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# EVOLUTION & FUTURE OF BIOCONTROL

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# Overview

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- **Introduction**
- **Definitions**
- **Historical Development**
- **Bio Companies**
- **Market Development**
- **Bio Products**
- **Macro Drivers**
- **Market Drivers**
- **Micro Drivers**
- **Multinationals**
- **Consolidation**
- **The Unexpected**
- **Market Growth**
- **Closing**

# Introduction

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## 2011—Co-Founded Dunham Trimmer

### LLC

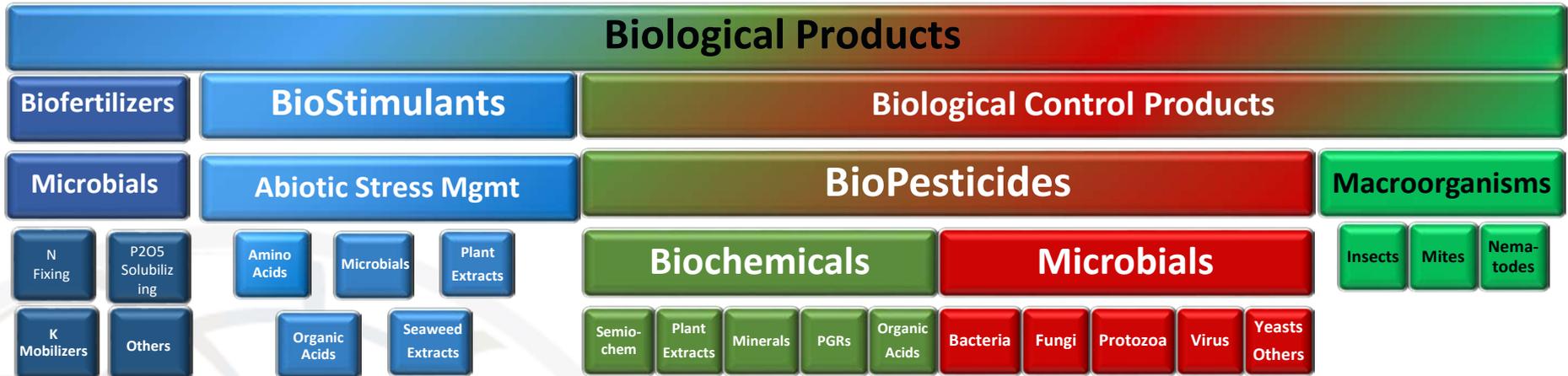
- Premier Biological Industries Market Research Firm
- Clients: Multinational CPC; Bio Companies; Investors; NGO's
- Due Diligence, Multi-client market data, Single client studies

## 2013—Launched 2BMonthly

- The Global Biocontrol & Biostimulant E-Newsletter
- Joint effort New Ag Int'l & Dunham Trimmer
- Subscribers: Companies, individuals interested in biological industries

# BIOLOGICAL MARKET OVERVIEW

## --INTRODUCTION--PRODUCT TYPES



### Biofertilizers

- Microbials used to enhance plant nutrient uptake from soil
- Nitrogen fixing bacteria make up largest group
- Others include mobilizers of specific nutrients (zinc, sulfur) and mycorrhizal fungi
- Biofertilizers regulated under country/state fertilizer regulations

### Biostimulants

- Seaweed Extracts make up the largest segment in this group
- Microbials, primarily bacteria, often used as seed or soil treatment to aid in nutrient assimilation
- Organic acids are humic and fulvic acids used as soil amendments, formed by the microbial degradation of plant matter.
- Definition and regulation of biostimulants 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.

