Control of Red mites in Laying Houses

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Dermanyssoid mites

- Introduction to *Dermanyssus gallinae*
- Problems related to its biological features
- Economic impact
- Infestation and infection in humans and animals
- New methods of controls

The red mite

- Chicken mite, Poultry red mite, *Dermanyssus gallinae.*

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The red mite

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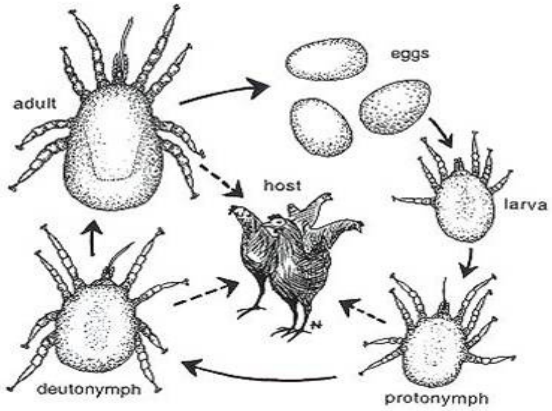
1st problem: size

- Farmers and practitioners (veterinarians or medical doctors) have difficulties to see it/recognise it on animals/patients
- Animals have difficulties to predate on it because of its size
- Patients are confusing it with red spiders and other arachnids

The red mite

- Has a very short life cycle



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Pseudoscabies caused by *Dermanyssus gallinae* in Italian city dwellers: a new setting for an old dermatitis

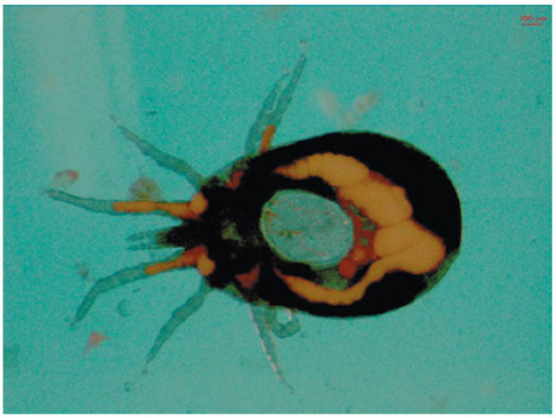

fig. 1 *D. gallinae*, female: an egg is visible within the abdomen.

Courtesy: Dr Maria Assunta Cafiero IZS Foggia, Italy

JEADV, 2008, 22, 1365-1401

2nd problem: its life cycle

- Larvae do not need to feed on blood so do not need to approach animals/patients but can still infect the environment and multiply when they become nymphs and then adults
- The life cycle is so short that you can have sporadic outbreaks as farms or houses can be very quickly completely infested

Prevalence

Table 1 Key data for poultry production and *Dermanyssus gallinae* prevalence

Country	Annual poultry production in million birds (average flock)	% in traditional cages	% in enriched cages	% in barns	% in free-range	% in organic systems	% in backyards	Other systems	*Dermanyssus* prevalence[a] (%)	Estimated annual cost of *Dermanyssus*
Denmark	2.7 (11,700)	56	<1	23	6	15	Unknown	Unknown	C: 32 B: 50 FR: 68 Organic: 36	Unknown
France	46.5 for laying hens and 111 for broilers (cages: 39,800; other systems: 5,700)	76.5	4.6	3.4	8.6	3.0	Unknown	8% "Red Label"	C: 72 B: 50 FR: 56 Organic: 80	Cages: 4.33 €/100 birds; alternative systems 3.83 €/100 birds)
Italy	486 including 435 for broilers and 51 for layers (15,000–20,000)	96.4	Unknown	2.4	0.5	0.7	Unknown		C: 74.1	Unknown
Japan	860 (unknown)	Circa 100	0	<1.0	0	<1.0	<1.0		C Layers: 85.2 C for broilers: 0.6	66.85 million €
Montenegro	0.43 (2,500–25,000)	87	4.0	3.75	1.00	Unknown	3.75	None	C layers 30–80	Unknown
Morocco	294 (unknown)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	BY: 90 C broilers: 20 C layers: 55	Unknown
Norway	3.6 (1,900)	54.0	26.0	18.0	0	2.0	0	None	C layers: 23	Unknown
Serbia	80.0 (unknown)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	C layers: 90	Unknown
The Netherlands	30.12 (26,600)	46.0	2.0	40	12.0	2.0	None	None	C: 82 B: 83 Organic: 78	11.0 million €
UK	860 (10,380)	60.0	Unknown	4.0	30.0	6.0	Unknown	Unknown	C: 7.5–87.5 B: 32.5 FR: 60.0	3 million €

