Some reflections on B and Q biotypes

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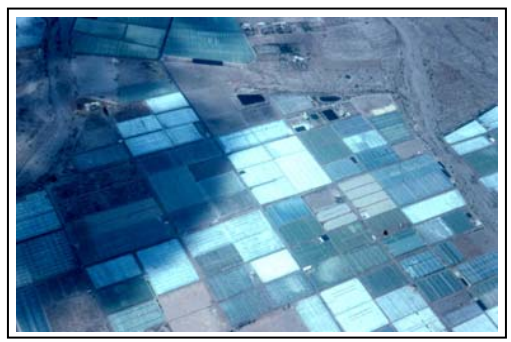


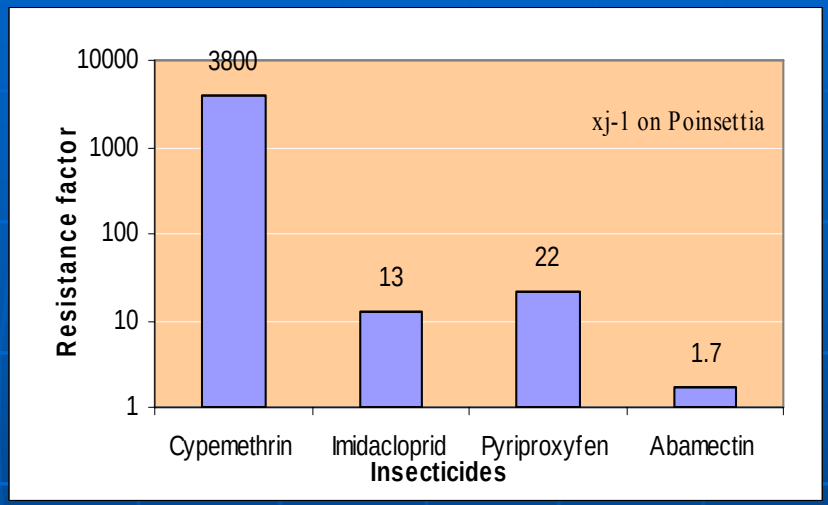
Historical perspective: 1

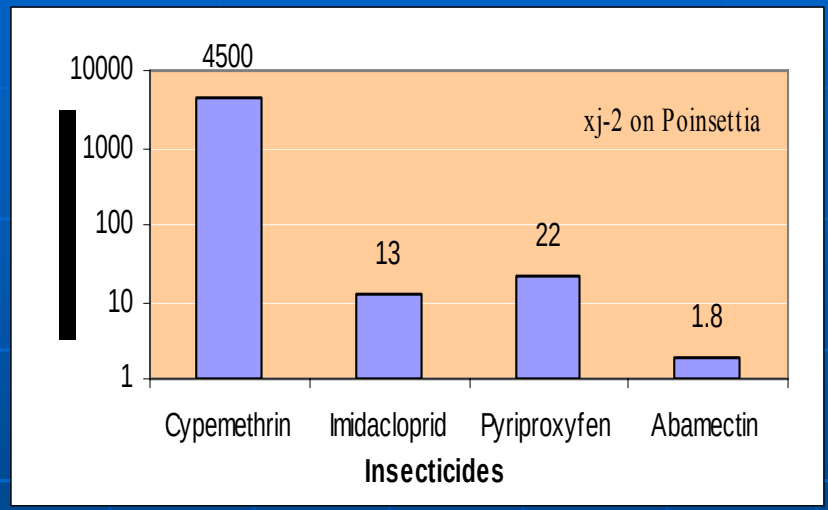
• Mid 1980s to 1990s: Major geographical expansion in B-types

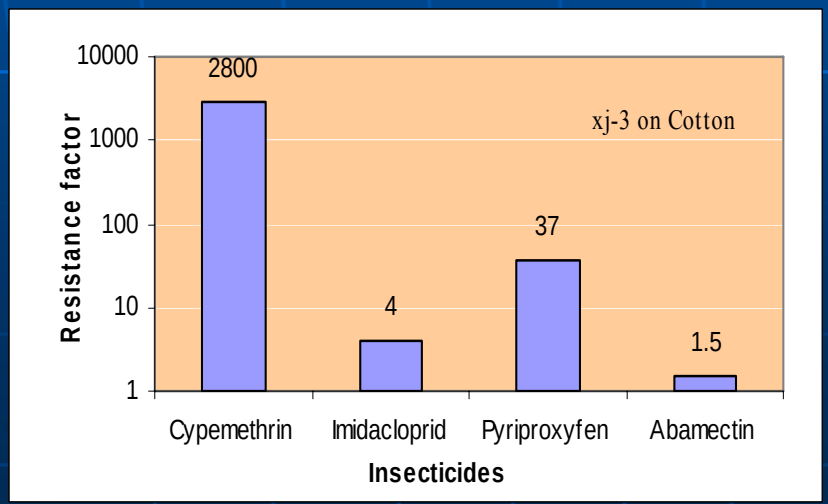
• B-types become predominant/supplant native biotypes due to wide host range, resistance to insecticides and/or other characteristics.

