Grower Summary

CP 80

Pathogen diversity, epidemiology and control of Sclerotinia disease in vegetable crops (HDC Studentship)

Annual 2012

Disclaimer

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 HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

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Project Number:	CP 80
Project Title:	Pathogen diversity, epidemiology and control of Sclerotinia disease in vegetable crops
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Contractor:	Warwick Crop Centre, University of Warwick, CV35 9EF
Industry Representative:	Martin Evans, Fresh Growers Limited,
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Headline

In initial laboratory trials brown mustard *Brassica juncea* 'Vittasso' significantly reduced germination of sclerotia of *Sclerotinia sclerotiorum* by 61% in comparison with an untreated control. Other biofumigant crops also significantly reduced germination, indicating they may be useful as part of an integrated disease management program.

Background

The pathogen – *Sclerotinia sclerotiorum*

Sclerotinia sclerotiorum (Lib.) de Bary is a plant pathogenic fungus that affects many economically important crops world-wide (Hegedus and Rimmer, 2005), (Purdy, 1979) and a wide host range of over 400 plant species (Boland and Hall, 1994). Crops susceptible to Sclerotinia disease include lettuce, vegetable Brassicas, oilseed rape, beans, peas, potatoes and carrots (Saharan and Mehta, 2008).

The long term survival structures for Sclerotinia are small black resting bodies called sclerotia (Willetts and Wong, 1980) which when brought close to the soil surface germinate to produce mushroom-like apothecia. These then release air-borne ascospores which infect plants, upon which further sclerotia are formed and are returned to the soil (Bolton *et al.*, 2006). Sclerotia can also geminate to produce hyphae which can attack plant tissues directly (Bardin and Huang, 2001). The number of sclerotia produced by *S. sclerotiorum* on different plant tissues is variable and is an important factor in determining the inoculum levels in soil following an infected crop (Leiner and Winton, 2006).

A related species, *S. subarctica,* has been found in the UK (Clarkson *et al.*, 2010) on meadow buttercup and also more recently in a carrot crop in Scotland. Previously this pathogen has only been found in Norway (Holst-Jensen *et al.*, 1998) and in Alaska (Winton *et al.*, 2006). The symptoms caused by *S. subarctica* are very similar to *S. sclerotiorum* and therefore may be undetected in crops in the UK. One aim of this work is therefore to establish the distribution and ecology of this species in the UK, on both crops and wild hosts.

Sclerotinia on carrot

This project will focus on Sclerotinia disease on carrots, as it is one of the most economically important diseases affecting carrot production worldwide (Kora *et al.*, 2005) and has been reported in over twenty carrot producing countries (Kora *et al.*, 2003). Previous research has shown differences in aggressiveness between isolates of *S. sclerotiorum* on carrots (Jensen *et al.*, 2008). Possible pre-harvest resistance has been shown in glasshouse trials with carrots, (Foster *et al.*, 2008) although it is thought that control of Sclerotinia disease in carrots is best obtained by preventing leaf infection and reducing the quantity of sclerotia in the soil (McQuilken, 2011).

Control of Sclerotinia disease

Fungicides are applied to kill ascospores before they infect plants, with the best protection obtained by spraying before canopy closure (McQuilken, 2011). The timing of spraying is critical to the effectiveness of protection provided by fungicides, so new control methods to reduce the viability of sclerotia in the soil would help to eliminate this issue. Also, some of the effective active ingredients in fungicides currently used routinely against Sclerotinia disease such as boscalid, carbendazim, cyprodinil, fludioxonil (Matheron and Porchas, 2008), azoxystrobin and difenoconazole are classed as medium to high risk for resistance (McQuilken, 2011).

