

GLOBAL BIOLOGICALS MARKET UPDATE MARCH 2016—BPIA



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2 March 2016

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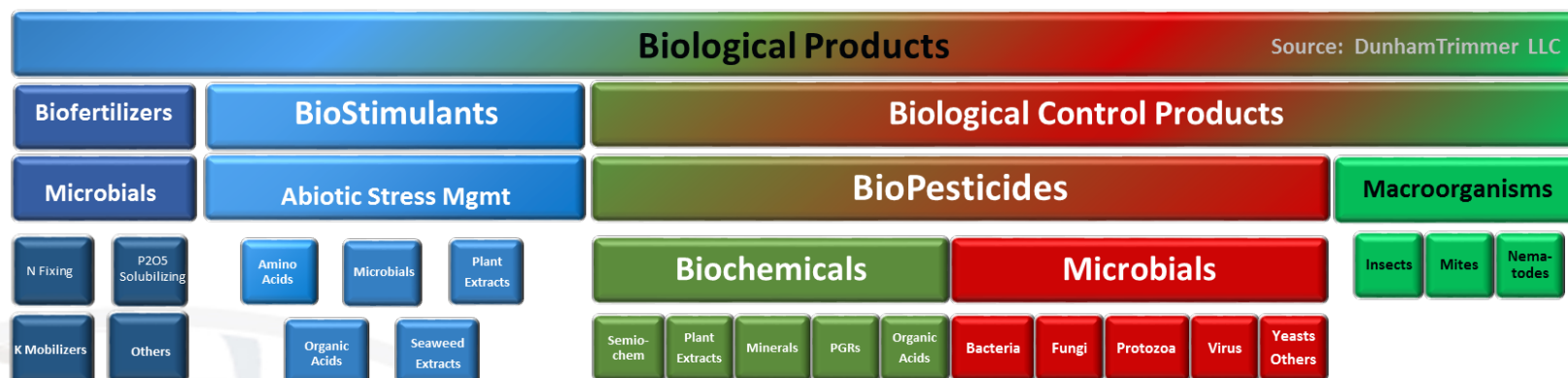
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2011—Co-Founded DunhamTrimmer LLC

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

2013—Launched 2BMonthly

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



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
- 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 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)

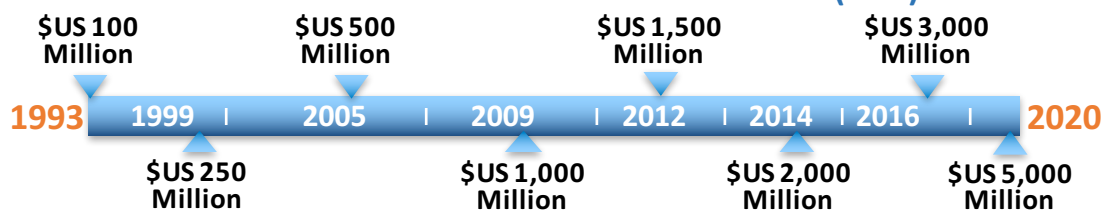
Microbials

- 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

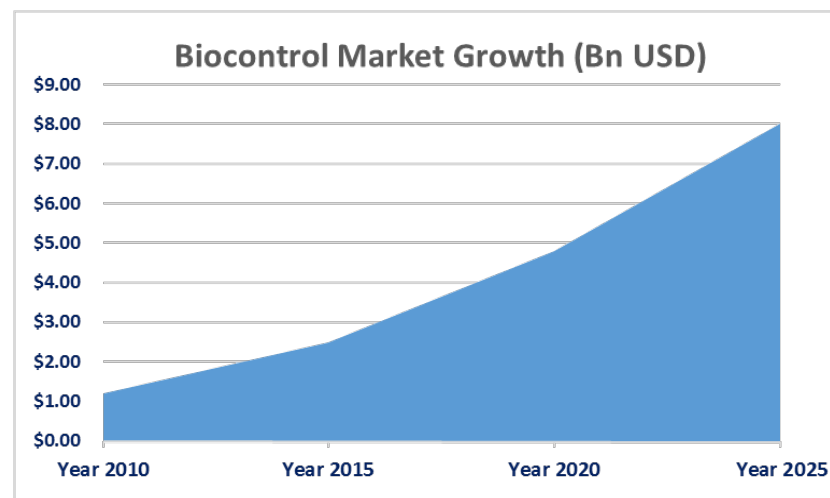
- Insects; Mites; Nematodes
- Insects followed by mites makeup the largest groups
- Unique in that the live organism in the form of eggs, larvae, pupae or adult is used.
- Most important challenge for Macros is logistics—shipping live organisms that have to have special care to survive
- Normally not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

