

AGRAQUEST[®] 

Innovative natural product solutions for pest management

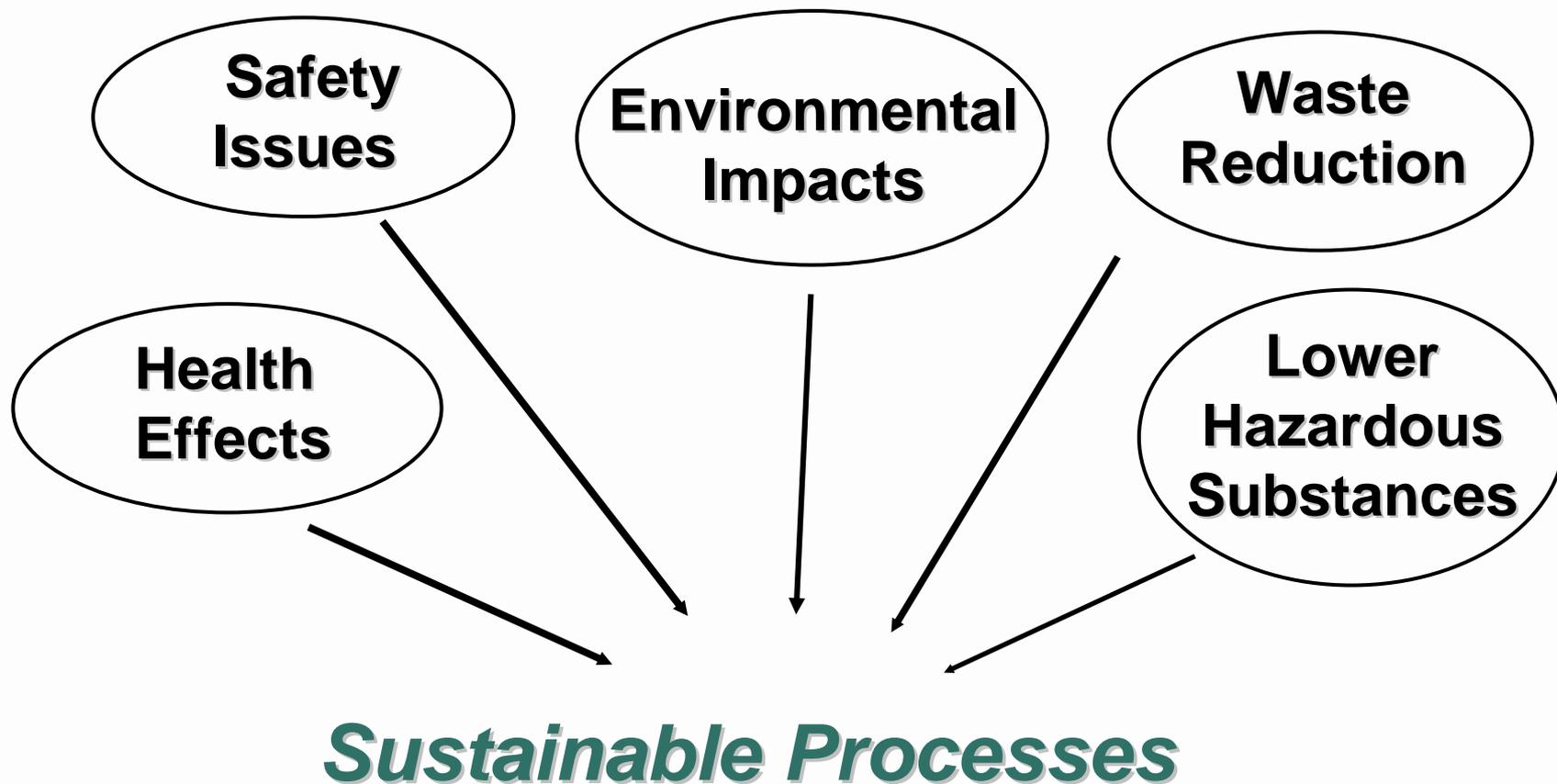
Green Chemistry:

The invention, design and application of chemical products and processes to reduce or eliminate the use and generation of hazardous substances...

Green Chemistry Encompasses:

- Safety issues -- Potential for fire, explosion
- Health effects -- Carcinogens, endocrine disrupters
- Environmental impacts on wildlife
- Waste reduction
- Reducing use of hazardous substances

Green Chemistry:



Green Chemistry in Agriculture:

- Safety

Synthetic chemical processes can lead to potential for industrial accidents



Green Chemistry in Agriculture:

- Health effects

FQPA was enacted to help evaluate pesticides and remove carcinogens and others with known health concerns

Organophosphates and other suspected oncogens are currently under review

Green Chemistry in Agriculture:

- Environmental impacts

Historic examples, DDT

Toxic effects on earthworms, beneficial microbes, aquatic organisms

Soil and water stream contamination

Green Chemistry in Agriculture:

- Hazardous substance reduction

Synthetic chemical processes may utilize toxic intermediates, reagents and organic solvents in production

Green Chemistry in Agriculture:

- Reduction of wastes

Traditional synthetic processes resulted in production of toxic or hazardous waste streams

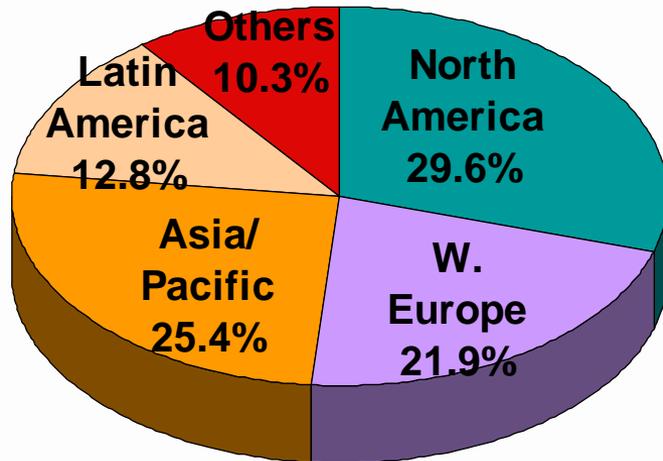
Green Chemistry in Agriculture:

How can natural products serve the goals of green chemistry and sustainable chemical processes?

