Technical Manual
2012

Elector for poultry red mite control.
Index

1. THE POULTRY RED MITE *(Dermanyssus gallinae, De Geer 1778)* 3
   Background and life cycle 3

2. POULTRY IMPACT 7
   Stress 7
   Blood feeding 7
   Vectors of disease 8
   Human reactions 8

3. CONTROLLING POULTRY RED MITES 9
   Measures to prevent introduction of new mites into the farm 9
   Farm service period measures 9
   In-flock control measures and farm management 10
   Control of poultry red mites 10
   Conventional methods 10
   Alternative methods 11

4. ELECTOR 14
   The spinosad story 14
   Mode of action 15
   Safety characteristics 16

5. APPLICATION 17

6. ELECTOR STUDIES 19
   Controlled studies 20
   Field studies 25

7. 10 IMPORTANT RECOMMENDATIONS WHEN USING ELECTOR 33

8. REFERENCES 34

Elector for poultry red mite control.
1. THE POULTRY RED MITE

Background and life cycle
The poultry red mite (PRM) *Dermanyssus gallinae* (De Geer 1778) is regarded as the most important ectoparasite of laying hens in organic and conventional egg production farms in Europe, and is responsible for losses up to 1.16€ per laying hen per flock (Emous et al., 2005). An infestation of these mites can reduce poultry welfare, increase mortality and cause allergic reactions in poultry facility workers (Van Emous et al., 2005). *D. gallinae* was first described by De Geer in 1778. It belongs to the sub-class Arachnida. The common name is poultry red mite or chicken mite. It feeds on blood of the host and, although it favors poultry and other birds, it will also feed on blood from other animals, including humans (Sikes and Chamberlain, 1954). PRM has three juvenile stages: larva, protonymph and deutonymph. Upon completion of the deutonymph stage, they start to feed, becoming adults capable of laying eggs and completing the life cycle. (Figure 1)
Elector for poultry red mite control.

1. RED MITE
2. POULTRY IMPACT
3. CONTROLLING RED MITES
4. ELECTOR
5. APPLICATION
6. ELECTOR STUDIES
7. RECOMMENDATIONS
8. REFERENCES

Egg of D.gallinae.

Hatching egg of D.gallinae.

Larvae stage of D.gallinae.

Engorged adult male of D.gallinae.

Adult female with egg inside.

Detail of the palps and chelicerae.
For the development from PRM larva to protonymph, no blood meal is required. PRM requires blood from a host for the development from protonymph to deutonymph to the adult (Axtell and Arends, 1990). PRM also requires blood for reproduction and to produce eggs.
Therefore, during the last three stages, PRM live as a parasite on poultry, wild birds and sometimes even on humans. An important characteristic of PRM is that it does not permanently reside on its host, but only feeds there. PRM spend 30-60 minutes on the hen, during an average visit (Maurer et al., 1988) while the rest of the time, it hides in cracks, crevices in the housing facilities of its host, seeking shelter where it can digest its blood meal, mate and lay eggs. PRM usually feed every 2-4 days, generally 5-11 hours after onset of the dark period of the day (at a 12/12hr. light/dark cycle) (Maurer et al., 1988). Very few mites feed during daylight and not all mites crawl on the host in the morning. The seasonal activity of the mites is mainly driven by temperature (Kirkwood, 1968). The optimum temperature for PRM to produce eggs is 25-30°C and the most favorable temperatures for juvenile development are between 25 and 37°C, where developmental rates are highest and mortalities low (Maurer and Baumgärtner, 1992). Their best survival rate is observed at a relative humidity (RH) of 70-90% (Nordenfors et al., 1999). Temperatures below -20°C and above 45°C are considered lethal. Although sub-optimal conditions reduce the speed of reproduction, the mites are able to survive and reproduce within a wide temperature and relative humidity range. In Sweden between May and October, more mites are found in traps in poultry houses than from November to April (Nordenfors and Höglund, 2000). Under moderate climatic circumstances (5-25°C), PRM may survive up to 9 months without feeding (Nordenfors et al., 1999). Hungry mites have several resources that help them find food. A very sensitive response to changes in temperature and odors enables PRM to migrate and locate its host; starved PRM can detect a temperature gradient as low as 0.005°C/ sec (Kilpinen, 2001). Resting mites react to a heat stimulus with increasing activity, probably as part of this host location process. This effect is most pronounced after 8-10 days of starvation (Kilpinen and Mullens, 2004). PRM reacts to surface skin lipids of the host, which act as feeding stimulants (Zeman, 1988).

Furthermore, kairomones are thought to play a role in the host location behavior, but it is unknown what specific kairomones are involved. Finally, carbon dioxide, which is known for its role in the host location behavior of other hematophagous arthropods, is important for host detection by PRM (Kilpinen, 2005). Once fed, PRM congregate in cracks and crevices to mate, it seems to return to the places where mites have previously congregated, a behavior that is guided by pheromones (Entrekin and Oliver, 1982).

Picture 14

Red mites travelling up and down the bird to feed.
2. POULTRY IMPACT:

The impact of PRM involves stress to the birds, blood loss from feeding, and vectors of several disease organisms to the birds. Additionally, PRM can affect humans, especially workers.

Stress

Huge mite infestations can produce severe levels of stress on the affected birds, seriously impacting bird health and welfare. Hen welfare and behavior can also be negatively affected when PRM infestations proliferate, with increases in behaviors such as feather pecking and head scratching resulting from infestation (Kilpinen, 2005).

The itching effect of the mites moving over the animals, and the skin reaction after the mite's bite, causes pronounced restlessness, sleep disturbance and discomfort, leading the hens, when possible, to avoid sleeping or resting on infested nests or perches.

In poultry, responses to stress are elevated levels of corticosteroids (Freeman, 1976). Some of the consequences of increased levels of corticosteroids are:

1. Reduction in food consumption: this leads to weight loss in the birds.
2. Decreased gonadal activity: egg production drop (Chauve, 1998) and loss of egg shell quality and egg size, as well as reduced fertility and hatchability in breeders.
3. Cardiovascular changes.
4. Lower immunological reactions.
5. Increased susceptibility to disease.

Blood feeding

PRM feed exclusively on blood; it ingests relatively large blood meals mainly during dark periods and once every few days. This can lead to a reduction in the number of erythrocytes and the packed cell volume (Kirkwood, 1968).

