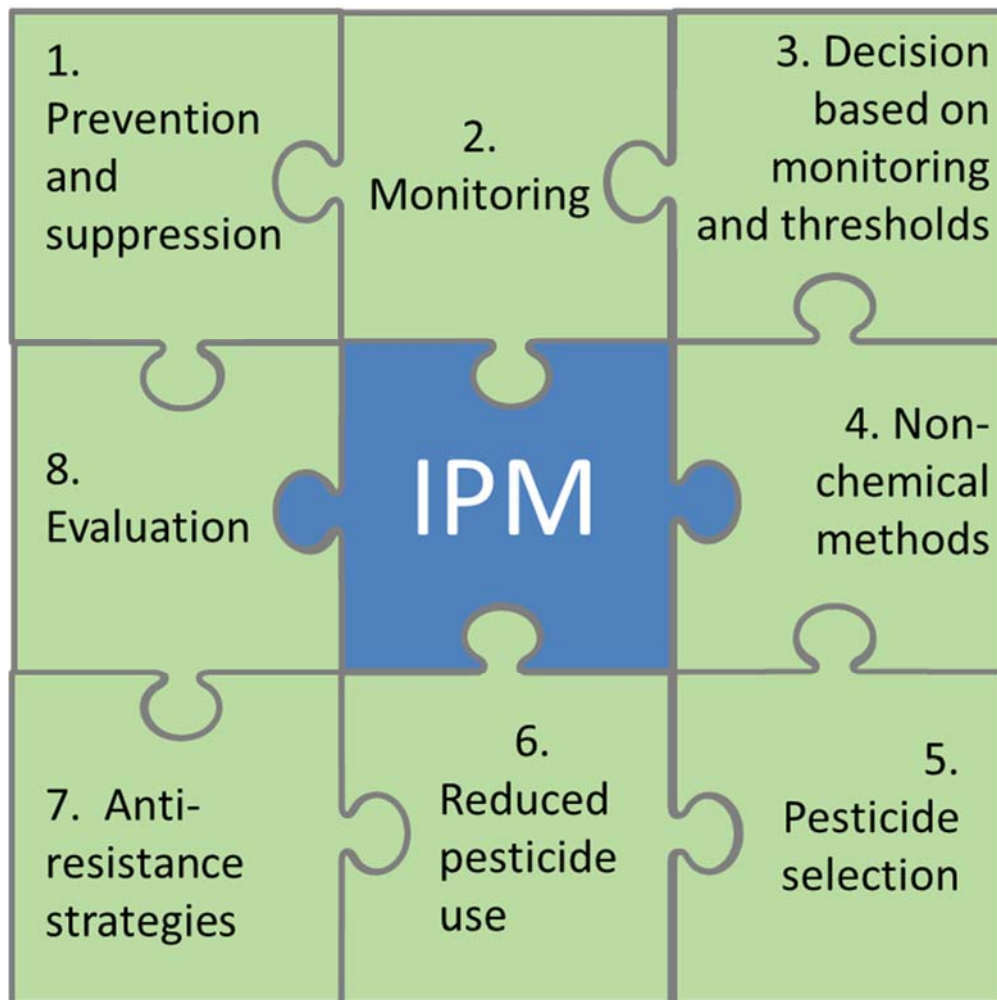


An elaboration of Integrated Pest Management (IPM) for Poultry Red Mite



Pests and diseases in the agricultural sector lead to a reduction of available food and feed throughout the world. In order to continue to meet the increasing demand for food and feed, losses must be reduced, preferably in a sustainable manner. Integrated Pest Management (IPM) is a sustainable method of limiting economic losses due to pests and diseases. It is based on eight steps: 1. Prevention and suppression of the population, 2. Monitoring, 3. Decisions to apply treatment are based on monitoring and a threshold value, 4. Use of non-chemical methods, 5. Use of selective chemical agents, 6. Reduce use of chemical agents, 7 . Anti-resistance strategies, and 8. Evaluation. By carrying out these steps it is possible to prevent and control outbreaks where pesticides (chemical, synthetic products against pests]) are used only if other means are generating limited results. This may reduce the number of problems regarding pesticide residues and the development of drug resistance.

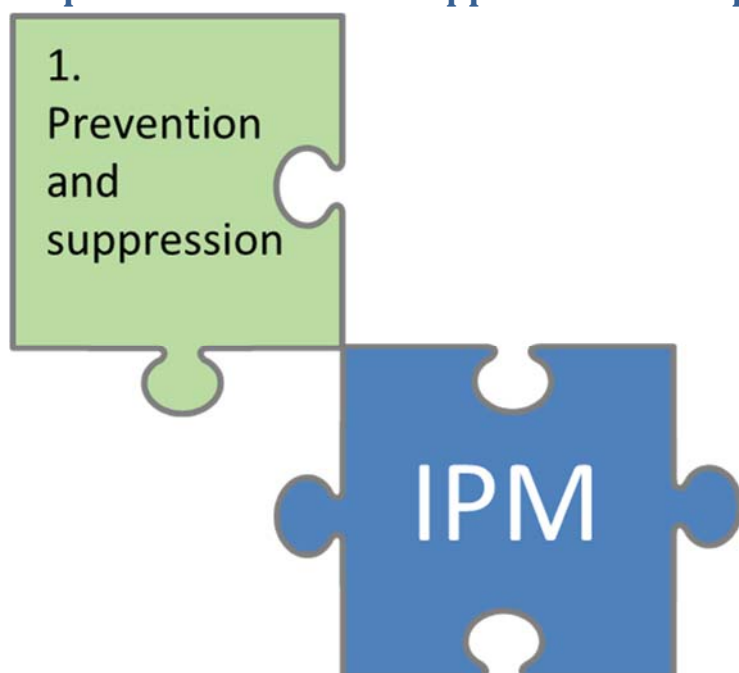
At present, IPM is mainly applied successfully against pests and diseases in crop production. In the livestock industry, IPM is also applied, though less so than in crop production. Despite the fact that the benefits of IPM have been described for poultry diseases and the vectors of poultry diseases, this methodology is only rarely used on layers to control of pests and diseases. A pest in laying-hen farming that is difficult to control at present is *Dermanyssus gallinae* (Poultry Red Mite). This is a blood-sucking mite with an almost worldwide distribution and a negative impact on animal health, animal welfare and production parameters. The number of IPM measures currently applied to *D. gallinae* is limited to cleaning between rounds, a number of preventive measures and the use of chemical agents or products that physically affect the mites. Improved IPM programs for *D. gallinae* will lead to a better control of this pest in laying-hen farms.

