Grower Summary

SF 131

Gooseberry: Plantation survey to determine the causal agents of individual branch & whole bush dieback or death and assessment of factors leading to greater incidence

Final 2013

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 Title:	Gooseberry: Plantation survey to determine the causal agents of individual branch & whole bush dieback or death and assessment of factors leading to greater incidence
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Contractor:	ADAS UK Ltd
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Headline

- A range of fungal pathogens were found associated with gooseberry branch dieback and bush death.

Background and expected deliverables

For many years, a serious problem for commercial gooseberry growers has been the unexplained dieback of either single or multiple branches or death of gooseberry bushes, with symptoms often occurring around the first full cropping year (Figures 1 and 2). This occurs throughout the UK on all current commercial gooseberry cultivars, apparently regardless of plant type or husbandry. As a result, some growers have held back from expanding their crop area despite an increase in demand for the fruit from all markets. Growers have struggled to control losses, often not knowing what pathogen is involved, although both soil (e.g. *Phytophthora* or *Verticillium* spp.) and air-borne fungal infections (e.g. *Eutypa* or *Phomopsis* spp.) are considered to be potential causes.

Figure 1: Whole bush death. No buds break in spring, or start to open and are killed.

Figure 2: Dieback of some branches. In May buds fail to break on some branches, whilst other branches look healthy or may develop smaller leaves. Between June to August: leaf wilting develops on some branches

The aim of this project was to sample a number of cultivars from gooseberry plantations across England, and to survey the range of husbandry techniques used, in order to see what fungi are present in bushes affected by dieback. Knowledge of the incidence of affected bushes and any particular distribution in the field could aid replanting decisions. Information on the presence or absence of particular fungal infections and the way the bushes were being grown and maintained was examined in order to identify any practices being carried out that might be either detrimental or beneficial to the health of plantations.

Summary of the project and main conclusions

Survey of symptoms

Whole gooseberry bushes from a range of current major commercial cultivars were collected from six fruit farms between May and September 2012, according to when the wilting or die-back symptoms became apparent. A further two farms were surveyed, but not sampled. The incidence and severity of the dieback or bush death was assessed and detailed information on the crop husbandry was recorded with the assistance of each grower. Ongoing loss of bushes was reported from all sites. Fourteen samples of dieback from 11 plantations were examined in the laboratory at ADAS Boxworth. Sampled bushes were selected to be typical

of the symptoms in each plantation. Symptoms on stems and roots were recorded before and after tissue was cut out for further diagnosis. The initial location of tissue damage leading to the disruption of vascular function varied between samples. Substantial main stem staining or girdling, or root rot had often occurred, with sudden branch dieback happening often at the time when there was either leaf expansion or fruit swelling on other branches on the same bush. In re-visited plantations, two months after sampling bushes with dieback, other bushes from the same plantation were nearly dead. The proportion of bushes with dieback ranged between 15 to 30% in six plantations, and 2 to 7% in another five. Plantations sampled were of the cultivars Invicta, Careless, Pax and Leveller and ranged from one to ten years old. Symptoms had either been observed in plantations not long after planting, or tended to be noticed two to four years later (Table 2).

Fungi associated with dieback

Various pathology techniques were utilised to culture potential pathogens and a large number of different fungi were isolated (Tables 1 and 2). Many fungi were likely to have been secondary colonisers of wounds caused by physical damage, for example *Fusarium* species. Other fungi were probably invading tissue caused by primary pathogens of woody tissue that can be difficult to isolate. There are difficulties in pathogen diagnosis of woody tissue damage because the primary pathogen often grows on further along the stem without initially causing symptoms, leaving the visibly damaged tissue to become colonised by other fungi. Diagnosis of causal fungi was problematic, as many fungi were isolated from inside the stained stem and rotted rot tissue (in particular several differently coloured species of *Fusarium*), and all may have contributed to the main stem and branch rotting and root rots. Symptoms could be categorised into six types depending on the location and internal or external appearance of the tissue damage (Table 1).

Table 1: Summary of gooseberry dieback symptom types and associated potential fungal and Oomycete pathogens on 14 samples – 2012

Symptom type	Associated fungi / Oomycetes	Number of samples with this symptom*
1. Root rot	*Phytophthora, Pythium, Fusarium, Cylindrocarpon*	7
2. Collar rot	*Phytophthora, Pythium, Fusarium*	3
3. Internal stem canker	*Fusarium*	11
4. Main stem wood staining	*Phytophthora, Eutypa,*	8
5. Twig bleaching	*Leptosphaeria,* other pycnidial fungi	13
6. Collapse of new shoot	*Botrytis*	1

* Bushes frequently had more than one symptom, and one sample was of twigs only.

