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Final report on the research project

Studies on the suitability of Cumbasil® Mite as an alternative treatment for the red chicken mite in laying hen houses

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1 Introduction

The red chicken mite has long been one of the most important economic pests in poultry farming and is difficult to control. It was recommended in 1942 to apply nicotine sulphate preparations, waste oil or petrol to the house equipment in order to combat the mites (GRIZMEK 1942). Today the treatment is slightly different and after the current fibronil scandal an intensified search for alternatives started.

An alternative could be an active substance-free prophylaxis by Witteler with their dust bath "Cumbasil® Mite". The dust bath should not only promote the natural behaviour of the animals, but also reduce the mites in the plumage of the animals with silicate bound to rock meal. The postulated mechanism is to be based on an unfavorable holding ability of the mites in the plumage of the animals, with which the interaction of the mite legs with the feathers is no longer possible, since the fine rock meal is to lay itself like a protective layer on the feathers.

The successful use of silicates in laying hen husbandry has already been described many times, but is often complex and expensive to handle. In addition, aspects of occupational health and safety must be taken into account during application, which also lead to a restriction (ban on use) in occupied hen house. For this reason, the dust bath could offer advantages through the continuous self-treatment of the animals.

From October 2016 to August 2017, a trial was carried out in a “Naturland” laying hen farm to investigate the effect of the product "Cumbasil® Mite" under practical conditions. The barn had four compartments with 3,000 animals each, so that two compartments each could be used as experimental and control groups. In order to detect a possible mite reduction, mite traps were set up and evaluated at regular intervals. In addition, data on the appearance of the animals and the group performance were recorded.

2 Literature review

2.1 Differences in behaviour and diseases in keeping of laying hens depending on the type of rearing

2.1.1 Hygienic conditions in various types of farming

In laying hen husbandry, a distinction is made between cage husbandry (today only developed cages or small group husbandry are permitted), ground / aviary husbandry and outdoor husbandry. From a hygienic point of view, cage keeping, which is no longer permitted today, is to be preferred because it clearly separated the animals from the faeces, there was no bedding and the furnishings were easy to clean. However, since the animals should eat, drink, rest and dust-bathe according to their species and this was only possible to a limited extent in the cages, cage husbandry was banned in 2010 and instead converted to small group husbandry or developed cages. (Vetion.de 2017). From a hygienic point of view, however, small group housing can still be rated better than floor and outdoor housing. In ground and outdoor husbandry, the bedding material and sitting litter, which are often made of wood, are particularly critical. One problem of keeping laying hens is that the laying period of the animals is one year and therefore cleaning and disinfection can only be carried out after the end of the one-year laying period. This means that the animals are kept in a hygienically precarious environment (bedding material) during the year, especially when kept on the floor. This can also be seen in the germ load of the air (5,000-10,000 cfu/l[1] air in floor housing compared to 200-400 cfu/l air in cage housing) and by higher pollutant gas loads in the stable. Due to the poorer hygienic conditions in the alternative housing systems, diseases such as smallpox viruses and histomonads, which were considered to have been eliminated in cage housing, are now gaining importance again. (MÜLLER & SCHLENKER 2007). In terms of husbandry technology, outdoor husbandry, with all its advantages and disadvantages, corresponds to the conditions of barn husbandry, but there are additional risk factors due to the available outdoors. In addition to the environmental impact of NH3 and the animal excrement contact in the run, the introduction of pathogens by wild birds and other wild animals is an important risk factor. Disease outbreaks such as avian influenza can therefore lead to a temporary stabling duty in outdoor housing (MÜLLER & SCHLENKER 2007), as was last the case in winter/spring 2017.

[1] Colony forming unit per litre volume

2.1.2 Characteristic behavioural disorders in the different types of housing

Due to intensive animal husbandry with high performance and limited space, behavioural disorders are known in laying hen husbandry for which various triggers are discussed. What is certain is that the large numbers of animals kept on the ground and outdoor husbandry mean a high level of social stress for the animals. Depending on the literature, chickens only form a fixed hierarchy up to 25 animals (MÜLLER & SCHLENKER 2007) up to 60 animals (VETION.DE 2017), which means that there are repeated ranking fights in large populations. In contrast to the assumption originally made, the animals do not form fixed subgroups (MÜLLER & SCHLENKER 2007). Only for aviary management is it discussed that the animals form relatively stable subgroups within the floors (VETION.DE 2017). Although there are no rankings in outdoor husbandry, the animals are better able to avoid them due to the increased space available. MÜLLER & SCHLENKER (2007) found that animals with a low social rank move in a smaller stable area than animals with a higher rank. This could explain why only a small part of the herd uses the run-out in outdoor farming. Beside the social stress and increased ranking fights, however, also behavioral-disturbances like egg and feather-pecking, cannibalism and outbreaks of panic are known. The main reasons for egg and feather pecking are lack of lime, poor stable climate, boredom, but also too large groups and too high stocking density. Therefore, although egg and feather pecking can occur in all types of husbandry, it is mainly known in ground and outdoor husbandry if there is not enough employment material available. Feather pecking can lead to cannibalism, which is particularly evident in cloacal pecking in hens and toe pecking in chicks. Overcrowding, high air temperatures and humidity and excessively bright lighting are discussed as causes of cannibalism (MÜLLER & SCHLENKER 2007). Hysteria and panic, on the other hand, are mainly known in soil and outdoor husbandry, where they lead to wall formation on the sides and result in suffocation and crushing of the animals. In cage farming it is less common and leads to injuries due to the smaller groups. The cause of neuromotoric excitation is often chronic stress due to low stable temperature, high NH_3 concentrations, excessively long light days and mutual injuries (MÜLLER & SCHLENKER 2007). Hysteria and panic can also be caused by frequent attacks by birds of prey and other wild animals in outdoor systems.

