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It's all about
RED MITE

POULTRY RED MITE AND ITS CONTROL KEY POINTS

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In Europe and others world areas egg producers have been suffering severe infestations of Poultry Red mites (PRM) for years. The prevalence exceeds 80% of the farms in most of main European egg-producing countries. Far from being a harmless presence, it is an economic loss of, at least, 0.5 EUR per hen and per year (Van Emous, 2005). In addition, the lack of protocols and products effective for their control has led many egg producers to a desperate situation. This has brought complications not strictly related to the ectoparasite but also to the control methods by themselves.

Dermanyssus gallinae

The scientific name of the PRM is *Dermanyssus gallinae*. It is a hematophagous mite that parasitizes several species of birds and, particularly, the hens. Unlike other external parasites, PRM does not live in birds but in cracks and crevices in surrounding area of the hens. During the night time, it moves up to hens to feed on their blood, and return to their resting area. Blood-feeding is not necessary for its survival, but it is for laying eggs, in the case of females, and for the molting, in the case of the two nymph forms.

PRM should be distinguished from the Northern Fowl Mite (*Ornithonyssus silvarum*) that is present in many countries such as USA and Brazil. Morphological differentiation between the two species is very complicated and should be done with a magnifying glass. However, its behavior is totally different because the Northern Fowl Mite lives in the hen and performs all its cycle on it. In addition, it only survives for a very limited time outside the host while it has been reported that the survival of PRM can reach the 7 months in the absence of hens.

Hens loss blood and even had anemia in cases of severe infestation. Due to the discomfort during nights, the resting

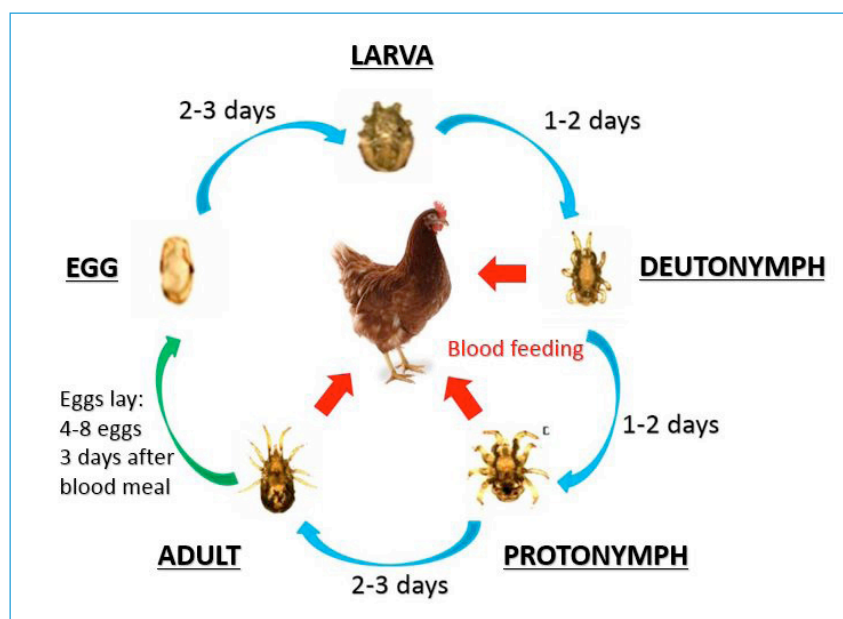
time is affected and hens will experience changes in behavior. We will see loss of feathers, pecking, cannibalism and opportunistic diseases such as *E.coli* will emerge due to immuno depression caused by stress.

Productive parameters (% of lay, egg weight, Feed conversion, body weight) are affected depending on the intensity of the infestation.

The egg quality can also be affected. There will be blood stained eggs. It is caused

by the eggs rolling over blood-ingurgitated mites during the collection by automatic systems. These eggs are B-classed in some markets and cannot be sold through regular channels.