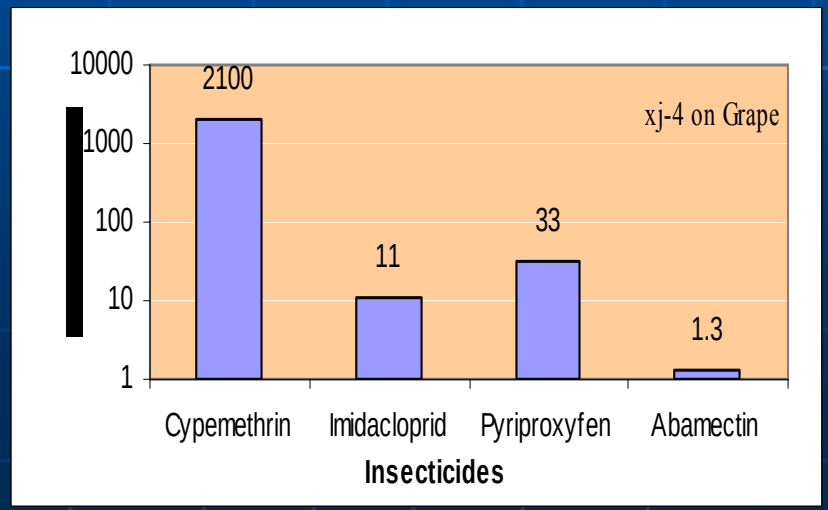
• B-types generally resistant to pyrethroids, but resistance to newer insecticide groups still patchy.

Resistance profiles of B-type strains of *B. tabaci* collected from Xinjiang, northwest China









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• Mid 1980s to 1990s: Major geographical expansion in B-types

• B-types become predominant/supplant native biotypes due to wide host range, resistance to insecticides and/or other characteristics.

• B-types generally resistant to pyrethroids, but resistance to newer insecticide groups still patchy.

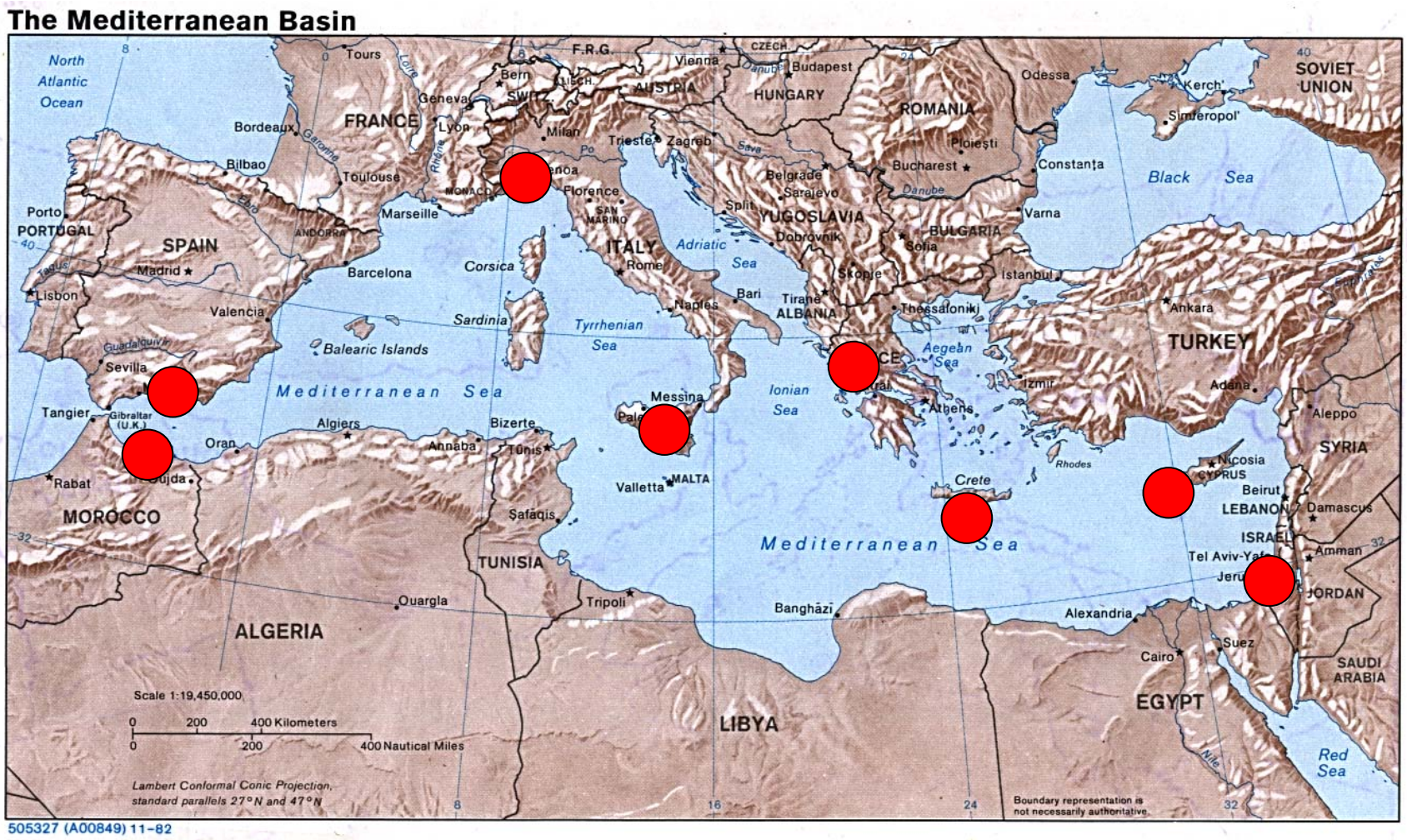
• However, some B-type populations are now strongly resistant to newer products (e.g. Guatemala).

