Grower Summary

FV 449

Onions: Investigation into the control of White Rot in bulb and salad onion crops

Final 2016

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AHDB Horticulture,
AHDB
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

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Project leader:	Dr John Clarkson, Warwick Crop Centre, University of Warwick
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Key staff:	Erika Wedgwood (ADAS) Matt Hamilton (ADAS)
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Industry Representative:	Phil Langley, G's Growers
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GROWER SUMMARY

Headline

Potential new treatments and approaches for the control of *Allium* white rot have been identified in a literature review. These include new chemistry, biological control, sclerotial germination stimulants and different methods of soil disinfestation. These approaches should be integrated in subsequent experimental work.

Background

Allium white rot, caused by *Sclerotium cepivorum*, can result in severe crop losses in both bulb and salad onion crops in the UK. Intensive cropping over many years has led to build-up of sclerotial inoculum of the fungus (long-lived resting bodies) in many of the fen and silt soils most suitable for *Allium* crops as well as in other areas. Once a field becomes infested, it is very difficult and costly to continue growing the crop as the sclerotia can survive for at least 20 years. There is therefore an urgent need to identify and develop integrated strategies for effective and long-term management of the disease through reducing the inoculum potential of infested soil, hence facilitating the sustainable production of onion crops.

The main aim of this first phase of the project, was to review the recent research on *Allium* white rot, focussing primarily on physical, chemical and biological approaches to disease control and to assess where possible the efficacy, practicality and cost of different disease management options. Results of this review will be discussed with the British Onion Producers Association (BOPA) and the AHDB in order to identify the most promising, practical and economic treatments to test in laboratory, glasshouse and field experiments as appropriate in a second phase of the project.

Summary

Review method and scope

A literature search was undertaken to review relevant scientific publications, conference reports, project reports (AHDB and from overseas) and technical information concerning *S. cepivorum* and its control. Published information on related sclerotial pathogens (e.g. *Sclerotium rolfsii* and *Sclerotinia* species) and other soilborne pathogens such as species of *Verticillium* and *Fusarium* was also included where relevant. ADAS carried out the majority of the review with support and editing provided by Warwick. The key topics covered were: biology and epidemiology of *S. cepivorum*, germination of *S. cepivorum* sclerotia, detection and quantification of *S. cepivorum* in soil, chemical control, biological control, sclerotial germination stimulants, soil disinfestation, improving soil health and integrated control.

Main outcomes of the review

The main approaches for management of *Allium* white rot were identified and associated treatments with potential for further investigation are as follows:

1. Chemical control

Review summary: tebuconazole has been widely used for white rot control in the UK and in many other parts of the world, but it is clear that alternative chemistry including azoxystrobin, boscalid, penthiopyrad and procymidone has good potential, given recent studies in Australia and USA (77-95% disease reduction). It is also evident that effective control with fungicides depends on the application method, with the most benefit from targeted seedbed sprays just after sowing and follow-up foliar sprays.

Next steps: test alternative chemistry using targeted application methods.

2. Biological control

Review summary: despite extensive research in many different countries, only one microbial product (Tenet) is registered specifically for use against white rot in New Zealand and Australia. However, a recent AHDB project FV 219b demonstrated that some UK registered biocontrol agents such as Serenade ASO (*Bacillus subtilis*) and Prestop (*Gliocladium catenulatum*) may reduce disease (70-77% disease reduction) although results were not always consistent due to variation in inoculum pressure. Since then other products have come onto the market that may also have potential. Again, application method is of key importance with in-furrow treatments being the most effective option for delivering these products to the root zone.

Next steps: Test the most effective biological control products available using targeted applications to the root zone.

3. Sclerotial germination stimulants

Review summary: S. cepivorum sclerotia only germinate in response to sulphur-related chemical compounds released from the roots of *Allium* plants. One of these with a high stimulatory effect is diallyl disulphide (DADS) which has been used to artificially initiate germination in the absence of a host, resulting in up to 80-90% reduction in viable sclerotia. Similarly, composted onion waste has also been used to achieve the same result but application rates and supplies are limited. Currently, there are no longer any commercial producers of DADS but other products based on garlic that are being developed for other crop protection applications, or for the food industry, may be a viable alternative. These include Ecospray products that are available in the UK and which contain actives which may stimulate germination of sclerotia.

Next steps: identify commercial sources of *Allium*-based products and test feasibility of use and efficacy.

