

10. Arthropod pests in poultry production

10.1 Prevalence of the chicken mite

The chicken mite, *Dermanyssus gallinae*, is a well known ectoparasite of poultry. In May 1997, a questionnaire was sent to approximately 400 Danish egg producers including different types of production facilities. The questions concentrated on the presence of chicken mites and what problems they may have caused. Almost 40% of the farmers answered the questionnaire and the results showed that approximately one third had chicken mites at that time. The lowest incidence of chicken mites was found among the organic egg producers, where only 14% had chicken mites. This is probably due to the low age of these production units which was only 3 years on average. In contrast to what is generally assumed, a relatively high incidence was also found in the battery systems (28%).

Table A0a. Answers to the question: "When was the last time you had chicken mites?"

	<i>Battery</i>	<i>Barn</i>	<i>Free-range</i>	<i>Organic</i>	<i>Total</i>
At present	28%	40%	39%	14%	31%
Last 3 years	4%	10%	29%	21%	13%
3-10 years	6%	10%	4%	4%	6%
Never	56%	32%	21%	54%	43%
Unknown	6%	8%	7%	7%	7%
# answers	53	50	28	28	159

The worst problems with chicken mites were observed in July and August, but some farmers reported incidences even in the winter months. As to the question how the hens are affected by the chicken mites, the most common answers were that the birds are disturbed, and more feather picking is observed. However, some farmers reported that they had mites, but they caused no problems.

The relatively low response rate could raise doubt whether these results are representative for all egg producers. Therefore, telephone interviews with 83 farmers in the groups "Barn", "Free-range", and "Organic" were carried out in the autumn of 1997. The largest deviation was seen among the "Barn" group where only 25% reported they had mites in the autumn. In comparison, the positive answers in the "Free-range" and "Organic"

groups were 44% and 25%, respectively. This indicates that at least the results from the last two groups show the actual prevalence of chicken mites in these types of egg production.

10.2 Behavioural response of the chicken mite to host related stimuli

During the day time, chicken mites usually remain hidden in cracks and crevices. They only come out to feed during the night. The question is how they find their way to a host. Studies related to this question were initiated in 1997. Several host-related stimuli were found that influenced the behaviour of the mites.

- Temperature changes - resting mites are activated by small increases in temperature.
- Vibrations - mites are activated by vibrations carried through the medium on which they are resting.
- CO₂ - may either activate the mites or increase their attention towards other stimuli depending on the light intensity.

More detailed studies on the effects of these stimuli alone and in combination will be carried out in 1998.

10.3 Aggregation pheromones of the chicken mite

Chicken mites are known to secrete a pheromone that induces an aggregation behaviour of fed mites. In 1997 preliminary experiments were carried out aiming at isolating this pheromone. A new bioassay was developed combining paper chromatography and behavioural studies.

Glass tubes in which large number of mites had been kept for several weeks were washed in ethanol. The ethanol extract was applied on filter paper and various solvents were added. After drying, fed female mites were placed on the paper and left over night in the dark. The aggregation sites of the mites were then taken as indications of the location of the pheromone.

These experiments confirmed the usefulness of this bioassay but separation by means of paper chromatography is not very efficient, and therefore the experiments are continued in 1998 with Thin Layer Chromatography.

10.4 Litter beetles as disease reservoirs

Litter beetles, in particular the lesser mealworm *Alphitobius diaperinus*, the hairy fungus beetle *Typhaea stercorea* and the foreign grain beetle *Ahasverus advena* are commonly found in broiler houses. These beetles are difficult to control chemically, and as their developmental time is rather short, they often constitute a pest problem. In addition they are potential transmitters of disease agents; for salmonella bacteria it has been shown that these species can be infected or surface-contaminated by salmonella bacteria.

The Ministry of Food, Agriculture and Fisheries has therefore supported a project with the following specific objectives: 1) to investigate the occurrence, biology and behaviour of the beetles, 2) to develop and implement strategies for the prevention and control of the beetles, and 3) to investigate if persistent infections with *Salmonella* or *Campylobacter* are related to the occurrence of beetle infestations.

