Spot a problem in OSR?

HGCA

from theory to field

Leaf spot diseases in oilseed rape account for massive losses suffered by UK growers. *CPM* reports on progress of recent HGCA-funded work into phoma stem canker and light leaf spot.

By Tom Allen-Stevens

Of all diseases in oilseed rape, none are more damaging than the big two: phoma stem canker and light leaf spot (LLS). According to Defra, estimated losses from phoma in 2010 were around £80M, while LLS cost UK growers over £140M (see chart on p51).

But these losses may only be scratching the surface of the damage the pathogens can do, believes Dr Jenna Watts of HGCA. "Phoma is a potentially economically devastating disease. Although we've seen a decrease in the incidence of the disease since 2007, it's important not to be complacent — there are reports of the breakdown of major R-gene resistance of cultivars in other countries.

"What's more, phoma is caused by two species of the Leptosphaeria pathogen. Control is currently focused on *L. maculans,* but in 2012 there was a sharp rise in the number of severe cankers caused by *L. biglobosa* — a species we currently know relatively little about."

HGCA-funded work is currently underway monitoring the different strains of the fungus and its virulence in relation to R-gene resistance (see panel on p53). "The project's found there are regional differences in *L. maculans* races. It's also brought to light new valuable information on *L. biglobosa.*"

Previously prevalent in Scottish and northern English crops, LLS is now truly a nationwide disease, she continues. "Indeed, the latest figures from the Defra survey show more southern crops were affected than those further north. Growers currently rely on the HGCA-supported Rothamsted LLS forecast *(see www.cropmonitor.co.uk)*, but scientific understanding of the disease has moved on. There's now potential to improve the forecast to help refine fungicide protection in the future."

So a new project is underway to bring growers a more accurate measure of LLS epidemic onset and when to protect crops with fungicides. "The nice thing about this work is that this information, that's been available to scientists, is now being developed into a form that'll be useful for growers – it'll give a predicted date of the onset of an epidemic, so growers can optimise control programmes."

While LLS is a problem mainly confined to the UK, phoma is a concern worldwide, causing losses of more than £1bn/year, according to Bruce Fitt, professor of plant pathology at the University of Herts.

"Despite our best efforts to control it, phoma stem canker still costs UK growers on average an estimated £100M/year. There have been instances in other countries where we've seen major resistance gene breakdown — in Australia this took just two years after the introduction of the new gene and caused 90% crop loss in commercial crops."

OSR cultivars have two types of resistance, he explains. Individual genes,

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HGCA-funded work has found there are regional differences in L. maculans *races, notes Jenna Watts.*

known as Rlm genes (resistant to *L. maculans*), allow the plant to recognise the fungus and mount a resistance response, halting the initial leaf infection. "The only problem is that the pathogen can adapt, and strains develop with virulence against the gene, so they overcome the resistance."

In addition, quantitative resistance relates to properties of the cultivar that allow it to suppress growth of the fungus. "The good news is that there's relatively good quantitative resistance in many UK cultivars, so a breakdown in one of the major R-genes wouldn't necessarily result in the dramatic losses seen in other countries."

R-gene virulence

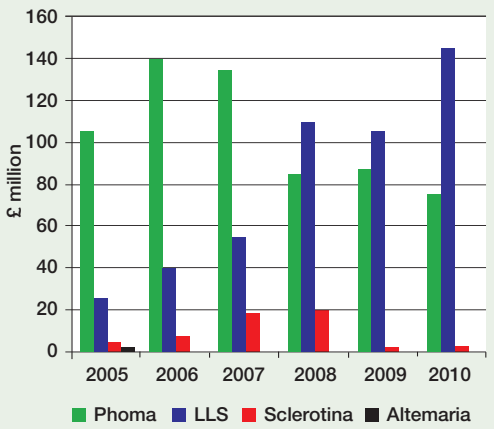
Field experiments were done at 11 sites in England using the cultivar Drakkar, that has no R-gene. Samples with phoma leaf spots were obtained and the fungus tested on cultivars carrying known R-genes (Rlm1-7 and Rlm9). "This told us whether the isolate was virulent against the R-gene," he continues.

The testing revealed that the resistance genes Rlm5, Rlm6 and Rlm7 are still effective in England. "Just 3% of the *L. maculans* population is virulent against the Rlm7 gene – that's not a high percentage. Again, that's good news since this is the gene we believe is widely deployed in UK cultivars."

