

Discovery of Novel Biocontrol Products from the Soil Microbiome



Annual Biocontrol Industry Meeting

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20 October 2015



World's Biggest, Most Important Industry



10%
OF GLOBAL GDP

\$5.6T
INDUSTRY

7.5B
PEOPLE TO FEED

Mounting Pressures Driving Need For Innovation



More
PEOPLE TO FEED

Less
LAND TO FARM

30%
YIELD LOSS FROM
CROP PESTS AND DISEASES



Agbiome: Who Are We?

DISCOVERY

High Potential
Microbial Genes, Strains
and Proteins Through
Proprietary Biodiversity
Screening Platform



DEVELOPMENT

Two Product Families



BIOLOGICALS

Strains Used
Directly as
Products



TRAITS

Genes Used
in Crops

VALUE CAPTURE

Initial Focus on Crop
Protection

- Diseases
- Pests
- Weeds

Rich Product Pipeline

12 DISCOVERY PROJECTS
1 IN DEVELOPMENT

Industry-Changing Investors

\$34.5M SERIES B SYNDICATE:

GATES FOUNDATION, UTIMCO, PONTIFAX,
POLARIS, ARCH, HARRIS & HARRIS, INNOTECH,
MONSANTO, SYNGENTA AND NOVOZYMES

Experienced Team

PRODUCT SUCCESSES

BIOLOGICALS FOR NEMATODE AND DISEASE CONTROL



RESISTANCE INDUCING CHEMICALS



1ST BIOTECH CORN PRODUCT



INSECT PROTECTION



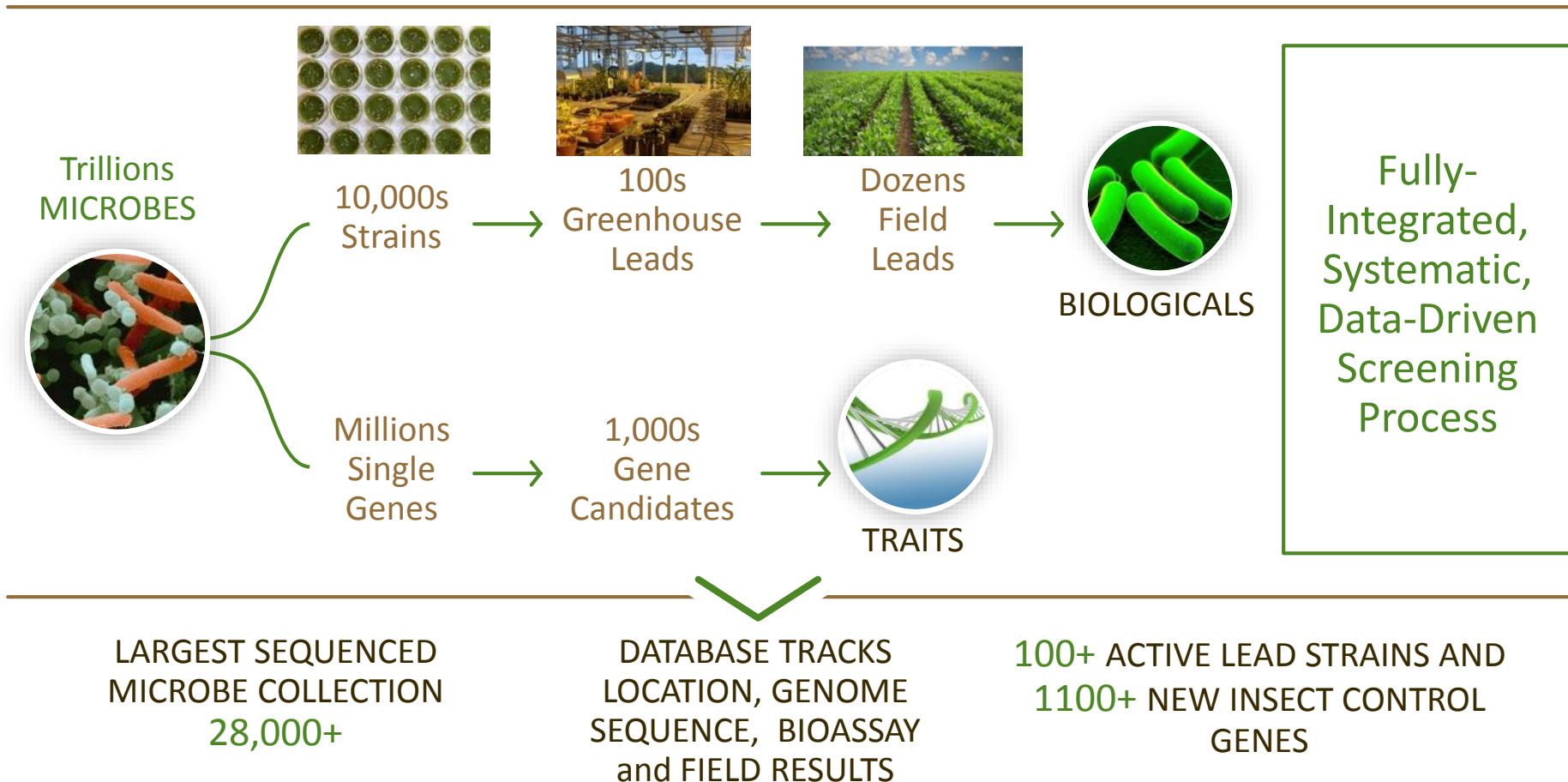
ADDITIONAL NOVEL TRAITS

- Herbicide Tolerance
- Insect Control
- Nematode Control

We Have a Passion for Feeding the World through Science

Our Proprietary, End-to-End Platform

GENESIS™: Gene and Strain Identification System



Field Collections



- Year-round collection for seasonal diversity; July & Sept in production fields
- Sample variety
 - Corn, soybean, other crop
 - Soil
 - Weeds
 - Insects
- AgBiome 50 States Project—38 and counting!



Agbiome Core Platform: Samples, Collections, and Isolates



Environmental Sample
 ex. corn root
 ex. millipede

4,393

Individual Collection
 ex. corn root endophytes
 ex. soybean phylloplane

14,572

Individual Microorganism
 ex. *Chromobacterium* sp.

