Grower Summary

FV 431

Swede: Control of Phoma dry rot

Final 2015

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Grower Summary

Headline

This study has demonstrated that root infection in swede can occur in the presence and absence of leaf symptoms. It was also shown that swede can be infected by the two Phoma species pathogenic to oilseed rape in the UK. Both findings increase our understanding of the disease cycle in swede and can be used to identify suitable control strategies for future testing.

Background

Phoma dry rot caused by the fungal pathogen *Leptosphaeria maculans* (imperfect stage *Phoma lingam*) is a major problem on swedes worldwide. Severe losses can occur in the UK from late autumn onwards in the field and in the stored crop. Most of the recent research on the epidemiology and control of *L. maculans* has been on Phoma stem canker in winter oilseed rape. This provides a substantial background on the disease cycle, infection requirements and variability (races) of this pathogen. In addition to *L. maculans* there is another species *Leptosphaeria biglobosa* that is considered less damaging on oilseed rape but also has *Phoma lingam* as the imperfect stage (known as Phoma B).

The development of Phoma in swedes has been difficult to interpret as leaf symptoms have not always been noticed in crops that developed dry rot problems. Swedes are sown in May which is usually after the period when oilseed rape stubbles release ascospores so young swedes should show little leaf Phoma infection. Swedes could be infected by ascospores during the autumn but passage to the bulb through leaf petioles could take several weeks when leaves are large. The swede bulb is a large structure so there may be direct infection by air-borne ascospores or splash-dispersed pycnidiospores. In oilseed rape, pycnidiospores are not considered to be important under UK conditions. Damage to the leaves or roots could increase the risks of Phoma infection particularly by pycnidiospores.

The aim of the work reported here was to improve control of dry rot in swedes through a better understanding of the disease cycle in this crop. Specific objectives were:

1. Improve understanding of the disease cycle in swedes;
2. Identify key timings for infection and disease development;
3. Compare findings on swede with existing knowledge on oilseed rape.

Summary

Objective 1 – Phoma disease cycle in swede

The progress of Phoma in four swede crops showed differences in disease development depending on geographical location (Table A). At Spalding in Lincolnshire, Phoma leaf spot was first observed on 17 July 2014. Incidence remained low until 22 October when it increased to 18% plants affected. The epidemic continued to develop until 94% of plants were affected on 11 February 2015. In Fife and Perthshire, no Phoma leaf symptoms were reported during the monitoring period, however, fungicides had been applied at these sites.

The Fife site received three fungicide applications, the first on 28 July 2014 [Azoxystrobin 1.0 L/ha (as Amistar: Syngenta Crop Protection)], the second on 12 September [Prothioconazole 0.4 L/ha (as Rudis: Bayer CropScience)] and the third on 30 September [Prothioconazole 0.4 L/ha (as Rudis: Bayer CropScience)]. First symptoms of dry rot on roots in the field were observed on 30 June, prior to first fungicide applications. Dry rot incidence increased to 15% by 4 August. At harvest on 28 November, disease incidence increased to 33%.

In Perth, no phoma leaf spot or dry rot symptoms were reported during crop growth. Dry rot was only reported when the crop was harvested on 20 October and 75% of roots had dry rot on this date. This crop received three fungicide applications, the first on 7 July 2014 [Azoxystrobin 1.0 L/ha (as Amistar: Syngenta Crop Protection)], the second on 4 August [Prothioconazole 0.4 L/ha (as Rudis: Bayer CropScience)] and the third on 27 August [Azoxystrobin 1.0 L/ha (as Amistar: Syngenta Crop Protection)].

This suggests that fungicide timings at these sites were suitable for controlling leaf infection but not for root infection. These observations can be used to target future work and establish optimum fungicide timings for disease control.

