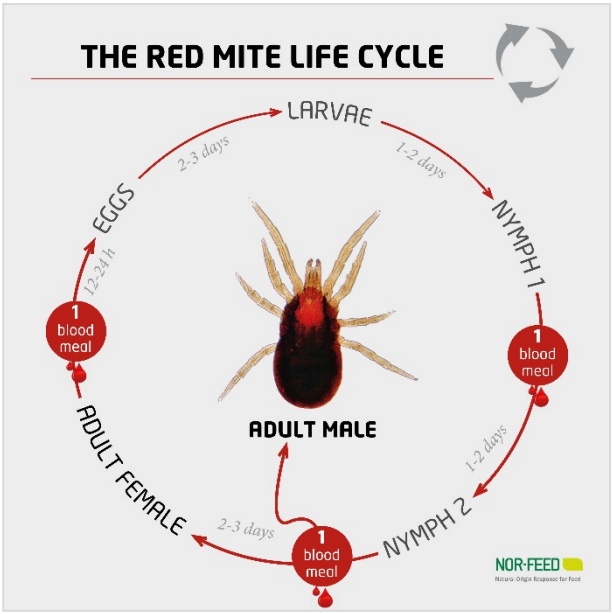
Plant extracts:

A new tool for the poultry red mite issue

By Agathe Labalette, product and R&D manager at Nor-Feed and …

Introduction

Dermanyssus gallinae, commonly named poultry red mite, is a blood-sucking ectoparasite. It is of economic importance as a worldwide pest in the poultry industry (Axtell and Arends 1990). Poultry red mite is also the most important ectoparasite affecting laying hens (Chauve 1998) and it is an increasing epidemiological and economical problem for the poultry industry worldwide. To control the poultry red mite, it is important to know its biology, its impact on the economy, the production and its worldwide prevalence. Conventional and alternative control methods exist and are different. Some plant extracts have demonstrated an effect on poultry red mite and could be repellent by their components on *Dermanyssus gallinae*. A recent study show the direct repellent effect of a mineral feed on *Dermanyssus gallinae*, and its effect to control the population.



The poultry red mite issue

a. Biology of *Dermanyssus gallinae*

Dermanyssus gallinae is a bird's parasite, especially found in laying hens farms.

Red mites are in contact with the birds only to suck their blood, mainly at night (Sparagano et al, 2014). The parasites eat every 2 to 4 days and usually spend up to one hour on the host. Most of its life cycle is spent off the host in cracks and crevices in roosting and nesting sites (Hearle 1938). The adult female measures about 1 millimeter after a blood meal. Their usual color is black or gray but become red after a blood meal.

Red mite life cycle consists of five stages: eggs, larvae, protonymph (nymph 1), deutonymph (nymph 2) and adult life. Only the last three stages require one blood meal to take the next step; adult females also need a blood meal to lay and mature the eggs (Roy, 2009). Males only eat occasionally. Protonymph, deutonymph, males and unfed females can survive during many months without eating (up to 9 months) according to Nordenfors et al (1999).

The red mite's fertility is lower than other ectoparasites. An adult female can produce up to 8 laying cycles, with one to eight eggs per cycle and an average total of twenty-three eggs (Olivier, 1996). Moreover, the life cycle of red mites lasts seven days at a temperature of 25 °C and 70% of humidity (Tucci et al, 2008).

b. Impact of red mites

The economic costs associted with production losses and treatments are estimated to 130 million € per year for the EU egg industry (Van Emous 2005). The estimated annual cost of poultry red mite and its prevalence are different between countries but the red mite and its damage are important around the world. The following table represents some of them (Sparagano et al., 2009; Georges et al., 2015):

Country	**Prevalence in cages system (%)**	**Estimated annual cost**
Germany	94%	Not estimated
United Kingdom	87%	3 million € / year
Japan	85%	66,85 million € / year
Netherlands	82%	11 million € / year
France	72%	1,7 million € / year

Red mites have various negative effects on hens such as high mortality, stress behavior (higher levels of preening, head scratching and gentle feather pecking), lower body weight and reduced egg quality due to blood spots (Chauve, 1998). Researchers agree that there are indications for the following effects of red mites (Mul et al., 2009):

- Increased water intake in infested hens
- Lower egg production from the flock overall
- Increased feed intake and lower feed conversion ration
- Avoidance of highly infested places by hens
- General increase of immune response and/or immune suppression of infested hens
- Disease transmission by red mites to hens
- Reduced feather quality of infested hens

