Myzus persicae (Peach-potato aphid)

- Highly polyphagous
- Parthenogenetic on field crops
- Sexual cycle on peach

Insecticide resistance mechanisms in *Myzus persicae*

Esterase confers resistance primarily to OPs and mono-methyl carbamates (categorised into S, R_1, R_2, R_3)

MACE confers extreme resistance specifically to the dimethyl-carbamate:

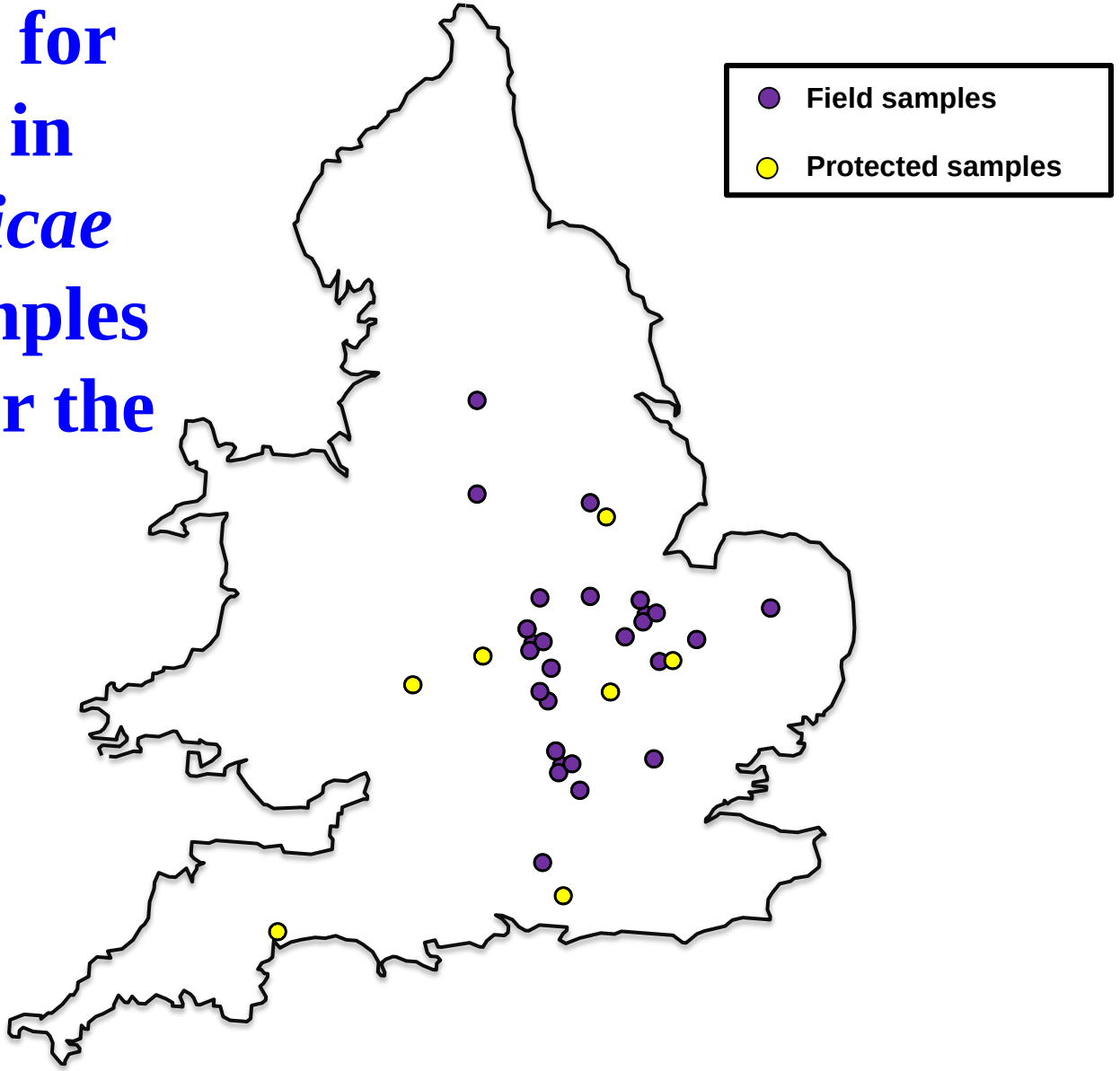
pirimicarb

Aphids are either SS, SR or RR

kdr and super-kdr confer resistance to pyrethroids

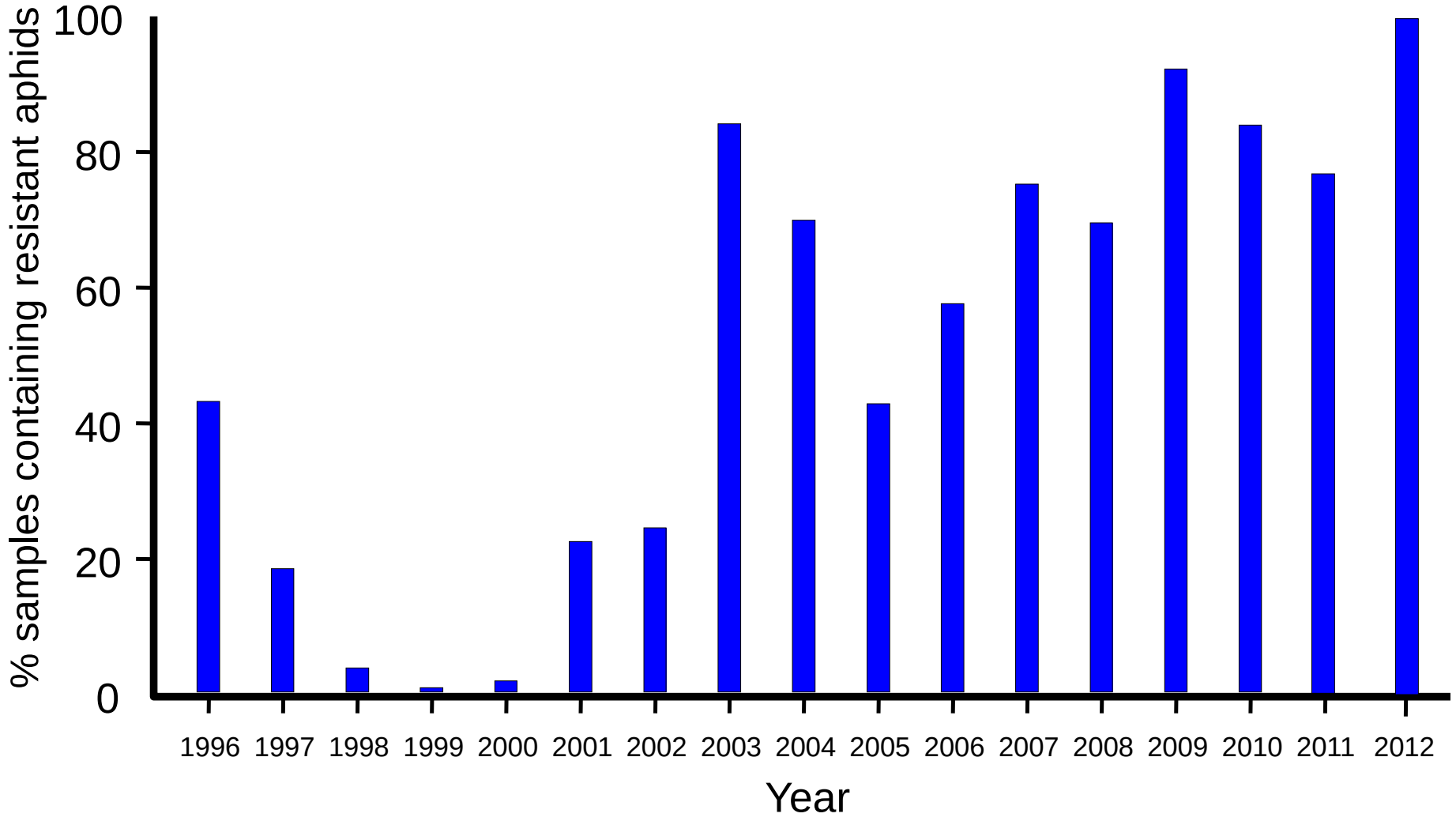
Aphids are either SS, SR or RR

Monitoring for resistance in *Myzus persicae* UK field samples collected over the years

