



techtalk

Considering oilseed rape traits

Limagrain's OSR breeding approach is to maximise crop yield potential while ensuring yield stability. For a variety to reach its full yield potential, it's critical to protect against any factors that suppress yield. Limagrain aims to achieve this by building traits into its OSR varieties that mitigate the impact of environmental and other stresses.



Strong genetics helps mitigate risks

Selecting varieties with the right combination of genetic traits and agronomic characteristics to suit the farm may be the key to successful OSR growing. *CPM* finds out how breeding can help protect yields.

By Lucy de la Pasture

Oilseed rape has always been considered a risky crop to grow, with yield variability from year to year just one of its many challenges. Plant breeders have been working hard to produce OSR varieties with better yield stability by breeding in traits or agronomic characteristics that help the crop withstand many of the environmental and management stresses it faces within a growing season.

Understanding how the genetics or traits within a variety help to protect the top-line yield from the host of factors that are known to depress yield is key to choosing the best varieties to

grow on the farm, believes Dr Vasilis Gegas, senior OSR breeder at Limagrain.

What is a trait?

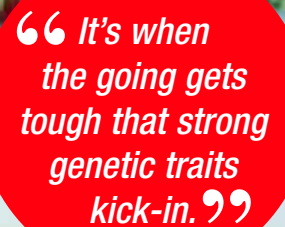
Traits can be classified as either qualitative, where variation occurs in discrete classes and is controlled by one or a few genes, or as quantitative characteristics, where variation is continuous and controlled by several genes, each having a minor effect.

In plants, the environment has a large influence over how a trait manifests itself, with certain agronomic characteristics such as height, stem stiffness and

seed yield particularly affected.

A big step was made by breeders in the 1980s with the development of the Ogura system for the production of OSR hybrids. This enabled the rapid spread of hybrid varieties in Europe and facilitated the introduction of specific genes through precision breeding.

Early trait breeding in OSR included the introduction of dwarfing genes that gave rise to semi-dwarf varieties. Disease resistance genes, such as the *Rlm7* gene for phoma stem canker resistance and the 'Mendel gene' for clubroot resistance, were also early



“It's when the going gets tough that strong genetic traits kick-in.”



Architect demonstrates the improvement breeders have made in yield since the first TuYV resistant variety was introduced in 2014.

developments.

The newest generation of traits include resistance to pod shatter and turnip yellow virus (TuYV), both of which were introduced into *Brassica napus* from different species. Resistance to herbicides, Clearfield varieties, and the creation of high oleic-low linolenic (HOLL) varieties by introducing FAD genes to alter oil quality, are also recent developments in OSR breeding.

How can they help?

The driving force behind plant breeding is bridging the gap between the genetic potential of OSR and yields that are realised on farm. Where plant breeders have succeeded in increasing the yield potential of varieties year on year, there's a stark contrast to performance on farm where OSR yields have stagnated.

When OSR is grown on a commercial basis, varieties face a whole different set of pressures than in trials — environmental, agronomic and crop management based. Breeders are now trying to produce varieties with different combinations of traits to help growers manage these risks and protect yield.

It's when the going gets tough that strong genetic traits kick in. For example, a variety with

robust disease resistance helps control of the disease when chemical application conditions are difficult, providing flexibility to the grower.

Apart from building multiple traits into varieties to protect yield, breeders are also working on a second tier of protection — their quantitative characteristics. By manipulating characters that aid crop management, such as height, stem stiffness and canopy structure, breeders are adding resilience to varieties to withstand UK environmental conditions.

What traits are useful?

Useful traits are very dependent on the environment the crop will be growing in. Breeders look at



Vasilis Gegas explains that breeders are combining traits to help growers manage risks.

how best to combine a range of traits so they can offer varieties that suit particular situations.

For example, growers in the North are looking for OSR crops that will establish quickly, so varieties need to demonstrate early vigour, winter hardiness, early maturity and must have robust disease resistance against light leaf spot (LLS).

