

Annual Biocontrol
Industry Meeting
ABIM 2014
Basel, Switzerland
October 2014



Science For A Better Life

Integrated Crop Protection Solution

(chemicals and biologicals) for control of Black Sigatoka disease on bananas:

An Illustrative Case Study for Sustainability

Denise Manker, Sarah Reiter and Manuele Ricci

ABIM | Basel | October 2014



The Banana Value Chain had a Problem

Bananas cannot be produced
without fungal control



Challenges in Banana Production



Cavendish variety is the main export banana and is **highly susceptible** to black sigatoka (*Mycosphaerella fijiensis*)

Four leading export countries are Ecuador, Costa Rica, Philippines and Colombia

Tropical climate conditions results in extremely **high disease pressure**

The fungicide market in bananas is more than **\$250 million** and more than **70%** is spent on managing black sigatoka





Black sigatoka is a devastating disease



- Sigatoka management requires year-round fungicide applications
- Control requires fungicide applications of up to 50-60 cycles in a year
- All fungicides are applied by air





Banana Production

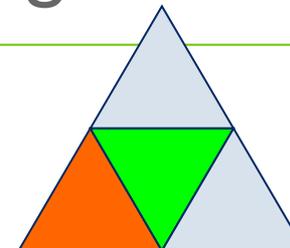
- Each banana tree produces one bunch
- After harvest, the “mother tree” is cut down and the next bunch will be produced by the “daughter” tree
- There is no crop rotation and no fallow time
- Diseased leaves are cut away and left on the ground
- Plantations can produce bananas for decades without replant

Resistance to systemics develops rapidly under these conditions





Resistance Risk Assessment: Pathogens Risk Ranking



Blumeria gr. tritici
Blumeria gr. hordei
Mycosphaerella fijiensis
Plasmopara viticola
Erysiphe necator

**High
Risk**

Septoria tritici
Rhynchosporium secalis
Oculimacula spp.

Phytophthora infestans

**Medium
Risk**

Puccinia spp.

smuts & bunts
(i.e. *Tilletia laevis* *T. tritici* - *Ustilago tritici*)

Rhizoctonia solani

**Low
Risk**

For managing *Mycosphaerella fijiensis* in bananas, FRAC recommends that MOST systemic applications should be applied in mixtures with non-cross resistance fungicides, such as Serenade