An adult mite ingests approximately 0.2 μl of blood (Sikes and Chamberlain, 1954) and high infestation rates of mites may cause severe regenerative anemia. Infested hens increase their production of new blood cells, but during periods of rapid mite population growth, blood loss exceeds blood production capacity, resulting in severe anemia (Kilpinen, 2005) and mortality.

In addition, this blood-feeding parasite increases the downgrading of the egg's commercial value, as a result of superficial blood and excrement staining (spotting) from engorged mites that are crushed on egg belts when they are returning to their hiding places (Chauve, 1998).
Elector for poultry red mite control.

Vectors of disease
PRM can be intermediate hosts or vectors of numerous poultry and medical diseases. *D. gallinae* certainly plays an important role in the transmission of Salmonellosis and other diseases found in poultry farms, particularly between successive flocks.

There are several bacterial and viral organisms that have been isolated from poultry red mites and support the red mite as a potential vector:

- *Salmonella gallinarum*
- *Pasteurella multocida*
- *Erysipelothrix rhusiopathiae*
- *Listeria monocytogenes*
- *Borrelia anserina*
- *Coxiella burnetii*
- *Spirochaeta gallinarum*
- Eastern Equine Encephalitis (EEE)
- Western Equine Encephalitis (WEE)
- St. Louis Encephalitis virus
- Venezuelan Equine Encephalitis (VEE)
- Newcastle disease virus
- Fowl Poxvirus
- Coronavirus
- Reovirus

Human reactions
With high red mite infestations or during the absence of birds in poultry farms, PRM can attack farm workers, causing several levels of skin reactions, dermatitis and urticaria.

Keeping in mind the potential role as disease vectors, red mite infestations are also a public health issue.

*Picture 18*

Red mites can attack humans.
In order to fight against PRM, it is necessary to focus on three points:
1. Prevent mites from getting into the poultry facilities
2. Thorough farm service period measures
3. In-flock control measures and farm management

1. Measures to prevent introduction of new mites into the farm:
Utilize strict biosecurity measures when entering the house:
• Clean, “one-use” protective clothing should be worn by visitors (handling workers, vets or vaccination teams) when entering the farm.
• Keep the surroundings and common areas of the poultry farms tidy and clean, and avoid wild fowl and rodents entering the house by using control measures.
• Avoid objects like egg trays, containers, transport or cleaning equipment that can introduce new mites on the farm.
• Whole house replacement with new birds, and confirm that they come from a red mite-free origin.

A deep cleaning during the service period is crucial to reduce poultry red mite population.

2. Farm service period measures
The service period is the most important period when controlling red mites. The objective at this stage is to provide the new poultry flock with the minimum carryover of red mites possible between flocks.
• Prolong this down interval as long as possible, so that remaining mite population can decline as much as possible.
• As soon as the house is depopulated, start cleaning the house with vacuum cleaning or high-pressure steam cleaning if possible, to remove dust and dirt harboring mite eggs and early red mite stages.
• High-pressure washing (Chauve, 1998) of the equipment is mandatory, and preferably using hot water with the intention of making remaining eggs hatch.
• One or two serial insecticide applications are recommended during this period, using different molecule classes than those used when birds are present (managing resistances program).
• Crucial during this period is disinfection. At least two serial deep disinfections must be done during this service period.
• Other environmental measures, like heating the house up to 45°C for several days, are very effective but economically prohibitive and not practical in most cases (Nordenfors et al., 1999).
• When choosing new equipment for the house, special attention must be paid to avoiding those which provide extra cracks and crevices that can shelter mites.
3. In-flock control measures and farm management

- With birds present, special attention must be paid to vacuuming or blowing all dust and dirt deposits that can contribute to hiding red mites.
- Lighting measures could decrease mite population, but it would interact with animal resting periods and is banned by the EU welfare regulation (EU-Directive 1999/74).
- When possible, try to maintain house temperature below 20°C. It would help keep the mite population from growing.
- Monitoring mite population provides insight into when treatments may be required and the effectiveness of treatments.
- A standard monitoring system, like the Elanco red mite traps, needs to be implemented in every poultry house, at least every 15 days, to monitor and anticipate a mite population outbreak.

CONVENTIONAL METHODS

Regular cleaning
Regular cleaning of poultry facilities and maintaining good hygiene practices are still considered laborious and their benefits are grossly underestimated. These approaches can aid in the removal of large proportions of the mite populations. Simple cleaning with water can remove a large number of mites and eggs (Nordenfors and Höglund, 2000).

Conventional acaricides
Another conventional method is the use of acaricides, although this may carry the risk of exposing eggs, poultry and humans to their residues. Furthermore, experts indicate that it is only a matter of time before PRM develops resistance to acaricides such as pyrethroids, making them ineffective, as already shown in Italy (Marangi et al., 2009), the UK (Thind and Ford, 2007), Sweden (Nordenfors et al., 2001) and France (Beugnet et al., 1997). With diminishing numbers of approved chemicals available, chemical treatments are not considered a sustainable solution. However, one compound (spinosad), which may show a) a rapid response, b) no indication of cross resistance and c) an extremely low mammalian toxicity, may offer a short-term solution or be used as part of an integrated approach in parallel with other control methods.

Silica
Silica dusts demonstrate no known poisoning effect to hens and humans and resistance is unlikely. The main benefit of silica is through its ability to immobilize a mite by adhering to its body, especially to the tarsal part of legs, and preventing locomotion. Silica products are also thought to cause damage to the protective cuticle of PRM, impairing its water balance so that it rapidly dehydrates and dies. In humans there is a small risk of silicosis, especially during application. Consequently, appropriate precautions must be taken. Silica products, especially powdered forms, can cause skin irritations, but other formulations are available (e.g., gel, fluid). The efficacy depends on the quality of the silica, environmental factors and the extent to which the silica attaches to the treated surfaces.

Elanco red mite trap.
Heating
Controlling PRM by heating hen houses to temperatures above 45°C is a well known and commonly applied method in the Netherlands and Norway. Heat treatment is usually carried out between the production cycles. In Norway, this method can be combined with a chemical treatment called phoxime prior to introducing the new flock. In the Netherlands, heat treatment without chemical treatment failed to provide a long-term control and the houses were re-infested within six months. This may be due to a number of factors, including being unable to achieve the required temperature throughout the building, given the larger and more complex hen houses and the high farm density in the Netherlands, or the absence of the use of chemicals. The main disadvantage of heat treatment is cost; another disadvantage of heat treatment is the risk of heat-related damage to the hen house equipment. To avoid damage, it is of great importance to continuously measure the temperature and to circulate the hot air with fans to minimize areas with sublethal temperatures where mites could survive. Because it may be possible for some mites to survive by escaping into areas with sublethal temperature, chemical treatment should always follow the heat treatment.