For land heavily infected with clubroot, choosing a variety with clubroot resistance is an essential trait to help protect yield. Traits such as TuYV and pod shatter resistance often go under the radar, as either the symptoms are difficult to recognise or crops won't come under the pressure these traits protect against every year.

But when these conditions do occur, valuable yield protection is gained. Pod shatter can be a very real problem in seasons where harvest is protracted or the crop is hit by hail storms, with yield losses of up to 80% in severe cases. Similarly, only genetics can safeguard crops from TuYV infection in seasons where aphid pressure is high.

How does a breeder introduce them?

Trait breeding involves two distinct phases, namely the discovery and the precision



TUYV is detected using ELISA tests in the lab.

breeding phase. The discovery phase involves identification of the genetic resource (i.e. wild species, landraces etc.) that carries the trait of interest, the genetic dissection of the trait (number of genes involved, mode of inheritance etc.) and the development of the necessary genetic or molecular tools (e.g. molecular markers) and screening methods (e.g. assays for disease screening) in order to follow the trait in subsequent stages.

Introduction of a particular trait from a genetic resource into elite cultivars through crossing and backcrossing and continuous screening is also an important aspect of the R&D phase and one that can be very lengthy as breeders try to retain the trait while eliminating possible undesirable characteristics associated with it.

Recent advances in the fields of molecular genetics, such as whole genome sequencing ▶

Grower utilises virus resistance to maintain oil quality

TuYV can reduce oil content in rapeseed by as much as 3% and raise glucosinolate and erucic acid levels in the extracted product, resulting in bitter taste for the consumer if used for cooking, according to grower Andrew Ownsworth, who's built a successful enterprise producing his own cold pressed rapeseed cooking oil.

To minimise the risk of tainting the award-winning product he sells across Lincs and the surrounding counties, he's looking at resistant varieties to ensure the brands reputation for great taste remains intact.

"We've started to pick out virus symptoms in crops, so I want to get something in our armoury that will help control it in the future. It's all about

keeping the taste right," he explains.

This season he has tried 10ha of candidate hybrid Architect, which not only offers protection against higher glucosinolate and erucic acid levels because of its TuYV resistance, but also a high gross output of 105% in the East/West, 44.6% oil and pod shatter resistance.

It also fits in nicely with his strategy to grow a mix of conventional and hybrid varieties, with a range of agronomic characteristics to spread risk and ensure the farm has enough rapeseed for the crush, whatever the season brings.

"The pod shatter is important as you invest a lot of effort and money in the crop, so it helps us protect the yield we

have. There's nothing worse than the wind blowing and all the seed dropping on the floor," says Andrew Ownsworth.

John Challans, Nickerson's seed specialist, says the pod shatter resistance should buy about 7-10 days at harvest over varieties that don't have the trait, so can be extremely valuable.

"An added benefit of pod shatter resistance is that it gives farmers the option of letting the crop ripen naturally, which not only increases oil content but also enhances oil flavour."

Architect is also vigorous and winter hardy, so is suited to growers UK-wide, and has a score of 6 for the two main oilseed rape diseases phoma stem canker and LLS, he adds.

"Architect doesn't rely on single



Andrew Ownsworth is growing a range of OSR varieties to spread risk and ensure he has enough rapeseed for the crush.

resistance genes, it has quantitative resistance (made up of multiple genes), so it's more robust. It isn't early flowering either, so lessens the risk of any frost damage in the spring," says John Challans.

Considering oilseed rape traits: top tips

- **Traits help manage risk** – select varieties with a combination of traits that will help protect yields on the farm.
- **Consider varieties not on the RL** – some traits, such as pod shatter resistance, aren't taken into consideration.
- **Support new genetics** – this enables breeders to keep improving new traits in pipeline varieties.

▶ (i.e. description of the plant's whole genetic profile), and phenomics such as deep high throughput phenotyping (i.e. very precise description of the way the trait manifests) have significantly accelerated these processes.

Once the different traits are introduced into an elite population, these can then be used to create the female and male parents that will give rise to new hybrid combinations. At this phase breeders are able to precisely introduce into hybrids combinations of different traits according to market requirements.

What difference do they make?

