10. Arthropod pests in poultry production

10.1 Litter beetles

The litter beetles, *Alphitobius diaperinus* (the lesser mealworm), *Typhaea stercorea* (the hairy fungus beetle), *Ahasverus advena* (the foreign grain beetle) and *Carcinops pumilio* are commonly found in Danish poultry houses. These beetles are difficult to control and often constitute a pest problem. In addition they are potential transmitters of human and avian disease.

In 1996 the Ministry of Food, Agriculture and Fisheries supported a three-year 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), and many veterinarians and poultry meat farmers.

The project will conclude in 1999, but has already achieved most of its objectives. The principal findings made so far are detailed below.

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10.2 The role of litter beetles in the transmission of disease

Fourteen broiler houses were non-randomly selected based on their salmonella infection status. Nine were persistently contaminated with salmonella while the remaining five were salmonella negative.

In each house, beetles collected from two consecutive flocks and during the empty period between these flocks were monitored for the presence of salmonella and campylobacter.

Beetles sampled during production were shown to be able to harbour salmonella and/or campylobacter, confirming earlier studies in Denmark and elsewhere. More significantly however, in one house, beetles collected during the empty period were also found to be salmonella positive. This demonstrates the potential for litter beetles to transfer infections between successive flocks. However, our results also suggest that salmonella from beetles may not always be transmitted to the chickens and that beetles living in infected houses can remain free of infection.

All cases of campylobacter positive beetle samples were detected in connection with a positive chicken flock. In no case was campylobacter isolated from beetles taken from an empty house.

This work was carried out in collaboration with M. N. Skov, L. Petersen and M. Madsen of the Danish Veterinary Laboratory, Århus. The findings will shortly be submitted for publication. All bacterial analysis was carried out by collaborators at DVL, Århus.

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10.3 A survey of litter beetles in Danish broiler houses

Samples were collected from 16 beetle infested broiler houses using two trap types. Wall-traps consisting of netting bags containing boiled wheat suspended against the outer wall out of reach of the chickens were found to be effective in collecting the fungus feeding species *Typhaea stercorea* and *Ahasverus advena*. Floor-traps made from sections of PVC pipe perforated with 4 mm holes, stoppered at each end and placed half-filled with chicken feed within the litter, were effective in collecting *Alphitobius diaperinus* and also collected *Carcinops pumilio*. Five of each trap types were placed in each broiler house for one week immediately prior to slaughter. The traps were then returned to the laboratory where the beetles collected were speciated and counted.

A. diaperinus was the most prevalent species and was found in all the houses surveyed. *T. stercorea* and *A. advena* were also common and were found in large numbers in many houses. No other beetle species were identified.

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10.4 Entomopathogenic fungi for control of litter beetles

This was the final year of the project, aimed at evaluating the potential of entomopathogenic fungi for the control of the lesser mealworm in poultry houses. In the laboratory we have selected a number of fungal isolates with high pathogenicity to larvae or adult beetles. The field efficacy of these isolates should be tested in the future. Planned experiments with application of fungus in bait stations were abandoned, as initial experiments showed that is was very difficult to attract the pest into the bait stations when placed under realistic conditions, i.e. in substrates providing alternative hiding places for larvae and adults. During 24 hours 5-10% of late-instar larvae would enter the bait stations, and the experiments indicated that the larvae were attracted to the stations primarily because they provided a hiding place, while the food provided (boiled wheat kernels or a solid substrate consisting of corn flour, wheat bran, dry yeast, water and agar) was not very attractive. It should be evaluated whether the selected fungal isolates can control the lesser mealworm by spreading in the population after 5-10% have been inoculated in bait stations. Furthermore, other food sources should be evaluated as baits.

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10.5 Insecticide use and resistance in beetles infesting broiler houses in Denmark

A survey of Danish broiler producers was conducted by way of a detailed questionnaire to ascertain the prevalence of litter beetle infestation, and the control measures used to manage them. A total of 177 questionnaires were returned completed and are included in our analysis. This represents approximately 54% of Denmark's broiler producers.

Almost 60% of those responding reported litter beetle infestation. Of these 76% used insecticidal treatments. A wide variety of insecticides were used, with organophosphates being the most popular one. In spite of the persistence of most infestations, all but one of the respondents reported good or moderately good effect from insecticidal treatment. However, in visits to infested farms soon after treatment we have often found large numbers of apparently unaffected beetles.

We are therefore currently carrying out a survey of insecticide resistance on litter beetles collected from infested farms. This study involves a range of insecticides including organophosphates, carbamates and pyrethroids. We plan to report on our findings in 1999.

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