Grower Summary

PE 024

Basil: Improving knowledge and control of downy mildew in protected and outdoor crops

Annual 2016

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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.

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Project title:	Basil: Improving knowledge and control of downy mildew in protected and outdoor crops
Project number:	PE 024
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Date project commenced:	01 September 2015
Date project completed (or expected completion date):	31 August 2017

GROWER SUMMARY

Headline

- Basil downy mildew infections can occur at temperatures between 5 and 25ºC.
- Agastache, lavender, sage and catnip can all act as alternate hosts for *Peronospora belbahrii*, the pathogen responsible for basil downy mildew.

Background

A recent BHTA survey showed that approximately 30 ha of sweet basil (*Ocimum basilicum*) is grown in the UK, with about 25% under protected conditions. The majority of the crop is grown outdoors in the summer. Several crops can be produced from the same area in the same season so the total area grown will be considerably larger than this. It has been estimated that the value of the crop is 'in the order of tens of millions of UK sterling'.

Basil downy mildew, caused by the biotrophic oomycete *Peronospora belbahrii* was first reported in sweet basil in the UK during the summer of 2010. Initially the disease was given quarantine status, with infected crops subject to statutory action; this status was lifted in 2012. The UK fresh basil industry is highly valuable and the recurring problem of downy mildew is causing growers major issues.

Although new to the UK, the disease is endemic in many parts of Europe (including Switzerland (2001), Italy (2003), France (2005) and Hungary (2011)), North America, Africa, Asia and South America.

There has been a great deal of work published on basil downy mildew however knowledge gaps have been identified, particularly relating to sources of inoculum, role of alternate hosts, epidemiology and control. These gaps will be addressed in this project.

Summary

In the first year of the project the main focus of work has been to,

1) Determine whether *P. belbahrii* is present in UK seed lots and whether infected seed can act as a primary source of infection.
2) Establish risk factors for infection of basil by *P. belbahrii*
3) Establish alternate hosts for *P. belbahrii*.

Determination of the presence of *Peronospora belbahrii* DNA in basil seed samples

To date 11 seed lots have been sourced, the majority of these have come from seed where there had been a problem with downy mildew in the ensuing crop. Of the 11 seed samples examined all but one contained *P. belbahrii* DNA. Six of the samples contained *P. belbahrii* DNA at similar levels across all five replicates suggesting an evenly distributed contamination of the sample. Of the six samples all but one contained high levels of *P. belbahrii* DNA, with two samples containing extremely high levels, with average cycle threshold (Ct) values of 24.7 and 29.9 respectively. The remaining four samples all contained low levels of *P. belbahrii* with between 1 and 4 replicates containing no *P. belbahrii* DNA.

Generally, Ct values of 29 or less are considered strong positive reactions and are indicative of abundant target DNA in the sample. Ct values of 30-37 are positive reactions and indicate moderate amounts of DNA, whereas values 38-40 are weak reactions and indicate a minimal amount or no target DNA in the sample.

Seed washings and oospore counts have been carried out on five samples. No oospores were detected in any of the seed washings suggesting that the *P. belbahrii* DNA detected in the seed was from an internal contamination.

Seed will continue to be sourced and analysed in the second year of the project.

Determine the conditions required for infection of basil by *P. belbahrii*

a) The effect of light on infection of basil by *P. belbahrii*.

Infection of basil by *P. belbahrii* was significantly affected by light. Incubation of basil plants in the light for the first 18 h after inoculation resulted in no plants developing downy mildew symptoms. In contrast, over 50% of the plants incubated in the dark developed the yellow discoloured areas on the upper leaf surface and brown downy sporulation on the underside of the leaves associated with basil downy mildew. This suggests that basil downy mildew infections are likely to occur overnight rather than during daylight hours.

b) The effect of humidity on leaf wetness

Downy mildew relies on the presence of water on the leaf surface for infections to occur. Environmental conditions such as humidity have a significant effect on the time taken for leaves to dry. Experiments carried out to determine the length of time it took for wet basil leaves to dry showed that increasing the humidity increased the length of time it took for water to dry from the surface of basil leaves. Leaves dried after 1 hour when exposed to a humidity