Historical perspective: 2

• Q-types formerly restricted to Mediterranean (?) where resistance to a broad range of insecticides (neonicotinoids, IGRs, pyrethroids) is now widespread

Spread of neonicotinoid resistance and Q-biotypes in the Mediterranean basin

Bemisia tabaci



Historical perspective: 2

• Q-types formerly restricted to Mediterranean (?) where resistance to a broad range of insecticides (neonicotinoids, IGRs, pyrethroids) is now widespread

• Q-types currently common over much of the Mediterranean, but not ubiquitous (B-types still occur).

• Q-types (plus multiple resistance) are now being transported on ornamentals to other parts of the world (e.g. USA, Japan, China, northern Europe)

…but care needed over claiming provenance!!

Dynamics of B- and Q-types appear to reflect interactions between resistance and other biological attributes

BUT

Concerns over Q-types relate primarily to its multi-resistance profile

(Invasions of multi-resistant B-types constitute an equally serious threat (would these be detected?)

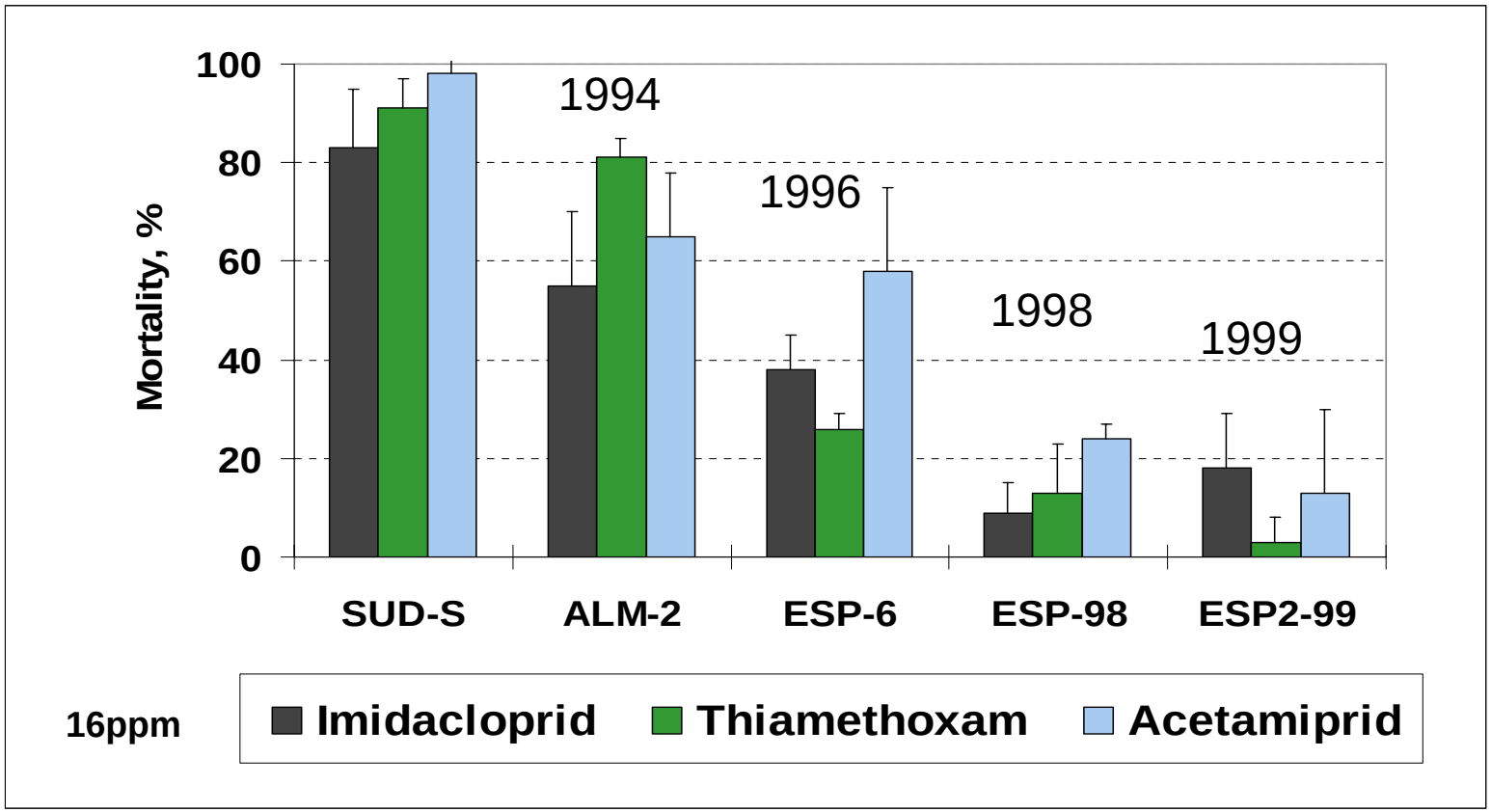
Resistance in Q-types in Europe

1. Neonicotinoids

- Now very potent in many regions

Resistance monitoring in Almeria, Spain

Almeria/Spain



Resistance in Q-types in Europe

1. Neonicotinoids

- Now very potent in many regions
- Broad-spectrum across group

Neonicotinoid resistance in *B. tabaci* from Almeria, Spain - 1999 and 2000

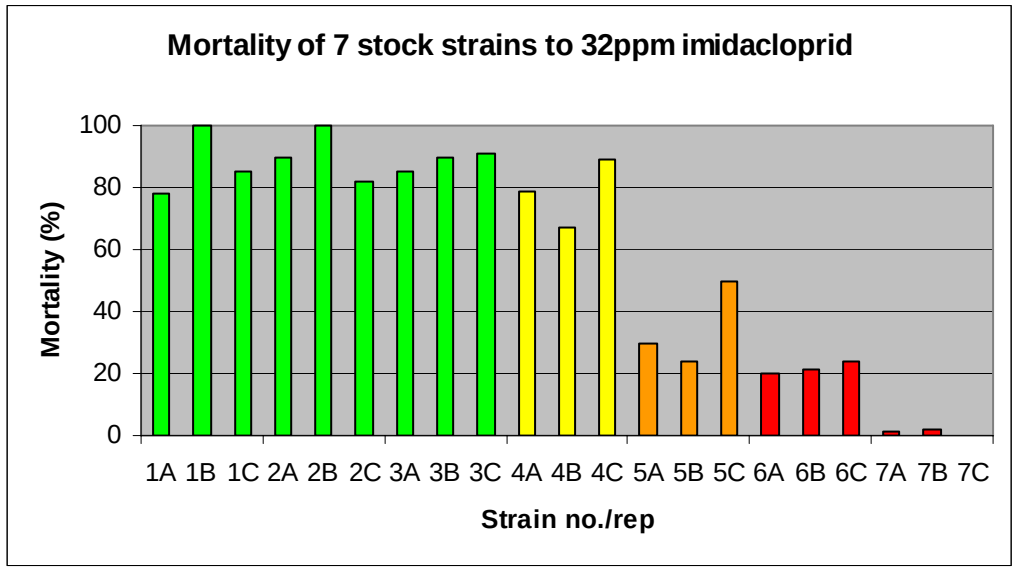
	Resistance factor: Imidacloprid	Thiamethoxam	Acetamiprid
Sudan -S	**1**	**1**	**1**
Esp-1999	**33**	**53**	**38**
Esp-2000	**>1000**	**301**	**142**

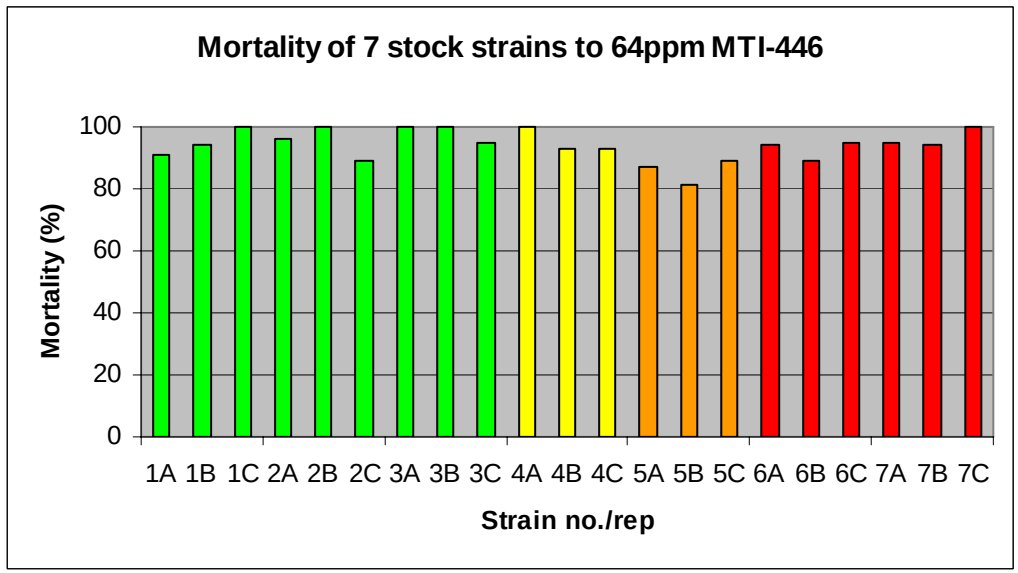
- dramatic increase in resistance levels
- broad cross-resistance among neonicotinoids
- major impact on control efficacy

Source: Stumpf and Nauen (Bayer)

Discriminating dose bioassays

No.	Strain name	Imid' resistance status
1	EGYPT1	S
2	PAK9	S
3	GRB	S
4	ALM1	LOW R
5	ESP99	MED R
6	AGUADULCE	HIGH R
7	SPAIN-R	HIGH R