This document describes the implementation of the eight IPM steps for the poultry red mite on a laying-hen farm. Three egg producers discussed the eight steps for feasibility and practicality. The eight steps have been described based on current knowledge. Fortunately, knowledge about combating the poultry red mite is still increasing. Adjustments to the eight formulated steps are possible. If you have suggestions for improvement, please feel free to contact me.

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Step 1: Prevention and suppression of the population



1. Prevention

"Prevention is better than cure". This is a widely heard statement that certainly applies to red mites. Red mites are not easy to control because they hide in cracks and crevices. Only when the cracks and crevices are full the red mites become visible in the hen house. The effect of control measures is often limited when large numbers of mites are present. A large part of the red-mite population does not come into contact with the pesticide as with clustering of mites the outer layer mites protect the inner layer mites. By saving costs and reducing yield reduction, prevention is probably the most cost-effective measure against red mite.

1.1 Preventing introduction and spread of red mites in laying hen houses

Measures that prevent the introduction and spread of red mites in laying hen houses can be subdivided into measures during lay and measures between production periods.

1.1.1 Preventive measures during lay

With the help of the checklist, determine the preventative measures for the introduction and spread of red mite in laying-hen facilities (see [Check list](#) (in English))

1.1.2 Preventive measures in-between production periods

Implementing preventive measures between production periods can, in a simple way, ensure a significant reduction of the red-mite population:

- ☐ Use compressed air when cleaning
- ☐ Cleaning
 1. Swept clean, remove lumps of dried manure,
 2. Wet (water and soap) or dry cleaning with high pressure ^{Note 1}
 3. Drying
- ☐ Disinfection ^{Note 2}
- ☐ Thermokill / Ozone ^{Note 3}
- ☐ Elector / Byemite treatment ^{Note 4}
- ☐ Apply liquid silica ^{Note 5}

Note 2: It is not known to what extent disinfection may kill the red-mite stages.

Note 3: Thermokill: Possibly a better impact when all compressed and soft manure has been removed. Ozone: Note that components may be affected. This is especially known for objects made of natural rubber. Preliminary testing may limit the damage.

Note 1: It is not yet clear what is better; Cleaning with water and soap or dry cleaning. Cleaning with water and soap can kill the red mites (because soap can clog the respiratory apertures), but water also creates air-humidity levels in which red mites and bacteria may thrive. In dry cleaning, you mainly transfer the bird mites. Proper cleaning and removal of dust are therefore necessary.

Note 4: For IPM, such products or pesticides may only be used when preventive and suppressive measures have proven to be ineffective.

Note 5 : In The Netherlands the use of (amorphous) silica and diatomaceous earth currently (still) fall under the RUB regulation (regulation pesticide exemptions). Please verify your local legal requirements.

1.2 Suppressing population growth

The red-mite population-growth can be suppressed by applying the following measures:

- ☐ Daily manure removal Note 1 below
- ☐ Keep the environmental temperature below 19 degrees Celsius Note 2
- ☐ Monthly dust removal / vacuuming, cleaning and removal of lumps of dried manure from egg belt protection plates and ventilation protection plates Note 3
- ☐ Apply Liquid Silica Note 4
- ☐ Soap and / or green soap with ethanol Note 5
- ☐ Q-perch Note 6
- ☐ Repellents on the housing system Note 7
- ☐ Essential oils (attractive and repellent (!)) Note 8
- ☐ Natural enemies (predatory mites) Note 9
- ☐ Bacteria (under development)
- ☐ Vaccine (under development)
- ☐ Fungus (under development)

Note 1: Every 2-3 days red mites climb up the chicken for about 0.5-1 hour to tap blood. In the dark (with a flash light) you can see how the red mites move in the system and on the hens. In case of lower infestations, the hens will shake due to irritation. With shaking, the mites also fall down, e.g. on the manure conveyor-belt. Thus, by removing manure, you also remove red mites. Do you want to know how many red mites are in/on the manure? Take a closable freezer bag. Fill it with manure for 1/5 of the bag (do not squeeze the manure). Put the bag on the cold floor (such that the chickens cannot touch it) and observe after one day how many red mites are in the upper part of the bag. In short: Removing manure = removing poultry red mites.

Note 2: Based on research in the respiration cells (published in the Journal of Animal Science), it was found that lowering the environmental temperature with one degree Celsius increases the hen's ME requirement with 8.54 KJ. At a feed energy content of 11.8 MJ / kg, this corresponds to 0.7 grams of additional feed. If you want to lower the temperature to 19 degrees Celsius (2 degrees below the desired 21 degrees), an extra cost of about 1.5-2 grams of feed per day per hen will be required. Does this compared favourably to the restlessness / energy consumption due to the red mites? Van Emous et al. (2005) have calculated that an infestation with red mites requires 4 grams of extra feed per day because the bird has to make new blood. On the other hand, based on survey results, he estimated that a serious contamination cost 2 grams of feed per day. So it

may break even. A next question is what are the other consequences of a red-mite infestation? Feather pecking? Reduced immunity? Stress? The additional advantage of keeping the red mite population low, then, is to prevent / reduce the cost of treatment. A disadvantage of such low temperatures relates to increase in health disorders of the laying hens.

Note 3: Probably the effects of vacuum cleaning and dust removal is underestimated. Although the effects are temporary, these measures will reduce the number of red mites (Nordenfors and Hoglund, 2010; Huber et al., 2011). Removing dust also removes red mites and red-mite eggs, thus reducing the red mite population.

Note 4: Note 5 : In The Netherlands the use of (amorphous) silica and diatomaceous earth currently (still) fall under the RUB regulation (regulation pesticide exemptions). Please verify your local legal requirements.

Note 5: Unfortunately, no research has yet been published on this. A solution used in practice is: 400 grams of green soap + 200 grams of methylated spirits in 10 litres of water, or 2 litres of green soap and 1 litre of spirits in 100 litres of water. Spraying under pressure. The effects of this solution on man, animal and environment are unknown. Please verify your local legal requirements.

Note 6: Perch with a low capacity electric wire that kills red mites when they try to reach the hens at night (Vencomatic; [video in Dutch](#)).

Note 7: Pageat, 2005. A duck pheromone has a repellent effect and is sold under the name of Wakumo (Vetopharma, France) or NoReds (Group-IRSAE.com). These products could be used to prevent red mites from getting into poorly accessible places. Their effect is unknown. Please verify your local legal requirements.

