Predatory mites against the poultry red mite

Tuomo Tuovinen
MTT Agrifood Research Finland

Nordic Poultry Conference 6–8 November 2013, Helsinki, Finland

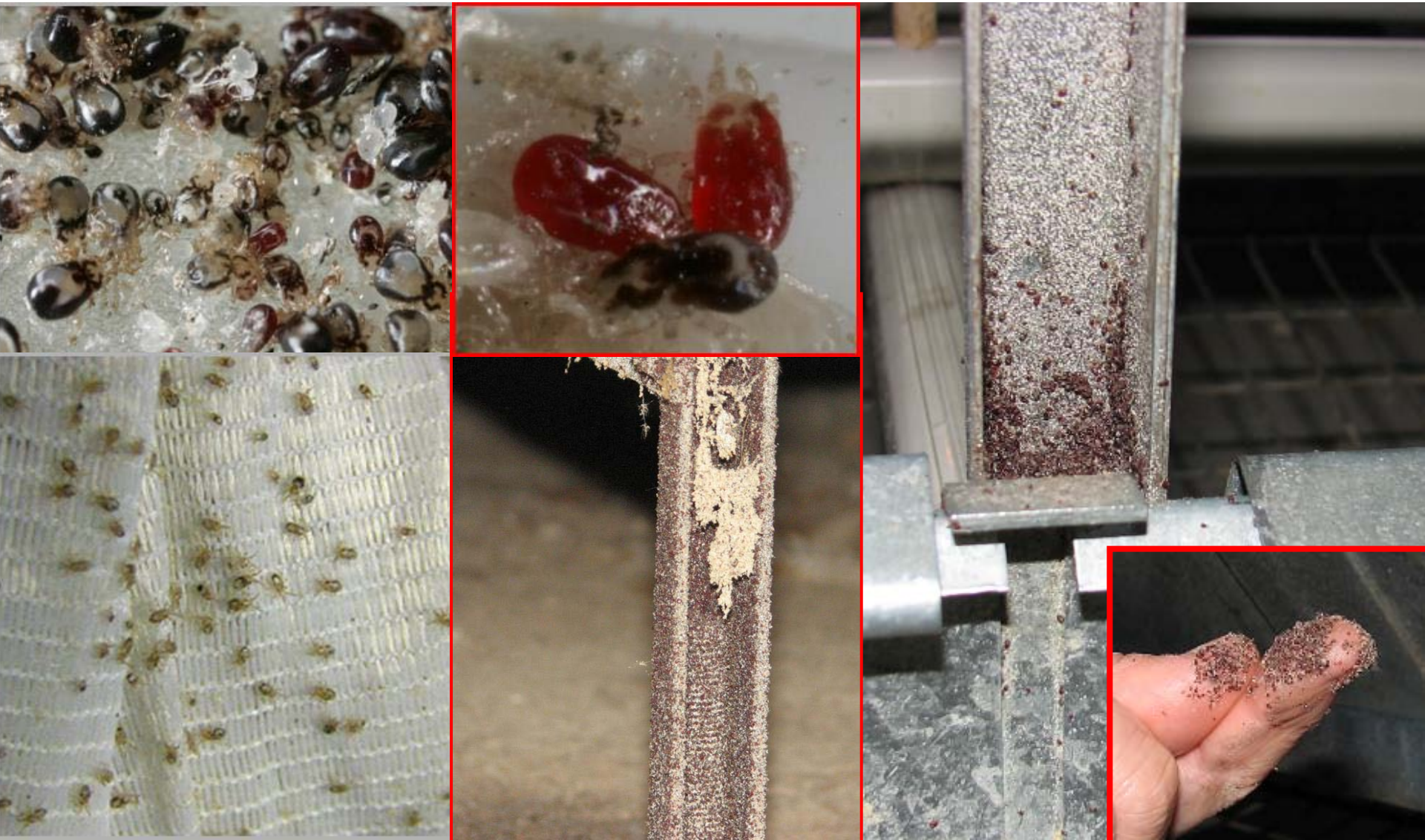
Introduction

Occurrence of the poultry red mite

- The poultry red mite ’PRM’ *Dermanyssus gallinae* is the most important ectoparasite of laying hens in Europe (*Chauve 1998*)
- The prohibition of conventional cages was expected to cause higher infestations due to more hiding places for PRM
- In Finland, PRM probably occurs in the majority of the commercial hen houses
- In the EU egg industry, economic costs of PRM (control and losses) have been estimated at €130 million per year (*van Emous 2005*)

Introduction

Occurrence of the poultry red mite



Introduction

Effects of PRM on laying hens

- PRM feeds on blood of hens during night hours
- Feeding of PRM may cause stress to hens and affect restless behavior
- The presence of PRM can cause blood spots on eggs
- Substantial feeding of PRM may reduce egg quality by thinning of shell
- High infestation may cause anaemia and even death of hens
- PRM may serve as a vector of pathogens
- PRM may suck also human blood and cause skin irritation

Introduction

Current control of PRM

- Prevention of initial infestation
  - PRM free pullets
  - Good hygiene to avoid PRM transportation by people, animals and goods
- Disinfection during the production break
  - Chemical disinfectants, acaricides, heat treatment
- Cleaning and vacuuming
- Acaricides, also during the egg production
  - Phoxim (Byemite) registered as a vet medicin against PRM
  - Permethrin, Pyrethrins registered against insects and mites indoors (in general)