Various non-organic soil amendments have been shown to inhibit sclerotial germination, such as potassium bicarbonate (Ordonez-Valencia *et al.*, 2009) and calcium cyanamide (Perlka®) (Huang *et al.*, 2006), but these are considered expensive by growers. Clipping of carrot foliage to prevent lodging and hence plant to plant spread of infection between beds was found to protect against Sclerotinia disease in carrots (Kora *et al.*, 2005), as does applying optimum amounts of nitrogen to limit canopy growth and lodging (McQuilken, 2011). There has been much research into biological controls, with *Coniothyrium minitans* being commercialised and marketed as ‘Contans WG’, although it does not always provide consistent results under field conditions (Fernando *et al.*, 2004).

It is thought that using *Brassica* green manure crops for biofumigation can provide control against Sclerotinia disease (Porter *et al.*, 2002), but further work is needed to establish which crops work against which pathogens, as *Brassica juncea* was found to be the only cruciferous plant to delay germination of *S. sclerotiorum* sclerotia in one study, (Smolinska and Horbowicz, 1999) yet *Brassica oleracea* var. *caulorapa* reduced mycelial growth in another (Fan *et al.*, 2008). A different study found that a blend of *Brassica napus* and *Brassica campestris* reduced the viability of sclerotia in the soil (Geier, 2009).

The aims and objectives of this project are:

Aims: To identify potential new soil treatments for control of Sclerotinia disease and to assess the impact of pathogen diversity on both aggressiveness and fungicide sensitivity.

Objectives:

i. To determine the effect of organic soil amendments on the survival of sclerotia of *Sclerotinia sclerotiorum*.
ii. To determine the aggressiveness of different *Sclerotinia* genotypes and species on commercial carrot varieties and quantify production of sclerotia.
iii. To evaluate the sensitivity of different *Sclerotinia* genotypes and species to fungicides.
iv. To investigate the epidemiology and control of *Sclerotinia subarctica.*
v. To carry out a population study of *S. sclerotiorum* on *Daucus carota* in the UK.

Summary of the results and main conclusions

Objective 1 - To determine the effect of organic soil amendments on the survival of sclerotia of *Sclerotinia sclerotiorum*.

Initial results show that some biofumigant crops can suppress carpogenic germination of *S. sclerotiorum*, hence reducing the number of apothecia produced. *Brassica juncea* 'Vittasso' provided the best control, reducing germination by 61% compared with the untreated control (Figure 1). Only a small reduction in germination was observed for mustard meal pellets (Biofence) and *Coniothyrium minitans* (Contans WG). Perlka® also performed well in the germination tests, as would be expected from previous research.

The results from a preliminary *in vitro* trial showed that *Brassica juncea* 'Pacific Gold' delayed or reduced mycelial growth of *S. sclerotiorum* on agar. Further such *in vitro* work is needed to establish whether the effect on sclerotia in the soil box experiments is due to the direct action of volatile gases being released from the plant material, or due to other effects such as increased microbial activity.