2.1.3 Causes of mortality and losses in laying hen husbandry

The losses can vary greatly according to the type of housing and range from 6% in cage housing (LÜHE ET AL. 2007) to 50% in outdoor housing (ANIMAL-HEALTH-ONLINE.DE 2000). Losses in cage and floor housing are relatively similar at 6 - 10%, with slightly higher losses in floor housing (LÜHE ET AL. 2007). This is mainly caused by the fact that there is particularly frequent infestation with ecto- and endoparasites in floor housing, inflammation of the ball of the soles and toes and increased injuries due to cannibalism. Further technopathies are strangulations, injuries to the stable equipment, fractures and luxations caused by getting stuck (MÜLLER & SCHLENKER 2007). The losses mentioned for barn husbandry also apply to free-range husbandry. In addition, however, there is the risk of pathogen entry with increased morbidity rates and losses due to damage caused by game mentioned in Chapter 2.1.1. Therefore the losses in free-range husbandry can be between 20 and 50% (ANIMAL-HEALTH-ONLINE.DE 2000). Here are typical illnesses in addition to these typical postural illnesses, such as inflammation of the fallopian tubes, deformation of the breastbone and fractures (osteoporosis), fatty liver syndrome and infectious hospitalism (stall fatigue) caused by germs. One reason for these diseases is the highly selective breeding for productivity without sufficient adaptability to the intensity of use (MÜLLER & SCHLENKER 2007). In principle, there are statistically fewer cases of illness and deaths in cage housing or in the developed cages due to, among other things, the stable ranking and the lower dust exposure. On the other hand, ground and outdoor husbandry is associated with increased social stress and disease, deaths and increased use of medication (VETION.DE 2017).

2.2 Red chicken mite *(Dermanyssus gallinae)*

2.2.1 Infestation with the red chicken mite *(Dermanyssus gallinae)*

The red chicken mite belongs to the order of the mesostigmata and in contrast to the northern fowl mite (*Ornithonyssus sylvarium*), which lives permanently on the host animal, infests the animals only at night to suck blood. Afterwards it withdraws again into cracks and crevices of the stable equipment. The development of the mite is strongly temperature-dependent and takes only four to nine days under optimal conditions (18 - 30°C) (PFISTER 2006), so that a female mite can produce up to 2,500 offspring in eight weeks (MUL & KOENRAADT 2009). The short development phase under optimal temperature conditions can lead to an explosive spread of the bird mite in warm weather periods.

The development cycle of the mite consists of four stages, the larva, the protonymph, the deutonymph and the adult animal. Only the nymphs and the adults suck blood and have four pairs of legs. The larva has only three pairs of legs and spends the time until moulting as a regressive transitional stage without feeding in the hiding places in the barn (PFISTER 2006).

An infestation with the red chicken mite expresses itself according to the way of life less through visible mites on the animals, but rather through restlessness, itching, blood-loss and reduced productivity (laying performance and/or weight-increase). If the infestation is very severe, the loss of blood can also lead to severe anaemia and death (especially in young animals) (SCHNIEDER et al. 2006). Only with very strong infestation mites are to be seen also during the day as red dots on the chickens and the animals suffer from high-grade anemias. In such an extreme infestation, numerous mites can be seen even on the carcasses (ARNOLD 2011; GRIZMEK 1942).

In most farms there is no continuous monitoring to assess the infestation, but rather it is determined by whether people are bitten when entering the barn itself, whether mites can be seen on the barn equipment (especially in the area of the perches) or whether even small blood spots can be seen on the eggs. Sometimes there are also mites on the eggs (SCHULZ 2014).

An infestation with the red chicken mite is not only a problem for the animals caused by the strong impairment, but can also trigger toxicoses and allergies (especially in humans). Furthermore, as a vector for pathogens, the mite poses a considerable health risk and can transmit salmonella, among other things. In Australia, the bird mite is also responsible for the transmission of bird spirochaetosis (HIEPE et al. 2006).

2.2.2 Control of the red chicken mite *(Dermanyssus gallinae)*

The control of the red chicken mite is often difficult since there are no approved products without waiting time for the application on the animals and the red chick mite, in contrast to the Nordic one, is not only on the animals but can survive for a long time in the stable and the stable equipment. Acaricides can only be used safely during the service period after stabling, which makes thorough cleaning and disinfection (C+D) with subsequent chemical mite control very important for laying hen farmers. The difficult legal situation with preparations that are permitted in occupied stalls but not on animals often leads to uncertainty among poultry farmers. It is unclear, for example, whether eggs and feed must be removed before such a treatment. This legal uncertainty has led to an increased search for alternatives to combating the bird mite. In recent years, the use of silicates as a biophysical mechanism of action has therefore established itself for treatment in occupied stables. The silicate can either be applied selectively to the mite nests or it can be nebulised throughout the entire barn. As biophysical control, silicates cannot form resistances and their use is also permitted in occupied stables. Basically, silicates are distinguished between amorphous and crystalline silicates. Due to the extremely sharp-edged small particles, in both silicates the evaporation-inhibiting wax surface is mechanically damaged and the animals dry out (STRIEZEL 2005; SCHNIEDER et al. 2006). Thus the effect of the silicate is dependent on the relative humidity and temperature, since the loss of fluid of the damaged animals is due to a concentration gradient (ZENNER et al. 2009).

