Grower Summary

FV 391a

Carrots: Development of artificial inoculation techniques for cavity spot caused by Pythium violae

Final 2017

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

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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.

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Project title:	Carrots: Development of artificial inoculation techniques for cavity spot caused by *Pythium violae*
Project number:	FV 391a
Project leader:	John Clarkson
Report:	Final report
Previous report:	None
Key staff:	Nicole Pereira Kathryn Hales
Location of project:	Warwick Crop Centre, University of Warwick
Industry Representative:	Ian Holmes, Stawsons
Date project commenced:	01/04/2016
Date project completed (or expected completion date):	31/07/2017

GROWER SUMMARY

Headline

Artificial inoculation of pot-grown carrot plants in the glasshouse with *Pythium violae* consistently resulted in the formation of small, stubby and stunted carrots. Typical cavity spot lesions were also observed on a large proportion of carrots in one experiment but the severity of the disease was generally low, with a maximum of six lesions per carrot. In a preliminary field experiment, artificial inoculation of carrots grown in macrocosms resulted in high incidence of cavity spot.

Background

Cavity spot of carrots is principally caused by the soilborne oomycete pathogen *Pythium violae* and continues to be the most economically important disease for UK growers with losses of at least £3-5 million per season. Control relies on the fungicide metalaxyl, but its efficacy in controlling the disease and the potential withdrawal of approval in the future are major concerns for the industry. However, previous AHDB-funded field trials have failed so far to reliably identify any new actives or approaches for control of *P. violae* due to no, or low levels of cavity spot development. One solution to the problem of low cavity spot levels is to artificially inoculate carrots in pots or the field with *P. violae* to ensure a high enough level of disease development such that activity of control treatments can be assessed reliably. However, a reproducible way of inducing cavity spot symptoms in carrots has yet to be developed, despite many attempts over decades of research. There is therefore still a clear need to try and develop artificial inoculation systems for *P. violae*. The overall aim of this project was therefore to develop methods for producing *P. violae* inoculum and determine the potential to cause cavity spot disease in glasshouse grown carrots. The specific objectives were:

1. Develop growth media and determine conditions to optimise inoculum production of *P. violae* mycelium / oospores by different isolates in controlled environment
2. Test the efficacy of different rates of *P. violae* inoculum in producing cavity spot symptoms in pot grown carrots in the glasshouse

Summary

Two methods were developed which allowed large numbers of *P. violae* oospores to be produced in both a liquid medium and a sand/oat-based solid substrate culture. The most spores were produced on the solid substrate after 10-15 weeks (47,639 oospores g^{-1}) and this medium was also the most amenable to inoculation as it could be easily mixed with compost or soil and carrots grown. However, oospore germination on agar was negligible as has been observed previously by other researchers.

In two long-term glasshouse experiments, artificial inoculation of the growing media using the *P. violae* solid substrate at five different rates (5, 10, 25, 50 and 75 oospores g^{-1}) initially resulted in some seedling death, reduced seedling size and a decrease in growth of foliage. However, at harvest, the principal effect of *P. violae* inoculation was the formation of small, stubby and stunted carrots with a much-reduced weight compared to the uninoculated control plants. These infected carrots were also characterised by a long hairy brown tap root with increased lateral root formation, many of which were collapsed. Typical cavity spot lesions were also observed in a large proportion of these stubby carrot roots in experiment 1 (up to 26%) but disease incidence was less in experiment 2. In both experiments, cavity spot severity was low with an average of approx. two lesions per carrot and a maximum of six lesions per carrot. *P. violae* could also be consistently isolated from the infected tap roots and cavity spot lesions, confirming that these symptoms were due to the inoculation. Generally, there was no clear effect of oospore concentration on the severity of any of these symptoms associated with *P. violae* inoculation.

A preliminary field experiment was also carried out as part of a PhD studentship and an approved follow-up project (FV 391b) whereby macrocosms (concrete pipes sunk in the ground) were filled with a soil / sand mix, artificially inoculated with *P. violae* solid substrate inoculum and carrots sown. In this situation, there was no effect of pathogen inoculation on either seedling survival or subsequent carrot growth but at harvest, a large proportion of the carrots (up to 40%) were affected by typical cavity spot symptoms.

Overall, inoculation with *P. violae* was very successful compared to previous attempts but further work is still required to reduce variation between experiments and increase the number of cavity spot lesions before the approach is used in extensive testing of control products in pot-based glasshouse tests or in the field.

Financial Benefits

If artificial inoculation with *P. violae* can be refined to reduce variation, this approach may allow much more reliable testing of new control products, hence resulting in considerable financial benefits associated with a reduction in the number of failed field trials.

Action Points

None at this time.