Grower Summary

M 062

Mushrooms: Inhibiting fungicide degradation in casing, and evaluating fungicides, biopesticides and diseased area covering methods for fungal disease control

Final 2017

Disclaimer

While the Agriculture and Horticulture Development Board seeks to ensure that the information contained within this document is accurate at the time of printing, no warranty is given in respect thereof and, to the maximum extent permitted by law the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.
Before using all pesticides check the approval status and conditions of use.
Read the label before use: use pesticides safely.

Further information

If you would like a copy of the full report, please email the AHDB Horticulture office (hort.info.@ahdb.org.uk), quoting your AHDB Horticulture number, alternatively contact AHDB Horticulture at the address below.

AHDB Horticulture,
AHDB
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

AHDB Horticulture is a Division of the Agriculture and Horticulture Development Board.

Project title	Mushrooms: Inhibiting fungicide degradation in casing, and evaluating fungicides, biopesticides and diseased area covering methods for fungal disease control
Project number:	M 62
Project leaders:	Dr Ralph Noble
Report:	Final, March 2017
Key staff:	Andreja Dobrovin-Pennington
Location of project:	NIAB EMR, Pershore Centre and grower sites
Project coordinator:	Dr Jude Wilson
Date project commenced:	1 September 2015
Date project completed (or expected completion date):	31 March 2017
Key words:	Mushrooms, Fungicides, Diseases

GROWER SUMMARY

Headline

- Vivando (a.i. metrafenone) provided good control of dry bubble disease irrespective of the prochloraz resistance of the *Lecanicillium fungicola* isolate
- Vivando and Sporgon (a.i. prochloraz) were equally effective in controlling wet bubble disease but Vivando also provided control of cobweb disease
- Shirlan (a.i. fluazinam) did not affect mushroom yield or produce fluazinam residues and has potential for disease control if tested at a higher rate
- Prochloraz degrades less rapidly in casing than metrafenone or fluazinam; the rate of degradation can be reduced by adding 25% recycled casing to fresh casing
- Glucose solution increased bacterial populations of the casing without causing blotch and may therefore have potential to suppress blotch causing Pseudomonads
- A 70% clay: 30% salt mixture was as effective in suppressing regrowth of pathogens and diseased mushrooms as salt, but with a smaller effect on SMC EC

Background and expected deliverables

Sporgon (a.i. prochloraz-manganese which rapidly dissociates into prochloraz) is the only approved fungicide for the UK mushroom industry. It provides good control of wet bubble (*Mycogone perniciosa*), moderate control of dry bubble (*Lecanicillium fungicola*) and weak or ineffective control of cobweb (*Cladobotryum* species). There has been reported resistance in some *Lecanicillium fungicola* isolates to prochloraz. Vivando (a.i. metrafenone) is approved for use on mushrooms in France and Spain. There is anecdotal evidence that Shirlan (a.i. fluazinam) can give control of cobweb disease.

Biopesticides for control of fungal patens in mushroom crops are restricted to bacterial products, since the mushroom is also a fungus. *Pseudomonas chlororaphis* MA342 (Cedemon or Cedress) has an EU registration for control of fungal diseases on cereals and Serenade Soil (*Bacillus subtilis* QST 713) is registered for a wide range of fungal pathogens on crops.

Fungicide-degrading microbes can metabolise prochloraz and other pesticides into inactive by-products, thereby reducing the efficacy of an applied dose. Inhibition of prochloraz and other fungicide degradation by promotion of a microbial population antagonistic to fungicide degrading organisms could lead to improved disease control.

Information from *in vitro* agar plate tests can provide information on the inhibition of mycelial growth and spore germination of different fungal pathogen isolates to different fungicide

concentrations. However, it is unclear how these fungicide concentrations translate into effective concentrations in casing *in vivo*.

Salt is widely used for covering patches of diseased mushrooms on growing beds but this has an adverse effect on the subsequent use of the spent compost in casing or growing media by increasing the electrical conductivity. The uses of mixtures with sand or clay may reduce the salt application to the casing thereby improving the quality of the spent compost.

Summary of the project and main conclusions

1. Mushroom yield was not significantly affected by casing amendments (bark, green waste compost, recycled casing, glucose solution), fungicides (Sporgon, Vivando, Shirlan) or biopesticides (Cedress, Serenade).
2. The application of a dilute glucose solution to the casing resulted in a sustained increase in the *Pseudomonas* and *Bacillus* spp. populations in the casing without stimulating bacterial blotch.
3. During a mushroom experiment in pots, prochloraz in the casing degraded by 46% compared with 81% for metrafenone and 77% for fluazinam.
4. Prochloraz degraded more rapidly when 25% bark was added to casing. Spent casing added at 25% did not affect prochloraz degradation in a pot experiment but reduced degradation in a large scale experiment from 53-71% to 25-33%.
5. Prochloraz was found in first flush mushrooms at levels just above the detection limit but not in mushrooms grown in 25% spent casing. Metrafenone was only detected in mushrooms grown in 25% bark or with Cedress added, and here only at levels close to the detection limit and well below the MRL for mushrooms. Fluazinam was not detected in mushrooms grown in any of the casing samples.
6. Sporgon and Vivando both significantly reduced the number of mushrooms with dry and wet bubble diseases compared with the untreated control. Shirlan also suppressed dry and wet bubble diseases but the effects were not quite significant at $P = 0.05$.
7. Cedress suppressed wet bubble disease (effect not quite significant at $P = 0.05$) but did not significantly affect dry bubble or cobweb diseases. It did not cause blotch.
8. A *Lecanicillium fungicola* isolate that showed resistance to prochloraz in agar plate tests was also resistant to Sporgon in a pot culture test. However, inhibition of pathogen mycelial growth rate or spore germination on agar plates did not fully reflect potential disease control with fungicides in pot culture tests.
9. The use of a 70% clay:30% salt mixture was as effective as 100% salt in covering diseased areas and prevent regrowth of pathogens or diseased mushrooms; using clay and salt instead of salt reduced the EC of the final spent casing.

Financial and environmental benefits

- Less dependency on a single fungicide (Sporgon a.i. prochloraz) assuming Vivando (a.i. metrafenone) is registered for use in the UK in 2017
- Control of dry bubble disease caused by prochloraz resistant *Lecanicillium fungicola* isolates, wet bubble disease and of cobweb disease using Vivando
- Reduced fungicides residues in spent compost for metrafenone compared with prochloraz
- Recycling 25% casing reduces dependency on peat and may reduce the degradation of prochloraz in casing following Sporgon application
- Stimulation of a non-pathogenic population of Pseudomonads in the casing, either by adding Cedress (*Pseudomonas chlororaphis*) or a dilute glucose solution may provide antagonism to pathogenic *Pseudomonas* species that cause blotch
- Using a clay:salt mixture for disease covering was as effective in preventing regrowth of pathogens or diseased mushrooms as salt, but with a smaller and less detrimental effect on the EC of the spent casing

Action points for growers

- Look out for the UK registration of Vivando to augment disease control using Sporgon
- Investigate use of recycled casing to reduce prochloraz degradation in casing
- Use a mixture of 70% clay and 30% salt instead of salt to reduce EC in spent SMC