Grower Summary

CP 184

Downy Mildew & Late Blight Control

2019 Annual Report

Project title:	Downy Mildew & Late Blight Control
Project number:	CP 184
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Report:	Annual report, January 2020
Previous report:	None
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The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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GROWER SUMMARY

Headline

Integrated management is now essential for the effective management of downy mildews on horticultural crops. Reported here is the first year of work on a project that seeks to bring together elements of advanced diagnostic study with knowledge on current treatments and possibilities for using and adapting decision support systems/tools (DSS/DST) to painlessly maximise integrated management possibilities.

Background

The oomycetes are a large group of fungus-like organisms many of which have evolved to become pathogens of plants. A large and varied group of oomycete plant pathogens are spread by air-borne and/or water-splashed propagules and cause diseases primarily of the above-ground parts of plants are collectively known as the Aerial Oomycetes. Horticulturally significant pathogens within this group are the downy mildews (main genera in horticultural crops: *Peronospora, Hyaloperonospora, Pseudoperonospora, Plasmopara, Bremia*), stem rots, shoot diebacks and blight caused by *Phytophthora* spp. as well as shoot and leaf 'blisters' caused by *Albugo* spp.

Diseases caused by aerial oomycetes typically exhibit rapid epidemics, which if left unchecked under optimal environmental conditions have the potential to cause complete crop loss either directly by mortality, or by rendering foliar and fruit produce unmarketable. Disease control options are limited or under-utilised and currently management is heavily reliant upon the use of fungicides, often used prophylactically, as none of the available chemicals can reliably achieve curative control, and once disease is observable in crops it will often already have become established and difficult to manage. Unfortunately, the number of currently available fungicides is becoming very restricted as a result of product withdrawals and too few new introductions. The resulting reduction in the number of active ingredients being used in control programs greatly increases the risk of pathogen populations developing fungicide resistance. The use of resistant varieties, where available, is a good disease management option although their use puts huge selection pressure on oomycete pathogen populations for new races capable of overcoming host resistance. Cultural disease management methods (e.g. appropriate tilth management, removal/treatment of crop debris, manipulation of environmental conditions), often have a limited impact on disease when used alone but can greatly (even synergistically, e.g. control of {a non-oomycete with analogous epidemiology} *Botrytis* grey mould in ornamentals, O'Neill *et al*., 2002), increase the efficacy of chemicals and plant resistance in integrated management programs. Similarly, the use of rapid pathogen detection and disease simulation models can optimise the timing of fungicide applications and in some seasons reduce their number – increasing efficacy whilst reducing costs and potential environmental impacts.

Integrated pest and disease management is an increasingly important and pertinent area of research for horticulture and this project aims, through the provision of reviews and best practice grower guides, to consolidate current knowledge, ensuring that measures that can be taken up are quickly disseminated and potential barriers to uptake identified. The project builds on current knowledge of several pathosystems (specifically downy mildew on lettuce, spinach and basil and to a lesser extent onion) to develop and validate the tools required for a long-term integrated approach to disease management. New tools for the genotypic analysis of *Bremia lactucae* populations, linked to phenotypic characteristics such as 'race' and fungicide sensitivity, will allow an understanding of population diversity to directly inform resistance deployment and breeding and fungicide stewardship to be greatly improved using an approach that has previously been highly successful for potato late blight (*Phytophthora infestans*, Ritchie *et al*., 2018). The other main strand of research focusses on identifying/verifying primary inoculum in spinach and basil by detection and viability-testing of seedborne infection to steer future integrated management both by improved quality screening and providing effective tools for assessing cultural controls. Here we report on the first year's progress with reviews of pathogen biology, dissemination of inoculum and the use of elicitors in disease management, progress with fungicide sensitivity monitoring as well as, assessing pathogen races and monitoring disease risks, and progress with PMA qPCR for determination of viable seed-borne infections.

Summary

Integrated management is essential for the effective management of downy mildews on horticultural crops. This amounts to careful management of all resources available to achieve a good result by accumulation of partial- or marginal-gains, including agronomy, use of resistant or tolerant varieties where available/suitable, of clean planting materials or seeds, manipulation of growing environments and irrigation as well as careful use, alternation and timing of fungicides and/or bioprotectants. This project is focussed on improving the possibilities for integrated management and developing best practice guides by: a) reviewing and collating information on potentially exploitable disease biology, on fungicides and elicitors still available (and any possibly in the future), and on disease forecasts and decision support

tools, b) developing and improving detection diagnostic procedures to screen seed for infection to help cut this significant source of disease and c) developing molecular detection and quantitation of *Bremia lactucae* as well as consolidating and building on knowledge of markers for traits like fungicide resistance in *B. lactucae* populations, and d) developing fungicide sensitivity test protocols to check pathogen populations for fungicide resistance.

In our first year of studies, the review work is largely completed and showing some useful areas where IPM may be refined and decision support tools more widely adapted. The review of elicitors has shown that there is promise of some useful activity in these materials that should be trialled for potential use as supporting components of integrated management strategies. PCR detection of *Peronospora belbahrii* (Pb basil DM) and *Peronospora effusa* (spinach DM) has been optimised and a new procedure PMA-PCR that can distinguish between living and dead pathogen has provided some promising initial results with Pb. The first sets of fungicide sensitivity assessments have revealed variable performance with Metalaxyl showing signs of widespread resistance, as might be expected, whilst Mandipropamid and Dimethomorph still show reasonable performance – the important point here is that the protocols gave useful data and it is the longer term patterns and the scope for monitoring them for changes that is key for managing future resistance. Finally, information on markers has been collated in collaboration with US research colleagues and new primers have been developed and are being tested for quantitative LAMP qPCR detection of *Bremia*.

Financial Benefits

Aerial oomycete infections significantly reduce crop yield, with those affecting plants in propagation, in particular, able to cause total crop loss, and those in ornamentals potentially causing crops to become unmarketable (Wedgwood, *et al.,* 2016). Although elicitors can reduce disease levels, control is not usually as good as products used directly against pathogens, and effectiveness can be more variable than plant protection products, consequently financial benefits will vary widely.

Action Points

Action points are not appropriate at this stage of the project