Resistance Risk of Biological Fungicides



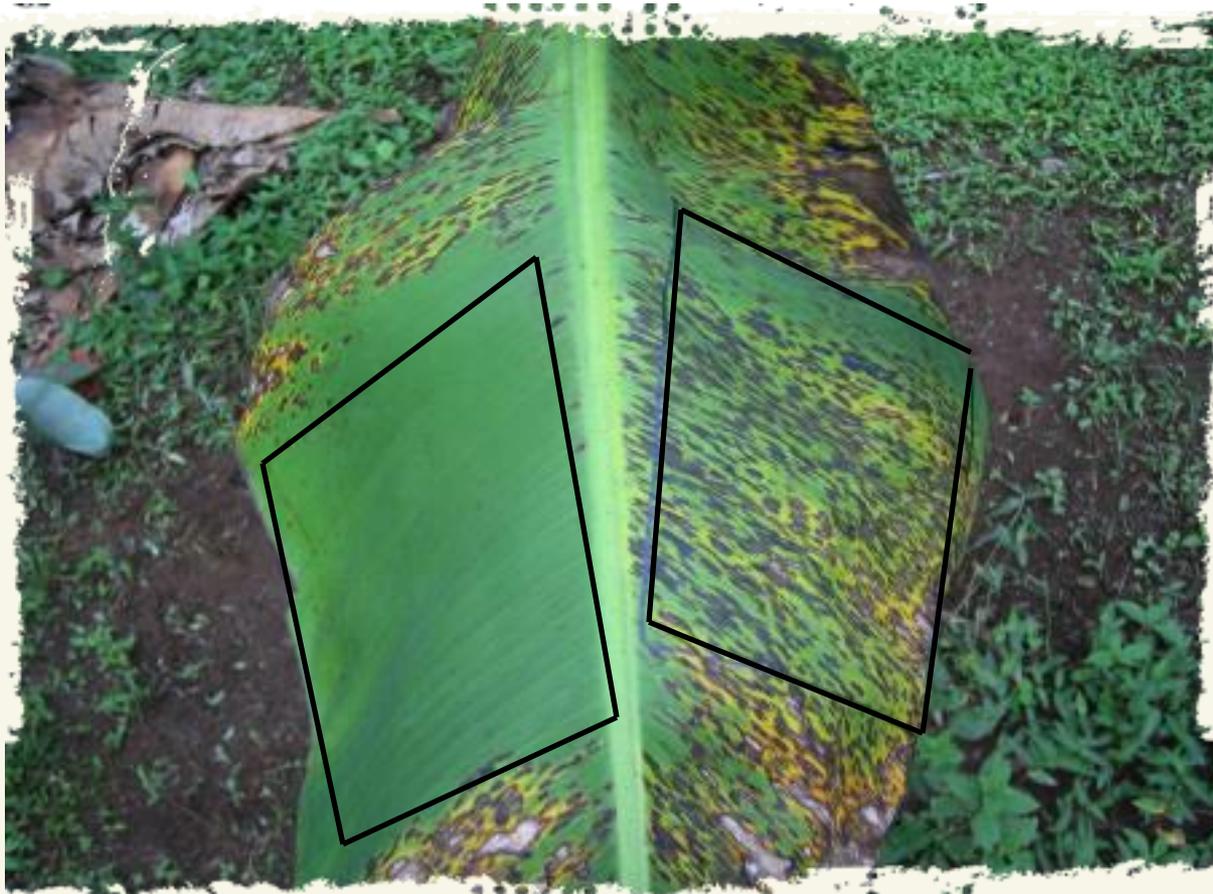
According to the `FRAC Code List`, updated 2013-04-29

- resistance is not known neither for F6, F7, P5, nor for NC target sites or categories
-  **SERENADE** is classified as F6 (microbial membrane disrupter)
- comparable to multi-site fungicides, `Biological Fungicides` such as  **SERENADE** can be generally considered as `Low Risk Groups` without any signs of resistance development

For Resistance Management, `Biological Fungicides` can be used in a similar way as multi-sites, if disease control efficacy is comparable as well