Introduction

Problems in pesticide use

- Very few pesticides available (registered against PRM)
  - Organophosphate acaricide phoxim (Byemite)
- Difficulties to use during egg laying period
  - ByeMite is allowed but difficult to avoid contamination of birds
- Doubts of safety and environmental contamination
- Development of resistance to synthetic pesticides in mite populations
  - Permethrin and other pyrethroids
- Insufficent effectiveness
- Difficult to get good coverage during egg laying period

Introduction

Biological or non-chemical alternatives

- Biological pesticides, earlier used for plant protection
  - Bacteria: *Bacillus thuringiensis*, *Sacharopolyspora spinosa* (Spinosad)
  - Fungi: *Beauveria bassiana*, *Metarrhizium anisopliae*
- Inert dust products
  - Silica based products (diatomaceous earths)
  - Sodium bicarbonate, aqueous suspension
- Plant derived products
  - Extracts of neem (Azadirachtin)
  - Essential oils (e.g. Paralice)
- Vaccination?

Introduction

Biological control by predatory mites

- Only few known natural enemies of PRM
  - *Cheyletus eruditus* – Acari: Cheyletidae
  - *Androlaelaps casalis* – Acari: Laelapidae
  - *Stratiolaelaps scimitus* – Acari: Laelapidae
- Model from greenhouses
  - Repeated ample releases of predators
  - Candidate species: soil-dwelling predaceous mites (Laelapidae)
- Laboratory experiments: feeding and reproduction
  - Selected species: *Stratiolaelaps scimitus* (=*Hypoaspis miles*)
- Layer house experiments
  - Cage and free-range systems

Potential biocontrol agents

Cheyletus eruditus

- *C. eruditus* is a predatory mite that commonly lives in bulk food stores such as granaries.
- It is also often found in animal feed, poultry litter, and mammal and bird nests.
- Its diet comprises a variety of insects and mites.
- It is present in many countries around the world.

Photo: H. Taylor

Photo: APPI, FR

Potential biocontrol agents

Androlaelaps casalis

- *A. casalis* is a soil dwelling predatory mite that preys on other mites and small invertebrates.
- It is present in soils world wide.
- Recently, it has been introduced as a predatory mite against red poultry mite (e.g. Koppert B.V. NL)


Photo: APPI, FR


Phot:o APPI, FR

Potential biocontrol agents

Stratiolaelaps scimitus

(*Hypoaspis miles*)

- *S. scimitus* is a soil dwelling predatory mite that is currently used in greenhouses against thrips and gnat larvae.
- It is mass produced in Finland
- This species was selected as a candidate predator against poultry red mite in 2009