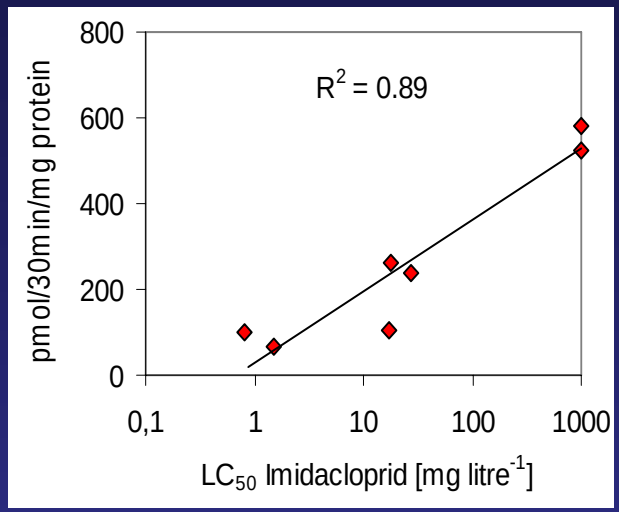


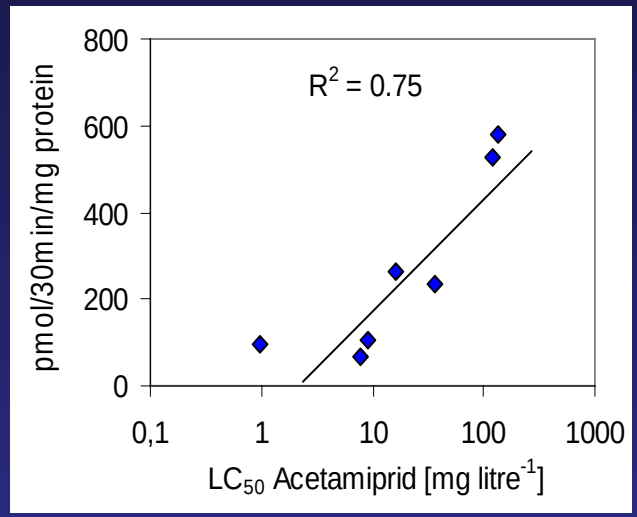
Resistance in Q-types in Europe

1. Neonicotinoids

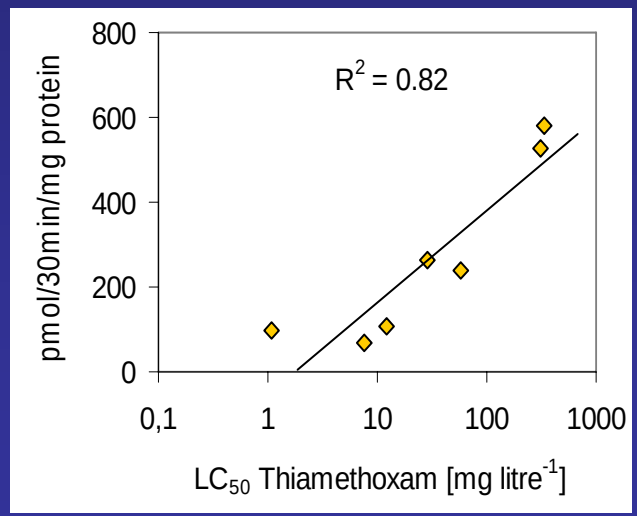
- Now very potent in many regions
- Broad-spectrum across group
- Conferred (solely?) by enhanced monoxygenase activity