Finally, PRM may act as a reservoir for numerous diseases. This has been shown for *Pasteurella* (Petrov 1975), *Salmonella* or *Escherichia Coli* (Valiente Moro 2009). Given its ability to survive from one flock to the next, it can play a decisive role in the persistence of diseases in the infested poultry houses.



Graph 1: Pritchard, James & Kuster, Tatiana & Sparagano, Olivier & Tomley, Fiona. (2015). Understanding the biology & control of the poultry red mite *Dermanyssus gallinae*: a review. *Avian pathology: journal of the W.V.P.A.* 44, 1-42. 10.1080/03079457.2015.1030589.

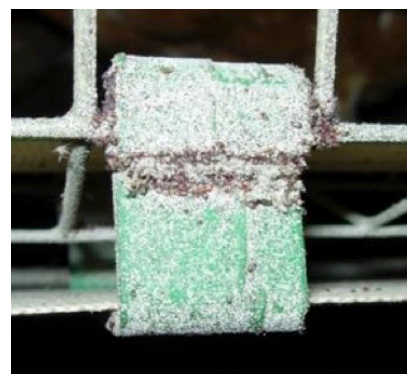
Why is so difficult to control Poultry Red Mite?

1. Perfectly adapted to its environment. The conditions of the current production farms (temperature, humidity, density of birds, cages or aviaries) are ideal for the development of PRM. In addition, their ability to survive in the absence of birds makes service periods not able to control the infestation by itself.

2. Few products available for its treatment. Especially in Europe and other parts of the world, the treatments in the presence of hens and eggs are very restricted. Authorized products, in many cases, have a reduced effectiveness or its application is hard-to-implement or have a high economic cost.

3. Development of acaricides resistances. PRM has shown a great capacity to acquire chemical treatment resistance. This has led to the situation where most of them are not performing well.

4. Limited knowledge of the biology, ecology and mite-host relationship of the mite. PRM is known since a long time and a large research effort has been conducted in recent years, however there are some aspects of the PRM that needs more research.



Picture 1 and 2: PRM colonies in different places of the cages

PRM control tips

1. Pay attention to PRM in your biosecurity protocol:

To keep the status of - Not infested - is the best economic option for a farm. If PRM is already infested the facilities, to avoid new introductions from other populations is essential to establish a control strategy. In order to achieve this goal, the absence of mites on replacement pullets, visits and all incoming material should be checked. The use of a HACCP system to control all the dangers of introduction and spread of PRM on farms (Mul 2009) can be useful.

2. Implement passive control systems.

PRM lives in henhouse structures as cages, eggs belts, manure belts, aviaries system and others. The environment has also a great effect on its population dynamics. We can create unfriendly environments to control its development. The following aspects should be considered:

Temperature and relative humidity: PRM lives comfortably in the production tempe-

RISK	HAZARD
++++	<ul style="list-style-type: none"> New flock pullets Containers/crates
+++	<ul style="list-style-type: none"> Poultry farmer / employee Infested manure
++	<ul style="list-style-type: none"> Visitors or external personnel
+	<ul style="list-style-type: none"> Infested cadaver dump Infested Eggs Scattering litter

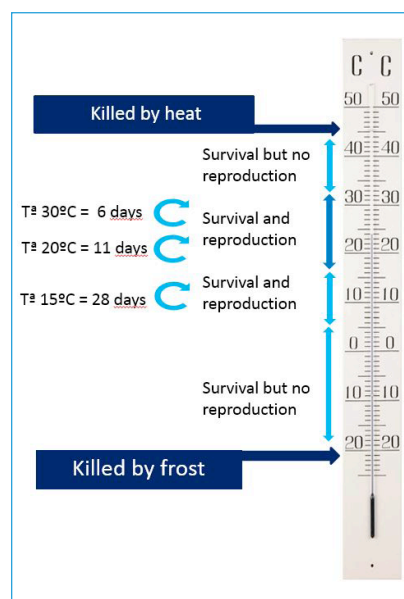
Table 1: PRM introduction hazards.

perature range (20-30 °C). Their cycles are faster at higher temperature and therefore its population grows faster. A relative humidity between 60-70% enhance also the development of the populations (**see graph 2**).

