Finding A Place for A New Microbial Biopesticide in Crop Protection Programs

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Who is Certis USA?

- Biopesticide developer, manufacturer & marketer
- Wholly owned by Mitsui & Co. (Fortune 500)
- Broad product portfolio (~30 active ingredients)
  - Microbials, botanicals, biochemicals, others
  - Agriculture, Ornamentals, Specialty, Home Garden
- Sales in over 50 countries, all continents except Antarctica
- Headquarters and R&D: Columbia, MD
- Manufacturing sites:
  - Wasco, CA (liquid fermentation)
  - Bangalore, India (neem extraction)
  - Butte, MT (solid fermentation)
- Dedicated North America field sales, technical & regulatory team
Active ingredient:
*Bacillus mycoides* isolate J (BmJ)

- Common species of bacterium in soil and plant samples worldwide.
- “Isolate J” from asymptomatic sugar beet foliage in field with severe *Cercospora* outbreak in Montana (Dr. Barry Jacobsen).
- Patented by Montana State University, licensed to Certis USA.
- Fermentation methods, scale-up and formulation developed by Certis.
Cercospora leaf spot in sugar beet

Field trials by B. Jacobsen (Montana State Univ.) & collaborators, 1996 - 2010.

Treatments:
1. Best labeled fungicide rotation (4 applications total).
2. BmJ alone (4 applications at $1 \times 10^6$ cfu/ml)
3. BmJ + ½ rate fungicide at disease onset, then 3 more BmJ applications.

% Efficacy vs. Untreated Check

Mean ± SEM over 11 growing seasons

Same disease control with fewer fungicide applications
• Little or no direct antagonistic effect on plant pathogens.
• Activates plant’s natural defenses against pathogens.
• Genetic and biochemical pathway similar to acibenzolar-S-methyl (Actigard®).
  – NPR1 - dependent
  – SA - independent
• New FRAC group:
  – P6 (microbial inducer of plant resistance).
• Induced resistance response detectable within 3 hours, lasts 18 – 21 days.
• No phytotoxicity in 20+ years of field trials.
**Registration/Labeling:**

- EPA & PMRA approved late 2016
  - OMRI listed (USA)
  - ECOCERT (Canada)
  - Exempt from residue tolerance - no PHI or MRL

- Water-dispersible granule (WG)
  - 40% active ingredient
  - Minimum 30 billion viable spores per gram

- Application rate:
  - 1.0 - 4.5 ounces/Acre
  - Target concentration: 4.5 oz/100 gal (= 10^7 spores/ml)

- Application methods
  - Ground sprayer
  - Aerial application (USA)
  - Stationary overhead sprinkler chemigation

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<table>
<thead>
<tr>
<th>Crop Type</th>
<th>Target Disease</th>
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<tbody>
<tr>
<td>Almond</td>
<td>Alternaria leaf spot</td>
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<tr>
<td>Citrus</td>
<td>Citrus canker</td>
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<tr>
<td>Cole crops</td>
<td>Downy mildew</td>
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<tr>
<td>Cucurbits</td>
<td>Anthracnose</td>
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<tr>
<td></td>
<td>Powdery mildew</td>
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<td></td>
<td>Downy mildew</td>
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<tr>
<td></td>
<td>Gummy stem blight</td>
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<tr>
<td>Tomato, peppers - all types</td>
<td>Bacterial leaf spot</td>
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<tr>
<td>(field &amp; greenhouse)</td>
<td>Bacterial speck</td>
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<tr>
<td></td>
<td>Early blight</td>
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<tr>
<td></td>
<td>Late blight</td>
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<td></td>
<td>Gray mold</td>
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<tr>
<td>Grapes</td>
<td>Downy mildew</td>
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<tr>
<td>Lettuce</td>
<td>Downy mildew</td>
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<tr>
<td></td>
<td>Powdery mildew</td>
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<tr>
<td>Legume veg</td>
<td>White mold</td>
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<tr>
<td>Pecan</td>
<td>Pecan scab</td>
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<td>Pome fruit</td>
<td>Fire blight</td>
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<tr>
<td>Potatoes</td>
<td>Early blight</td>
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<tr>
<td></td>
<td>Late blight</td>
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<td></td>
<td>White mold</td>
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<tr>
<td></td>
<td>Potato virus Y (seed)</td>
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<tr>
<td>Spinach (field &amp; greenhouse)</td>
<td>Downy mildew</td>
</tr>
<tr>
<td></td>
<td>Leaf spots</td>
</tr>
<tr>
<td>Sugar beet</td>
<td>Cercospora leaf spot</td>
</tr>
</tbody>
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See product label for specific use instructions and other information.
Potato Early Blight

Four applications on a 14-day interval by ATV-mounted R&D spray boom delivering 25 GPA at 30 psi through 2 nozzles/row.

RAUDPC = Relative Area Under the Disease Progress Curve.
Potato Late Blight

AUDPC

- 5 weekly applications by tractor-mounted side boom sprayer (45 GPA at 30 psi, 3 nozzles/row).
- Natural infection augmented by artificial inoculation with *P. infestans* (US-23).
- Although not effective alone, LifeGard replaced half of total fungicide when used in tank mix, without loss of efficacy.

**Efficacy (% reduction vs. UTC) indicated for each treatment.**

Final foliar blight severity (%)

- Weekly applications by ATV-mounted spray boom (25 GPA at 80 psi, 3 nozzles/row).
- Artificially inoculated with *P. infestans* (US-22).
- LifeGard alt. std. fungicide was as effective as full fungicide program. Reduced fungicide program w/o LifeGard was not.
Grape Downy Mildew

- 7 applications at 14d intervals with hooded boom sprayer (50 GPA pre- & 100 GPA post-bloom).
- LifeGard applied at 4.5 oz/100 gal (10^7 cfu/ml).
- Disease severity evaluated on 20 fruit clusters at harvest.
- LifeGard was as efficacious in stand-alone applications as a grower’s standard fungicide program.
- Reducing frequency of fungicide application by alternating with LifeGard resulted in the same efficacy as the full fungicide program. Reducing fungicide frequency without LifeGard resulted in more disease.
**Spinach - Final severity (%) 12 DAA5**

- Efficacy (% reduction relative to UTC) indicated for each treatment.

**Head Lettuce - AUDPC**

- Weekly appl. by CO₂ backpack (40 - 50 GPA, 3 nozzles).
- Inclusion of LifeGard in rotation with standard fungicides resulted in improved disease control with fewer total fungicide applications.

- Weekly appl. by CO₂ backpack (40 - 50 GPA, 3 nozzles).
- Products and rates per acre:
  - LifeGard (BmJ): 2.25 oz (10⁷ cfu/ml)
  - Blockade* (acibenzolar-S-methyl): 0.75 oz
- LifeGard performed similar to Blockade in a rotation with standard fungicides.

*Blockade® is a registered trademark of Syngenta Crop Protection, Inc.
Biopesticides in IPM?