Towards Integrated Pest Management in Azalea to Control Broad Mite

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07/03/2012
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Introduction

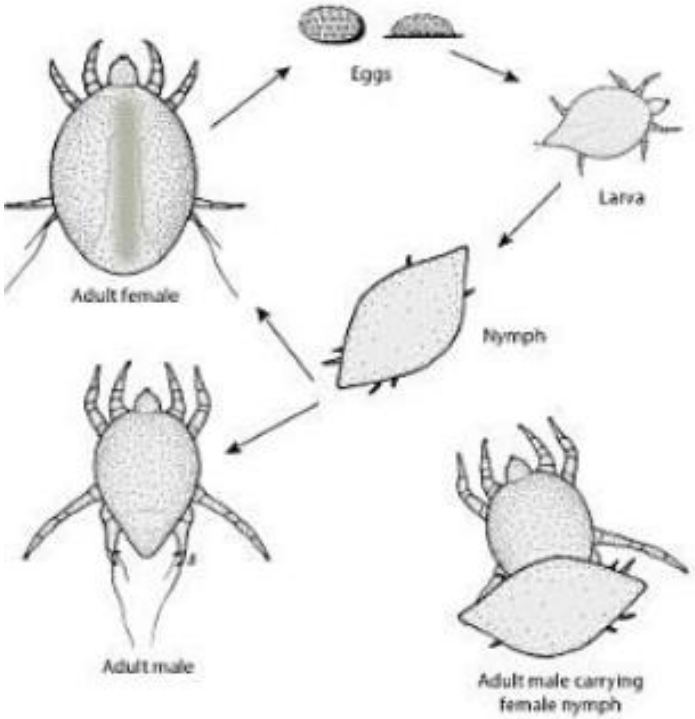
Situation

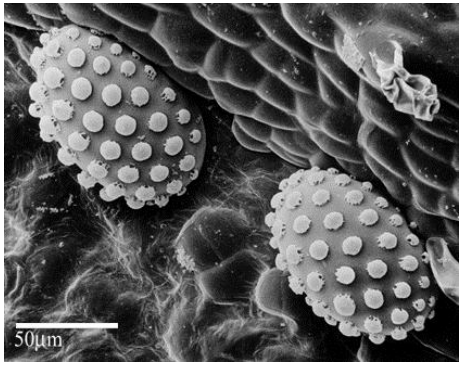
- Pot azalea is the most important flowering pot plant in Belgium (35 million plants/year)
- Problems caused by broad mites have become increasingly important
- Number of authorized products declined
- Obligation to apply IPM from 2014 onwards

Introduction

Broad mites

- Family: Tarsonemidae (> 500 species)
  - *Polyphagotarsonemus latus*
- 150 µm
- Life cycle: Egg – Larva – Nymph – Adult
- Development on azalea (egg -> adult):
  - 13,3 days at 15°C
  - 6,5 days at 20°C
  - 4,2 days at 25°C





Introduction

Prevention
- Clean start material
- Good hygiene
- Resistant cultivars

Broad mite

Preparations
- Cultivar selection
- Clean start material
- Economic thoughts

Coordination
- Training employees
- Treatments

Chemical Treatments
- Different chemicals
- Cocktails

I P M

Non-Chemical Treatments
- JA-hypothesis
- Predatory mites
- Alternative culture techniques

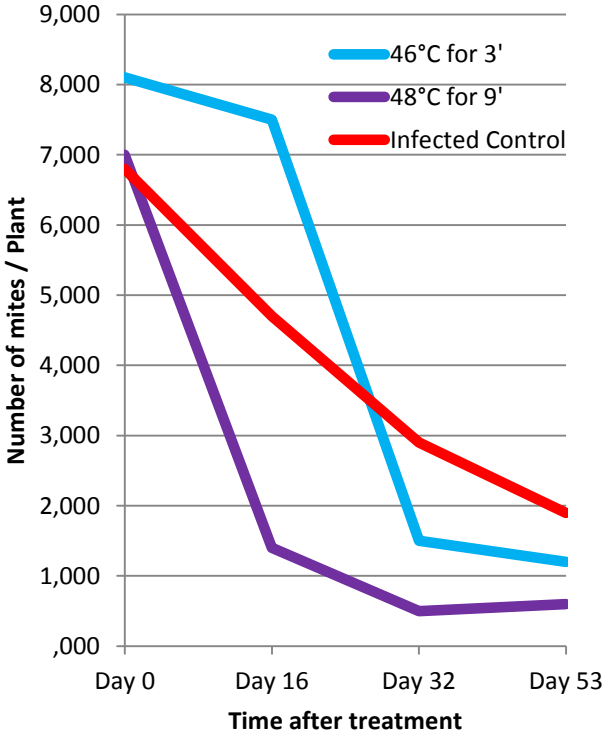
Observation
- Population dynamics
- Monitoring
- Early discovery