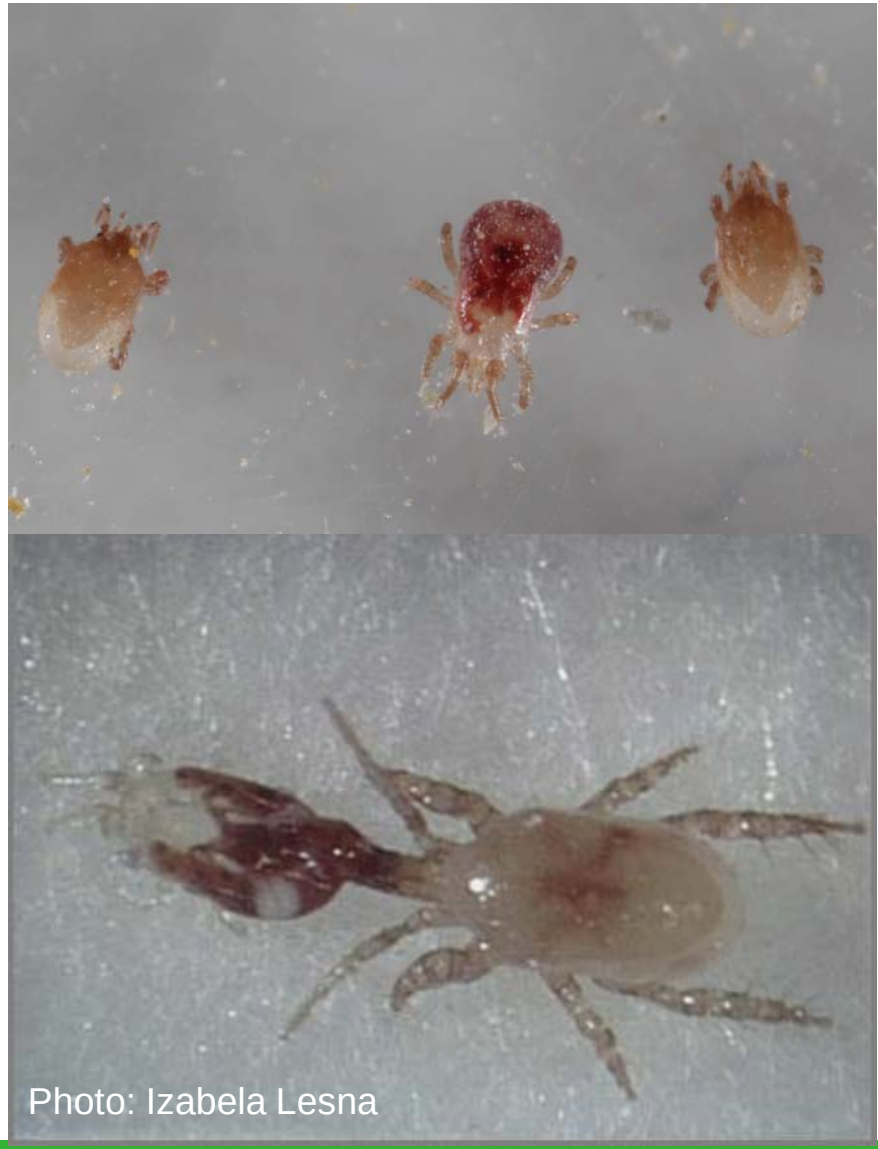
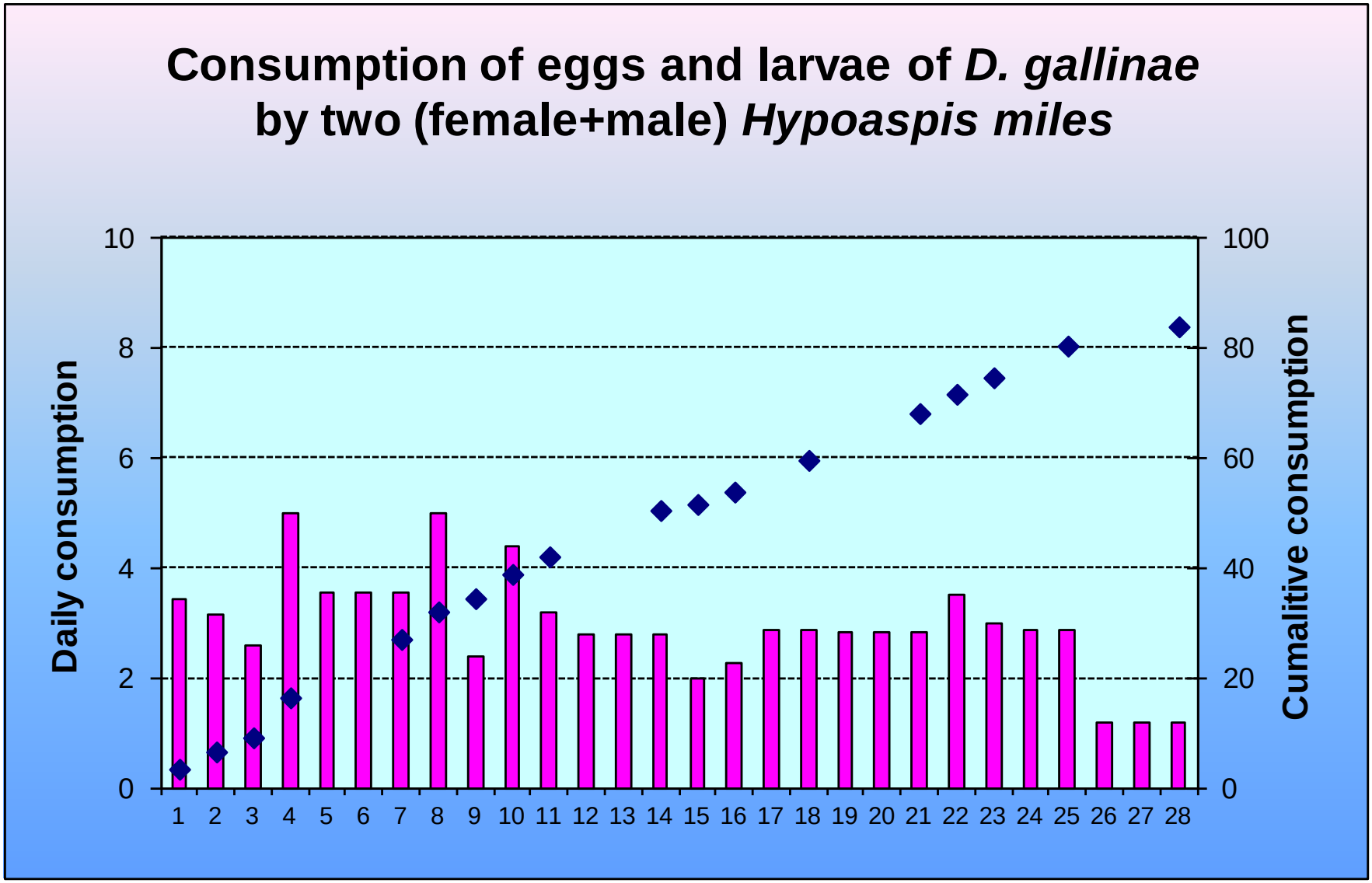