By contrast, all the population is virulent against Rlm2, Rlm3 and Rlm9, rendering the genes ineffective, but the picture for Rlm1 and Rlm4 differs across England, he reveals. "This surprised us — on some sites, most of the population was virulent against Rlm1, but only a small proportion was virulent against Rlm4. On others, populations were partially virulent against both genes, but the percentage of virulent isolates differed between sites."

This raises the potential benefits from ▸

Winter oilseed rape disease losses (England)



(Source: Defra)

Leaves infected with L. maculans *produce large pale lesions.*

▸ developing a strategy to regionally deploy cultivars according to their complement of resistance genes, assuming this information is accessible, says Bruce Fitt. "Similar schemes operate in France, Canada and Australia. If the phoma population in Yorks, for example, is virulent against Rlm4, then discourage growers from using cultivars with that R-gene. Where a pathogen population isn't exposed to the gene against which it has developed virulence, it can become avirulent and provide disease control again."

But the regional variation isn't the only surprise the project has thrown up. While the research team was focused on monitoring L. maculans, shortly before the 2012 harvest, damage was found in crops that was uncharacteristic for the species.

"We've always been led to believe that *L. maculans* is the more damaging species. But in the dry autumn in 2011 there was a late release of ascospores. This meant *L. biglobosa,* that's not normally a problem, was probably the major pathogen responsible for the phoma damage in that year," maintains Bruce Fitt.

Close consultation

Normally *L. maculans* causes canker at the stem base, but much of the damage seen in crops was caused by severe cankers in the upper stem. "That's not normal for infections by *L. maculans,* and suggests that *L. biglobosa* can cause severe epidemics.

"This is significant because the two species can't easily be distinguished at leaf-spot stage, but of greater concern, *L. biglobosa* isn't known to be very sensitive to many azole fungicides. What's more, we don't know much about cultivar resistance to this species, but my guess is that there isn't much."

Meanwhile the team has also been testing how temperature influences the effectiveness of different R-genes. At an increased temperature (up to 25°C), some of the R-genes were rendered ineffective in cultivars kept in controlled environment conditions. "We don't currently know why this happens, but if we can understand the basis of it, it may well be extremely useful information for breeders, especially if temperature insensitivity is linked to durability of resistance genes."

Bruce Fitt believes that L. biglobosa *was probably the major pathogen responsible for the phoma damage in 2012.*

Results from the final year of experiments still have to be analysed and pulled together with the rest of the data. "We've improved our understanding of host resistance and now know a lot more about the pathogen itself, and how it's distributed.

"There's more to learn about temperature effects and *L. biglobosa,* for example, but we're in close consultation with colleagues in other countries. There's plenty of potential now to exploit new developments in genomics and genetics of the host and pathogens to build on this work, which

New disease information on OSR welcome

Half of Charles Tomkins' arable area near Kettering, Northants, is drilled with oilseed rape. This means disease susceptibility of the 275ha of Astrid, Vision, Fashion and Rivalda he grows is a key concern.

"We've had bad phoma problems in the past," he says. "Light leaf spot (LLS) had never previously been a serious concern. Verticillium Wilt is the current worry — that hit the Astrid hard, and I think it's becoming more important."

It's a straight wheat/OSR rotation the farm follows across the mainly heavy clays. The OSR is direct drilled with an old Bettinson direct drill, and then the land is ploughed into the following wheat crop. "The direct drilling does wonders for blackgrass and slug control, while I reckon the plough helps reduce the phoma and sclerotinia pressure," he comments.

With no seed dressings applied, the OSR is drilled up to 20 Sept, he says. "We generally get a reasonable emergence. Flea beetle has rarely been a serious problem — if we see it, we spray with Hallmark (lambda-cyhalothrin)."

Phoma and LLS control has centred around autumn and spring applications of flusilazole. "I look at the Rothamsted site for the phoma and LLS forecasts. Last year the Astrid didn't receive an autumn fungicide, but did have one in spring. We shall probably move to Proline (prothioconazole) for leaf spot control now, but I'd like to have more information on varietal resistance."

For phoma, Charles Tomkins points to the system run in France, where growers get access to details on which Rlm genes are present in OSR varieties, the make-up of the current *L. maculans* population and resistance status *(www.cetiom.fr)*.

"We ought to have a system in the UK, similar to the rust diversification groups, that gives you good information about phoma. We know from rust that a disease rating of 9 can't be relied on. It's the same with phoma — we need more information on quantitative resistance, as well as which Rlm genes are present. If you don't know what's in them, how can you make an informed decision?"