Design and material used in the construction of cages and aviaries: It has a great effect on the appearance and distribution of PRM since most of the population lives on these structures. A design considering a possible infestation, the non-use of some materials (such as wood) and even introdu-

cing equipment intended for control of the PRM can have a positive effect.

Light photoperiod. Intermittent light programs are positive in the control of the PRM because they interfere in their nocturnal activity. Check that these programs are allowed in the country applicable legislation.



Graph 2: Temperature effect in the PRM life cycle

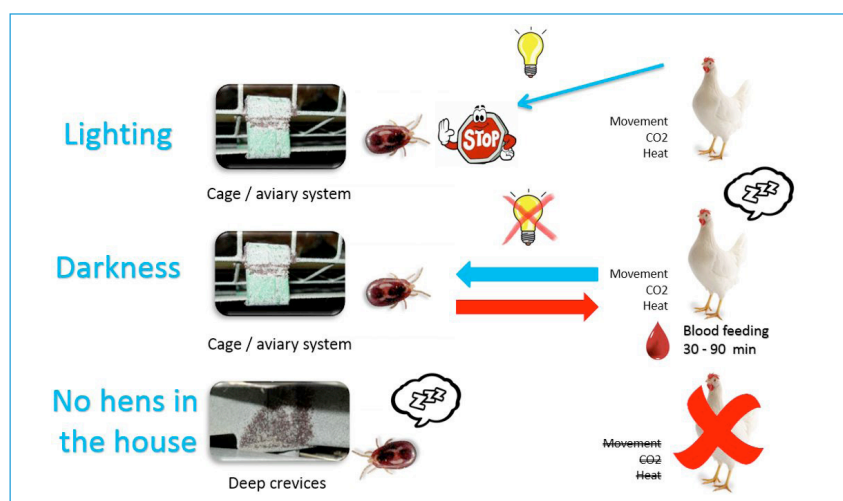
Routines of work and use of material. It is very important to organise the work flow and person transit in the farm to avoid the spread of PRM between houses. Similarly, a high-frequency manure removal avoids using the manure belts as a rest area by PRM.

3. Adapt the Clean&Disinfection protocol to PRM: During service period, PRM will be not eliminated only by hens depopulation. However, it is the perfect time to take actions to strongly impact the dynamic of the PRM population and heavily reduce it, since they don't have blood available and therefore can not continue with their life cycle. Unfortunately, shortly after depopulation, PRM will hide in cracks and crevices of the farm structures and enter into lethargy. It is crucial to reduce significantly the PRM population at this moment so the PRM population is reduced significantly before next flock arrives.

In order to achieve this goal, it is critical to perform a shock treatment in the first 24 hours after the house depopulation. Washing the farm with soap and hot water is also important to eliminate those mites that have found shelter in the superficial areas of the equipment.

Heat treatments have been described and used in European countries. PRM is killed by a temperature above 45°C, heating the house at this temperature can eradicate the population of mites. However, this is a very delicate operation because it can cause damage in the cages or aviaries structures or even buildings. In addition, it must be ensured that a new infestation from other farms or other houses after treatment is avoided.

4. Monitor populations of PRM. After introducing a new flock in the house, the population of PRM will begin to wake up from its lethargy, to suck blood from the birds and to increase the population size. The population growth rate mainly depends on the temperature and humidity in



Graph 3: PRM daily activity

the hen house, but is very difficult to predict its evolution. PRM populations can explode exponentially within one week during the production period making in this way the treatments against them less effective. For this reason, it is highly recommended to use monitoring systems and count the number of mites to follow the dynamics of the population and deal with it before the population is out of control.

