

# Bigger, bolder, stronger?

Wandering through the microplots of Saaten Union's cereal breeding centre in Picardy, north of Paris, is a bit like a trip through nature's misfits. There are wheats, triticales and ryes of every shape and size – vast leggy types weighed down by huge ears, some with broad, bold flag leaves, but plastered in rust. Some are awned, some are iridescent green, and occasionally you come across some that really catch your eye.

A tiny strip of double-dwarf wheat, with ears barely 20cm from the ground, is one such example. "What we've done is combine two existing genes and changed the harvest index," says Dr Volker Lein,

Saaten Union's director of research. The result is a variety with a high grain output from a low overall biomass.

"It could be useful where resources are limited, but you don't need the straw – a wheat that needs less water and inputs to grow. The downside currently is that it also has a reduced root system, so that's what we're looking at, and hoping we can improve."

There are close to 50,000 different lines that Volker Lein and his team are looking at. It's the foremost hybrid wheat-breeding programme in Europe, turning out varieties such as Hystar, which is claimed to produce consistently high yields and

For a while, it's been claimed that hybrid wheat has a yield benefit of at least 1t/ha, but seed production has remained a niche activity. CPM gets exclusive access to developments set to bring it into the mainstream.

By Tom Allen-Stevens

quality, even in marginal situations.

The aim with a hybrid wheat is to cross two different varieties and achieve heterosis – the hybrid vigour that gives the resulting crop enhanced performance. But it's not easy to breed a wheat hybrid – the crop is self-pollinating, with pollen transferred by wind, and efficient genetic male sterility (as used in hybrid barley breeding, for example) will take at least another five to seven years.



Volker Lein is looking for a good match in the genomics of a hybrid's parents.

So the two parent lines are grown side by side in strips, and then one line is treated at a crucial stage with Croisor (sintofen), a specialist growth regulator that effectively renders it male sterile.

"It's best when the pollinator, male line is a bit taller than the male-sterile, female line as wheat pollen is relatively heavy," explains Volker Lein. "The male must also have good anther shedding and the female must be open-flowering and easy to

sterilise. You're looking for both lines to have a long flowering period and for this to be synchronised.

"We get our parent stock from breeders all over Europe, including the UK. UK varieties often make good female lines – they tend to be shorter – but are often terrible at shedding anthers, which remain in the glume. Santiago works, for example, but Robigus doesn't."

Only the male-sterile line is harvested for the hybrid seed, and this is monitored carefully to ensure the Croisor has had the desired effect – applied just a day late and purity of the hybrid seed nosedives.

"The European minimum standard for purity is 90%, but we work to a purity of 95%. We put bags over a number of the female plants which allow air to pass through, but not pollen. If any ears set seed inside the bag, we know the Croisor hasn't worked."

So is it worth going to all this effort? Work

carried out by ENSAIA, an independently funded French research group, suggests it is. In trials, the root biomass of hybrid wheats was found to be 60% greater, and the shoot biomass 46% more, than its parent lines.

"Every tiller of a hybrid wheat plant ▶

Double dwarf wheat has a higher grain output from a lower overall biomass.



“The potential for hybrid crosses is greatly increased – you can create more of everything and more of anything.”



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Bags placed over a number of the female plants allow air to pass through, but not pollen to test if the Croisor has worked.

► is stronger,” claims Pierre-Louis Carrier, Saaten Union’s hybrid wheat product manager. “In fact, it’s hard to identify the

main tiller, and the plant stays greener for longer.”

The extra root biomass gives the hybrid plant a clear advantage, he claims, especially in more marginal situations. “On a light soil, they’re better at nutrient

scavenging and they also utilise N better. In a drought, hybrid roots dig deeper and where there’s water-logging, the greater root mass reduces the chances of plant asphyxia.

“If you have a homogenous, fertile soil, you probably won’t notice much benefit. But in a variable soil, it’ll tend to iron out the differences.”