Neonicotinoid resistance in *B. tabaci*

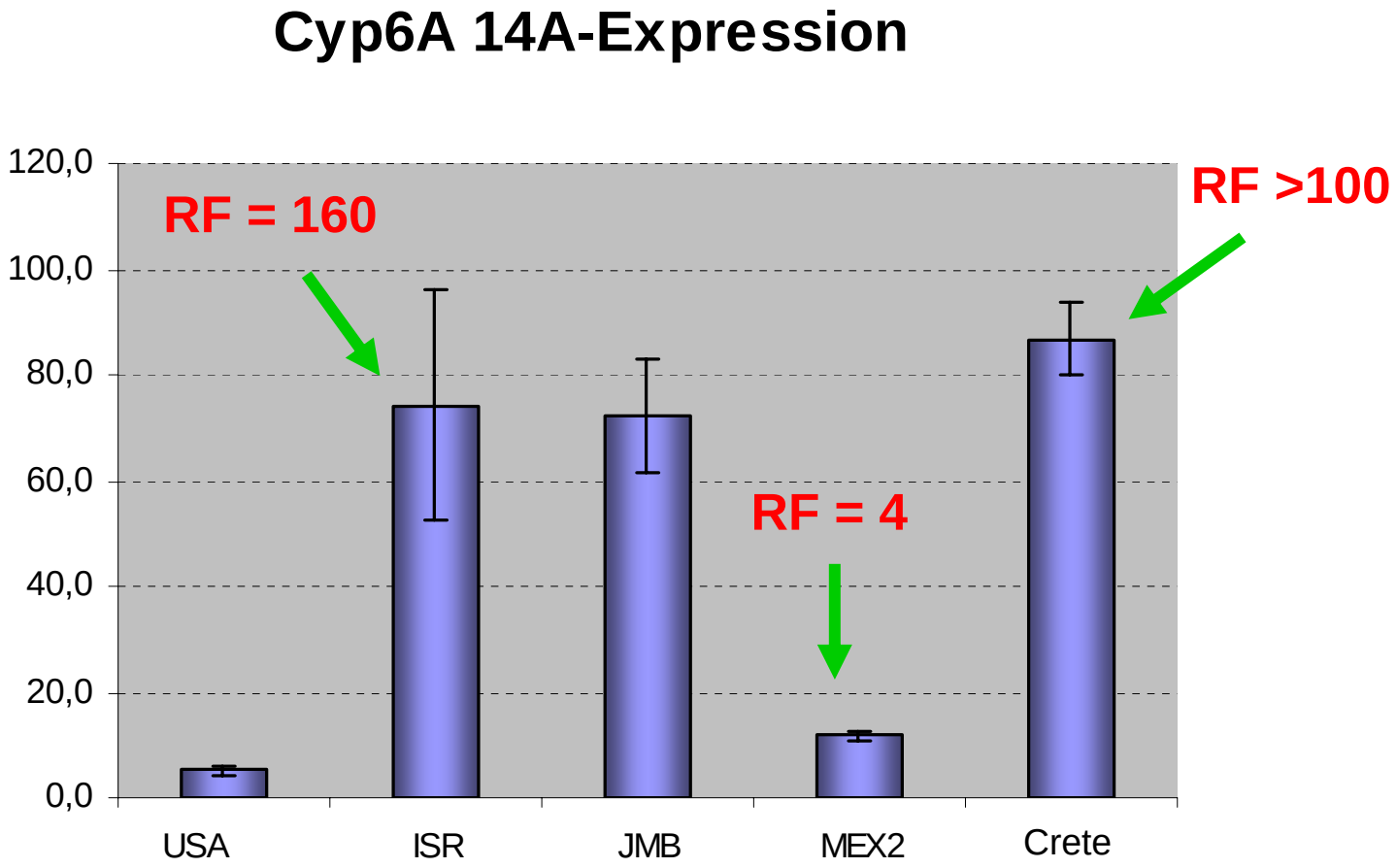




Resistance factors strongly correlated with cytochrome P450-dependent mono-oxygenase activity



Biochemistry of neonicotinoid resistance – molecular analysis of *B. tabaci* P450 genes identified *cyp6A14A* levels linked to neonicotinoid resistance*



*Data kindly provided by Dr. Juergen Benting (Bayer CropScience, Monheim, Germany)