[a] *C* cages, *B* barns, *FR* free-range, *BY* backyard

From: Sparagano et al (2009) Experimental and Applied Acarology, 48 (1-2), 3-10

Poultry Systems

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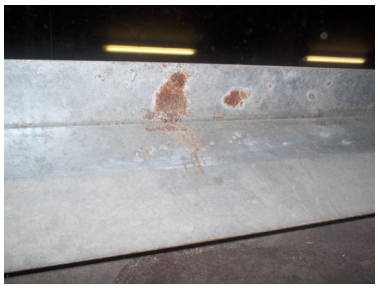
3rd problem: its behaviour

- Red mites are attacking animals/humans mainly during the night (when victims are asleep!)
- They will stay on target only a 1-2 hours
- They will go back in the dark (cracks and crevices) to digest the blood

The red mite

- Feeds for short periods during darkness and lives in house substructure.



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Economic costs

- Economic costs for the EU egg industry have been estimated at €130 million/year
- Annual costs: UK (€ 3.0-4.0m), The Netherlands (€ 11.0m) Japan (€ 67.0m)

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- Consequences on animal and human health

Welfare issues for animals

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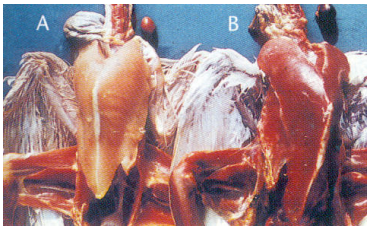
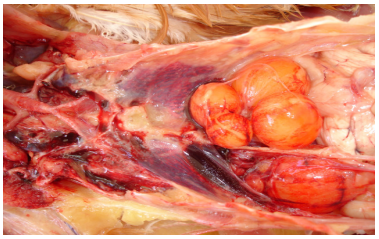
Anaemia





Impact of egg quality

EU Rescape project: 16 countries working on egg quality

Welfare on humans

- Risk for humans because of itching dermatitis

Photo 1 from Professor Sahibi, Morocco

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Human health issues

Figure 2 A 2-year-old child with red mite bites on the abdomen

Figure 3 A 69-year-old woman with red mite bites on the legs

Cafiero et al (2009), International Journal of Dermatology, 48, 1119-1121

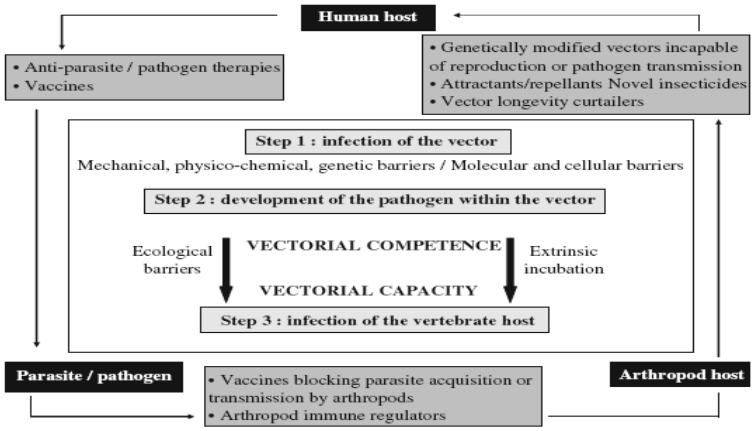

Fig. 1 Schematic representation showing the typical transmission cycle of a vector-borne parasite or pathogen between a human host and an arthropod vector, and potential steps for intervention. Different steps of the vectorial transmission are shown in the case of a biological vector