Note 8: Although we appear to be able to direct the red mites with essential oils (spray solutions) to visible places and keep the red mites out of cracks and crevices, it is not known how such products work in a commercial hen house. Essential oils may also kill the mites. The best effectiveness is expected when the red mites are hungry. It can thus be effective during the empty period between two production periods. Keep in mind that essential oils may also affect other organisms (predatory mites, tempex beetles). High concentrations may even kill the chickens. Certain herbs can also lead to depressed chickens (George et al., 2010). Check before use whether the compounds are legally permitted and thus avoid harmful side effects.

Note 9: Predatory mites are natural mite predators. Each species of mite has different natural predators. To control red mites, you can use a number of predatory mites including the *Androlaelaps casalis*, *Stratiolaelaps scimitus* and the *Hypoaspis aculeifer*. The predatory mites *A. casalis* and *H. aculeifer* grab an egg or another stage of the red mite, insert the snout (chelicerae) and suck the body fluids from the mites. The mite gets injured, resulting in more loss of body fluids and death. A predatory mite can be a hunter chasing the red mites or it can wait until its prey passes by. Every mite also has a preference for a different environment. Usually the predatory mites are so-called soil mites that are present in and on the floor, accordingly they are less well able to climb. The climate in the laying-hen houses is not ideal for a predatory mite.

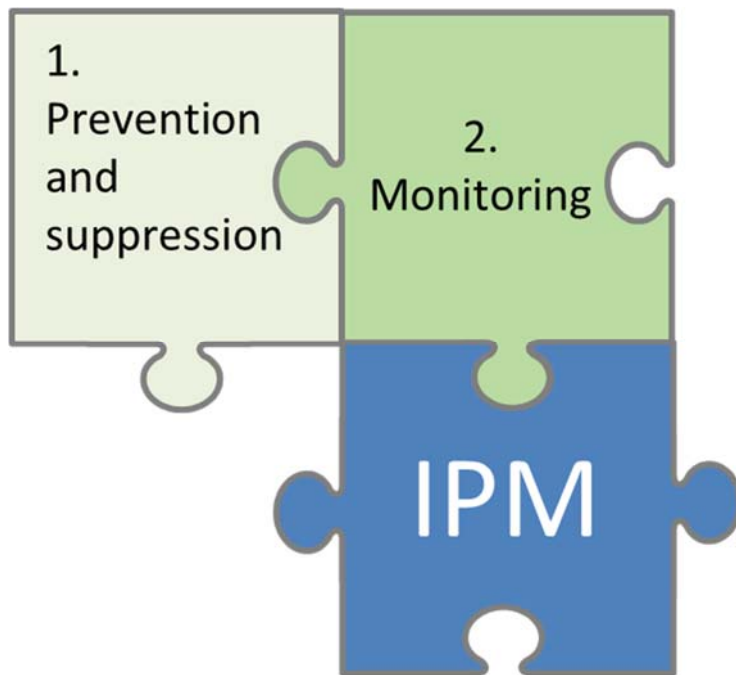
For a good anti-red-mite effect of the predatory mites, Rentokil uses two different predatory mites; A predatory mite that waits until the red mite passes by (the lazy one) and a predatory mite that hunts (the active one). The lazy predatory mites are spread out at the laying nests and at other places known to hide the red mites during daylight. The active predatory mites are kept in rearing bottles which are suspended in the housing system of the laying hens with a clamp.

The use of predatory mites in red-mite control, Rentokil states, is most effective when implemented in combination with integrated pest management (IPM). An important element of IPM is to monitor the population. Based on this monitoring, an impression can be obtained of the growth or decrease in the amount of red mites. This also indicates whether the predatory mites do their job well, or if more predatory mites are needed for proper control. Fighting red mite using

predatory mites is only effective if this method is used at the beginning of the laying round. When the hen house does not contain birds in between production periods, the house is cleaned (broom clean) after which the predatory mites are placed in the system, before the hens arrive. The number of predatory mites needed is determined by the number of laying hens present. From the moment of placement, the poultry farmer will have to monitor and report on the red mites weekly to Rentokil. Every four weeks the mites are replenished. After the first laying round with predatory mites, a balance is to be expected between predatory mites and red mites. Thorough cleaning in between production periods is then discouraged because it also distorts the balance.

Note: Use only legal and registered products against pests and disease agents. Check this by referring to your supplier, by consulting the Biocide database of your country or by consulting the veterinary medicine database.

Step 2: Monitoring



2. Monitoring

2.1 Why?

- To be able to follow the development of the red mite population accurately
- To be able to apply a timely treatment (at low numbers), which may enhance the probability of an effective treatment
- To determine the effect of a treatment

We know that a treatment never has the same effect on a red-mite population. This possibly is an effect of the indoor temperature (at higher temperatures the population grows faster), the age of the laying hens and the management at the farm. Monitoring the poultry red mite population generates insights into the rate of population growth and the impact of a treatment.

2.2 Methods

From a list containing many monitoring methods two poultry farmers selected the monitoring methods that would not take much time to implement. Poultry farmers preferred:

- visual observations of the population: **MMS method**, Cox et al. (2009),
- easy and cheap traps: **Rickstick**, [Van Emous and Ten Napel](#) (2007),
- **Simplified Passive Tape Trap** by Roy et al. (2014)
- The automated red-mite counter: In the near future Hotraco will have an **automated mite counter** for sale (Mul et al. [2015](#), [2016](#)).

The two poultry farmers valued the AviVet trap because they only had to install the traps and then send them to AviVet. This company then determines the number of red mites per trap. The traps and the counting of mites costs money (www.AviVet.nl; <https://doi.org/10.3382/ps/pew428>).

2.2.1 MMS method

Visual observations using the "Mite Monitoring Score System" (MMS) are performed in a laying-hen house at predetermined locations. These are always at the beginning and at the end of a row (not every row has to be sampled). The locations are at least 20 meters apart. The observations are made in at least 3 locations per row. The sampling locations are never directly opposite each other. If a location has been determined in the longitudinal direction of a row, the observation is performed at 2 or 3 different heights. The locations are marked such that the same locations are sampled every week. Visual observation is performed within 1m² around the marked location. A flashlight is used to assess the presence of red mites in cracks and crevices and / or on the system (Figure 1). Everything is viewed within 1 m²: The vertical constructions, the perches, the laying nests, etc. For the scoring, the following criteria are used:

Score 1 = Mites visible in holes, cracks and crevices

Score 2 = Mites visible in unprotected locations.