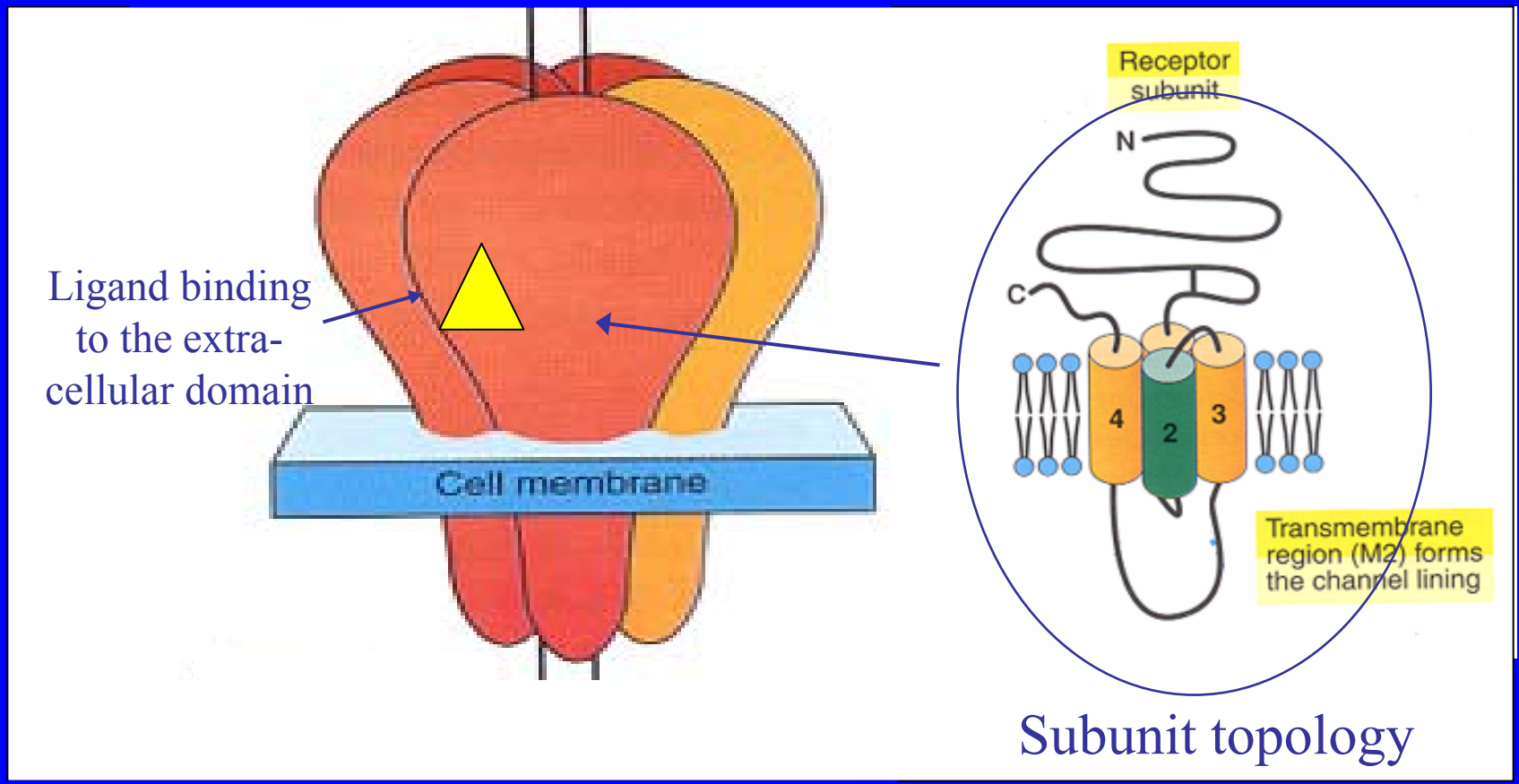
Resistance in Q-types in Europe

1. Neonicotinoids

- Now very potent in many regions
- Broad-spectrum across group
- Conferred (solely?) by enhanced monoxygenase activity
- Therefore cross-resistance to pymetrozine
- No target-site resistance (so far)

Brown planthopper, *Nilaparvata lugens*

Structure of the nicotinic acetylcholine receptor (nAChR)



- complex pentameric structure
- diversity of subunits implies a diversity of receptor structures?
- if so, is a single mutation in one subunit gene sufficient for resistance?

A tyrosine (Y) to serine (S) mutation in the Nlalpha1 and Nlalpha3 subunits confers broad-spectrum target-site insensitivity to neonicotinoids

Resistance in Q-types in Europe

2. Pyriproxyfen

- Highly potent, specific, monogenic
- Mechanism unknown

3. Buprofezin

- Little studied, assumed to be significant

3. Pyrethroids

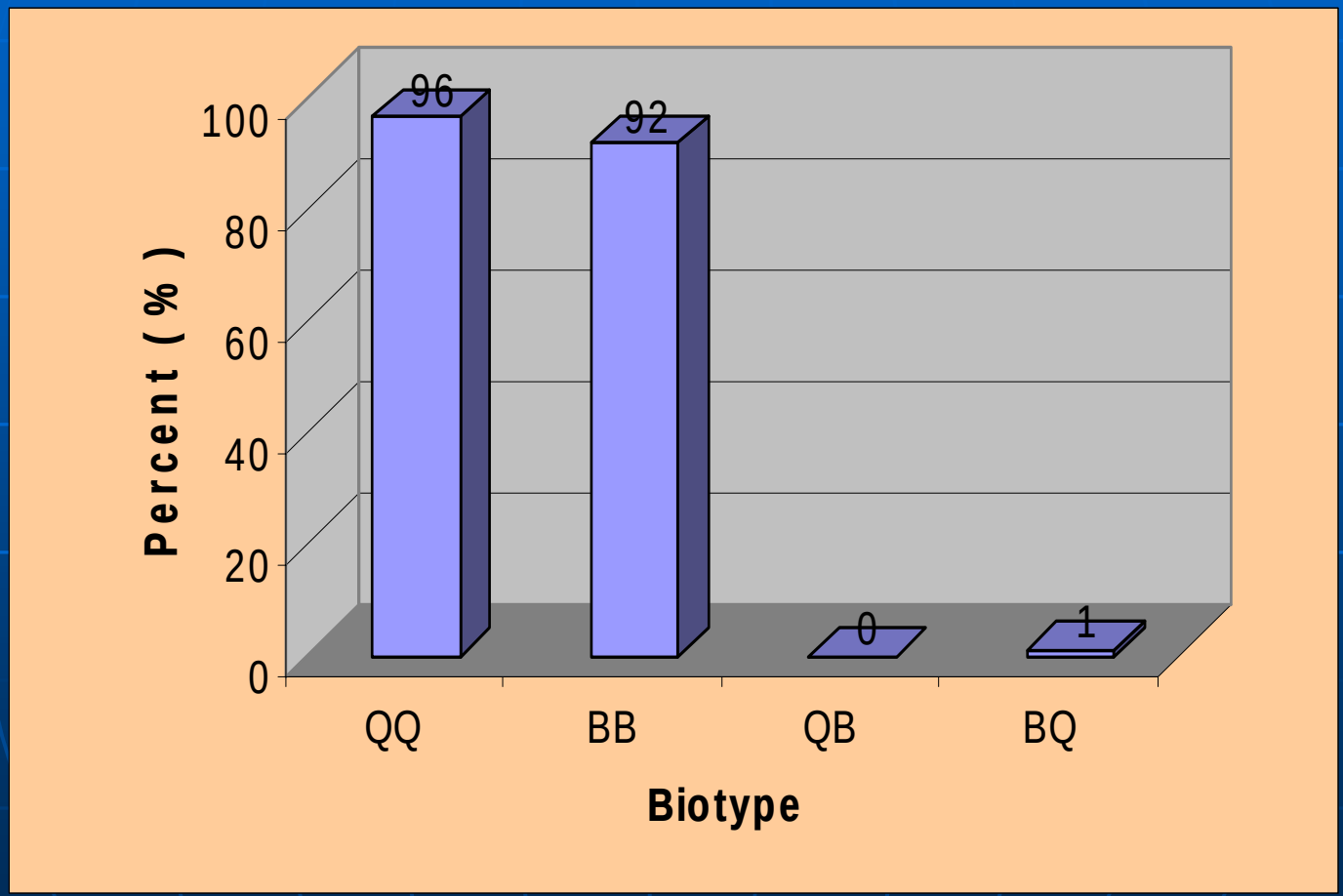
- Widespread, potent, combination of detoxification and target-site insensitivity (kdr)