#### 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

### Macroorganisms

- Insects; Mites; Nematodes
- Insects followed by mites makeup the largest groups
- Unique in that the live organism in the form of eggs, larvae, pupae or adult is used.
- Most important challenge for Macros is logistics—shipping live organisms that have to have special care to survive
- Normally not classified as a Biopesticide—only as Biological Control Products

Source: DunhamTrimmer LLC

# Stepping Back-Where it all started

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- 17<sup>th</sup> Century
  - Nicotine used to control plum beetles
- 1835
  - Agostine Bassi demonstrated that white-muscadine fungus (*Beauveria bassiana*) could be used to cause an infectious disease in silkworm
- 19<sup>th</sup> Century
  - mineral oils as plant protectants
- 1901
  - Bt was isolated from a diseased silkworm by Japanese biologist Shigetane Ishiwata
- 1911
  - Ernst Berliner in Thuringen, Germany, rediscovered Bt
  - classified as type species *Bacillus thuringiensis*
- Early 1920 s
  - French growers began to use Bt as a biological insecticide
- 1938
  - first commercially available Bt product, Sporeine, appeared in France
- 1950's
  - In USA, widespread use of biopesticides began to take hold as a host of research on Bt efficacy was published

*\*Sources: BPIA website & Willem Ravenburg's book, "A Roadmap to the successful Dev & Comm of Microbial Pest Control..."*

# Stepping Back-Where it all started

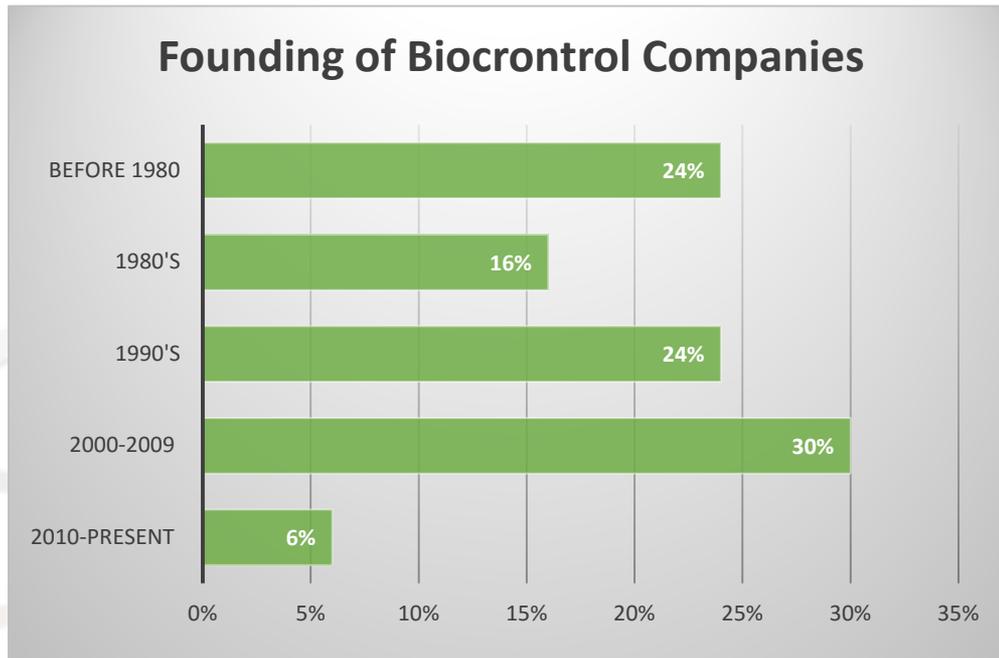
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- 1956
  - Pacific Yeast Product Company developed an industrial process known as submerged fermentation, which allowed production of Bt on a large scale
- 1973
  - *Heliothis* NPV was granted exemption from tolerance and the first viral insecticide Elcar received a label in 1975
- 1977
  - *Bacillus thuringiensis* var. *israelensis* (toxic to flies) was discovered
- 1979
  - U.S. EPA registered the first insect pheromone for use in mass trapping of Japanese beetles
- 1983
  - the Bt strain *tenebrionis* (toxic to beetles) was discovered

*\*Sources: BPIA website & Willem Ravenburg's book, "A Roadmap to the successful Dev & Comm of Microbial Pest Control..."*

