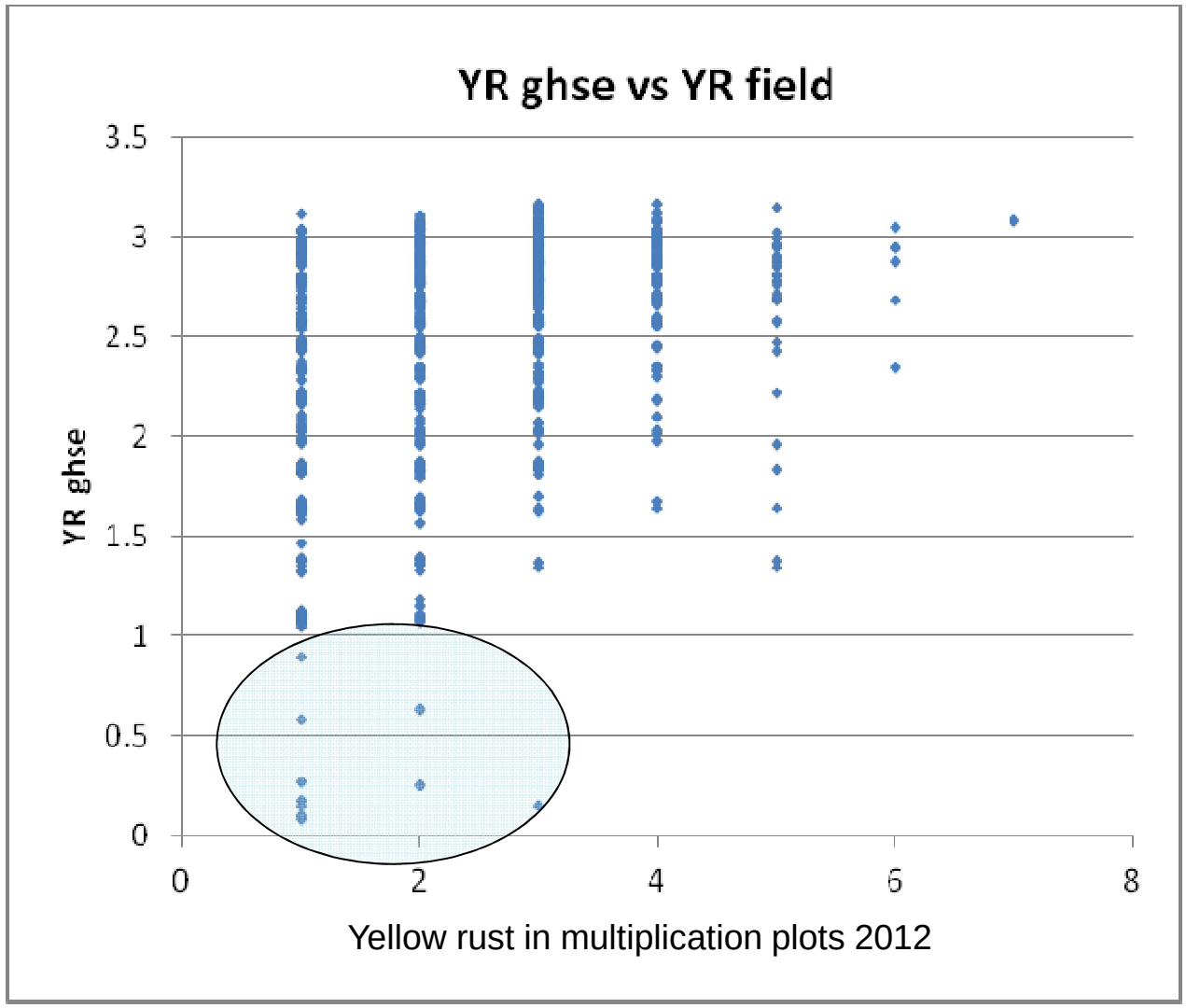
Yellow rust samples collected from three farm crops of Warrior winter wheat earlier this summer have re-infected the variety in the first round of testing by NIAB TAG.

