Project Overview

Optimisation of mycopesticides for control of lesser mealworm

January 2020 – January 2022

Background and project importance

Lesser mealworm (*Alphitobius diaperinus*), also known as darkling or litter beetle, is a significant insect-pest of the chicken meat industry in Australia and overseas. This is due to its ability to carry avian and food borne pathogens and damage the structures of broiler houses through tunneling. Current control measures for lesser mealworm are chemical-based and though they are somewhat effective, they produce residues and are subject to the inevitable development of insecticide resistance. Two specific species of fungi that can act as parasites to insects have been identified as potential alternative control agents for lesser mealworm. Both fungi are natural pathogens of lesser mealworm and are not toxic to birds or mammals. Moreover, both fungi species have been formulated into mycopesticides that have been registered in Australia and overseas.

Preliminary research by AgriFutures Australia (PRJ-010321) developed a proof of concept for mycopesticide control of lesser mealworm populations in chicken meat broiler houses using two species of fungi. Field trials conducted at a meat chicken farm in southeast Queensland showed that treatment of the broiler-house floor under feedlines and along walls with the granular mycopesticide formulations resulted in a significant suppression of lesser mealworm populations. This new project will see the continued testing of one of the mycopesticide formulations at different chicken farms with varying husbandry and chicken shed conditions. These new field trials will gather data to attract a commercial partner to produce a mycopesticide for the chicken meat industry to use against lesser mealworm.

Objectives

The broad objective of this project is to optimise a mycopesticide (a pesticide where the main active ingredient is composed of fungus) in order to control the pest, lesser mealworm (*Alphitobius diaperinus*), in meat chicken sheds.

This optimisation will be achieved by testing the mycopesticide against lesser mealworm populations at meat chicken farms that use a variety of husbandry practices and in varying conditions.

An additional objective of the research is to test the potential of using a mycopesticide in conjunction with chemical insecticides for greater effect on the lesser mealworm population. This data will be used to try and attract a commercial partner to produce mycopesticides that can be used by the chicken meat industry in Australia.

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Research

In its first year, the project will conduct field trials with a granular formulation of mycopesticide based on one species of fungus. It will compare its efficacy in sheds with partial litter re-use to those with fully replaced litter regimes. These trials will extend from summer into winter when lesser mealworm numbers are lower and fungal efficacy potentially greater to test seasonal effects on the effectiveness of the mycopesticide.

In the laboratory, a liquid formulation of the mycopesticide will be developed for comparison to the granular formulation. Laboratory testing will also be conducted on the potential use of current industry insecticides with mycopesticides at the same time to see whether they improve overall efficacy.

In the second year, field trials will be conducted on hard floor meat-chicken sheds with variations in spatial application; for example, only applying the mycopesticide to the brooding section of the shed. The field trials in the second year will test both a granular formulation and a liquid formulation of the mycopesticide. These trials will optimise the mycopesticides for lesser mealworm control and generate the data needed for commercial uptake.

Outcomes

The research hypothesis is that mycopesticides can provide a low-cost and environmentally friendly alternative to synthetic insecticides for the control of lesser mealworm in chicken-meat production sheds.

Other expected research outcomes include the confirmed efficacy of the mycopesticide in chicken sheds that use full litter replacement husbandry and soil floors versus in chicken sheds that use partial re-use systems with both soil and hard floors. The efficacy of a liquid formulation of the mycopesticide will also be evaluated. Laboratory data on the combination of mycopesticides with chemical insecticides as a control strategy for lesser mealworm will also be generated from this research.

Implications

The development of an effective mycopesticide to control lesser mealworm that is non-toxic to birds and humans will have a significant impact on the Australian chicken meat industry. It will contribute to sustainable practices and environmental protection and build consumer confidence in chicken meat production. The non-toxic nature of the mycopesticides provides new opportunities for the disposal and marketing of chemical-free used litter. Alternating mycopesticides with industry-approved insecticides for lesser mealworm control could increase the longevity of these insecticides. Mycopesticides use a different mode of action to chemical insecticides and therefore will kill lesser mealworm populations that have developed chemical insecticide resistance. There is also the potential for the industry to use lower doses of insecticide with a mycopesticide for a combined effect.

Lesser mealworm control with registered mycopesticides opens a gateway for fungal control of other pest species and a potential reduction in chemical use across all industries requiring insect control.

Publications

Rice SJ, Baker DK, Leemon DM (2019) Development of mycoinsecticide formulations with Beauveria bassiana and Metarhizium anisopliae for the control of lesser mealworm, Alphitobius diaperinus, in chicken broiler houses. BioControl 64:489-500

Rice SJ, Baker DK, Mayer DG, Leemon DM (2020) Mycoinsecticide formulations of Beauveria bassiana and Metarhizium anisopliae reduce populations of lesser mealworm, Alphitobius diaperinus, in chicken-broiler houses. Biol Control 144.

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