The poultry red mite (*Dermanyssus gallinae*): a potential vector of pathogenic agents

Claire Valiente Moro · Carlos J. De Luna · Alexander Tod · Jonathan H. Guy · Olivier A. E. Sparagano · Lionel Zenner

Exp. Appl. Acarol. 2009, 48 (1-2) 93-104

Dermanyssus gallinae as a vector

- The mechanisms of transmission of vector-borne diseases from *D. gallinae* to its host are unclear
- However it has been linked with several bacterial and viral diseases

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Table 1 Bacteria and viruses likely to be associated with *D. gallinae*

	Pathogens	Isolation from mites	Experimental transmission not demonstrated	Experimental transmission demonstrated	Related references
Virus	Avian Paramyxovirus type 1 Newcastle disease	√			Arzey (1990)
	Saint-Louis Encephalitis Virus (Flavivirus)		√		Chamberlain et al. (1957)
	Tick-Borne encephalitis Virus (Flavivirus)		√		Wegner (1976)
	Fowl Poxvirus Smallpox			√	Shirinov et al. (1972)
	Eastern Equine Encephalitis Virus (Togavirus)			√	Durden et al. (1993)
	Western Equine Encephalitis Virus (Togavirus)			√	Chamberlain and Sikes (1955)
	Venezualan Equine Encephalitis Virus (Togavirus)			√	Durden et al. (1992)
Bacteria	*Pasteurella multocida*			√	Petrov (1975)
	Erysopelothrix rhusiopathiae	√			Chirico et al. (2003)
	Salmonella gallinarum	√			Zeman et al. (1982)
	Listeria monocytogenes	√			Grebenyuk et al. (1972)
	Coxiella burnetii			√	Zemskaya and Pchelkina (1967)
	Spirochetes			√	Ciolca et al. (1968)

From Valiente-Moro et al, 2009, EAA, 48 (1-2) 93-104

- Control Methods- Update

Current control

Synthetic acaricides, e.g. carbaryl, diazinon, dichlorvos, permethrin.

HOWEVER: Resistance to a range of pesticides is widely reported.

Fenitrothion no longer available for UK use, despite its once widespread application (Fiddes et al., 2005).

No available products for *D.g.* control in Sweden (Chirico & Tauson, 2002)!

Controlling the red mite

- Limited control methods:
- ✓ Control typically via chemical spraying
  - Limited due to mite resistance (see Marangi et al, 2009, EAA, 48 (1-2) 11-18,
  - Chemical withdrawal
  - Health issues related to acaricide use
- More effective means of control needed
  - Such as vaccine development, plants, natural products for desiccation, predator, better management…

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Novel approaches

- Bio-control
  - Desiccating products
  - Plant extracts
  - Predators
- Vaccination
  - Vaccinated animals would kill the mites feeding on them and reducing the mite population
- Monitoring
  - To reduce the risk of initial infestation and subsequent proliferation.

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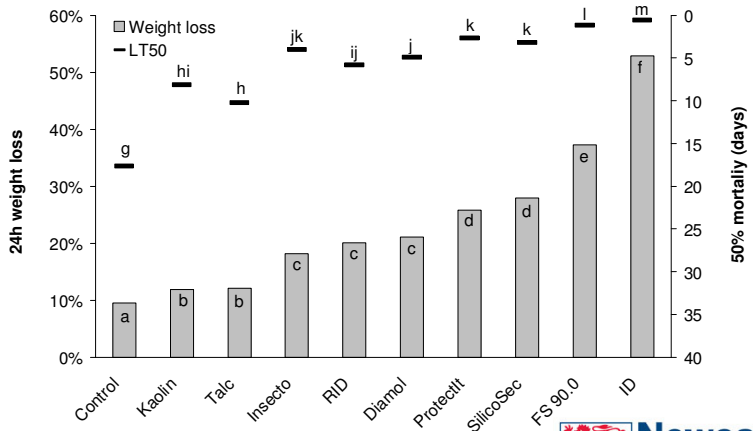
Biocontrol 1- Dessication