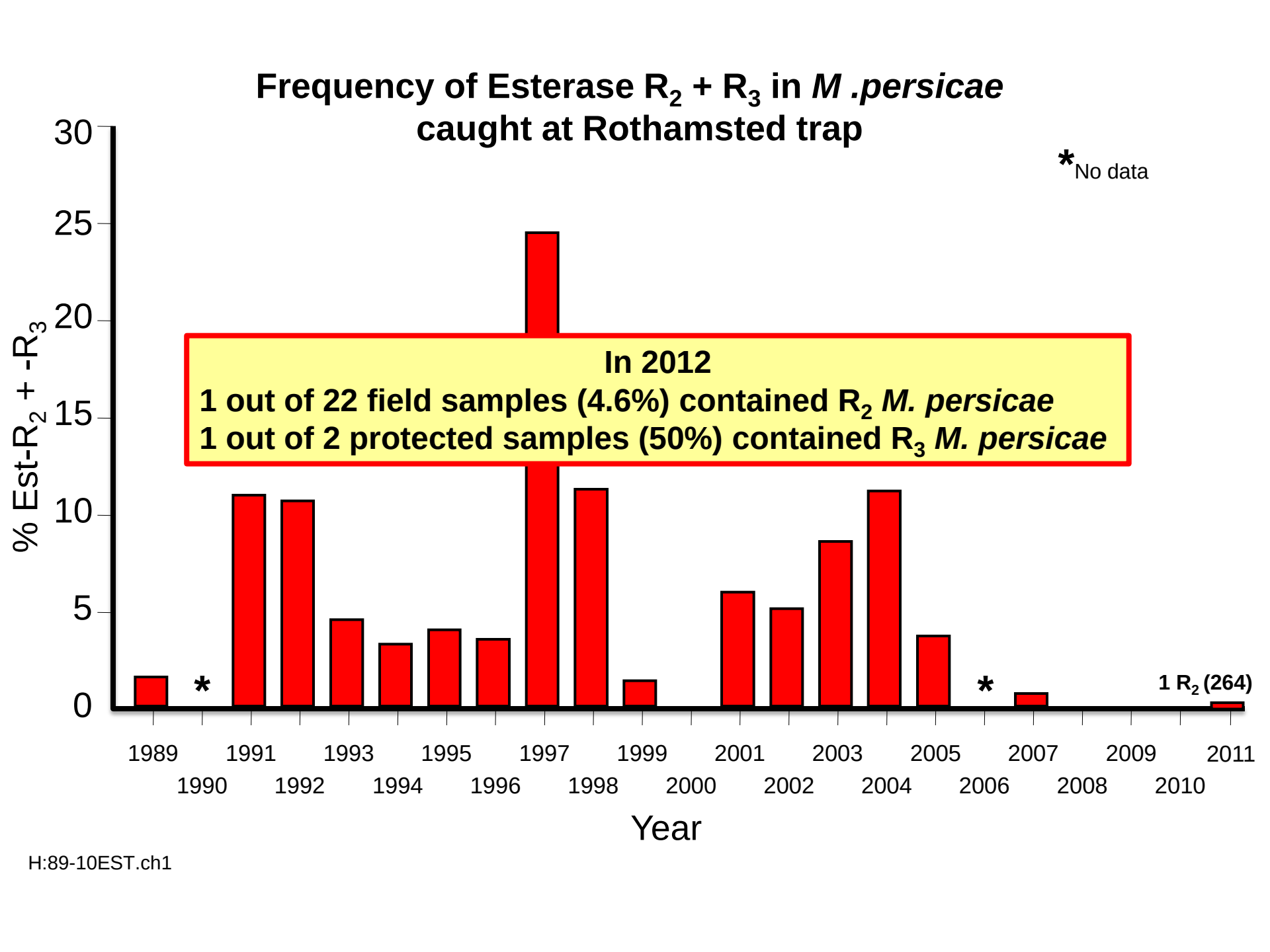


MACE and esterase resistance

Field samples that contained at least one MACE aphid



Up to testing Nov 21, 2012

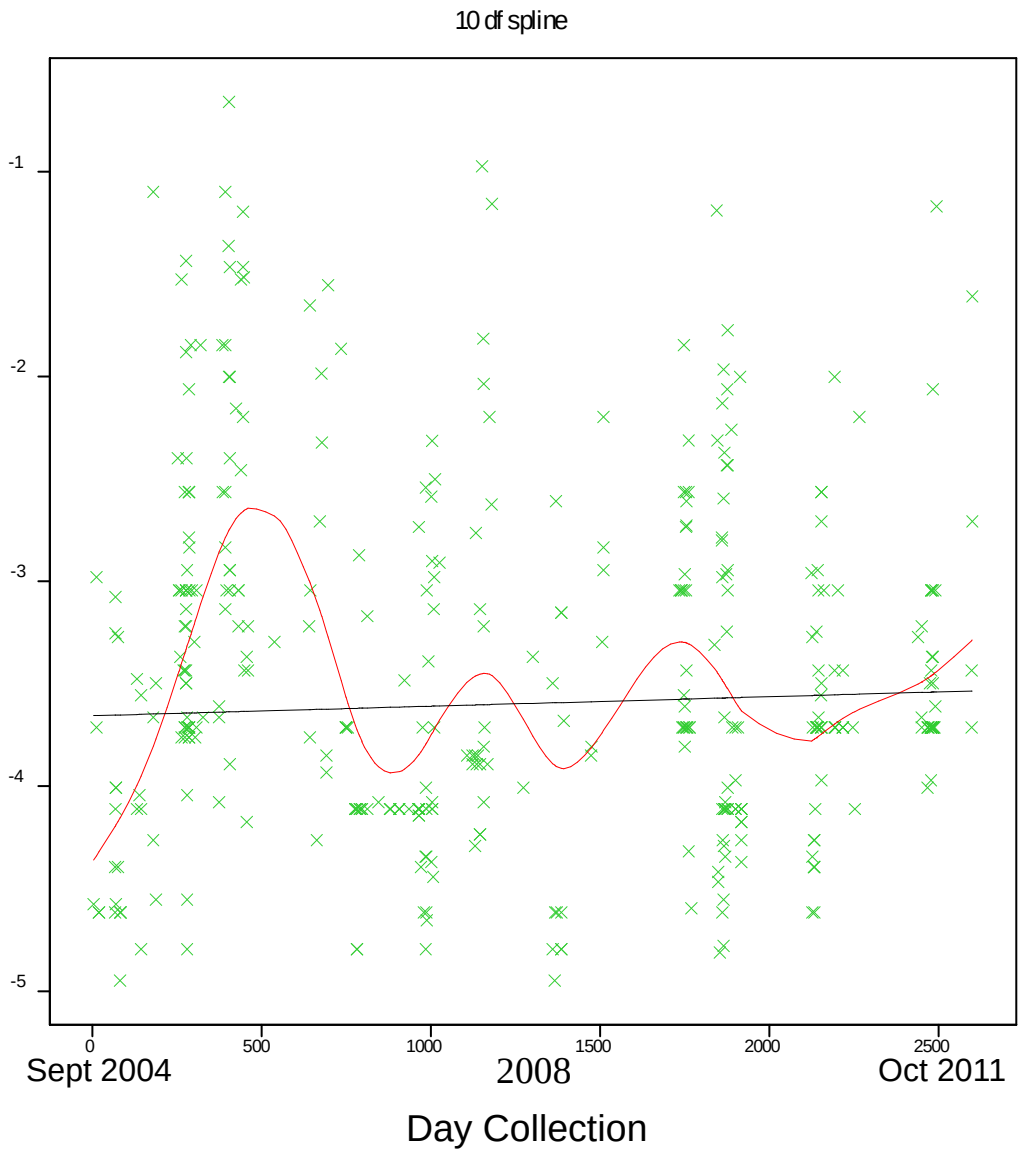

Frequency of Esterase R_2 + R_3 in *M .persicae* caught at Rothamsted trap
*No data
In 2012
1 out of 22 field samples (4.6%) contained R_2 *M. persicae*
1 out of 2 protected samples (50%) contained R_3 *M. persicae*
1 R_2 (264)
% Est-R_2 + -R_3
30
25
20
15
10
5
0
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
H:89-10EST.ch1