With the loss of neonicotinoid seed treatments and increasing resistance to insecticides, control of aphids has become more and more difficult and

subsequently aphid-borne diseases more prevalent. TuYV is one such disease spread by the peach potato aphid (*Myzus persicae*).

There's an increasing body of evidence that demonstrates the trait's ability to protect the yield of crops under TuYV pressure. Multi-year yield trials across Europe showed Architect, the first TuYV resistant hybrid, yielded 115% of the non-resistant controls under high incidence conditions (virus infection >80%). The same variety yielded 105% of the controls in low incidence sites (virus infection <20%).

The high yield potential of Architect is an example of how the yield penalty initially associated with the introduction of TuYV resistance has been overcome since the introduction of the trait in Amalie in 2014.

How are the varieties identified?

Picking varieties can be tricky and decisions are often influenced by the most pressing issue at the time. In the last three years, the RL has shifted towards varieties with high LLS resistance scores due to widespread disease and difficulties controlling it on farm.

But the RL isn't a gospel, it's a good guide and source of information. It's also important to base variety decisions on experience of the farm. Some traits, such as pod shatter resistance, aren't identified



The pod shatter resistance trait can protect yields and extend the harvest period.

within the RL so its importance in safe-guarding yield can be overlooked.

A large proportion of commercially grown varieties are outside the RL, which reflects that growers 'look outside the box' when OSR growing becomes more difficult. Supporting new genetics from introduction enables breeders to continue working on the trait and the genetics will only get better as new varieties are introduced and any yield penalty overcome.

What traits are breeders working on?

Limagrain breeders have a number of near-market traits they are developing. Sclerotinia tolerance is likely to be the next trait introduced and screening for Verticillium resistance is an ongoing process. It's a disease that's likely to increase in importance as more growers

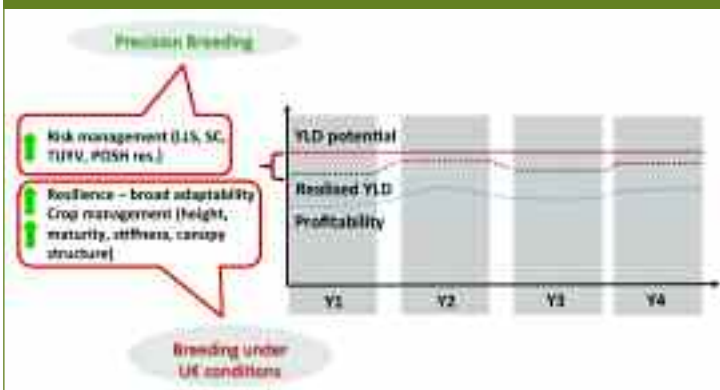
adopt min-till and direct-drilling techniques.

New sources of clubroot and TuYV resistance are also high on the agenda. But the main disease breeders are currently working on is LLS. It's a difficult disease to work on because of the way the pathogen evolves, but Limagrain breeders are searching for new sources of resistance. ■



Typical autumn leaf discoloration caused by TuYV.

Genetics – bridging the gap



The driving force behind plant breeding is bridging the gap between the genetic potential of OSR and yields that are realised on farm.

Sponsor message

Limagrain's dedicated UK OSR breeding programme based in Rothwell, Lincs is unique in that it focusses specifically on challenges that UK OSR growers face.

Varieties such as Anastasia, Aquila and new hybrids Arrow and Architect, all offer very good autumn vigour. Annalise is a new conventional with TuYV resistance. Arrow has a unique combination of resistance to LLS and RLM7 phoma resistance, whilst Nikita, new for the east-west this year, has the best available rating of 7 for LLS.

Pod shatter resistant varieties

Aquila, Arrow and Architect all guard against crop loss owing to summer storms, delayed harvest, or combine damage.

Oil bonuses can make a huge difference to crop profitability; on a 3.4t/ha crop you can earn an extra £35/tonne simply by growing high oil varieties such as Annalise or Nikita, rather than another variety with a lower oil content.

Look out for these key traits when selecting your OSR variety for the coming season to maximise yield potential.