Sciarid flies on growing mushrooms - A McKinnon

# SUSTAINABLE **PEST AND DISEASE MANAGEMENT**

**Pest and disease outbreaks pose a risk to any horticultural business, and the Australian mushroom industry is no exception. Outbreaks can result in significant financial losses for the grower, and broader reputational damage to the sector as a whole. As consumers increasingly demand produce that is clean and green, a sustainable approach to pest and disease management will help protect market access for the industry into the future.**

## Paulette Baumgartl spoke to Dr Aimee McKinnon about her new project.

A new Hort Innovation project, led by Dr Aimee McKinnon from Agriculture Victoria, investigates effective alternatives to complement current pest and disease management strategies for the mushroom industry.

Mushroom parasites and bacterial diseases cause heavy losses in commercial mushroom farms worldwide, and the risk of such outbreaks in Australia has been identified as a major threat to the industry.

The project team from Agriculture Victoria, based at the AgriBio Centre for AgriBioscience in Bundoora, are investigating the use of non-synthetic biorationals in mushroom Integrated Pest and Disease Management (IPDM).

Their three-step approach begins with reviewing current scientific knowledge on the use of novel biorationals to control pests and diseases of mushrooms and

Sciarid larvae growing/feeding on oyster mushroom grain spawn (in a lab fly culture) - A McKinnon

identifying potential biorationals that are currently available in Australia.

Following this, potential products and agents targeting key pathogens and pests, such as *Trichoderma* species green mould and sciarid/phorid flies, will be tested in controlled laboratory conditions for general efficacy. this will include ensuring that agents do not interfere with mycelium growth.

Agents and biorationals that show potential in the laboratory will then be tested in trials at the Marsh Lawson Mushroom Research Unit at the University of Sydney.

## Biorationals for sustainable pest and disease management

Biorationals are biologically based pesticides used for plant (or fungal) protection. The definition is broad, including product formulations with live microorganisms, derivatives from microbes and semiochemicals which attract or repel pests. Worldwide, the market for biorationals has topped AUD $4.5 billion, with investment in the development of products growing rapidly. Farmers of all crops are increasingly adopting biological approaches. It is vital that the Australian mushroom industry also develop a 'Plan B' for pest control.

"The use of biorationals has rapidly increased in the last decade, both because of a reduction in available pesticides and because of growing public concern around sustainable plant production," Dr McKinnon said.

"This has boosted research on biorationals around the world; and so, what we see now is an increase in the availability of new and better quality biorational products on the market."

Fungal diseases such as dry bubble (*Lecanicillium fungicola*), cobweb (*Cladobotryum* species), wet bubble (*Mycogone perniciosa*), and green mould (*Trichoderma* species) impact yield and harvest quality by reducing

the cropping surface or causing direct damage to caps. Larval feeding by sciarids and phorids can also directly impact mycelial development of crop mushrooms, resulting in crop losses.

"While the control of these typical fungal diseases and insect pests with the current suite of available fungicides and biocides is often effective, their overuse risks the development of resistant fungal strains and pesticide resistance," Dr McKinnon said.

"Insecticide efficiency is often limited by the difficulty of mixing chemicals into the compost to achieve sufficient contact without being toxic to the mushroom crop."

## Ensuring Australia's knowledge capacity

Dr McKinnon is excited about the project's potential to build and expand on the existing knowledge in Australia.

"This project provides the opportunity to discuss candidate biorationals with other Australian experts, including Dr Warwick Gill [University of Tasmania], Judy Allan, and Dr Michael Kertesz [University of Sydney], as well as contributing to training new, future experts through a PhD student down the track," she said.

Dr Aimee McKinnon

Projects such as these provide further opportunity to address problems as they arise. This will help the Australian mushroom industry prepare for future challenges, such as the development of pesticide resistance, or de-registration of a key pesticide product.

"We are thinking ahead, considering how pests and diseases may evolve and new problems arise as inevitable changes come into play, such as the transition to alternative casing."

"Knowledge of how biorationals complement existing practices is important, but even more so is the future-proofing of industry though the development of new technologies. We should be ready for when chemical options diminish or simply become ineffective through overuse."

## About the researcher: Aimee McKinnon, AgriBio, Agriculture Victoria

Dr Aimee McKinnon is a research scientist conducting research on microbial-based biorationals as new technologies to target insect pests in integrated pest and disease management.

Aimee has expertise working with insect pathogens and with beneficial soil microorganisms for plant health. She has experience in developing molecular diagnostic methods and in biological control of insect pests for IPM.

Other team members include Dr Paul Cunningham (Research Leader for Invertebrate and Weed Sciences at Agriculture Victoria) with input from Agriculture Victoria's Plant Pathology research team.

Mixed sciarid/phorid flies collected at an oyster mushroom farm in Melbourne - A. McKinnon

## GLOSSARY OF TERMS

**Don't know your biorational from your non-synthetic? Unsure of the difference between organic and biological? Read on...**

**Biorational:** An all-encompassing term that includes environmentally friendly agents such as living micro-organisms, microbial derived products, attractants (lures), plant essential oils, and insect growth regulators.

**Biological**: Usually refers to a microbial agent, but may include genetic technologies such as RNA products

**Agent:** An active ingredient or organism

**Organic**: From Oxford Dictionary: 1. "Relating to or derived from living matter" 2. Food produced using a method that excludes synthetic* pesticides. *Noting that 'synthetic' implies artificial here, but technically, natural products can sometimes be synthesised.

**Non-synthetic**: Not artificial, derived from naturally occurring products.

## A TALE OF TWO PETRI DISHES

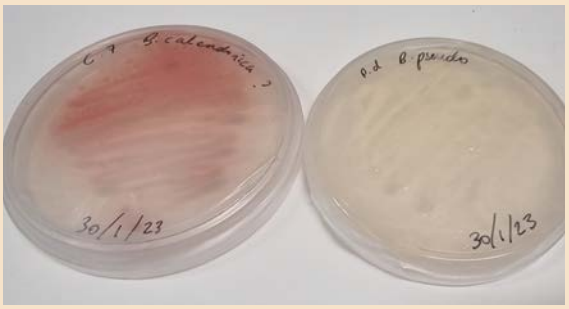
Dr McKinnon investigates insect pathogens (fungi and bacteria) for potential control of insect pests.

These insect pathogens do not harm plants and can be even beneficial for plants either by stimulating plant growth or by antagonising soil-borne fungal pathogens. It is possible that some species may be compatible with mushroom cultivation. Insect pathogenic fungi strains are already commercially available in Australia as soil health and microbiome amendments.

The ultimate aim is to test novel biorationals as IPDM technologies. Agents that potentially have multiple benefits to mushrooms are of particular interest for further research and development.

AgriBio holds a collection of entomopathogenic (insect killing) fungi which have been tested against a range of insect pests including flies and fly larvae (fruit flies, house flies). The photo below shows two petri dishes featuring closely related fungi. One species (left) is producing a pink metabolite. These fungi are known to produce a suite of insecticidal metabolites that can be extracted and tested against insect pests and fungal pathogens for control activity. So even if the fungi cannot be used directly in mushroom compost, their products might still be useful.

Dr McKinnon hopes this research project will lead to finding novel agents that could be very useful in the future, as well as identify new formulations that are available now for testing.



Petri dishes of insect pathogenic fungi (both are Beauveria species).

Hort Innovation Strategic levy investment | MUSHROOM FUND

This project has been funded by Hort Innovation using the mushroom research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au