Global BioControl Market Benchmark Values (USD)



- **17th Century**
 - Nicotine used to control plum beetles
- **19th Century**
 - *Beauveria bassiana* could be used to cause an infectious disease in silkworm
 - mineral oils used as plant protectants
- **20th Century**
 - Bt was isolated from a diseased silkworm
 - Bt classified as type species *Bacillus thuringiensis*
 - French growers began to use Bt as a biological insecticide
 - 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
 - Pacific Yeast Product Company developed an industrial process known as submerged fermentation, which allowed production of Bt on a large scale
- **1970's**
 - *Heliothis NPV* the first viral insecticide Elcar received a label
 - *Bacillus thuringiensis var. israelensis* (toxic to flies) was discovered
 - U.S. EPA registered the first insect pheromone for use in mass trapping of Japanese beetles

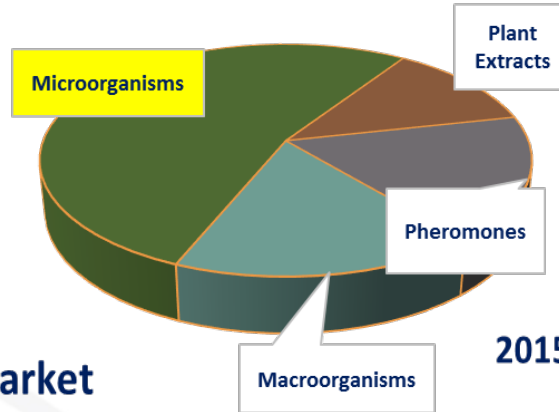
*Sources: BPIA website & Willem Ravenburg's book, "A Roadmap to the successful Dev & Comm of Microbial Pest Control..."



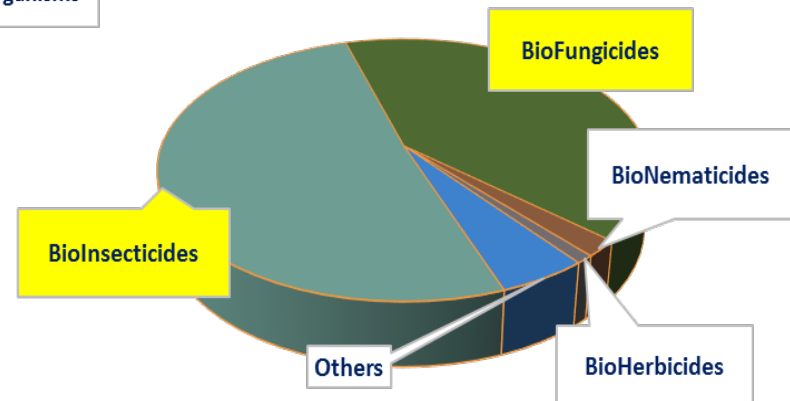
Source: Dunham Trimmer Bio Market Database

