Many faces of phoma

> *There's emerging evidence that targeting L. maculans has led to selection for **L. biglobosa** in the field.*

OSR Disease

The discovery of a new variant of phoma pathogen in the UK, previously unidentified in Europe, is a reminder that diseases aren't static, they can change. *CPM* discovers what we know about them and whether oilseed rape could be at risk.

By Lucy de la Pasture

If there are two things the COVID-19 pandemic has highlighted, then it's possibly the ability of pathogens to mutate and the importance of surveillance to monitor populations for these changes so it can be established whether they are of significance.

Whereas COVID-19 has had eye watering amounts of money made available to do this, funding is a perpetual struggle in plant pathology. That means it's possible any changes in pathogen populations may not be picked up early enough to contain the spread of new pathotypes.

And this is something that concerns Rothamsted Research plant pathologists, Dr Kevin King and Professor Jon West, who have recently discovered a variant of the fungus that causes phoma stem canker on oilseed rape for the first time in Europe.

"Phoma leaf spot/stem canker is caused by two closely related fungal pathogens, *Leptosphaeria maculans* and *L. biglobosa*," he explains. "Within this species complex are different genetic subgroups, only identifiable by genetic analyses, which are referred to as 'subclades'.

"The term 'subclade' can, in a way, be considered similar to the term 'variant' used to describe different COVID-19 viral strains," explains Kevin.

Genetic subclades

"There are nine subclades in total: two subclades for L. maculans and at least seven (so far identified) subclades for *L. biglobosa.* These subclades have been named based on the original plant host or location — for example the *L. biglobosa* 'canadensis' subclade was first reported in Canada, whereas the *L. biglobosa* 'australensis' subclade was first described in Australia."

Until recently, only two of the nine genetic subclades had been identified as commonly occurring and geographically widespread in Europe — namely *L. maculans* subclade 'brassicae' and *L. biglobosa* subclade 'brassicae'.

"Although an additional subclade of *L. biglobosa* had previously been identified, this was a single isolated report on asp-of-Jerusalem (Dyer's woad) in France in 1951, and thus appears extremely rare."

However, in 2021 research at Rothamsted, published in the *European Journal of Plant Pathology*, identified an additional subclade — *L. biglobosa* 'canadensis' — for the first time in Europe at sites in the South of England and Northern Ireland on wasabi crops. A further subclade, *L. biglobosa* 'brassicae', was also discovered affecting wasabi crops in the West Midlands.

Greenhouse testing then showed that both subclades could cause disease in OSR, cabbage and pak choi, confirming they have potential to infect other brassica crops, not just wasabi.

The discovery is of particular interest because, having once been the phoma species of lesser importance, *L. biglobosa* is becoming increasing influential in phoma outbreaks in OSR crops.

"In the past phoma disease management strategies focused primarily on *L. maculans*, which is associated with larger leaf spot lesions and sometimes more damaging basal stem cankers," explains Kevin. ▸

Kevin King says more work is required to establish the importance of a new subclade of the phoma pathogen found in the UK, which was previously unknown to be present in Europe.

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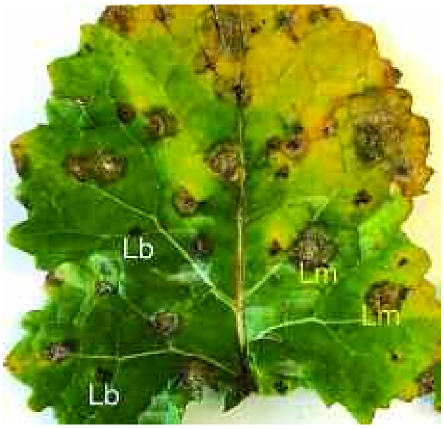

Phoma leaf spot caused by the co-occurring fungi Leptosphaeria maculans (Lm: generally larger lesions with cracked centres with many internal black pustules) and Leptosphaeria biglobosa (Lb: generally smaller darker lesions with few if any internal black pustules).

▶ "However, there's emerging evidence that targeting *L. maculans* has led to selection for *L. biglobosa* in the field."

One of those phoma management strategies has been the extensive use of major resistance gene *RLm7* in OSR breeding programmes, which has been very successful at reducing the impact of phoma in varieties that incorporate the gene. But could there have been unintended consequences?

"There's clear evidence now that the deployment of resistance genes against *L. maculans* may not, in some instances, be as effective against *L. biglobosa* which could have led to selection for *L. biglobosa* in field populations.