Table A. Summary of Phoma leaf spot and dry rot occurrence in four swede crops, cv. Magres, in 2014-15

Site	Date sown	Leaf spot		Dry rot	
		First noted	Maximum incidence (date)	First noted	Maximum incidence (date assess)
1. Lincs	12 May 2014	17 July	94% (11/2/15)	12 Aug	17% (8/12/14)
2. N. Yorks	16 May 2014	3 Dec	44% (3/12/14)	Nil	0
3. Fife	29 May 2014	-	0	30 Jun	30% (28/11/14)
4. Perthshire	15 May 2014	-	0	20 Oct	75% (20/10/14)

Objective 2 – Key timings for infection and disease development

Root and leaf inoculation experiments on swede cv. Magres demonstrated for the first time that both *L. maculans* and *L. biglobosa*, the two species responsible for causing stem canker in oilseed rape are also responsible for causing leaf lesions and dry rot on swede (Table B). In the UK, air-borne ascospores are the predominant source of infection for oilseed rape and first symptoms of naturally occurring leaf lesions in swede pot experiments at ADAS Boxworth on 10 October coincided with first observations in oilseed rape on 22 October 2014 (Figure B).

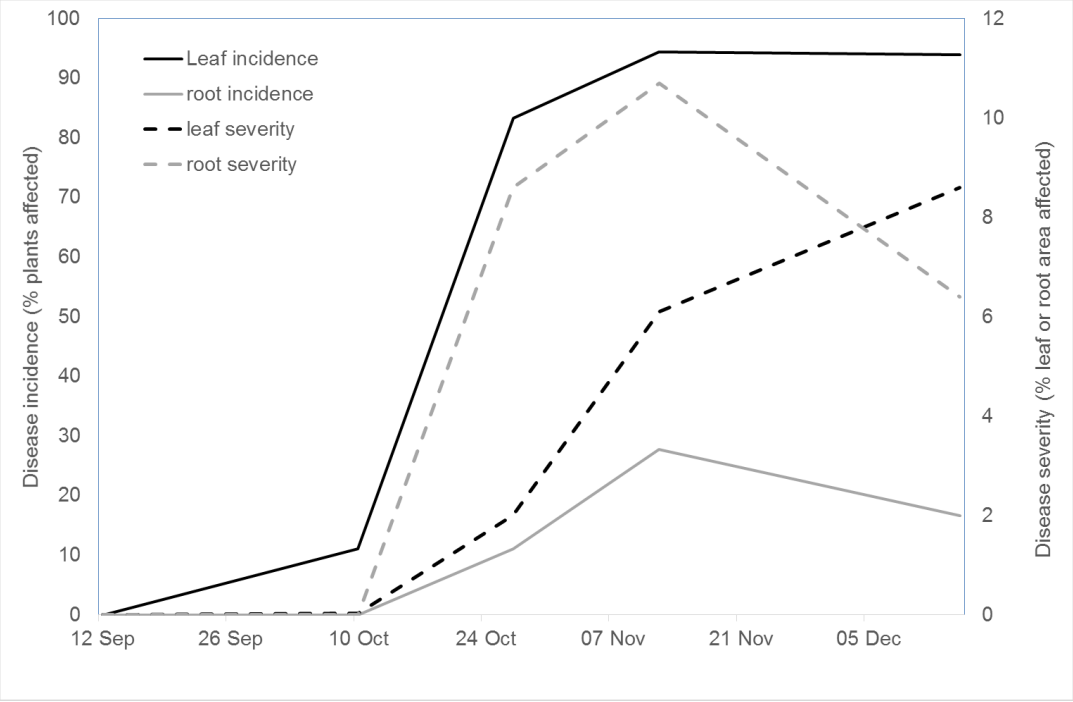

Figure B. Progress of natural Phoma leaf infection and root infection on uninoculated swede in the pot experiment at ADAS Boxworth. Disease was assessed until the final non-destructive root assessment on 12 December 2014. No fungicides were applied.