Moreover, red mites can have a serious impact upon human health. Apart from causing skin irritation and itching, the mites can cause allergic skin reactions (Sahibi et al., 2008; Potenza et al., 2008).

c. Control methods

Control methods can be divided into two parts: conventional methods and alternative methods (Mul et al., 2009):

<u>Conventional methods</u>

Method	**Characteristics**
Acaricides	Different molecules such as pyrethroids, carbamates, organophosphates, amitraz.
Silica dust	Immobilizes the mites and dehydrates it.
Heat treatment	Heating hen houses to temperatures above 45°C is commonly applied in The Netherlands and Norway.

Alternative method

Method	Characteristic
Lighting programme	¼ hour light and ¼ hour dark. Not allowed in Europe (EU Directive 1999/74 dadicates a coutinous dark period of at least 8 hours.
Natural acaricide	Include essential oils, herbs or plant extracts. Spinosad obtain from bacteria.
Predatory mites	There are many species of predatory mites.
Repellent in feed	Use of plant extracts with a feed grade to repel the red mites from the hens.

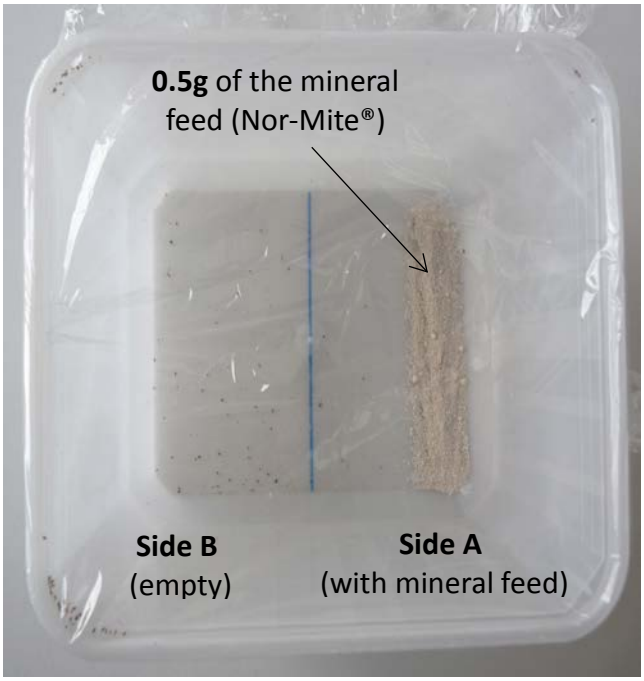
According to the bibliography, the biology and the increase of the infestation, *Dermanyssus gallinae* is very difficult to control. It's very important to have good hygiene practice and reduce the possible vectors. Some control methods exist and could be complementary. In this perspective a repellent in feed was developed and show good perspectives to control red mites.

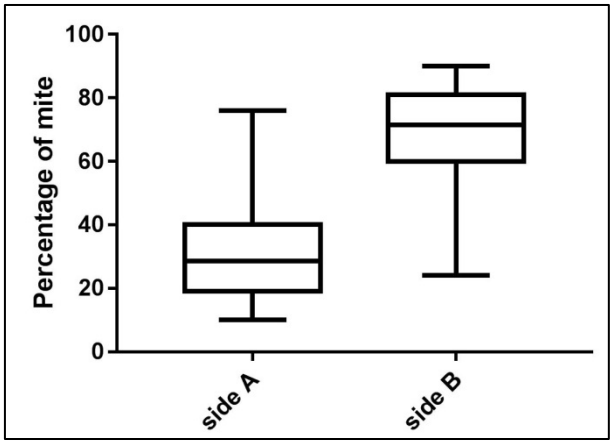
Plant extracts repellent against *Dermanyssus gallinae*

Some feed grade (Reg. 1831/2003) plant extracts are repellent for arthropods such as *Cymbopogon nardus* or *Eugenia caryophyllus* essential oils (Nerio et al., 2010). Moreover, the substances ingested by the hens are rapidly absorbed and excreted (Gabriel et al., 2013). For this use, a mineral feed (Reg. 767/2009) containing of plant extracts such as *Cymbopogon nardus* and *Eugenia caryophyllus* and containing a rate of crude ash superior to 40% was developed (Nor-Mite®).

