New microbial pesticides for managing insect pests and plant pathogens

150 years

BASF
We create chemistry

Katherine Walker
Technical Service Rep

Nemasys®

Beneficial Nematodes

150 years

BASF
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- **Nematodes that attack pests**
- **Five key species**
- **Favorable regulatory profile**
  - Quick to market
- **Meets Value Chain Demands**
  - 0-MRLs, 0-PHI, 0-REI
  - Excellent IPM tool
- **Flexibility for the farmer**
  - Pest control until harvest
  - Compatibility with beneficials and pollinators
  - Persistent in the soil for long term control

What are Beneficial Nematodes?

Microscopic worms that target a wide-range of pests

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Naturally-occurring macro-organisms

Enter through openings of target pests

Reproduce inside the host pest

Powerful sustainable biological tool

Used worldwide by growers and gardeners

Safe for the environment

Nemasys®

Beneficial Nematodes

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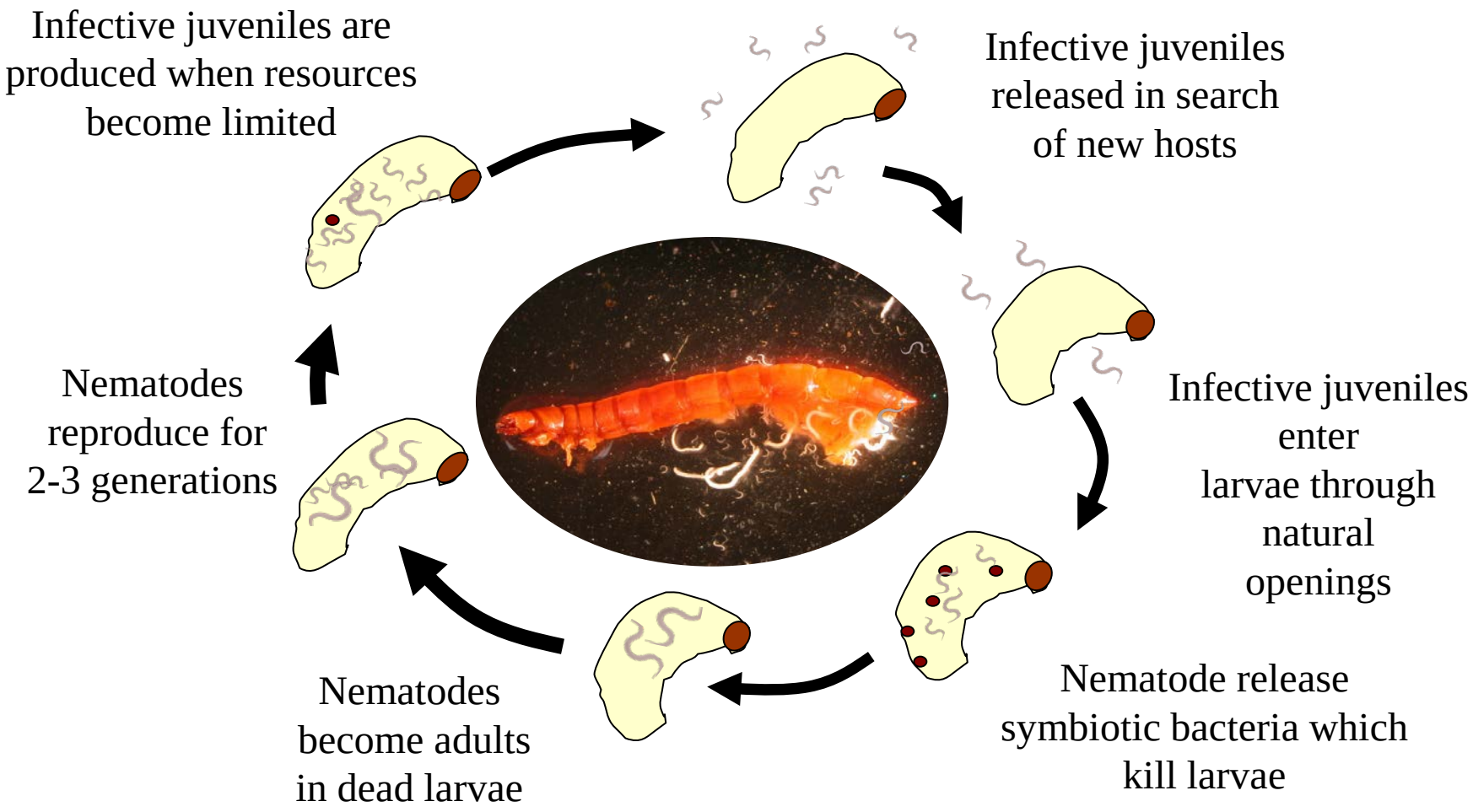
Nemasys mode of action

