Naturalis®
(a.s. Beauveria bassiana strain ATCC 74040):
effective against Tetranychid mites and harmless to predatory Phytoseiid mites

Edith Ladurner, Massimo Benuzzi, Sergio Franceschini, Andrea Braggio
Intrachem Bio Italia S.p.A., R & D Department
Naturalis®

- **Naturalis** is a bioinsecticide containing at least $2.3 \times 10^7$ viable conidiospores / ml of *B. bassiana* strain ATCC 74040.

- ATCC 74040 was obtained from the cotton boll weevil, *Anthonomus grandis*, at the USDA-ARS Crop Insect Research Center, Lower Rio Grande Valley, Texas, USA (not genetically modified).

- In 2005 Intrachem Bio International S.A. (Geneva, Switzerland) acquired the intellectual property rights from Troy Biosciences Inc.

- Manufacturing occurs under the control of Intrachem Production S.r.l. (Bergamo, Italy).

- **Naturalis** is registered in USA, Mexico, Italy, Spain, Greece, Switzerland, Morocco, UK, Hungary, Cyprus, Slovenia, Ireland, Turkey (Dopteril), and Korea.

- Registration is pending in the Netherlands and Germany.
**Beauveria bassiana**

- *Beauveria bassiana* (Deuteromycetes, Moniliales) was first recognized in 1835 by Agostino Bassi as the causal agent of the white muscardine disease of the silkworm.
- *B. bassiana* can affect a wide range of arthropod pests, including mites, and all their developmental stages (eggs, immature stages, and adults).
- Various strains differ in their host range and selectivity.
B. bassiana ATCC 74040

Mode of action - contact bioinsecticide

- The conidiospores, in contact with the insect’s cuticle, germinate and form an appressorium.
- A fine penetration hypha perforates the cuticle, grows, and differentiates into other penetration hyphae. The fungus invades the insect’s body.
- The mycelium proliferates by feeding on the host’s haemolymph, and blastospores are produced.
- The host dies within a few days due to depletion of nutrients and dehydration.
Major targets

- White flies
- Tetranychid mites
- Thrips
- Wireworms
- Fruit flies (Tephritid flies)

Tetranychid mites

Strawberry, Spain 1998 (Agrichem Bio S.A.)

Tomato, Italy 2006 (Agrigeos)
**Summary of 3 recent laboratory studies on the effects of Naturalis on:**

<table>
<thead>
<tr>
<th>Study no.</th>
<th>Target mite (Prey)</th>
<th>Non-target mite (Predator)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Tetranychus urticae</em></td>
<td><em>Phytoseiulus persimilis</em></td>
</tr>
<tr>
<td>2</td>
<td><em>Tetranychus urticae</em></td>
<td><em>Neoseiulus californicus</em></td>
</tr>
<tr>
<td>3</td>
<td><em>Eotetranychus carpini</em></td>
<td><em>Kampimodromus aberrans</em></td>
</tr>
</tbody>
</table>
Assessments
- % corrected mortality according to Abbott on eggs and females
  \[ M(\%) = \frac{(MT - MC)}{(100 - MC)} \times 100 \]
- fecundity (no. eggs/female/day)
- % egg hatching
- effects on generation exposed to treatment (F0) and successive generation (F1)

Exposure
- Type: direct contact (micro-immersion bioassays; leaf dip bioassays; direct spray)
- Applied rate: recommended field rate of Naturalis (80-120 ml/100 l; 0.08-0.12% v/v)

Material and Methods
- for details see cited literature
Results Study 1

Tetranychus urticae & Phytoseiulus persimilis

% corrected mortality (Abbott)

## Results Study 1

**Tetranychus urticae & Phytoseiulus persimilis**

No. eggs/female/day (F0) and % egg hatching

### Prey

<table>
<thead>
<tr>
<th></th>
<th>Tetranychus urticae</th>
<th></th>
<th>Phytoseiulus persimilis</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. eggs/female/day</td>
<td>% egg hatching</td>
<td>No. eggs/female/day</td>
<td>% egg hatching</td>
</tr>
<tr>
<td>Naturalis</td>
<td>0.04</td>
<td>0.0</td>
<td>1.6</td>
<td>82.5</td>
</tr>
<tr>
<td>Control</td>
<td>3.51</td>
<td>81.0</td>
<td>3.1</td>
<td>86.5</td>
</tr>
</tbody>
</table>

### Predator

Results Study 2
*Tetranychus urticae* & *Neoseiulus californicus*

% corrected mortality (Abbott)

<table>
<thead>
<tr>
<th></th>
<th>Eggs</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prey</td>
<td>85.5</td>
<td>53.5</td>
</tr>
<tr>
<td>Predator</td>
<td>19.7</td>
<td>20.6</td>
</tr>
</tbody>
</table>