Score 3 = Clusters (groups larger than 1 cm²) visible in holes, cracks and crevices.

Score 4 = Clusters (groups larger than 1 cm²) visible in unprotected locations.

For example, a protected location is around nuts, screws, rings and underneath u-profiles. Small clusters may be added together within the square meter.

The MMS method is performed at least once every two weeks.



Figure 1 Carrying out the MMS method

A treatment is being carried out:

- At an average monitoring score higher than 1.5 (in the warm period higher than 1)
- If there was a score of 3 in one location (in the warm period a score of 2),
- In case of complaints from the staff,
- Blood spots on the eggs or dead chickens.



Figure 2. Score 3: Clusters of red mites are visible in the cracks and crevices, larger than 1 cm². (Experimental Poultry Centre in Geel, Belgium)



Figure 3. Score 4: Groups of red mites at unprotected locations larger than 1 cm². (Experimental Poultry Centre in Geel, Belgium)

2.2.2 Rickstick method

See explanation for the method [here \(in Dutch\)](#). The Rickstick is easy to make of a PVC pipe and a round wood that fits into the PVC pipe. Saw 12 cm of PVC pipe and 10 cm of round wood. Place a small screw in the middle of the length of the round wood. Turn the screw into the middle of the wood so that the wooden stick is fixed into the PVC pipe. This screw prevents the hens from grabbing the stick. Around the screw you will find the first red mites. Place the Rickstick with pull straps (tie wraps) under the perch. Place 10 to 12 Ricksticks distributed evenly spread throughout the house, but in easily accessible places. Weekly check the Ricksticks, slide out the round wood and determine the score (see Figure 4). Write the score on a piece of paper. Then clean the round wood and the PVC pipe using a brush. Remove the Ricksticks just before a treatment and return them into the system shortly after treatment.

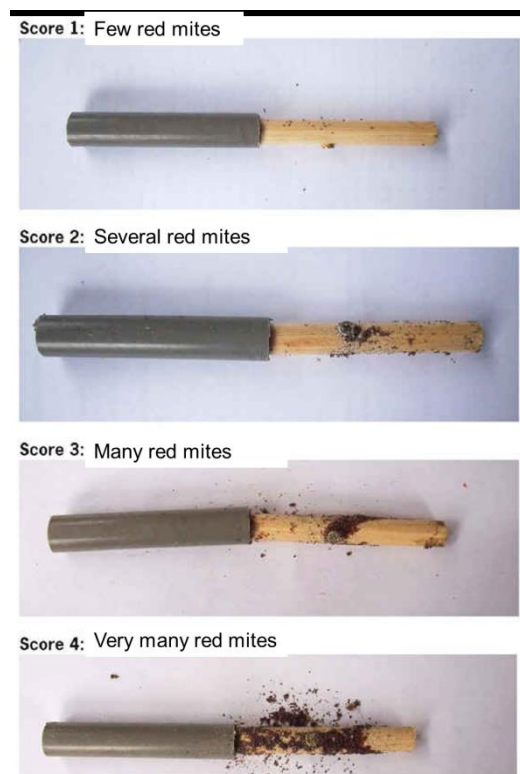


Figure 4. Red mite score for the Rickstick method

2.2.3 Simplified Passive Tape trap (SPT) method

The Simplified Passive Tape Trap (SPT, Roy et al., 2014; Chiron et al. 2014) method is easy to make, like the Rickstick. Use 5 cm to 8 cm long piece of a 3 cm-wide, blue painting tape. Fold the ends a bit (see Figure 5, Panel A) and wind the tape around round objects in the poultry house (mesh (see Figure 5, Panel B), perch). By folding the ends of the tape, the tape is easily removed. The red mites are found under the tape after a week. Count the number of red mites under the tape and assign a score: 0 = no red mites found below or in the tape; 1 = 1-9 red mites visible in or below the tape; 2 = small groups of more than 10 red mites in or below the tape; 3 = groups, clusters or bunches of red mites in or under the tape (see Figure 6). Place 10 to 12 traps evenly spread throughout the hen house, in easily accessible places. Check the traps on a weekly basis, register the scores on a piece of paper and replaced the traps with new ones.

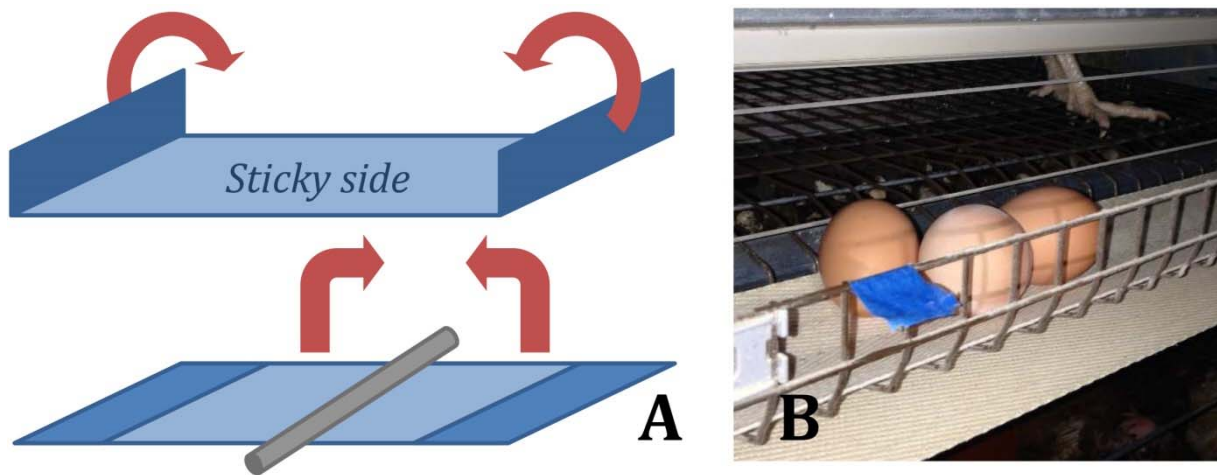


Figure 5. The Simplified Passive Tape trap (SPT) to monitor red mite; made of painters' tape (panel A) (after Roy et al. 2014). Panel B shows an example of how a small trap is attached at a layer farm (Thanks to A.Varescon 2014).