No known resistance to spiromezifen, abamectin, (others?)

Biology of B- and Q-types

Can resistance (and other) genes be transferred between biotypes?

Percentage of crosses producing female F_1 offspring



Pre-zygotic barriers

Pre-copulation: pairing

Intra- and inter- biotype crosses paired with similar success and within a similar time period

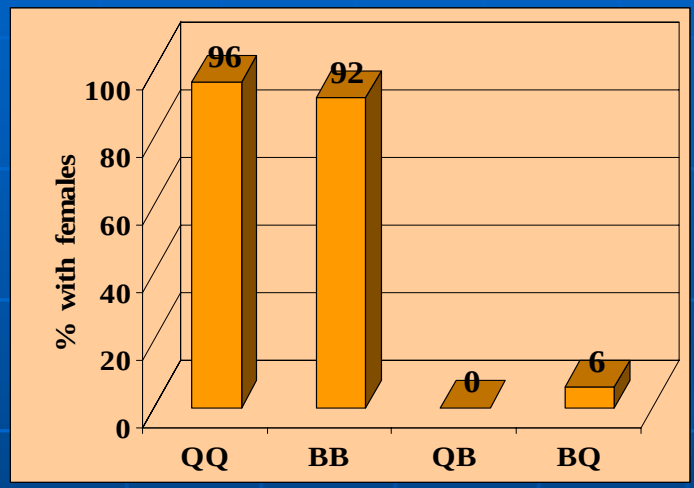
Copulation: mating

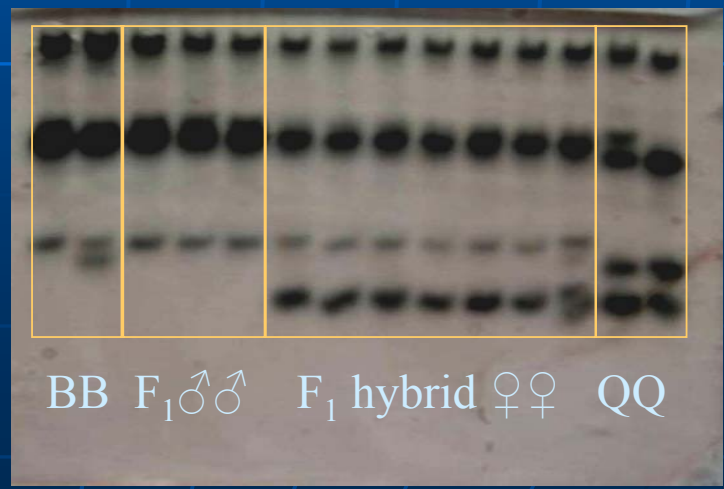
All intra-biotype pairs copulated within 4-30 minutes of pairing

All inter-biotype pairs failed to copulate within 3 hours (duration of exp.), apparently due to female rejection

Post-zygotic results

- Some inter-biotype crosses produced F_1 females
- Hybrid status confirmed
- All (100's) F_2 progeny failed to develop past the egg stage





Biology of B- and Q-types

Can resistance (and other) genes be transferred between biotypes?

Pre- and post-zygotic reproductive barriers, so seems unlikely……

….. but would be difficult to track if genes conferring ‘B-ness’ and ‘Q-ness’ get detached from biotype ‘markers’

Biology of B- and Q-types

Competition between biotypes

Pascual and Callejas (2004), Nombela *et al.* (2002), Horowitz *et al.* (2005):

Evidence that B-types can out-compete Q-types when insecticides aren't used (or when 'unresisted' insecticides used?). Is this due to fitness drawbacks associated with resistance in Q-types, or a general handicap?

Rothamsted (unpublished data)

Outcome of using 'equally resisted' strains inconsistent.

Control of Q-types in Europe

• Use of less-resisted insecticides or mixtures (but *ad hoc* at times)

• More widespread application of IRM recommendations (cf. Israel and USA)

• Reduce use of insecticides

- insect-proof netting, double doors, UV film etc.

- mass release of biocontrol agents (do biotypes differ in vulnerability to BCA's?)