# Biocontrol Companies Today

## Founding of Biocrontral Companies



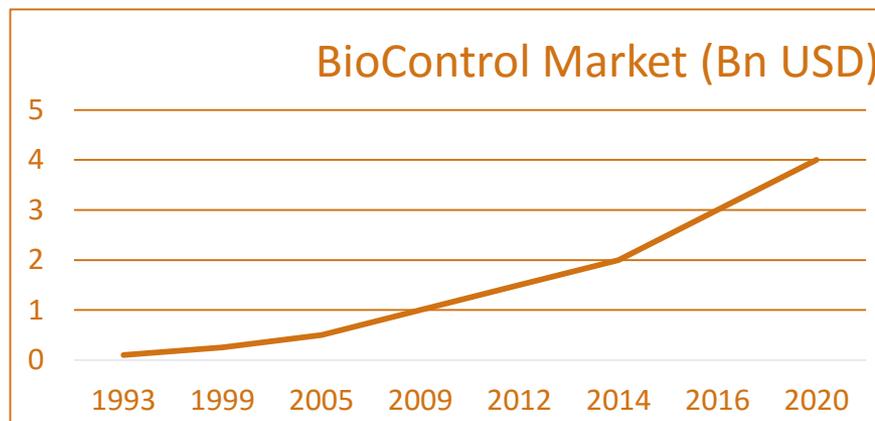
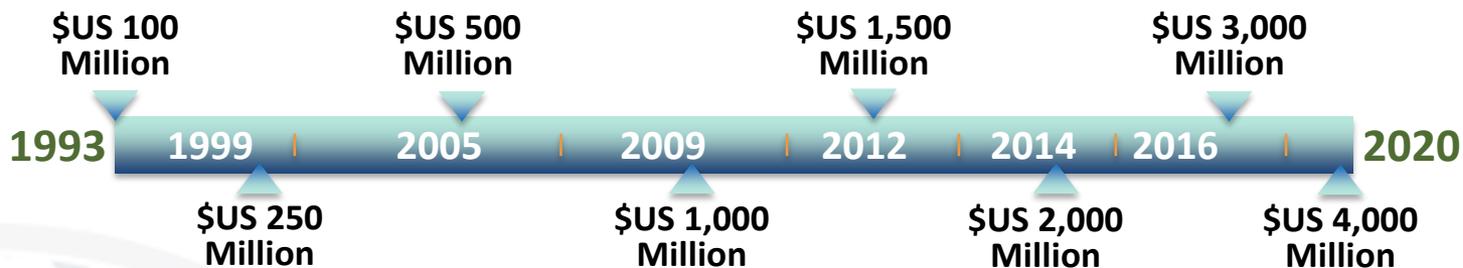
## Founding Members IBMA 14-9-1995

- **Abbott**
- **Agrisense**
- **BCP**
- **Biobest**
- **BioTop**
- **Ciba Bunting**
- **ESA**
- **Koppert**
- **Novo Nordisk**
- **NPP**

Source: DunhamTrimmer Company Database / IBMA

# Global Landscape

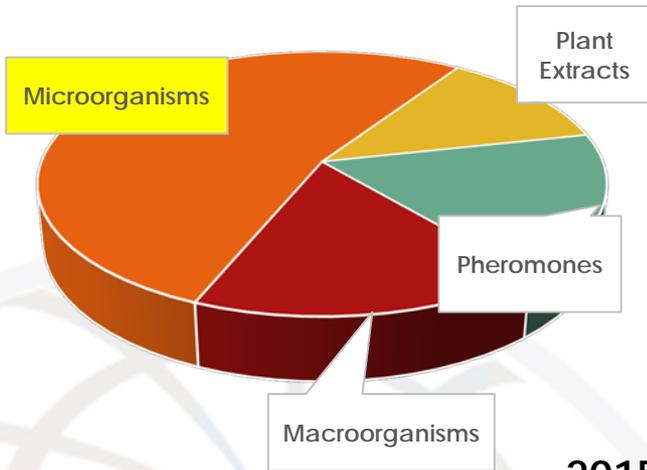
Global BioControl Market Benchmark Values (USD)