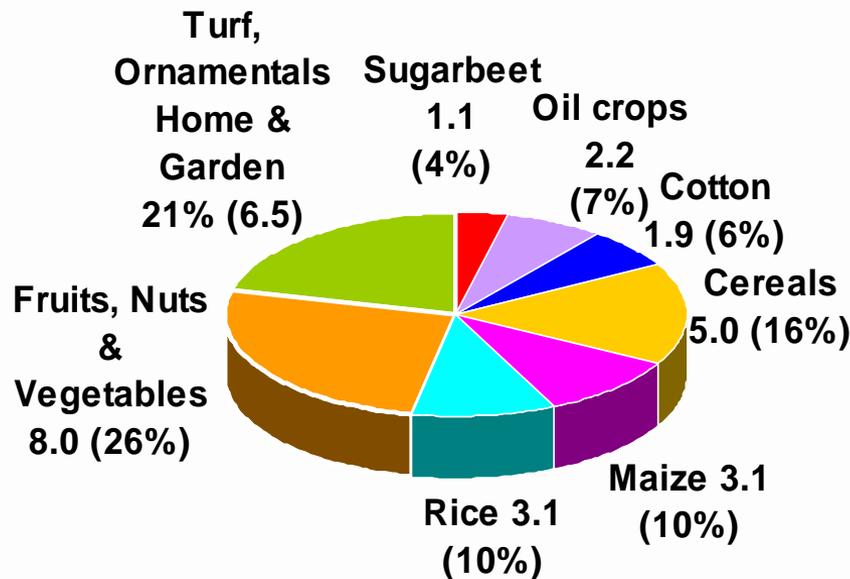
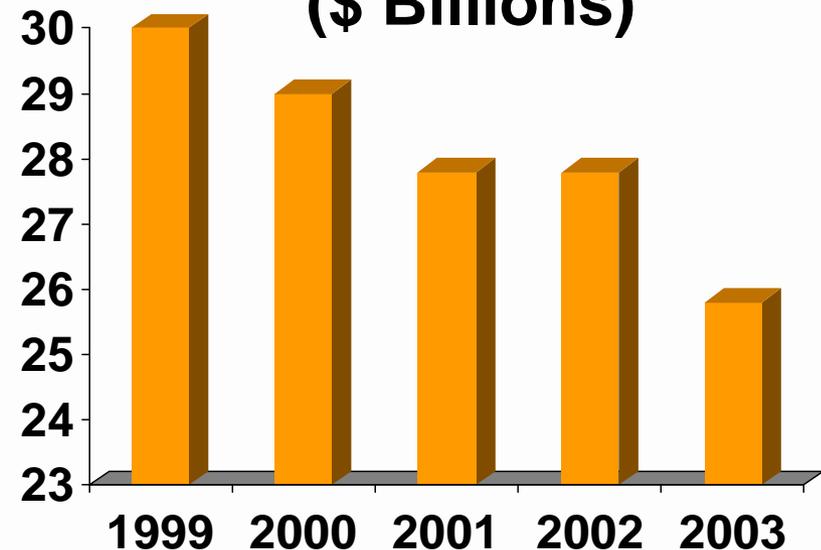
Green Chemistry in Agriculture:

What are the driving forces behind development of natural products as green pesticides?

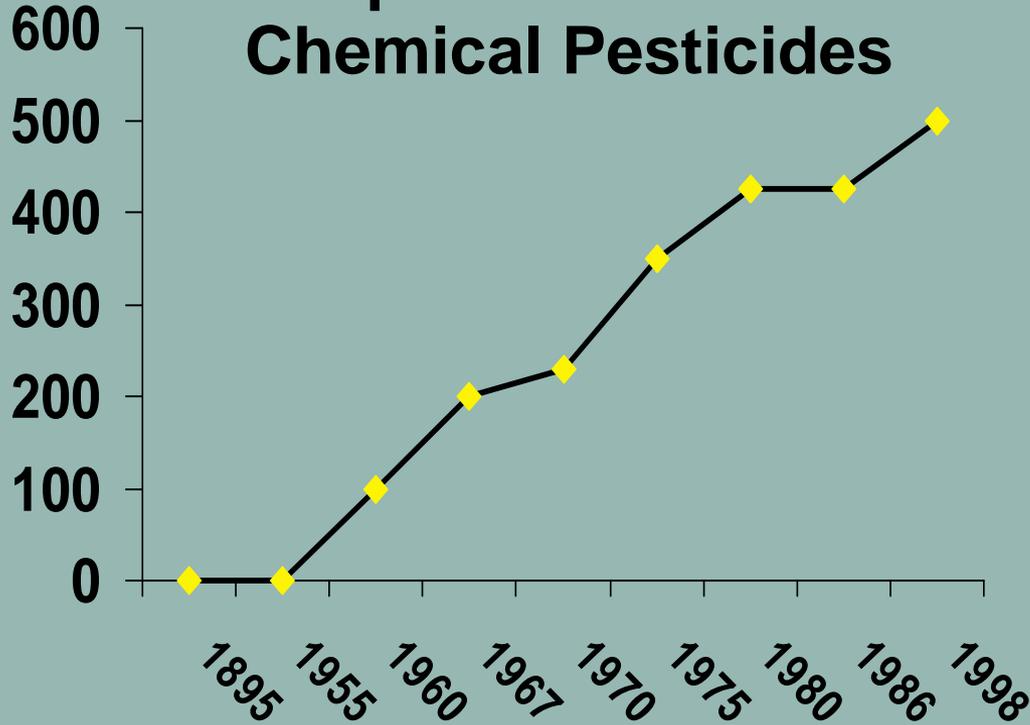
2003 Global Pesticide Market by Crop and Region:



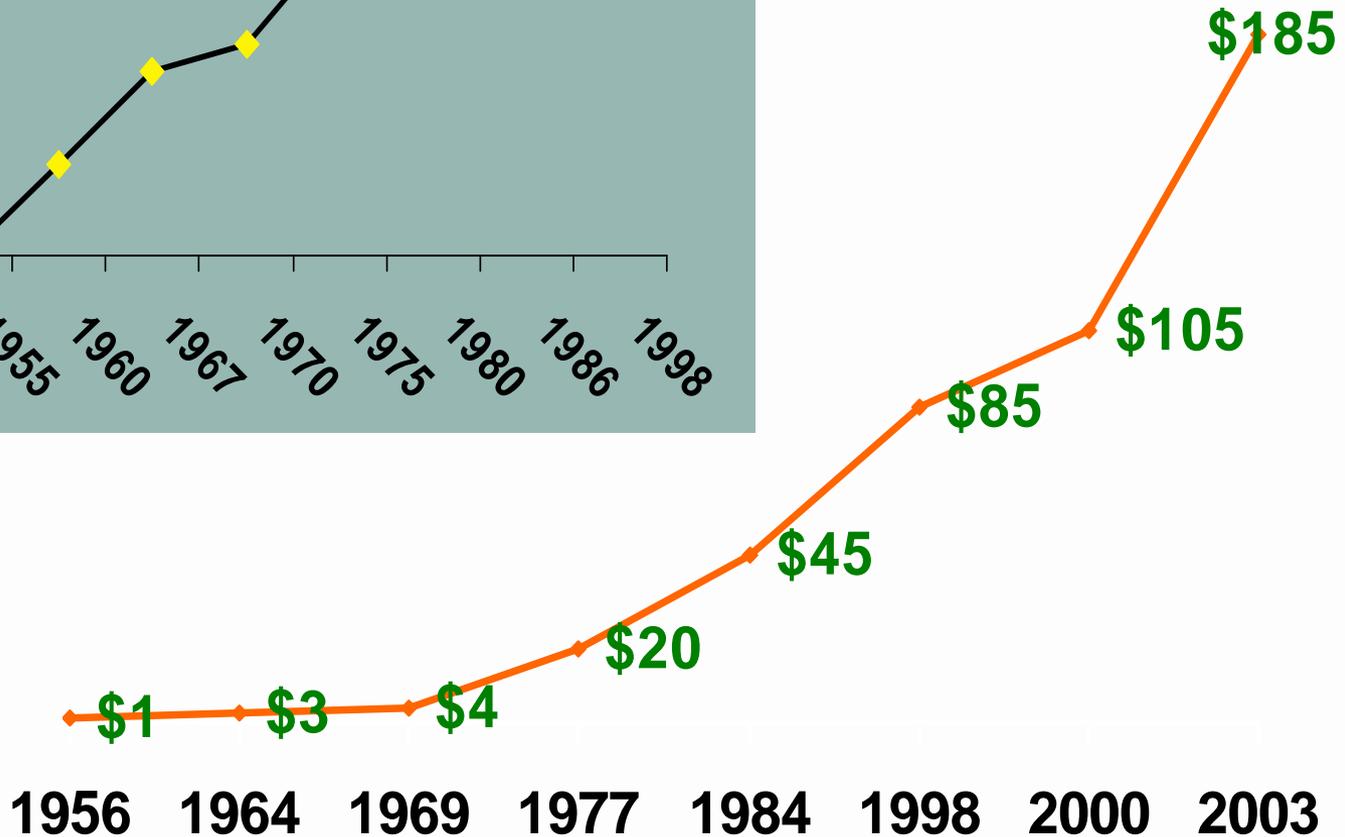
Global Chemical Pesticide Market (\$ Billions)