Photo: Izabela Lesna

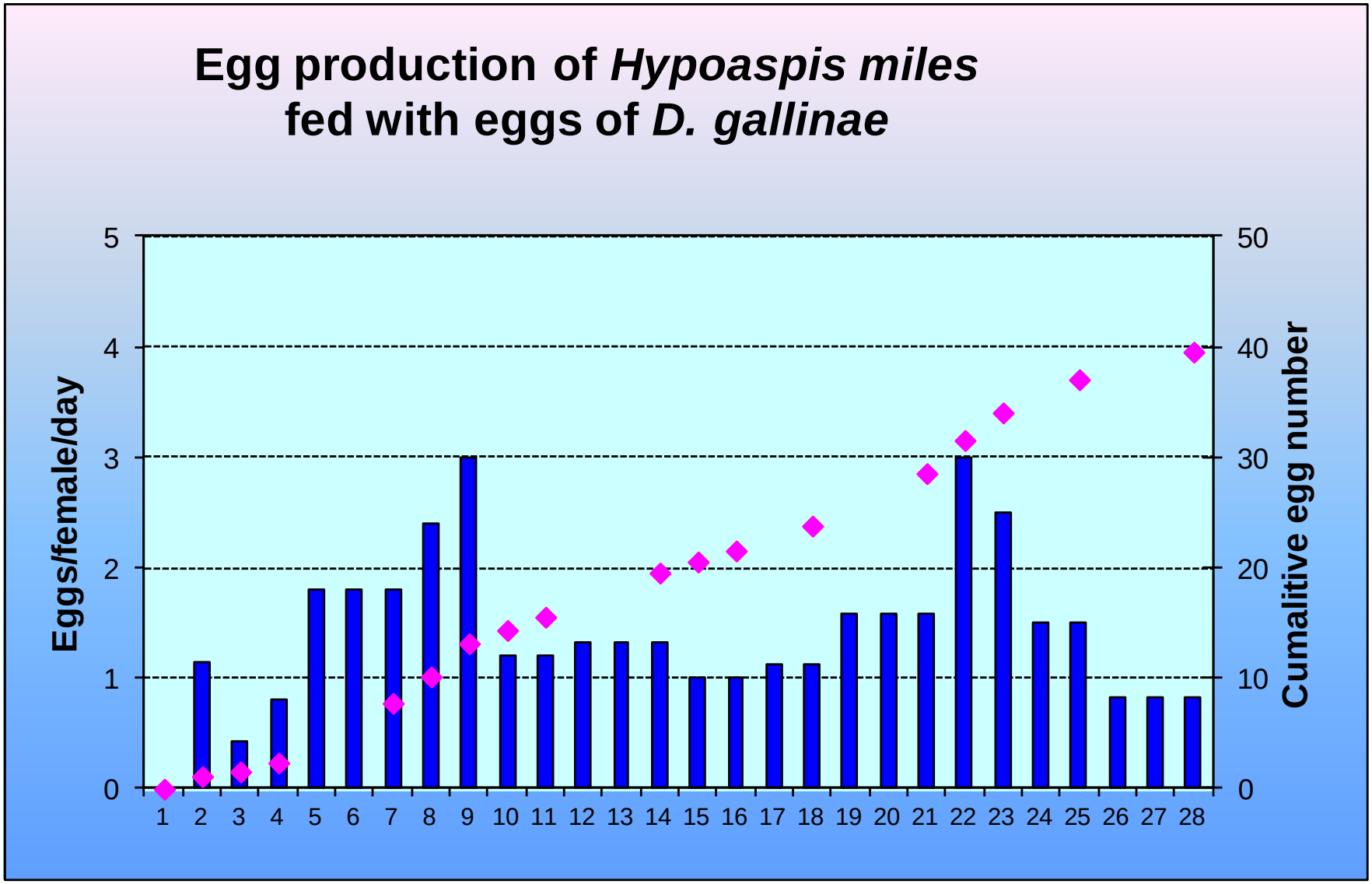
Laboratory experiments

- *Stratiolaelaps scimitus* (*Hypoaspis miles*)
- Tests in petri dishes
- Female and male predatory mites in dish
- Fed daily by surplus of eggs, larvae or nymph stages of PRM
- Registered:
  - Number of consumed PRM eggs, larvae and nymphs per day
  - Number of laid eggs/day/female

Laboratory experiments



Laboratory experiments



Laboratory experiments

Summary

- *Stratiolaelaps scimitus* completed the life cycle when fed on PRM eggs and larvae
- *S. scimitus* consumed 1,5 eggs or larvae of PRM/day
- *S. scimitus* produced 1,5 eggs/day when fed by PRM
- *S. scimitus* produced 40 eggs in 30 days when fed by PRM

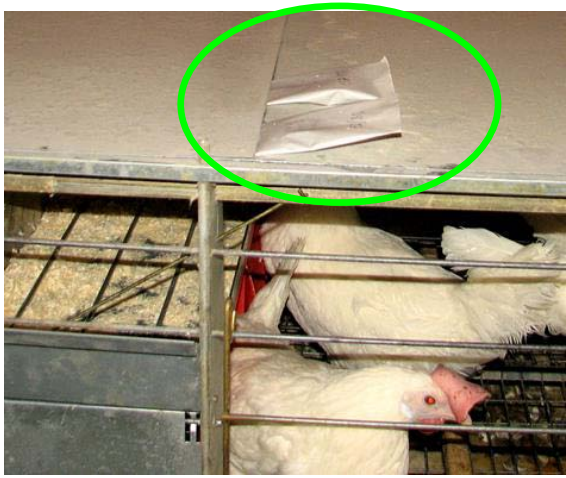
✓ Egg laying was comparable to the egg laying when fed by acariid mites (used in massproduction)