- Infective juvenile nematodes search actively for a prey.
  They enter the prey via natural openings.
  Inside the prey they release bacteria.

- The bacteria inside the nematode can kill the pest within 48 hrs.
  The insect body is food for the nematodes.
  New infective nematodes develop within the dead insect.

Biology
Nemasys – Mode of Action



The Nemasys® range

- Ten products based on five species of nematode.
- Different products but with the same species based on market differentiation.

Where are Beneficial Nematodes used?

The Nemasys portfolio of products is sold into a versatile range of crop segments

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Greenhouse


Mushrooms


Fruit


Landscape & Nursery


Vegetables


Citrus


Turf


Forestry


Home & Garden

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Beneficial Nematodes

What are the pest targets?

The Nemasys portfolio contains key species and their key targets

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Nemasys Product	Nematode Species	Segment	Key Pest(s)
Nemaslug	*Phasmarhabditis hermaphrodita*	**Lawn & Garden**	**Grey Slug, glasshouse slug, water snail**
Nemasys G	*Heterorhabditis bacteriophora*	**Turf & Landscape**	**Chafer grub, White grub**
Millenium	*Steinernema carpocapsae*	**Lawn, Garden, Nursery**	**Chinch bugs, caterpillars, red palm & pine weevil**
Nemasys L	*Steinernema kraussei*	**Garden**	**Black Vine Weevil, Strawberry Weevil**
Nemasys	*Steinernema feltiae*	**Indoor plants, interiorscape**	**Western Flower Thrips, fungus gnat**

Nemasys®
Beneficial Nematodes

Nemasys®
Beneficial Nematodes

150 years

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- Manufactured using liquid fermentation techniques in Littlehampton, UK.
- Formulated in an easy to use water dispersable gel.

