BIOLOGICAL CONTROL
GLOBAL MARKET OVERVIEW
Outline

• Introduction
• Bio Industry
  – Definition
  – Market Drivers
  – Bio Companies
  – Consolidation
  – Top Bio Companies
• Biocontrol Market
  – Products
  – Historic Growth
• Biocontrol Landscape
  – Product Types
  – Use Segments
  – Regions / Key Countries
Introduction

2011—Co-Founded DunhamTrimmer LLC
- Premier Biological Industries
- Strategic Business Consulting & Market Research Firm
- Clients: Multinational CPC; Bio Companies; Investors; NGO’s
- Due Diligence, Multi-client market data, Single client studies

2013—Launched 2BMonthly
- The Global Biocontrol & Biostimulant E-Newsletter
- All the Bio news direct to your inbox monthly
- Joint effort New Ag Int’l & DunhamTrimmer
- Subscribers: Companies, individuals interested in biological industries
**BIOLOGICAL MARKET OVERVIEW**

--- INTRODUCTION ---

**PRODUCT TYPES**

- **Biofertilizers**
  - Microbials used to enhance plant nutrient uptake from soil
  - Microbials primarily bacteria, often used as seed or soil treatment to aid in nutrient assimilation
  - Biofertilizers regulated under country/state fertilizer regulations

- **BioStimulants**
  - Seaweed Extracts make up the largest segment in this group
  - Organic acids are humic and fulvic acids used as soil amendments, formed by the microbial degradation of plant matter
  - Microbials, primarily bacteria, often used as seed or soil treatment to aid in nutrient assimilation
  - Definition and regulation of biofertilizers is still under development in most parts of the world

- **BioPesticides**
  - Biopesticides are derived from natural materials, such as plants, bacteria, and certain minerals
  - Biopesticides target specific pests and are inherently less toxic than synthetic pesticides

- **Biological Control Products**
  - Insects, Mites, Nematodes

- **Macroorganisms**
  - Insects; Mites; Nematodes

- **Biochemicals**
  - Plant Extracts; Minerals & Others; PGRs; Semiochemicals; Organic Acids
  - Plant Extracts make up the largest segment in this group
  - Semiochemicals (pheromones) has the largest actual number of products
  - Largest challenge for Plant Extracts is manufacturing and consistent quality in the active ingredient(s)

- **Microbials**
  - Bacteria; Fungi; Virus; Protozoan; Yeasts
  - Bacteria, followed by Fungi make up the largest groups commercially (>90%)
  - Microbials are the largest market of biopesticides at US$1.3 Bn.
  - Biggest challenges for microbials are formulation related: 1) Shelf-life; 2) Stability; 3) Performance enhancement
Bio Market Drivers

- **Regulatory**
  - Lower cost & shorter timeline
- **Pest Resistance**
  - Multiple MOA (Mode of Action)
- **Portfolio Mgmt Tools**
  - Full Program Offer
- **Food Marketers/Consumer Demand**
  - Reduced chemical residues
- **Worker safety/flexibility**
- **Sustainability**

<table>
<thead>
<tr>
<th></th>
<th>Manufacturers</th>
<th>Growers</th>
<th>Consumers</th>
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<tbody>
<tr>
<td>Regulatory</td>
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<tr>
<td>Pest Resistance</td>
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<td>✓</td>
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<td>Portfolio Mgmt Tools</td>
<td>✓</td>
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<tr>
<td>Food Marketers</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Worker safety</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Sustainability</td>
<td>✓</td>
<td>✓</td>
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</tbody>
</table>
Future Market Drivers

• Fewer new synthetic crop protection active ingredients will emerge - too expensive, too long!
• Crop improvement, including GMOs and new gene edited crops, will be the cornerstone of agriculture for defined traits/markets
• Improved market access for biopesticides & biostimulants will drive market growth, together with new technologies and compatible solutions
• Federal registration guidelines for Biostimulants in EU and possibly USA will make market more attractive
• Integration of cost-effective alternatives – ICM for sustainable agriculture
Biological Companies

- >400 Bio Companies*
- >200 Biocontrol Companies*
- >100 Biostimulant Companies*
  *(outside of India/China)

- 98% of Bio Companies are Privately Held
- ~5 Biocontrol Companies have > $100 Mn AR
- 75% of Biocontrol companies have <$10 Mn AR
- Biocontrol Companies are Found Worldwide

- Founded by Research individuals
- Most apparent weakness is Market Access—lack resources
- Generally lack funding for rapid market growth