Although the active ingredient silicon oxide is classified as harmless to humans and livestock, the use of crystalline silicates can cause silicosis (dust lung disease) in humans due to the alveolar particle sizes and chickens can also suffer lung damage due to inhalation toxicity (ZENNER et al. 2009). This is not entirely insignificant, especially with regard to occupational health and safety, which is why the use of amorphous silicate dusts should be increasingly avoided. Due to their particle size, these dusts can be completely absorbed in the lungs and therefore cannot be expected to cause any health damage if inhaled (SCHNIEDER et al. 2006). In addition to the use of silicate dusts, it is also possible to use amorphous silicon dioxide as a liquid preparation. The silicon dioxide penetrates through the respiratory organs and causes the mites to dry out from the inside (ARNOLD 2011).

As the treatment is quite complex and difficult overall, the focus should be on reducing the introduction and spread of mites. MUL & KOENRAADT (2009) have developed an evaluation scheme based on HACCP (Hazard Analysis and Critical Control Points) in order to carry out a risk analysis in the farms for this purpose. Categories such as feed, environment (introduction by e.g. rodents, wild birds), stable equipment, origin of the animals were created and evaluated with regard to their risk of introducing and spreading the mites, so that an average risk value can be determined for each category. This can help to identify and avoid risk factors in the farms (MUL & KOENRAADT 2009) and thus also to reduce mite pressure in the long term.

2.3 Mechanism of action of Cumbasil® Mite

With regard to the possible mode of action and the initial scientific investigation prior to practical use, the product Cumbasil® Mite was tested in the laboratory on bird mites taken from a farm and the effects were investigated.

The individual study parameters, the selected methods and the results can be found in the following research notes, which are available for download in the appendix of this report or on the website www4.fh-swf.de/cms/research notes/

Garmeister, R. & Boelhauve, M. (2019): Investigation on the size distribution of Cumbasil® Mite in comparison to other silicate preparations for the control of the red chicken mite. Research Notes, No. 3/2019, SWUAS

Garmeister, R., Schulz-Beenken, A. and Boelhauve, M. (2019): Investigation on the invasiveness of Cumbasil® Mite on the red chicken mite (Dermanyssus gallinae). Research Notes, No. 4/2019, SWUAS

Garmeister, R. & Boelhauve, M. (2019): Investigation on the influence of Cumbasil® Mite on the movement of the red chicken mite (Dermanyssus gallinae) on feathers. Research Notes, No. 5/2019, SWUAS

Garmeister, R. & Boelhauve, M. (2019): Investigation of the influence of Cumbasil® Mite on the migration activity of the red chicken mite (Dermanyssus gallinae). Research Notes, No. 6/2019, SWUAS

Garmeister, R., Schulz-Beenken, A. and Boelhauve, M. (2019): Electron microscopic examination of the influence of Cumbasil® Mite on the extremities of the red chicken mite (Dermanyssus gallinae). Research Notes, No. 7/2019, SWUAS

In a brief summary, the individual investigations showed that the product Cumbasil® Mite does not cause any damage to the outer shell of the bird mites and therefore has no drying effects on the mites. The movement activity of the bird mites, on the other hand, is significantly slower - after contact with Cumbasil® Mite, the mites run " like on marbles". This effect was reversible by simply washing the mites with water.

The lifespan of the mites in the treated and untreated groups did not differ. Based on the initial laboratory tests, there are no indications of a possible biocidal effect.

3 Material and methods

3.1 Information on the hen farm

The study took place on a "Naturland" farm in Westphalia, Germany with 12,000 laying hens. The animals were housed in a Meller aviary with four compartments of 3,000 animals each. The stable was a new building, which was occupied with the 5th passage. The farm had been using Cumbasil since the beginning of 2016 and had also fogged the occupied barn with silicate once, as the mite pressure had increased significantly in August 2016. The herd for the preliminary experiment was set up in January 2017. The stoves newly installed in February 2017 were used for the actual experiment, which lasted until the beginning of August 2017.

3.2 Experimental design

The preliminary experiment accompanied the old herd from October 2016 to the end of the laying period (January 2017) in order to estimate the current mite pressure with the help of mite traps. In addition, the performance data (e.g. laying performance, feed consumption, ground eggs) of the entire laying period were evaluated in order to estimate the average farm and compartment performance.

The study started in February 2017 with the stabling of the new young hens. For the test, two adjacent compartments were equipped with the Cumbasil dust bath and two other compartments were left untreated as negative controls. In order to prevent the Cumbasil from fogging into the other compartments during dust bathing, the first two compartments should be assigned to the test group and the rear two to the control group (see experimental design Fig. 1). In order to determine the exact amount of Cumbasil® Mite consumed, bagged goods were used for the duration of the test. One bag of 25 kg each per week and dust bath had to be refilled. This corresponds to an application rate of 75 kg per week and compartment or 1.3 kg per chicken per year. The animals were weighed at the beginning of the stabling. Another weighing followed on 13.06.2017. The last weighing took place at the end of the test on 01.08.2017. 20 animals per compartment were weighed, which allowed an average weight to be determined. In addition, at the beginning three mite traps were placed in each compartment at intervals of four to six weeks, towards the end of the test with an increase in the outside temperatures and thus also with an increased mite pressure, the mite traps were placed every two weeks (from 13.06.2017 - 01.08.2017).