Table 2: Incidence of branch dieback and whole bush death in surveyed gooseberry plantations in 2012 and apparent primary source of dieback on sampled bushes

Bush cultivar	% bushes with die-back	% whole bushes dying	% of total bushes	When dieback was first observed	Plantation age	Symptoms and diagnosis
Invicta	*	*	7-8%	From about 5 years ago	10 years	Stem rot from tying-back (*Fusarium*)
Careless	*	*	1-2%	Not sure	5-6 years	Main stem rot from tying-back (*Fusarium avenaceum*)
Careless	5	-	5%	After 4th year	10 years	Root rot (*Pythium, Fusarium*). Stem rot (*Eutypa* identified by Fera)
Invicta	7%	-	7%	After 4th year	8 years	Main stem girdling (*Pythium*, *Phytophthora* and *Fusarium*)
Leveller	20%	-	20%	*	*	New shoot wilt (*Botrytis, Fusarium*)
Pax	30%	20%	50%	Over the last 3 years	5 years	Root (*Phytophthora* and *Cylindrocarpon*) and stem base rots (*Phytophthora*)
Invicta	5%	1%	5-6%	2-3 years after planting	3 years	Stem rot via wounds (isolate under Fera review)
Invicta	-	20%	20%	not long after planting	1 year	Root rot (*Fusarium*)
Invicta	-	15%	15%	not long after planting	2 years	Root rot (*Cylindrocarpon*)
Invicta	5%	-	5%	mainly after 4 years, some before	4-5 years	Stem rot via pruning wound
Invicta	10%	2%	12%	2-3 years after planting	5 years	Not sampled
Invicta, Hinnon-maki Red & Yellow	5%	2%	7%	2-3 years after planting (branch), 3-4 years (death)	6-7 years	Not sampled. Invicta more susceptible than either Hinnonmaki Red or Hinnonmaki Yellow

Plantations shown shaded together were on the same farm. * Information not provided for this plantation of Leveller.

Staining in the wood that resembled *Verticillium* infection (mottling of the vascular tissue, or a stained vascular ring) and wedge-shaped sectors typically associated with *Eutypa* entry at wounds were seen, however neither pathogen was isolated from these tissues. *Fusarium* sp. was isolated from a V-shaped internal stem lesion and *Eutypa* sp. was instead isolated from diffuse grey xylem (wood) staining. Internally stained woody stems commonly occur following *Botrytis*, *Botryosphaeria* or *Phomopsis* infection (for example in blackcurrant bushes), but these pathogens were not isolated from staining inside gooseberry stems. The pathogen *Fusarium avenaceum* was isolated from black stem staining. *Botrytis cinerea* rot was only seen on green shoots of gooseberry. Pycnidia, including *Leptosphaeria sp*., were present on twigs of most bushes, but could have been secondary in twigs already stressed by tissue death lower down the stems. No *Phomopsis* sp. was isolated from pycnidia.

Phytophthora occurred in some bushes, sometimes causing brown rotting on part of the root system and leading to branch death on that side of the bush. Stem staining by *Phytophthora* root rot produced either a diffuse grey or mottled brown discolouration, with some more concentrated areas, deep in the wood leading up from the roots. Girdling and loss of bark (collar rot) also arose from local *Phytophthora* infection. One sample had severe collar rot, with *Pythium* sp. (normally considered to be a weak pathogen) as well as *Phytophthora* sp. isolated from the softened-bark main stem. Severe root rot from *Phytophthora* was identified leading to the loss of lengths of row. *Cylindrocarpon destructans* was found in some other rotted roots, but was also isolated from apparently healthy roots.

Lateral flow device kits, as available to growers, were utilised to diagnose the presence of *Phytophthora* and *Pythium*. Some isolates from main stem and branch internal staining and twig fruiting-bodies were sent to a second laboratory, The Food and Environment Research Agency (Fera), for further examination or molecular diagnosis. As well as the stem dieback pathogens *Eutypa* and *F. avenaceum*, isolates included *Paecilomyces* and *Ulocladium* which are saprophytic (not pathogenic) fungi.