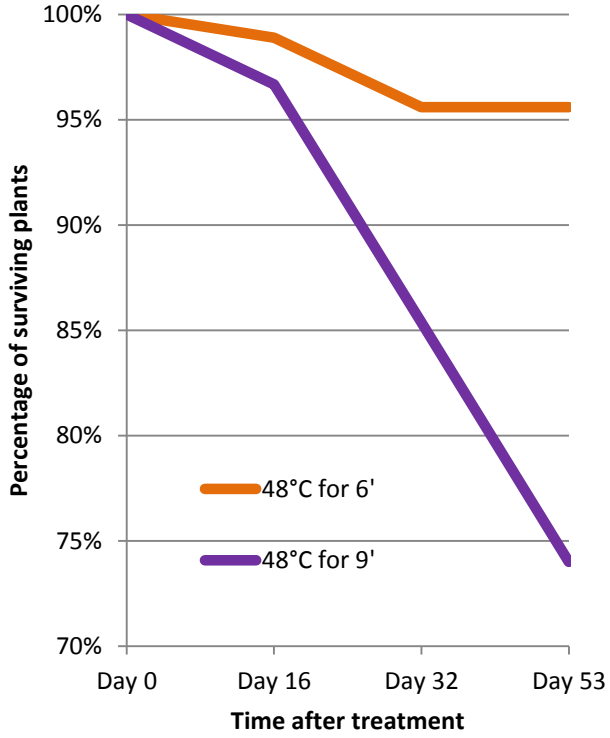
Research → **Practice**

Clean start material

Desinfection

- Reducing problems by starting with clean cuttings
- Hot water treatments of cuttings at 46 or 48°C for 3' to 9'.





Predatory mites for preventative control

Predatory mites in azalea

- Tests for broad mite control
  - *A. swirskii* most efficient
  - *A. limonicus* has potential
- Tests for numbers of predatory mites per 100 m^2
  - No difference using 50, 75 or 100 predatory mites

=> Preventative control by predatory mites has potential

- Essential for proper use of predatory mites is knowledge about broad mite biology
  - Development rate at different temperatures
  - Cold tolerance

Screening for resistance in germplasm

Preliminary work

- Screening for resistance against broad mites was done before in:
  - Chilli (Ahmed *et al.*, 2001)
  - Watermelon (Kousik *et al.*, 2007)

  => Resistance was found in several cultivars from both plants

- Screening of a representative selection of *Rhododendron* spp.
  - Representative selection based on different traits
    - ✓ Commercial types
    - ✓ Plants with hairy leaves and stem
    - ✓ Plants with herbaceous soft leaves
    - ✓ Plants with firm leaves

Screening for resistance in germplasm

Experimental layout

- 30 genotypes
- 4 replicates
- 7 weeks of evaluation

Screening for resistance in germplasm


Kassandra 20 days after infection


Desiree 20 days after infection

Evaluation

- Scoring genotypes
  - 5 classes based on visual symptoms
  - Twice a week

- Quantitative detection
  - Detection in ethanol and counting under binocular
  - 3 and 7 weeks after infection using three tips from one plant