Various system based on traps have been proposed for monitoring PRM. Almost all of them rely on the recovery of mites while they are "escondidos" for resting. The monitoring should fulfill several requirements:

- ✦ Provide reliable data of the population on the farm
- ✦ Monitor the spatial distribution of the population within the house
- ✦ Be able to detect low populations of PRM
- ✦ Monitor the effectiveness of the applied treatments
- ✦ Help in the decision-making
- ✦ Be cheap and of of and easy implementation

Traps should be distributed randomly along the house. It is also important to monitor different tiers. Normally, highest population are found at areas close to the end of the manure belt and close to the end of the egg collection belts.

Data should be recorded to know the trends of the populations, along the house and in time. This information and its management are vital to establish a control plan that allows to treat PRM appropriately.

Cardboard traps:

A rectangular piece of corrugated cardboard (140x70x3 mm)



Tube traps:

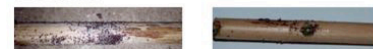
PVC tube (10 cm, 18-20 mm diameter)
Wooden stick (12 cm, 14-15 mm diameter)
Screw



Score 1:



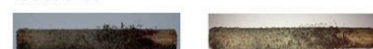
Score 2:



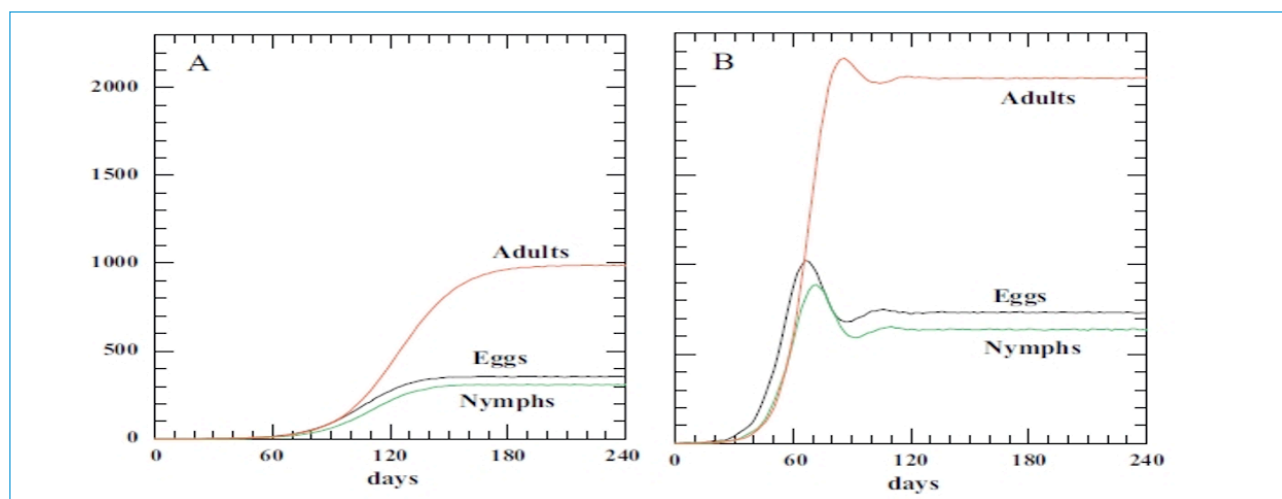
Score 3:



Score 4:



Graph 4: Different PRM traps for monitoring



Graph 5: Two PRM population dynamic models in non-favorable (A) and favorable environmental conditions. Adapted from Hubber (2011)

5. Treat with effective products. The choice of treatment product is one of the key points to have positive results in the control of mites. A treatment product should at least have these characteristics:

- ✦ Authorized and no residues in eggs
- ✦ Able to have a powerful impact on the population of PRM.
- ✦ No harmful effect in the hens or workers
- ✦ Easy to apply or, at least, viable application on production conditions
- ✦ Affordable cost

Unfortunately, in many countries few products meet these characteristics. Nevertheless, different types of PRM control product are available in the market:

Chemical products: It has been the main tool to control PRM for years. Unfortunately, the emergence of resistances for many active molecules has reduced dramatically its effectiveness. Products rotation and good application practices are highly recommended to prevent or, at least, to delay it.