Single Leaf Tests



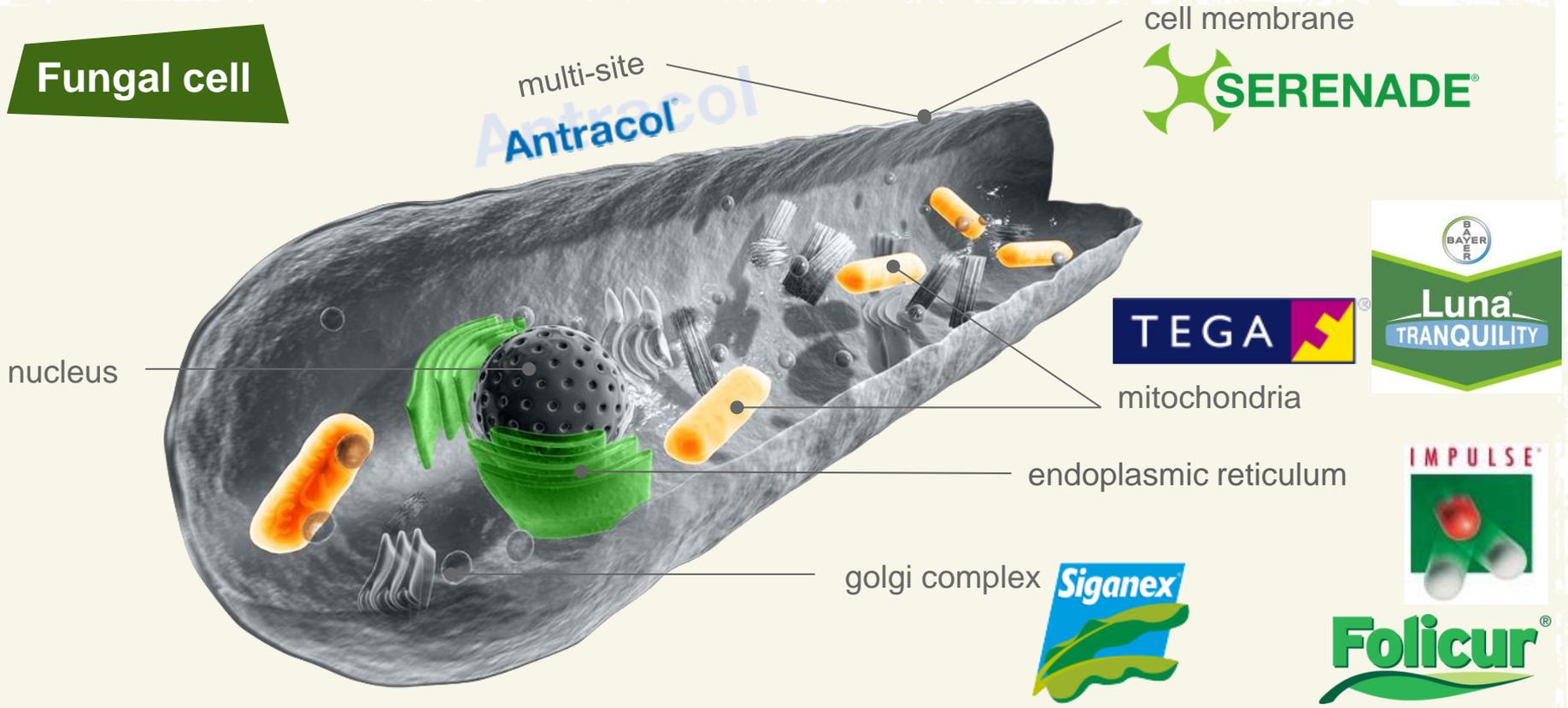
Efficacy of SERENADE



Modes of Action – A Treasure of Diversity



Fungal cell



Fungicide classes inhibit different cell functions





Optimizing Resistance Management: Maximize Efficacy - Minimize Resistance Risk



| | MS/BF | DMI | QoI | SDHI | SBI | AP |
|------------------|-------|-----|-----|------|-----|----|
| 40 sprays/season | 9+x* | 7 | 2 | 3 | 11 | 8 |
| 30 sprays/season | 7+x* | 6 | 2 | 3 | 7 | 5 |
| 20 sprays/season | 4+x* | 4 | 1 | 2 | 5 | 4 |
| 10 sprays/season | 2+x* | 2 | 1 | 1 | 2 | 2 |

* number of solo applications of multi-sites or biological fungicides plus x number in mixture with systemic fungicides

MS: multi-site
 BF: biological fungicide
 DMI: azole
 QoI: strobilurin
 SBI: amine
 AP: anilino-pyrimidine

The most stable situation is given when a maximum diversity of modes of action is used, including 'Biological Fungicides' as alternative for multi-sites