Screening for resistance in germplasm

Plant	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
	n = 4	n = 4	n = 4	n = 3	n = 3	n = 3	n = 3
1	0	0	0,5	1,33	1,33	2	2
2	0	0	0	0,67	0,67	1	1,33
3	0	0	1	1,33	2	2	2
4	0	0	0,5	1,33	1,33	1,33	1,33
5	0	0,5	0,5	1,67	1,67	2,33	2,33
6	0	0,5	1,5	2	2	2,33	2,33
7	0	0	0,25	1	1,33	1,33	1,33
8	0,25	0,75	2	2	2,33	2,33	2,33
9	0	0	0,5	1,33	1	1,33	1,33
10	0	0,25	1,25	2	2	3	3
11	0	0	0,5	1	1,67	2	2
12	0	0,25	1	1	1,67	2	2,33
13	0	0,25	0,75	1,33	1,33	2	2
14	0	0,5	1,25	1	1	2,33	2,33
15	0	0,25	1	1,33	1,67	2,33	2,33
16	0	0	1	1,33	1,67	2	2,33
17	0	0	1,25	2	2	2,33	2,33
18	0	0	0	0,33	1	1	1,33
19	0	0	1	1,33	2,33	2,33	2
20	0	0	0	0	0	0,67	0,67
21	0	0	0,75	2	1,67	2,33	3
22	0	0	0,5	0,33	1	1,33	1,67
23	0	0	0,25	0	0,33	0,33	0,67
24	0	0	0	1,33	1,67	1,33	1,33
25	0	0	0	0	0	0	0
26	0	0	0,25	0	0	0,33	0,67
27	0	0	0	0	0	0,33	0,33
28	0	0,5	1	1,67	2	2,33	2,67
29	0	0,5	1,25	1,67	2	2,67	2,67
30	0	0	1,25	1,33	2,33	2,33	2,67

Conclusions

- Genetic variation is available BUT repetition is needed
- Lag between detection of mites and first visual symptoms
- Explosive increase in number of mites followed by a decline (also reported by Gerson *et al.*, 1992)

Commercial
Hairy leaves and stem
Herbaceous soft leaves
Firm leaves

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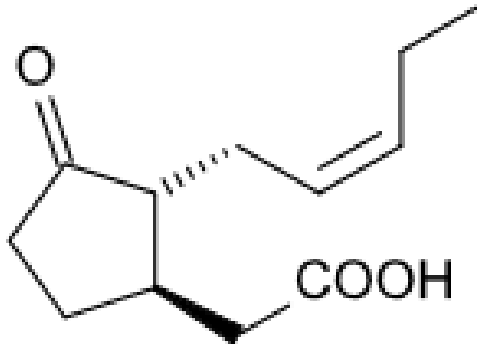
JA-hypothesis

JA to induce resistance in azalea?

JA = Jasmonic Acid, a natural occurring plant hormone

- Involved in morpho-physiological changes in shape and structure:
  - Senescence ↑
  - Root growth ↓
  - Shoot growth ↓
  - Tuber formation ↑
  - Number of inflorescences ↑
  - …
- But also role in **DEFENCE**!! ↑



JA-hypothesis

JA to induce resistance in azalea?

Plant defense

- Interaction between three main players (basic model):

JA/Ethylene ←→ Salicylic Acid

- Depending on:
  - Type of plant
  - Type of stress, pathogen
  - Environment

  => Complex process

JA-hypothesis

JA to induce resistance in azalea?