"Warrior had been previously resistant to all yellow rust disease isolates at seedling and adult plant stages. The new isolates have been shown to infect the seedlings of the variety, which is evidence that we are dealing with a new race," explains Rosemary Bayles, principal cereal pathologist at NIAB

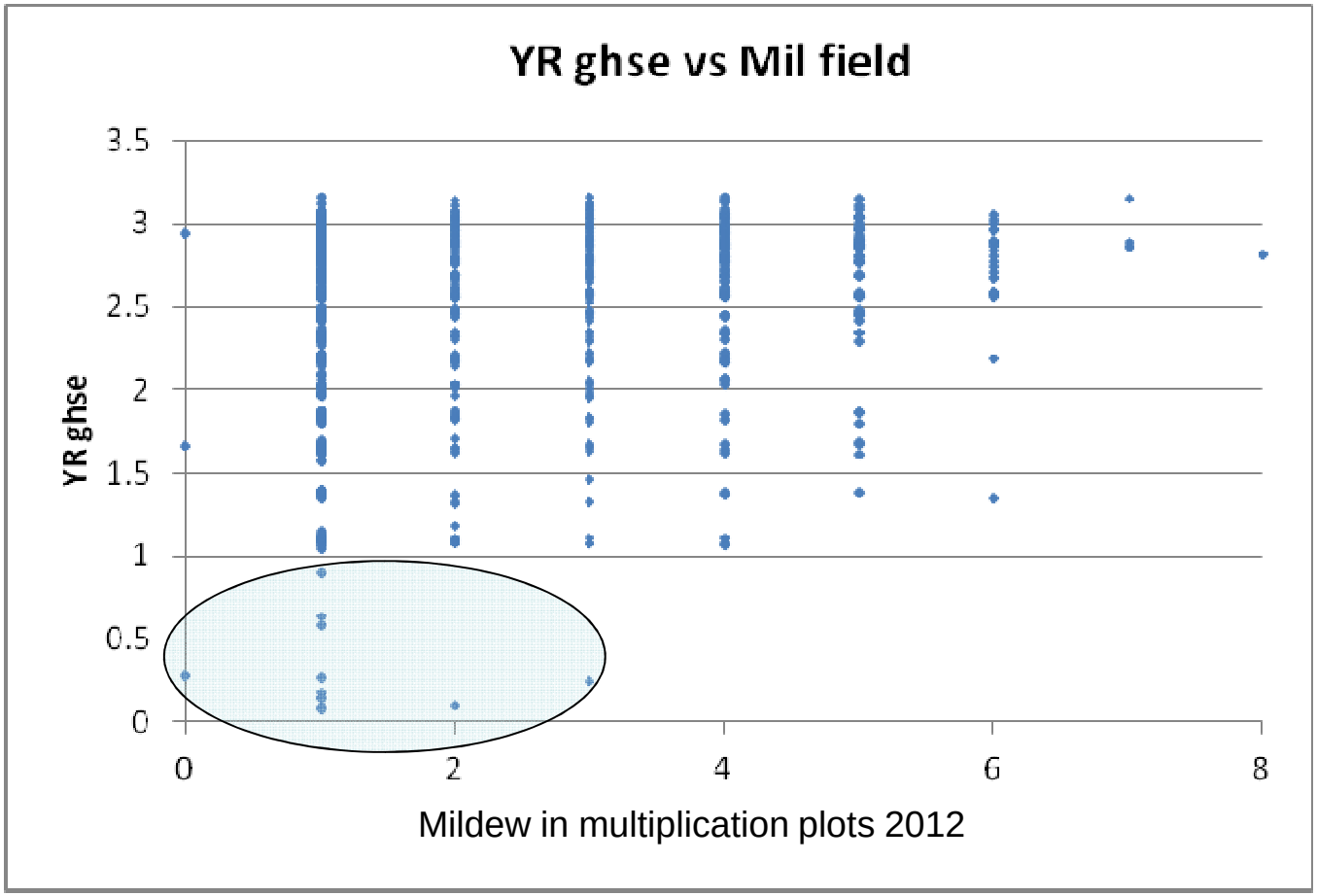
Distribution of disease scores



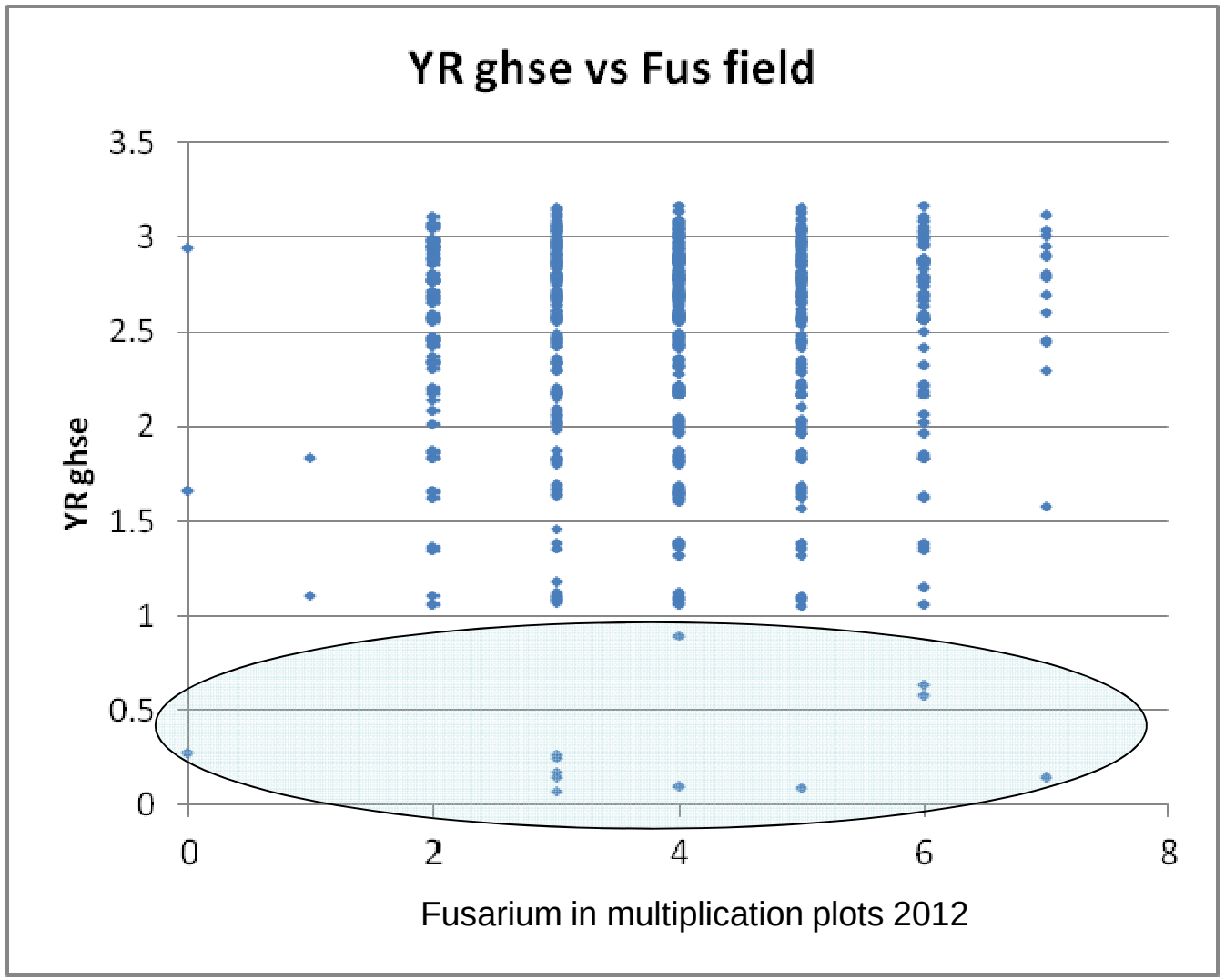
Correlations with 2012 multiplication plots: yellow rust