Strong resistance to neonicotinoids!
(Nic-R++)
Great moments in evolution

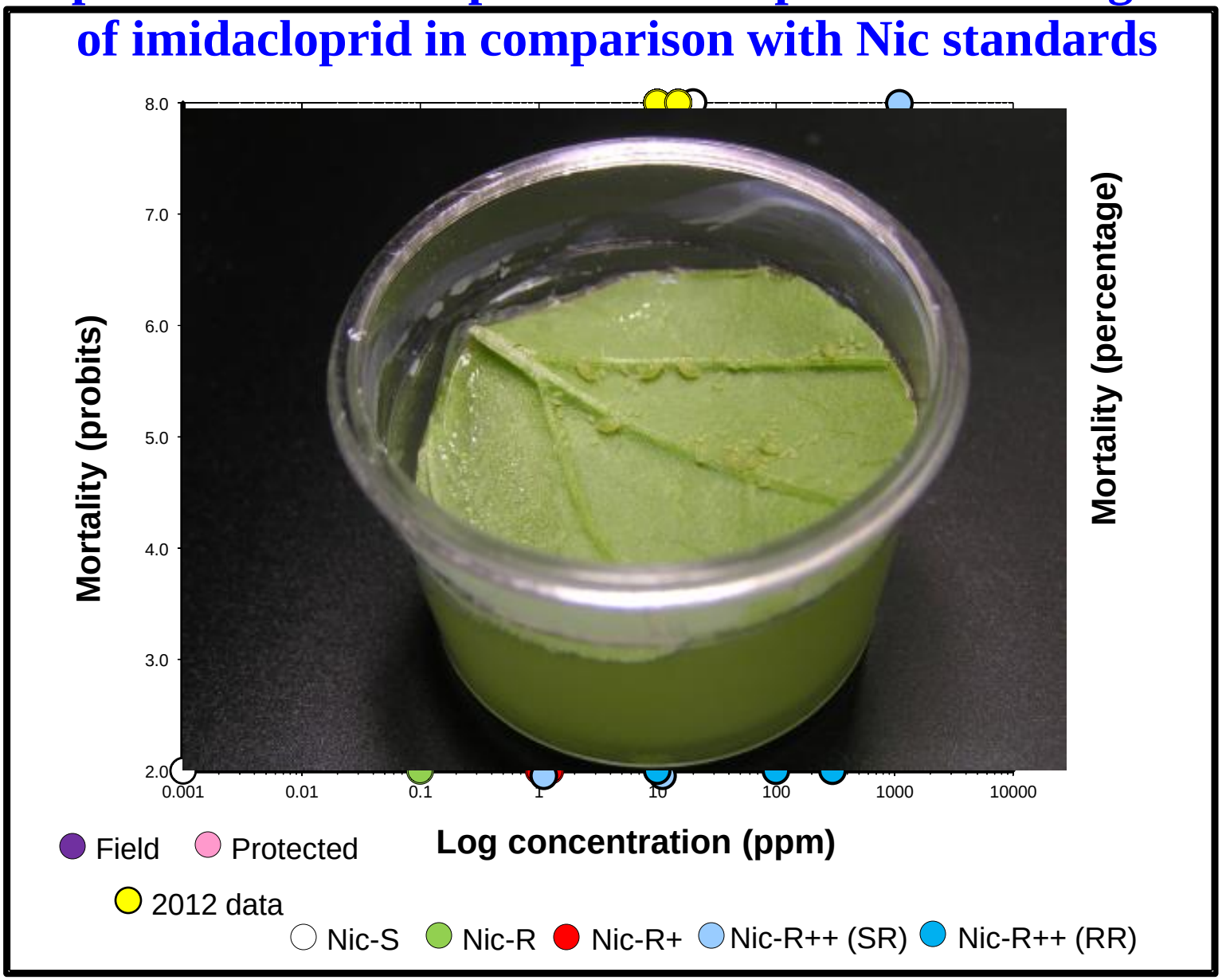
Response to imidacloprid

Frequency of field samples containing at least one ‘mobile’ aphid (10 ppm imidacloprid screening)

Plot of 10 df spline (red curved line) fitted to logit transformed proportion mobile aphids (Y Axis) versus day number of sample collection (X Axis).



Response of field and protected samples to screening dose of imidacloprid in comparison with Nic standards



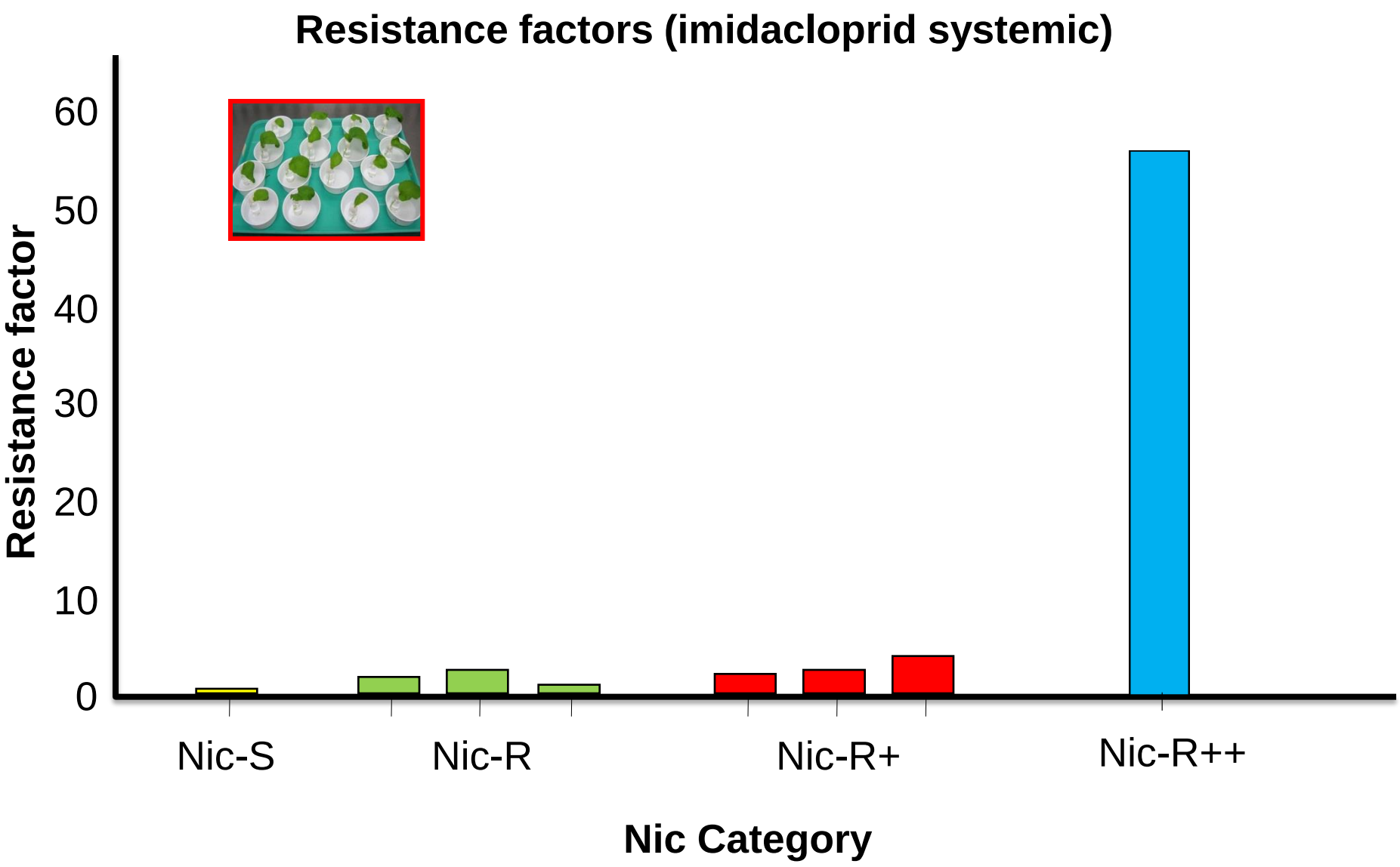
Resistance factors (imidacloprid topical)