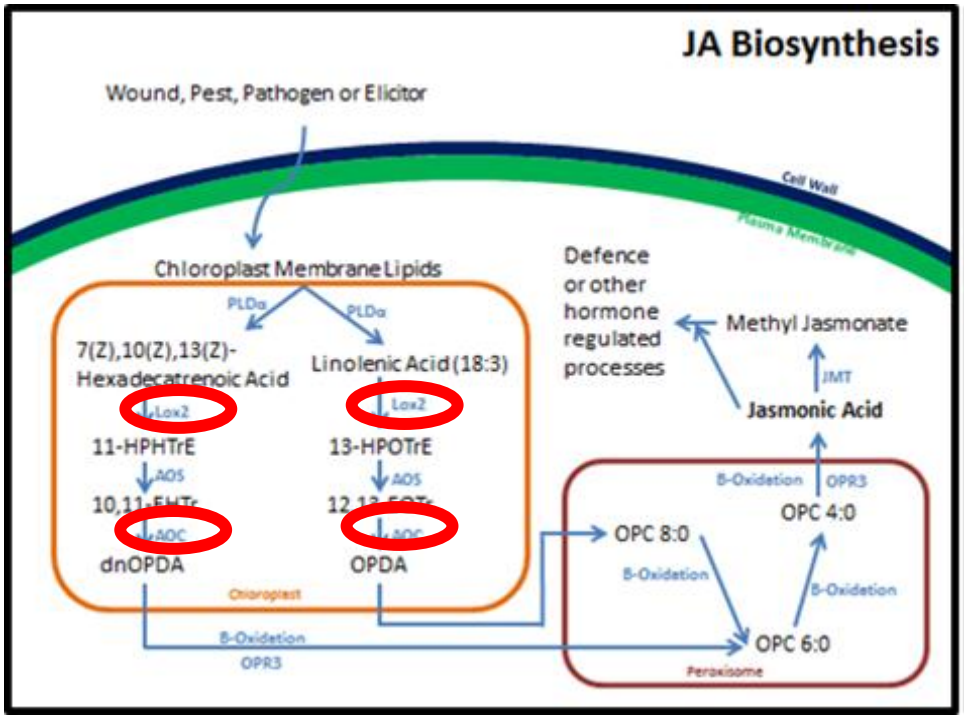
Literature

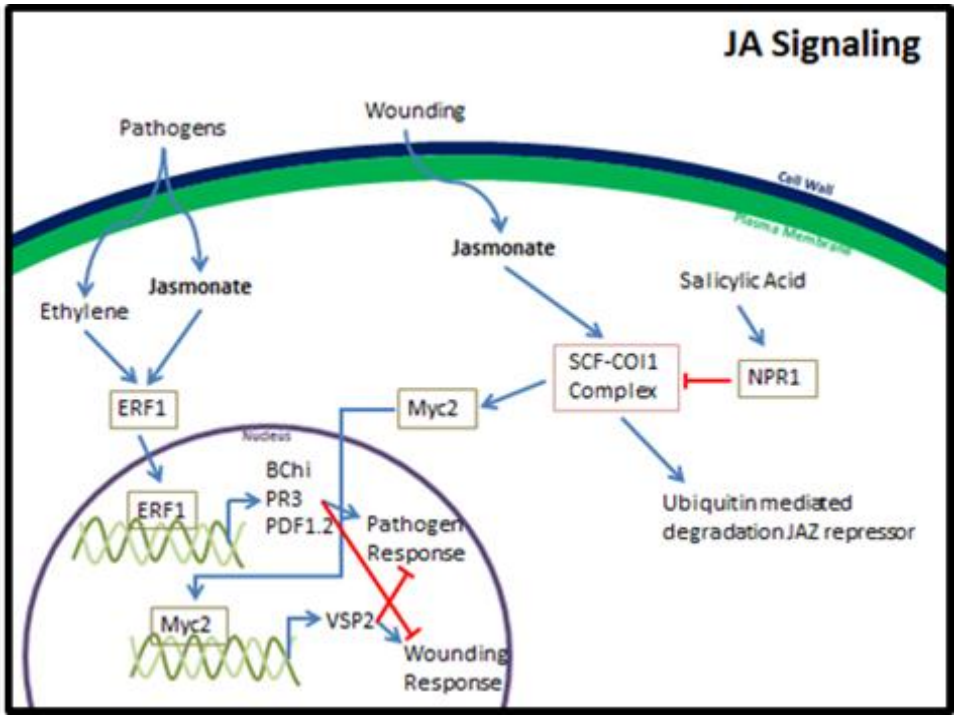
- Induction of JA enhances resistance among:
  - Powdery mildew in grapevine (Belhadj *et al.*, 2006)
  - Thrips in *Arabidopsis* (Abe *et al.*, 2008)
- Broad mites activate JA pathway:
  - Expression of LOX genes is induced in cucumber under broad mite infection (Grinberg *et al.*, 2005)
- Jasmonate induced plant responses limit mite proliferation:
  - Two-spotted spider mites in Cotton (Omer *et al.*, 2001)
  - Two-spotted spider mites in *Arabidopsis* (Li *et al.*, 2004)
  - Two-spotted spider mites in Pansy and Impatiens (Rohwer & Erwin, 2010)