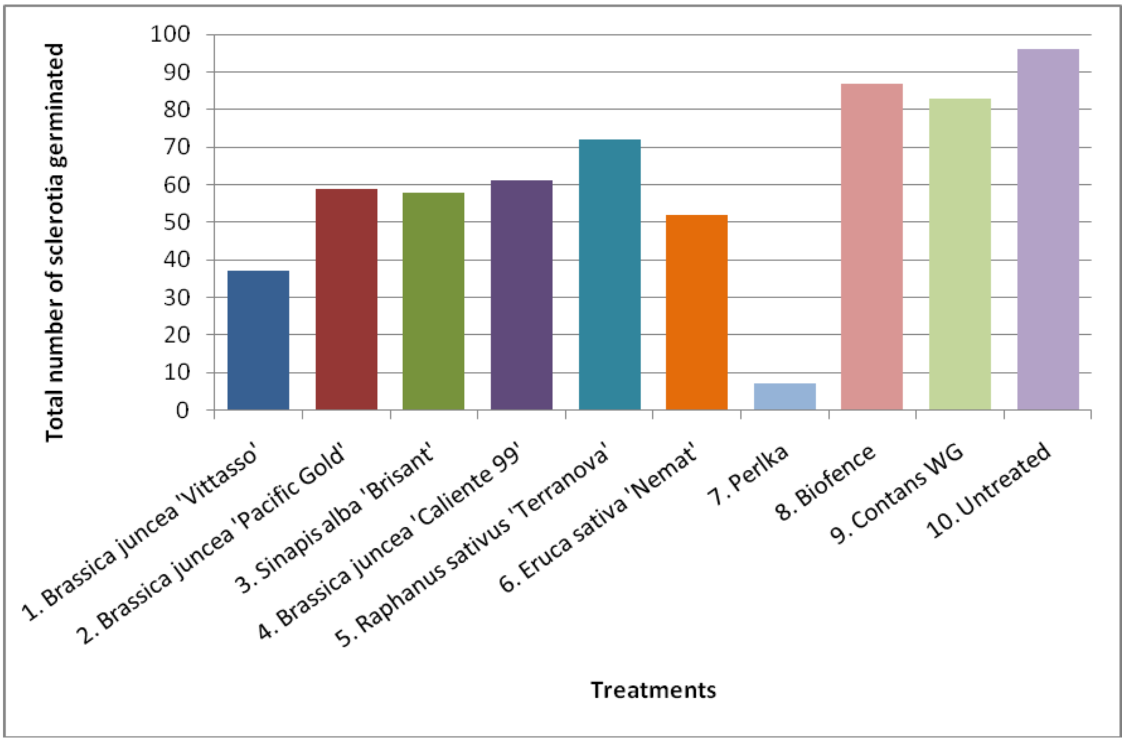

Figure 1 – The effect of biofumigant crops (treatments 1 to 6), Perlka®, Biofence and Contans WG on final germination of sclerotia after 150 days in a soil box biofumigation experiment.

Objective 2 - To determine the aggressiveness of different Sclerotinia genotypes and species on commercial carrot varieties and quantify production of sclerotia.

Roots from a carrot diversity set grown by the Genetic Resources Unit at Wellesbourne were inoculated with different isolates of *S. sclerotiorum.* Generally, isolate L6 produced smaller sclerotia in large numbers, and isolate L44 produced large sclerotia in small numbers. Some of the carrot accessions produced only a small quantity of sclerotia for both isolates, and these may be useful for any future breeding of new carrot varieties. The amount of sclerotia returned to the soil by an infected crop will therefore vary depending on the isolate causing the infection.

Whole carrot plant inoculation trials are currently underway to establish if there are any differences in susceptibility.

Objective 4 - Epidemiology and control of *Sclerotinia subarctica.*

Preliminary results from studies using DNA based microsatellite markers show that there is considerable diversity in isolates of *S. subarctica* that have been obtained from Scotland, in comparison with those obtained from buttercups in Hereford. *S. subarctica* has been found in all sampling carried out in Scotland so far and it is hoped that further sampling in Scottish crops will indicate how prevalent this species is, particularly as symptoms of infection in the field appear to be the same as *S. sclerotiorum*.

Conclusions

- Initial results show that all but one of the biofumigant crops tested against *S. sclerotiorum* sclerotia significantly reduced carpogenic germination and production of apothecia*.*
- *Brassica juncea* 'Vittasso' reduced carpogenic germination of sclerotia by 61% in comparison to the untreated control.
- *Brassica juncea* 'Pacific Gold' completely inhibited mycelial growth of *S. sclerotiorum in vitro* and delayed growth at lower rates.
- Some carrot roots produce very few sclerotia and could be used in future breeding programs.
- Initial results suggest that *S. subarctica* isolates are more diverse in Scotland compared to those found in Herefordshire.

Financial Benefits

Financial benefits have yet to be established – further details on this expected at the end of year 2 of the project.

Action Points

Experiments are still underway to establish proof of concept, so no action points at present.