a. In vitro trial

A study (Labalette et al., 2016) was made in order to verify the repellent effect of a blend from plant extracts such as *Eugenia caryophyllus* and *Cymbopogon nardus*, by the use of 0.5g of the mineral feed, Nor-Mite®. To exacerbate the effect the dose was 8 times higher than for the hens. 0.5g was disposed in 12 plastic boxes (13.5cm*11cm*7cm) separated in 2 compartments. The side A contained the mineral feed and the side B was empty. Then poultry red mites were randomly disposed in each box to study their behavior when exposed to the product. The number of mites in each zone was recorded and the results were statistically analyzed by Mann Whitney (V 2016).





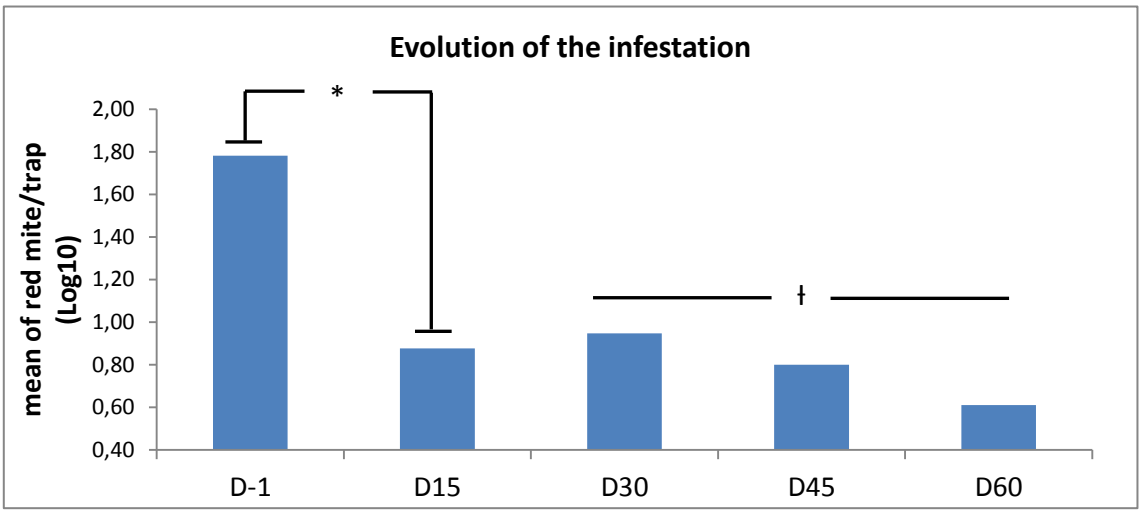
The computation revealed that 68% of the poultry red-mites were positioned on the side B, away from the product, after the 3 hours period at room temperature. Moreover, the statistical analysis revealed that the mite repartition was significantly different ($p<0.001$).

In this trial conditions, the mineral feed containing plant extracts, such as *Eugenia caryophyllus* and *Cymbopogon nardus*, significantly impacts the behavior of the poultry red mite, demonstrating its repellent effects.

b. The use of mineral feed on farm to control *Dermanyssus gallinae*

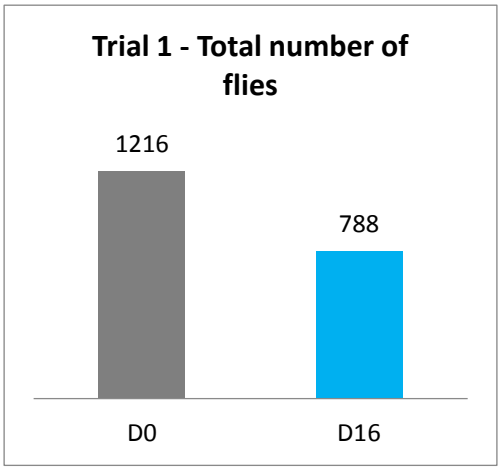
In order to verify the use of the mineral feed containing *Eugenia caryophyllus* and *Cymbopogn nardus*, Nor-Mite® was tested on farm infested by *Dermanyssus gallinae*. A trial was conducted 30 000 laying hens, in French commercial farms during 60 days. To estimate the red mite pressure, we used cardboard trap, 1 for every hens, for a 24 hours period. Then the traps were frozen at -18°C for 72 hours, and the number of mites in all the traps was counted. The same protocol was repeated every 15 days until 60 days. The mineral feed was used at an inclusion rate of 500 ppm. The results were analyzed pairwise (every 15 days with D-1) by Wilcoxon test (Graphpad, 2016).