"There may also be some differences between the two species in sensitivity to fungicides, so it's crucial to target disease management strategies to both *L. maculans* and *L. biglobosa* to ensure sustainable phoma control."

Given the subclade 'canadensis' hasn't previously been seen in Europe, is there anything we can glean from parts of the world where it has been noted?

Kevin thinks it's too early to tell. "Since the first description of *L. biglobosa* subclade 'canadensis' in Canada, it's subsequently been confirmed elsewhere in North America and Oceania. The 'canadensis' subclade has recently (in 2021) been identified in northern China, although previous surveys in China had found only *L. biglobosa* subclade 'brassicae'.

"These observations, plus the additional discovery of *L. biglobosa* subclade 'canadensis' in Europe last year, indicates an expansion in geographic range, although additional work is again required to investigate this possibility," says Kevin.

If 'canadensis' is spreading globally this could point to differences in pathogenicity compared with the other genetic subclades, suggests Kevin. Further research is needed to properly explore potential differences in pathogenicity between the subclades and it highlights the importance of funding further research in this area, he adds.

"Interestingly, both the *L. biglobosa* subclades 'brassicae' and 'canadensis' had not been reported on wasabi previously. The impact of these pathogens on the financially lucrative 'green gold' wasabi swards requires further investigating."

As for its significance to UK OSR crops, there's still much to discover, says Kevin. "Further research is now essential to understand the implications of these research findings, including investigating the distribution of *L. biglobosa* subclades 'brassicae' and 'canadensis' on OSR and vegetable brassicas in the UK.

"It would also be useful to identify whether any additional Leptosphaeria subclades are already present but have been overlooked," he says.

"It's necessary to explore whether the *L. biglobosa* subclades pose distinct threats to OSR crop health and whether they might require different disease management strategies. And we also should try and better understand the potential for sexual crossing or hybridization between the *L. biglobosa* subclades and the potential for emergence of new pathogen threats." ■

Protect azoles when using in OSR

Light leaf spot caused by the fungus Pyrenopeziza brassicae with the characteristic white sporulating pustules.

Further work led by Rothamsted has also been investigating the fungicide resistance status of *Pyrenopeziza brassicae*, which cause light leaf spot in OSR, and chemical control options for the disease.

The study has extended beyond the UK, taking in OSR/canola crops throughout Europe, Oceania and North America to determine how the sensitivity of populations to the main groups of fungicides has changed.

Over 90% of the c583,000ha of UK-grown winter OSR crops receive at least one application of foliar fungicide for disease control, mainly targeting light leaf spot, phoma and, in the spring, sclerotinia. Fungicides are also sometimes employed for growth regulation purposes, he says.

Most crops receive around two/three sprays per growing season, with azole chemistry (difenoconazole, prothioconazole, tebuconazole), and QoIs (azoxystrobin) most widely used.

The findings of the research project, published in *Plant Pathology* last year, indicate that for *P. brassicae* in the UK, isolates from northern counties were significantly less sensitive to tebuconazole than isolates from the southern end of the country, says Kevin.

"This could reflect that, until recently, light leaf spot had been more common in northern OSR crops, so fungicide use against the disease has been employed for longer than further south, where the disease is now also commonplace."

The study also looked at how best to protect azoles, which have been the cornerstone of fungicide strategies for many years. It's also a group of chemistry which is running short of options as the regulatory system continues to pick off actives as they attempt to go through the renewal process, meaning protecting the efficacy of those that remain has become increasingly important.

The results support using a QoI (strobilurin) or SDHI mixing partner with an azole to reduce the risk of resistance occurring, says Kevin.

But that's not all that came out of the study, he adds. "Two genetically distinct evolutionary linages of *P. brassicae* (termed lineage 1 and lineage 2) have recently been described from an international collection of isolates. To date, all isolates from Europe and Oceania have been identified as lineage 1, whereas in North America all isolates have been determined to be the recently discovered lineage 2"

Kevin believes that's of interest because in some US western states — Washington and Oregon — light leaf spot has recently taken on a new significance, with incidences of the disease appearing differently and spreading very rapidly.

"The cause was found to be the newly identified lineage 2 of light leaf spot and it's of concern given the speed of its spread in the US because it could potentially spread into Canada, which is a major grower of OSR (canola)," he says.

"Horizon scanning is important with crop diseases so we're aware of emerging threats. If lineage 2 light leaf spot were to arrive in the UK, then it could pose a real problem given its rapid invasive spread in the US.

"It's therefore crucial to at least maintain, and ideally increase, funding for plant pathology research including surveillance strategies to help reduce the risks to plant health posed by new and emerging pathogen threats," he concludes.