Crop Protection Market Characteristics
- “Manufacturers create demand”
- “Distributors take orders”
- A typical multinational in US has >300 field personnel
- A Typical Biocontrol Company in the US has 5-10 field personnel
98% of Bio Companies are Privately Held
~5 Biocontrol Companies have > $100 Mn AR
75% of Biocontrol companies have <$10 Mn AR
Biocontrol Companies are Found Worldwide
~50% have Full New Product Discovery programs
Founded by Research individuals

Source: DunhamTrimmer Company Database

~400 Bio Companies*
~250 Biocontrol Companies*
~200 Biopesticide Companies*
~150 Biostimulant Companies*
*(outside of India/China)
Bio Industry Acquisitions

2B Monthly Reported Intercompany Activity

- **M & A / JVs / Investments**
  - 2016 — 24 Major Agreements
  - 2015 — 23 Major Agreements
  - 2014 — 24 Major Agreements
  - 2013 — 16 Major Agreements

- **Distribution—Market Access**
  - 2016 — 13 Major Agreements
  - 2015 — 4 Major Agreements
  - 2014 — 22 Major Agreements
  - 2013 — 14 Major Agreements

- **R & D / Manufacturing**
  - 2016 — 8 Major Agreements
  - 2015 — 12 Major Agreements
  - 2014 — 16 Major Agreements
  - 2013 — 9 Major Agreements

<table>
<thead>
<tr>
<th>Acquisitions by &quot;Major Six&quot; CPM Companies</th>
<th>Chemical</th>
<th>Seed</th>
<th>Biopesticides</th>
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<tbody>
<tr>
<td>Syngenta</td>
<td>46</td>
<td>19/5</td>
<td>3</td>
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<tr>
<td>Bayer</td>
<td>33</td>
<td>24/5</td>
<td>3</td>
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<tr>
<td>BASF</td>
<td>11</td>
<td>2/1</td>
<td>1</td>
</tr>
<tr>
<td>Dow</td>
<td>8</td>
<td>17/5</td>
<td>0</td>
</tr>
<tr>
<td>Monsanto</td>
<td>0</td>
<td>76/12</td>
<td>5</td>
</tr>
<tr>
<td>DuPont</td>
<td>3</td>
<td>5/6</td>
<td>1</td>
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<tr>
<td>TOTAL</td>
<td>101</td>
<td>143/34</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>50 years</td>
<td>20 years</td>
<td>4 years***</td>
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</table>

* Acquisitions (direct & indirect)
** Partial Ownership
*** >$US 2 Bn

2013-2016 — 87 Major Investments in Bio Industries
## Top Biocontrol Companies

<table>
<thead>
<tr>
<th>Company</th>
<th>Revenue Estimate (Millions USD)</th>
<th>Product Type</th>
<th>Subtype</th>
<th>Use</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valent Bio</td>
<td>&gt;$200</td>
<td>Microbials</td>
<td>Bacteria</td>
<td>Bioinsecticides</td>
<td>Bt's, PGRs, some biostims</td>
</tr>
<tr>
<td>Koppert</td>
<td>$150</td>
<td>Macros</td>
<td>All</td>
<td>Insect control</td>
<td>Full line macros, some microbials</td>
</tr>
<tr>
<td>Certis USA</td>
<td>$100</td>
<td>Microbials</td>
<td>Bacteria</td>
<td>Bioinsecticides &amp;</td>
<td>Bioinsecticides &amp; Baculoviruses, others</td>
</tr>
<tr>
<td>Bayer</td>
<td>~$100</td>
<td>Microbials</td>
<td>Bacteria</td>
<td>Biofungicides</td>
<td>B. subtilis</td>
</tr>
<tr>
<td>Syngenta</td>
<td>~$50</td>
<td>Microbials</td>
<td></td>
<td>Bionematicdes</td>
<td>Pasteuria</td>
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</table>
BIOCONTROL
MARKET OVERVIEW
BIOCONTROL MARKET LANDSCAPE
GLOBAL MARKET PROJECTIONS
ASSUMPTIONS-COMMENTS

• Market Value Resources
  – DunhamTrimmer interaction with wide global network of industry executives & leaders
  – Published market reports, articles, conference presentations, NGO / Government sourced reports