Also, many of them have been forbidden in many countries due to the residues in eggs or poultry. A righteous observation of local normative should be followed and in any case consumer health protection should prevail in the use of these products.

Finally, the toxicity of the molecule should be considered during the application. First, to preserve workers health but also for the hens health. Keep in mind that some molecules can be accumulated in fat tissue and that toxicity can differ from birds to humans.

Silica dust: These kind of products have been used widely in Europe as an alternative for the chemical ones. Their main advantages are that they have no chemical residues and that its mode of action is by its physic effect on PRM.

The disadvantage inconvenient, its application can be tricky and can stain eggs. Some of this product can be used as powder and others as a kind of gel paint. Their effectiveness and persistence will vary due to different application forms.

Natural acaricides: Several essential oils and plant derived products have been proposed as acaricides. Their main advantage is the lack of residues in the egg. Unfortunately, most of these products have been very volatile and very low persistence in the environment.

A repellence effects to PRM has been shown also for some of these products. This fact has opened the opportunity to use these products not only as acaricide,

but also to alter the behaviour of the mites when approaching the hens. They have the additional advantage that they can be applied by water. Used in this way it can interfere in the PRM blood feeding and thus stop life cycle or reduce its performance.

Predator mites: Commercial kits containing PRM predator mites as *Hypoaspis aculeifer* or *Androlaelaps casalis* are available. However, the ratio prey/predator should be respected and, thus, it is only effective for small farms units or low infestation levels.

Others: Entopathogenic fungi, endosymbiotic bacteria or repulsive hormones are under study to be used as PRM-control but they are not available in the market nowadays. Vaccines are also under research but for the time being they are not commercially available.

6. Treatment Application. The application technique is a key point for the success of treatments because its effectiveness largely depends on it. Basically, PRM control product are applied in two ways:

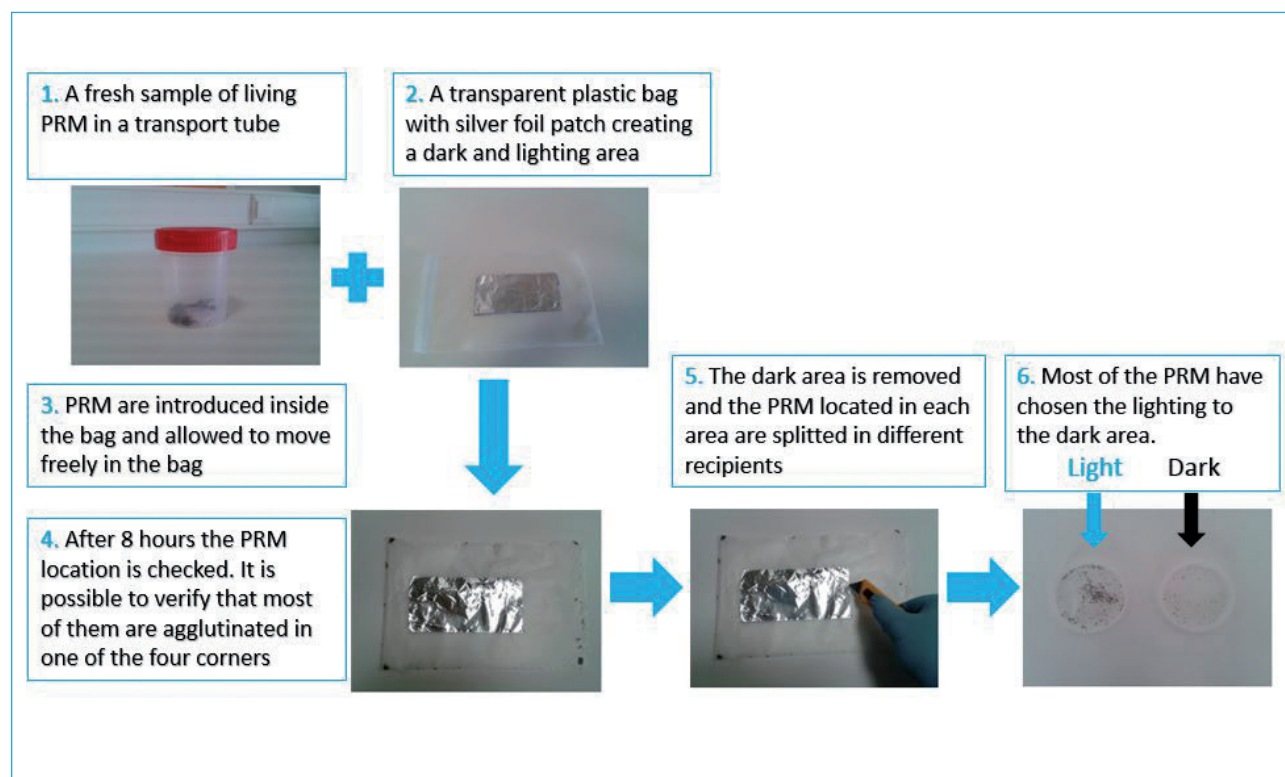
Spraying or painting application: As PRM is not living in the hens but in its surroundings structures, the aim of the method is to paint with the control product all transit areas of the mite.. PRM will have contact