Housing systems
In the Netherlands, several designs of housing systems have been tested to prevent PRM from reaching the hens. In these systems there are very few contact points between the perches and the floor. To minimize migration of PRM to the perches, barriers containing oil or silicas are installed to prevent mites from reaching the hens during the night. Another design-related method for lowering the mite burden in the hen houses is to minimize the hiding places by using slatted floors and laying nest floors with more open structures and fewer hiding places for the mites. Although these adaptations do not solve the problem, they can provide good results when integrated with other measures.

Production chain
Finally, another conventional approach to controlling PRM is to consider the production chain. It is generally known that PRM is not only present in layer farms, but also in rearing farms. Transport of eggs, birds and manure are known risk factors for introducing PRM. Visitors, including workers, are a risk factor. Good hygiene processes and openness in relation to PRM problems is important in reducing the spread of PRM along the production chain.

ALTERNATIVE METHODS
Lighting program
One alternative method to control PRM infestation is to use a specific lighting program. Research in Belgium indicated that a light schedule of 15 minutes light and 45 minutes dark could reduce PRM infestations (Zoons, 2004). This effect has been verified by research from other countries, although some farms reported that the effect disappeared after a time. It is unclear why this lighting program affects PRM. Possible explanations are that PRM activity is inhibited by light and thus, with short periods of darkness, the mites cannot reach the hens and/or PRM are unable to reach their hiding places in time, so the hens are able to eat them. As EU-Directive 1999/74 for the protection of laying hens dictates a continuous dark period of at least 8 hours, this light schedule is not allowed in Europe and thus no light pattern option is available. Whether there are other possibilities within the regulations to control PRM with light has not been discussed.

Picture 22
Congregated Dermanyssus gallinae.
Another alternative method is the use of attractant or repellent odors. French research indicates that PRM responds to these odors, but the reactions are not always predictable and the strength of the odors can confound responses. Furthermore, PRM produce odors themselves to attract other PRM, and, in the case of high infestations, it is not clear which will be more attractive: the appealing natural odors of clusters of PRM or artificially applied odors. Researchers agreed that odors could be manipulated to give some control, but more research is needed to find a workable concept.

Natural acaricides include essential oils, herbs or plant extracts which contain a chemical component that kills PRM (George et al., 2008a, b; Maurer et al., 2009). Despite their natural origin, these acaricides may be harmful to humans and animals and may result in residues. The existing commercial products also lack consistency in the concentration of the actual components due to influences of weather, sun, soil, etc. on the growing plants, and due to the variability in concentration of active ingredients in existing commercial products. Furthermore, resistance can build up just as it does with chemical acaricides. Success therefore will depend greatly on the method of application.

Predatory mites are another alternative option. Mites are already widely used in the control of pests in greenhouses. The use of these predators to control PRM appears promising, especially if the predators will attack all stages of PRM. If these predatory mites hide in the daytime in the same cracks and crevices as PRM, they may disrupt the natural aggregation of PRM and also would not be easily pecked by the hens. The speed of reproduction of the predator mites would need to reflect the population dynamics of PRM and they would have to be capable of keeping the number of PRM at an acceptably low level. Additionally, they should be able to withstand and survive the conditions found in the poultry houses. The selection of suitable candidate predatory mites should also take into account any impact on human and poultry health. There are many species of predatory mites, and research will focus on those species that fit the basic profile. To select these, mites and insects will be collected from the nests of birds that reuse nesting sites (Lesna et al., 2009). The predators found will be assessed on their ability to feed on PRM and its different stages, and the candidate predators will be reared and assessed under conditions similar to those in poultry houses. The best candidate will then be tested on a small scale.

Entomopathogenic fungi

These fungi are capable of infecting and killing insect and mite species. The spores of the fungi germinate on the host cuticle, penetrate it and spread through the body. After the fungus has killed the mite, it can grow out of the mite cadaver and produce more spores, increasing the chance for other PRM to be infested, potentially increasing persistence of control (Steenberg et al., 2005). There is a wide variety of fungi, many of which are well documented in terms of specific characteristics and their area of application. To control PRM, a fungus is needed that affects PRM and/or its eggs and thus prevents its multiplication. A very important aspect is safety to non-targets, such as humans, poultry and eggs. The fungi have excellent safety characteristics and isolates are being investigated. The selected fungi should be able to survive in PRM and the ecosystem of PRM (e.g., the high ammonia levels, 25°C and 75% RH in poultry houses). In some preliminary studies, fungi were able to affect PRM, but the multiplication rate of the fungi was too low to reduce the PRM population effectively. These first results indicate that it is possible to use fungi as a control method for PRM. The persistence of fungal isolates on materials such as metals (Hong et al., 2005) that may be found in poultry units suggests that long-term protection is feasible. With selection of a suitable isolate, fungi appear to have the potential to provide a successful eradication strategy for the future.
Vaccination
In the UK, research is being conducted to develop a vaccine against PRM (Arkle et al., 2008). The idea is that hens develop a natural defensive reaction if they are bitten by PRM. This reaction can have many different expressions. For example, the hen can react by making its skin thicker and thus more difficult to penetrate. Another proposal is the introduction of an antibody in the blood that makes the blood coagulate the moment it enters the mite. Natural resistance like this usually starts slowly, but can be accelerated by vaccinating animals with mite components. Researchers in the UK already have obtained some positive results in their preliminary studies. However, it takes time to develop an effective vaccine, and it is likely that it will be several years before the first vaccine is available.
The spinosad story
The discovery of the insecticidal properties of the natural fermentation product spinosad began in 1982, with a Lilly scientist’s vacation in the Caribbean. At an abandoned rum still, he collected several soil samples. These samples were returned to the laboratory to determine the presence of biological activity. Three years later the fermentation products from these samples were shown to have insecticidal activity. By 1986 Eli Lilly’s scientists identified the organism producing the biologically active substances. They determined that this was a new species of actinomycete bacteria and named it *Saccharopolyspora spinosa*. Within one year, scientists had identified the most highly active metabolites of *S. spinosa*. A highly effective formulation was identified and developed through five years of extensive testing around the world. This formulation contained a mixture of two of the most active metabolites, spinosyn A and spinosyn D. The name spinosad is derived by combining the species name, spinosa, with the two metabolites, A and D.