From Kilpinen and Stenberg, DIAS, Denmark

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Biocontrol 2-Plants 1

- From those 20 essential oils Lavender (*Lavandula* spp.) essential oils have proven toxic to poultry red mite since it contains an insecticide known as linalool.
- They may offer an alternative to synthetic acaricides for managing this pest.

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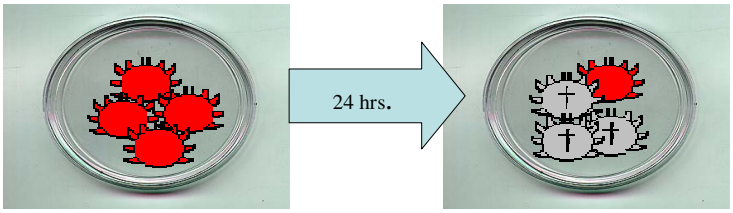
Biocontrol 2- Plants 2

- poultry red mite are placed in Petri dishes with a filter paper impregnated with an essential oil from one of the selected six types of lavender.



From George et al, Newcastle University, UK

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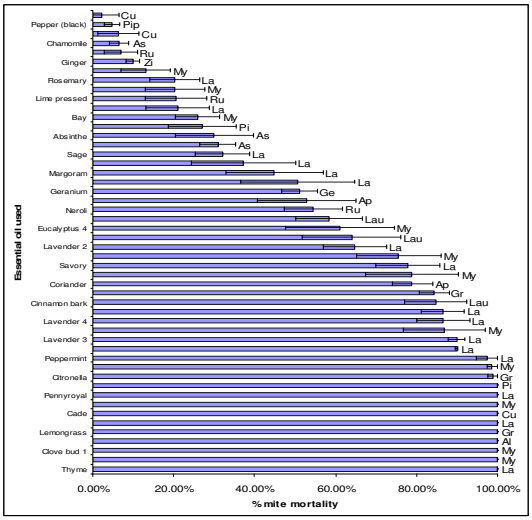
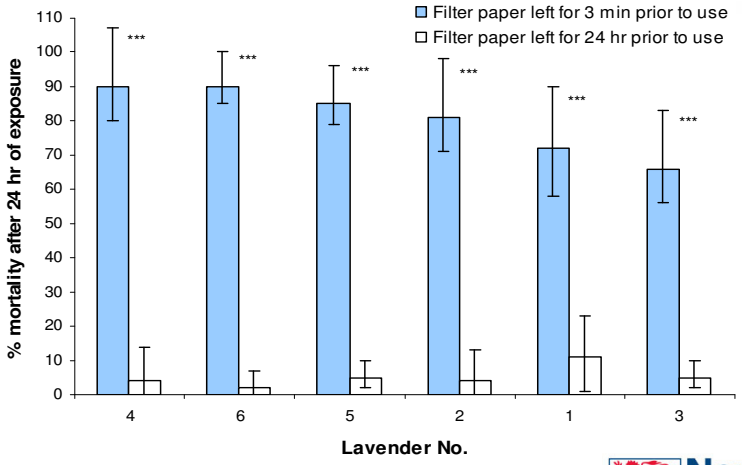
Plant-derived products (PDPs)

Mean *D.g.* mortality when exposed to different essential oils in 24 hr contact toxicity tests at 0.21 mg/cm² (George et al., 2009).



