



from theory  
to field

# The spread of the cruciferous curse

Did your oilseed rape crop lodge badly, shortly before harvest? Were the freshly cut stems brown or black? Perhaps you had unusually stunted plants or bare patches in your field. If these symptoms sound familiar, your crop could be falling foul of verticillium wilt or clubroot — two pathogens spreading through UK soils like a cruciferous cancer.

"Soil-borne diseases are an increasing problem in oilseed rape," notes Jenna Watts of HGCA. "Short rotations, spurred on by the profitability of the crop, have exacerbated problems with clubroot, while verticillium wilt, that was only discovered in UK crops five years ago,

“ We now know verticillium wilt is capable of causing significant yield loss, and it has done so this year. ”

is now the cause of significant concern.”

And yet an accurate picture of the impact of these diseases on UK crops still doesn't exist. "You never know with OSR until you put the combine through whether it'll yield well or disappoint, but the crop now has a very important role on most UK farms, sometimes out-performing wheat gross margins. So there's a very clear need for management information, based on sound research, that'll take out some of these uncertainties and make OSR less of a gamble."

HGCA funds a variety of resources that do exactly that, she points out. Examples include the light leaf spot and phoma forecasts. In addition, there's a wide array of research underway or recently completed. "This is helping improve our understanding of OSR disease, how rotational effects and soil management impact on it, and it's equipping growers with tools, such as diagnostics, monitoring and fungicide-efficiency data, to give them more control over what they gather in at harvest."

This year's harvest has raised the profile of one pathogen in particular, according to Dr Peter Gladders of ADAS Boxworth. "We now know verticillium wilt is capable

**As oilseed rape rotations get tighter, soil-borne diseases, such as verticillium wilt and clubroot, threaten to eat into the crop's profitability. CPM looks into the research set to help growers through.**

*By Tom Allen-Stevens*

of causing significant yield loss, and it has done so this year," he reports.

This is a disease that wasn't even on the radar for UK growers or agronomists until 2007. Caused by the soil-borne pathogen *Verticillium longisporum*, it's been an important disease of OSR in much of continental Europe for some time, causing up to 50% yield loss, and affects other cruciferous crops around the world.

"I've been looking for it in UK crops for the past 20 years," claims Peter Gladders. "But it wasn't until we were assessing a crop in Kent, as part of routine monitoring five years ago, that we found a case which was then confirmed through DNA testing." ▶



*Verticillium wilt is most evident in the field close to harvest.*

► There was a second confirmed case near Hereford in the same year, so HGCA commissioned a research review to draw together what was known about the disease, and the implication for UK crops. Plants are infected at the seedling stage, and the infection then creeps up, usually

unnoticed, through the stem via the xylem cells during stem extension.

"It's not until the crop ripens that symptoms appear, usually as vertical yellow or brown bands on the stem. Because of this, it's difficult to tell whether the disease has affected the crop or whether it's just natural senescence. Either way, there are only certain years when the disease is particularly evident to the trained eye," says Peter Gladders.

### Badly infested

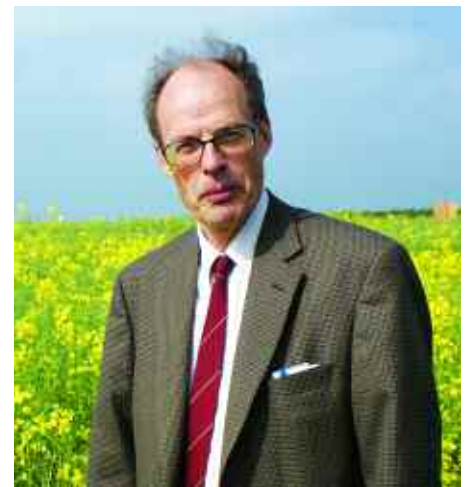
The review threw up a number of questions. "We needed to know more about how the disease affects UK crops, and what proportion of soils is infected. Examination of the Kent and Hereford crops in 2007 showed that most of the fields were quite badly infested, so this is a disease that has been building up over many years and is only now beginning to cause problems."

There was also a need for a rapid diagnostic test to help identify the pathogen, and research was needed to assist development of resistant varieties, he says. "Finally, we were keen to assess the impact on the rotation — the rate of decline in the soil in between susceptible crops — to inform rotational planning."

A three-year project started in Jan 2010. Monitoring for verticillium wilt was built into the CropMonitor assessments, which gauge disease levels and impacts on 100 randomly selected fields throughout the UK every year.