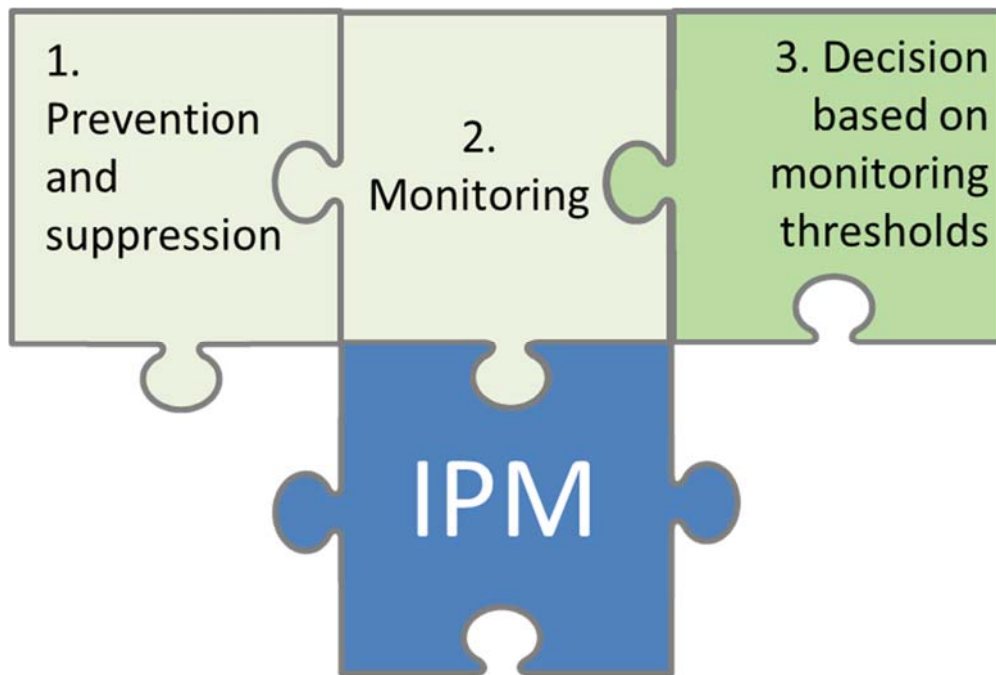
An easy-to-use passive trap			
Rating scales	4-state scale EXP	2-state scale FIELD	
No mite	0	0	
A few indiv. (1-9)	1	0	
Sparse groups (>10)	2	1	
Clusters	3	1	

Figure 6. Scores for the SPT method (Roy et al., 2014).

Roy advises to treat the birds when an increase in red mites has been observed at more than two successive occasions.

Step 3: Decision based on monitoring and thresholds



3. Decision to treat is based on monitoring and threshold value

The poultry farmer decides when and what measure (control or management measure) will be carried out on the basis of monitoring results and / or advice from a red-mite specialist.

3.1 Why?

- For effective control (preventing a treatment that is applied too late)
- To avoid unnecessary treatment (and thus to save costs and the environment)
- To prevent resistance (due to incorrect and very frequent use of pesticides)

3.2 Threshold values

Unfortunately, there are no known threshold values, such as a number of red mites or a reduction in performance. It is therefore useful to keep the economic figures up to date. This gives more insight into the economic consequences of a red-mite infection.

Every product against red mites has an optimal moment of application. Consult the supplier for the most effective moment to use it. In addition, each product also has an application protocol. Such a protocol indicates how and when treatment is most effective.

The MMS monitoring method and the SPT monitoring method (see step 2) have provided a guideline for applying a compound. These guidelines are shown below.

3.2.1 MMS method

A treatment is being carried out:

- With an average monitoring score higher than 1.5 (in the warm period higher than 1)
- If there was a score 3 in one location (in the warm period a score of 2)
- In case of complaints from the staff
- Blood spots on the eggs or dead chickens

3.2.2 SPT method

A treatment is advised when an increase is observed at more than two consecutive moments (Roy Personal Notice 2016).

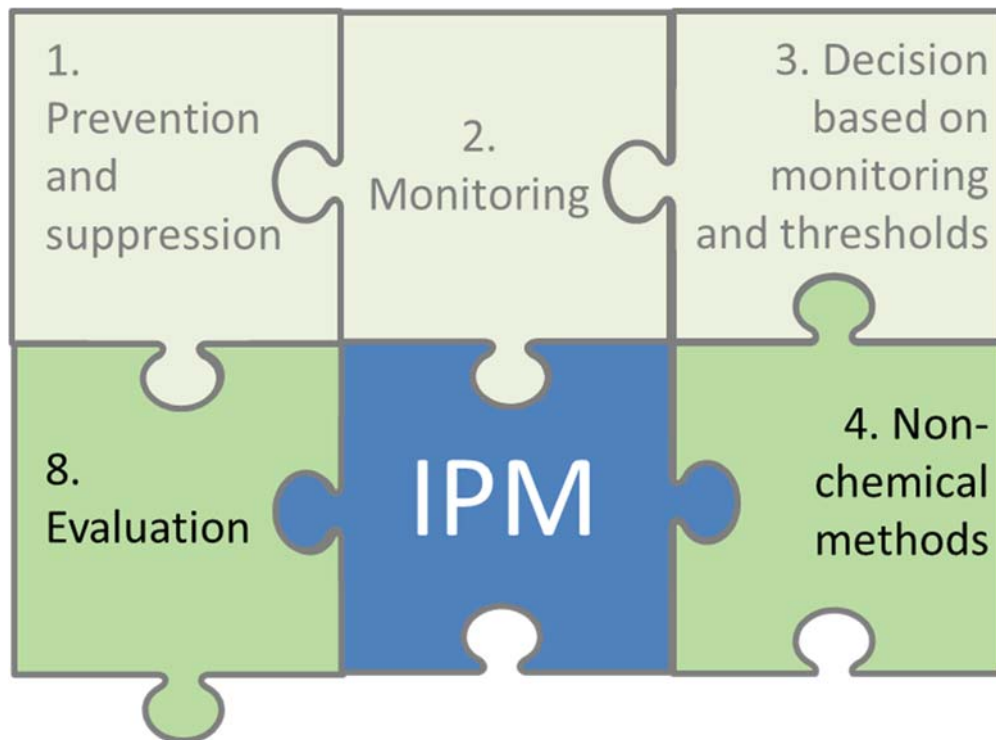
3.2.3 Rickstick method

For the Rickstick method, no threshold has been established. Personally (M. Mul) I would start a treatment when a score of 2 has been observed in the hen house.

3.2.4 Other methods to monitor red mites

Inquire with the provider of the monitoring method as to what they recommend as a threshold for a treatment.