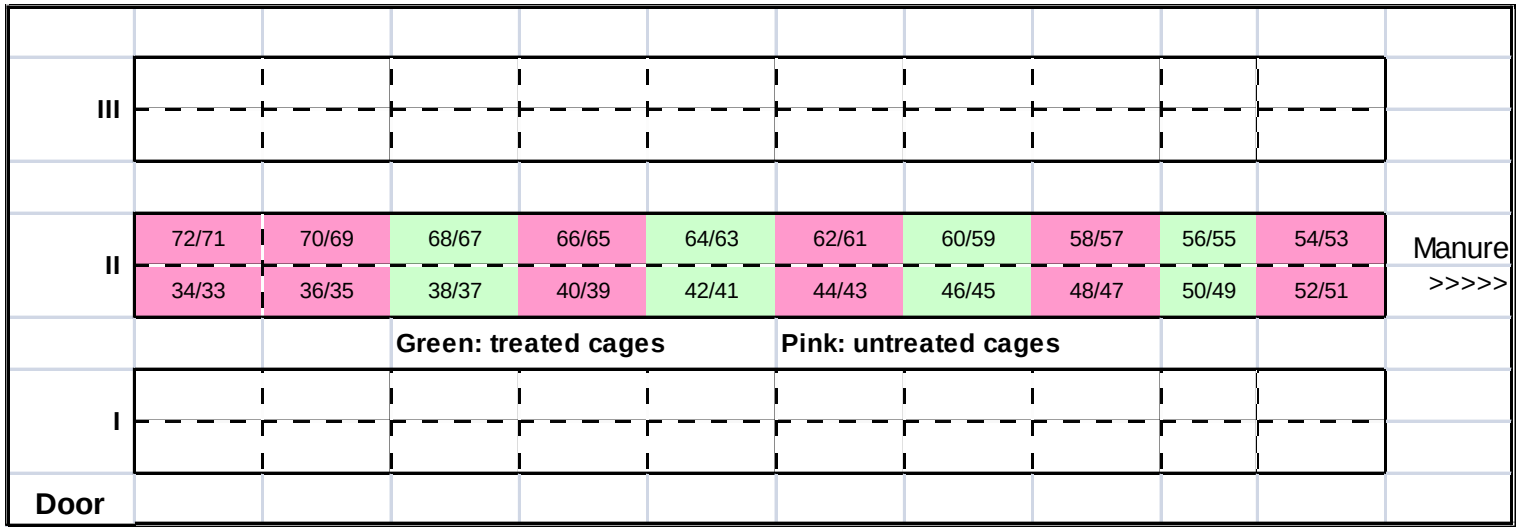
✓ PRM lays 2-3 eggs/day – twice that of *S. scimitus*

✓ For any control effect *S. scimitus* mites are needed more than the initial adult PRM population?

Cage battery experiments

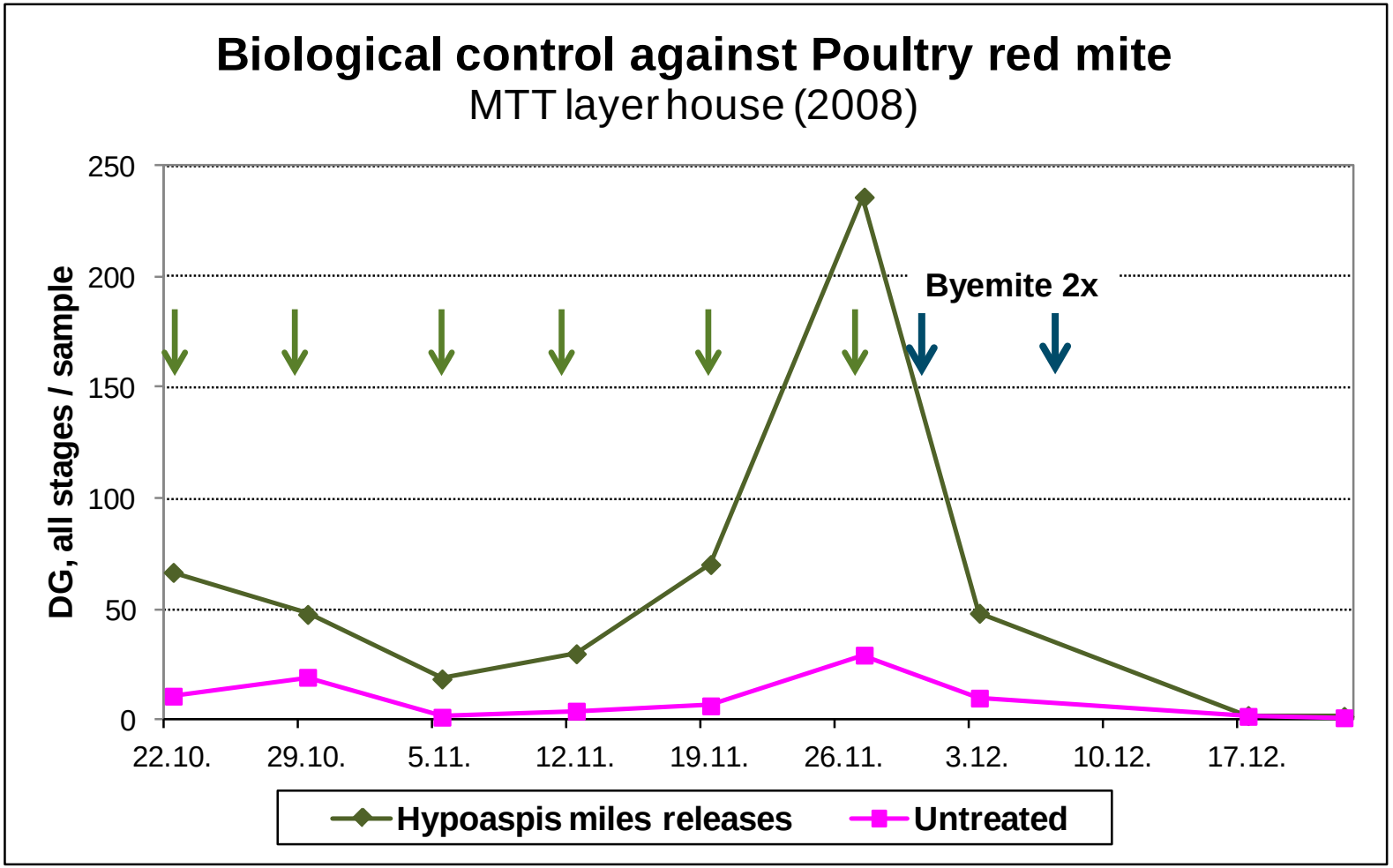
- The first effort in a small (960 hens) layer house
- Three batteries with pairwise cages of 8 layers
- Weekly introductions of *S. scimitus* after the first ocular observation of PRM in slow release sachets (1000 mites) placed on the roof of the cages (only the middle battery)