Pest Species Resistant to Chemical Pesticides



Average Cost to Develop a Chemical Pesticide (\$ Millions)



Consumer Demand for Safer Foods:

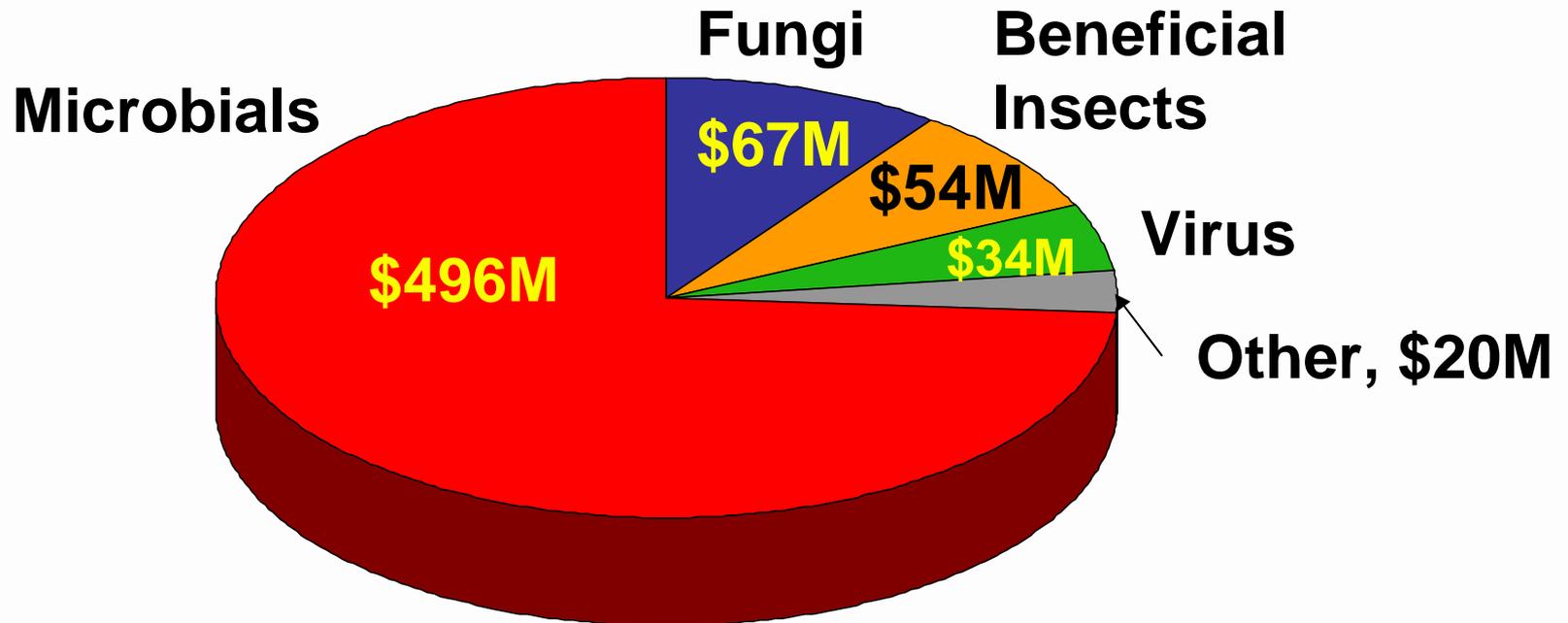
+20% *Compounded Annual Growth*

Organic Market



Biopesticide Market 2005:

**Biological Pesticide Market
~\$670M**



Barriers to Biopesticide Development:

- Competitive agricultural sector requires cost-effective production methods
- Expectations of distribution channels
1-2 year shelf life, ambient temperatures
- Expectations of farmers: Consistent efficacy, ease of use
- Perception of inferior quality
- Target-specific action reduces market potential

Green Chemistry in Agriculture:

How can natural products serve the goals of green chemistry and sustainable chemical processes?

Natural Products as Green Pesticides:

Fermentation derived natural products

- Safety

Fermentation processes with inherently lower accident potential

Natural Products as Green Pesticides:

Fermentation derived natural products

- Health effects

Natural products are known for target-specificity

Typically low mammalian toxicity profile

Natural Products as Green Pesticides:

Fermentation derived natural products

- Environmental impacts

Target-specific natural products

Low impact on beneficials, wildlife

Environmental breakdown results in benign products

Natural Products as Green Pesticides:

Fermentation derived natural products

- Hazardous substance reduction

Fermentation processes do not generally require the use of hazardous substances or solvents

Natural Products as Green Pesticides:

Fermentation derived natural products

- Reduction of wastes

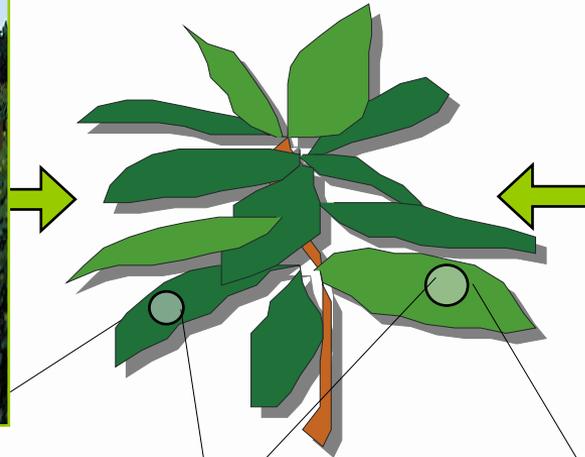
Waste from fermentation processes
may be utilized as agricultural fertilizers