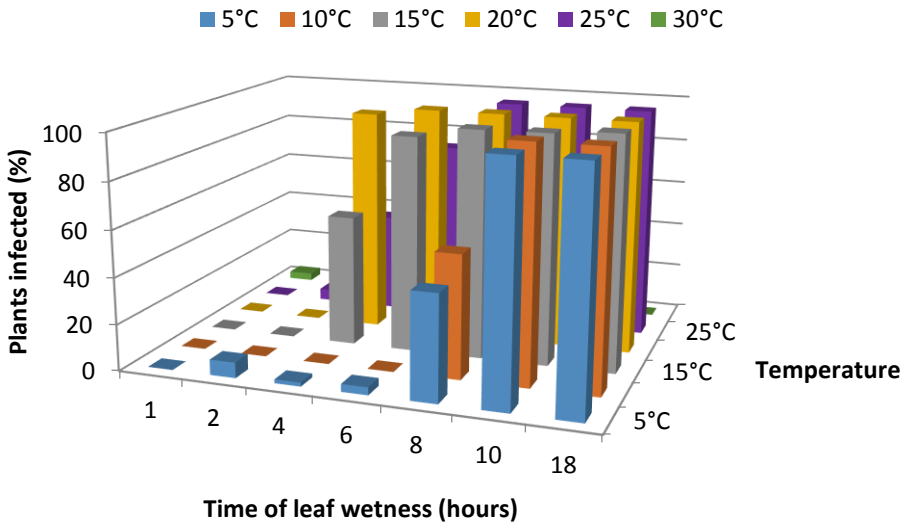
of 20%, 2.5 hours at 50% humidity and 6 hours at 80% humidity. Leaves subjected to 100% humidity remained wet for the duration of the test.

This testing was carried out on basil grown under protection. As leaves grown outdoors may have different physiological characteristics which, in turn, affect how water is distributed on the leaf these tests will be repeated on outdoor grown basil.

c) The effect of temperature and leaf wetness on the infection of basil by *P. belbahrii*

Infection of basil by *P. belbahrii* was examined at six temperatures (5, 10, 15, 20, 25 and 30°C) and six leaf wetness periods (1, 2, 4, 6, 10 and 18 hours). Downy mildew infection occurred when plants were incubated at temperatures between 5 and 25ºC with the infection highly dependent on the length of time a leaf was wet (see Figure below). Limited or no infection of basil plants occurred at 30ºC irrespective of leaf wetness duration. Limited infection also occurred, irrespective of temperature, when leaves were wet for 2 hours or less. Increasing leaf wetness to 4 hours resulted in 97% of basil plants becoming infected by downy mildew when they were incubated at 20ºC. Four hours of leaf wetness also resulted in infection when plants were incubated at 15 or 25ºC, however the level of infection was reduced compared to plants incubated at 20ºC, with 56 and 43% of plants infected at 15 and 25ºC respectively. Increasing leaf wetness to 6 hours increased infection at 15ºC and 25ºC to 93% and 78% of plants respectively; 100% of plants were infected at these temperatures when leaf wetness was increased to 8 hours. A minimum of 8 hours of leaf wetness was required for downy mildew infection of basil to occur at 5 or 10ºC, with 45 and 53% of plants infected respectively. Increasing leaf wetness to 10 hours resulted in 100% of plants infected at both 5 and 10ºC.

Combining all these data suggest that infection of basil is only likely to occur overnight when humidity is greater than 70%. A risk grid based on these data will be produced to help growers determine when the basil plants are most at risk of infection by downy mildew.



Effect of temperature and leaf wetness on infection of basil by *Peronospora belbahrii*.

The existence and importance of alternate hosts for *P. belbahrii*

Fourteen plant species from across the Lamiaceae genus were tested for susceptibility to *P. belbahrii*. Of the plant species tested agastache, lavender, common sage and catnip were the only ones which showed symptoms associated with *P. belbahrii*. Profuse sporulation was observed following infection of agastache and lavender, sporulation was sparse following infection of common sage and no sporulation was observed on catnip. Basil plants inoculated with spores obtained from the infections on sage, lavender and agastache all showed symptoms of basil downy mildew.

All the alternate hosts identified were herb crops so growers should take care if growing the alternate host crops at the same time as basil. The lack of weed crops in the list of alternate hosts should make disease management easier as there appears to be no route for overwintering/spread of *P. belbahrii* via these plants.

Fungicide control

Basil downy mildew symptoms in an outdoor fungicide efficacy trial were low due to the warm/dry conditions, with symptoms first observed in the 4th week of the trial. Treatment programmes proved most effective in reducing downy mildew symptoms with a range of products showing suitability for use in fungicide programmes. The most effective programme consisted of treatments with Revus (mandipropamid) / a coded product HDC F226, closely

followed by programmes with treatments of Fubol gold (metalaxyl-M + mancozeb) / Revus, and Fenomenal (fenamidone + fosetyl-aluminium) / Revus.

These will be further evaluated in project year 2. No oospores were observed in the diseased material.

Financial Benefits

It is too early to predict the likely financial benefits from this project. However, the pathogens responsible for downy mildew are aggressive and, under favourable environmental conditions, can cause significant economic losses.

Action Points

- Check crops regularly and where practical, if foci of infected plants are found remove them immediately by carefully bagging to avoid dispersing spores to other plants.
- For protected crops ensure there is adequate air circulation around plants to minimise prolonged periods of leaf wetness by better spacing and by increasing the ventilation in the glasshouse. If possible, avoid overhead watering as this is likely to aggravate the disease. If it is necessary to water from overhead then do this early, on days when solar radiation levels will ensure the leaves have a chance to dry out quickly.
- Remove leaf and other plant debris at the end of the season to minimise the risk of carry-over of the disease and maintain effective weed control in and around the growing areas.
- Consider growing host crops independently from each other.