Simoni et al., 2010. Attività di *Beauveria bassiana* sull’acaro fitofago *Tetranychus urticae* e sul fitoseide *Neoseiulus californicus*. Atti Giornate Fitopatologiche 1, 305-310.
**Results Study 2**

*Tetranychus urticae & Neoseiulus californicus*

No. eggs/female/day of females exposed to treatment (F0) and females of 1st generation after treatment exposure (F1)

### Prey

<table>
<thead>
<tr>
<th>Prey</th>
<th>Tetranychus urticae</th>
<th>No. eggs/female/day</th>
<th>No. eggs/female/day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F0</td>
<td>F1</td>
</tr>
<tr>
<td>Naturalis</td>
<td>2.9</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>4.7</td>
<td>5.2</td>
<td></td>
</tr>
</tbody>
</table>

### Predator

<table>
<thead>
<tr>
<th>Predator</th>
<th>Neoseiulus californicus</th>
<th>No. eggs/female/day</th>
<th>No. eggs/female/day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F0</td>
<td>F1</td>
</tr>
<tr>
<td>Naturalis</td>
<td>1.3</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>2.4</td>
<td>2.7</td>
<td></td>
</tr>
</tbody>
</table>

Simoni et al., 2010. Attività di *Beauveria bassiana* sull’acaro fitofago *Tetranychus urticae* e sul fitoseide *Neoseiulus californicus*. Atti Giornate Fitopatologiche 1, 305-310.
Results Study 3
Eotetranychus carpini & Kampimodromus aberrans

% corrected mortality (Abbott)

... something to consider:

**Example - active substances for mite control on tomato**

<table>
<thead>
<tr>
<th>Active substance</th>
<th>Status (Annex I)</th>
<th>Target stage</th>
<th>MRL (tomato)</th>
<th>PHI (tomato)</th>
</tr>
</thead>
<tbody>
<tr>
<td>abamectin</td>
<td>included</td>
<td>all mobile stages</td>
<td>0.02</td>
<td>7</td>
</tr>
<tr>
<td>clofentezine</td>
<td>included</td>
<td>eggs</td>
<td>0.3</td>
<td>15</td>
</tr>
<tr>
<td>etoxazole</td>
<td>included</td>
<td>eggs, larvae</td>
<td>0.02 *</td>
<td>3</td>
</tr>
<tr>
<td>fenpyroximate</td>
<td>included</td>
<td>all mobile stages</td>
<td>0.2</td>
<td>14</td>
</tr>
<tr>
<td>tebufenpyrad</td>
<td>included</td>
<td>all mobile stages</td>
<td>0.5</td>
<td>14</td>
</tr>
<tr>
<td>B. bassiana GHA</td>
<td>included</td>
<td>?</td>
<td>n.r. **</td>
<td>0</td>
</tr>
<tr>
<td>B. bassiana ATCC 74040</td>
<td>included</td>
<td>all</td>
<td>n.r. **</td>
<td>0</td>
</tr>
<tr>
<td>hexythiazox</td>
<td>voluntarily withdrawn</td>
<td>eggs, larvae</td>
<td>0.5</td>
<td>7</td>
</tr>
<tr>
<td>fenazaquin</td>
<td>voluntarily withdrawn</td>
<td>all</td>
<td>0.5</td>
<td>7</td>
</tr>
<tr>
<td>fenbutation oxide</td>
<td>voluntarily withdrawn</td>
<td>all mobile stages</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>propargite</td>
<td>voluntarily withdrawn</td>
<td>all mobile stages</td>
<td>2</td>
<td>15</td>
</tr>
</tbody>
</table>

* indicates lower limit of analytical determination
** not requested

Source: [http://ec.europa.eu/sanco_pesticides/public/index.cfm](http://ec.europa.eu/sanco_pesticides/public/index.cfm);
Win BDF, Banca dati Agrofarmaci: [http://www.winbdf.it](http://www.winbdf.it)
Naturalis against Tetranychid mites - benefits:

- effective against all stages, especially eggs
- unique mode of action, different from that of any conventional chemical acaricide
- suitable for inclusion into resistance management strategies (can be tank-mixed with numerous insecticides and acaricides)
- no pre-harvest interval and no detectable MRL: useful to reduce risk of undesired residues in final produce
- safe to beneficials, humans, and environment
- suitable for any pest management strategy, Organic Farming included

In conclusion, Naturalis can be considered a valuable pest management tool for sustainable agriculture!
Thanks are due to:

- Prof. Carlo Duso
  University of Padova, Italy

- Dr. Sauro Simoni
  CRA - Agricultural Research Council, Florence, Italy

- Agrichem Bio S.A.
  Madrid, Spain

you for your attention!