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Nemasys: shelf live

Product Storage

- ✓ Temperature Between 41- 45º F
- ✓ Nematodes Viable for 4 to 8 weeks

Nemasys beneficial nematodes: unique formulation

Stable, concentrated formulation easily dispersible in water

Nemasys beneficial nematodes: easy application

Ready for use

Nemasys – Application Methods

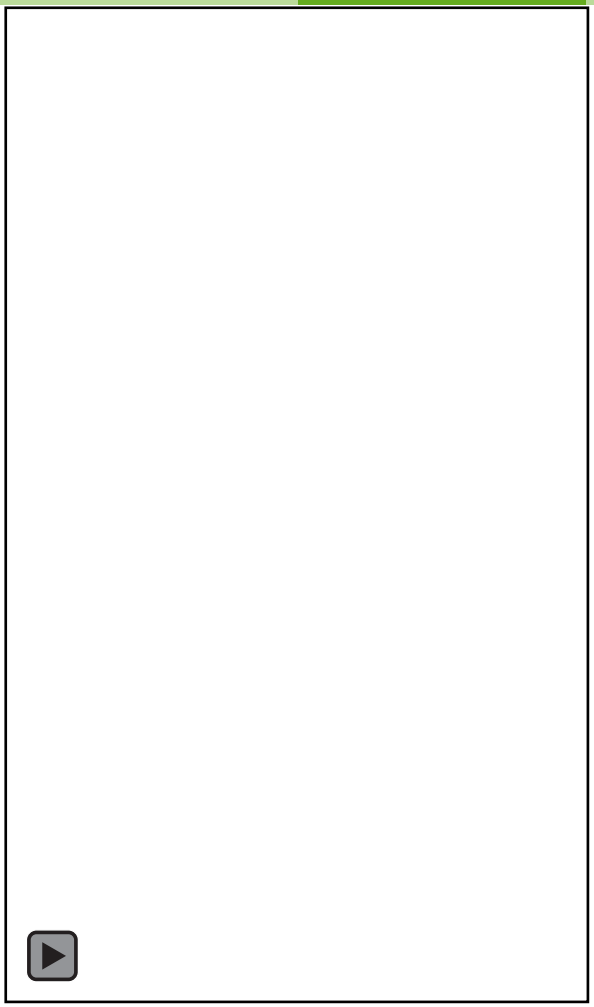
Beneficial Nematodes Portfolio

Applying Nemasys to Brussel sprout field

Nemasys for strawberries

Applying Nemasys on fruit trees

Nemasys in the greenhouse



Nemasys applied with spot applicator kit

Nemasys application check

- Before application – spraying solution
- During application – nematodes coming out the nozzles

Vital nematodes

Quality Assurance

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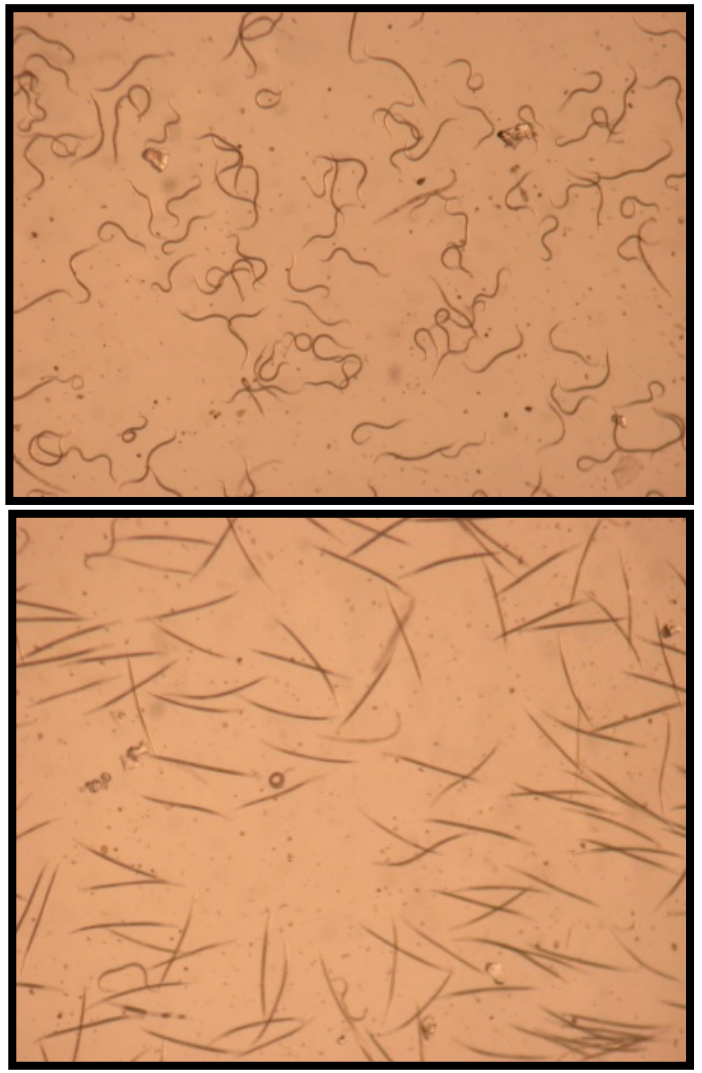
Viable:

- Nematodes various shapes
- Nematodes moving



Non-viable:

- Nematodes straight
- Nematodes not moving


Spraying of Nemasys beneficial nematodes

Application conditions

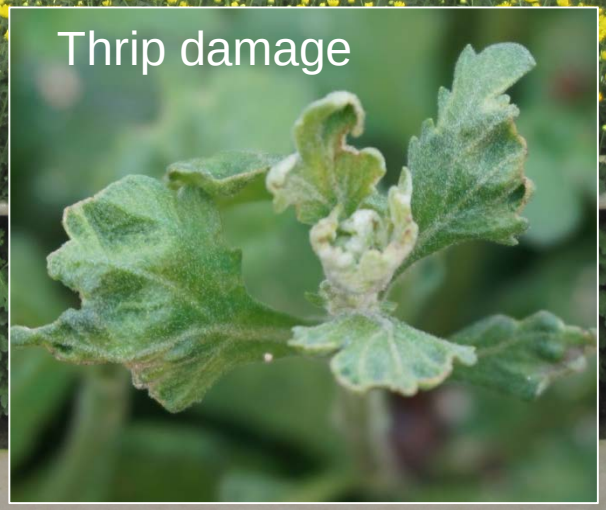
- Use on moist soils / crops (Pre-irrigation is useful)
- Apply during overcast conditions
- Avoid direct sunlight / drying out, will kill nematodes
- Temperature between 5° and 30°C (40 – 85 º F)
  (Depending on nematode species)
- Optimize conditions for contact between nematode and target pest
- Keep soil / crop wet after application

Main pest chrysanthemums: thrips!

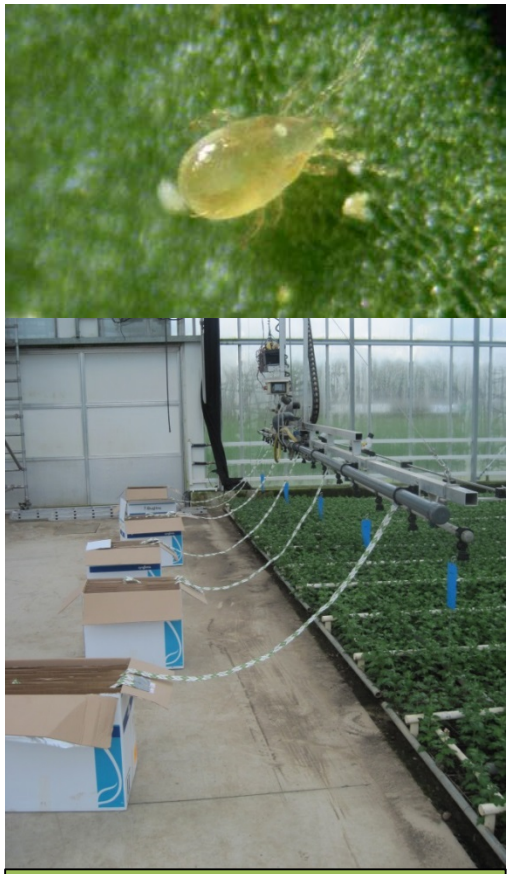
- Thrips are a consistent problem
- Years of mono cultures in the same greenhouse
- Thrip populations (partial) resistant against chemicals
- Thrips quick multiplication
- Thrips hide in crop and soil

  - **Thrips control = a range of control measurements**
  - **More and more growers are giving beneficial nematodes a fixed place in their IPM programs**