Plants 3-Lavender oils



From George et al, Newcastle University, UK

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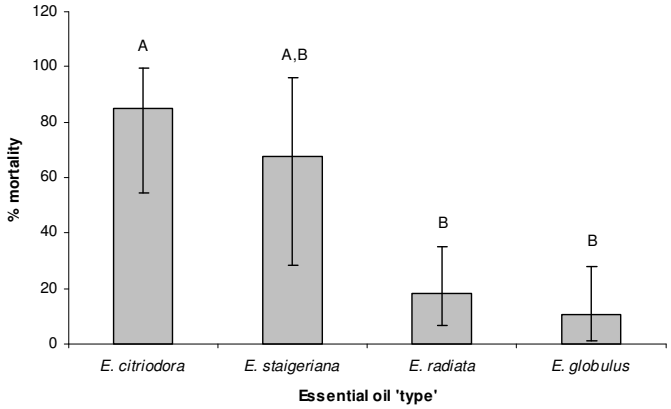
Plants 4 – Eucalyptus oils



From George et al, Newcastle University, UK

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Biocontrol 3 - Predators

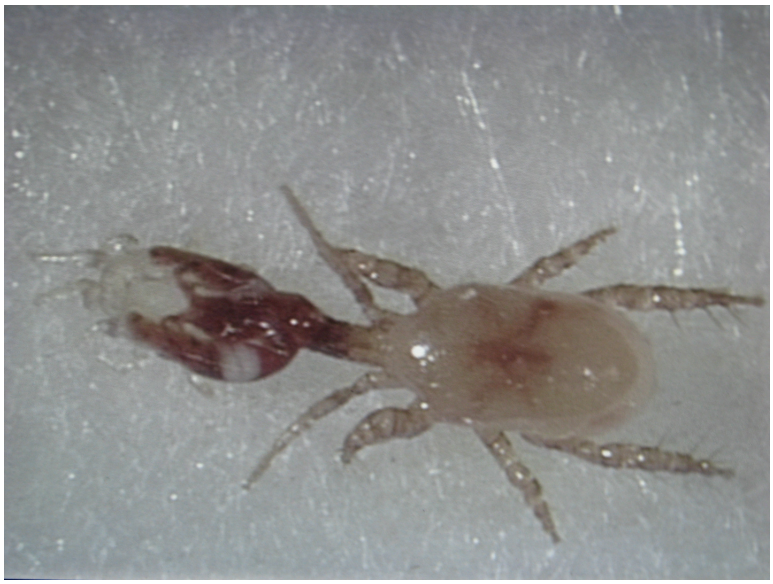

Photo courtesy of Urs Wyss and Izabela Lesna, The Netherlands

Control 4: vaccination

- 39 day-old naïve birds
- Reared in floor pens on wood shavings: day-old until infestation
- Feed and water *ad libitum*

From George et al, Newcastle University, UK

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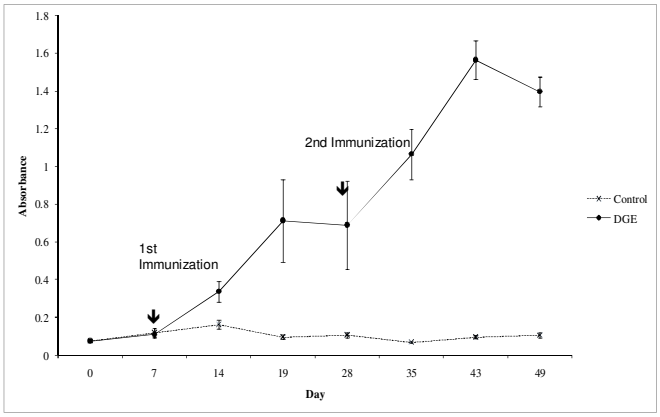
Vaccination-IgY - ELISA



From Harrington et al, Newcastle University, UK

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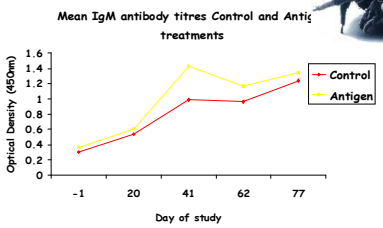
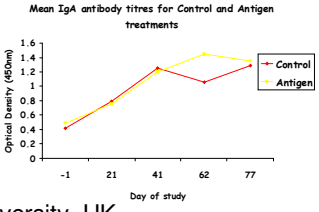
Vaccination
IgM and IgA-ELISA