4. Soil disinfestation

Review summary: Sclerotia of *S. cepivorum* can also be killed by other methods including chemical and biofumigation, soil solarisation, steaming, flooding and anaerobic disinfestation. The use of chemical fumigants has now been severely restricted but recently a new product based on dimethyl disulphide (DMDS) aimed at nematode control has also been shown to have activity against *S. rolfsii* and registration is now being sought in the UK. DMDS is present both in composted onion waste and brassica residues and is recognised as a fungitoxic compound and hence may have potential against white rot. Biofumigation through the chopping and incorporation of certain brassica crops (usually mustards or radish) into soil has also received attention for control of soilborne diseases, but remains largely untested against *S. cepivorum*. The main problem of using this approach as a control measure is the cost and logistics of fitting a biofumigant crop into a rotation and most crops will not produce adequate biomass over the winter period. However, a number of biofumigant-derived products such as mustard meals and oils are coming onto the market and may have potential for more immediate application. Of the other soil treatments, anaerobic disinfestation (ASD) also holds some promise. This process involves incorporating an organic feedstock such as a green manure, irrigation and sealing with plastic to initiate anaerobic conditions. ASD has been shown to reduce disease caused by *S. rolfsii* and, while untested for control of white rot, other studies have shown that flooding and high soil moisture conditions reduce viability of *S. cepivorum* sclerotia. Finally, steaming and soil solarisation although potentially effective for white rot control, are probably impractical due to cost and the UK climate, respectively.

Next steps: test most promising approaches; biofumigant crop products, DMDS fumigation and ASD.

5. Improving soil health

Application of organic amendments such as green manures, manures and composts may have a general beneficial effect on soil health through increased microbial activity and lead to general suppression of soilborne diseases including sclerotial pathogens. However, there is little evidence that this approach is particularly effective for control of *S. cepivorum*.

Next steps: although soil health / microbial activity must be maintained to maximise potential disease suppression, this approach is difficult to test in the short-term.

6. Integrated control

No single management practice has resulted in complete control of *Allium* white rot, and for that reason, some studies have sought to combine a number of different approaches. Generally, this has resulted in an enhanced level of disease control and notable examples include combinations of biological control agents and fungicides, DADS and fungicides, and biological control agents with green waste.

Next steps: develop and test integrated control approach based on individual treatments identified above.

Financial Benefits

The bulb onion and salad onion sectors at 8,945 ha and 1601 ha respectively, were worth £97M and £24M in 2013 (Defra horticultural statistics, 2014). White rot can greatly reduce marketable yields and cause significant financial losses and it is estimated that a minimum of 2-3% of UK bulb onions are affected annually equating to around £2.9M of lost crop. In salad onions the level of damage is higher at around 10-15% equating to £3.6M. Reduction of these losses by just 50% through development of an integrated control approach would increase the value of bulb and salad onions by £3.3M annually.

Allium white rot control needs to be sustainable and remain effective over the medium to long term, which is challenging due to the diminishing availability of effective fungicides/chemical soil sterilants and the absence of other fully effective disease management options. Integrated disease management programmes that combine a wide range of management options, considering soil, seed/set and crop, offer the greatest potential for long-term sustainable control of white rot. Integrated white rot control programmes that restrict the use of chemical fungicides through the adoption of alternatives will help to manage/prevent resistance in the remaining, or new, chemical fungicides.

Integrated control could for example include the use of anaerobic digestion solids in ASD (£125/ha) or germination stimulant (£180/ha) to reduce sclerotial inoculum followed by fungicide (£18/ha) or biological (£288/ha) treatments. The possible overall outlay of around £500 would be financially worthwhile given crop values of over £10,000 per hectare.

Areas of silt and fen soils with high yield potential have been abandoned due to high *Allium* white rot levels and other growing areas are also infested. It is now possible for growers to send soil samples for molecular quantification of *S. cepivorum* inoculum although the value of this in predicting disease levels has yet to be assessed. Adoption of integrated strategies that take account of density of sclerotia and integrated approaches to reduce inoculum and disease may allow some areas to be brought into production and current areas to remain in production.

Action Points

- Map areas of white rot infested land using crop records and/or the results from soil samples, and ensure farm staff are aware of them.
- Take care that your own, or hired, farm equipment does not bring contaminated soil onto “clean” land.
- Consider preventative use of fungicides (including seed treatment) if there is a white rot risk in the field.
- Be aware that a combination of methods including cultural, biological and chemical controls will be required for the reduction of white rot sclerotia in soil and the prevention of crop infection.