Resistance factor

60
50
40
30
20
10
0

Nic-S
Nic-R
Nic-R+
Nic-R++

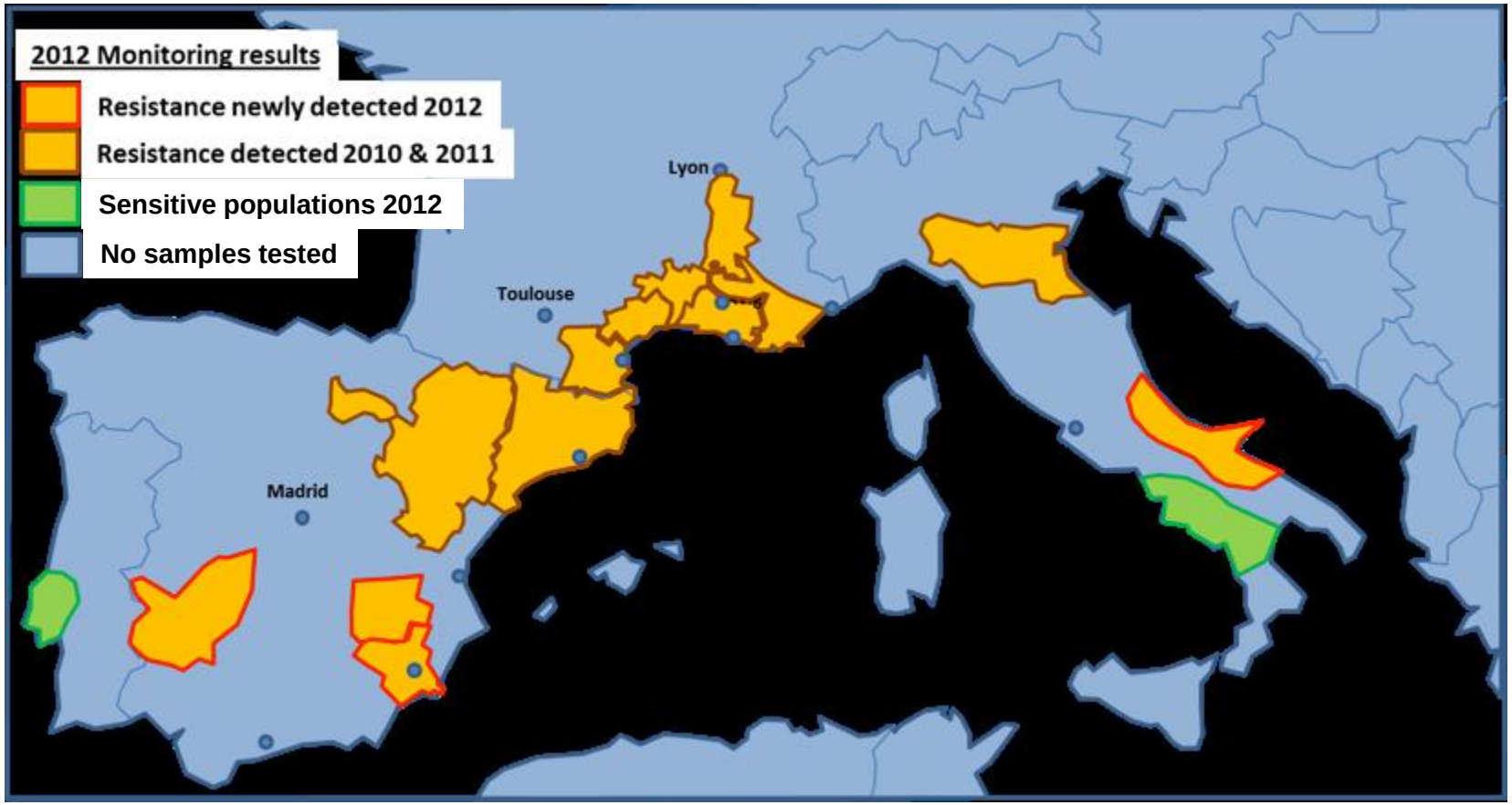
Nic Category


Resistance factors (imidacloprid systemic)
Resistance factor
60
50
40
30
20
10
0
Nic-S
Nic-R
Nic-R+
Nic-R++
Nic Category

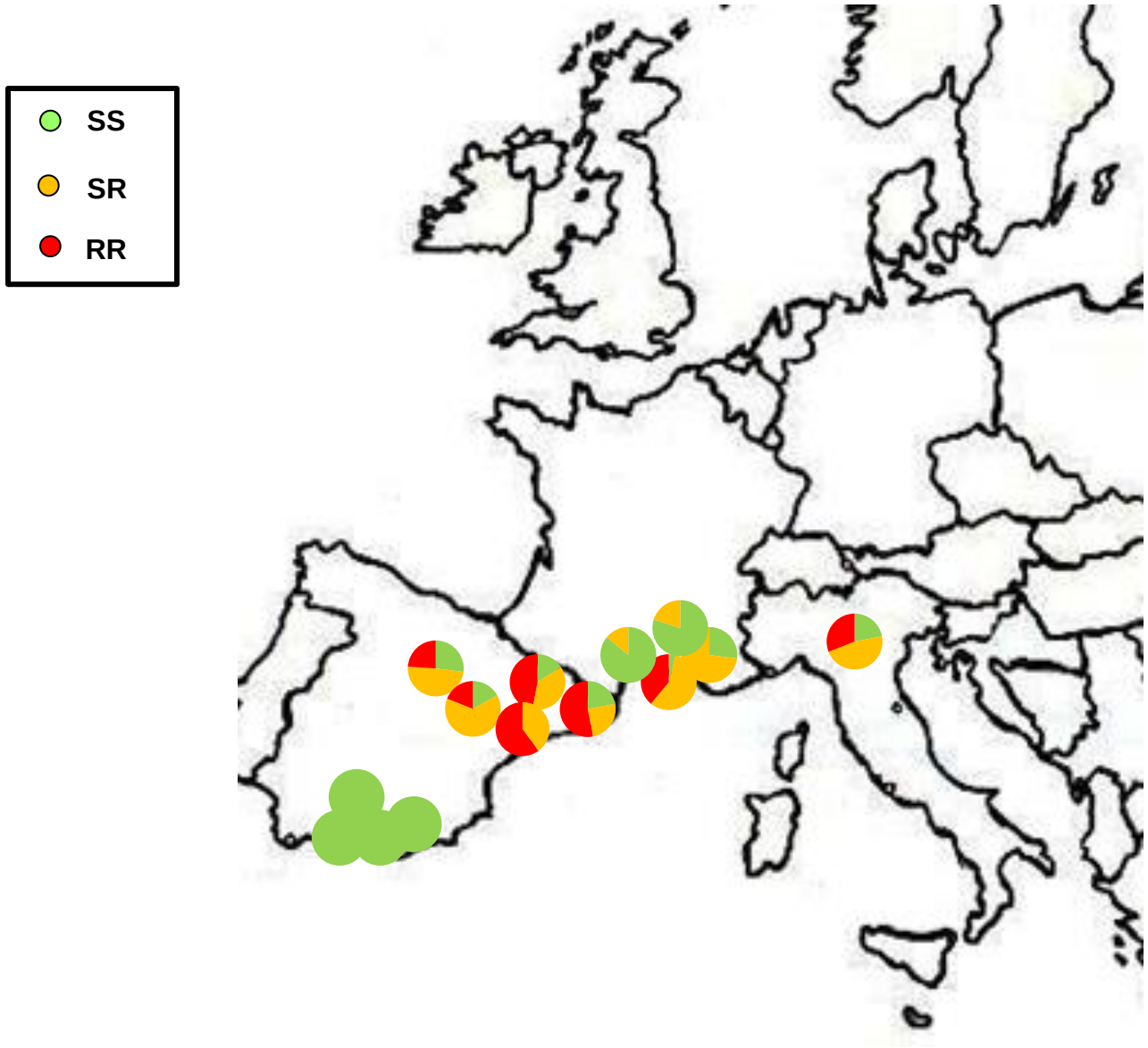
Monitoring for Nic-R++ target site-based resistance