Step 4: Non-chemical methods



4. Non-chemical methods

Biological, physical, mechanical and other non-chemical methods of control are preferred when it comes to control methods. The laying-hen farmer decides when and what measure (control or management measure) will be carried out on the basis of monitoring results and / or on advice from a red-mite specialist.

4.1 Why first non-chemical?

- Because IPM aims to control pests effectively, minimising the negative effects on humans, animals and the environment

4.2 Several non-chemical methods

This section describes a number of non-chemical agents. It is a summary of agents without judging their effectiveness. For more background information, I refer to the report "[Bloedluizen \(vogelmijten\) op papier en in de praktijk](#)" (Poultry red mites on paper and in practice; report in Dutch)." and Step 1 of IPM for red mite.

Use only legal and registered products against pests and disease agents. Check this by referring to your supplier, by consulting the Biocide database of your country or by consulting your countries veterinary medicine database.

After applying a control method/ agent, its effectiveness is determined through monitoring; Step 8 of IPM for red mite "Evaluation". In case of ineffectiveness, a different method should be used because of cost and for environmental reasons, provided the supplier of the product indicates that the effects of a control treatment can only be seen in the longer term.

4.2.1 Mechanical

Remove dust (and thus) mites, eggs using a:

- Brush*
- Steel brush
- Vacuum cleaner *
- High pressure (with and without water)*

4.2.2 Physical

Kill eggs and mites using:

- Local treatment of mites by heating them with a small burner (attention to fire hazard)
- Heat treatment*. Only applicable when the house does not contain laying hens. During 2-3 days the house is heated to a minimum of 50 °C. Mostly followed by a treatment to control the first mites after treatment.
- Ozone treatment*. Only applicable when the house does not contain layers
- Silica* (in powder and liquid form of which liquid silica seems to be the most effective.) The effectiveness depends on 1) the silica product, 2) the amount of dust in the housing system before it is applied and 3) humidity.

4.2.3 Physiological

Physiological agents exert their effect through the blood of the hens on the physiology or life cycle of the red mites:

- Garlic
- Vitamin B2
- Water additives with essential oils and sometimes with alcohol or glycol

4.2.4 Biological treatment

In nature, pathogens, natural enemies are present that may affect the viability of the red mites:

- Natural enemies*: *Alphitobius diaperinus* (tempex beetle), *Cheyletus eriditus* (predatory mite), *Androlaelaps casalis* (predatory mite), *Stratiolaelaps scimitus* (predatory mite) (Maurer and Hertzberg, 2001; Chauve 1998; Kozlov, 1970; Maurer and Hertzberg, 2001; Lesna et al., 2012). Suppliers, among others, Rentokil, Biobest, Refona, APPI.
- Bacteria: *Bacillus Thuringiensis* (Nordenfors, 2000; Chauve, 1998)
- fungi: *Beauveria bassiana*, *Metarhizium anisopliae*, *Trichoderma album*, *Paecilomyces fumosoroseus* (Kaoud, 2010; Steenberg and Kilpinen, 2003; Steenberg et al., 2006; Tavassoli et al., 2011; Immediato et al., 2015)
- Chicken

4.2.5 Natural treatments

These agents are based on natural products and can kill or impede the bird mites.

- Green soap and spirits*
- Soaps (Detergents)*
- Lime
- Rapeseed oil
- Essential oils*

* See step 1 IPM for further explanation

4.2.6 Repellents and attractants

Substances that have an attractive or repulsive effect, may induce red mites (populations) to move to certain locations and thus be driven from places that are difficult to reach. These agents are still used very little in practice.

- Wakumo (Vetopharma, France)* or
- NoReds (Group-IRSAE.com)*

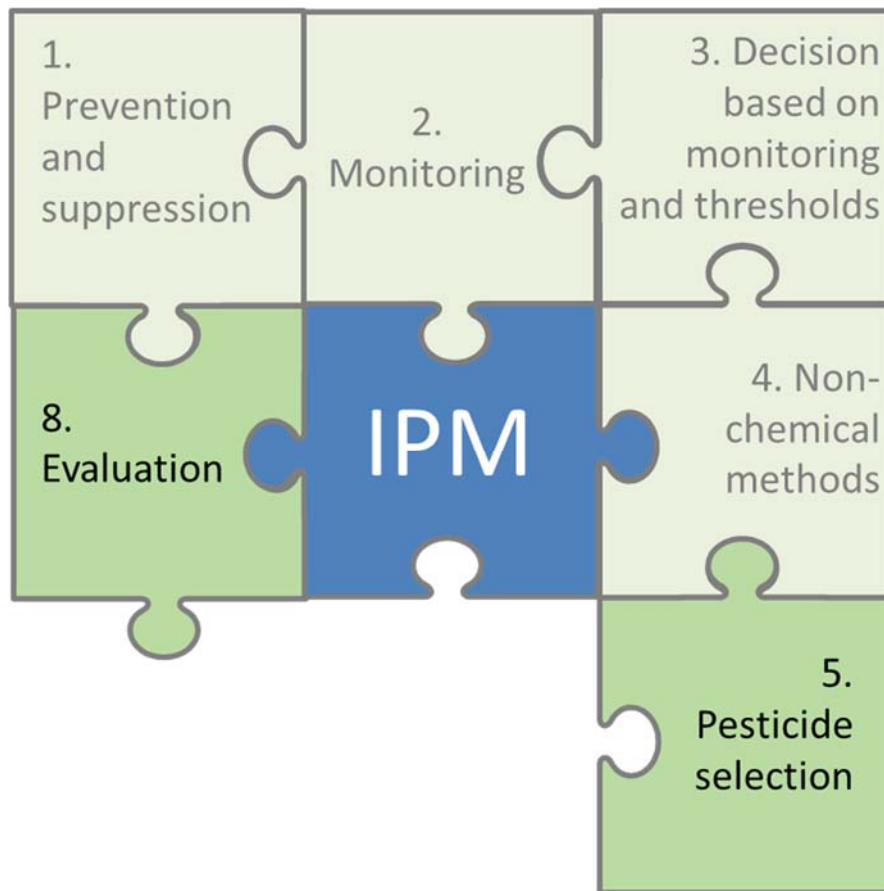
* See step 1 IPM for further explanation

4.2.7 Modifying the housing system

The current housing system gives the red mites every opportunity to carry out its natural behaviours. There are plenty of places to rest. Often these places are inaccessible to the laying hens, perhaps the main natural enemy of the red mite.