Chemical structure of Spinosad

Spinosyn A

Spinosyn D

Latest class of active ingredients
Spinosad belongs to the latest class of active ingredients (*spinosyns*) for the control of red mites (*Dermanyssus gallinae*). Spinosyns are more potent and specific in their activity and consequently have a reduced toxicity for non-target species, as well as the environment (Dow AgroSciences, 2001).

Elector’s active ingredient spinosad
Spinosad, a natural product derived from fermentation of the microorganism *Saccharopolyspora spinosa*, is the active ingredient in Elector.

Elector is a suspension concentrate formulation that contains 480 g spinosad/L.

The Elector label claims include: control of red mites, darkling beetles/mealworms, house flies, and stable flies infesting animal facilities. Applications and precautions differ by country. Read labels and follow label directions for each country.
**Excellent efficacy through novel mode of action**

Elector has a very high efficacy. It only needs to be applied once per treatment, so a single spray is sufficient to control red mite. Elector is effective against all mobile stages (adult, nymph, larvae) of the red mite (T9CDE090010, 2010).

In insects and mites, the mode of action of spinosad is associated with excitation of the insect nervous system (Salgado, 1998). Spinosad uniquely alters the function of nicotinic and GABA-gated ion channels (Salgado, 1998; Watson, unpublished data), in a manner consistent with the observed neuronal excitation. However, spinosad does not interact with known binding sites for other nicotinic or GABAergic insecticides such as neonicotinoids, fiproles, avermectins and cyclodienes (Dow AgroSciences, 2001).

Elector works on a unique and different part of the nerve system. This different mode of action requires the pest to adapt to two receptors instead of one, making it hard for the red mite to survive (Dow AgroSciences, 2001).

Elector acts on a specific nicotinic acetylcholine receptor (AChE) and, in addition, blocks the chloride channel of the GABA receptor. This effect results in progressive paralysis due to loss of body fluid and eventually kills the red mite. So while the onset of the paralysis is rapid, the death of the mites is delayed. Therefore Elector also has a delayed mode of action. The full effect on the poultry red mite is apparent after 3–5 days.

**Dual exposure**

The red mites are exposed twice by direct and indirect uptake (T9CGB09001, 2009). As a result of the spraying, the red mite comes into contact with the active ingredient directly, but at the same time it is exposed to Elector during its migration across the surfaces that have already been treated. This dual exposure gives Elector a very high efficacy.

**Residual effect**

After the building has been treated, the mite population gradually decreases for a minimum period of up to 14 days. Red mites have a cycle of approximately 7 days, running from the egg stage to the adult mite. Thanks to the duration of the residual effect, mites newly hatched from the eggs are very likely to encounter the active ingredient. One application of Elector can control poultry red mites for up to 12 weeks (T9CDE090011, 2010). Duration depends on concentration, accuracy of application and red mite challenge.

**Elector has shown no cross resistance**

Spinosad has a novel mode of action that makes it ideal for resistance management programs. It has shown no cross resistance with existing chemistries and can be rotated with all other classes of existing and experimental products. Spinosad has excellent activity on many insects with historic resistance problems.

Insecticide class rotation is recommended to delay the potential of insecticide resistance to any class of insecticide. Spinosad is the ideal rotation class of insecticide because there is no cross resistance to other classes.

It is believed that no quick loss of sensitivity of red mites will occur, because spinosad targets two receptors as opposed to only one (Dow AgroSciences, 2001; Hanley, 2002; Salgado, 1998).

**Longer lasting, fewer treatments**

Elector has a continued effect and can control red mite for up to 12 weeks (T9CDE090011, 2010). So fewer applications are needed, and that reduces labor costs and stress for the birds.
Safety characteristics

Presence of layers
Because Elector has excellent safety characteristics, it can be used during production. Spraying Elector in the presence of layers has no impact on animal behavior or egg production (T9CGB09002, 2009).

No need to discard eggs
The eggs produced while spraying can be marketed, because applying Elector does not result in any harmful residues (T9C180534, 2008). However, according to good agricultural practice, it is recommended to remove the eggs before spraying with Elector and thus avoid any unnecessary exposure.

No extra protection required
Due to Elector’s excellent safety characteristics, there is no requirement for extra safety precautions. As well as being user friendly, Elector is environmentally friendly and does not disperse an unpleasant chemical smell during spraying (Dow AgroSciences, 2001). Always read, understand and follow the label and use directions. Product labels may vary by country.

Reduced risk classification - United States
Spinosad has been classified by the U.S. Environmental Protection Agency (EPA) as a reduced risk pesticide product. This classification affords preferential registration and expedited label expansions to select products that meet the agency’s stringent criteria and pose less risk to public health and the environment than available alternatives. Spinosad has been classified by the EPA as a reduced risk insecticide product because of its low acute mammalian toxicity, low toxicity to fish and wildlife, safety to beneficial insects and compatibility with integrated pest management programs. The reduced risk registration program was established by the EPA in 1994 to expedite favorable human safety and environmental impact profiles than currently available alternatives. Since the inception of this program, a total of only 18 new pesticides have met the stringent criteria established by the EPA and have been classified as reduced risk products:
• Reduced risks to human health
• Reduced risks to non-target organisms
• Reduced potential for contamination of valued environmental resources (water, air, soil)
• Broadened adoption of integrated pest management programs

Green Chemistry Award – United States
In 1999, spinosad was awarded one of the U.S. government’s top environmental honors, the Presidential Green Chemistry Challenge Award. The award recognizes technologies and products that incorporate the principles of green or sustainable chemistry into chemical design, manufacture and use. The recognition of “Spinosad - A New Natural Product for Insect Control” with this prestigious honor was based on its highly selective insecticidal activity and environmentally compatible characteristics. The category for which spinosad was chosen to receive the award was “designing safer chemicals.” The Presidential Green Chemistry Challenge Award was established by the White House in 1995 to recognize outstanding contributions of chemical processes and products that reduce negative impacts on human health and the environment relative to the currently available technology. The award is highly competitive in nature and categories include designing safer chemicals, alternate synthetic pathways, and alternate solvents and reaction conditions. Spinosad is one of only 4 pesticide products to be honored with this award.