Chrysanthemus: thrip damage

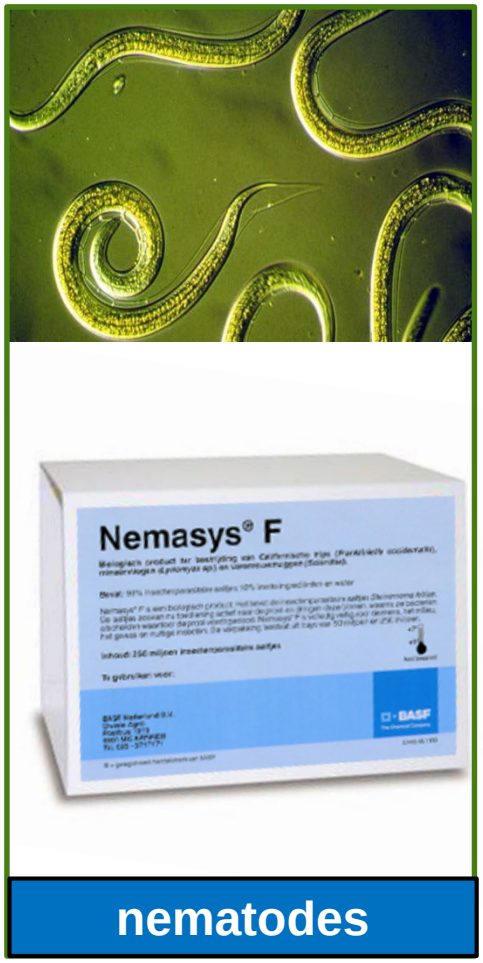


Thrip control chrysanthemum
predatory mites + beneficial nematodes



predatory mites

+

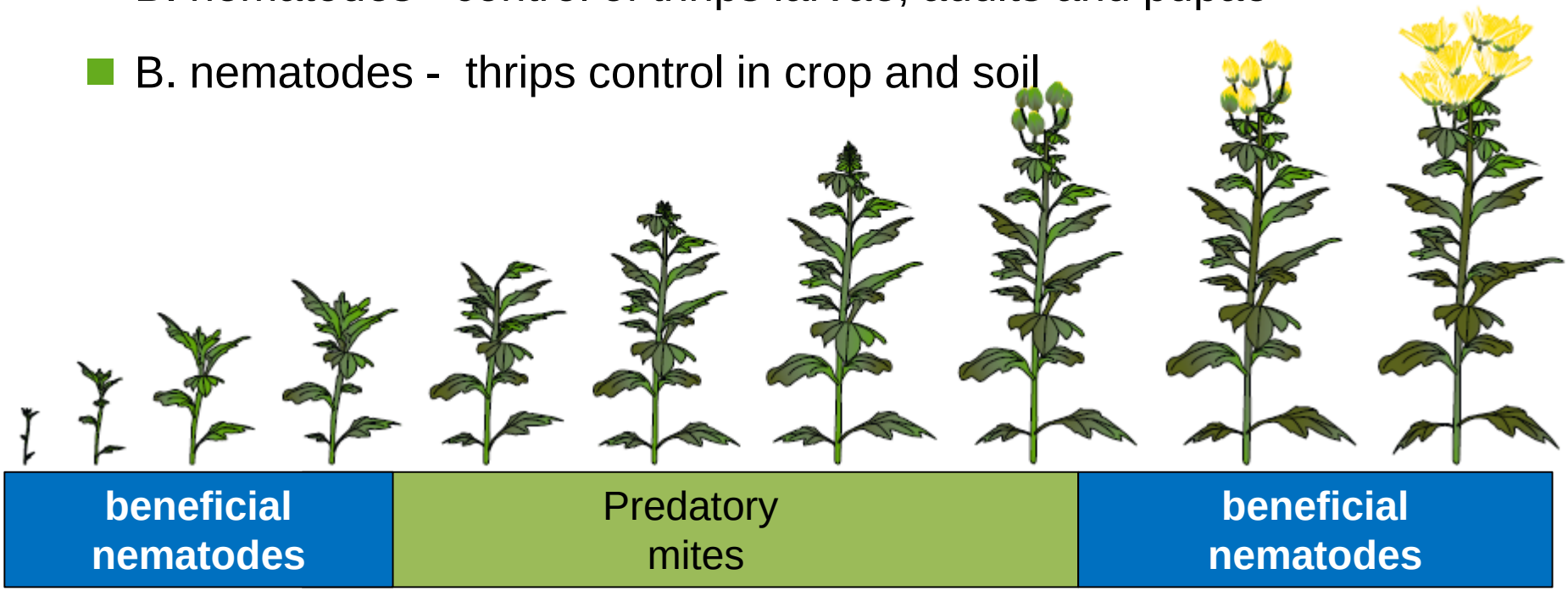


nematodes

- Good combination against thrips

Predatory mites + beneficial nematodes complementary

- P. mites - control of thrips larvae
- B. nematodes - control of thrips larvae, adults and pupae
- B. nematodes - thrips control in crop and soil



WFT in Strawberries

- **Target** – WFT larvae and adults
- **Opportunity**:
  - Current chemical options require stewardship (Spinosad/Spinetoram)
  - Nemasys (*S.feltiae*) shows high efficacy in other crops
  - Favorable conditions for Nemasys activity (cool application temps, high moisture soil)
- **Current activities:**
  - 2 Replicated trials in 2016 – high variability with foliar apps, moderate pressure
  - 2 large scale trials in 2017 – good control, but no UTC for comparison, foliar apps only.
  - 2018 – soil apps?

