Biostimulants and Biologicals: A Natural Synergy

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Ag Biotech, Inc.
Presentation Outline

- Plant hormones and crosstalk
- Main actives in Vitazyme
- Biofertilizers in general
- Bio Seed actives
- Our symbiotic Cycle
- Results in California
The Common Players

Functions governed by BRs

- Increased chloroplast development
- Promote cell expansion and division in shoots
- Root growth in low concentrations
- Pollen tube elongation+growth
- Seed germination
- Cell elongation when acting with auxins

No evidence for long distance transport, however, follow-up applications will compound the effects
Brassinosteroid signaling

Overall model

Cell Membrane

Nucleus

Courtesy of Thomas Gate:
https://www.youtube.com/watch?v=0KFvZimh36A
### Key proteins table

<table>
<thead>
<tr>
<th>Process</th>
<th>Abbreviation</th>
<th>Full name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biosynthesis</td>
<td>CPD DWF4</td>
<td>Cytochrome P450 monooxygenase CYP90A1 Steroid 22-alpha-hydroxylase</td>
</tr>
<tr>
<td>Inactivation</td>
<td>BAS1 SOB7</td>
<td>Degenerately functioning Cytochrome P450s</td>
</tr>
<tr>
<td>Receptors</td>
<td>BRI1 BAK1</td>
<td>Brassinosteroid Insensitive 1 BRI1 associated kinase</td>
</tr>
<tr>
<td>Signalling Circuitry</td>
<td>BKI BSK BSU1 BIN2</td>
<td>BRI1 kinase inhibitor S/T protein kinase S/T protein phosphatase Shaggy-related protein kinase</td>
</tr>
<tr>
<td>Transcription Factors</td>
<td>BES1 BZR1</td>
<td>BRASSINAZOLE-RESISTANT 2 BRASSINAZOLE-RESISTANT 1</td>
</tr>
</tbody>
</table>

BRI1 → BKI → BES1 and BZR1 → nucleus→ chloroplast development genes (GLK1/2) → Increases sensitivity to more brassinosteroids

Courtesy of Thomas Gate: [https://www.youtube.com/watch?v=0KFvZimh36A](https://www.youtube.com/watch?v=0KFvZimh36A)
Triacontanol: The Other Workhorse

- Fatty alcohol found in cuticle waxes and beeswax
- Mobile growth stimulant
- Not concentration sensitive
- Known for drought stress relief, enhancement of photosynthesis
- Increase of carbohydrate metabolism enzymes, L(+)‐adenosine
Triacontanol Mode of Action

**CASCADE EFFECT**

- **TRIA**
- **Cell membrane**
- **Secondary Messenger 9-B-L(+)-adenosine**
- **Enzymes Enzymes Enzymes**

**Increased metabolism**

**Accumulation of critical intermediary metabolic compounds**

**Greater dry weight and growth**
Plant response to Triacontanol

- Increased rate of CO2 fixation
- Increase in specific activity of RuBisCO and phosphoenolpyruvate carboxylase
- Increased activity of key respiratory enzyme malate dehydrogenase
- Net increase in CO2 uptake
- Increased carbohydrate and amino acid production

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Bacteria

Fungal hyphae bring nutrients to roots

Plant exudates exit roots

Microbial metabolites enter roots
Guaranteed analysis:

- Paenibacillus azotofixans...... $1 \times 10^6$ CFU/g
- Bacillus megaterium ............ $1 \times 10^6$ CFU/g
- Bacillus mucilaginosus......... $1 \times 10^6$ CFU/g
- Bacillus subtilis ................ $1 \times 10^6$ CFU/g
- Trichoderma harzianum ....... $1 \times 10^6$ CFU/g
Known Benefits

- Conversion of unavailable forms of N P and K into plant available forms in the soil solution
- Balancing of the C:N ratios in the soil
- Improving seedling vigor + Leaf area index
- Non-crop specific inoculate
- Facultative, Gram-positive strains - 1 yr stability
- **Rhizosphere - competent**
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grower’s standard</td>
<td></td>
</tr>
<tr>
<td>Grower’s standard + PGH</td>
<td></td>
</tr>
<tr>
<td>Bio Seed 0.1% seed weight</td>
<td></td>
</tr>
<tr>
<td>Bio Seed 0.2% of seed weight</td>
<td></td>
</tr>
</tbody>
</table>

**Tomatoes, day 19**
Salinas, CA 2019
Increased chloroplast development
Cell expansion and division in shoots
Root growth
Pollen tube elongation + growth
Net increase in CO2 uptake
Increased carbohydrate and amino acid production

**The Symbiotic Cycle**

- **The plant feeds the soil organisms**
  - Cyanobacteria
  - Bacteria
  - Fungi
  - Actinomycetes
  - Algae
  - Protozoa

- **Soil organisms feed the plant**
  - Vitazyme active agents
  - Hormones
  - Growth regulators
  - Antibiotics
  - Enzymes
  - Minerals

Conversion of N P and K into plant available forms
Carbon sequestration
Growth of auxiliary root network
2018 Strawberry Results

Holden Research and Consulting, Oxnard, CA

- July 16 planting date
- 18 pickings Oct 2nd - Dec 5th
- 50 g/ac Bio Seed + 16 oz/ac Vitazyme in drench
- 5 Foliar Vitazyme applications (every 3 weeks)
- Treated and control blocks received NPK applications
- Program cost: $65.60
# Results

<table>
<thead>
<tr>
<th>Programs</th>
<th>Total marketable  8lb trays/acre</th>
<th>Total Net returns/acre</th>
<th>% Marketable berries</th>
<th>Net profit/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grower’s standard</td>
<td>1191 b</td>
<td>$7800</td>
<td>62.0 b</td>
<td>----</td>
</tr>
<tr>
<td>Bio Seed + Vitazyme</td>
<td>1529 a</td>
<td>$10,516</td>
<td>66.1 a</td>
<td>$2650</td>
</tr>
<tr>
<td></td>
<td>+ 338</td>
<td>+ $2716</td>
<td>+ 4.1</td>
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</tr>
</tbody>
</table>

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**Chart 2:** Vitazyme in Strawberries - Ventura County - Fall 2018 - Cumulative Marketable Production by Pick Day

**Chart 4:** Vitazyme in Strawberries - Ventura County - Fall 2018 - Cumulative Marketable Production Net Return by Pick Day

*Means followed by the same letter do not significantly differ (P < 0.05) – Holden Research and Consulting.*

*Holden Research and Consulting - David Holden*
2018 Cabbage Results

Holden Research and Consulting, Oxnard, CA

- Oct 11 planting date
- Harvested Jan 4, 2019
- 400 lbs 6-24-24, followed by AN 20/ CAN 17
- 50 g/acre Bio Seed + 16oz/acre Vitazyme in drench at planting
- Foliar sprays of Vitazyme at 18 and 47 DAP
## Results

<table>
<thead>
<tr>
<th>Programs</th>
<th>Marketable head weight (g/head)</th>
<th># 50 lb Boxes/acre</th>
<th>Tons/acre</th>
<th>Added Income</th>
<th>Net Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grower’s Standard</td>
<td>784.2 b</td>
<td>878 b</td>
<td>21.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bio Seed + Vitazyme</td>
<td>886.3 a</td>
<td>970 a</td>
<td>24.25</td>
<td>$2252</td>
<td>$2208</td>
</tr>
</tbody>
</table>

+ 102.1 g  + 92  + 2.3

![Cabbage yield graph](image)