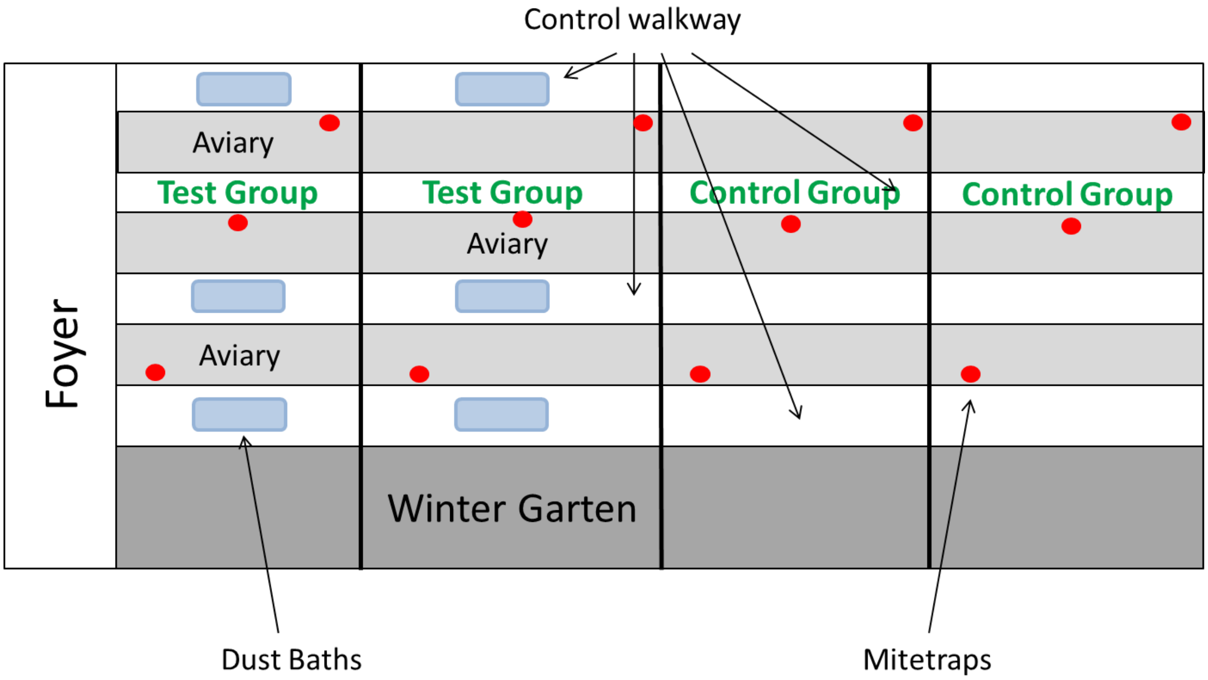


Fig. 1: Experimental drawing

3.3 Data collection

Performance data such as laying performance and feed consumption were recorded daily by the farm manager. However, this data was only recorded at the barn level and not at the compartment level. Only losses, bottom eggs, animal weights and animal observation could and should be recorded for each compartment. In addition to the mite traps, these data should be used to estimate mite pressure, as it is known that increased mite pressure affects laying performance and animal behaviour, among other parameters (HIEPE et al. 2006). In order to better assess the performance, the performance of the previous herd (2016) was also recorded (see 3.2). Since both herds were kept in February and under the same conditions, a comparison of the performances is possible.