Organic classification - EU
Organic certification has been established for spinosad in the EU. There are established MRLs for spinosad within the EU (EU Pesticides Database. http://ec.europa.eu/sanco_pesticides/public/index.cfm) EU applicable MRL for Spinosad Reg. (EC) N° 839/2008 – Reg. (EC) N°149/2008:
• Spinosad MRL eggs: 0.2 ppm
• Spinosad MRL poultry meat: 0.2 ppm

Elector for poultry red mite control.
5. APPLICATION

Application is a key component to control red mites in poultry houses. Red mites live in areas that are difficult to treat. These areas include: areas between joints, cracks and crevices, under bent surfaces, the ends of metal bars, anyplace where two surfaces connect and anyplace where dust can accumulate. Poultry houses can contain millions of areas capable of harboring mites. Application to the exposed and unexposed areas is required to obtain a complete and thorough treatment.

Application equipment

Each farm has its own application equipment, which varies from farm to farm. Application equipment ranges from a backpack pump-up sprayer holding 5 liters of liquid, to a trailer-mounted sprayer holding 500 liters of liquid in a reservoir. The selected application equipment will depend on the characteristics and dimensions of the poultry house facilities.

Spray equipment can be a single spray nozzle, or multiple nozzles as shown below.

Uniform coverage of the spray wash with enough pressure to penetrate cracks and crevices where the red mites are located during the day is required to achieve all the potential efficacy of the Elector treatment.

Apply Elector with low-pressure spray equipment in order to ensure that spray drops remain on the surfaces to be sprayed. Do not apply Elector with high-pressure cleaning equipment.

Dosage

Elector is a water-based suspension formulation. It is designed to be mixed with water and applied as a finished spray. Steps to follow include:

- Follow label directions for the correct dilution.
- Shake container prior to opening.
- Always use the label dose of 60 ml/7 liters of water the first time you apply Elector.
- Use only label dose of 30 ml/7 liters of water after a 60 ml/7 liters dose or when the infestation level is very low.
- Make sure the tank and sprayer have been cleaned properly.
- Fill water reservoir with half the water required to treat the area.
- Test spraying nozzles with water to ensure they are not clogged.
- Add half of the Elector dose into the water reservoir.
- Complete filling the spray reservoir with water to the correct level.
- Shake backpack sprayer while walking and use reservoir agitations if available.
- Use all material the same day and do not carry over material to the next day.
- Ensure a coarse spray with enough pressure to penetrate cracks and crevices.

Elector for poultry red mite control.
Application tips
• Application is key to a successful treatment for controlling red mites.
• Take time to do a complete treatment.
• Clean the entire house before treatment in order to minimize the amount of dust over the poultry facilities.
• Treat the entire house, and apply until the runoff point.
• Make sure all the targeted surfaces have been reached, and re-apply to these areas if necessary.
• Try to minimize the effect of ventilation by switching off part of the ventilation systems. In houses with high ventilation needs, the air speed inside the house can contribute to uneven spray distribution.
• Isolate and treat any new birds introduced to the flock.
• Try not to modify the Elector-treated surfaces at least for a 10-day period (disconnect blowers and brushes; do not apply any other product).
• Monitor and record mite populations at least every 15 days.
• Rotate classes of insecticides between flocks or during the flock.

Do’s
• Do treat birds for mites before introducing them to the flock.
• Do use working equipment exclusively for each house in order to minimize entry of new red mites.
• Do treat the entire house at once.
• Do thoroughly clean the application tank to avoid contact between Elector and other products.
• Do control biosecurity and visitors to minimize entry of new red mites.

Don’ts
• Don’t rush a spray job.
• Don’t mix Elector with other insecticides or disinfectants.
• Don’t use pre-treated water when preparing Elector.
• Don’t overuse one insecticide (which could lead to resistance).

Picture 27
Ensure the full coverage of all the structures by spraying until runoff.

Elector for poultry red mite control.
Several studies confirm Elector’s efficacy:

**Controlled studies**

2. “Spinosad as Measured by in vitro Efficacy Against Poultry Red Mites (*Dermanyssus gallinae*).” ZeckLab, Germany. Trial T9CDE090010.
3. “A Dose Determination Study Examining Two Doses of Spinosad (Elector) for the Treatment of Poultry Red Mite (*Dermanyssus gallinae*) in Conventional Cages Stocked with Laying Hens.” New Castle University. Trial T9CGB90002.

**Field Studies**

4. “Post-Approval Study: Field Study to Evaluate Elector Against Poultry Red Mites (*Dermanyssus gallinae*).” ZeckLab, Germany. Trial T9CDE090011.
Study 1

The Residual Toxicity of Spinosad as Measured by in vitro Efficacy Against Poultry Red Mites (Dermanyssus gallinae), New Castle University. T9CGB090001.

The objective of this study was to determine the residual efficacy of four concentrations of spinosad against the poultry red mite (Dermanyssus gallinae) in vitro on a galvanized surface over a 28-day period.

Overall study design
Poultry red mites collected from a commercial layer farm were placed on a galvanized metal sheet previously coated with Elector (spinosad) solutions of four differing concentrations (i.e., 0.00 g/L, 0.97 g/L, 1.94 g/L and 3.88 g/L.) Elector was applied to the surfaces as a coarse spray to the point of runoff, and allowed to dry. Each dose level consisted of four replicates with approximately 25 red mites per replicate. Mites were exposed to the treated surfaces at eight time points (2.5 hours, 1, 3, 7, 10, 14, 21 and 28 days) post-spraying. Efficacy was determined by counting and recording the number of live (active, clear locomotion), moribund (passive, hardly any locomotion, but showing some movement, e.g., of legs) and dead mites (no movement) after 48 hours (+/- 45 minutes).

Results
A dose response was observed with a decrease in activity over time. The high dose was more effective than the medium and low doses. The high dose provided more duration than the medium and low doses. The untreated group maintained low mortality levels throughout the study. Statistical analysis of the data using Turkey’s test (P< 0.001) confirmed the results. Efficacy results are demonstrated in Figure 1.

Figure 1

Mean percentage mortality (where both dead and moribund mites were considered together) of adult female Dermanyssus gallinae exposed to different doses of Elector at set times after product application. Error bars show ± SEM, n = 4 for all means.
Study 2

Spinosad as Measured by in vitro Efficacy Against Poultry Red Mites (Dermanyssus gallinae), ZeckLab, Germany. T9CDE090010.

The objective of this study was to determine the efficacy of two concentrations of spinosad against all stages (egg, larvae, nymph and adult) of the poultry red mite (Dermanyssus gallinae) in vitro.

Overall study design
The study consisted of laboratory experiments in which poultry red mite eggs were placed onto treated and untreated filter paper (eggs, larvae) or red mites were placed into treated and untreated packets (engorged nymphs, engorged adults). Two different spinosad concentrations and a placebo (water only) treatment were evaluated. The two dosage levels of spinosad evaluated were 2 mg and 4 mg.