Initial yield data from field trials in 2011 suggest that yield loss doesn't necessarily follow on from a high degree of infection. "This season, however, we've seen a lot

*It was not until 2007 that Peter Gladders spotted the first UK case of the disease during routine monitoring of a crop in Kent.*



## Yield drop points to wilting worry

Alarm bells started ringing for Essex farm manager Paul Coxall, when apparently identical fields of oilseed rape yielded 1t/ha different at harvest. "I first suspected something was wrong when I spotted areas of the crop that looked bleached white, while the OSR on virgin land next door still looked healthy. But it was the combine that confirmed we had a problem."

This year, he's grown V280, a Vistive HOLL variety, on the entire 134ha OSR area farmed by E&R Fuller, near Saffron Walden. There's a one-in-three year rotation across the total 380ha farmed, with winter wheats, grown in two blocks of land. "What got me suspicious about verticillium wilt were the varieties I grew in these fields last time, back in 2009. One block grew Castille and the other Catana."

The ex-Catana area yielded the farm average of 4.3-4.5t/ha, but the block that had previously grown Castille struggled to achieve 3.5t/ha. Meanwhile, the OSR on virgin land brought in 4.8t/ha. "Looking back at previous yield data, the 2009 Castille didn't perform very well, and I think the crop encouraged disease inoculum."

This year, as the combine cut through the crop, the damage from the disease was revealed, he reports. "I've seen flat OSR before, but I've never seen stems destroyed. In places, the crop had completely given way."

Verticillium wilt has now been confirmed as the cause, but Paul Coxall believes there's little growers can do to manage a crop through the disease when it takes hold. "I don't think I could have given it a better start or put more attention into the crop's management."

The seed had a Cruiser (fludioxonil+ metalaxyl-M+ thiamethoxam) plus Take Off dressing, then two treatments of Proline (prothioconazole) were applied in the autumn, followed by two of tebuconazole in the spring — with the crop receiving two applications of Amistar (azoxystrobin) and Filan (boscalid) for sclerotinia as well.

The hybrid, Vistive variety was established at 50 seeds/m<sup>2</sup> with a Sumo 3m Trio fitted with a Terracast seeder unit, with some pressed and the rest rolled after establishment. "You couldn't fault the crop — there was good vegetative



*Verticillium wilt was confirmed in a block of OSR where previously Castille had been grown.*

growth above ground and strong 250-300mm taproots underneath."

The V280 is believed to be moderately susceptible to verticillium wilt, while varieties currently in the ground are Extrovert and Agatha, a conventional type available from Grainseed. "There's just a small area of Agatha, but both varieties score well for the disease. Because of the level of infection I've witnessed, verticillium wilt has got to decide which varieties I grow from now on. The trouble is, there's a lot we still don't know about it — there needs to be more work done to help us manage it."



of verticillium wilt in the plots on a heavily infested site, and 80% of plants in the susceptible varieties were dead. Farm reports suggest badly affected crops have lost about 10% of their yield to verticillium.”

Monitoring over three years has revealed that 16% of UK fields are infected with the disease. “The good news is that this figure could be viewed as relatively low. Only 6% of the fields sampled overall had 30% or more plants affected. But the bad news is that there’s a core of OSR fields with a high level of infection, and this could well cause problems in future crops.”

### Disease hot spot

Distribution across the UK suggests a disease hot spot across Cambs, Herts, Beds and Northants. “We’re seeing twice as much in those counties as in the rest of the country. It’s the OSR heartland in England, with fewer rotational alternatives. The area has heavy soils and generally hot, dry summers, which we’ve found tend to encourage the disease. But growers in Kent and the South East, and right up to Yorks shouldn’t get blasé — we’re finding it there, too.”

Agronomy also has a significant

influence over whether the crop suffers, notes Peter Gladders. “Drilling date and early growth are crucial. Plants with a poor rooting system or under stress are most likely to be affected where the disease is present. But very early sowing increases exposure to inoculum, so this practise should be avoided.”

There’s now much more reliable information on impact and spread of verticillium wilt, he concludes, but with just a few months of the project left, questions still remain. “Yield loss is the biggest bug bear. Hopefully data from this harvest, once it’s all in, will provide more conclusive information. But the effect on crops is seasonally dependent — it doesn’t cause damage every year, and we’re still not clear on the factors that drive this.

“We expected last year to be bad, for example, as it was hot and dry, but crops weren’t really affected, while this year was cool and wet and they were. We suspect it relates more closely to conditions at germination and stem extension, but this needs more work.”

There’s also a question over varietal ranking. The project has revealed varieties have significant differences in the way they respond to verticillium wilt. So should



*Yellow or brown stripes extend from soil level up to upper branches as ripening begins.*

they be rated for the disease in the HGCA Recommended List (RL), in the same way as for light leaf spot and phoma stem canker? “Varietal effects are certainly consistent, but there’s not yet enough data to provide resistance scores,” says Peter Gladders.