- No significant differences in IgM titres



- No significant differences in IgA titres



From Harrington et al, Newcastle University, UK

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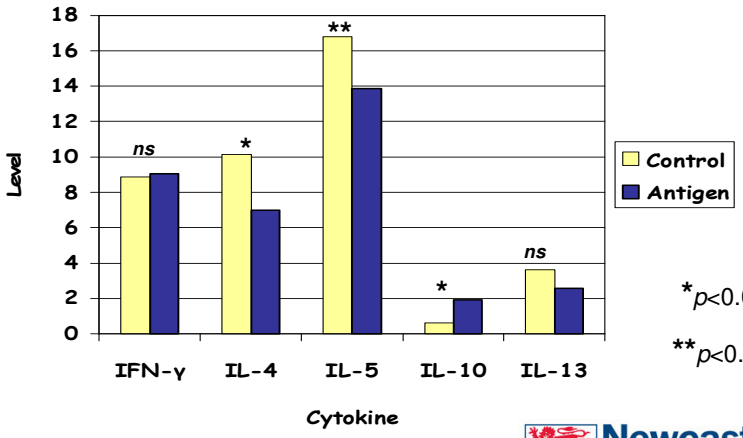
Vaccination-Cytokines



*p<0.05

**p<0.01

From Harrington et al, Newcastle University, UK

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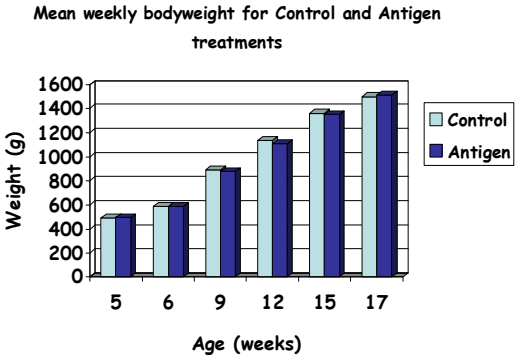
Vaccination-Bodyweight

- No significant difference in weekly bodyweights between treatments



From Harrington et al, Newcastle University, UK

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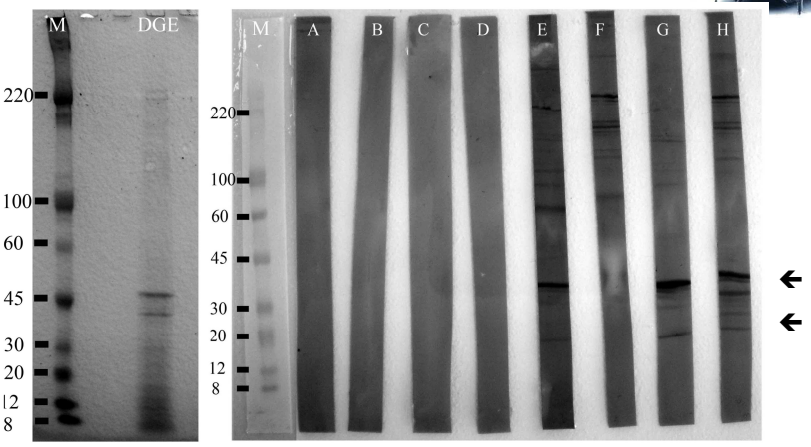
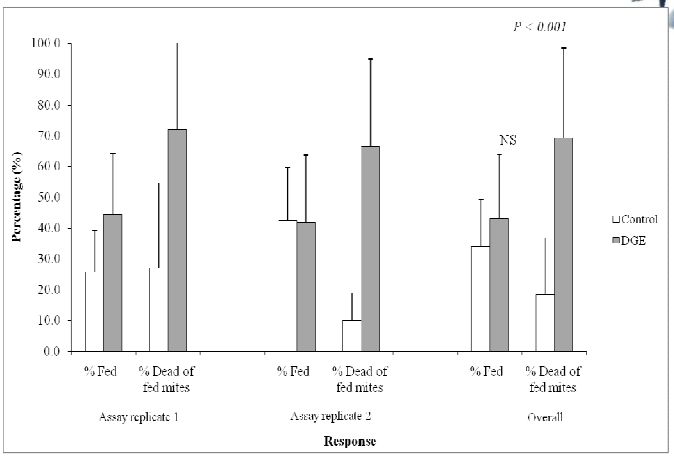
Vaccination- Western blot