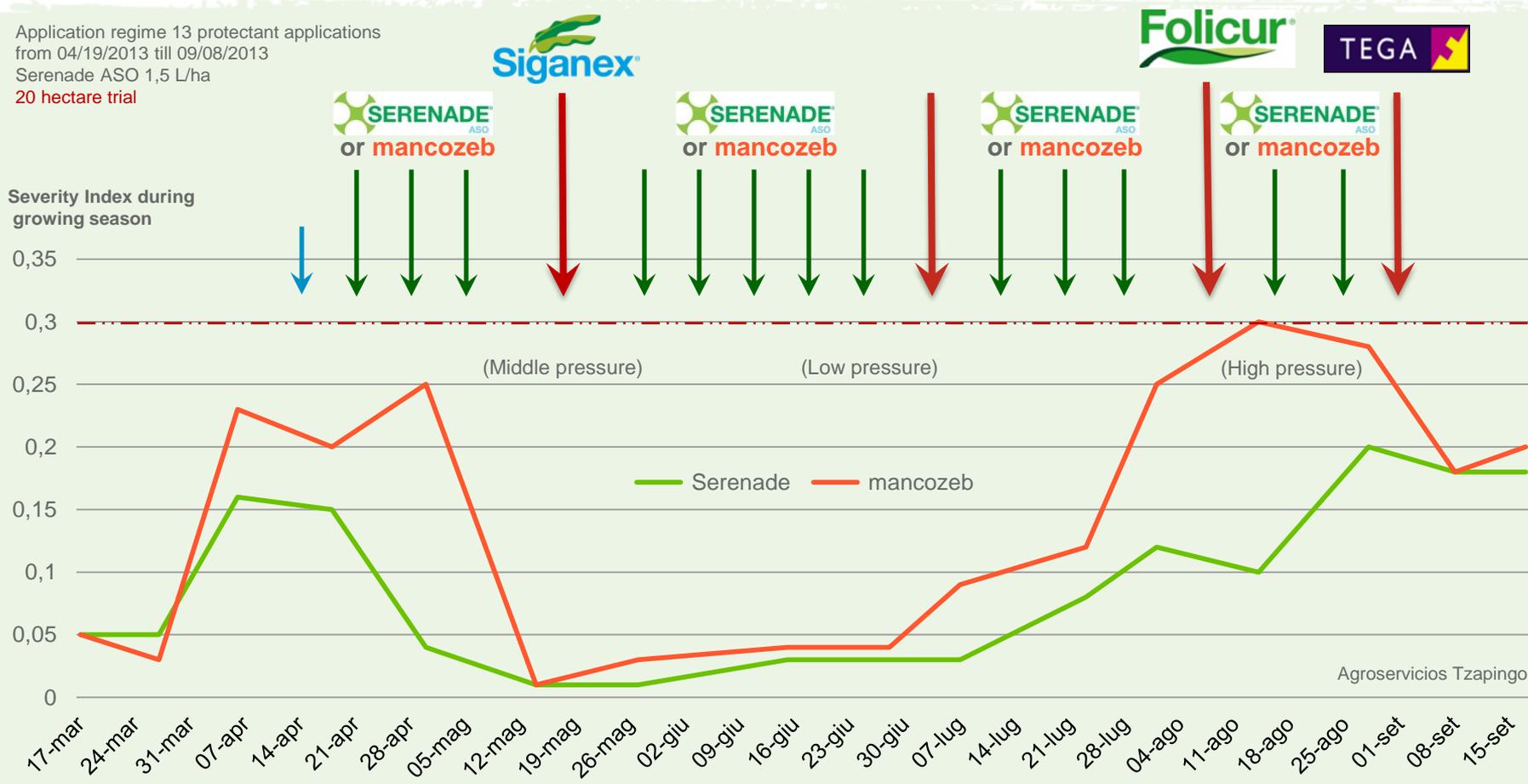


Integrated Program for Black sigatoka control

Bananas in Mexico



Application regime 13 protectant applications from 04/19/2013 till 09/08/2013
 Serenade ASO 1,5 L/ha
 20 hectare trial