Distribution of affected bushes within rows

At five sites, all bushes in three adjacent rows were assessed to determine if there was any particular spatial distribution of affected plants. Symptom development on individual bushes between bud break and fruiting was monitored on two of these farms. Some grouping of dieback bushes occurred, but they were equally likely to be scattered singly in rows anywhere along the lengths. At other sites where root rot, rather than initial stem damage was reported, there were clusters of infected plants along the rows.

Starting points for infection and symptom development

The development of branch wilting was attributed to the following sources:

- Staining in die-back branches was frequently traced back to the main stem, rather than from any damage or infection at the site of wilting;
- Browning from branch stubs, leading down into the main stem, was often a source of infection;
- Twisting of main stem or pulling back of branches to wires is likely to have caused stress cracks allowing pathogen entry and gradual rotting over several years;
- Root rotting caused wilting in the same way as direct main stem infection;
- Healthy vascular tissue often remained on one side of the main stem to allow leaves to emerge, but branches on the affected side of the main stem received insufficient water in hot weather (particularly during fruiting) and wilt followed suddenly.

Husbandry practices

Husbandry surveys were collated and examined in relation to the various types of damage and potential pathogens found in samples. Two surveys were completed by growers in addition to those where samples were taken. The range of damage locations on bushes and potential pathogens recorded was too diverse to allow matching of practices to problems across several sites. No particular good or bad practices were identified – all growers had losses and it was only particular bushes that showed symptoms amongst others given the same management. One bush-specific management activity, which would justify further investigation, is plant management at planting. At this time, if branches are pulled back under tension to wires or pruned off then a slow canker can develop. Similarly, sharply bending the roots of transplants to fit the planting hole could allow entry of ubiquitous soil fungi and these can slowly reduce root area and rot can spread up into the main stem. It is also possible that when bushes are pruned in winter wounds are slower to heal and these may become infected, particularly if the bush is pruned with tools used to cut out infection in other plants.

Financial benefits for growers

There are an estimated 180 ha of gooseberries in the UK with a market price range of £3,000 to £4,800 per tonne. Given a yield of 10 tonne/ha, the farm-gate value of the gooseberry crop in the UK is probably around £5.4 to £8.6 million. One of the main reasons that the UK market share for gooseberries has been unable to expand has been the loss, or fear of loss, of bushes to dieback. Growers have stated that there are demands for both fresh and processing which cannot currently be met by British grown Assured Produce fruit. There is

also a buoyant market for this crop via PYO, farm shops and other direct-from-farm retail outlets. If dieback could be reduced the production of gooseberries could be increased to meet the demand.

Growers have previously reported that on average 5-10% of their bushes once established and fully cropping (especially cv. Invicta) die and another 5 to 10% of bushes suffer dying back of one or two branches (either failing to break bud or wilting and dying between bud burst and the start of harvest). This means that if losses due to dieback are on average 10% per annum then the problem could be costing the industry £540,000 to £860,000 per annum.

Action points for growers

- All pathogens detected in this work can be carried in or on planting stock, so if producing your own stock, ensure cuttings taken are only from visibly healthy plants and if any problems develop get them diagnosed;
- Plant cuttings in soil without previous root problems or crop debris, or use fresh growing media and stand pots / trays off the soil;
- Examine planting material for root death (a Lateral flow device can be used to confirm *Phytophthora*) and for cankers where stems have been pruned off – do not plant affected plants;
- Wherever possible, do not plant gooseberry in fields where *Phytophthora* or *Verticillium* was present in previous crops, as their resting bodies survive many years in the soil;
- *Eutypa* enters the vascular system at wounds so it is advisable to prune during the growing season, when wounds are more likely to heal quickly, rather than in November;
- Many other fungi colonise wounds, especially if wounds are open in mild humid weather, so growers should minimise pruning or do it when it is dry;
- Pathogens can be carried on pruning tools so aim to sterilise tools in the field after working on diseased tissue;
- When tying branches to wires, aid to avoid straining them and avoid creating wounds as these allow pathogen access;
- Clear away pruning material from crops as soon as possible and destroy it so that spores cannot spread from infected debris to the crop;

- Utilise information on the symptoms and lifecycles of the main pathogens of gooseberry and control measures available in the HDC Gooseberry Grower Guide.