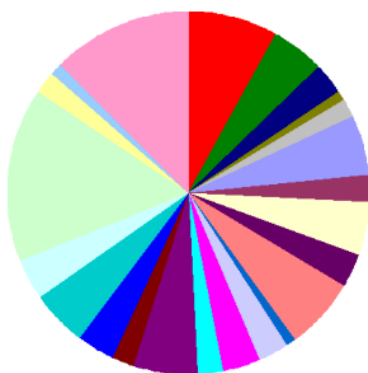
28,267

sequenced

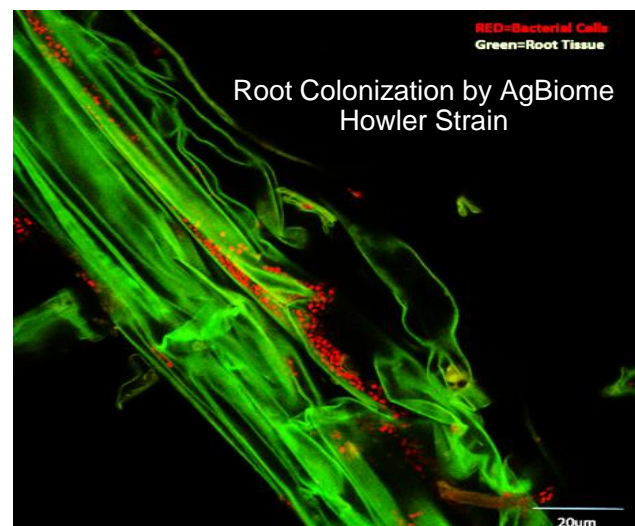
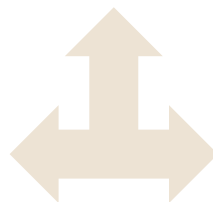
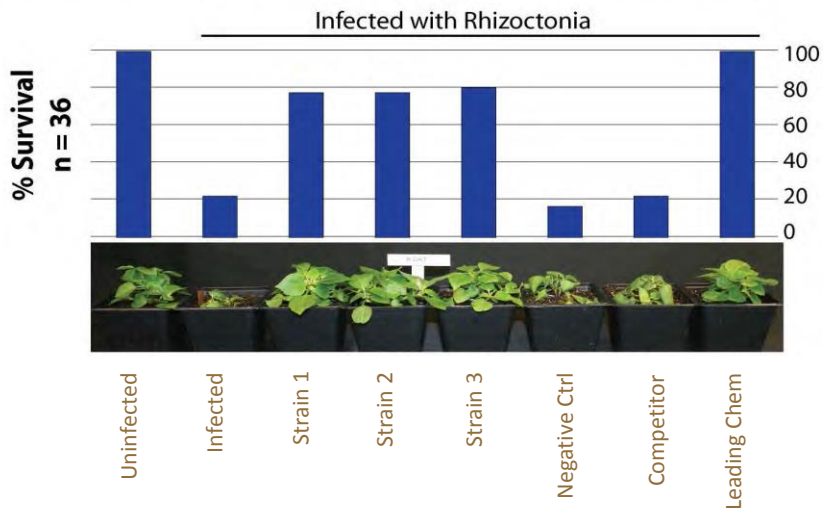
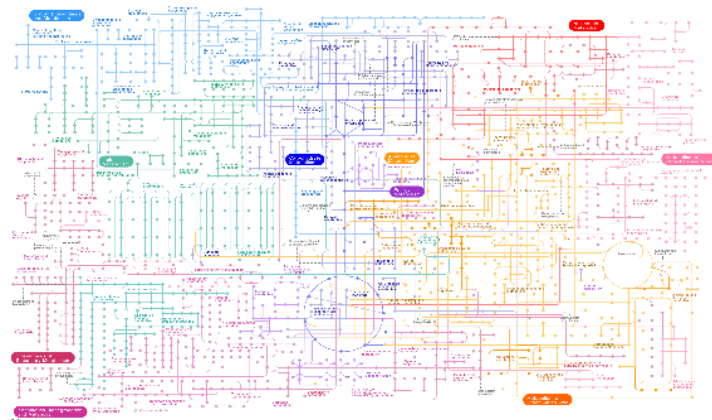
20,927

As of October 2015

Functional Genomics Informs Putative Modes of Action



- Cofactors, Vitamins, Prosthetic Groups, Pigments (348)
- Cell Wall and Capsule (199)
- Virulence, Disease and Defense (129)
- Potassium metabolism (31)
- Photosynthesis (0)
- Miscellaneous (71)
- Phages, Prophages, Transposable elements, Plasmids (10)
- Membrane Transport (225)
- Iron acquisition and metabolism (113)
- RNA Metabolism (196)
- Nucleosides and Nucleotides (129)
- Protein Metabolism (279)
- Cell Division and Cell Cycle (35)
- Motility and Chemotaxis (112)
- Regulation and Cell signaling (140)
- Secondary Metabolism (8)
- DNA Metabolism (102)
- Fatty Acids, Lipids, and Isoprenoids (254)
- Nitrogen Metabolism (72)
- Dormancy and Sporulation (3)
- Respiration (145)
- Stress Response (213)
- Metabolism of Aromatic Compounds (159)
- Amino Acids and Derivatives (664)
- Sulfur Metabolism (78)
- Phosphorus Metabolism (53)
- Carbohydrates (507)