IRAC eConnection Issue 31

Source: IRAC December 2012



Monitoring for R81T (neonicotinoid-R) mutation in *Myzus persicae* populations from Southern Europe



Field simulator-based studies on whole plants that have been foliar-treated with neonicotinoids or pymetrozine

Myzus persicae clones:
4106A (Nic-S), 926B (Nic-R), 5191A (Nic-R+)
SPN (Nic-R++/SR), 5444B (Nic-R++/RR)

Foliar spray treatments:
Thiacloprid, Acetamiprid
Host: Potato (Desire)

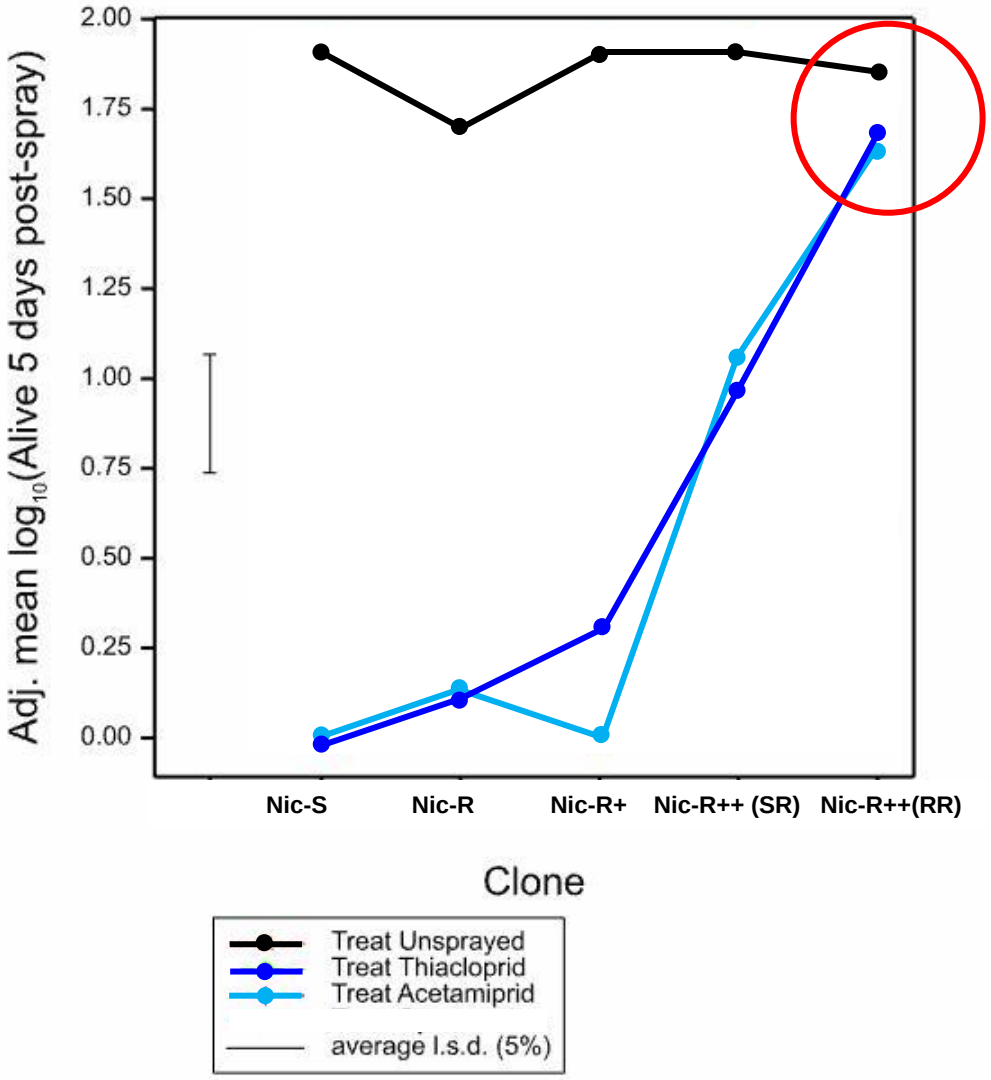
LC50 (ppm) response to imidacloprid for *Myzus persicae*

(topical micro-application bioassays)

Clone	LC_{50} (95% CL)	Slope	Resistance Ratio	Viability*
Nic-S	0.424 (0.312-0.549)[a]	1.5	**1**	0.05
Nic-R	5.018 (4.302-5.650)[b]	3.0	**12**	1
Nic-R+	18.50 (10.80-30.76)[c]	1.0	**45**	5
Nic-R++ (SR)	176.6 (67.80-765.2)[d]	0.8	**>400**	10
Nic-R++ (RR)	7,392 (4,061-23,324)[e]	1.1	**>17,000**	1,000

*Highest dose (ppm) where viable offspring were produced

Response to foliar sprays for *Myzus persicae*
(on whole plants in simulators)



Host Preference Study

Nic-S, Nic-R, Nic-R+ and Nic-R++ *M. persicae* clones transferred to a range of hosts.

Aphids clip-caged to leaves on plants to see if they produce nymphs that are then capable of becoming adults and reproducing.


Nic-RR (Nic-R++)
100 ppm imidacloprid


Sugar beet
?