This study confirmed that both Phoma species (*L. maculans* and *L. biglobosa*) present in the UK infect swede (Table B) and therefore measures to decrease the exposure of crops to ascospores in the autumn would be beneficial to decreasing crop risk e.g. through targeted fungicide applications. Where roots were inoculated, there was a significant effect of wounding on the incidence of roots affected and also the severity of internal dry rot symptoms (Table C), however, whether wounding is a key requirement for dry rot development in field has yet to be proven.

Table B. Infectivity of different spore types of *L. maculans, L. biglobosa* and naturally occurring ascospores on swede leaves on 12 November, 15 days after inoculation.

Trt	Species and spore type	Wounding (Yes/No)	Incidence (% plants with lesion)	Lesion severity (% leaf area affected)
1.	No inoculation	Yes	0.0	0.0
2.	No inoculation	No	0.0	0.0
3.	*L. maculans* (pycnidiospores)	Yes	16.7	0.2
4.	*L. maculans* (pycnidiospores)	No	14.3	0.4
5.	*L. biglobosa* (pycnidiospores)	Yes	11.1	0.7
6.	*L. biglobosa* (pycnidiospores)	No	25.0	0.2
7.	Ascospores	Yes	0.0	0.0

8.	Ascospores	No	40.0	0.6

Table C. Incidence of dry rot on inoculated swede roots, with and without wounding prior to inoculation.

Isolate/spore type	With wounding	Without wounding
No inoculation	11.3 ± 10.6	0.0 ± 0.0
L. maculans	33.7 ± 8.5	8.3 ± 5.1
L. biglobosa	0.0 ± 0.0	11.1 ± 5.8
Ascospores	7.9 ± 5.2	18.1 ± 8.6
FPr	0.017	

A range of symptoms were observed in field and pot experiments and are shown in Figure C.

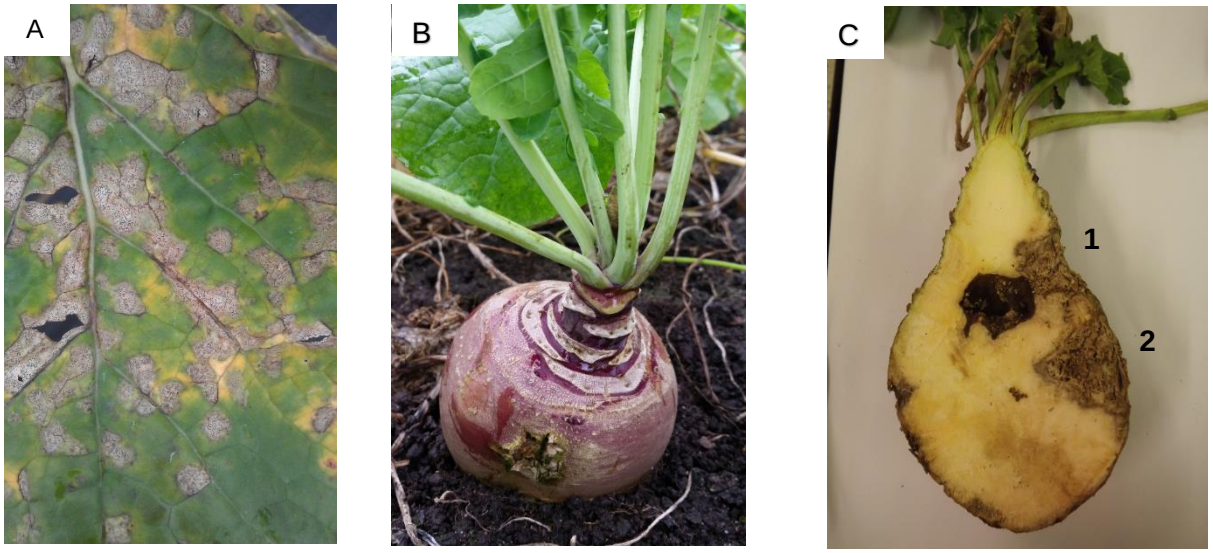

Figure C. Phoma leaf spotting on leaves showing chlorosis of the leaves associated with lesion formation (A) and the extent of leaf damage with the movement of the fungus through