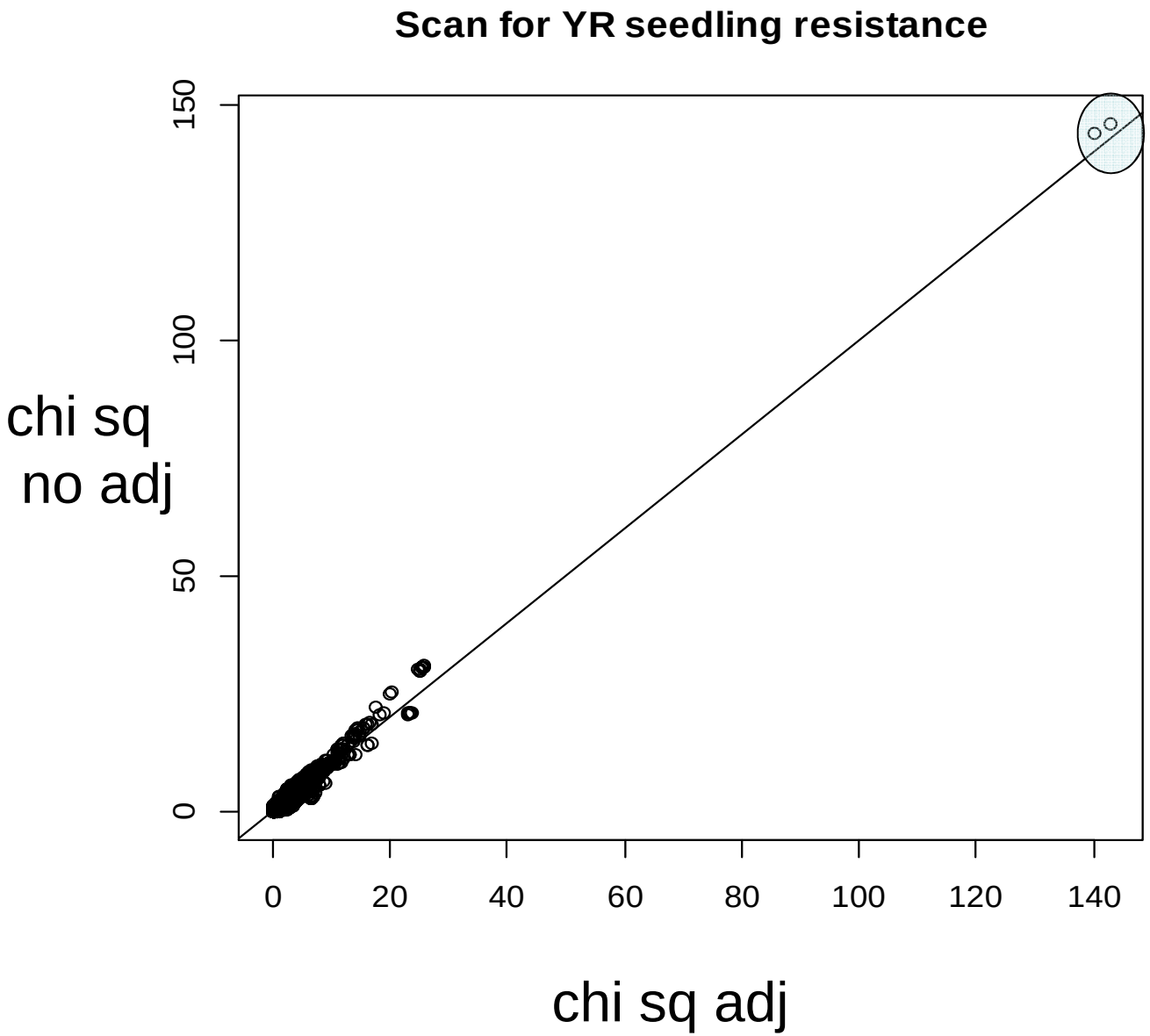


Correlations with 2012 multiplication plots: mildew



Correlations with 2012 field scores: fusarium



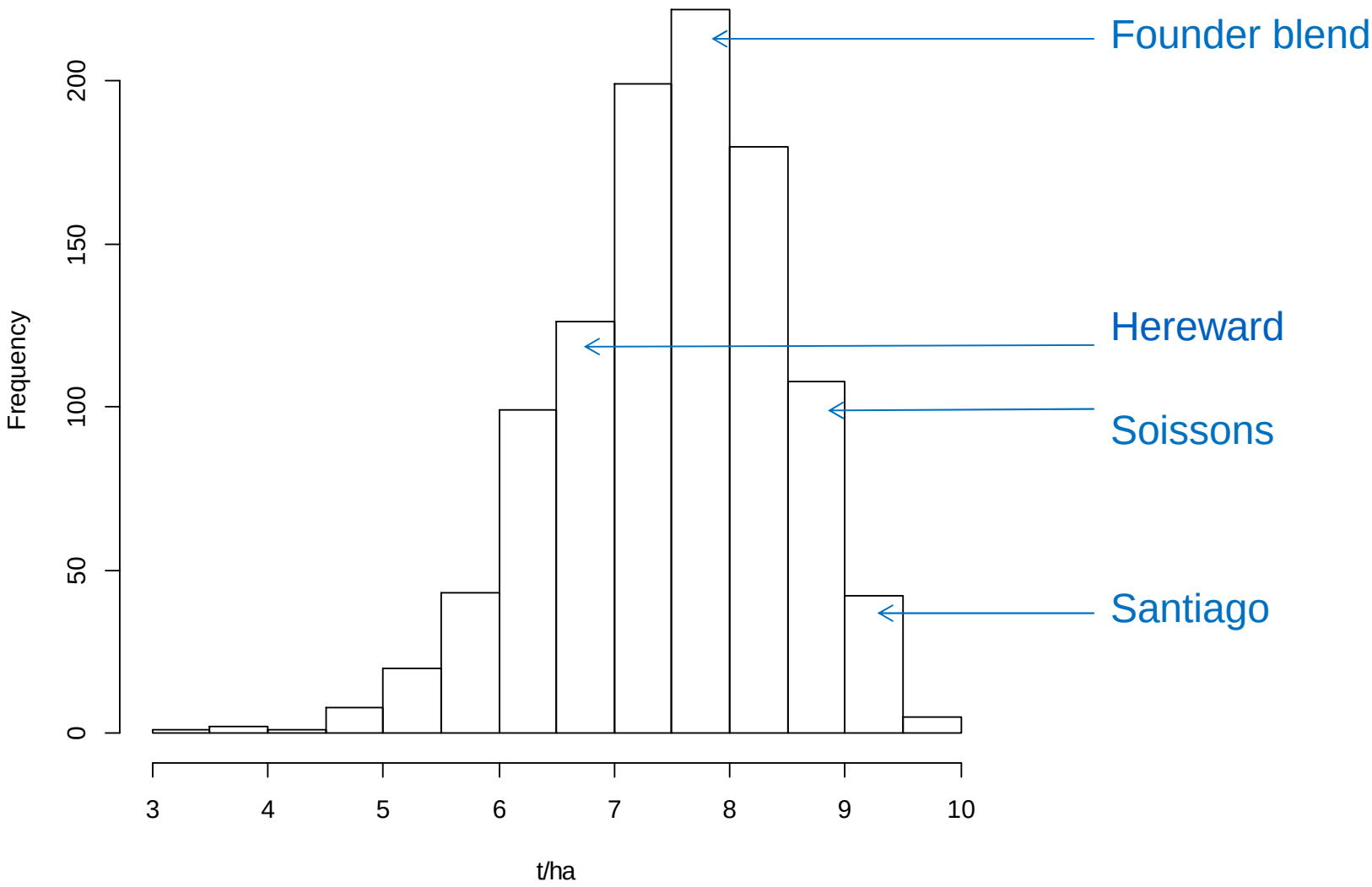

Scan for YR seedling resistance
chi sq no adj
chi sq adj
0
50
100
150
0
20
40
60
80
100
120
140

2012 yield trial: state of the art phenomics

1068 entries, 2156 plots, 2.6 ha (65 cricket squares)

High throughput phenotyping with two genome wide yield-potential assessment instruments.

Distribution of line means for yield



Breeders: how good are they?

Breeder's selections made on 2011 multiplication plots

Mean of population	7.45	t/ha
Mean of lines tagged in 2011	7.81	t/ha
Proportion of lines tagged	0.09	
Realised heritability	0.35	
Heritability per plot in 2012	0.67	

Sublime

MEL 172-4

Ridiculous

MEL 133-2
chlorotic

MEL 005-3
wheat on the cob

MEL 054-1
OWBM queuing up

Genomic prediction

Cross validation correlations with WAGTAIL and MAGIC

Ridge regression

Trait	FT	HT	FHB	FHB.adj	Av
all data	0.38	0.31	0.32	0.29	0.3
M → M	0.20	0.20	0.18	0.19	0.2