The project involves collaboration between the Danish Veterinary Laboratory, the Danish Poultry Meat Association, the Danish Pest Infestation Laboratory (Project co-ordinator), as well as many veterinarians and poultry meat farmers.

The project was established in 1996, and by now samples of beetles have been collected and analysed for the presence of *Salmonella* and *Campylobacter* from a number of sites across Denmark. This work will continue in 1998. A survey of the distribution and extent of beetle infestation and a study of insecticide resistance are also planned for 1998.

A. Spencer and J. B. Jespersen

10.5 Behaviour and population dynamics of litter beetles in broiler houses

A master's degree project on the population dynamics and behaviour of litter beetles (specifically *Alphitobius diaperinus*, *Typhaea stercorea*, and *Ahasverus advena*) in a broiler farm was initiated in September 1996, and is planned to end mid-1998.

All of these species are common pests in stored products world-wide and have therefore been extensively studied in laboratory trials. However, little or no work has been carried out on the field biology of these beetles in chicken production facilities. This project examined population increase, developmental rates, flight activity and habitat preferences in a commercial broiler facility for the beetle species mentioned above. The investigation was carried out as a field study in two six-week periods. A new trap design was used in the experiment and was therefore tested as part of the study. All experiments were carried out on a Danish broiler farm on Funen.

The development times from egg to adult emergence of *T. stercorea*, *A. diaperinus* and *A. advena* were estimated to be approximately three weeks, four weeks and five to six weeks, respectively. All three species were therefore only able to complete one generation within one chicken rearing period of six weeks. *T. stercorea* and *A. advena* were observed to leave the litter shortly after adult emergence. All three species had a distinct preference for a particular environment and the distribution of the two large fungus feeders, *T. stercorea* and *A. advena*, was closely correlated in all samples. *A. advena* was the only beetle to fly in significant numbers.

Tube traps were well suited for monitoring the activity of adult *T. stercorea*, *A. advena* and *A. diaperinus* adult and larvae in the litter. Bait bags were well suited for monitoring of the activity of *T. stercorea* and *A. advena* on the walls.

A full description of the investigation is now being published as a master's thesis by L. D. Erichsen; the results will later be published as a formal paper.

L. D. Erichsen and J. B. Jespersen

10.6 *Typhaea stercorea*, a carrier of *Salmonella* in a Danish broiler house

In a collaborative project with the Danish Veterinary Laboratory, the ability of the hairy fungus beetle *Typhaea stercorea* to act as a carrier of *Salmonella infantis* in a broiler house between broiler rearing cycles was investigated. The investigations were partly carried out in a broiler house with a permanent *S. infantis* infection, and partly as a laboratory trial, where specified pathogen-free chicks were fed with *S. infantis* positive *T. stercorea* collected from the broiler house. It was concluded that *T. stercorea* may act as a potential carrier of *S. infantis* between successive broiler cycles.

The results are detailed in a paper by B. Hald, A. Olsen and M. Madsen entitled “*Typhaea stercorea* (Coleoptera: Mycetophagidae), a carrier of *Salmonella enterica* serovar *Infantis* in a Danish Broiler House” (In Press) *Journal of Economic Entomology* 1998.

J. B. Jespersen

10.7 Entomopathogenic fungi for control of litter beetles

In 1996 a survey was conducted of the natural occurrence of entomopathogenic fungi in litter beetles. Beetles from only five locations (N=45) were infected by entomopathogenic fungi, and the fungus prevalence was low not only for the lesser mealworm (*Alphitobius diaperinus*) but also for other potential beetle pests in poultry farms (*Typhaea stercorea*, *Ahasverus advena*). However, despite the limited natural occurrence of entomopathogenic fungi, a previous screening showed that larvae of the lesser mealworm (*Alphitobius diaperinus*) were susceptible to strains of most species of hyphomycetes tested (*Beauveria bassiana*, *B. brongniartii*, *Paecilomyces farinosus*, *P. fumosoroseus*, *Metarhizium anisopliae*, *Verticillium lecanii*, *Acremonium* sp. and *Fusarium* sp.). Tests with *B. bassiana*, *M. anisopliae* and *P. fumosoroseus* confirmed earlier observations that larvae and pupae were much more susceptible to infection than adults. Bioassays, in which insects were immersed in aqueous spore suspensions, showed that it was possible to select fungal strains that were not only highly pathogenic to larvae but also showed relatively high pathogenicity against adult beetles. These strains will be tested in cage

experiments to evaluate their potential for spread in populations of the lesser mealworm.