CHEMICAL TREATMENTS	INORGANIC TREATMENTS	NATURAL PLANTS PRODUCTS
Pyrethroids cipermethrin, deltamethrin, permethrin, flumethrin Organophosphates phoxim, diazinone, chlorfenvinphos, chlorpyrifos Carbamates Carbaryl Amidines Amitraz, Endectocides ivermectine, abamectine Spinosyns spinosad Isoxazolines: fluralaner, Benzoilureas triflumuron (growth control)	Silicates gel or dust Diatomea earth Sulphur Sodium bicarbonate Mineral oils	Plant derived products: Azadirachtin Essential oils: thymol, carvacrol, eugenol, geraniol Repelents: citronellal, D-limonene, eucalyptol

Check if the product are allowed under your local regulation before to use it

Use only livestock products and under veterinary supervision

Table 2: PRM control products



Graph 6: a small experiment to show the PRM behaviour in presence of light and its tendency to form mite aggregates

with it in its go-and-comeback from its hives to the hens. For better result, long-persistence product should be chosen to enhance to possibility of contact with the PRM. Hence, some basic rules should be followed by the application of the product:

- ✦ Respect the dosage of the product
- ✦ Respect the total quantity of product per bird
- ✦ Train applicator specifically for the use of acaricides
- ✦ Use adapted-material for the application
- ✦ Implement treatment protocols and audit the compliance periodically

Drinking water or feed application: The aim is to get a level of PRM control product in the blood stream. Because females, deutonymphs and protonymphs should have a blood feeding during the life it is an excellent method to reach most of the population. However, product should meet certain characteristic to be used by this way:

- ✦ No chemical residues in egg
- ✦ Very low toxicity for the hens
- ✦ Absorbed into blood when orally administered

In the case of acaricides, all the flock should ingest the treatment to assure that no females are left to lay eggs. Moreover, keep in mind that this treatment will not reach eggs and larvae. Therefore, a second treatment after seven days is highly recommended.

Conclusion

Even if PRM will continue being a challenge in several areas of the world in the next years, integrated control systems are a great help to keep under control the infestation and its economic losses. Easy-implemented and science-based control programs should be the more successful.

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Picture 3: Worker applying a PRM treatment



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