Q and B biotypes—distribution, crop relation, and their relevance to insecticide resistance

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Two biotypes of *B. tabaci* have been identified in Israel:

- **B** - (early 1990’s)
- **Q** - (2000)
RAPD-PCR products of various *Bemisia tabaci* strains from Israel

Lane 1 - DNA ladder; 5 - a sample without DNA

Lanes 2, 4, 7 - samples from Sde-Eliyahu, w-Negev & standard B

Lanes 3, 6 – samples from the Carmel Coast & standard Q
Biotypes of *B. tabaci* in Israel, 2002-5
## Crossing studies, Q/B (field strains)

<table>
<thead>
<tr>
<th>Parents</th>
<th>Offspring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>Males</td>
</tr>
<tr>
<td></td>
<td>Females</td>
</tr>
<tr>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Negev (B)</td>
<td>Negev (B)</td>
</tr>
<tr>
<td>Negev (B)</td>
<td>Arava (Q)</td>
</tr>
<tr>
<td>Arava (Q)</td>
<td>Arava (Q)</td>
</tr>
<tr>
<td>Arava (Q)</td>
<td>Negev (B)</td>
</tr>
</tbody>
</table>
In the Arava Valley (Israel); biotype survey was conducted during 2004–5.
Organic vs. conventional crops

- In the Arava Valley (Israel); biotype survey was conducted during 2004 – 2005.

- Greenhouse organic peppers, cucumbers and melons – B.

- Conventional greenhouses – Mostly Q
Proportion of *B. tabaci* biotype Q and B sampled from sunflower and cotton fields during 2005 cotton season in the Ayalon Valley, Israel

![Graph showing the proportion of *B. tabaci* biotype Q and B sampled from sunflower and cotton fields during 2005 cotton season in the Ayalon Valley, Israel. The graph includes dates from May 3 to August 24, with labeled applications of Endosulfan, 'Polo', and Cypermethrin. The graph also indicates the percent of Q insects in sunflower and cotton fields.]
Proportion of *B. tabaci* biotype Q and B sampled from sunflower and cotton fields during 2005 cotton season in the Carmel Coast, Israel.

The graph shows the proportion of *B. tabaci* biotype Q and B from May 31 to August 24, with data points marked for each date. The graph includes annotations for Endosulfan and ‘Polo’ treatments and shows the percentage of Q biotype in both sunflower and cotton fields.
Biotype tolerance to insecticides affects their field composition

A ↔ B
B ↔ Q
Various populations of *Bemisia tabaci* collected in Israel, their biotype definition and resistance to pyriproxyfen

<table>
<thead>
<tr>
<th>Strain</th>
<th>Collection date</th>
<th>Location</th>
<th>Biotype</th>
<th>Resistance (RR)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>S</em></td>
<td>1987</td>
<td>Tzor’a</td>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td>Yesha-99</td>
<td>1999</td>
<td>W- Negev</td>
<td>B</td>
<td>2</td>
</tr>
<tr>
<td>BD-00</td>
<td>2000</td>
<td>Bet Dagan</td>
<td>B</td>
<td>4</td>
</tr>
<tr>
<td>Negev-00</td>
<td>2000</td>
<td>W- Negev</td>
<td>B</td>
<td>0.4</td>
</tr>
<tr>
<td>BS-00</td>
<td>2000</td>
<td>Bet She’an</td>
<td>B</td>
<td>9</td>
</tr>
<tr>
<td><em>Pyri-R</em></td>
<td>1991</td>
<td>GH, W- Negev</td>
<td>Q</td>
<td>1,200</td>
</tr>
<tr>
<td>HC-00</td>
<td>2000</td>
<td>Carmel Coast</td>
<td>Q</td>
<td>637</td>
</tr>
<tr>
<td>AV-99</td>
<td>1999</td>
<td>Ayalon Valley</td>
<td>Q&gt;b</td>
<td>167</td>
</tr>
<tr>
<td>AV-00</td>
<td>2000</td>
<td>Ayalon Valley</td>
<td>Q&gt;b</td>
<td>81</td>
</tr>
<tr>
<td>W-Gal</td>
<td>2000</td>
<td>W- Galilee</td>
<td>Q&gt;b</td>
<td>25</td>
</tr>
</tbody>
</table>
Monitoring pyriproxyfen resistance,
Carmel Coast 2002-3

Egg mortality (%) vs. Concentration (ppm)

Early season

Late season

B

Q

2002LS
2003ES
2003LS

HC-03-tig
Resistance to Pyriproxyfen and biotype Q

- In areas where the use of pyriproxyfen ceased, resistance levels declined to some extent, while...
- Level of susceptibility was restored completely in the lab (gen. 15-20).
- Biotype-related resistance?
Monitoring Pyriproxyfen Resistance, Ayalon Valley, Israel
Lab assays
Susceptibility of *B. tabaci* strain (AV-02) to pyriproxyfen

Laboratory conditions (15th generations)

Egg mortality (%)

- **S** = susceptible
- **G0** = the original strain
- **Unt** = untreated
- **Act** = selection to Actara (thiamethoxam)
- **Msp** = selection to Mospilan (acetamiprid)
Mix of Q&B (1:1, with similar R) maintained for 20 generations; partly pressurized with pyriproxyfen; another part - kept untreated.
Proportion of *B. tabaci* biotypes throughout the generations

<table>
<thead>
<tr>
<th>Generation</th>
<th>untreated</th>
<th>Pyri-selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-0</td>
<td>1B:1Q</td>
<td>1B:1Q</td>
</tr>
<tr>
<td>G-4</td>
<td>B</td>
<td>1B:1Q</td>
</tr>
<tr>
<td>G-8</td>
<td>B</td>
<td>Q&gt;B</td>
</tr>
<tr>
<td>G-12</td>
<td>B</td>
<td>Q</td>
</tr>
<tr>
<td>G-16</td>
<td>B</td>
<td>Q</td>
</tr>
<tr>
<td>G-20</td>
<td>B</td>
<td>Q</td>
</tr>
</tbody>
</table>
Interaction of *B. tabaci* Biotype

1. Both the B and Q biotypes are present in Israel
2. Field populations may consist of a mixture of biotypes
3. Reproductive incompatibility maintains their genetic isolation
4. A possible link exists between *B. tabaci* biotypes and insecticide resistance
5. Tolerance of Q-type to pyriproxyfen, neonicotinoids and other new insecticides (?)
6. Without exposure to insecticides – higher fitness to “B” (?)
7. Insecticide applications select for Q-type.
We can surmise the following scenario:

Appearance of Q biotype accompanies resistance to pyriproxyfen and/or neonicotinoids.

Treatments in accordance with IRM programs moderate selection for resistance to those insecticides and concurrently reduce the appearance of the Q-type.

Reuse of the above insecticides against *B. tabaci* may increase occurrence of the Q-type and development of resistance to one or another group of insecticides.

(Selection to insecticides in B biotype of *B. tabaci* is feasible, but it is probably slower than in the Q type).
Unsolved questions

1. Does B-type have higher fitness than Q-type (is it more competitive)?

2. Why does “B” take over “Q” after several generations under lab conditions?

3. Reproductive barrier: attraction, mating behavior, fertility, symbiont related?
Thanks for your attention