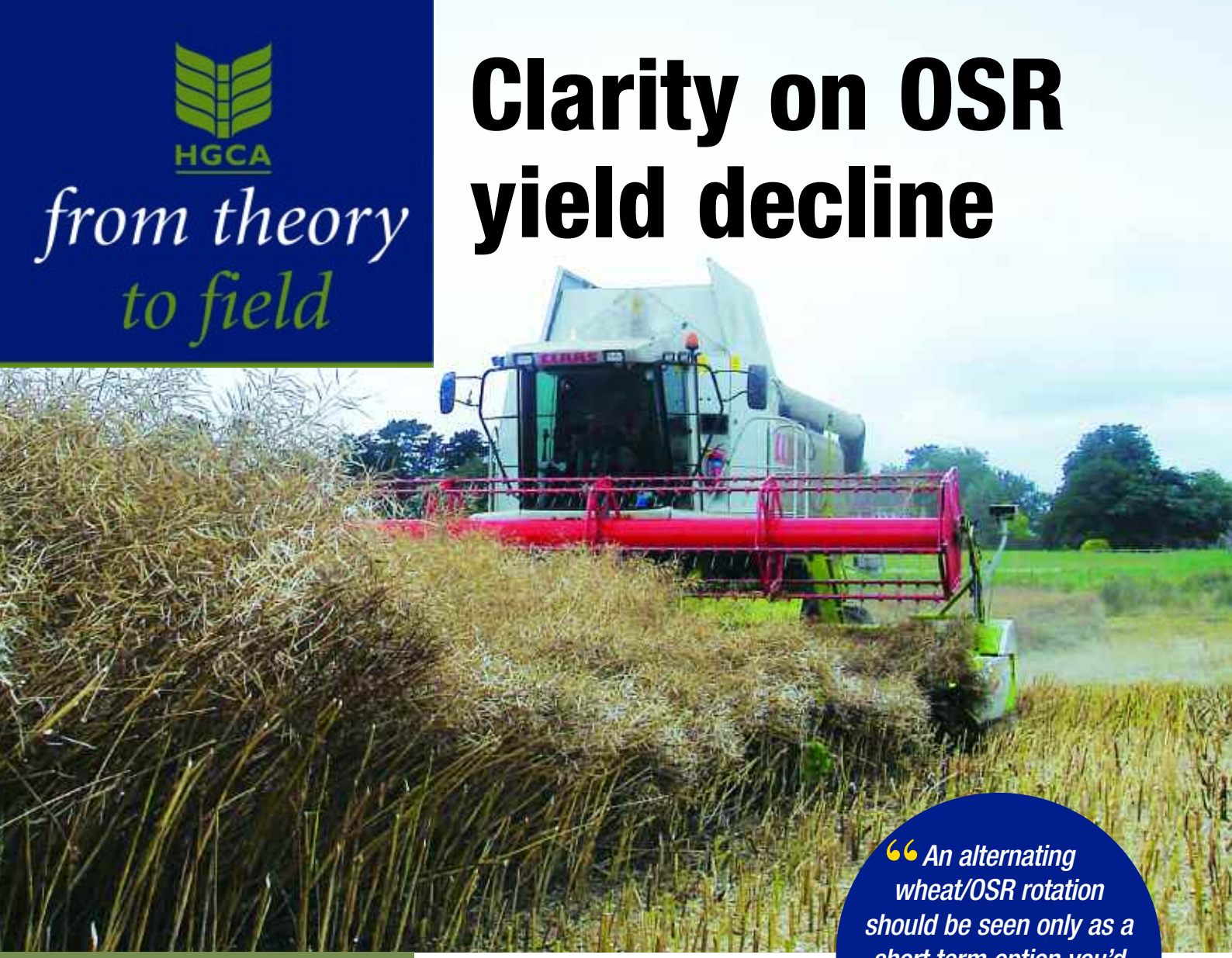
HGCA

from theory to field

Clarity on OSR yield decline



A long-term HGCA-funded project, which has recently reached its conclusion, set out to quantify the scale of the yield decline growers can expect in tight oilseed rape rotations. It also unlocked some of the crop's most closely guarded soil pathology secrets.

By Tom Allen-Stevens

This year, the combine will have entered many oilseed rape crops propelled by high hopes and expectations of bumper yields. If those didn't materialise, despite getting everything right, the weather may get the blame, or perhaps it was that missed input timing. There's also likely to be an unnerving niggle for some growers that OSR is now too close in the rotation and that bumper crops are now a feature of yesteryear.

In reality, yield decline in OSR has become something of a national conundrum, says Amanda Bennett of HGCA. "Yields haven't increased substantially in the last 20 years, despite improvements in varietal yield potential. But the reasons why simply aren't clear."

While the answer is likely to involve a range of complex and interacting factors, there's one inescapable truth about OSR in the UK, she says. "With the crop enjoying relatively high prices, OSR is being grown more frequently within the rotation."

This raises a whole host of other questions: What's the likely extent of yield decline? How will this affect financial returns? How often should OSR be grown within a rotation to optimise farm performance? And perhaps most importantly, what exactly is causing the yield decline — can it be managed?