3.4 Mite trap

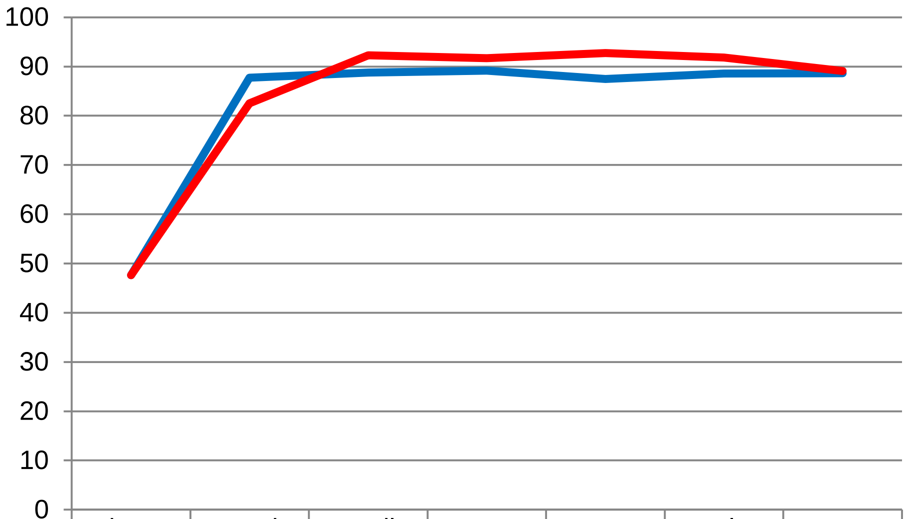
For a better estimation of the mite pressure, the installation of mite traps has proven to be effective. In the Netherlands, for example, PVC pipes with a wooden stick in the middle are used to create an attractive retreat for the mites. But traps made of cardboard paper, fabric or cloth have also proven themselves in various studies (MUL & KOENRAADT 2009; BARTLEY ET AL. 2017). ZENNER et al. (2009) and SCHULZ (2014) have also successfully used various mite traps in their investigations. The studies have shown the importance of protecting the traps from the chickens, as traps made of cardboard paper, in particular, are often pecked at. Therefore, mite traps that are protected either in a tube or with tape seem to be a better method to measure mite pressure. Usually the traps are placed as close as possible to the animals. Fastening to or under the perches or laying out the traps in the nests has proven successful here (SCHULZ 2014; MUL & KOENRAADT 2009; ZENNER et al. 2009). During a 24-hour installation period, the traps were mostly counted or evaluated using a score (1 - 5) (MUL & KOENRAADT 2009). If the traps are set up for a longer period of time or if the mite pressure is very high, they can also be weighed and the number of mites estimated (SCHULZ 2014). ZENNER et al. (2009) found in their studies on mite monitoring that not only the type of trap, but also the location of the trap have an influence. Thus, the site is even more sensitive than the type of trap, as more mites were caught on the perches than in the nests.

For our own investigations, traps similar to those used in the Netherlands and by SCHULZ (2014) were used. Each trap consisted of a PVC empty pipe in which crepe paper was rolled up. So that the chickens could not pull out the crepe paper immediately, the traps had to be placed out of reach of the animals (e.g. under the nest mats). At the beginning, the mite traps were set up in a 6-week rhythm, as the outside temperatures did not yet indicate a significant increase in the mite population. The mite traps were set up in the afternoon at predetermined locations (below the nests, see Fig. 1). Three tubes were laid out for each compartment and collected the following morning (at the same time). The tubes were packed directly in the barn into previously labelled sealable bags for transport. A separate bag was used for each tube and uniform labeling/numbering was carried out. The mites in the tubes were then counted in the laboratory of the South Westphalia University of Applied Sciences (SWUAS) and the developmental stages of the mites were determined at each count. Weighing or scoring of the mite traps was dispensed with due to the low number of traps and mites.

4 Results and discussion

4.1 Evaluation of biological performance and animal weights

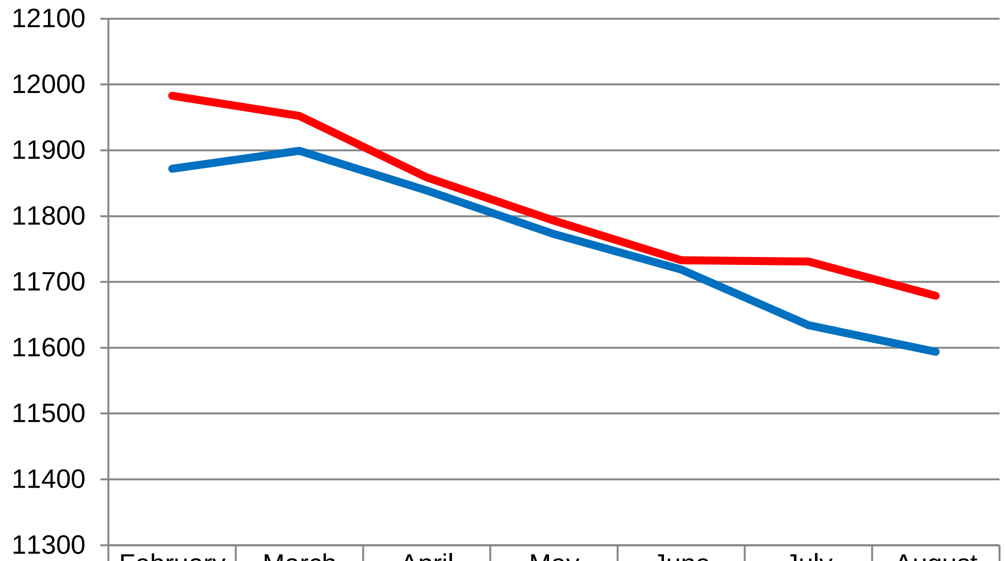
For the evaluation of the biological performance, the data of the previous herd (2016) were compared with the data of the trial herd (2017), since during the study it was unfortunately not possible to record the laying performance and other data at compartment level. Both herds started the laying period with 48% laying performance (eggs per day / livestock) (see Fig. 2). While the herd of 2016 did not lay over 90%, the laying performance of the experimental herd was already 92% from April onwards.



	February	March	April	May	June	July	August
Performance in % 2016	48	88	89	89	87	89	89
Performance in % 2017	47,66	83	92	92	93	92	89

Fig. 2: Laying performance of both herds (2016 and 2017) from February to August

In addition to the tendentially higher performances, the herd of 2017 also recorded a tendentially higher animal population (cf. Fig. 3), whereby the losses of both herds can be rated as very good overall at <1% and due to the low loss rates an evaluation of the losses per compartment was dispensed with. The losses of the experimental herds (2017) were a little lower overall and the sudden increase in losses in April 2017 can be explained by a disease of the herd (blackhead disease) and was afterwards also declining again.