Note: Severity Index below 0,3 considered as a healthy plantation



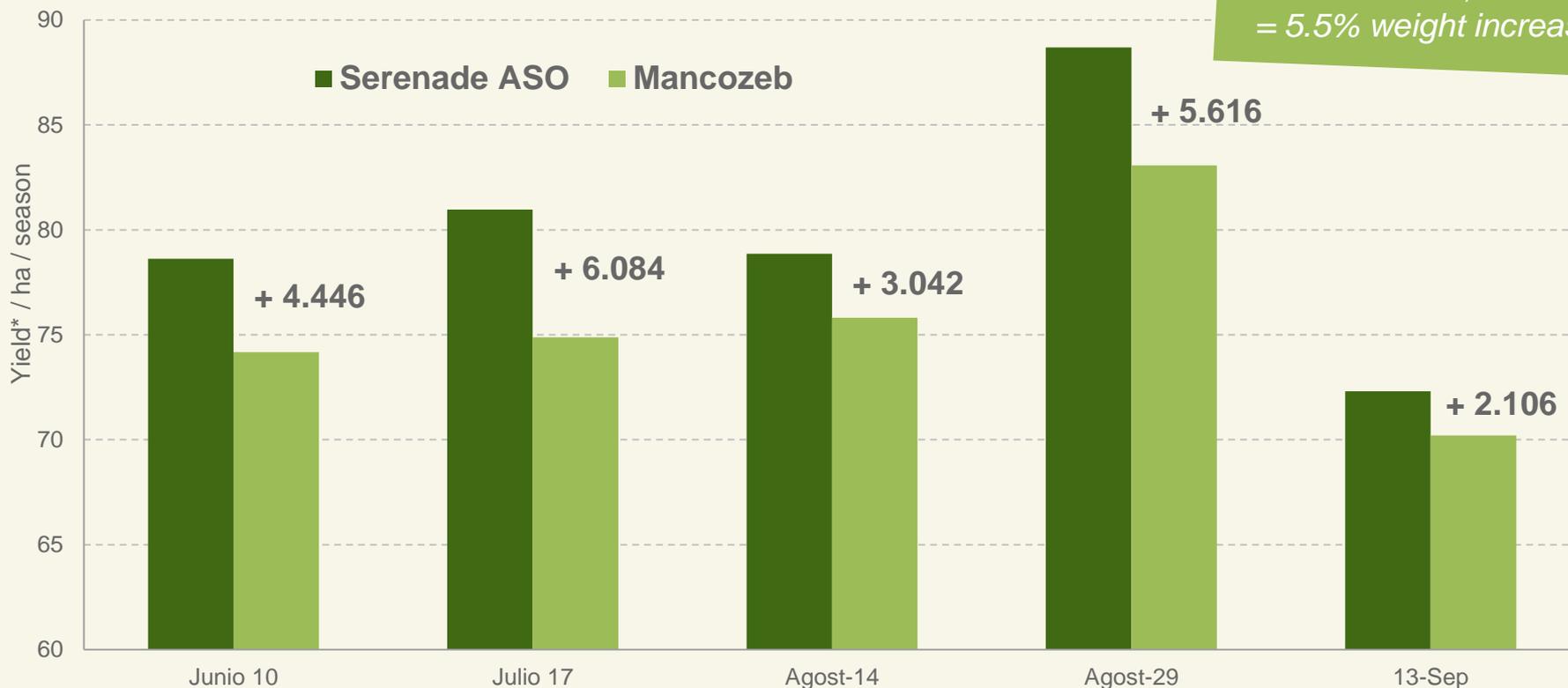
Yield increase (*Large scale trial*) Bananas in Mexico



Application regime 13 protectant applications from 04/19/2013 till 09/08/2013
Serenade ASO 1,5 L/ha
20 hectare trial