2015 AGBIOME PRODUCT PORTFOLIO

PROJECT	BIOLOGICAL	TRAIT	PHASE 0	PHASE 1	PHASE 2	PHASE 3	PHASE 4
Soilborne Disease Control			[Progress bar from Phase 0 to Phase 4]				
Asian Soybean Rust Control			[Progress bar from Phase 0 to Phase 2]				
WCRW Control			[Progress bar from Phase 0 to Phase 1]				
Sucking Pest Control			[Progress bar from Phase 0 to Phase 1]				
Lepidopteran Control			[Progress bar from Phase 0 to Phase 1]				
Nematode Control			[Progress bar from Phase 0 to Phase 0]				
Disease Control			[Progress bar from Phase 0 to Phase 1]				

This table uses industry standard phases for traits and equivalent for biologicals:
 Phase 0 is discovery
 Phase 1 is early research; could involve proof of concept in model plants
 Phase 2 is proof of concept in target crop(s)
 Phase 3 is event selection, early regulatory and early product development work
 Phase 4 is regulatory, development and pre-marketing – first sales are next

HOWLER™

1ST PRODUCT



HOWLER™
BIOLOGICAL
FUNGICIDE



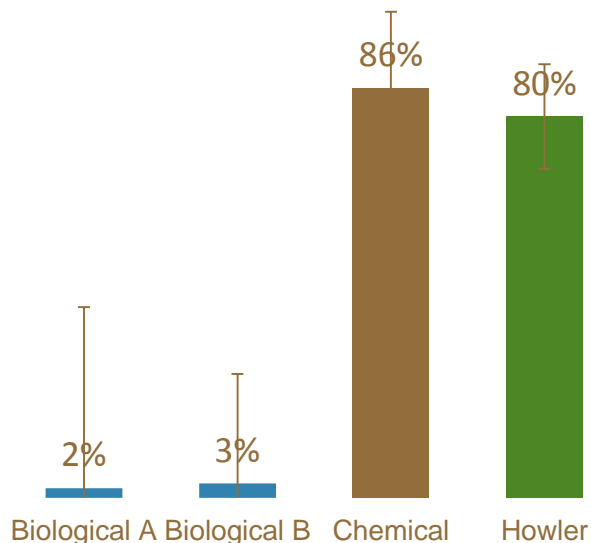
Active on
Multiple Diseases:

- Soilborne “Damping Off”
- Fusarium Head Blight on Wheat
- Asian Soybean Rust
- *Botrytis* Fruit Rot
- *Phytophthora* Late Blight
- Curative Activity

