Efficacy of SERENADE® on Grape (Chardonnay) Powdery Mildew, Bunch Rot, Sour Rot (Yolo County, CA - 1999)

- Selling in US, Chile, Mexico, Costa Rica, Japan, Philippines, Guatemala, Honduras, New Zealand, Israel, Switzerland; Pending EU, Argentina
- No performance failures after >2 million pounds sold
- No significant grower complaints
- +80% conversion from demo to sale

Unique Combination of Lipopeptides

Chemistry Profile of Serenade

- Iturins
- Surfactins
- Agrastatins/Pipastatins

Unique combination of lipopeptides: a unique blend of biofungicides designed to combat grape diseases effectively. The profile includes a variety of compounds, each with specific roles in disease control. The diagram illustrates the chemical composition and relative abundance of these compounds over time, highlighting their efficacy in preventing and managing powdery mildew, bunch rot, and sour rot in grapes.

Merrill Lynch
Botrytis Gray Mold 0% inhibition: Iturins 10ppm or Agrastatins 50ppm

Botrytis Gray Mold 90% inhibition: Iturins 10ppm + Agrastatins 2.5ppm

The lipopeptide compounds in Serenade synergize each other but are not active alone.

Serenade Makes Chemical Programs Better

- Serenade synergizes many classes of synthetic chemistry: EBDCs (e.g., dithane, maneb), Topsin, and strobilurin chemistry
- Combining Serenade in tank mix or rotation with lower rates of chemicals provides better results than chemical only programs

Proven examples:
- Florida tomatoes: 2lbs + 2 lbs copper
- Bananas: Serenade + 1/2 rate mancozeb
- Beans: 2lbs Serenade + 1-2 lbs Topsin
- Apples: reduce Captan in scab program
- Lower rate of sulfur on all crops
Serenade as a resistance management tool

A major banana company has observed that farms that applied Serenade 20 times a year in a program for sigatoka control had higher strobilurin susceptibility than farms that applied Serenade only 6-8 times in a year.

Product Line Extensions

- Rhapsody® for disease control of ornamentals: commercial growers of flowers, foliage and bedding plants, trees
- Great for resistance management

- ‘Serenade Garden’ 24 oz Ready to Use in ~800 stores 2004
- New category - first certified organic pesticide in Wal-Mart
- Small revenue for W-M but growth rate higher than conventional products
Arabesque™ BioFumigant

*Muscodor albus,* a new fungal species

Fungus isolated from cinnamon tree bark, Honduras

Stops and kills a range of molds, bacteria, insects, nematodes

Produces a mixture of >20 volatile (gaseous) compounds

---

**GC trace of volatile natural products produced by *Muscodor albus***

<table>
<thead>
<tr>
<th>Compound</th>
<th>Retention Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-methyl-1-butanol</td>
<td>10.00</td>
</tr>
<tr>
<td>2-methylbutyl isobutyrate</td>
<td>15.00</td>
</tr>
<tr>
<td>Isobutyric acid</td>
<td>20.00</td>
</tr>
<tr>
<td>Ethyl propionate</td>
<td>25.00</td>
</tr>
<tr>
<td>Isobutyl alcohol</td>
<td>30.00</td>
</tr>
<tr>
<td>Phenethyl alcohol</td>
<td>35.00</td>
</tr>
<tr>
<td>2-methybutyl acetate</td>
<td>40.00</td>
</tr>
</tbody>
</table>
Arabesque™ BioFumigant Controls Fruit Rots
(and many other molds and bacteria, including human pathogens E.coli, Salmonella and others)

Control of Tomato and Pepper Soil Diseases
- L: Soil mixed with M. albus and Rhizoctonia
- R: Soil mixed with Rhizoctonia only
- 40 days after transplanting
AgraQuest’s Pipeline

<table>
<thead>
<tr>
<th>Approval Timeline</th>
<th>Serenade®</th>
<th>Rhapsody® Biotune®</th>
<th>Biotune® Adjuvant</th>
<th>Sonata®</th>
<th>Virtuoso™ Arabesque™</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2003</td>
<td>2004</td>
<td>2005</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Serenade Biofungicide: Fruit, nut, veg diseases
- Serenade Garden: Garden plant diseases
- Rhapsody Biofungicide: Ornamental diseases
- Biotune Adjuvant: Enhances biopesticides
- Sonata Biofungicide: Downy & powdery mildews
- Ballad Biofungicide: Rusts in soybeans, cereals, legumes
- Arabesque Biofumigant: Molds, insects, nematodes
- Virtuoso Bioinsecticide: Caterpillars, flies, mites

Criteria for Successful Product Adoption

- Number 1 - Does it work? (as well or better than existing chemical pesticides)
- Number 2 - What does it cost?
- Number 3 - What other benefits are there? Is it safer?
The Value Proposition

- Growers can increase profits while increasing food and worker safety, reducing environmental impact, with protection right up until harvest

![Bar charts comparing conventional lettuce growers with organic growers.](chart)

Main Reasons Biopesticides Used
(from 2003 BPIA Market Survey)

<table>
<thead>
<tr>
<th>Reason Volunteered</th>
<th>FL PCA</th>
<th>CA Distributor</th>
<th>FL Grower</th>
<th>CA Grower</th>
<th>FL Grower</th>
<th>Golf Supt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmentally Safe:</td>
<td>30%</td>
<td>46%</td>
<td>43%</td>
<td>30%</td>
<td>75%</td>
<td></td>
</tr>
<tr>
<td>Operator Safety:</td>
<td>23%</td>
<td>29%</td>
<td>20%</td>
<td>23%</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Product Efficacy:</td>
<td>17%</td>
<td>29%</td>
<td>17%</td>
<td>13%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>More Natural/Safe:</td>
<td>10%</td>
<td>11%</td>
<td>10%</td>
<td>13%</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Public Perception:</td>
<td>9%</td>
<td>--</td>
<td>3%</td>
<td>7%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Organic Farming:</td>
<td>13%</td>
<td>--</td>
<td>--</td>
<td>3%</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>
Main Reasons Biopesticides Not Used (from 2003 BPIA Market Survey)

<table>
<thead>
<tr>
<th>Reason</th>
<th>Volunteered</th>
<th>CA PCA</th>
<th>FL Distributor</th>
<th>CA Grower</th>
<th>FL Grower</th>
<th>Golf Supt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not as Effective</td>
<td>44%</td>
<td>50%</td>
<td>27%</td>
<td>13%</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>Higher Cost</td>
<td>46%</td>
<td>36%</td>
<td>23%</td>
<td>23%</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>Lack of Awareness</td>
<td>14%</td>
<td>29%</td>
<td>47%</td>
<td>47%</td>
<td>43%</td>
<td></td>
</tr>
<tr>
<td>Old Habits</td>
<td>4%</td>
<td>--</td>
<td>13%</td>
<td>10%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Lack of Research</td>
<td>6%</td>
<td>7%</td>
<td>--</td>
<td>7%</td>
<td>15%</td>
<td></td>
</tr>
</tbody>
</table>

Biopesticides will play a role in the Future of California Agriculture

- Consumers and global trade are driving agriculture to more benign products
- Adoption may be faster outside the US
- There are many more new biopesticide AIs waiting approval than traditional products
- There is a gap between land grant university research and on-farm usage [researchers test stand-alone; farmers use tank mixes and rotational programs]
- On-farm demos with emphasis on IPM programs can bridge the gap
- Farmers need more information about these new products