This is being seriously considered, ►

**advert removed**



Clubroot spores can remain viable in contaminated soils for up to 18 years.

▶ however, says Jenna Watts. “As part of the HGCA RL protocol, we’ll be requesting that trials are assessed using a common method in the future. The timing of assessments and methods used will be discussed with researchers this Dec”.

Peter Gladders believes good agronomy will be the key to keeping the disease under control. “A rotation of at least one in every four years is needed before inoculum levels are likely to decline. Good establishment and top-notch agronomy thereafter will keep the plant stress-free, and that’s 80% of the battle with verticillium wilt, with variety choice providing the rest,” he concludes.

For clubroot, developing an in-field test to assist growers is now the aim. A reliable test should be commercially available in the near future, reports Alison Wakeham from Worcester University’s National Pollen and Aerobiology Research Unit (NPARU).

*Clubroot builds over a number of years until the plant’s ability to overcome it can’t cope, says Alison Wakeham.*



“But just having a detection kit is not what it’s all about — it’s knowing what to do with the results.”

Clubroot is one of the most important plant pathogens of cultivated cruciferous crops worldwide. Caused by the soil-borne microorganism *Plasmodiophora brassicae*, mild infections lead to slow plant growth, lack of uniformity, delayed harvesting and yield loss, while severe cases lead to total crop failure. Spores can remain viable in contaminated soils for up to 18 years. Clubroot infection can occur after flooding from contaminated water, but it’s often present in soils at low levels.

### Threshold level

“Growers often say they don’t have a problem, then one year they notice widespread infection. But it doesn’t just suddenly appear — the disease builds over a number of years to a threshold level above which the plant’s ability to overcome it can’t cope,” says Alison Wakeham.

“We need a way to detect the disease at low levels, so growers can take action to manage it. Once you go over the tipping point, it’s very difficult to do anything about it.”

In the lab, a molecular test can determine the presence of clubroot in soil, and this has been used to develop an in-field, lateral-flow device that’s delivering results with a fair degree of confidence, she reports.

But there’s a problem: “In certain soil types, there are inhibitors that make it problematic to get accurate results, particularly in clays and silts. We’re now developing buffers that’ll remove these problems so the test will work over all soil types.”

Sampling methodology is also important, she says. “The greatest levels of clubroot are often found in hollow, compacted areas, such as gateways, while following a W pattern gives an overall assessment of a field.”

Alongside this, a model is being developed that can be used with a knowledge of the soil spore-loading data and the composition of the soil to forecast the potential for the disease to develop. “What we hope to put in place is a system whereby growers are given a low, medium or high risk.

“In low-risk situations, we’ve confirmed that applications of 7.5-10t/ha of Limex to raise the pH can be effective at keeping clubroot at bay. Where there’s a medium risk of infection, growers could strategical-

ly use resistant varieties. If there’s a high risk, you should really question whether it’s worth planting a cruciferous crop at all.”

Previous HGCA-funded research, led by SAC, established a level of infection of 53% of Scottish fields, while subsequent Crop Monitor surveys indicate about 1% of OSR crops in England have clubroot problems. In OSR, 10-20% of plants affected can result in a yield loss of 5-10%, while 100% of plants affected can cause total yield loss in extreme cases.

While resistant varieties offer good control, varietal resistance to clubroot is under pressure in some parts of the UK, particularly in the north east of Scotland, and there are some areas where resistant varieties aren’t resistant to all clubroot races, the research concludes. In successive crops of Mendel and Cracker, that share the same resistance mechanism, strains of clubroot that can overcome this can build up, according to HGCA Topic Sheet 110. So growers are warned that over-reliance on varietal resistance in short rotations will increase the risk from strains of clubroot for which there are currently no resistant varieties. ■

## Research round-up

HGCA project 3618, Importance and management of verticillium wilt in winter oilseed rape, runs for three years from 1 Jan 2010. Its aim is to quantify the importance of the disease in UK OSR crops and identify methods for managing the disease. Its total cost is £104,047, of which HGCA is funding £99,997, with the research carried out by ADAS, Farmacy, FERA and University of Warwick.

HGCA project 3525, Further development of an in-field test for resting spores of clubroot control based on detection, runs for four years from 1 April 2009. Its aims are to develop an in-field test for resting spores of clubroot and to use this to investigate integrated management strategies for clubroot control. Total cost is £296,814, of which HGCA is funding £100,000, and partners are HDC, S&G Seeds, Limex and Ag-Chem, with the research carried out by Warwick HRI and the University of Worcester.