Avoiding cracks and crevices in a new housing system seems impossible, but with the right materials and knowledge about construction, current systems could really be improved. Another approach is to provide the red mites with the most ideal resting and hiding places near the resting areas of the laying hens. The laying hens could help control the red mites by making these shelters easily accessible to the laying hens on a daily basis. A number of examples are depicted in the report "A structured design approach with focus on the PRM problem in laying hen facilities". This report can within a short time frame (6-9-2017) be found at the website of www.COREMI.eu.

Step 5: Use of selective chemical compounds



5. Use of selective chemical products

Only after it has been found that prevention and non-chemical methods are insufficiently effective may chemical agents be used. It is therefore preferable, first of all, to use agents specifically intended for red mite.

After applying a control method / agent, its effectiveness is determined by monitoring; Step 8 of IPM for red mite "Evaluation". In case of ineffectiveness has been shown, a different method should be used for cost and environmental reasons, provided the supplier of the product indicates that the effects of a control measure can only be seen in the longer term.

5.1 Why use selective chemical compounds?

- Because it helps prevent side effects such as eradication of non-target animals and limiting the negative effects on humans, animals and the environment.

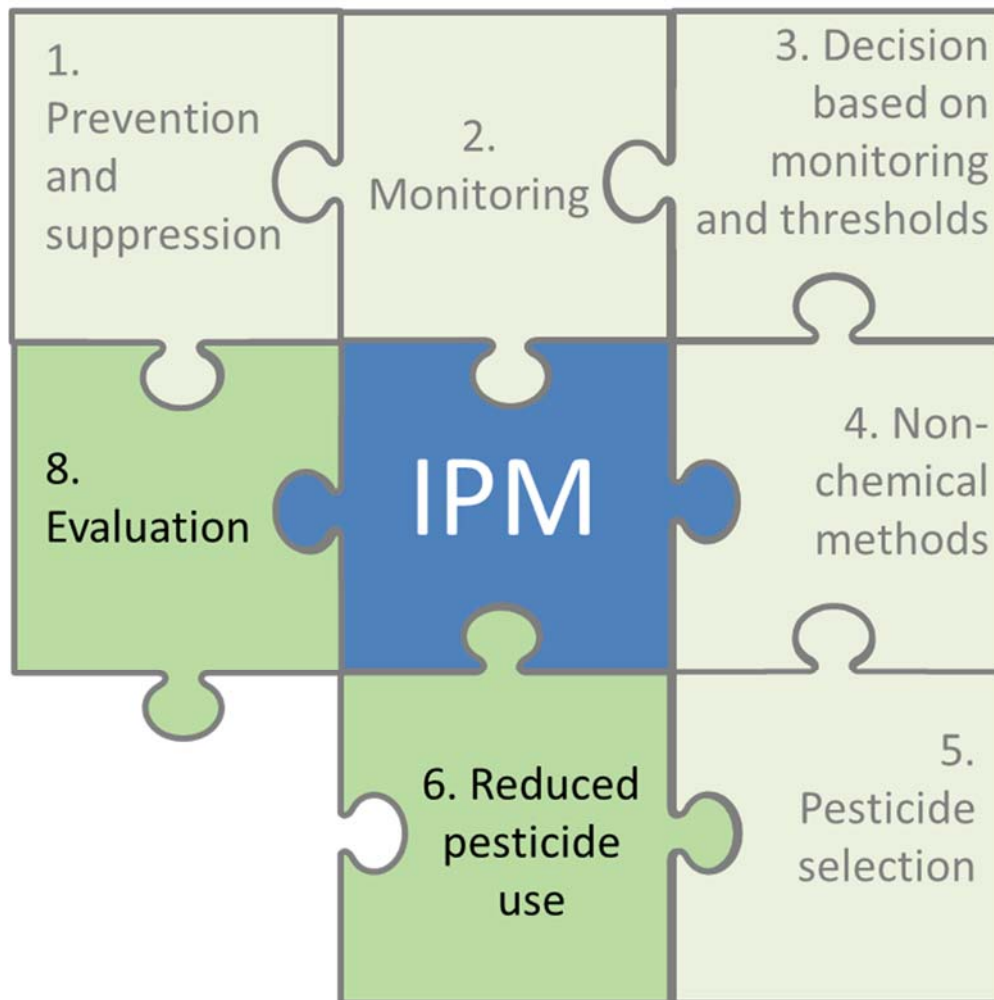
5.2 Selective chemical compounds to treat red mite

There are no chemical (synthetic) agents available that only have a toxic effect on bird mites.

Byemite (Bayer), Elector (Elanco) and Lurectron (Denka) do not only kill the poultry red mites, but also other insects and spiders.

It is recommended that future research be carried out on the development of a poultry red mite specific agent.

Step 6: Reduce the use of chemical pesticides



6. Reduce the use of chemical pesticides

When using antimicrobial agents, attention should be paid to minimizing the use of the drug by:

- A. Using the correct recommended dose
- B. Limiting the number of applications, but in accordance with the product description
- C. Administering the agent locally

6.1 Chemical pesticides that have been allowed

Chemicals used for red mite must be legally allowed and used according to the directions for use and the instructions. In the Netherlands permitted agents are registered on the [CTGB website](https://www.ctgb.nl/nieuws/onderwerpdossiers/laag-risico-middelen/rubregelregeling-onderdelen-bestrijdmiddelen) (College for authorization of plant protection products and biocides). Other agents are listed in the Veterinary Medicine database (<https://www.diergeneesmiddeleninformatiebank.nl/en/>). Also check if the product is mentioned in the RUB regulation (regulation pesticide exemptions) (For The Netherlands: <http://www.ctgb.nl/nieuws/onderwerpdossiers/laag-risico-middelen/rubregelregeling-onderdelen-bestrijdmiddelen>).

Below is a list of authorized resources (in The Netherlands at 1-5-2017) against poultry red mites. As mentioned earlier, these agents are not specifically targeted to red mites and can therefore also kill other organisms. Also, the pesticides may often not be used in the presence of the animals. Check your local permission sites if the agents are (still) allowed. Some admitted agents are: Byemite (medicine), Elector, Lurectron Flow, MS Cy-Fly, Solfac liquid.

Chemicals are not always effective. You can have your farm's red-mite resistance to the agent checked beforehand. Determination of resistance to agents can be performed by Arthrotox UK. This British company is affiliated with the University of Northumbria. <http://arthrotox.co.uk>.