OMRI (Organic) Certifiable

HIGH EFFICACY

% Growth vs. Inoculated Control



TRAJECTORY

EPA Submitted 2015

Sales 2016

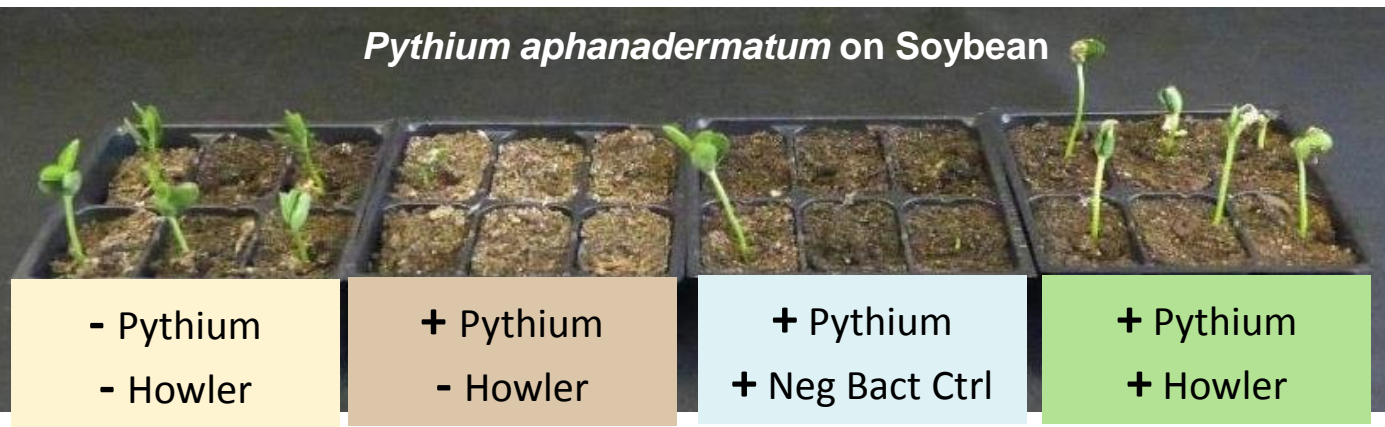
\$15M Greenhouse Crops

\$50M+ Row Crop

>20X More Effective than Current Biologicals and
Comparable to Chemical Treatment

Howler™ Controls Soilborne Diseases

Pythium aphanidermatum on Soybean



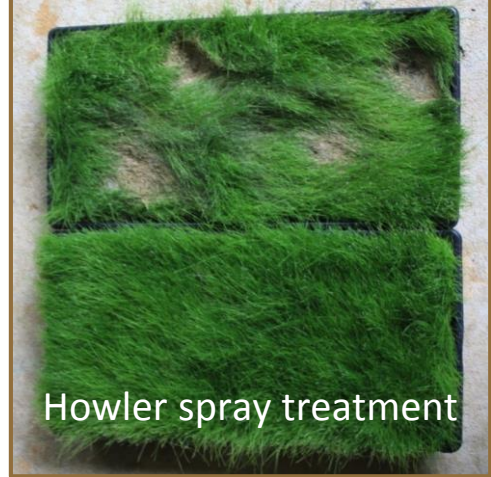
- Pythium
- Howler

+ Pythium
- Howler

+ Pythium
+ Neg Bact Ctrl

+ Pythium
+ Howler

Penncross Turf Rhizoctonia solani



Howler spray treatment

Phytophthora controlled by fungicide and Howler™



Control

Howler

Subdue
(fungicide)