	February	March	April	May	June	July	August
Animal stock 2016	11872	11899	11839	11773	11719	11634	11594
Animal stock 2017	11983	11952	11859	11793	11733	11731	11679

Fig. 3: Livestock of both herds (2016 and 2017) from February to August

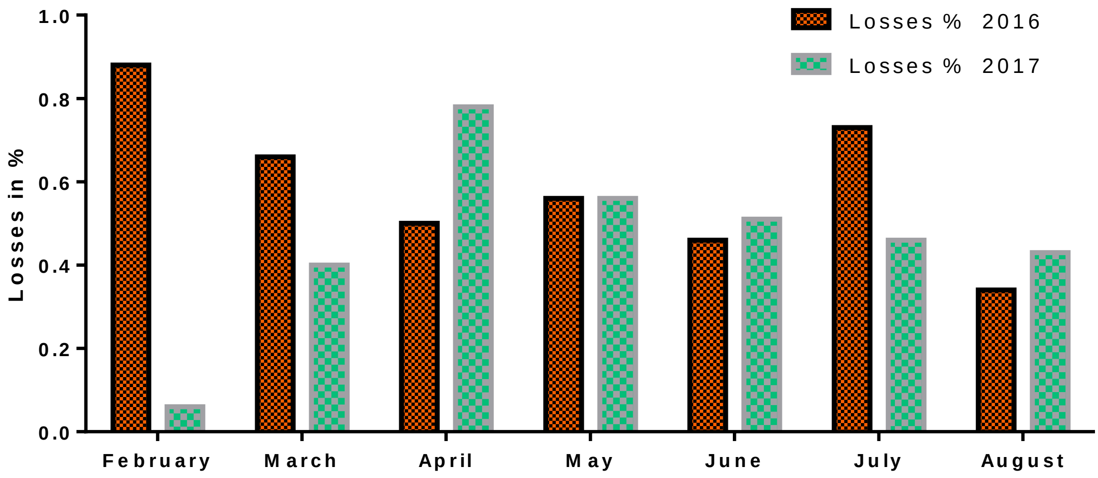
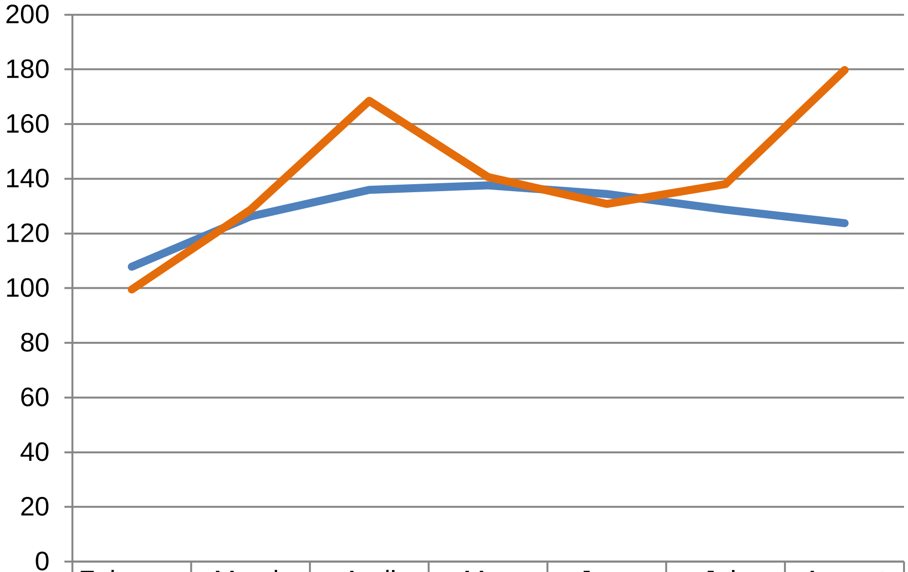


Fig. 4: Losses of both herds (2016 and 2017) from February to August



	February	March	April	May	June	July	August
g feed/animal/day 2016	107,78	126,23	135,93	137,54	134,44	128,66	123,81
g feed/animal/day 2017	99,54	128,66	168,50	140,64	130,81	138,01	179,81

Fig. 5: Feed consumption of both herds (2016 and 2017) from February to August

As can be seen in Figure 5, feed consumption in the trial herd was higher than in the previous herd. The downturn in June/July 2017 could be explained, among other things, by the weather conditions. The hot and humid temperatures with partly strong temperature fluctuations and thunderstorms could have affected the feed intake. The overall good feed intake is also reflected in the live weights of the animals. At both weighing dates, the average weight of the animals was 1.9 - 2.0 kg, which was to be expected according to age and laying period. The live weights show significant differences between the groups in the favor of the experimental group (see Table 1). However, a difference between the weighing dates did not result in statistical differences.

Tab. 1: Mean values and standard deviations of animal weights

	N	mean values	standard deviation	p – value
Test	80	1.99	0.17	0.021
Control	80	1.93	0.16	
1. Weighing	80	1.96	0.19	0.887
2. Weighing	80	1.96	0.16	

4.2 Evaluation of mite traps

Due to the colder temperatures into May 2017, the mite traps showed only minor mite evidence during this period. With the rise in temperature from the beginning of May 2017, more and more mites were caught, with more mites tending to be in the traps from the control compartments. Table 1 shows an overview of the total number of captured mites including the number of traps without mites. Figure 6 shows the evolution of mite numbers over time. The figure clearly shows the sharp increase in the number of mites detected in the control compartments 3 and 4.