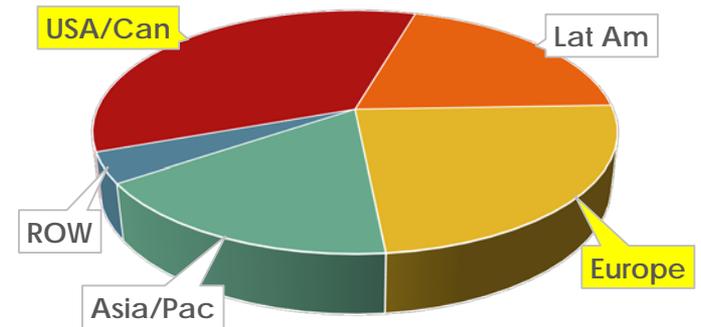
Source: BioMarket Database DunhamTrimmer LLC

# Biocontrol Market Stats

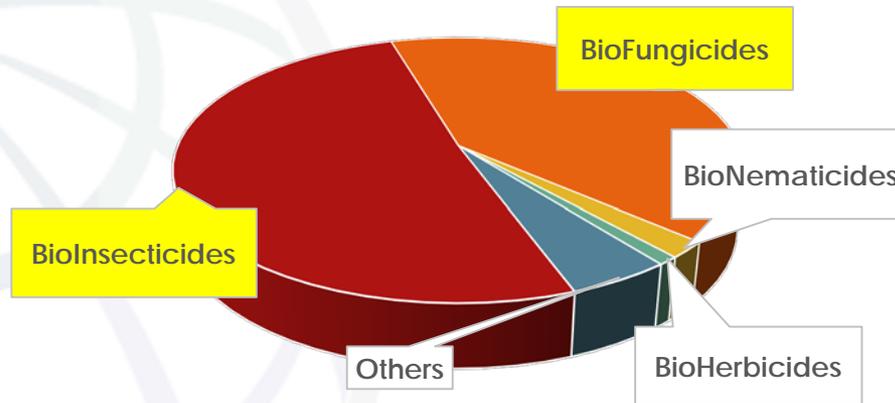
## 2015 Biocontrol Market



## 2015 Biopesticide Market

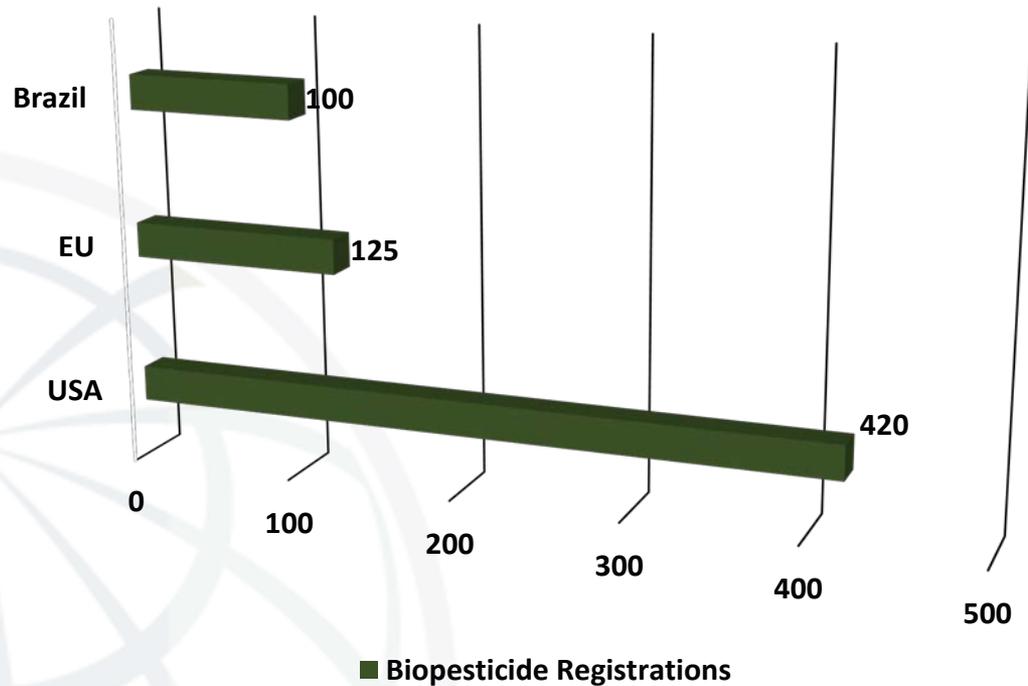


## 2015 Biopesticide Market

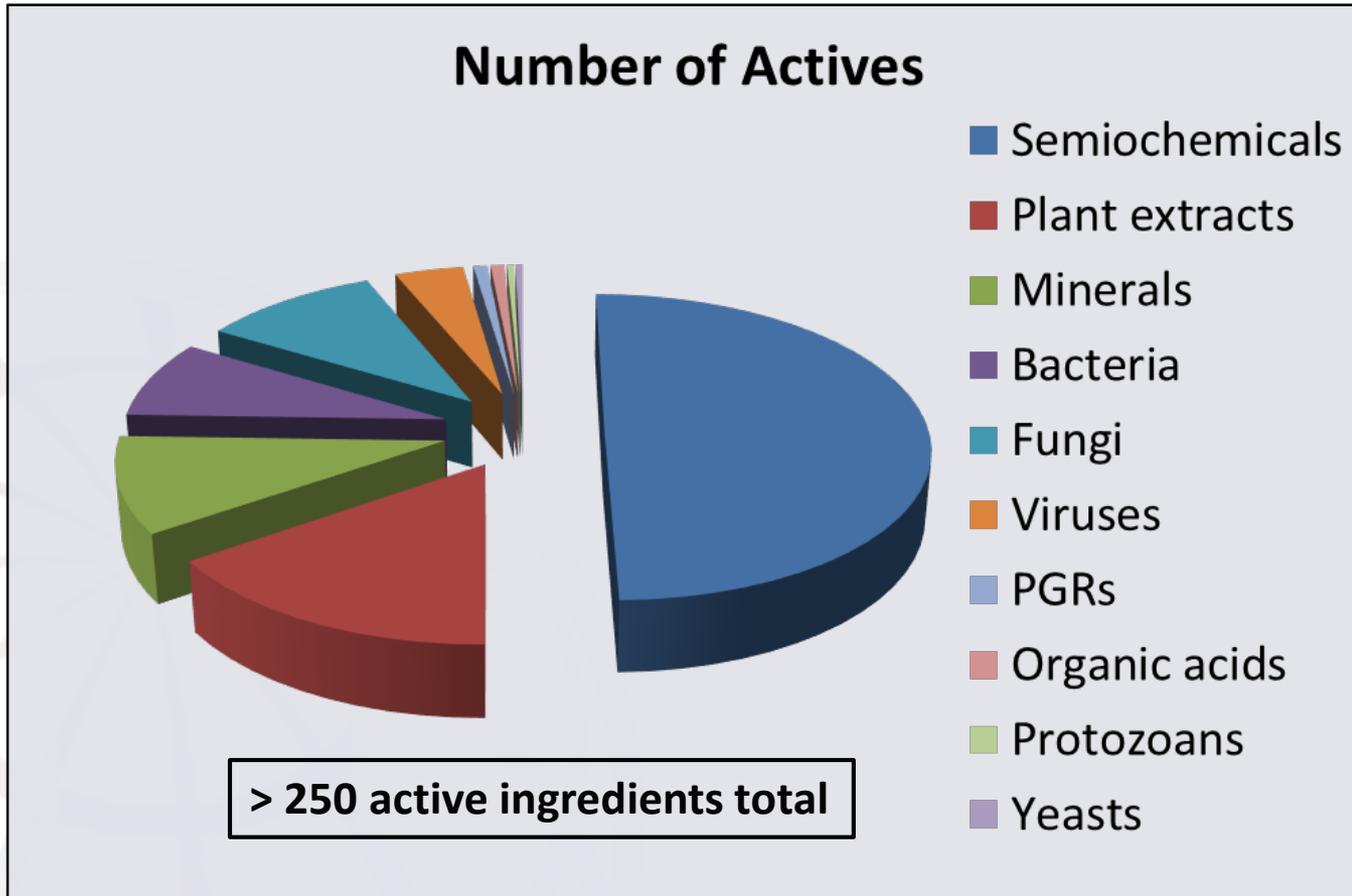


## Biopesticides - Registered Products

### BIOPESTICIDE REGISTRATIONS

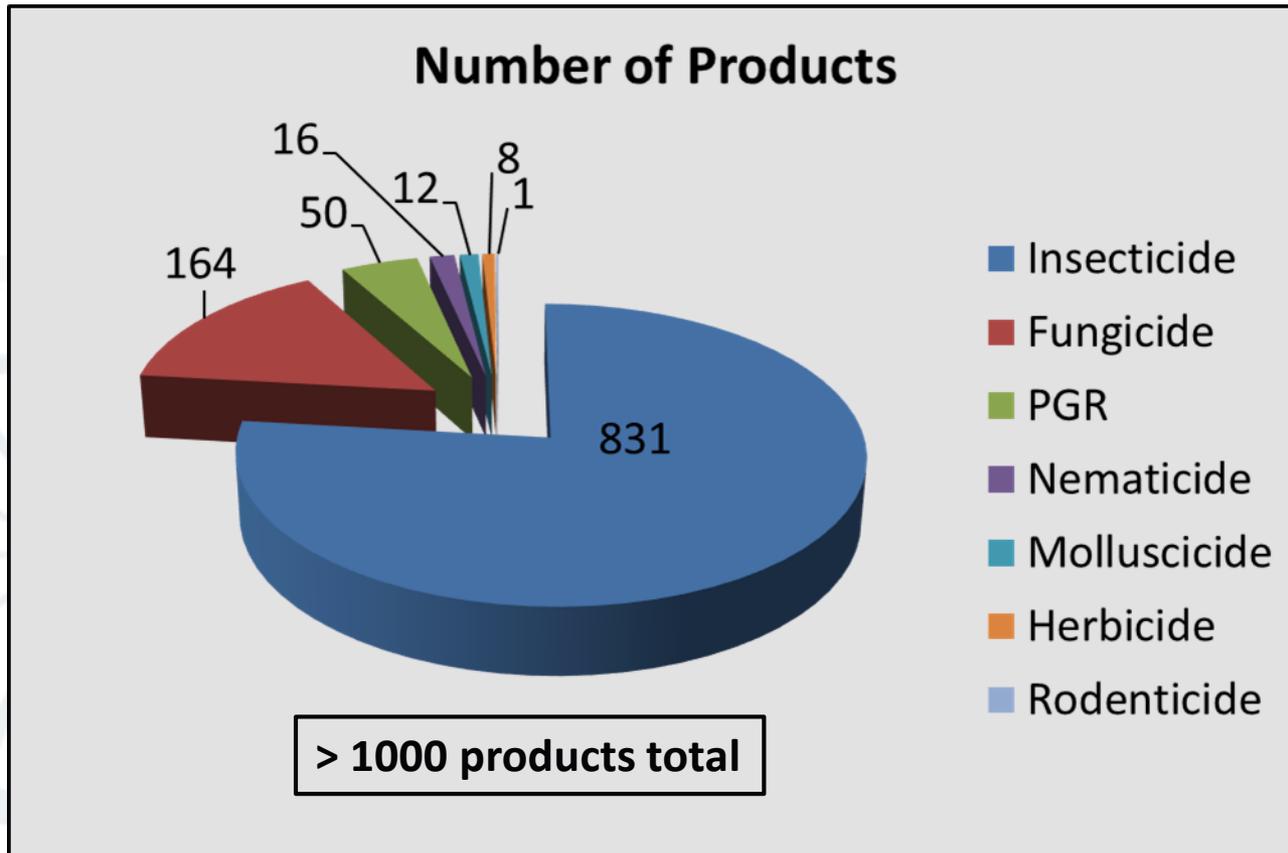


# Biopesticide – Active Ingredients



Source: DunhamTrimmer BioPesticide Industry Overview: Products

## Biopesticide – Use Patterns



Source: DunhamTrimmer BioPesticide Industry Overview: Products

# Sustainable Agriculture



**70% more food by 2050, using.....**

- ❑ Less land
  - Less water
    - ❖ Less Fertilizer
- ✓ Fewer pesticides

To produce.....?

## WATER

- ❑ 1 Slice Bread—40 liters