W → W	0.59	0.59	0.54	0.42	0.5
M → W	0.09	-0.01	0.00	-0.02	0.0
W → M	0.06	-0.01	0.02	-0.02	0.0

Genomic prediction

Cross validation correlations with WAGTAIL and MAGIC

LASSO

Trait	FT	HT	FHB	FHB.adj	Av
all data	0.39	0.52	0.38	0.48	0.4
M → M	0.31	0.56	0.32	0.50	0.4
W → W	0.46	0.56	0.53	0.32	0.5
M → W	0.16	0.25	0.22	0.21	0.2
W → M	0.08	0.01	0.02	-0.03	0.0

Next steps

Publish.

Release data and seed.

Get more phenotypes.

Test recombinant Spring lines.

Test for bread-making quality.

Start work on the other generations and populations.

WAGTAIL - MAGIC as mutual validation sets in GWAS

MAGIC wheat in the UK: not just for mapping

Andy Greenland
Phil Howell
Nick Gosman
James Cockram
Rhian Howells
Richard Horsnell
Gemma Rose
Alison Bentley
Toby Barber
Claire Pumfrey
Elodie Ray
David Lee
Pauline Bansept
Samia Samed
Alison Bentley

Ania Kowalski (JIC)
James Elderfield (U of Camb)

Colin Cavanagh, (CSIRO)
Matthew Morell (CSIRO)
Rodney Edmonsdon
Noel Ellis (IBERS)
Sacha Allen (University of Bristol)
Donal O'Sullivan (University of Reading)