Market Value Segments

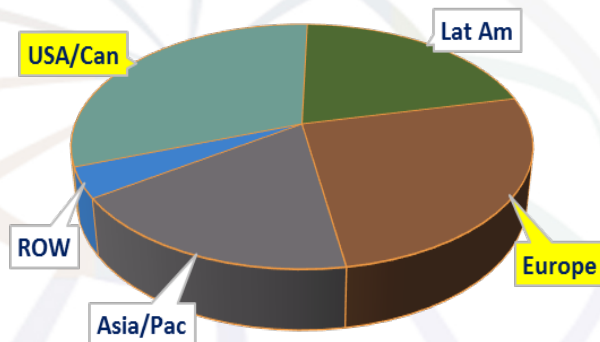
2015 Biocontrol Market



2015 Biopesticide Market

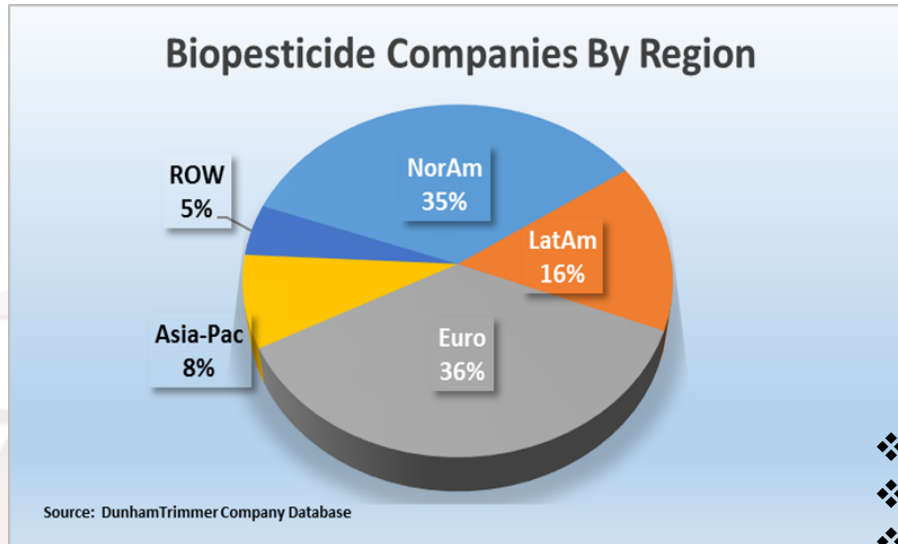


2015 Biopesticide Market



Source: DunhamTrimmer Bio Market Database

Bio Companies

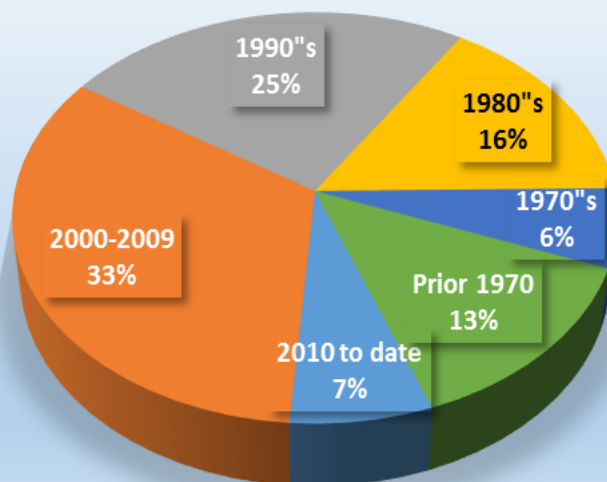


~400 Bio Companies*
~250 Biocontrol Companies*
~200 Biopesticide Companies*
~150 Biostimulant Companies*
**(outside of India/China)*

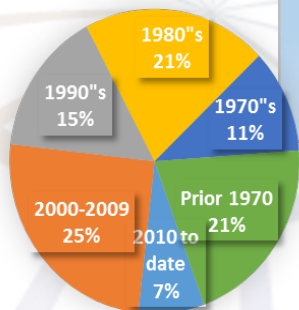
- ❖ **98% of Bio Companies are Privately Held**
- ❖ **~5 Biocontrol Companies have > \$100 Mn AR**
- ❖ **75% of Biocontrol companies have <\$10 Mn AR**
- ❖ **Biocontrol Companies are Found WorldWide**
- ❖ **~50% have Full New Product Discovery programs**
- ❖ **Founded by Research individuals**