- 1 bag Chips—190 liters
  - ❖ 1 Hamburger—2400 liters
- 1 Steak—7000 liters

According to the UN Food & Agriculture Organization the world needs to produce more food between 2000 and 2050 than was produced during the previous 10,000 years

# Climate Change

## Climate Change Impacts Crops Through:

- Increased CO<sub>2</sub> concentration
- Higher temperatures
- Altered, more variable precipitation patterns

**EFFECTS WILL NOT BE UNIFORM**  
➤ Vary by crop & geography

## Climate Change will alter pest problems:

- ❖ Potential magnitude is uncertain
- ❖ Some weeds benefit more from higher CO<sub>2</sub> than crops
- ❖ Higher temperatures can increase or reduce plant disease & insect pressure
- ❖ The range of pests attacking crops or people will change

## Extreme weather events will be more common:

- ✓ Heat waves, droughts, freezing, floods.....
- ✓ Timing & location of these events during crop development can greatly influence the impact

# “Snake Oil” to Science

## “Snake Oil”

- Biological “enthusiasts”
- Non-scientific, non-replicated data
- Promoted marginal activities
- **“Over Promised—Under Delivered”**

## Science

- Scientific designed replicated trials
- Scientific data
- Improved fermentation technology
- Understanding of “Mode of Action”
- **Deliver on promised results**

# BioControl Companies

**>300 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**

# 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



Manufacturers	Growers
✓	
✓	✓
✓	
✓	✓
	✓
✓	✓

# Multinationals

**MONSANTO**

**novozymes** Rethink Tomorrow

**agraxis**

**MONSANTO BioAg**

+RNAi Assets

>\$300 Mn

**BAYER** Bayer CropScience

**AGRAQUEST**

**prophyta**

better food. better world.

**PONCHO**

**VOTIVO**

>\$500 Mn

**syngenta**

**deVGen**

**PASTEURIA** bioscience

**Afla-Guard** GR

> \$650 Mn

**BASF**

**BECKER UNDERWOOD**  
Inventing the Future

> \$1 Bn

**VALENT BIOSCIENCES CORPORATION**

Osage Mftg Plant

**Mycorrhizal Applications, Inc**

>\$150 Mn

**FMC Agricultural Solutions**

**CHR HANSEN**

**CAEBiosolutions**  
Center for Agricultural and Environmental Biosolutions

>\$ ?? Mn

**DU PONT**  
The miracles of science™

**TAXON BIOSCIENCES**

> \$ ?? Mn

# Acquisitions

## 2BMonthly Reported Intercompany Activity

- **M & A / JVs / Investments**
  - ✓ 2014 –**24** Major Agreements
  - ✓ 2013 –**16** Major Agreements
- **Distribution—Market Access**
  - ✓ 2014 –**22** Major Agreements
  - ✓ 2013 –**14** Major Agreements
- **R & D / Manufacturing**
  - ✓ 2014 –**16** Major Agreements
  - ✓ 2013 – **9** Major Agreements