Tab. 2: Overview of total captured mites per compartment

compart ment	status	number of traps	thereof evaluable	Thereof without mites	min.	max.	median
1	Test	18	18	6	0	33	1
2	Test	18	18	10	0	29	0,5
3	Control	18	16	3	0	204	3,5
4	Control	18	17	7	0	208	5

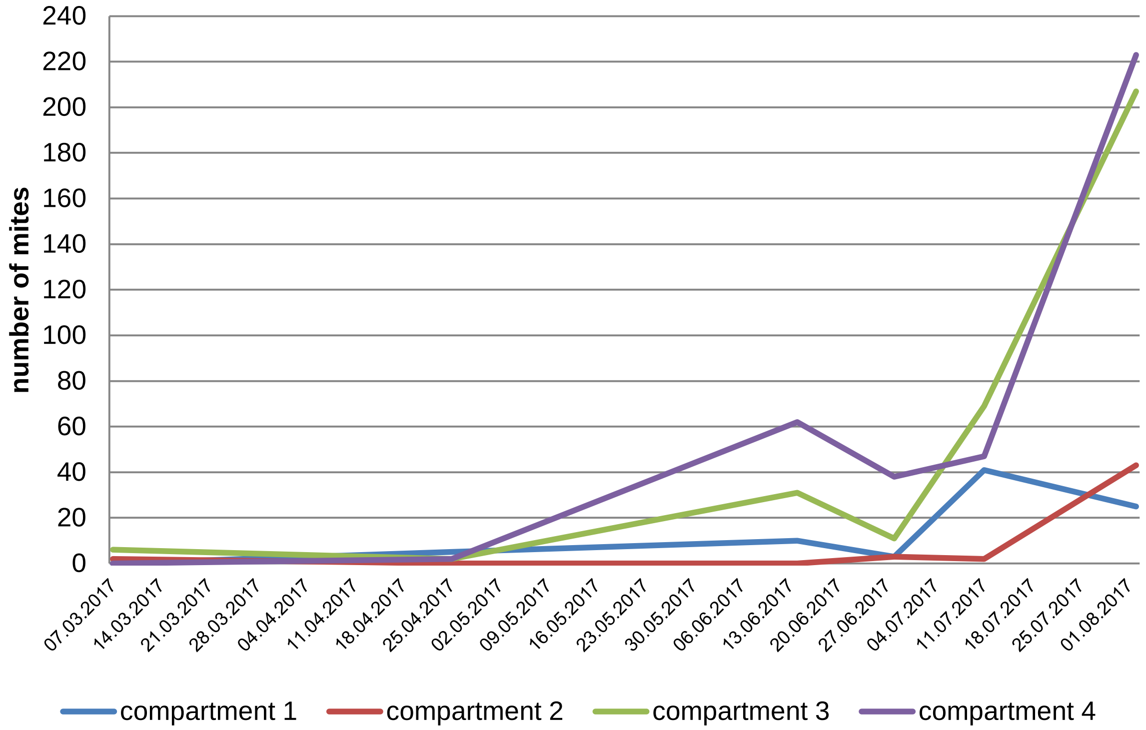
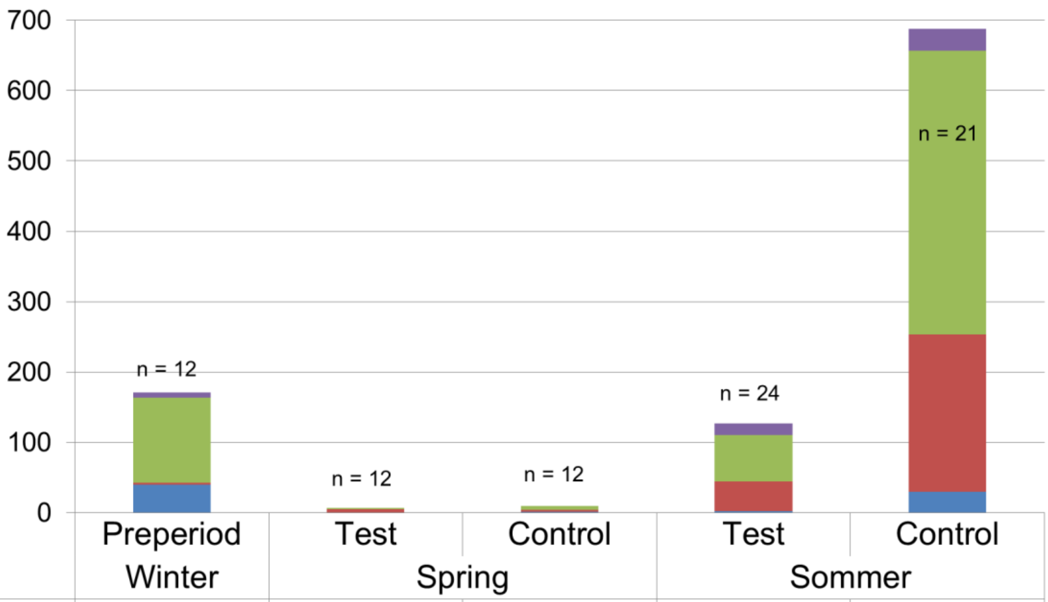