Bio Companies

Biopesticide Companies Year Founded

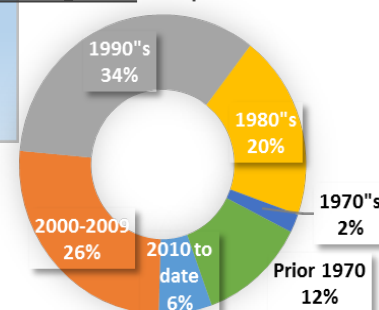


Biostimulant Companies Year Founded



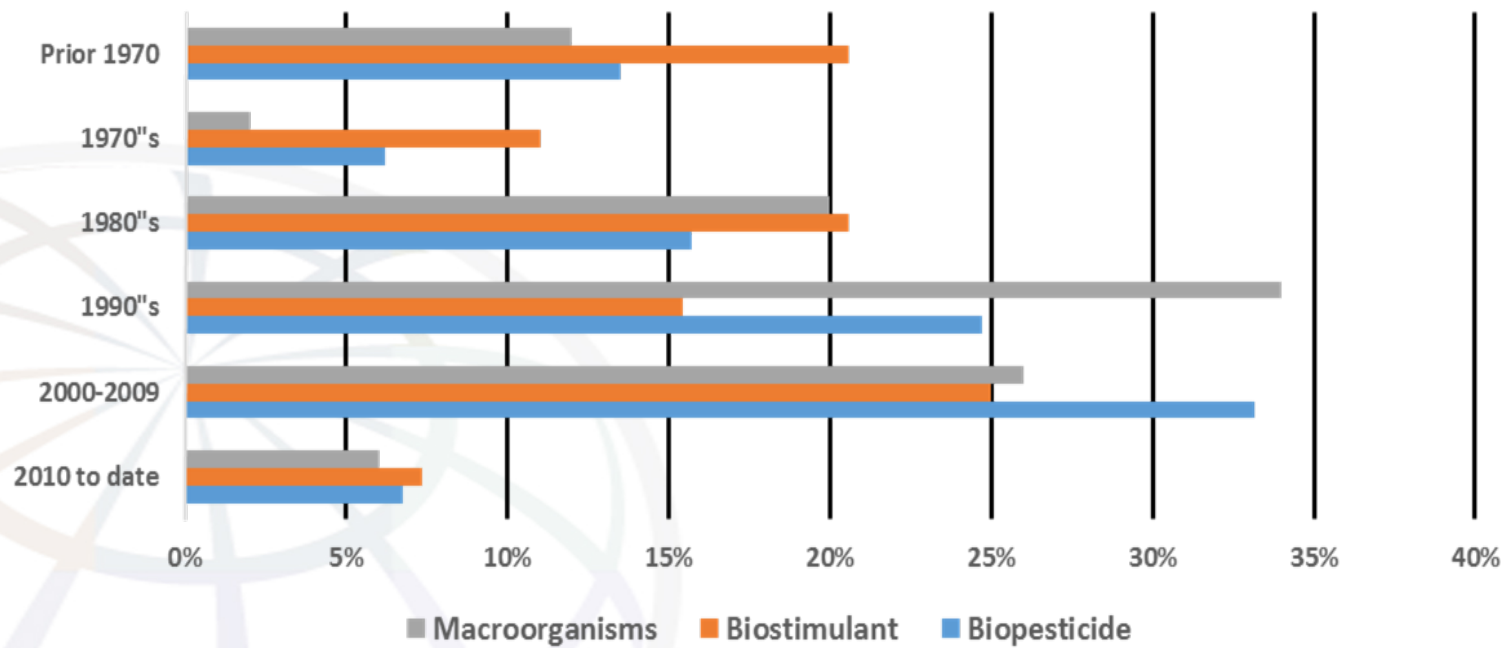
Source: DunhamTrimmer Company Database

Macroorganism Companies Year Founded



Bio Companies

Biocompanies Years Founded



2BMonthly Reported Intercompany Activity

➤ M & A / JVs / Investments

- ✓ 2015 – **20** Major Agreements
- ✓ 2014 – **24** Major Agreements
- ✓ 2013 – **16** Major Agreements

➤ Distribution—Market Access

- ✓ 2015 – **15** Major Agreements
- ✓ 2014 – **22** Major Agreements
- ✓ 2013 – **14** Major Agreements

➤ R & D / Manufacturing

- ✓ 2015 – **16** Major Agreements
- ✓ 2014 – **16** Major Agreements
- ✓ 2013 – **9** Major Agreements

Acquisitions by "Major Six" CPM Companies

	Chemical	Seed	Bio Industries
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
TOTAL	101	143 / 34	13
	50 years	20 years	5 years***

