Grower Summary

TF 226

Systemic infection and symptom expression of *Neonectria ditissima* in relation to endophytes conditioned by environmental stresses

Annual 2019

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 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:	The molecular basis of pathogenicity of *Neonectria ditissima*
Project number:	CP 141
Project leader:	Richard Harrison, NIAB EMR. Robert Jackson, Reading University.
Report:	Final report, June 2019
Previous report:	Annual report 2017
Key staff:	Antonio Gomez Cortecero, NIAB EMR
Location of project:	NIAB EMR
Industry Representative:	Tony Harding. Worldwide fruit. Acorn House, Unit 68-69, John Wilson Business Park, Harvey Drive, Chestfield, Whitstable, Kent, CT5 3QT.
Date project commenced:	Oct 2015
Date project completed:	June 2019

GROWER SUMMARY

Headline

- Trees held for long periods in cold-storage led to increased canker incidence post-planting in orchards.

Background and expected deliverables

European Canker, caused by *Neonectria ditissima*, has become the most damaging disease of apple in recent years across all major apple growing regions worldwide. Modern cultivars lack effective resistance to this pathogen and in Europe, the most efficacious methods of chemical control are no longer available. Cultivars differ in their susceptibility but there is no absolute resistance. Previous work, conducted at NIAB EMR, has demonstrated that asymptomatic infection in nursery trees is a significant source of the disease in production orchards. The most economically important damage occurs when the nursery-borne latent infection becomes active and develops into canker on the main trunk during orchard establishment (within three years of planting) – leading to tree death. Ample empirical evidence suggests that stresses following planting can promote symptom expression of those nursery-borne latent infections.
An endophyte is a microbe that lives within a plant for at least part of its life cycle without causing apparent disease. Endophytes have been found in all species of plants studied to date although the endophyte/plant relationships are not well understood. Certain microbial endophytes can help plants to tolerate biotic stress, such as attacks by plant pathogens and herbivory, or abiotic stresses, including salt, drought or heat stresses. It has been shown in numerous host species that recruitment of specific microbes into the rhizosphere is partially under host genetic control and there is increasing evidence that host genetics influence the microbes occupying the endophytic niche. Endophyte composition can also be influenced by pathogen presence and crop management practices. Current research focuses on how we could exploit endophytes to produce crops that grow faster and are more resistant and hardier than crops lacking particular endophytes.

We have recently obtained preliminary data showing a link between antagonist fungal endophytes with cultivar tolerance to *N. ditissima*. One fungal endophyte group, identified as belonging to the genus *Epicoccum* (most likely as *E. purpurascens*, previously known as *E. nigrum*), is much more abundant in two canker-tolerant cultivars than in two canker susceptible cultivars. *Epicoccum purpurascens* is a known antagonist against *Monilinia laxa* (causing stone fruit brown rot) and is being commercially exploited for control of brown rot on stone fruit. It is natural, therefore, to speculate whether the abundance of *E. purpurascens* is related to tolerance to canker development and, if so, whether we could exploit *E. purpurascens* for canker management.

In this BBSRC LINK project, we aim to build on the preliminary data to investigate whether cultivar differences in tolerance to *N. ditissima* are associated with specific endophytes and, if so, identify the organism(s) and conduct further *in vitro* and *in vivo* biocontrol assays to assess

specific endophytes against *N. ditissima*. As well as the direct effect against the canker pathogen we shall study whether these specific endophytes could reduce canker development via inducing host defence systems against the pathogen. To improve breeding for canker resistance, we shall determine to what extent the recruitment of specific endophytes is genetically controlled by hosts by mapping QTLs (quantitative trait loci) and to determine the extent of overlaps of these QTLs with those mapped for canker resistance. We are conducting experiments to assess (1) to what extent recruitment of endophytes is influenced by soil characteristics and host genotypes, and (2) whether canker symptom expression is related to planting times and the abundance of specific endophytes across a number of orchards. Finally, to assist in canker management, we are investigating the extent to which endophyte profiles of a specific apple genotype can be influenced by management practices (irrigation and soil amendment).

Summary of the project and main conclusions in Year 2

We have successfully initiated all experimental studies on time.

(1) We have profiled endophytes at leaf scars of eight cultivars with differing tolerance/resistance against apple canker; the data are currently being analysed.

(2) A number of *Eppicocum* endophytes were obtained from apple and shown to have antagonistic effects against apple canker under *in vitro* tests.

(3) Drenching stool-beds with *Eppicocum* can increase the concentration of *Eppicocum* endophytes in rootstock plants. However, applying *Eppicocum* as a foliar spray to orchard trees did not result in significant increases in endophytic *Eppicocum*.

(4) Inoculation of plants with PGPR or AMF at planting time appeared to have resulted in increased tree development.

(5) Longer duration of trees in cold-storage led to increased canker incidence post-planting.

Financial benefits

These results are from the second year only of a four-year project so it is too early to quantify financial benefits to growers. However, the result that impacts commercial apple production most is the effect of storage duration on canker development.

Action points for growers

- At this stage of the project, there is only one action to recommend to growers: plant trees as soon as possible after lifting.