A remarkably long HGCA research project set about addressing these questions, starting in 2003, led by Ron Stobart of NIAB TAG (formerly The Arable Group). "It was a four-year project with a four-year extension," he explains. "It's a real rarity to get a project that lasts that long, but when you're dealing with rotational factors, it takes many years to get the required data."

> *"An alternating wheat/OSR rotation should be seen only as a short term option you'd use to cash in on a market high, or to realign your overall rotation."*

The project focused on a field at NIAB TAG's Morley site in Norfolk, that was divided up into 6m by 24m plots and cropped with a range of rotational intensities. "It had been in a sugar beet rotation, so was virgin OSR land — that was crucial so we could gauge the true extent of the yield decline over the years.

"As a sandy clay loam, it was probably on the light side of most OSR-growing areas, but otherwise we tried to keep all parameters very similar to commercial farming practices."

Once chosen, the establishment practice and varieties were kept largely the same throughout the project. So all plots were ▸

Ron Stobart found an alternating wheat/OSR rotation delivered a 12% yield penalty, compared with a crop grown on virgin land.

▸ ploughed and pressed every year — standard practice in 2003 — the wheat variety was Napier, which then switched to Brompton after two years, while Winner was the OSR cultivar under scrutiny.

"We needed to keep it simple and weren't sure whether changing variety or establishment practice might skew results. Back then, everyone was growing Winner, so that's the variety we stuck with."

There were a range of differing rotational intensities under investigation, including continuous OSR, alternating wheat with OSR and OSR one year in three. "For the first four years, we had some plots going into OSR for the first time, so we could compare the rotated crop with a virgin-land situation. Later in the study, these plots also helped us look at the longer, six or seven-year gap."

The data confirmed what the researchers had suspected — that high intensity OSR does knock back the yield (see table on page 13). "In this study, we found on average a 12% yield reduction in an alternating wheat/OSR rotation, compared with the crop grown on virgin land, which was about 0.5t/ha, based on our yields. When we compared this with continuous OSR, that penalty increased to around 18%," reports Ron Stobart.

Four-year gap

"The yield reduction once you get to one year in three or four is harder to pinpoint, as there's a lot of factors that could be influencing the data. But if you wanted to maximise the yield from an OSR rotation, you'd want to move to a rotation with at least a four or five-year gap, based on our results.

"In gross output terms, using the yield data from our experiment, if the OSR price was to rise to more than twice the wheat price, the shorter rotations start to look more attractive. But you have to question how sustainable that is — in a commercial situation, you'd start to introduce weeds and diseases that we specifically kept out of the trials. An alternating wheat/OSR rotation should be seen only as a short term option you'd use to cash in on a market high, or to realign your overall rotation."

So what was causing the yield reduction? "There's one low-tech answer that we drew quite quickly from the trials. In tighter rotations, you get more volunteers, and these appeared to be suppressing the yield."

These were assessed by counting plants that had established between the rows. Typically, in the continuous plots, up to 40 plants/m^2 fell outside the drill lines, compared with seven plants/m^2 in the virgin plots. "Almost as many volunteers were emerging in the continuous plots as the plants that were drilled. In a min-till situation, you might expect the number of volunteers to be even higher."

But volunteers didn't explain the yield reduction on their own, notes Ron Stobard. "What's more, known pathogens were discounted. We managed the plots under an intensive management routine so phoma, light leaf spot, insects and slugs weren't an issue. Moreover, no clubroot or verticillium pathogens were found on the site throughout the project."

But what scientists did find on the site could have far-reaching implications for both OSR management and breeding for years to come. "There are two soil-borne pathogens that we didn't know affected OSR that were found in varying levels across the plots," he reveals.

This was an almost chance discovery. One of the original intentions of the project was that it should act as a 'living laboratory' ▸

OSR result prompts rotational rethink

Worcs grower Jim Bullock says he's had a disappointing oilseed rape harvest this year. "We only got 3.25t/ha from Excalibur and PR46W21. The crops didn't like standing in the wet. Overall this result is poor and I don't think it's sclerotinia as we haven't had much, so we're reviewing our cropping for next year."

The farm has moved to a rotation that he admits is tighter than he's comfortable with. "We're now seeing a slightly downward trend with the OSR. It's a weather-dependent crop, so it's very difficult to judge whether the tight rotation contributes to this yield decline, but we're finding it harder to achieve bumper crops than we used to."

Winter and spring beans used to have a firm place on the 320ha farm near Malvern, slotting into a six-year rotation that saw one OSR crop as the other break, two winter wheats and a crop of oats. A direct-drilling enthusiast, Jim Bullock established the beans and the OSR behind a subsoiler, with the farm's Kuhn 4m triple-disc drill establishing cereals straight into the stubble.

"Beans were a great crop and did wonders for the rotation. But for the past five years the price hasn't justified growing them, and you simply can't get the yields."

So the crop was dropped from the rotation, along with the oats. "Again the oats were a useful break from wheat, but we were having problems controlling the grassweeds — if someone can come up with a solution for brome and blackgrass in oats, I'd happily grow them again."