*** Acquisitions (direct & indirect)**

****Partial Ownership**

***** >\$US 2 Bn**

Multinationals

MONSANTO
novozymes
agradis
+RNAi Assets
MONSANTO BioAg
Rethink Tomorrow
>\$300 Mn

BAYER Bayer CropScience
AGRAQUEST[®] prophyta
better food. better world.
PONCHO
VOTIVO
>\$500 Mn

syngenta
deVGen
PASTEURIA[™]
Afla-Guard[®] GR
>\$650 Mn

BASF
BECKER UNDERWOOD
Inventing the Future
> \$1 Bn

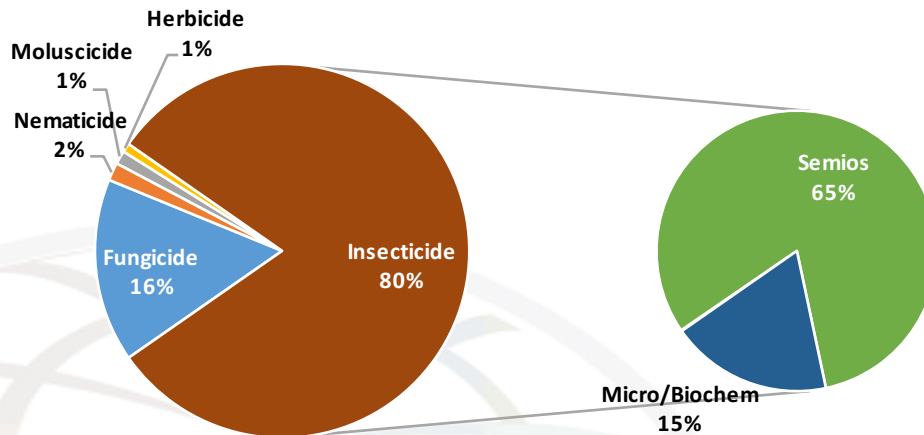
VALENT BIOSCIENCES
CORPORATION
Osage Mftg Plant
Mycorrhizal Applications, Inc.
>\$150 Mn

FMC Agricultural Solutions
CHR HANSEN
CAEBiosolutions
Center for Agricultural and Environmental Biosolutions
>\$?? Mn

DUPONT
The miracles of science[™]
TAXON BIOSCIENCES
> \$?? Mn

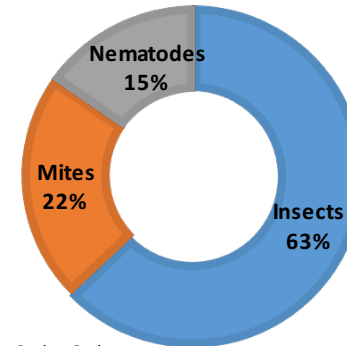
Bio Products

Biopesticide Product Numbers by Use Segment



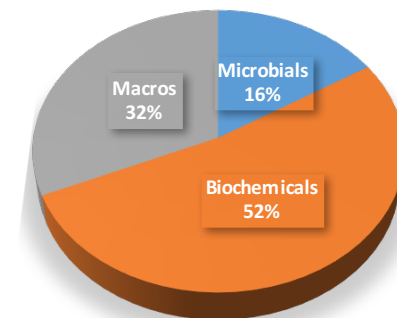
Source: DunhamTrimmer Products Database

MACROORGANISM PRODUCT TYPES



Source: DunhamTrimmer Products Database

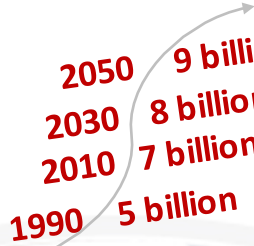
Biocontrol Product Types (A.I.s)



Source: DunhamTrimmer Products Database

Sustainable Agriculture

Global Population Growth



Year	Population
1990	5 billion
2010	7 billion
2030	8 billion
2050	9 billion

To produce.....?

WATER

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

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

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

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 CO₂ 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 CO₂ 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

Source: US EPA

20 October 2015

“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**

Closing

- 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

THANK-YOU QUESTIONS?