T. Steenberg and J. B. Jespersen

10.8 The potential of entomopathogenic nematodes as biological control agents of *Typhaea stercorea* (L.) (Coleoptera: Mycetophagidae) in broiler houses

Insecticides have been used in attempt to control *Typhaea stercorea*. However, an integrated approach (IPM), which includes biological control, is suggested as a better and more sustainable way to control the beetle. One group of biological control agents is entomopathogenic nematodes and their associated bacteria, which are unharmed to vertebrates, and therefore have potential as biological control agents in broiler houses.

The susceptibility of immature and adult *Typhaea stercorea* to four entomopathogenic nematode species was tested on filter paper. One nematode species, *Steinernema carpocapsae*, proved to be more effective against *T. stercorea* than the others and was selected for further studies. The persistence and virulence of *S. carpocapsae* were tested in several combinations of wet chickenfeed, wheat, straw and capillary matting (used in plant nurseries) with the intention of creating a bait system that would attract the beetles and protect the nematodes from adverse effect of the chicken manure. The efficiency of *S. carpocapsae* was particularly high in a combination of chickenfeed and capillary matting with a moisture content of 50-55% wet weight, at 26°C, 100% RH. However, when the relative humidity was 70% RH, which is representative for the conditions in the broiler houses, the pathogenicity of the nematodes was limited.

The efficiency of the chickenfeed bait and a similar wheat bait placed in tube traps was tested in chicken litter with beetles in large plastic containers. After 72 and 120 hours of exposure time, only few beetles were found inside the tube traps. However, dead beetles found outside the tubes were infected with nematodes, indicating that some beetles had invaded the tubes and therefore had the potential to spread the nematodes to the litter and thus to other beetles.

For the time being the combination of the limited attraction ability of the bait system in chicken litter and the limited persistence of the nematodes in

the bait - when placed under realistic humidity levels - makes the bait and tube trap system incomplete for the use of controlling *T. stercorea* in broiler houses.

T. S. Mortensen

10.9 Chemical control of litter beetles in a parent flock farm

The lesser mealworm *Alphitobius diaperinus* (together with certain other beetle species) is a problem in the egg production houses of parent flock farms, which produce eggs for broiler production. The problems are mainly related to the damage that the beetles cause to the insulation of the houses and the potential of the beetles to act as reservoirs for pathogens, in particular salmonella.

A field test was carried out to evaluate the efficacy of treatments made with Baycidal WP 25 alone or in combination with Baythion-EC or Solfac WP 10 to control litter beetles (in particular *A. diaperinus*) in such parent flocks. The active ingredients in Baycidal WP 25, Baythion-EC, and Solfac WP 10 are triflumuron, phoxim and cyfluthrin, respectively.

The test was carried out in a parent flock in South Jutland and ran from February 1997 until January 1998. The farm comprises eight houses, separated by a feed alley. One week before new hens were introduced, two of the houses were sprayed with Baythion-EC, while two other houses were sprayed with Solfac WP 10. In both cases the treatment involved spraying the walls up to one metre above ground level, and spraying the floor up to one metre from the walls. These four houses, together with two further houses, were treated with Baycidal WP 25 at different intervals from April to December. The Baycidal WP 25 treatments involved topical application to the manure heaps under the slats. Two houses were left as untreated controls.

The efficacy of the treatments was monitored every two weeks by the placement of 10 tube traps in each house between one and three days on the top of manure, out of reach of the hens. All the treatment strategies successfully controlled *A. diaperinus* in the six treated poultry houses, whereas in the two untreated control houses the number of *A. diaperinus* increased steadily during the period.

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