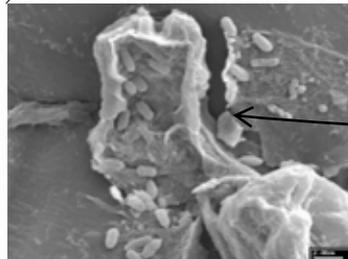
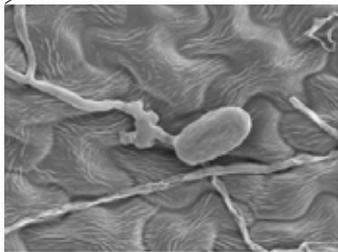
- *Bacillus subtilis* strain discovered by AgraQuest in a peach orchard in Fresno County, CA
- The first and only broad spectrum biofungicide 
- ~1,000 field trials on 32 crops in the U.S. and 22 other countries
- Registered in US, Chile, Mexico, New Zealand, Israel, Costa Rica, Japan, Korea, Guatemala, France, Italy, Turkey, Philippines, Honduras, Colombia, Argentina, Switzerland
- In progress in Brazil, Spain, Greece, Austria, Morocco, Panama, Bolivia, Thailand

How SERENADE[®] Works:

Applied Just Like Other Products



Mildew on Untreated Leaf Surface



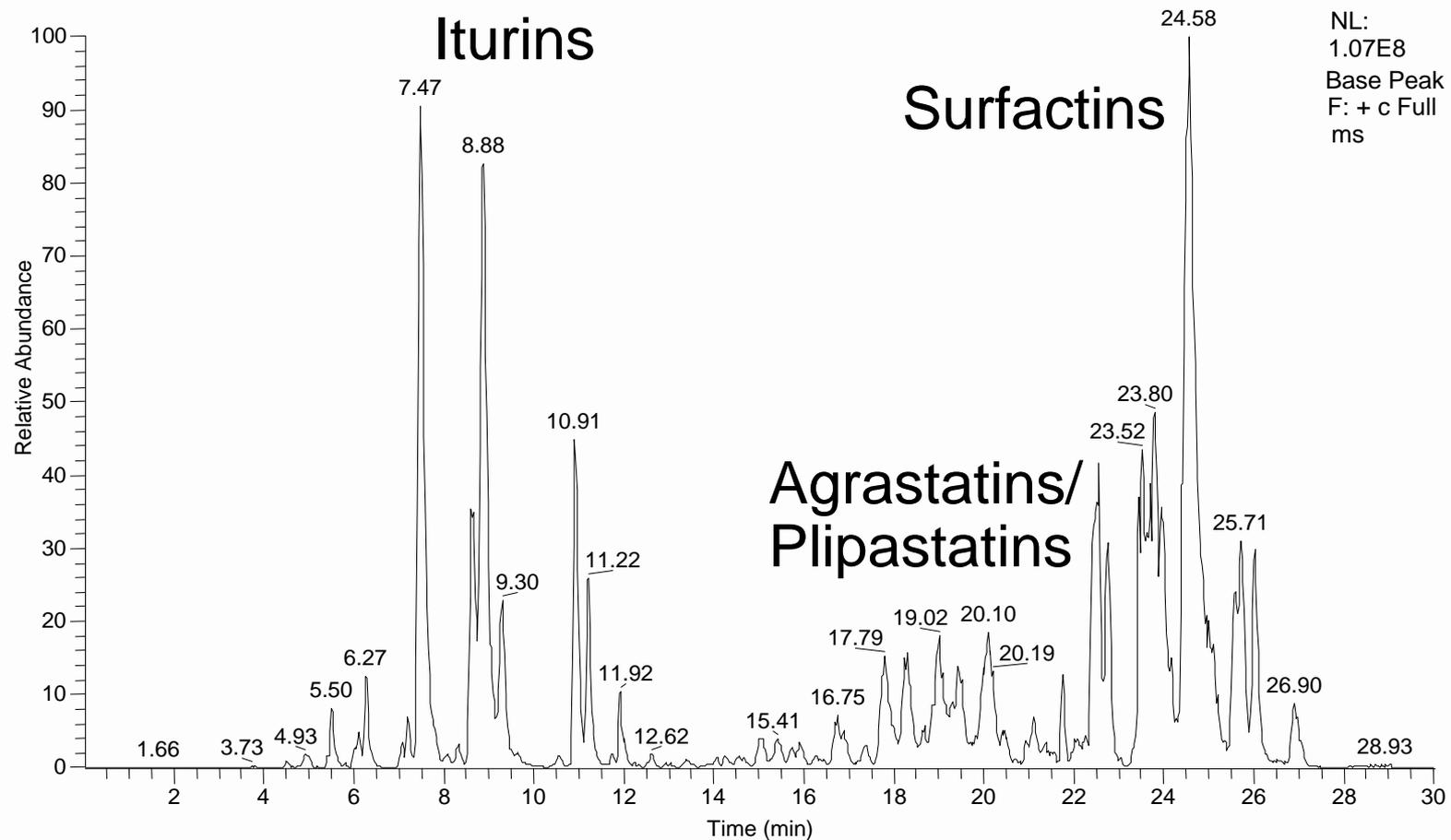
Novel Modes of Action

- Competes for space and food on the leaf surface
- Prevents spore from germinating
- Directly attacks germinating pathogen spore
- Excretes a suite of antifungal lipopeptides

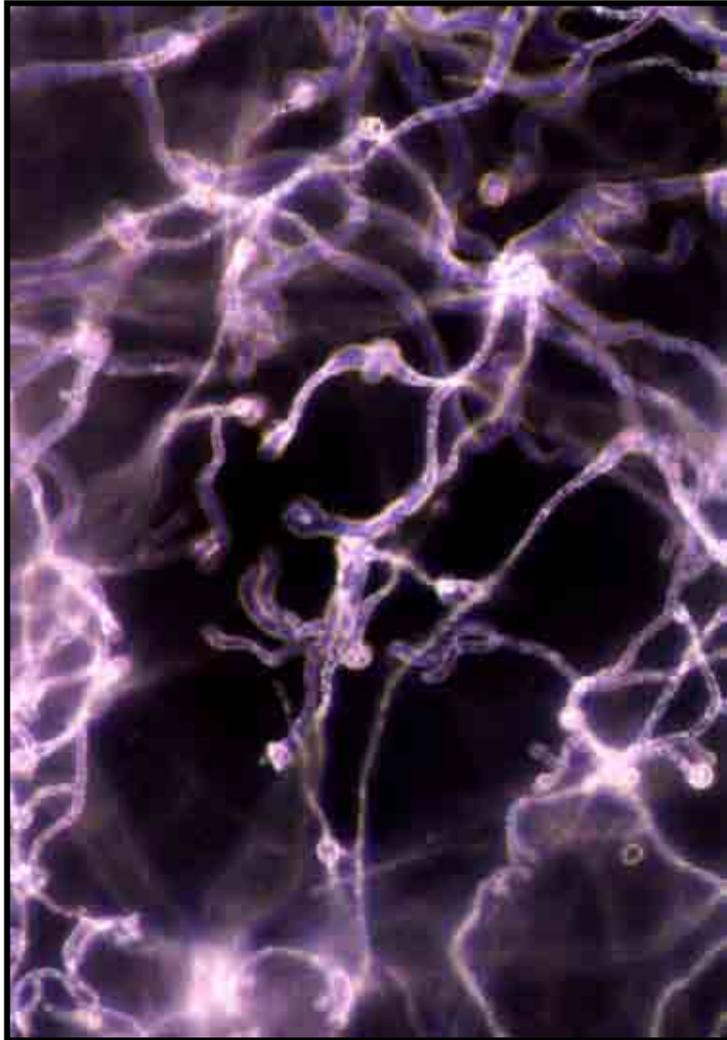
SERENADE
Destroys Germinating Spore

LCMS Profile of SERENADE:

RT: 0.01 - 30.01



***Botrytis* 0% inhibition Iturins
10ppm or Agrastatins 50ppm**



***Botrytis* 90% inhibition Iturins
10ppm + Agrastatins 2.5ppm**



Efficacy of SERENADE on Grape (Chardonnay) vs. Powdery Mildew (Yolo County, CA - 1999)



Untreated

SERENADE

Efficacy of SERENADE vs. Pear Fire Blight

Untreated

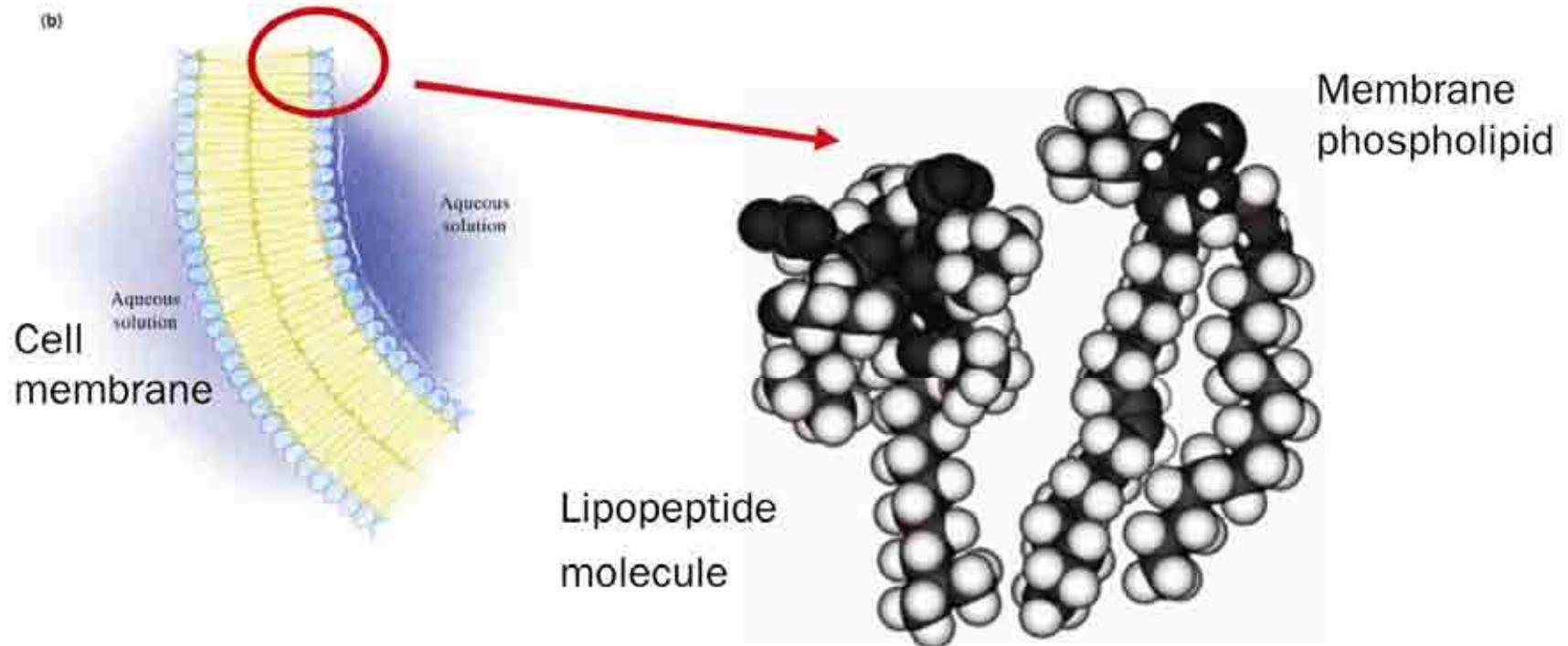


Treated



Using Synergy as a Way to Reduce Total Pesticide Load:

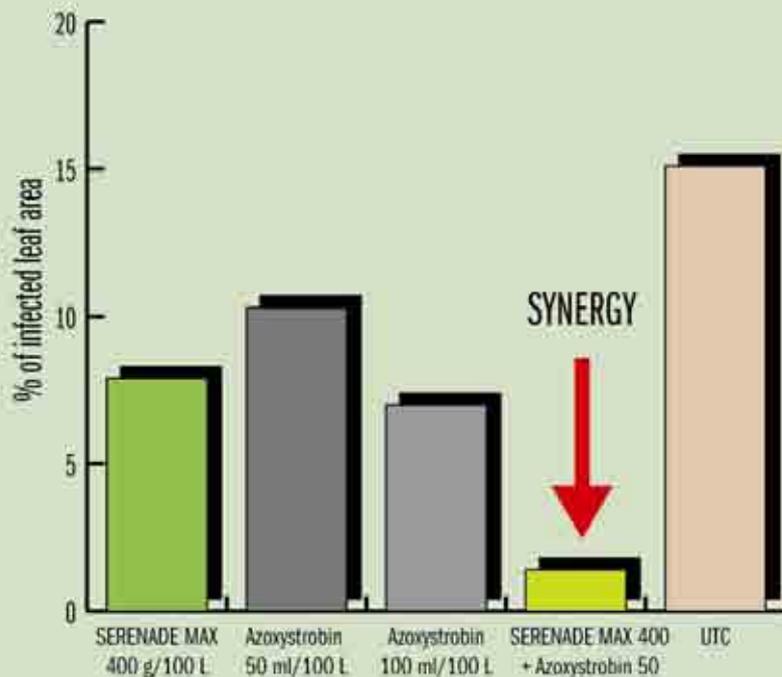
SERENADE lipopeptides make membranes porous which could allow other small molecules into the pathogen cell.



Using Synergy as a Way to Reduce Total Pesticide Load:

SERENADE MAX vs. Powdery Mildew on Grapes

M.L. Gullino, Università Degli Studi di Torino, Italy - 2006



SERENADE MAX vs. Powdery Mildew on Grapes

M.L. Gullino, Università Degli Studi di Torino, Italy - 2006



Where can we have the biggest impact in furthering Green Chemistry goals?