This’ll bring a yield advantage (see panel) and a grain quality advantage too, continues Pierre-Louis Carrier. “Because hybrid wheat

## Hybrid wheats – should I grow them?

Little known in the UK, and not even recognised on the HGCA Recommended List, sales of hybrid wheat are strengthening year on year in France — a 2011 survey of 500 French farmers who grow hybrid types has revealed the crop delivers almost a tonne extra per ha over a conventional type.

“There was a 93% satisfaction rate among the farmers surveyed,” reports Pierre-Louis Carrier. “Most cited better tillering as the main advantage with hybrid wheat.”

While some of the growers surveyed were growing only hybrids, most had 20-34% of their wheat area sown with a hybrid variety, with the balance made up of certified and farm-saved seed. New users plant just a field, and then tend to increase their area of hybrid wheat year on year, the survey showed. “Growers reported an average yield advantage of 0.94t/ha, with 58% achieving more than 1t/ha over conventional wheat.”

Hybrid varieties make up around 6.5% of the certified wheat seed market in France, with Hystar by far the biggest selling variety, accounting for 60% of Saaten Union’s sales. “Our sales overall are rising by 15% per year.”

What’s more, hybrids are performing well under independent scrutiny, he adds. “In CTPS trials (equivalent to UK RL trials), Hystar achieved a yield of 126.4% untreated and 112.5% treated. It’s always at the top, and that’s on good soils — on poorer land, it would probably be more like 130%.”

Grain quality also tends to be good — although the variety’s not recognised as a

John Poulton says UK growers are getting on average a 2t/ha yield advantage from hybrid wheat.



pure milling wheat by French millers, they can include up to 40% in the grist with no reduction in quality, maintains Pierre-Louis Carrier.

“We also have milling wheats, such as Hybery, launched in France in 2010, and biscuit-quality varieties, such as Hyteck launched in 2011.”

So if hybrid wheat’s so good, why hasn’t it caught on over here? “One of the problems has been seed availability, and much of that’s been down to the sterilising agent, Croisor,” says John Poulton of Cropco, responsible for marketing Hystar and other Saaten Union hybrids in the UK.

“Until last year, Croisor was only registered for use in France. Relying on this registration has made it difficult for Saaten Union to develop production of the hybrid varieties. But in 2011 it received Annexe 1 listing, safe-guarding the hybrid programme, and we’ve seen a real drive from the company since then in terms of developing both the market and new lines.”

The technology itself isn’t new, however — Monsanto developed the first hybrid wheat variety in 1982. Some growers will remember the likes of Cockpit and Mercury, marketed in the UK in the mid-1990s, and Dupont’s Hybrinova programme, also based on the use of Croisor.

But both Monsanto and Dupont opted to exit the market, selling their interests to Saaten Union in 2000 and 2002 respectively. Since then, the company has shaken up the varieties in its portfolio — dropping many lines, refocusing those that remained and securing a future for Croisor.

“The UK market is really quite tiny, and only really started anew in 2011,” says John Poulton. “We’ve now established a distribution channel and set up three major trial sites across the UK, looking at the agronomy and performance of around 50 varieties, so that we can make sure the UK grower gets the best out of them.”

But Cropco’s stopped short of entering them in National List or RL trials. “You can’t compare them side by side — the seed rate, harvest date and much of the agronomy is different. It would simply be misleading.”

So how do they perform in the UK? “Growers are currently getting on average a 2t/ha yield



There was a 93% satisfaction rate among 500 French hybrid wheat growers, says Pierre-Louis Carrier.

advantage, but this ranges from 0-3t/ha. You need a 0.5t/ha benefit to justify the seed cost. Most start by trying 1ha, then move to a whole field, as generally they’re impressed and find a good use for it within their portfolio.”

Hystar would be classed as a Group 4 soft wheat, suitable for feed or export. No buy-back contracts or premiums are available, although discussions with a few end users are underway.

Agronomically, the variety is very early maturing, he says. “It’s barley-early — like Soissons. It stands about 75-100mm higher than most varieties, but it’s very stiff, which is down to the heterosis — it has a thicker stem wall and bigger root mass, so very rarely lodges.”