Four replicates with approximately 25 red mites in each replicate were exposed to each treatment level. Red mites were exposed one time. Live, moribund and dead red mites were counted on 3 or 5 days post exposure for the engorged adults and 5 or 6 days for the engorged nymphs.

The experimental unit for engorged nymphs and engorged adults was the Mite Package Test. Filter papers 10 cm x 7.5 cm were used. The papers were folded and the sides closed by clips. The red mites (nymphs and adults) were placed in the open side. The test substance was sprayed into the opening of the filter paper bag directly above the red mites. The filter paper bag was closed by another clip and placed in a bowl with a little water plus detergents to avoid migrating of red mites. At the end of the exposure period, the red mites were counted using a stereo microscope and the number of living red mites, dead red mites or affected (moribund) red mites was recorded. The experimental unit for eggs and larvae was the Filter Paper Test. Round-shaped filter papers (diameter 8.4 cm) were prepared with equal 1 x 1 cm fields and preserved in a plastic petri dish until beginning of trial. Approximately 100 mite eggs were placed on the surface of the test paper using a small brush. The eggs and filter paper were sprayed and then allowed to dry for approximately 1 hour. The inner surface of petri dishes were also treated and dried. The treated papers were placed in the treated petri dishes and closed with parafilm. The eggs on the surface of the treated paper were checked daily for 5-6 days until all larvae of the untreated control hatched and the number hatched had been recorded. All hatched larvae were counted on day 5 or 6 by using a stereo microscope and differentiated into dead or living.

Results - engorged adults
Four trials were conducted to determine the efficacy of spinosad against engorged adult red mites. One trial had a 3-day observation period, three trials had a 5-day observation period. Percent dead + moribund for the 3-day observation was 43.2% with 2 mg and 89.3% with 4 mg. Percent dead + moribund for the 5-day observation trials ranged from 53.0% to 73.8% with the 2 mg dose and from 81.4% to 98.3% with the 4 mg dose. The percent dead + moribund for the untreated group was 2.4%.
Mortality (dead + moribund) rates when engorged adult red mites are exposed to 2 mg of Elector (spinosad) and observed for 3 and 5 days post-exposure.

Mortality (dead + moribund) rates when engorged nymph red mites are exposed to 2 mg of Elector (spinosad) and observed for 5 and 6 days post-exposure.
**Results - engorged nymphs**

Three trials were conducted to determine the efficacy of spinosad against engorged nymph red mites. They show that spinosad is effective in controlling nymph red mites. One trial had a 5-day observation period; two trials had a 6-day observation period. Percent dead + moribund ranged from 94.9% with the 2 mg dose to 98% with the 4 mg dose for the 5-day observation time. Percent dead + moribund for the 6-day observation time ranged from 90% with the 2 mg dose to 98% for the 4 mg dose. The percent dead + moribund for the untreated group was 4.1%. (Figure 5)
Study 3

A Dose Determination Study Examining Two Doses of Spinosad (Elector) for the Treatment of Poultry Red Mites (Dermanyssus gallinae) in Conventional Cages Stocked with Laying Hens, New Castle University. T9CGB90002.

Overall study design

A small commercial layer house was used for the trial that contained two rows of Big Dutchman layer cages. Red mites were collected in ADAS mite monitor traps for 4 weeks pre-spraying to monitor the mite infestation. Each cage contained four laying hens at the start of the study. The study was a four-replicate, blinded, randomized block design comparing two levels of spinosad with a negative control. To reduce the risk of red mite migrating from one treatment group to another, a three-cage wide, three-tier high buffer zone was used, with the center cages of each buffer zone being treated with Insect Barrier Glue to prevent mite migration between treatments. Three dosage levels (i.e., 0.00 g/L, 1.94 g/L (low) and 3.88 g/L (high)) of Elector were applied to the surfaces as a coarse spray to the point of runoff. Mite traps collected mites for 24 hours and the mites collected (at three different mite stages) were identified, and the number of eggs, larvae, adults and nymphs (fed and unfed) recorded. Post-spraying mite collections were made on days 3, 7, 14, 21, and 28.

Results

Overall, the results showed that poultry red mite populations were reduced in cage groups following treatment with Elector. There was no significant difference in mite mortality between the two different dose rates of spinosad, although at all times post-spraying, fewer mites were collected from cage groups treated with the higher dose. The percentage reductions seen relative to the control peaked for both spinosad dose levels at 14 days post spraying (87% and 97% reductions at the lower and higher dose, respectively). Population structure was influenced by treatment in an interesting and inconsistent way. Initial reductions in the proportion of adult females were observed 7 and 14 days post-spraying in spinosad-treated cage groups, but with increases in adult female proportions at later dates. As would be expected, the number of nymphs and adult males per adult females generally followed the opposite trend. Oviposition rate also varied with treatment inconsistently, being generally reduced by treatment with spinosad, but with an (albeit inconsistent and non-significant) increase in oviposition rate seen in response to spinosad treatment 7 and 14 days post-spraying. Spinosad appeared to have an effect on mite feeding status. Although this was only significant 14 days post-spraying, in general, there was a trend for increased levels of engorgement in spinosad-treated cage groups. Finally, it was interesting to note that mite populations appeared to experience a natural decline according to numbers in traps 21 days post-spraying. No adverse reactions were observed.
Mean total number of poultry red mites retrieved from cage groups under different spinosad treatments at different days post-spraying (PS).

Within a column, means followed by a different letter are significantly different at $P < 0.05$.

*Mean total number of poultry red mites retrieved from cage groups under different spinosad treatments at different days post-spraying (PS).*
Study 4

Post-Approval Study: Field Study to Evaluate Elector Against Poultry Red Mites (Dermanyssus gallinae)
ZeckLab, Germany. T9CDE090011.

The objective of this study was to evaluate the efficacy of Elector against the poultry red mite (Dermanyssus gallinae) in a commercial poultry layer facility.

Overall study design
The study consisted of one commercial facility with two poultry layer houses. A different facility served as an untreated control. The houses were of the aviary style for cage-free birds. Two houses were treated with Elector one time and one house was not treated. Efficacy evaluations will be made over a 93-day period post-treatment. The diluted solution was applied using commercial application equipment (ELECTRA GmbH, Wittenberg) with a 250 ml storage tank and permanent stirring unit while working, 50 m flexible tube and two 0.08 mm cones. Two doses (30 ml, 60 ml) were applied. The control house remained untreated throughout the study. The poultry house (stable) was sampled for red mites from 10 locations throughout each house (treated and untreated). The 10 locations were sampled from the caged area of the house (connecting links).