Botrytis Strawberry Fruit Rot

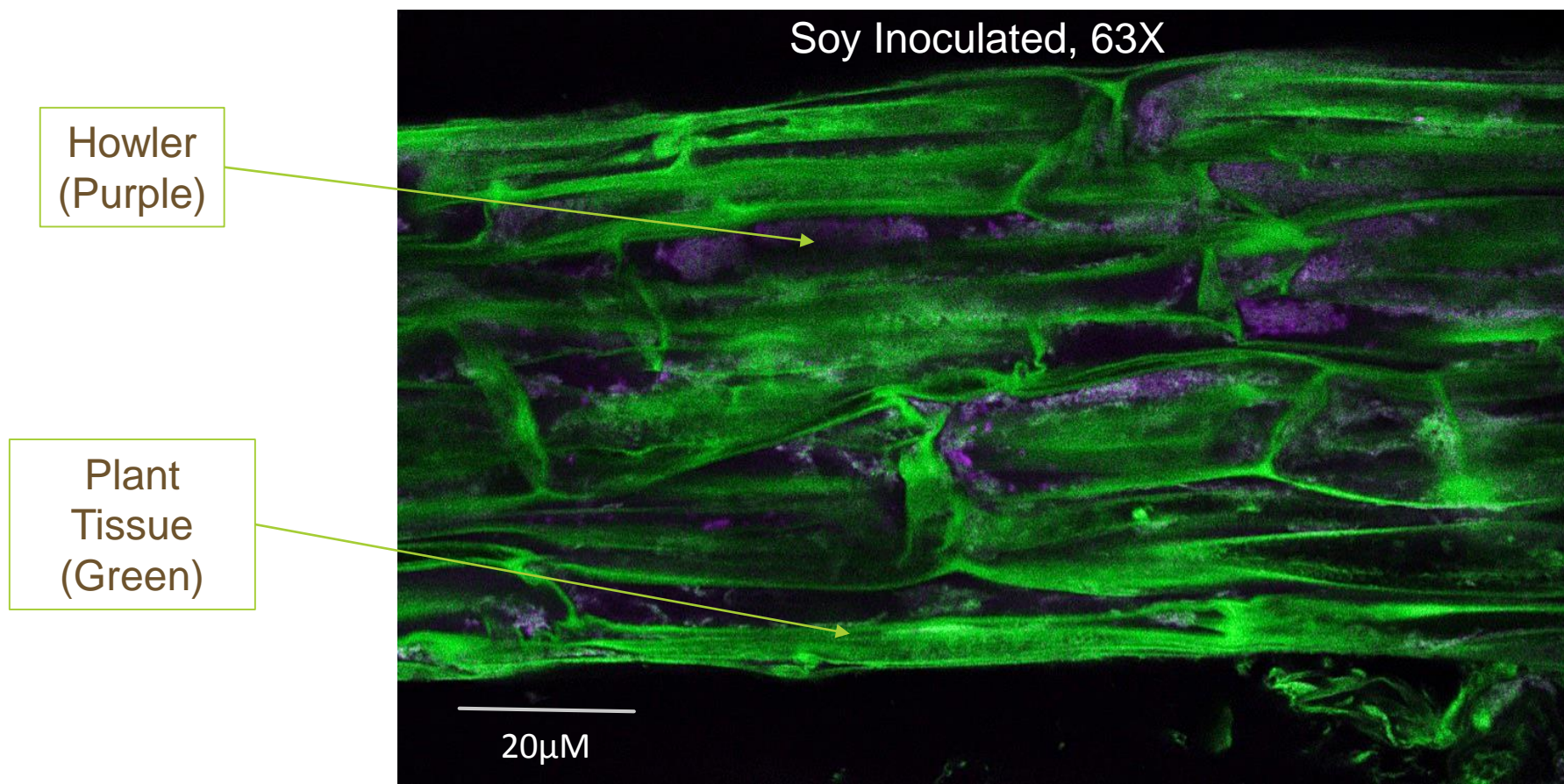


+ Howler 1:1

- Howler

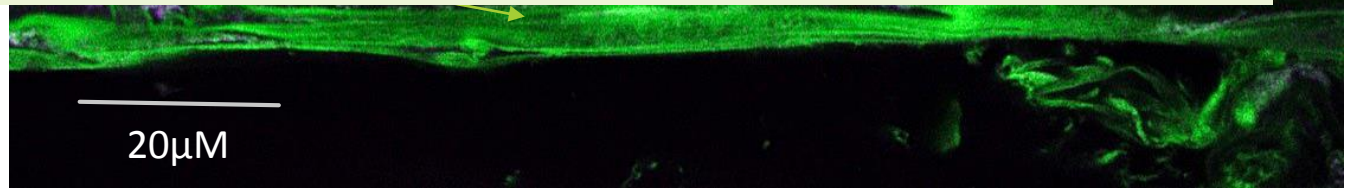
+ Howler 1:2

Howler™ Colonizes Host Plants



Howler™ Characteristics

- ✓ Potential for combination activity—colonization of roots by live bacteria and presence of active metabolites in treatment
- ✓ Native strain has activity against *Rhizoctonia solani* equivalent to chemical standards
- ✓ Multiple antifungal and anti-oomycete activities
- ✓ Regulatory genes and biosynthetic pathways understood



Howler™ Manufacturing

- Grows well in inexpensive media
- Compatible with chemical fungicides
- Scalable
- No special cleanup requirements
- Formulation as WP and ST with GRAS inerts that qualify for organic labeling
- Optimization underway, significant improvements already achieved
- Stable for >9 months (latest time point tested as of October 2015)



Development and Go-to-Market



- Large-scale field trials
- Scale-up, manufacturing and advanced formulation
- Implementation of marketing and distribution plan
- Make key hires
- Initial launch
 - turf and ornamentals in 2016
 - field crops in 2017

Thank You!



Better Microbes. Better Crops. Better World.™