Potato

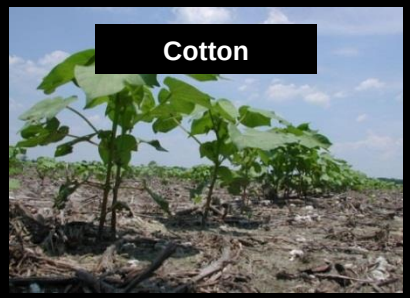

Oilseed rape


Cabbage

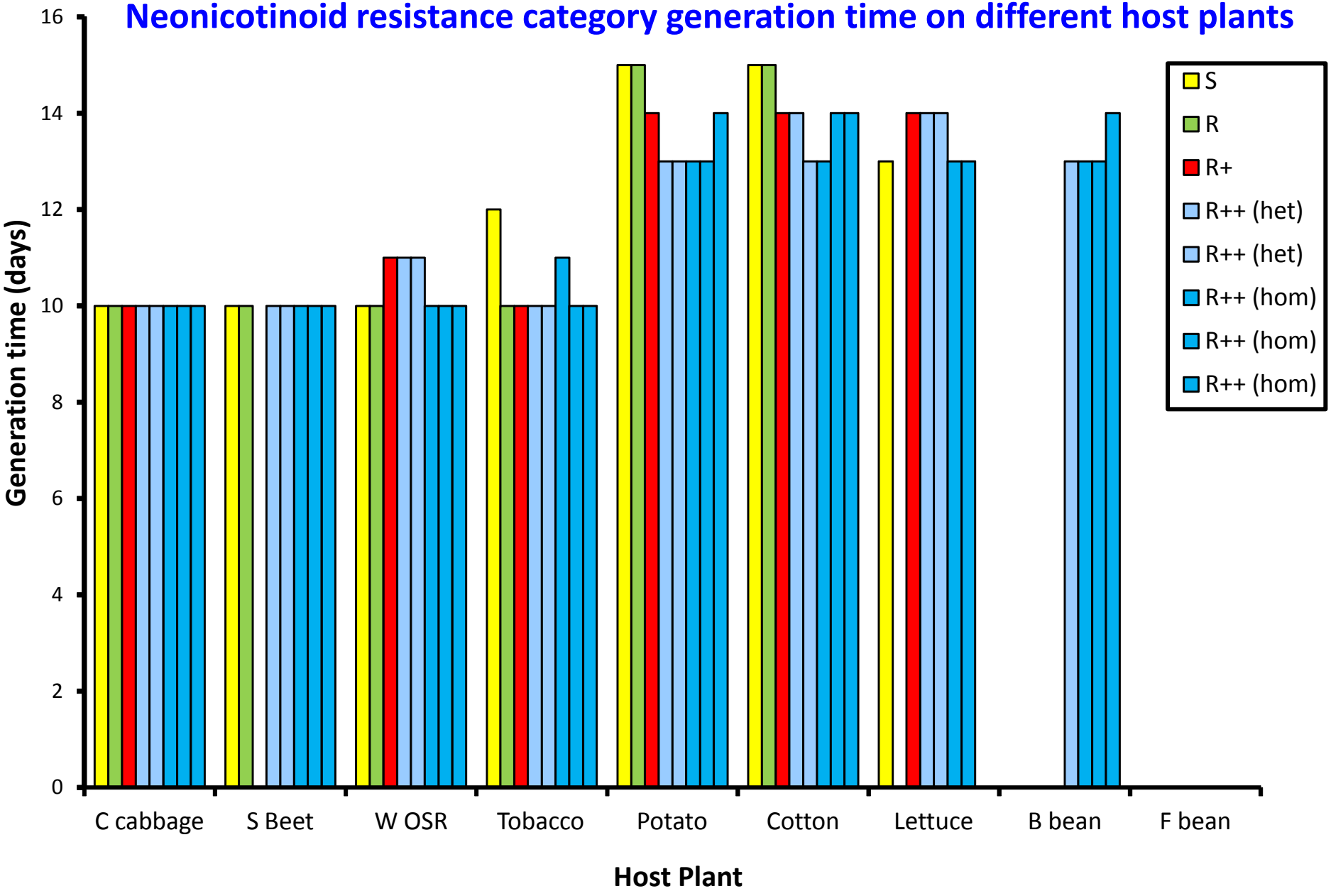

Lettuce


Broad bean


French bean

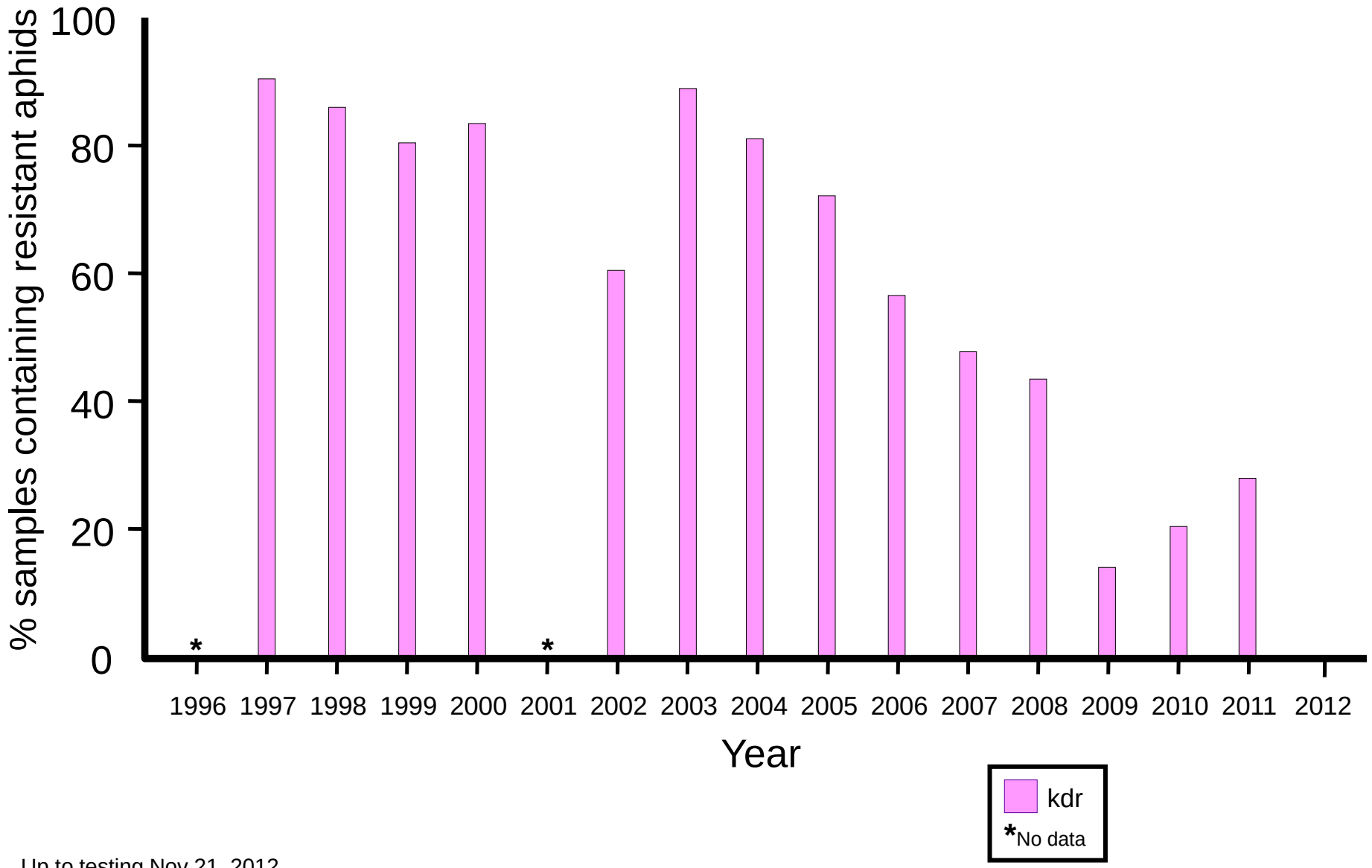

Cotton


Tobacco


Neonicotinoid resistance category generation time on different host plants
Generation time (days)
0
2
4
6
8
10
12
14
16
C cabbage
S Beet
W OSR
Tobacco
Potato
Cotton
Lettuce
B bean
F bean
Host Plant
S
R
R+
R++ (het)
R++ (het)
R++ (hom)
R++ (hom)
R++ (hom)

Resistance to pyrethroids

Field samples that contained at least one kdr aphid



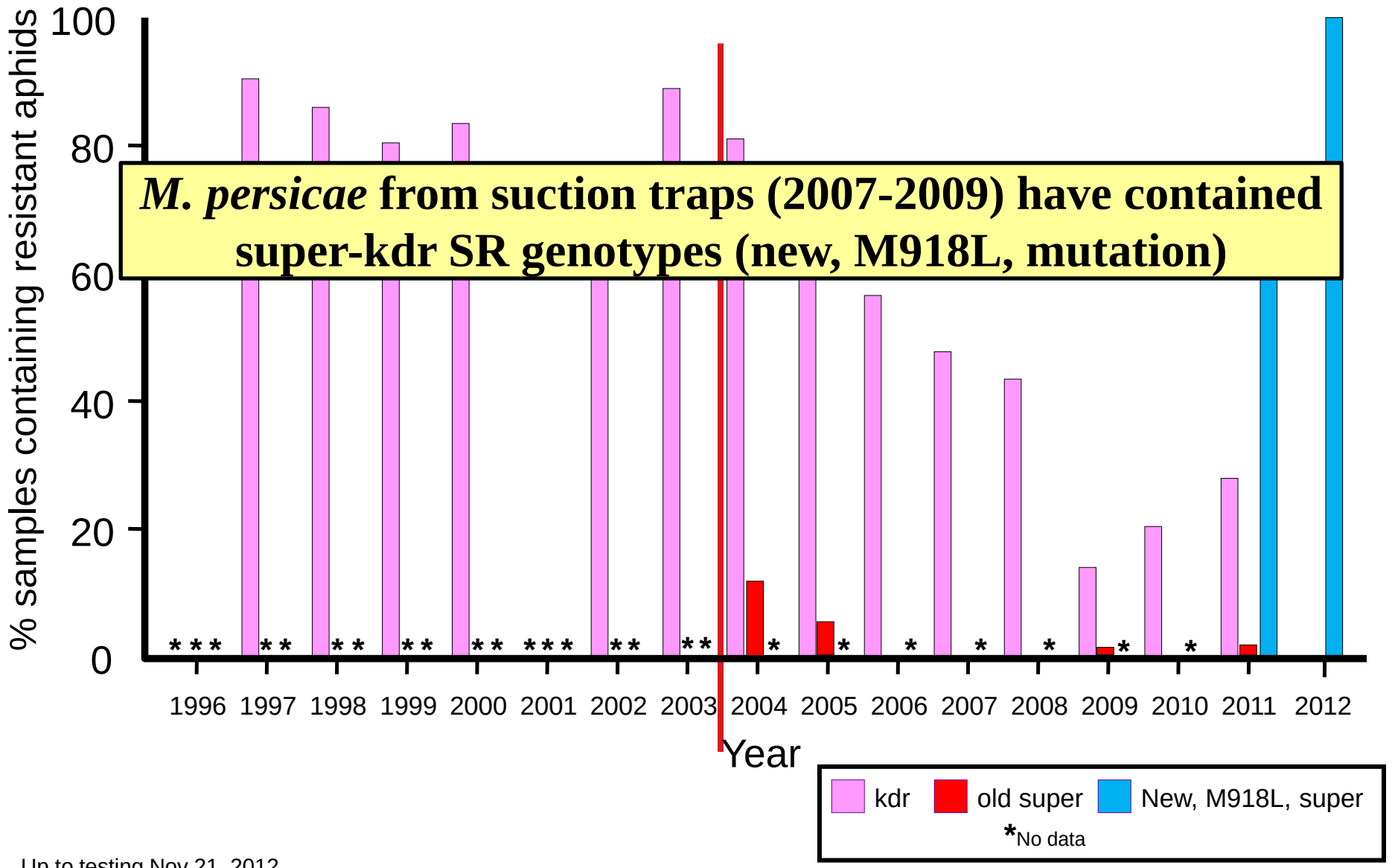
Up to testing Nov 21, 2012

New super-kdr mutation found in UK!

Decreases in the frequency of kdr aphids have occurred despite the continued high usage of pyrethroids sprays in the UK – an apparent inconsistency that is probably explained by the recent discovery that *M. persicae* can carry another, new target site mutation conferring resistance to pyrethroids.

The 'O' and 'P' micro-satellite *M. persicae* genotypes possess this new target site mutation in the heterozygous form. This is a variant of the 'old' super-kdr type, but involves the amino acid methionine changing to leucine instead of threonine at the super-kdr position (i.e. it is M918L instead of M918T).

Field samples that contained at least one kdr/super-kdr aphid



Up to testing Nov 21, 2012

Summary of *Myzus persicae* resistance in the UK

High frequency of resistance to pyrethroids and pirimicarb. The possible repellency of pyrethroids against aphids carrying the new super-kdr needs to be tested.

Low frequencies of aphids carrying low resistance to neonicotinoids (Nic-R types) are being found but this will not cause control failures when they are exposed to insecticide treatment rates recommended for aphids.

No resistance to pymetrozine or flonicamid.

Screening live aphids for their response to different compounds remains very important even if there are diagnostic DNA tests for resistance mechanisms available.

Thanks to:

Bayer
Belchim
Certis
DuPont
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Sumitomo
Syngenta

ADAS
AHDB-HGCA
AHDB-Horticulture
AHDB-Potato Council
BBRO
Dewar Crop Protection
Rothamsted Insect Survey