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Cabbage Root Maggot in Brassicas

- **Target** – Cabbage Root Maggot (*Delia radicum*) larvae.
- **Opportunity**:
  - Opportunity to support current chemistry (Chlorpyrifos/Spinosad)
  - Nemasys (*S.feltiae*) shows high efficacy vs other dipterans
  - Favorable conditions for Nemasys activity (cool application temps, high moisture soil)
- **Current activities:**
  - 2018 – possible trial work

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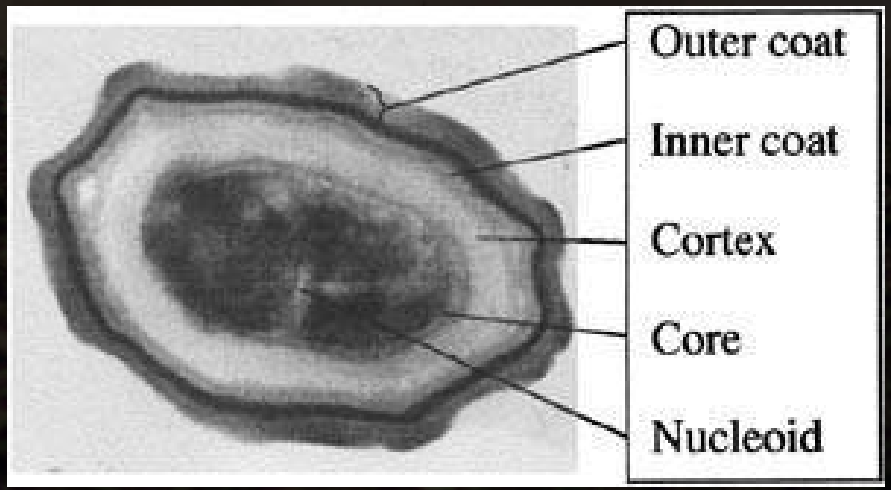
Serifel® Biofungicide

- A common, naturally occurring bacterium - *Bacillus subtilis*
  - *Bacillus amyloliquifaciens* – strain DMBI 600
- Foliar and in-furrow uses
- Formulation contains *Bacillus subtilis* spores
  - Robust under storage
  - Compatible with other products



Electron microscope cross-section of a spore of *Bacillus subtilis*. The spore is 1.2 microns across, about 100 times smaller than the width of a human hair. *(Credit: S. Pankratz)*

Serifel® Biofungicide
Modes of Action

- When sprayed, Serifel spores are dormant
- On leaves or soil, spores grow and reproduce
- Fungi are inhibited in two ways:
  1. Spores give off metabolites
     - Metabolites inhibit the spores & mycelia of fungi
     - Lipopeptides disrupt fungi membranes allowing better penetration of tank mixed fungicides
  2. On the surface they compete with fungi for nutrients and space
     - When first on the bus, they take up available seats