Average yield

Mancozeb: 75,6 ton
Serenade: 79,8 ton
= 5.5% weight increase

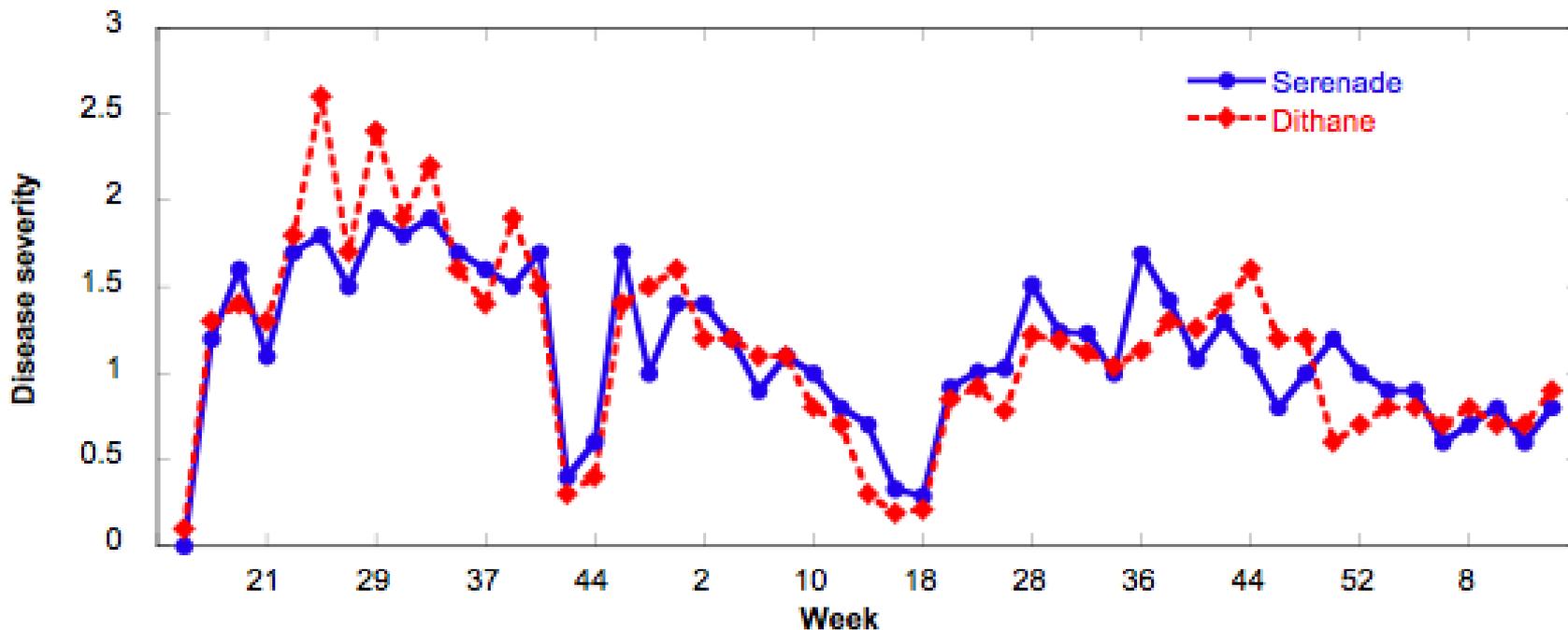


* Weight of whole bunch (incl. raquis); 2,100 plants/ha; average yield w/o raquis on this area: 51 ton/ha



SERENADE[®] Bio-Fungicide

Costa Rica, large plot commercial program



Two years of study demonstrated SERENADE is as effective as Dithane, with improved worker safety profile and leaves no pesticide residue.



Plant Health Effects

SERENADE Plot



More open leaf canopy

- Program with SERENADE produced better nodal spacing and less crowded leaves on banana trees
- Observations suggest that plants appear to reach maturity and produce their fruit faster with SERENADE*

Mancozeb Plot



Crowded leaves



Integrated Crop Solutions in Banana: A new growing paradigm



Integrated solutions help sustainably optimize banana production

- Control of aggressive disease
- Managing resistance with multiple modes of action
- Help optimize plant health and yield by introducing use of Serenade, a biological contact fungicide





THANK YOU
FOR YOUR
KIND ATTENTION