The first experiment: Results

- PRM population followed by corrugated cardboard traps
- Green arrows indicate the introductions of *S. scimitus*



The first experiment: conclusions

- In the beginning the treatment cages were significantly more infested than untreated
- The ocular observation of PRM was too late for monitoring
- During the first weeks some control effect noticed both in treated and untreated cages –the predatory mites moved also vertically in the battery (a few found in traps)
- Majority of *S. scimitus* left the sachets in two weeks
- After four weeks PRM population started to grow again
- Too low humidity is a critical factor for predatory mites
- Byemite treatments were effective and only a few mites were trapped in late December

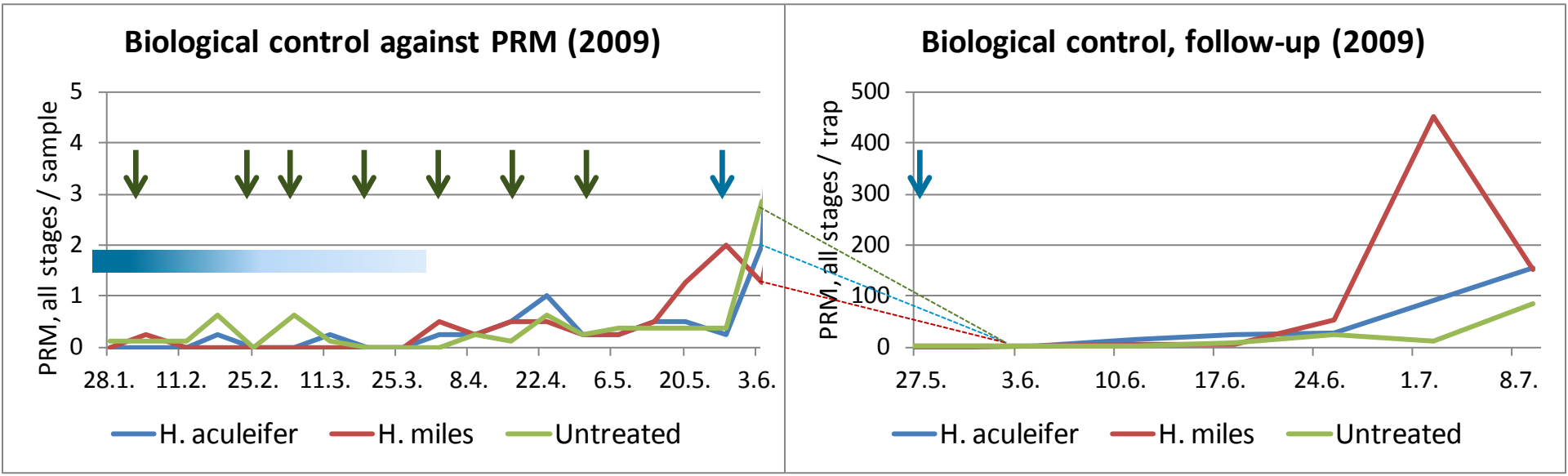
The second experiment: methods

- Monitoring of PRM by cardboard traps
- First mites in the traps triggered the introductions
- Fortnightly releases of *S. scimitus* and *Hypoaspis aculeifer* in slow release sachets (1000 mites) placed on the roof of the cages (only the middle battery)

III											
II	72/71	70/69	68/67	66/65	64/63	62/61	60/59	58/57	56/55	54/53	Manure
	34/33	36/35	38/37	40/39	42/41	44/43	46/45	48/47	50/49	52/51	>>>>>
			Green: H. aculeifer		Yellow: H. miles		Pink: untreated cages				
I											
Door											

The second experiment: results

- Arrows indicate the release dates (4.2.-28.5.)
- Vertical blue line indicates the possible effective period of earlier Byemite treatments
- Four weeks after the last release of predatory mite PRM population exploded



Second experiment: conclusions

- First PRM were noticed seven weeks after the last Byemite treatment
  - In the laboratory tests the effect of Byemite treatment lasted at most 100-120 days
- Cardboard traps revealed the infestation in time
- No real untreated control was possible to arrange in the same layer house
- PRM population growth was slow when compared to the previous experience of PRM population
- The results encouraged to start experiments in commercial layer houses

Farm experiments: how to manage?