Serifel® Biofungicide
Modes of Action

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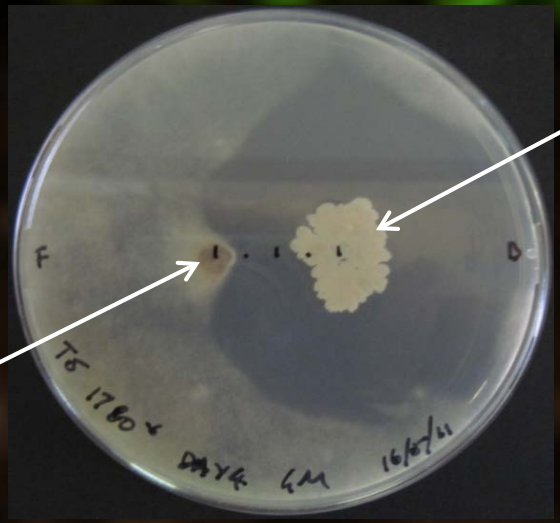
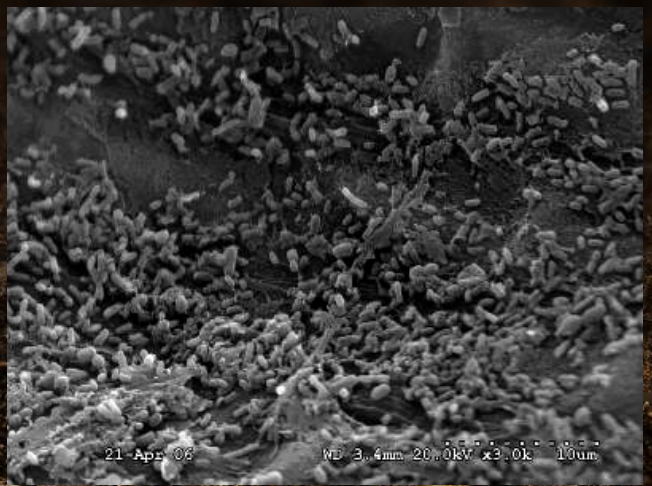
1. Metabolites inhibit fungal growth



2. Serifel takes up available seats on the bus



Serifel spores colonizing
a root surface

Serifel® Biofungicide – Modes of Action

Plant Protection from Outcompeting the Pathogens

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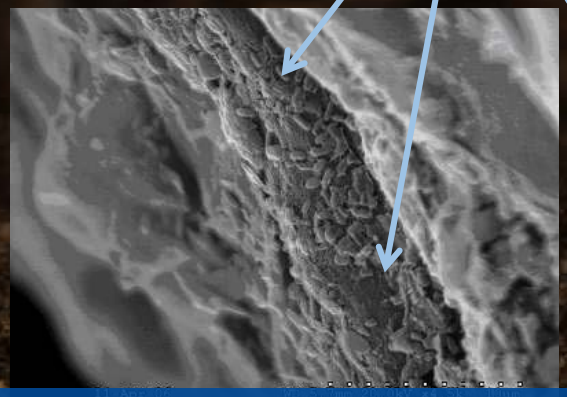
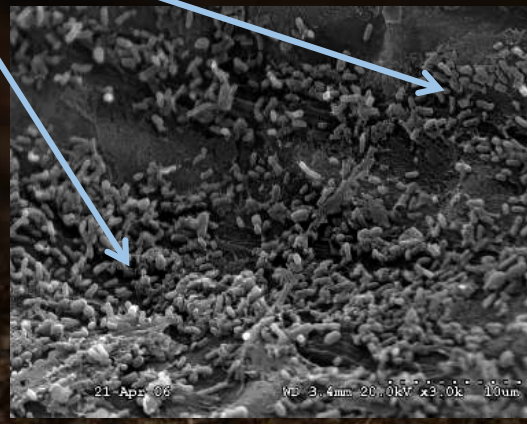
- Serifel spores remain dormant until conditions are suitable to grow
- Serifel spores grow and reproduce on the surface of the plant
  - ✓ Competition for limited nutrients
  - ✓ Key factor is who gets there first
  - ✓ Early colonizer advantage
  - ✓ Niche exclusion
  - ✓ No seats left on the bus