From Harrington et al, Newcastle University, UK

Vaccination-Efficacy



From Harrington et al, Newcastle University, UK

Vaccination Phase 2: Recombinant antigens

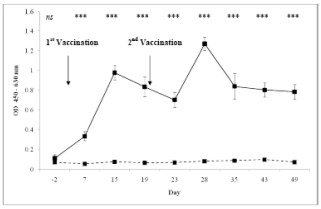
Contents lists available at ScienceDirect

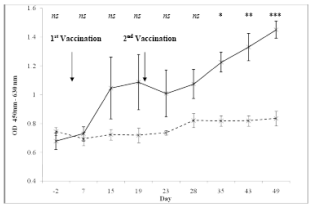
Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Immunisation with recombinant proteins subolesin and Bm86 for the control of *Dermanyssus gallinae* in poultry

David Harrington[a], Mario Canales[b], José de la Fuente[b,c], Carlos de Luna[a], Karen Robinson[d], Jonathan Guy[a], Olivier Sparagano[a,*]





Monitoring 1

- **1. Is vermin control outside the poultry house carried out by a professional organization?**
- **2. Are there any stacks etc. alongside the house?**

3. Is there a 2-m wide strip along the house that is free of vegetation?

- **4. Is there a gravel or paved strip immediately**
- **alongside the house?**
- **5. Is the poultry house bird-tight?**

6. Are the outside doors provided with door springs?

From Mul et al., Wageningen University, UK

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Monitoring 2

7. Is there any accommodation standing or hanging (including outside runs) for hobby poultry/birds immediately next to the house?

8. Are the spaces below the corrugated roof sheeting covered or filled?

- **9. Do you use only dry and clean litter?**
- **10. Are the members of the set-up group wearing clean work clothing and have they taken a shower before coming to the farm?**
- **11. Do you demand from your rearing farm that clean containers and crates are used to transport the hens?**

From Mul et al., Wageningen University, Netherlands

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Monitoring 3

<u>Brief checklist against red mite</u>

<u>in pullets before transport to the farm</u>

1. **Is vermin control outside the house carried out by a professional organization**
2. **Has the light been put on one hour before the catchers take on their job?**
3. **Do you use only clean crates and containers for the transport of pullets?**

From Mul et al., Wageningen University, Netherlands

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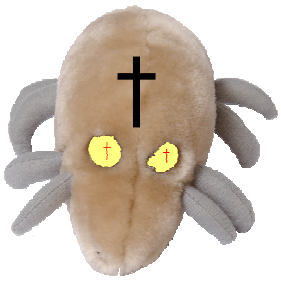
Aims



Update see Special Issue of Exp. Appl. Acarol.

Collaborators

- At Newcastle University, UK
  - Dr Jonathan Guy
  - Dr David George
  - Dr Carlos de Luna
  - Mr Dave Harrington
  - Mr Chris Bulman
- In The Netherlands
  - Dr Monique Mul, Dr Izabela Lesna, and Dr Rick van Emous, Wageningen University
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- In France
  - Dr Sophie Le Bouquin, Dr Adeline Huneau, Mr Didier Huonic (AFSSA)
- In Denmark
  - Dr Ole Kilpinen and Dr Tove Stenberg, Lyngby
- In Italy
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