- How to release the predatory mites
  - Cage batteries and free range aviaries – different methods?
  - Slow release sachets are possible only in cage batteries as hens will peck them immediately to pieces
  - In aviaries PRM spend the daytime in various places depending on the structures – how to get predators into the right places?
- Several methods studied in free range aviaries
  - Short pieces of drain pipes, filled with predatory mite production materials fixed in perches
  - Same units put on roofs of nests
  - The idea was to provide predatory mites the possibility to reproduce in aviaries

Methods of introductions

Paper bags

Pieces of drain pipes

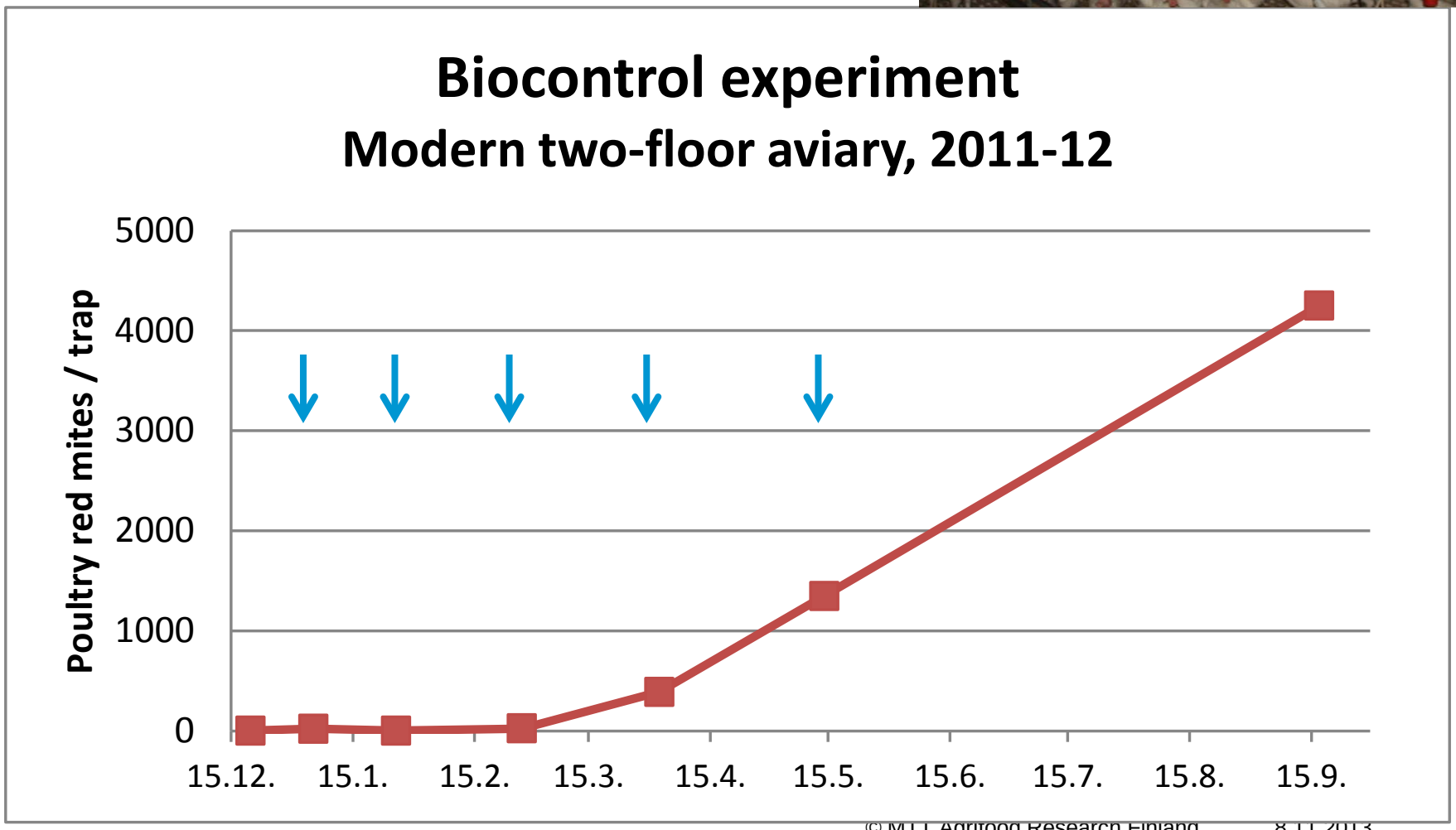
Farm experiments: monitoring trap

Farm experiments: results (example)

- Case: modern free-range aviary (2011-2012)
  - Two floors, in all 21000 layers
  - One quarter of the upper floor treated by *S. scimitus*, other parts (7/8) of the aviary left untreated
  - Releases of *S. scimitus* in pieces of pipes, 180 predators/layer (on the roof of nests in the treated part) at 3-4 weeks intervals
  - PRM follow-up by velcro-trap (MTT) fixed around perches in different parts of the aviary
- Results
  - PRM numbers stayed low for two months, but exploded after four months
  - PRM numbers in the treated area did not differ from untreated
  - Indications of better effect in the perch next to the nests

Farm experiments: results

Blue arrows: releases of *S. scimitus* (in pieces of drain pipes)