- Organic agricultural production still only makes up for 1-5% of total production
- Conventional agriculture relies on integrated programs to avoid resistance development
- Biopesticides used in conventional IPM programs will result overall lower environmental impact

SERENADE Program

Low Chemical & Better Disease Control

Serenade Program

Green tip:

Champ 2F 6pts

25%bloom + Petal

fall:

Serenade Max 1 lb

+Agrimycin 17 0.5 lb

+Captan 50 4 lb

+Sovran 4oz (PF)

Full bloom + 1st

Cover:

Serenade Max 2lb

+Captan 50 4 lb

2nd – 5th Cover:

Serenade Max 2lb

+Topsin-M 8oz

6th Cover:

Serenade Max 1lb

+Sovran 4 oz

Grower Program

Green tip:

Champ 2F 6pts

25% + Full bloom:

Agrimycin 17 1.0 lb

+Captan 50 4 lb

Petal fall:

Agrimycin 17 1.0 lb

+Captan 50 2 lb

+Sovran 4 oz

1st Cover:

Agrimycin 17 1.0 lb

+Captan 50 4 lb

+Topsin-M 8oz

2nd – 5th Cover:

Ziram 76DF 2lb

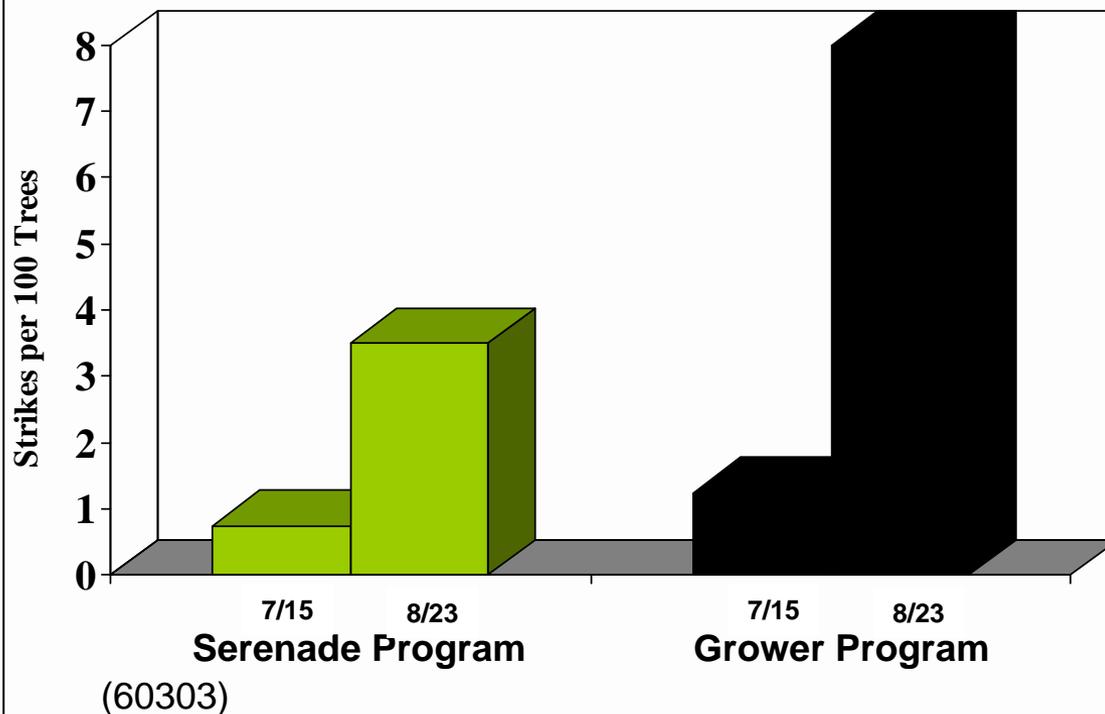
+Topsin-M 8 oz

6th Cover:

Ziram 76DF 1lb

+Sovran 4 oz

SERENADE vs. Fire Blight on Apples
Agr.assistance, Wayne County, NY, 2006



SERENADE Program

Low Chemical & Better Disease Control

Serenade Program

Green tip:

Champ 2F 6pts

25%bloom + Petal fall:

Serenade Max 1 lb

+Agrimycin 17 0.5 lb

+Captan 50 4 lb

+Sovran 4oz (PF)

Full bloom + 1st Cover:

Serenade Max 2lb

+Captan 50 4 lb

2nd – 5th Cover:

Serenade Max 2lb

+Topsin-M 8oz

6th Cover:

Serenade Max 1lb

+Sovran 4 oz

Grower Program

Green tip:

Champ 2F 6pts

25% + Full bloom:

Agrimycin 17 1.0 lb

+Captan 50 4 lb

Petal fall:

Agrimycin 17 1.0 lb

+Captan 50 2 lb

+Sovran 4 oz

1st Cover:

Agrimycin 17 1.0 lb

+Captan 50 4 lb

+Topsin-M 8oz

2nd – 5th Cover:

- Ziram 76DF 2lb

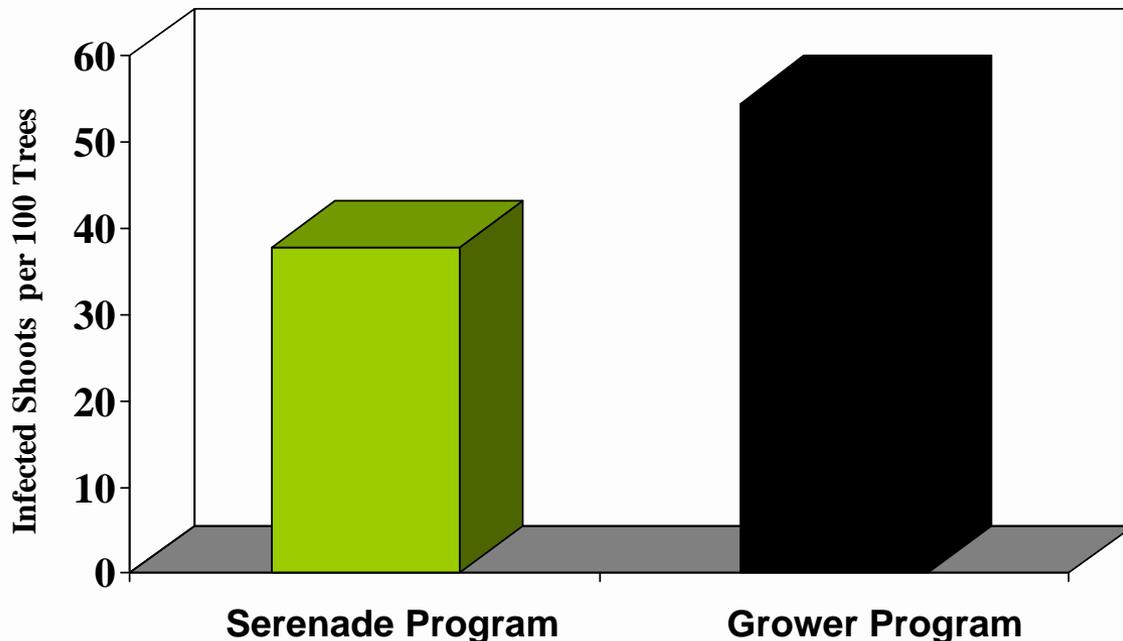
+Topsin-M 8 oz

6th Cover:

Ziram 76DF 1lb

+Sovran 4 oz

SERENADE vs. Powdery Mildew on Apples Agr.assistance, Wayne County, NY, 2006



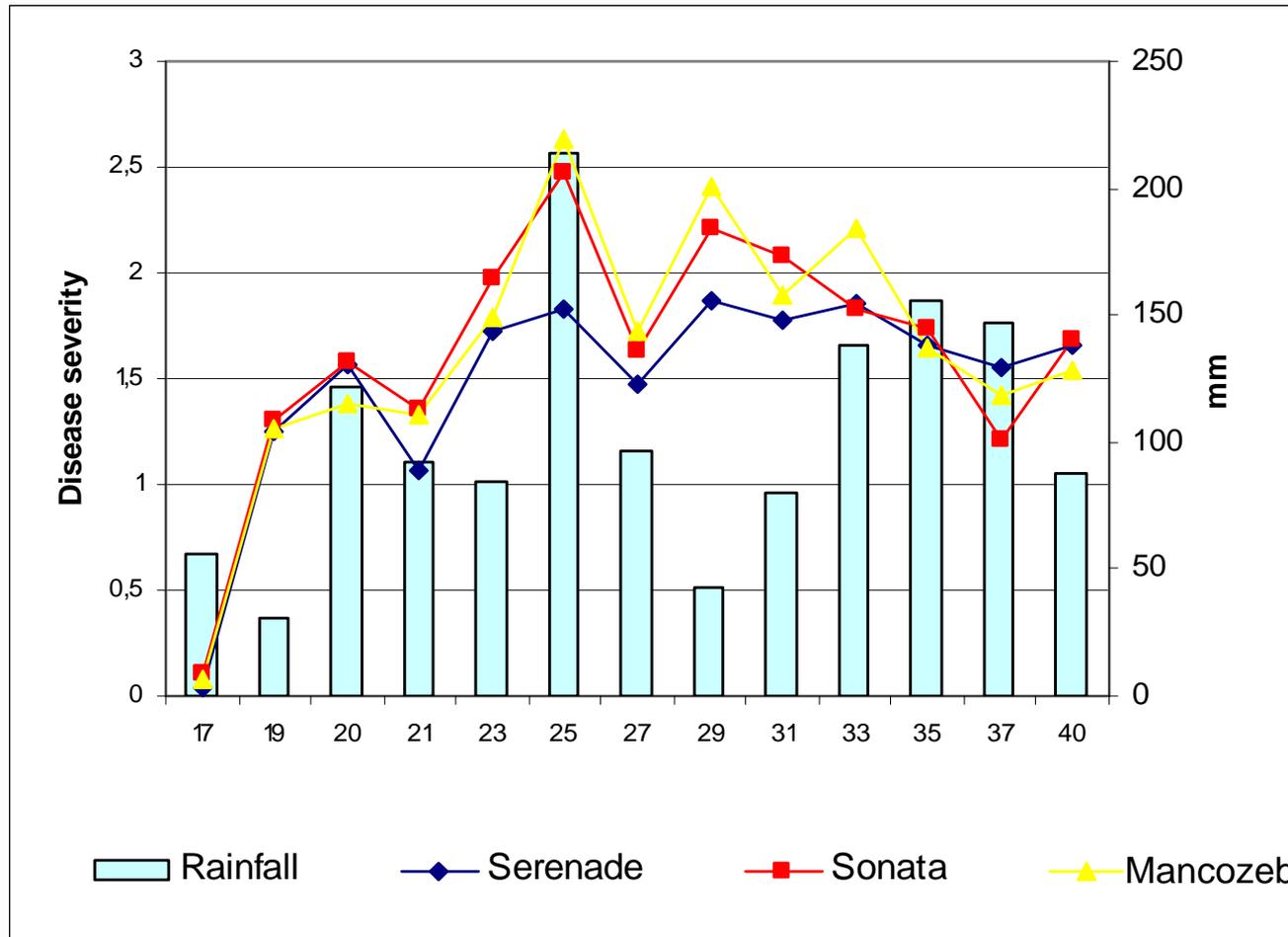
(60303)

Costa Rica Has the Highest Disease Pressure Due to Climate:

- Control of black sigatoka requires fungicide applications of 50-60 cycles in a year.
- Resistance has developed to all classes of systemics to some degree.
- SERENADE can replace up to 20 mancozeb treatments with equivalent control

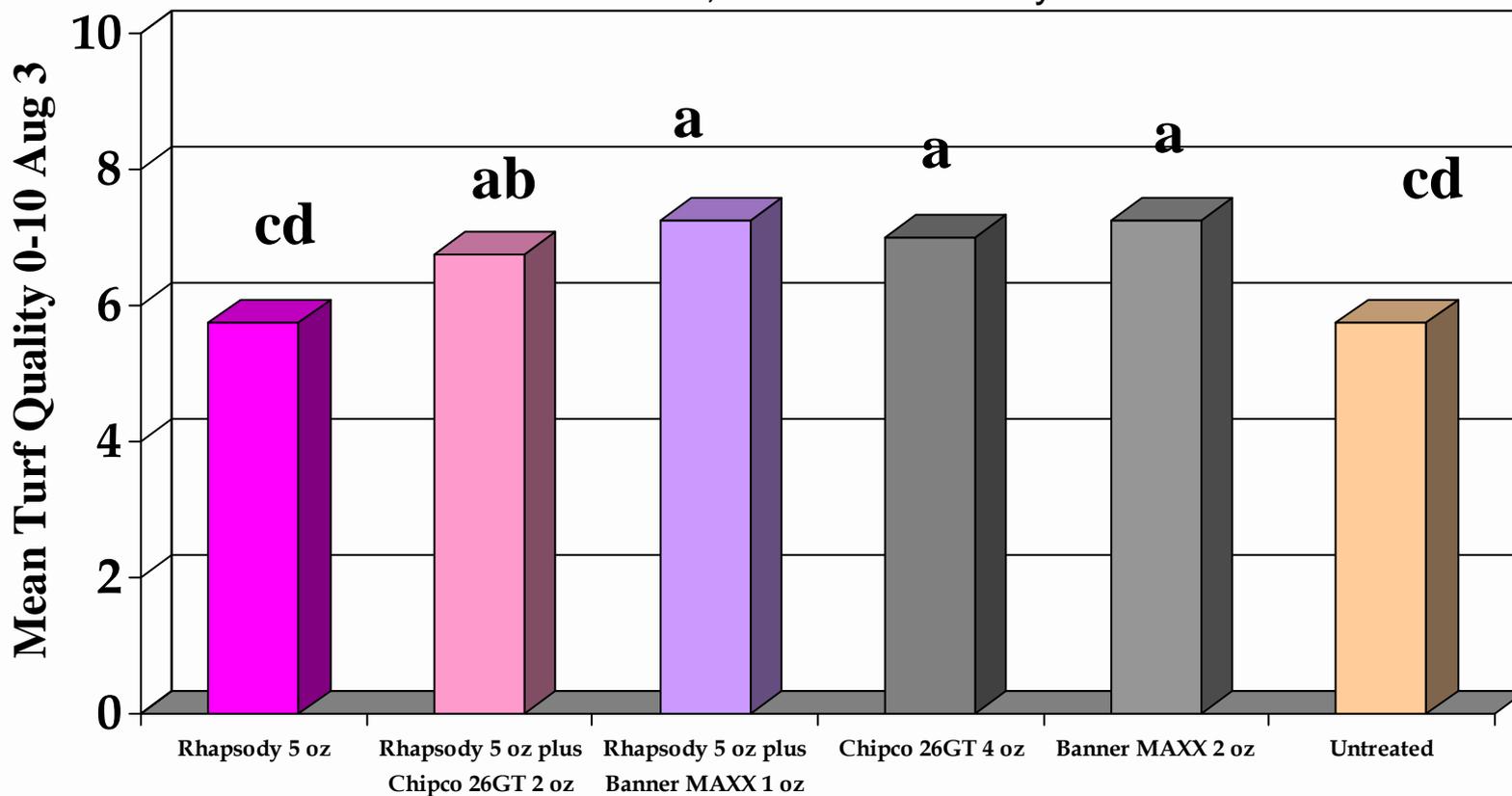


Long Term, Large Plot Sigatoka Trial:



Fewer Chemicals, Excellent Turf Quality

RHAPSODY vs. Dollar Spot of Turf 9 WAT1
R. Latin, Purdue University - 2006



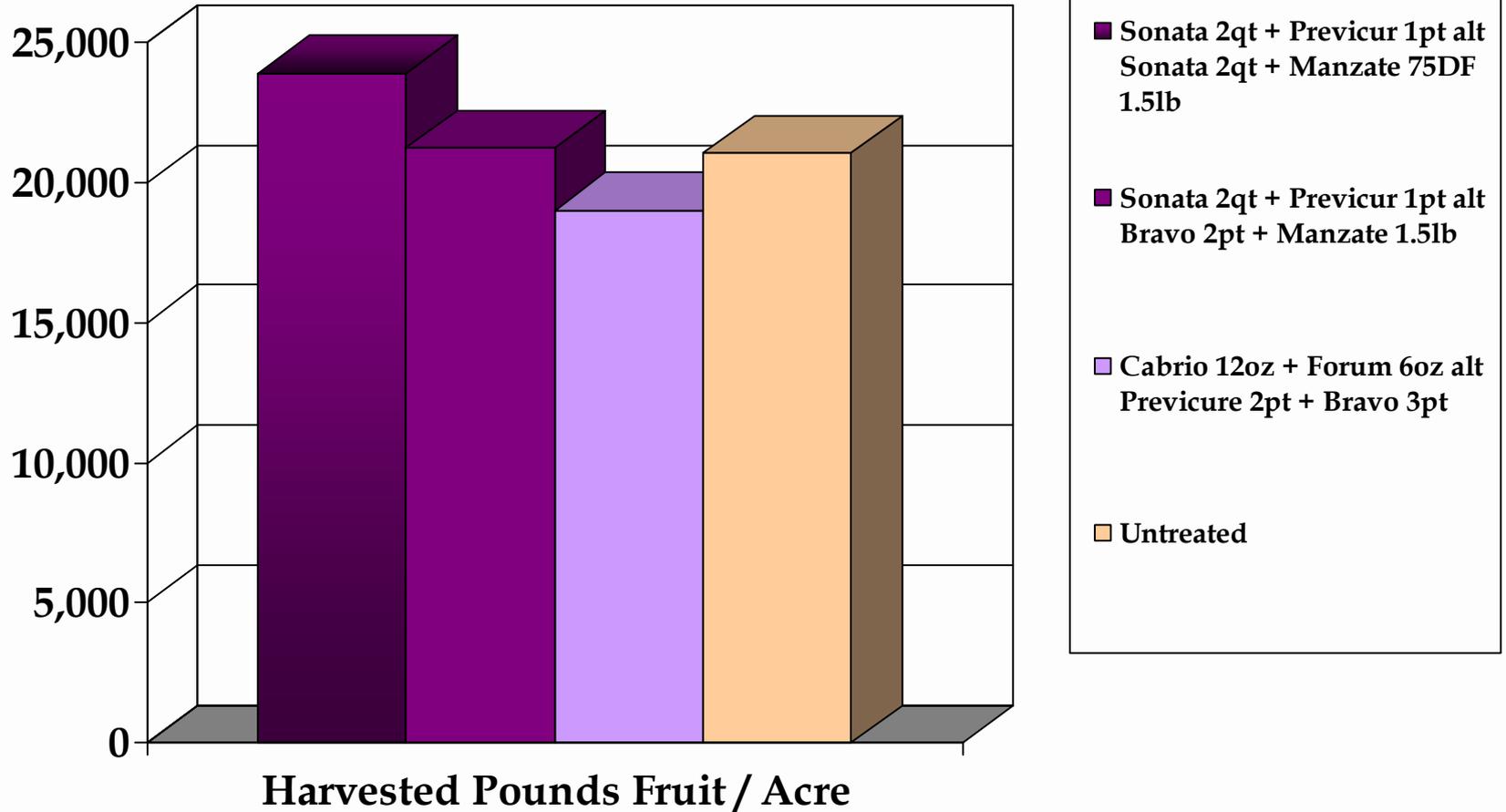
Four applications, 14 day intervals. Moderate disease severity. Means followed by same letter NSD 0.05 Waller-Duncan-K.

SONATA®

- SONATA® is an effective biological fungicide that provides excellent control for:
 - Powdery Mildew
 - Rusts
 - Blights (Early & Late)
 - Downy Mildew
- *Bacillus pumilus* formulated for effective, economical extended control of fruit, vegetable, & nut diseases

SONATA Program:

SONATA vs. Downey Mildew on Winter Squash
Dr. Pernezny, UFL - 2006



Biotune added to all SONATA treatments at 0.2% V/V

SONATA Program, Fewer Chemicals = Larger Fruit & Higher Yield



SONATA 2qt + Previcure 1pt
Alt. SONATA 2qt + Manzate 75DF 1.5lb+ Biotune 0.2% v/v



Cabrio 12oz + Forum 6oz
Alt. Previcure 2pt + Bravo 3pt

Biopesticides Can Overcome the Hurdles:

- Positioned in a program as a “natural product with equal or better performance than synthetic fungicides” and the added benefits of: resistance management; application flexibility; OMRI listed; no pre-harvest restrictions; environmentally friendly profile; excellent in IPM programs
- Target grapes, tomatoes & peppers, bananas, lettuce, apples/pears, vegetables, hops, cherries, walnuts and home & garden
- Two year shelf life, standard for agrochemicals
- Same price for both conventional and organic growers, comparable to newer synthetic chemicals



Green Chemistry in Agriculture:

Natural products can serve the goals of green chemistry and sustainable agriculture.

SERENADE[®]
MAX

SERENADE[®]
ASO

SONATA[®]

RHAPSODY[®]

KEYNOTE[™]

2007 AgraQuest, Inc.

Serenade, Sonata, Rhapsody, & Ballad are registered trademarks of AgraQuest, Inc. These trademarks are registered in the U.S. Patent and Trademark Office as well as in the intellectual property offices of numerous other countries worldwide.

The SERENADE and RHAPSODY products are protected by U.S. Patent Nos. 6060051, 6103228, 6291426, 6417163, and 6638910. In addition, these products are protected by patents in numerous other countries.

The SONATA and BALLAD products are covered by U.S. Patent Nos. 6245551, 6586231, and 6635245 and by patents in numerous other countries.

Products comprising the Muscodor fungus are protected by U.S. Patent No. 6,911,338 and are the subject of numerous pending patent applications worldwide.

AgraQuest owns the following product registrations: Serenade MAX - EPA Reg. No. 69592-11; Serenade ASO - EPA Reg. No. 69592-12; Sonata - EPA Reg. No. 69592-13. These products are also registered in numerous other countries worldwide.