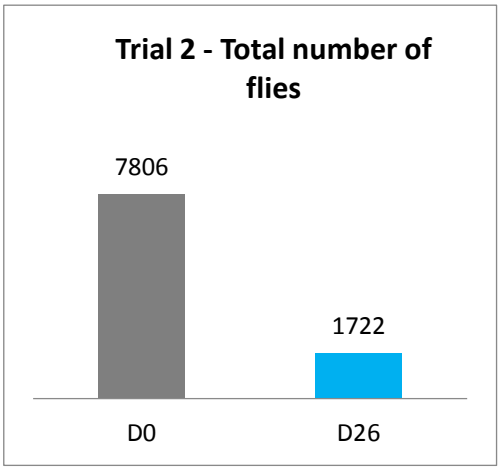
The number of red mites was significantly decreased after 15 days (*$p<0,05$) and the population was maintained (ŧ$p<0,06$) under initial count over the 60 days of trial. The number of red mites was around 65 red mites / trap at D-1 and 10 red mites / trap at D60. During the use of Nor-Mite® the number of red mites / trap was under 15.



c. The use of mineral feed on farm to control flies

Moreover, two trials were conducted to test the efficacy of the mineral feed on flies. The first one was conducted on 6 800 colored broilers (trial 1) and the second one on 26 000 laying hens (trail 2), in two different Taiwanese commercial farms during 16 days and 26 days respectively. Adhesive traps with an attractive odor (1 for every 1000 hens) were placed in the farms during 24h. Traps were used to count the flies and to observe level of infestation. The mineral feed was used in feed at an inclusion rate of 500 ppm. Flies were counted on the first day of the trial (D0) and on the last one.





In each trial, the population of flies has decreased with the use of the mineral feed. In the first one (16 days, 6 800 broilers) the total number of flies was lowered by 35%. In the second trial (26 days, 26 000 laying hens) the total number of flies was lowered by 78%.

Conclusion

Red mites have evidenced a high impact on laying hens production. Due to its life cycle and habits as well as its biological characteristic, it is very difficult to control them and maintain the population at a low level. A mineral feed containing plant extracts was developed to held controling the infestation by its repellent effect in feed. Under a mineral feed form, this solution has evidenced a beneficial impact on the infestations by *D. gallinae* in poultry production. Moreover, a beneficial effect is also observed on flies' infestation. By its effect, the ambiance of the farms is improved for both workers and animals with no negative effect on the feed consumption or the zootechnical performances.

Lise ROY, PhD, and Marine El Adouzi, PhD student

Lise ROY is currently an Assistant Professor of Population Biology and Ecology at the Université Paul-Valéry Montpellier 3 and a member of the research center Centre d'Ecologie Fonctionnelle et Evolutive (CEFE) in Montpellier. Her PhD thesis was focused on host specificity and dissemination routes within the genus *Dermanyssus* in both wild and domestic birds and she subsequently performed studies on the population dynamics and monitoring of the Poultry Red Mite (PRM) *Dermanyssus gallinae*. Marine El Adouzi is a PhD candidate working with L. Roy and is skilled in biological control using predatory mites in crops. Both recently begun a study on mite communities dwelling in poultry litter/manure, with the aim of better understanding possible suppressive effect on PRM of non hematophagous mite communities commonly dwelling in layer farms. Lise Roy, Marine El-Adouzi and their team work also with Nor-Feed to characterize the mode of action of a repellent *in feed* to control some arthropods such as *Dermanyssus gallinae*.

L. Roy is currently MC member of COREMI, leader of the working group WG3 ('Genetic structure') and member of the core group. M. El Adouzi is MC substitute, as well as WG1 (Biocontrol) and WG3 participant.

The project COREMI "**Improving current understanding and research for sustainable control of the poultry red mite *Dermanyssus gallinae*"** aims to consolidate the existing expertise and knowledge on poultry red mite and to generate a synergic/holistic approach to improve health, welfare and productivity of the laying hens through more effective prevention and control of poultry red mites.

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COREMI http://www.coremi.eu/

Lise ROY & Marine El-Adouzi

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