That left the farm with a three-year rotation — 65ha of OSR is the break in front of 220ha of first and second winter wheats. "We also have 35ha of spring wheat, which plays a valuable part in the rotation. But we can't carry on with cropping as close as we are.

"We think we'll probably bring spring beans back in next year — I notice the price has come back up a bit so I don't think it'll result in too much of a financial hit."

No-till enthusiast Jim Bullock is considering lengthening his rotation.

And past experience tells him they should fit in well with the no-till regime on his silty clay soils. "A lot of growers think you can't direct-drill beans, but you can. We haven't used a plough for around 15 years and the soil structure is very good — this year's wet harvest is going to be a challenge, but I think we'll fare better than most."

Following the discovery of new soil pathogens that could be linked to yield decline, two new projects assessed biomass above and below ground.

▸ for complementary research. In each of the plots, only the central 2m was taken to yield, allowing thorough investigation of the rest of the crop.

Meanwhile, a Defra-funded project, led by Warwick HRI (part of the University or Warwick), was studying how crop rotations affected the microbial diversity of soils. Amanda Bennett was on the project team that carried out the research. "The plots at Morley provided the ideal samples for us to analyse. There were two soil-borne pathogens in particular that were found in greater abundance in the continuous and alternately rotated plots, compared with the virgin OSR plots."

They were *Olpidium brassicae* and *Pyrenochaeta spp*. Both pathogens were known to scientists, but their prevalence and affect on OSR had never before been assessed. "Olpidium was of particular interest because it's an obligate parasite that needs living root material to survive."

This spurred two more short HGCA projects, towards the end of the initial research. "We suspected the pathogens would cause a problem to root functions, but wanted to assess the impact of a tight rotation on the yield components of a plant, both above and below ground," says Ron Stobart.

Root biomass

"In closer rotations, we found there was a reduction in the root biomass. Above ground, where there was less root biomass, which also tended to effect the vegetative growth and ultimately meant the plants produced less seed. It could be that plants with a low root biomass produce more vegetative growth as a mechanism to try to generate more roots."

Although the interactions in the soil are very complex — more than can be fully analysed in a single research project — the rotational trials have quantified the yield decline and assessed the gap in the rotation, notes Ron Stobart.

"We're also now beginning to find out what's contributing to this yield decline, which is something we didn't know five years ago." It's paved the way for further projects, including a five-year study, funded through

Research round-up

HGCA project 2922, Impact of previous cropping on winter oilseed rape yields, ran for eight years from Aug 2003, completing in July 2011. Its aim was to test the hypothesis that growing OSR constrains yields of future OSR crops grown in the same field. Its total cost was £98,891, funded entirely by HGCA, with the research carried out by The Arable Group (now NIAB TAG).

Two other HGCA projects have followed on as adjuncts to project 2922 — the impact of oilseed rape cropping frequency on rooting (3649) and components of yield (3648). Their aims have been to ascertain how the rotational intensity of OSR cropping influences root growth in the crop and to record the components of yield. The rooting project ran for 24 months from Dec 2009 and cost £25,682, while the components of yield project ran for 21 months from April 2010 and cost £12,702. Both projects were funded entirely by HGCA and led by TAG, with SAC a partner for the rooting project.
For more information visit *www.hgca.com.*

Rotational results

	Crop and yield (t/ha)						
Rotation	**Year 1**	**Year 2***	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**
OSR year 1	OSR	WW	WW	WW	WW	WW	WW
	3.05	9.21	8.73	5.92	11.27	7.83	6.46
OSR year 2	WW	OSR	WW	WW	OSR	WW	WW
	8.80	2.34	10.09	7.16	3.52	8.78	6.58
OSR year 3	WW	WW	OSR	WW	WW	WW	WW
	8.95	8.91	4.24	10.12	11.28	8.07	7.10
OSR year 4	WW	WW	WW	OSR	WW	WW	WW
	8.69	8.74	8.87	3.55	12.64	8.33	5.94
Continuous OSR	OSR	OSR	OSR	OSR	OSR	OSR	OSR
	2.87	2.4	3.78	2.65	2.96	1.91	2.63
Alternate OSR	OSR	WW	OSR	WW	OSR	WW	OSR
	2.82	9.25	3.86	9.73	3.29	8.68	3.17
OSR 1 yr in 3	OSR	WW	WW	OSR	WW	WW	OSR
	3.05	9.91	8.91	3.57	12.67	8.54	3.00
Alternate OSR	WW	OSR	WW	OSR	WW	OSR	WW
	8.63	2.40	9.09	3.01	12.33	2.31	6.75

** Variable crop establishment of the autumn-sown crop in year 2 meant the plots were re-established in the spring.*

Volunteers accounted for up to half the plants counted in the continuous OSR plots, and contributed to the yield decline.

the Technology Strategy Board, that will look in more detail at the two soil pathogens, assessing their prevalence nationally, and evaluating whether there's any varietal difference in how plants react.

"There's a lot going on in the soil pathology and rooting of OSR, that we've only just begun to understand, and this could hold huge potential to push the productivity of the crop on farm," he concludes. ■