Typically, the seed rate would be in the 170-240 seeds/m<sup>2</sup> range. “Drill to a depth of 25mm — the variety benefits from accurate seed placement, but will fare well in more marginal soils. It’ll tiller well, producing around twice as many as conventional types.”

Keep an eye on the variety in early spring, he advises. “It gets away early, and is generally about 10-14 days ahead of other varieties throughout the season. But it scavenges N well, so may not need an early application. In many parts of France it’s favoured for its low N requirement because they have greater restrictions than here in the UK. We can use this advantage to maximise yield.”

Disease-wise, mildew and eyespot are its weaknesses — Saaten Union has rated the variety a 3 and 4 respectively. “But everything else is a strength — its resistance to septoria and rusts is phenomenal, and independent work has confirmed it has a particular strength against fusarium.”

For more information, including UK distributors, go to [www.cropco.co.uk](http://www.cropco.co.uk).

## Super wheat prospect from breeding breakthrough

A new generation of ultra high-performance wheats could be grown commercially within five years, following a ground-breaking genetic innovation. Saaten Union has just announced a joint R&D project with Israel-based seed company Kaiima, with the two working together on polyploid hybrids.

“Wheat is already a hybrid of three ancestors, making it a hexaploid (6x),” explains Volker Lein. “Kaiima has developed dodecaploid (12x) wheat. It’s slightly larger, its ear is slightly bigger, but significantly, it has more DNA. That means the potential for hybrid crosses is greatly increased — you can create more of everything and more of anything.”

The new phenomenon developed by Kaiima, termed Enhanced Ploidy, is entirely non-GMO and natural. Instead of having the usual

42 chromosomes (three pairs of seven), the new wheats have double this number.

“The breakthrough only came about 18 months ago. I never knew it was possible to have a stable, dodecaploid variety,” remarks Volker Lein. Crossing 6x varieties with 12x will create an entirely new range of hybrids, claim the project partners, with significantly higher biomass (both grain and straw yield), and improved grain protein content and quality.

“I’ve always considered the wheat genome as working with three bibles. Sometimes there are pages missing, or deletions, but you can build the story with the text you have. This innovation doubles the material we have to work with, so there are six bibles, and considerably more choice in text available to build a story. We’ll be able to create hybrids



Saaten Union’s microplots could soon be full of polyploid super wheats.

that are vastly superior to their parents.”

The first polyploid hybrids adapted to Europe will be submitted for registration in France within three years, with commercial seed expected in 2017.

utilises N better, has a broader flag leaf and stays green longer, it feeds the ear better and builds protein. It produces a sample with a 1000-grain weight greater than the parent lines.”

The downside is the seed cost. Although it’s sown at about 60-70% of the rate of a conventional variety, the cost per ha is about double.

### Remarkably consistent

“A seed crop only yields 3t/ha of hybrid seed. Because the use of Croisor has to be exact, seed production is very inconsistent — and yet the daughter hybrid wheat is remarkably consistent. It does mean you need a good seedbed and a good drill to ensure a good establishment percentage.”

But it takes more than banging a couple of wheat varieties together to make a successful hybrid, which is where Volker Lein’s microplots come in. “The right varieties have to be matched,” he says.

“The more I know about the parents, the better I can match the genomics. Genetic markers are now helping us find good matches and identify heterosis. At any one time, we’re looking at 12,000 varieties, but 90% of these can be dropped out quickly.”

The challenge is to engineer real genetic improvement. “You’re constantly looking at ways to make it better — to breed in a new resistance, or more pathways to improve resistance.

“Wheat is a vehicle that has so many uses — bread, biscuits, bioethanol — but how can you play around with its genes to match its end use better? You could breed a bread wheat that doesn’t have to have 12% protein, if it had the right type of protein, for instance. That could save nitrogen, and it takes three litres of oil to produce 1kg of N,” points out Volker Lein. ■

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