Acquisitions by "Major Six" CPM Companies			
	Chemical	Seed	Biopesticides
Syngenta	46	19*/5**	3
Bayer	33	24/5	3
BASF	11	2/1	1
Dow	8	17/5	0
Monsanto	0	76 / 12	5
DuPont	3	5/6	1
<b>TOTAL</b>	<b>101</b>	<b>143 / 34</b>	<b>13</b>
	50 years	20 years	4 years***
<b>* Acquisitions (direct &amp; indirect)</b>			
<b>**Partial Ownership</b>			
<b>*** &gt;\$US 2 Bn</b>			

# Case Study-Brazil 2014

## Pest – Corn earworm (*Helicoverpa armigera*)



## Biocontrol

- Regulatory system delays
- Government approved biocontrol products (baculoviruses) under emergency provisions
- Biocontrol products are main viable control option available
- Changing mindset of growers to biocontrol solutions

## Background

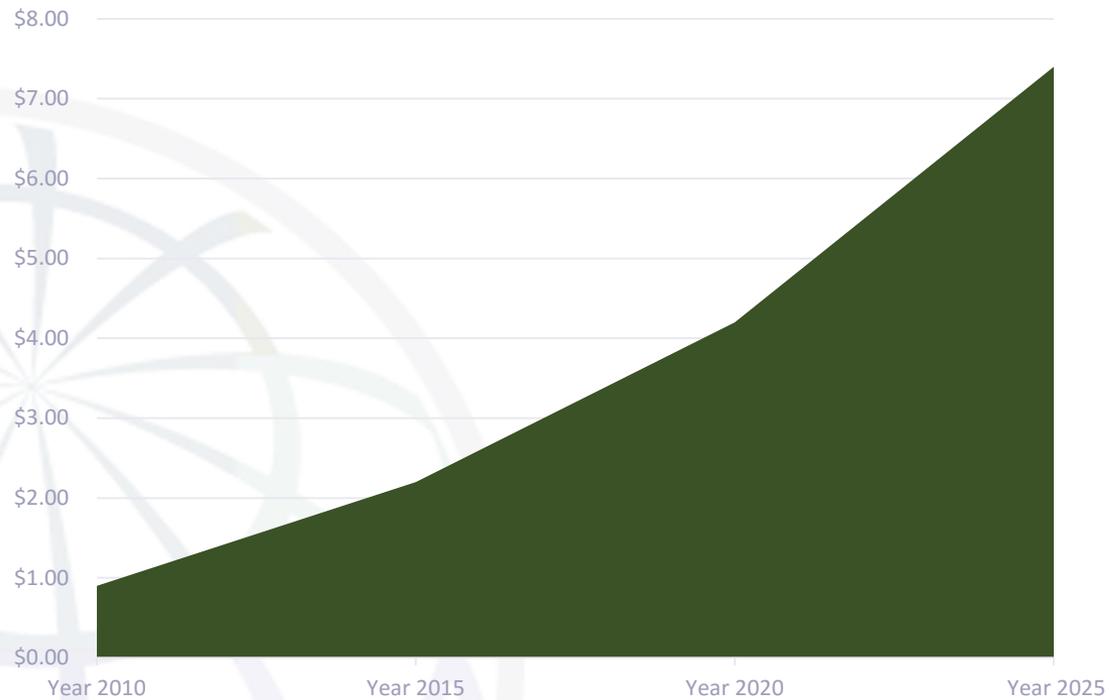
- Widespread in Old World, first found in Brazil in 2012
- Quarantine pest, likely arrived by import
- Voracious feeder in many crops – corn, cotton, soybeans, many vegetable crops
- BT crops do not control; no registered insecticides
- “Perfect Storm” due to continuous cropping & tropical climate
- 2013 crop losses estimated 5 to 10 billion Real

## Market Growth

- Biocontrol Market Grew by over \$100 Mn in 2014
- Growth for the total CPM

# Biocontrol Market Growth

Biocontrol Market Growth (Bn USD)



# Closing

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- 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

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# THANK-YOU FOR YOUR ATTENTION

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