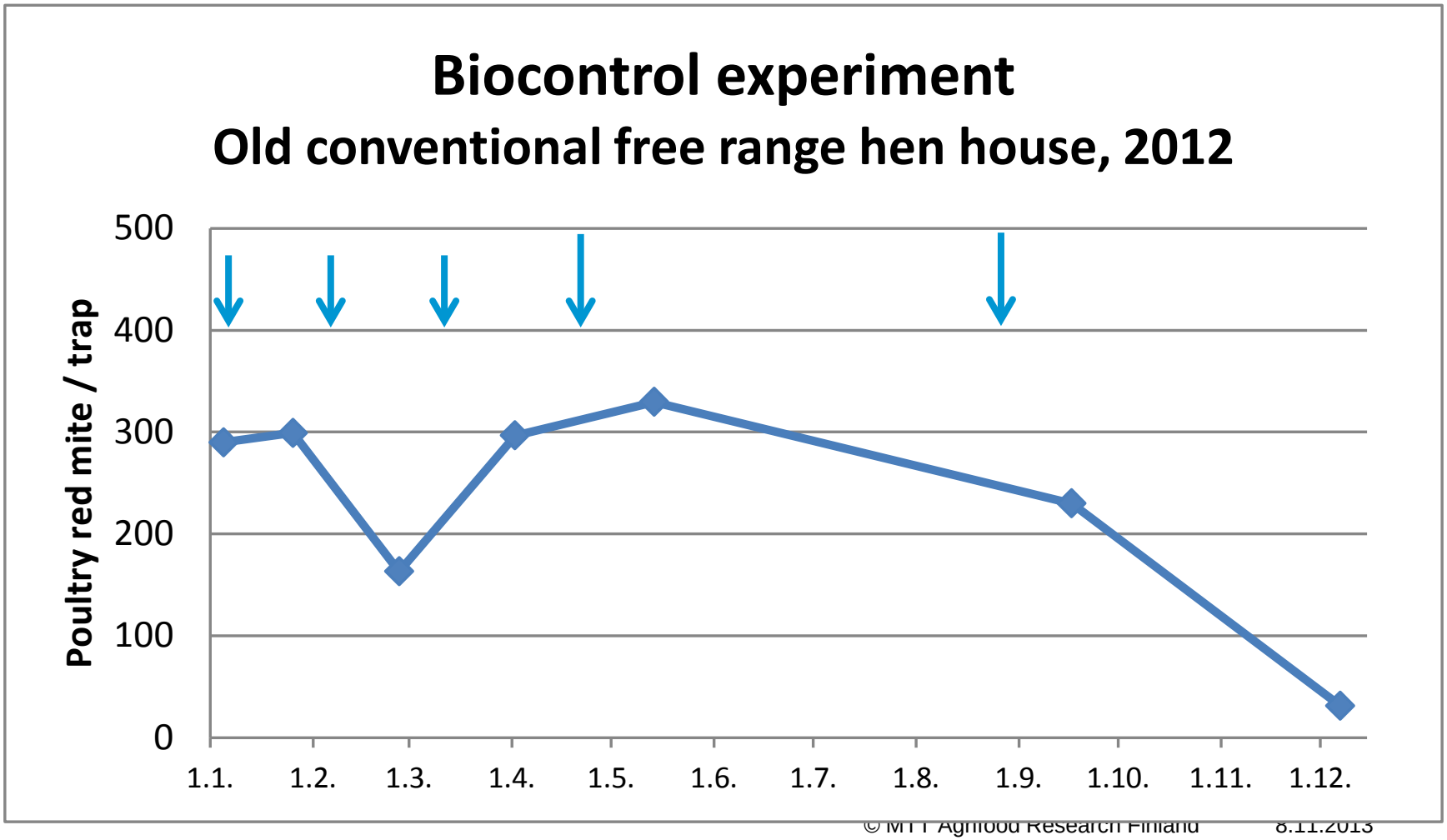


Farm experiments: results (example)

- Case: conventional free-range hen house (2012)
  - Old cowhouse furnished for 7000 layers
  - Loose materials of *S. scimitus* spread on the roofs of nests and into the floor, each time10-35 predators/layer, at 4-5 weeks intervals, with a summer break, in all 110 predators/layer/year
  - PRM follow-up by velcro-traps fixed round perches in different parts of the aviary
- Results
  - PRM numbers stayed tolerable in Jan-May, in June-Sept PRM was not monitored but no problems were reported, and again in Oct-Dec PRM numbers stayed low
  - Considerable numbers of *S. scimitus* were present in the traps

Farm experiments: results

Blue arrows: releases of *S. scimitus*
(in pieces of drain pipes)



Farm experiments: results

- Case: organic free-range hen house (2013)
  - 9000 layers, in three separated units
  - High initial PRM infestation, high mortality of layers in the start of the test
  - Loose materials of *S. scimitus* spread on the roofs of nests and on the wooden perches, each time 75 predators/layer, at 2-3 weeks intervals, in all 375 predators/layer in June-August
  - PRM follow-up by velcro-traps fixed round perches
- Results (preliminary)
  - PRM numbers stayed high, releases of *S. scimitus* affected the growth of PRM population but did not reduce it significantly
  - Layers' mortality figures returned almost the normal level

Farm experiments: conclusions

- Introductions of *Stratiolaelaps scimitus* can limit the growth of PRM population in various environments
- However, in most conditions *S. scimitus* was not able to reproduce or colonise in the henhouse
- Repeated introductions are needed in most cases
- Early detection of PRM is essential for proper timing of inroductions
- Better release methods of predatory mites are needed
- Construction and structures of henhouse devices may influence PRM population growth and success of biological control

Challenges for biological control by predatory mites

- Prevention of initial infestation: the basis of PRM control
- Integration of different preventive and direct control methods
- Reliable monitoring method in different layer systems
- Improvement of structures for better coincidence of predator and prey
- Improvement of release methods for biological control agents
- Repeated introductions according to monitoring results: how much, how often?
- Search for better biocontrol agents for PRM still going on

Acknowledgements

Thanks to:

- Makera, Ministry of Agriculture and Forestry
- The Finnish Poultry Association
- Biotus Ltd.
- Poultry farms