Fig. 6: Evaluation of the captured mites over time

The results not only show the temperature-dependent development of the mites with rapid reproduction in the summer months, but also that the increase in the mite population in the test compartments with Cumbasil® Mite (1 and 2) is significantly more moderate. This is also evident when the compartments are evaluated together and subdivided into the respective development stages (Fig. 7). The results of the preliminary experiment (winter) presented show that mites were present in the barn at the beginning of the experiment and the higher proportion of larvae in comparison could be an indication of the reduced development speed in winter. Since the mites can survive up to five months without blood sucking, it can be assumed that mites and larvae were still present at the time of new stabling (after a two-week service period). It was found out that the mites spread rather slowly in spring due to the lacking or delayed temperature increase and that at that time there was no difference between experiment and control. Only with the almost explosive reproduction in the summer a difference could be recognized. Even if the difference is very clear, the results cannot be statistically verified due to the small number of samples and the strong fluctuations (lack of variance homogeneity within the groups).



	Preperiod	Test	Control	Test	Control
	Winter	Spring		Sommer	
Adult	7	0	0	17	31
Deutonymph	121	2	6	66	404
Protonymph	3	5	3	42	223
Larvae	40	0	1	2	30

Fig. 7: Distribution of captured mites according to development stages. Numbers indicate countable mite traps (with at least 1 mite in trap) per season and group.

An important finding in the counting of mites showed that a mite treated with Cumbasil could be identified in one of the traps from the test compartment. This shows that the way from the dust bath to the nests or to the mites seems to work.

After the increase of the mite population in the control compartments was foreseeable, the study was terminated in favour of the animals and animal welfare and the two control compartments were also equipped with the Cumbasil® Mite dust bath.

4.3 Evaluation of animal observations and other observations

The observations of the farm managers, own observations during data collection and video recordings during the stall tour served as animal observations. This would have been an indication, especially in the case of the restlessness of the animals during mite infestation, which is repeatedly described in the literature, to record differences between the groups. During the experiment, however, none of the groups had more eggs laid (avoiding the nests), increased frightfulness or feather pecking. This was to be expected with the moderate development of the mite population, which was already evident in the evaluation of the mite traps. Overall, therefore, no difference could be detected in the animal observations. Only at the last appointment on 02.08 a clear restlessness and frightfulness of the animals could be observed. Furthermore, the first signs of cannibalism were to be seen on the date, which was especially evident in the increased loss of feathers around the cloaca. However, there was no clear difference between the groups. Since the farm managers also reported that the animals had eaten less during the last days and that it was very humid, the unrest could also have been caused by the heat stress as all groups were affected. Nevertheless, the considerable increase in the number of mites in the traps of 02.08 will certainly have contributed to the restlessness and alarm. It can be assumed that if the experiment had been continued, the number of mites in the control compartment would have increased further and that this would have shown differences in animal behaviour and other parameters in the long term.

6 Summary

The examination of the product in a laying hen farm indicated that in the groups with Cumbasil® Mite the infestation pressure with red chicken mites was greatly reduced. In the warm summer months, the detection rate of the mites also increased in the experimental groups, the infestation was significantly lower compared to the control groups. At this time, the first changes in the animals of the control groups, based on the higher mite infestation, were visible and measurable:

- Thus, the average animal weight of the control group decreased significantly.
- In addition, signs of increased discomfort in the control groups from lesions on the feathers to feather pecking tended to be more common than in the Cumbasil® Mite group.
- Differences were also seen in laying performance, which was 5-6% higher in the experimental groups than in the previous laying period. The control groups remained at the old level even during the current laying period.
- A difference in the number of bottom eggs could not be described.

Since the experiment was discontinued in agreement with the farmers at that time, it can only be assumed that a longer and stronger infestation of the animals of the control groups with bird mites would result in a difference to the animals of the experimental groups.

The examination of the mite populations with regard to developmental stages showed that nymph and larval stages could be detected in both groups. This means, in addition to the equal survival times of the red chicken mites of both populations without end host described above, that also in the experimental group with Cumbasil® Mite bloodsucking acts of the bird mites must have taken place. From this it can be further deduced that even the examination in a practical operation with Cumbasil® Mite showed no sign of a biocidal effect.

In summary, dust baths of the laying hens with Cumbasil® Mite mechanically restrict the possibility of performing the bloodsucking act of the red chicken mite at the end host which is necessary for further reproduction. Cumbasil® Mite is suitable for controlling the red chicken mite population, but will not eliminate it. This also implies that after the laying hens have been housed, the retreats of the red chicken mite must be treated.

The summaries of this experiment can be found in the following research notes, which are available for download in the appendix of this report or on the following webpage:

www4.fh-swf.de/cms/forschungsnotizen/

Fiege, F. & Boelhauve, M. (2019): Investigation of the impact of alternative control of the red chicken mite on its population and on animal health in laying hen husbandry. Research Notes, No. 8/2019, SWUAS

Fiege, F., Garmeister, R. and Boelhauve, M. (2019): Investigation of the effect of alternative mite control in laying hen husbandry - distribution of the mite population. Research Notes, No. 9/2019, SWUAS

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