A layout of the house was made and the positions of collecting sites were identified and marked. The collecting sites were sampled prior to treatment (Day 0) and in alternating weeks for 13 weeks post-treatment. The first week collections were made from sites 1, 3, 5, 7, 9, 11 and 13 (odd numbers), and the second week 2, 4, 6, 8, 10, and 12 (even numbers).

A paint brush (2 cm width) was used to remove red mites and debris from the locations (sample size for each area was approximately 10 x 10 cm). Each collected sample was transferred into a urine sample container. The container was sealed.

The urine containers with the red mites were taken to ZeckLab where the red mites were counted.

In each poultry house a notebook was maintained throughout the study to record all the events that took place during the 13-week trial.

The collected samples were inspected at the laboratory. Live red mites from each sample were collected and fixed on slides with polyvinylractophenol. The red mites were identified by life stage and the number recorded for: not engorged larvae, not engorged nymphs, engorged/partially engorged nymphs, not engorged adults, and engorged/partially engorged adults. If more than 500 red mites were obviously seen in one sample, 10% of the material was counted and extrapolated.

An observation of "when a re-treatment is required" was added to the study, suggesting poultry house managers use judgment and discretion for re-treatment. This observation was prompted by a 74% reduction in red mite counts observed on day 49. In this observation, red mite populations were difficult to find and the investigator and study monitor realized there was no correlation between % control and a re-treatment would be required. An additional observation was added to the study to provide data when the producer would treat due to the increase in red mite population.

Results
The results of the field study are presented in Table 1 and Figure 5. The field study showed that Elector provided effective control of red mites infesting poultry houses for up to 42 days (80% reduction) for the 30 ml dose and up to 77 days (94% reduction) at the 60 ml dose. Red mite populations in the untreated control group remained constant throughout the study.

Visual observations by the producer and investigator showed re-treatment was required on Day 56 (10.310 red mites sampled) for the 30 ml dose and Day 93 (11.510 red mites sampled) in the 60 ml dose. There were no adverse events reported.
Table 1

<table>
<thead>
<tr>
<th>Sampling Day</th>
<th>Total number of red mites</th>
<th>Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>House 1 4 mg/ml</td>
<td>House 2 2 mg/ml</td>
</tr>
<tr>
<td>0</td>
<td>10260</td>
<td>12010</td>
</tr>
<tr>
<td>7</td>
<td>71</td>
<td>241</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>38</td>
</tr>
<tr>
<td>21</td>
<td>1</td>
<td>263</td>
</tr>
<tr>
<td>28</td>
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<td>35</td>
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<td>42</td>
<td>7</td>
<td>2248</td>
</tr>
<tr>
<td>49</td>
<td>1</td>
<td>3110</td>
</tr>
<tr>
<td>56</td>
<td>196</td>
<td>10310</td>
</tr>
<tr>
<td>63</td>
<td>280</td>
<td>n.c.</td>
</tr>
<tr>
<td>70</td>
<td>444</td>
<td>n.c.</td>
</tr>
<tr>
<td>77</td>
<td>565</td>
<td>n.c.</td>
</tr>
<tr>
<td>84</td>
<td>3066</td>
<td>n.c.</td>
</tr>
<tr>
<td>93</td>
<td>11510</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

n.c.: Not collected

Reduction of red mites in field trials after treatment with Elector 4 mg/ml and 2 mg/ml in laying hen houses.

Figure 7

% reduction of red mites

<table>
<thead>
<tr>
<th>Day</th>
<th>7</th>
<th>14</th>
<th>21</th>
<th>28</th>
<th>35</th>
<th>42</th>
<th>49</th>
<th>56</th>
<th>63</th>
<th>70</th>
<th>77</th>
<th>84</th>
<th>93</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 mg/ml</td>
<td>99.5</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>99.9</td>
<td>99.7</td>
<td>99.9</td>
<td>98.6</td>
<td>97.9</td>
<td>93.1</td>
<td>94</td>
<td>56.8</td>
</tr>
<tr>
<td></td>
<td>2 mg/ml</td>
<td>98.5</td>
<td>99.7</td>
<td>97</td>
<td>99.5</td>
<td>93.4</td>
<td>79.2</td>
<td>74.3</td>
<td>26.8</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
<td>n.c.</td>
</tr>
</tbody>
</table>

n.c.: Not collected

Reduction of red mite (Dermanyssus gallinae) after treatment with Elector (spinosad).

Elector for poultry red mite control.
Study 5

Elector efficacy evaluation against Poultry Red Mite (Dermanyssus gallinae) in commercial laying hens.

The objective of the study was to monitor the efficacy and duration of Elector in controlling red mite infestations (Dermanyssus gallinae) in commercial layer farms. The study scope was limited to monitoring the evolution of red mite infestations in layer houses through ADAS® red mite traps at 0, 11, 22, 45 and 64 ± 2 days after spraying Elector.

Overall study design:
This multi-site study involved 20 commercial caged layer flocks in Spain. Each flock was individualized in a single poultry house. The poultry houses were moderately to highly infested with poultry red mites.

Poultry houses were of different sizes and conditioning. Both conventional and enriched caged premises were present in the study.

A pre-treatment assessment of red mite numbers was conducted at each house.

This study used the commercial Elector formulation containing spinosad (480 g/L suspension concentrate), which was diluted in water according to label dosage of 60 ml/7 L of water.

All the spraying systems used in the study were those already present at the farm sites and commonly used by producers to apply other products like insecticides or disinfectants. The two application systems used in this study were the low-pressure hand-held sprayer and the push sprayer in caged housing, both equipped with storage tank and permanent stirring system while working, to ensure a homogeneous mixture. These spraying systems and the application process itself were reviewed and supervised by the investigator in order to verify the correct, uniform and precise application of the mixture and guide the farm operators on the correct spraying process.

No additional treatments or alterations to the cages were made after a single Elector application for a 64-day period.

On behalf of the good practice procedures, the eggs were removed from the belts before the spraying in order to avoid unnecessary exposure.

Treatment efficacy and duration on the red mite infestation control was assessed by comparing post-treatment red mite numbers in the ADAS red mite traps on days 11, 22, 45 and 64 ±2 days after the treatment with Elector, with the pre-treatment’s counts (day 0).
A huge reduction in red mite count was detected from day 0 to day 11, with a statistical difference (p<0.05) between both means. From day 11 to day 64 the mite counts remained low. Mite count means of days 11, 22, and 64 were statistically equal (p>0.05). Only a statistical difference (but not relevant) was found between mite counts of days 11 and 45.