Charles Tomkins feels growers need more information on quantitative resistance to phoma, as well as which Rlm genes are present.

HGCA plays a crucial role in selecting for disease resistance, he feels. "Good disease resistance in varieties has a place on farms — not every grower wants to spend their life on a sprayer. But equally I think it's unlikely all growers will select for disease resistance over yield.

"However, the breeders have to see a potential reward in aiming for resistance over yield. So it's important the research sheds new light on these diseases and that HGCA uses the information when putting together the Recommended Lists."

Neal Evans aims to give growers accurate information on spore release as well as an epidemic onset model to help them time fungicide sprays more accurately.

would ensure more secure production for UK OSR growers," concludes Bruce Fitt.

For LLS, the new project is set to deliver growers an accurate idea of when best to spray for the disease, explains Dr Neal Evans of Weather Innovations (WIN). "Crop Monitor data shows the incidence of LLS has risen steadily in England for the past six years. In 2011/12, more than 80% of crops were affected, while within those crops, 30% of plants were hit. That translates to an average yield loss of 10%, and it can be more than 1t/ha in severe cases."

It's in the south and east of England that incidence of the disease has risen most dramatically, but why? "We really don't know, and that's one of the reasons we're doing this study," he continues.

LLS is a polycyclic disease, so unlike phoma it'll have several generations within a single crop. The disease is initially spread on the wind through ascospores, but also within the crop via rainsplash. It usually arrives in autumn, but carries on developing throughout the winter. Preventative fungicide applications in autumn, often repeated in spring, are required to keep the disease under control.

"The current forecast indicates the risk of infection," notes Neal Evans. "It'll tell you in autumn how much LLS you can expect in the spring when it'll be too late to control. But it won't tell you when the disease is coming into the crop."

The aim with the new forecast system is to give growers accurate information on spore release as well as an 'epidemic onset model' which will help growers time fungicide sprays more accurately. "If you can improve control of the initial infection, there'll be less disease going into the winter," he notes.

A series of met stations, run by WIN, and spore traps, run by ADAS in England and SRUC in Scotland, is delivering data into models that are being developed to provide a more accurate forecast of how the disease will develop.

"Some valuable work, carried out by a post graduate student at Rothamsted Research, has helped determine the parameters required for development of apothecia (the fruiting bodies of the fungus) and air-borne ascospores, as well as the conditions needed for spore release."

Monitoring plots at Rothamsted, ADAS and SRUC sites, drilled with three OSR cultivars with different levels of resistance are providing real information on how the disease develops within the season.

"We already have LLS in the monitoring plots this season. It looks as though it'll be a very similar year to 2013 in terms of levels of the disease, although the wet, mild weather may mean there's potential for it to be even more severe," he reports.

The model will be up and running by autumn 2014, but it'll take a year or two of testing and validation before it's reliable for growers, he adds. "But we're putting out regular reports via our Twitter feed (@leafspot) for those who'd like to follow progress." ■

Research round-up

HGCA project 3676, Understanding resistance to decrease risk of severe phoma stem canker on oilseed rape, runs from Jan 2011 to Dec 2014. It aims to decrease future risk of the disease by developing a scheme for effective use of host resistance and by using temperature as a means to improve understanding of how the host resistance works. Led by University of Herts, its total cost is £1,127,000, with BBSRC-LINK the main funder and £124,000 funded by HGCA, as well as a further £11,800 provided in-kind. The project's industry partners are Co-operative Farms, NFU, Chadacre Agricultural Trust, Felix Thornley Trust, Perry Foundation, DSV, Elsoms Seeds, Grainseed, LSPB, Monsanto, Pioneer, Saaten Union, Syngenta and Limagrain.

HGCA project 3814, Investigating components of the oilseed rape light leaf spot epidemic responsible for increased yield loss to the UK arable industry, runs from Aug 2013 to Dec 2016. It aims to develop and validate a novel decision-support tool to predict the onset of a light leaf spot epidemic. Led by Weather INnovations, with scientific partners ADAS, SRUC and Rothamsted Research, its total cost is £92,711 of which HGCA is contributing £77,711. Bayer CropScience is the project's industry partner.

Information Sheet 23, Fungicide performance in oilseed rape, was updated in Nov 2013 and is available to download at *www.hgca.com.*

Light leaf spot has several generations within a single crop and is initially spread on the wind through ascospores, but also multiplies within the crop via rainsplash.

L. biglobosa *isn't known to be very sensitive to many azole fungicides and causes lesions in the upper stem leading to canker further up the plant.*