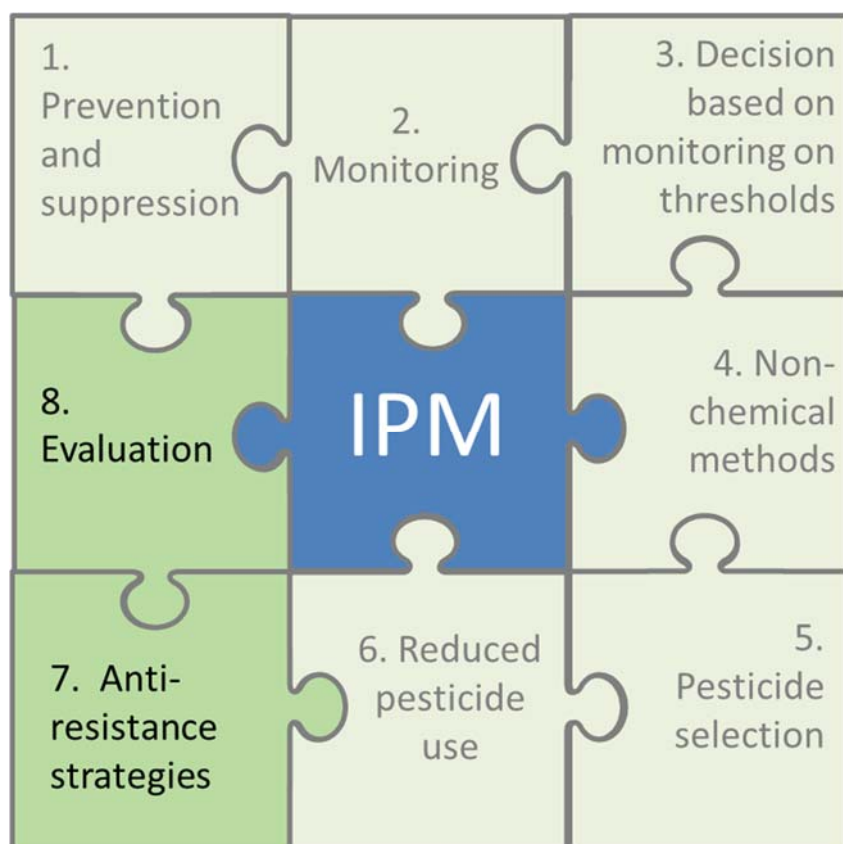
6.2 Local application

Monitoring data show that local administration of a pesticide is only effective if the population is still very small. Only at the very first observations of red mites in a particular location local treatment may be effective. Such so-called spot-treatments are often used in weekly monitoring and direct control of poultry red mites with soap and ethanol.

6.3 Only use effective compounds

After applying a control method / agent, its effectiveness is determined by monitoring the results; Step 8 of IPM for red mite "Evaluation". In the event of ineffectiveness, a different method should be used for reasons of cost and the environment unless the supplier of the product indicates that the effects of a treatment can only be expected in the longer term.

Step 7: Anti-resistance strategies



7. Anti-resistance strategies

In order to prevent the risk of developing resistance to the treatments, the products used will have to be:

- A. alternated sufficiently
- B. rotated or maybe
- C. perhaps be administered simultaneously.

Ad a. The description of the authorized products indicates how often the agent may be used per production round. This maximum allowable number of treatments has been determined so as to achieve effectiveness of the drug as long as possible. Therefore, please limit yourself to the maximum number of treatments.

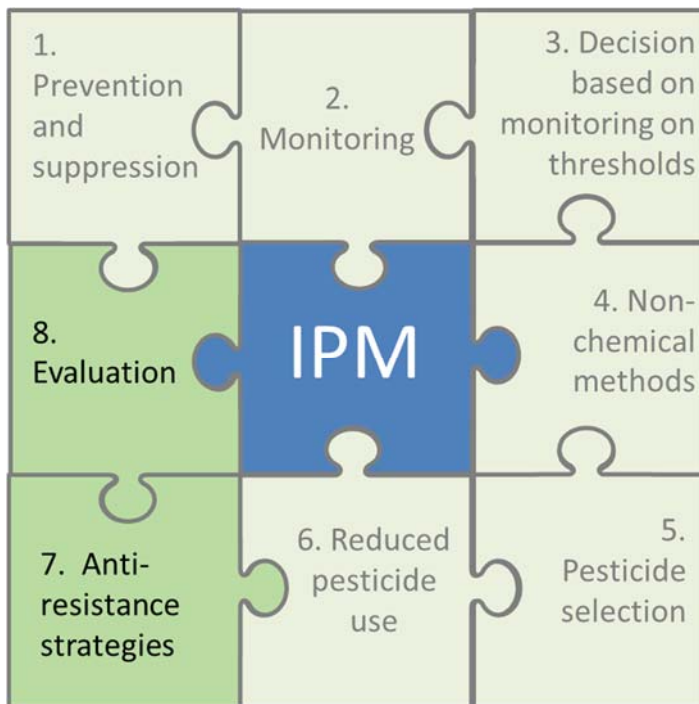
Ad b. Products used in an alternating schedule must have a different mechanism of action. Verify this at your supplier's.

Ad c. The products that are used together must be compatible. The concentrations should always be administered according to the recommendation. Sparagano and others (2014) have drawn up a table showing combinations of anti-red-mite agents. This table is shown below. However, it should still be supplemented.

8. Evaluation

After applying a control method / agent, its effectiveness is determined by monitoring the results; Step 8 of IPM for bird mite "Evaluation". In the event of ineffectiveness, a different method should be used for reasons of cost and the environment, unless the supplier of the product indicates that the effects can only be seen in the longer term.

Step 8: Evaluation



8. Evaluation of products and measures

After applying a preventive measure or a treatment/agent, its effectiveness is determined by monitoring the results; Step 8 of IPM for bird mite "Evaluation". In the event of ineffectiveness, a different method should be used for reasons of cost and the environment, unless the supplier of the product indicates that the effects of a treatment can only be seen in the longer term.

Frequent (at least weekly, preferably daily) monitoring not only provides insight into the effectiveness of an agent or measure, but also provides insight in the duration of effectiveness. Below you find the results of daily monitoring of red mite in commercial hen house. X-axis = age of a batch of hens (days). Y axis = growth. At the leftmost blue mark a treatment has been applied. If the marks are above the green line then the population has grown. If the marks are below the green line then there has been a decline in the population. After 10 days the marks are already above the line. Thus, the agent appears to be effective for a duration of 10 days.