The design of the multi-site study did not allow the comparison of means within the farms, so no statistical tests were performed. Nevertheless, the tendency observed in almost all the farms is quite similar to the overall efficacy results described above.

Conclusions:
• The present study showed that Elector provided effective control of red mites infesting poultry houses for at least 64 days (81.2% red mite reduction).
• One Elector treatment at label dose of 60 ml/7 L of water is enough to control severe red mite infestations in commercial layer hens.
• These trials showed that to reach a good efficacy and duration in controlling red mites with Elector, application is crucial. Spraying until the runoff point and using a sufficient amount of mixture was necessary to achieve the full potential of the product (approximately 20 ml of spray/layer was required when the hen stocking density is 550 cm²/layer).
• There were no adverse events reported.
Study 6

*Elector efficacy evaluation against Poultry Red Mite (Dermanyssus gallinae) in Portuguese commercial layer hens.*


The objective of the study was to monitor the efficacy and duration of Elector in controlling red mite (*Dermanyssus gallinae*) populations in Portuguese commercial layer farms, on caged layer hen premises. The study scope is limited to monitoring the evolution of red mite populations in the layer house, through ADAS red mite traps on day 0, 10, 30 and 60 ±1 day after spraying Elector.

**Overall study design**

The study involved two commercial caged layer hen farms belonging to two different producers (Trial 1: 19,500 hens; pen #7 and Trial 2: 21,840 hens; pen #8), business partners of the same company, located in Portugal, individualized in a single pen each. The poultry houses were all moderate to highly infested with poultry red mites.

The caged layer hens’ houses were approximately of the same size and management conditions. A pre-treatment assessment of red mite numbers was conducted at each house.

Elector was applied in each house following label guidelines and label dosed to 60 ml/7 L of water. The investigator was present during the whole application process in order to supervise and guide the farm operators on the correct spraying procedures.

No other treatment or further alteration to the cage’s surface was made after a single Elector application for a 60-day period.

Treatment efficacy and duration on the red mite infestation control was assessed by comparing post-treatment red mite numbers in the ADAS red mite traps on days 10, 30 and 60 ±1 day after the treatment with Elector, with the pre-treatment’s counts (day 0).

Each poultry house was sampled for red mites from three locations in both facilities: first row, middle row and last row, and the level of red mites in each row and the three corridors average level was calculated in both cases. The three locations were sampled from the cage structures, in areas where mites were observed. A layout of the house was made and the positions of collecting sites identified and marked (4 traps per row; 3 rows per pen = 12 traps in total). One numbered ADAS red mite trap was installed at each collecting site.

On the day before each sample collecting session, a black-holed plastic card was placed inside the ADAS traps for the mite collection. This card stayed in place for 24 hours of exposure before being removed and placed in a urine sample container with a 50% alcohol solution that killed and released all the mites inside.

The solution with dead mites was spread over a graduated board to proceed with counting all the parasite mobile forms (larvae, nymphs and adults). All the counts were recorded and shared with the person responsible for production for the company.

In each trial a red mite counting session was carried out on the day before the spraying session and 10, 30, and 60 ± 1 days after the Elector application.
Figure 10

Farm 1: Three row averages

Figure 11

Farm 2: Three row averages

Farm Trial 1: Three row averages.

Farm Trial 2: Three row averages.

Elector for poultry red mite control.
The summary of the results regarding the infestation levels of *Dermanyssus gallinae* versus the number of days from the Elector application in the two farms included in the study is shown in Figure 12 (below).

**Figure 12**

![Image of graph showing infestation levels](image)

*Red mites infestation level (Trial 1 & Trial 2) - summary.*

This graphic clearly shows that the infestation by *Dermanyssus gallinae* mobile forms, in both cases, reached its minimum level at 10 days after the Elector application and was kept on a low level, until 60 days post-application.

The level of red mite mobile forms was higher at 60 days after Elector application in the case of the Trial 1 (pen #7), although it was still lower than the initial infestation level before Elector usage.

The level of red mites found at 60 days post-application was still very low in Trial 2 (pen #8).

**Conclusions**

This study demonstrated that Elector is effective in controlling the red mite (*Dermanyssus gallinae*) populations that infested the houses of the caged layer hens studied, for at least 60 days.

A single treatment with Elector at the label dose of 60 mL/7 L of water was effective in controlling red mite infestations in caged layer houses. In both cases, the stocking density was lower than 550 cm²/layer (EU legal minimum cage area per layer hen required): Trial 1: 590 cm²/layer and Trial 2: 455 cm²/layer. The low stocking density in Trial 2 did not prevent Elector from being effective.

It was clear from this trial that following the label indications regarding Elector application is critical for field success at the farm level, for red mite control, since it determines the product’s persistence and duration of efficacy. Spraying the cages using a low-water pressure application system, the constant agitation of the water tank solution and the spraying in all the cage surfaces and hot spots for red mites nesting and travelling are crucial as well.

There were no adverse events reported.
7. 10 IMPORTANT RECOMMENDATIONS WHEN USING ELECTOR

1. Identify and apply over places where mites can be seen moving or hiding, including cracks and crevices.

2. Before the application of Elector, clean all surfaces, removing as much dust as possible.

3. Thoroughly shake the Elector bottle before use. Clean the tank and sprayer before preparing the Elector solution.

4. Fill half the tank with water, start the agitation and add the necessary amount of product. Rinse the Elector bottle at least three times into the tank when empty.

5. Fill the tank and maintain agitation throughout the treatment in order to maintain homogeneity.

6. Do not mix Elector with other products, and do not use pre-treated water (especially peroxides) for the preparation of the mixture. Prepare Elector solution just before use.

7. Apply Elector uniformly on all the surfaces with a low pressure spray until the runoff point.

8. Do not alter Elector-treated surfaces for at least 10 days (i.e., do not apply other products and disconnect all the ventilation systems). Do not apply with high-pressure cleaning systems or nebulization.

9. One application = one treatment (a second application is not needed due to the residual effect).

10. It is recommended to follow good management practices: remove the eggs before application to avoid unnecessary exposure.

Elector for poultry red mite control.
8. REFERENCES


The label contains complete use information, including cautions and warnings. Always read, understand and follow the label and use directions. Product labels vary by country.

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