Serifel spores colonizing a root surface

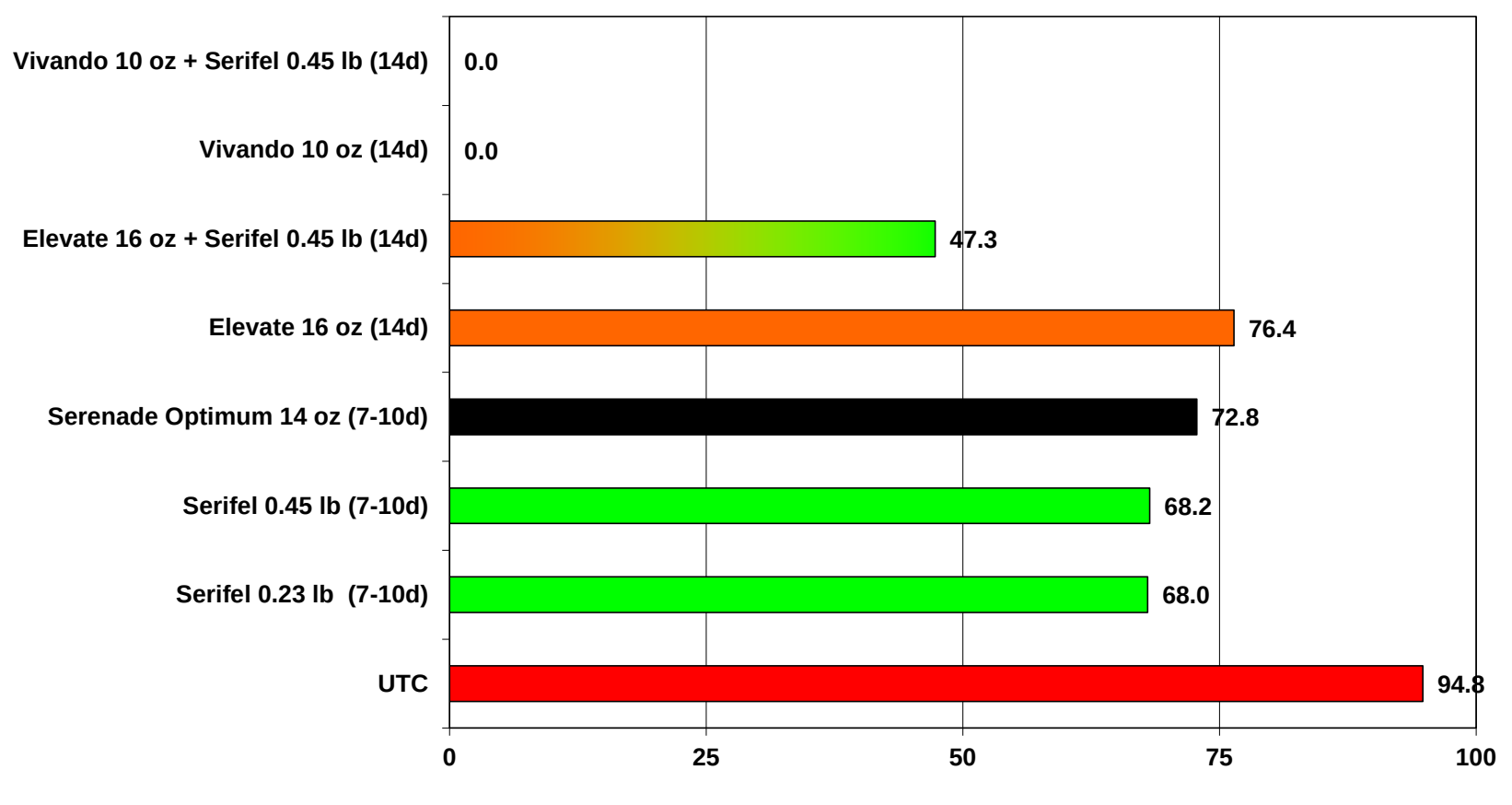




Serifel® is <u>Most Effective When Applied Before the Disease</u> is Present

Field Research Results

Serifel® Biofungicide Foliar Applications in Grapes



1 trial – Hughson, CA

All trts with 0.0625% Induce

(..d) indicates spray interval

Average Percent Severity of Powdery Mildew on Fruit

62/0 DAT/DALT

Serifel® Biofungicide
Formulation

- Wettable Powder
- Maintain constant agitation
- Large particle size requires 50 mesh screens

Serifel® Biofungicide

- Crops Labeled:

Berry and small fruit, citrus, cucurbit, fruiting veg, **grape**, pome, stone, **strawberry**.

Add crops and evaluate different application methods

BASF

We create chemistry

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