• Market Value Assumptions
  – No significant events are projected to impact market growth
    • Potential upside factors
      – Development of new technologies, especially in the area of microbial products could biostimulant market growth
      – Impact of regulatory changes in the EU, USA or other lead countries
    • Potential downside factors
      – Entrance of new technologies in to the market that directly impact existing biological technologies use (new microbial products, RNAi, CRISPR gene editing)
      – Adverse macro economic events in key countries
      – Impact of regulatory changes in the EU, USA or other lead countries

• DunhamTrimmer believes that it is highly likely that the development of new microbial technologies may positively impact the overall market. This has not been projected because of the uncertainty of timing and actual success.
Global Market

- Global Biocontrol Market is $2.8 Bn today growing to over $11 Bn in 2025
- Microbials growing faster as both small and large companies invest in microbial discovery and development
- All three product segments growing much faster than the traditional crop protection market
- Microbials will continue to make up nearly 60% of market through 2025

2020 Product Line Mkt Share

<table>
<thead>
<tr>
<th>Microbials</th>
<th>Macro-organisms</th>
<th>Biochemicals</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>13%</td>
<td>14%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Global Biocontrol Mkt--Product Line Values-Bn usd

- Microbials
- Macro-organisms
- Biochemicals
- TOTAL

25-April-2017
Regional

- NorAm and EU make up 2/3 of the market.
- EU growth could accelerate if the regulatory system is revised to give more preference to biopesticides.
- Latin America is growing fastest and will overtake Asia as the third largest region by 2025.
USA

- Largest single country market with over $750 million in sales
- Expect to grow to over $3 billion by 2025
- Nearly 2/3 of the market microbial products
Global Use Segments

- Bioinsecticides and biofungicides make up over 90% of market
- Bionematicides growing quickly with recent entry of new products and more in company pipelines
- Bioherbicides largely absent with no significant or successful products
Use Segments

USA

- USA is overwhelmingly an insecticide and fungicide market
- Bio-nematicide uses increasing particularly as seed treatments
Global Market

Product Types

- Microbials are largest type
- Microbials growing faster as both small and large companies invest in microbial discovery and development
- All three product segments growing much faster than the traditional crop protection market
- Microbials will continue to make up nearly 60% of market through 2025
**Product lines**

**Microbials**

- Bacterial based products, led by Bacillus sp based products, dominate the market.
- Fungi make up a smaller, but substantial portion.
- Viruses have had notable successes in selected markets for control of specific insects (e.g., *Helicoverpa armigera* in Brazil).

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**2020 Microbial Sub-Type Mkt Shares**

- **Bacteria**: 18%
- **Fungi**: 18%
- **Virus**: 17%
- **Others**: 17%
- **TOTAL**: 20%

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**Global Microbial Mkt--Prod Sub-Type Values-Bn usd**

- **Bacteria**: $8.0
- **Fungi**: $4.0
- **Virus**: $1.0
- **Others**: $1.0
- **TOTAL**: $14.0
Product lines

Biochem

- Pheromone products highest in value, but made up of large number of small products
- Other biochemicals mainly plant extracts
- Challenge for plant extracts is consistency in supply chain from year to year
Product lines

USA

- Microbials dominate USA market and are fastest growing segment
- Biochemicals slower growth
- Macros important in greenhouse and covered crops
General Conclusions

• Biological Ag Industries—Sustainable Growth-12%-17%
  – Biocontrol / Biostimulants / Biofertilizers
• Green technology / Sustainable technology
• More efficient use of resources
  – Pesticides / Fertilizers / Inputs
• Rapidly growing entrepreneurial companies
• Consolidation – Market Access
Disclaimers

• DISCLAIMER STATEMENT: This document contains information that, at the time of publication and to our best judgement, reflects the situation in the marketplace. However, markets are constantly changing and this report cannot reflect all those changes. DunhamTrimmer makes a strong effort to provide the most accurate and up-to-date information in all documents.

• The information in this document has been taken from as many sources as feasible, including alternate reviews and analysis, in order to improve its accuracy. The interpretation of that data is a subjective process and DunhamTrimmer does not accept any liability related to any loss, damage or other accident arising from the use of information presented in this document.

• DunhamTrimmer has developed databases covering the biological industries of Biocontrol, Biopesticides, Biostimulants & Biofertilizers including data on companies, products and market landscape. All databases are available for purchase from DunhamTrimmer.

• For more information about these products please contact DunhamTrimmer LLC at info@DunhamTrimmer.com
If I had an hour to solve a problem and my life depended on it, I would use the first 55 minutes determining the proper questions to ask.

Albert Einstein