=> **Hypothesis**: Activation of JA pathway may induce resistance against broad mites in pot azalea

JA-hypothesis

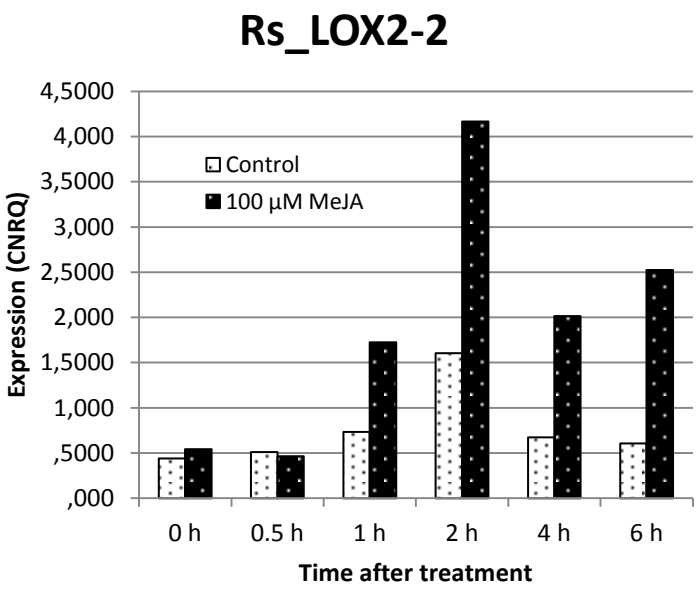
JA to induce resistance in azalea?

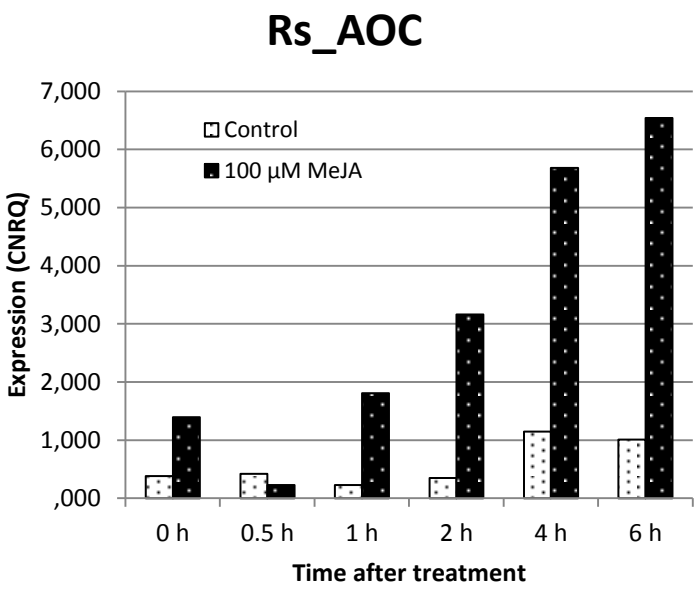




JA-hypothesis

JA to induce resistance in azalea?





JA-hypothesis

JA to induce resistance in azalea?

Future research

- Apply tool after broad mite infection in pot azalea

Successful experiments

- Possible applications:
  - Early discovery of disease
  - Screen for genotypes in early responding
  - Test elicitors that attract predatory mites
  - Search for biocides
  - …

Conclusions

Working on **alternative strategies** overcoming the broad mite problem in pot azalea:

- **Hot water treatment** of cuttings can possibly reduce the number of mites during rooting
- Preventative control is possible using **predatory mites** e.g. *A. swirskii*
- **Genetic variation** towards resistance against broad mites is present in the germplasm
- Applying MeJA as elicitor induces the **jasmonic acid** defense pathway, potential applications lie ahead
- Better insights in broad mite **population dynamics** is necessary for the development of new alternative IPM strategies
- Training growers in **monitoring** is essential for implementing alternative IPM strategies

Thanks to…

- Magali Losschaert
- Johan Witters
- Ellen De Keyser
- Jan De Riek
- Tine Maes
- Johan Van Huylenbroeck

- Bart Van Delsen
- Els Pauwels
- Johan Ongena
- Dirk De Cock
- Bruno Gobin

- Patrick De Clercq

Thank you for the attention!

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