the leaf veins on 12 November 2014 in the pot experiment at Boxworth. (B) Dry rot observed on field grown swedes on 27 October 2014 in Scotland (Photo: Tracy Yoxall, SRUC). Cross section of swede (C) showing two lesions originating from different infections: near the upper root following inoculation (1) and the soil surface (2) from the pot experiment at Boxworth.

Objective 3 – Comparison of Phoma on swede and oilseed rape

In oilseed rape, lesions produced on the leaves are responsible for causing stem cankers as the fungus grows through the leaf veins and down through the petiole to the stem. The appearance of symptoms in the stem can take over 6 months and severity is dependent on the timing of the onset of the epidemic in the autumn and subsequent temperatures. In contrast, dry rot on swede was observed within one month of leaf infection or in the absence of leaf infection at monitoring sites. This differed from oilseed rape as there was less time between the appearance of leaf and root symptoms on swede. Rainfall in August and September has been shown to be a key factor in determining ascospore release, with more rain resulting in an earlier release date. Earlier epidemics are known to be more damaging and the Phoma epidemic on oilseed rape in autumn 2014 was late, with first symptoms in oilseed rape observed on 22 October. The most severe Phoma epidemics occur in the south in the UK and this has been attributed to increasing winter/spring temperatures coupled with higher average temperatures. Leaf Phoma and dry rot symptoms observed in swede coincided with when Phoma leaf symptoms were observed in oilseed rape, suggesting that fungicides could be better targeted in the autumn for disease control on swede.

Conclusions

- The two Phoma species pathogenic to oilseed rape present in the UK (*L. maculans* and *L. biglobosa*) can cause both Phoma leaf spotting and dry rot on swede;
- Ascospores can initiate epidemics on swede in the UK;
- Inoculation experiments showed that both ascospores and pycnidiospores can cause Phoma leaf spot and dry rot on swede;
- Leaf infection was not always observed with dry rot on swede;
- Wounding of the root appeared to increase the incidence of roots affected as well as increase the severity of internal dry rot symptoms.

Financial Benefits

This project has identified key parts of the lifecycle at which the casual pathogen of dry rot could be targeted.

In oilseed rape the fungicides to control the disease are targeted in response to a leaf threshold of 10 to 20% plants affected. In the field monitoring part of this project, the presence of leaf infection did not always seem to be necessary for the development of dry rot symptoms at all sites. In the pot experiment, the onset root infection occurred at a similar time in all treatments. Both observations suggest that there may be specific weather criteria that increases the risk of root infection, however, this would require further investigation to confirm.

It has also highlighted that both Phoma species present on oilseed rape in the UK (*L. biglobosa* and *L. maculans*) can infect swede roots and leaves. This has significance for disease control as *L. biglobosa* is often associated with Phoma development later in the season than *L. maculans* and it is critical that strategies to monitor and control the disease are effective on both species. The next step will be to test whether fungicides can be better targeted, either in response to weather criteria or a leaf threshold, to reduce future losses.

Action Points

- Avoid growing swedes in close proximity to fields where oilseed rape was grown the previous season.
- Bury crop debris from previous oilseed and swede crops to minimise production of air-borne spores.

Recommendations for future work

This project has identified three areas to investigate to improve the control of dry rot in swede:

1. Identify weather variables affecting dry rot development, whether those criteria are related to timing of spore release and can be used to predict crop risk;
2. Improve the targeting of fungicide programmes for dry rot control using weather based risk criteria or fungicide application in relation to a leaf disease threshold;
3. Evaluate the efficacy of fungicides currently used to control Phoma in oilseed rape against dry rot on swede.