

GM – worth the wait?

An HGCA-funded study has reviewed the likely impact on UK farms if GM crops were introduced. With exclusive access and insight, *CPM* follows its findings to uncover the truth on what the technology really offers.

By Tom Allen-Stevens



“This is about starving innovators of the tools and the opportunity to bring a whole new realm of agricultural productivity to the world.”

Suppose the current restriction on growing genetically modified (GM) crops came to an end. Suppose the GM varieties currently grown in the Americas, Asia and Australia were available to UK growers, and that there was a market for the produce. Would it actually be a benefit to grow them?

The political wranglings over the technology continue, and remain in stalemate. European ministers voted in Jan to allow decisions on growing GM crops in EU member states to be made on a national basis. This comes into force this spring, so any crop approved by the European Food Safety Authority (EFSA) can be grown by a member state.

Individual countries can opt out, however, and don't have to give a valid scientific argument to do so. Defra has indicated it favours the technology, but devolved administrations appear opposed to it.

Meanwhile, consumer opinion is equally split — a recent survey by the Food Standards Agency showed an increase in the number of respondents saying they were concerned about GM foods to almost a quarter. This was 3-4% higher than in previous surveys, notes the FSA.

UK farmer's perspective

But away from the politics and opinion, precious little has been done to ascertain what the impact would be for UK growers, says Dr Vicky Foster of HGCA. “There have been loads of reports published on GM crops, but none have actually addressed the technology from a UK farmer's perspective.

“We felt it was important to develop an independent evidence base, free from distortion and speculation, to better prepare the industry for the implications of GM crop production, should the technology become available in the UK.”

Which is why HGCA recently commissioned a study, carried out by staff at the University of Reading. “We wanted an independent report that was scientific and robust. We emphasised that we didn't want a pro-GM nor anti-GM review. We wanted the facts and figures to speak for themselves,” she stresses.

And the fact is, it does pay, concludes the study, but only under continued pest or weed pressure. The research team used a dynamic economic model, focusing on herbicide-tolerant (HT) oilseed rape and insect-resistant (IR) maize, such as the Bt maize currently ▶



Vicky Foster didn't want a pro-GM nor anti-GM review, but was keen that the facts and figures speak for themselves.

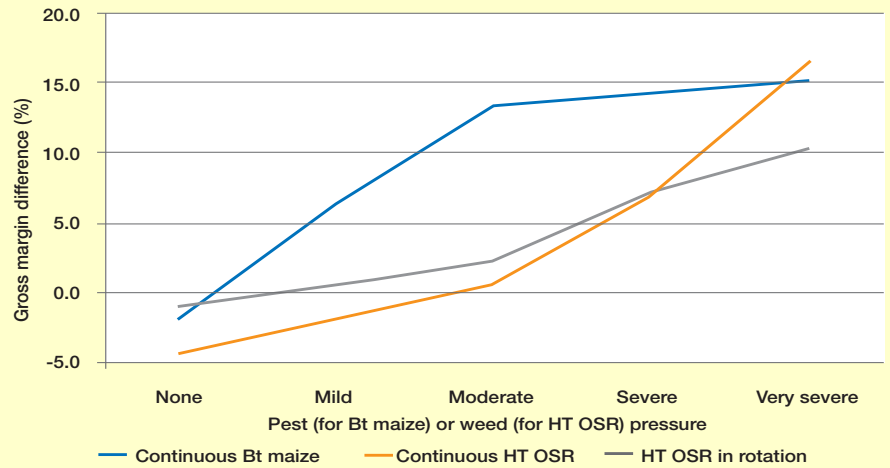
► grown in Spain and the only GM crop allowed to be grown in the EU. These are the technologies that would most likely be adopted by UK growers, points out Vicky Foster.

Another tool

"In the right situation, it's another tool to have in the toolbox. In very severe pest and weed pressure situations, gross margins could increase by up to 15.2% for continuous IR maize, 16.6% for continuous HT OSR and 10.2% for HT OSR in a four-crop rotation. But the technology premium for GM seed and the cost of co-existence measures would depress gross margins in the absence of these pressures," she notes.

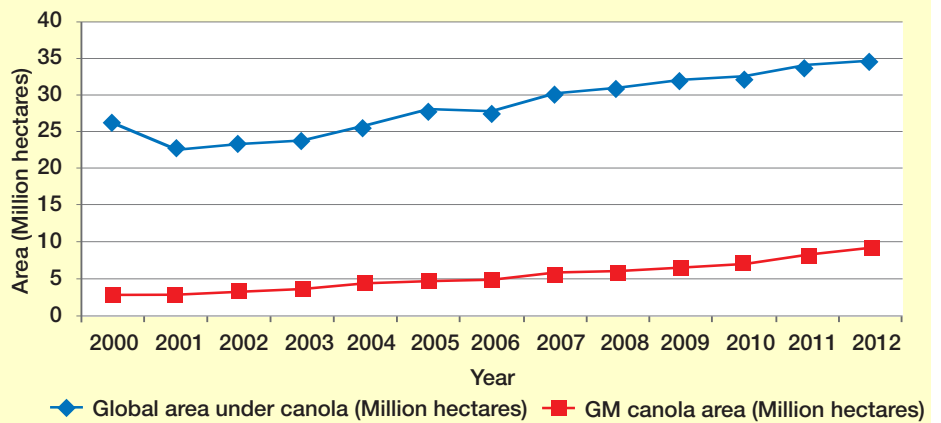
Other benefits include a cleaner crop following a GM crop, better soil condition and a reduced weed burden returned to the land. The review team found little evidence to suggest there'd be environmental damage, but that GM crops may even be beneficial as they result in less pesticides and herbicides applied, and also allow reduced tillage.

Projected financial benefit of GM over conventional crops for UK growers



Source: University of Reading

The growth in global and GM OSR area



Source: FAO and International Service for the Acquisition of Agri-biotech Applications (ISAAA)

The animal feed sector would benefit from cheaper supplies, continues Vicky Foster. "The UK feed supply chain is already using GM products to manufacture livestock feed. There would be initial costs to support a segregated feed supply chain, but there'd be no long-term or structural implications."

The greater challenge for the industry if GM crops are introduced will be to understand how to use them effectively, she feels. "There's much we can learn from the experiences of farmers in other countries, particularly in relation to weed ►

While opinion is still split in Europe over whether GM crops should be grown, 97.5% of Canada's canola crop is herbicide tolerant.



Impact of likely coexistence measures on UK growers

Coexistence measure	Burden to farmer
Five-year record keeping of seed purchases and product sales	Lowest
Asking your neighbours about their plans to cultivate their equivalent conventional crop	
Cleaning the drill after sowing GM seeds	
Planning the sowing of your GM crop in such a way that it does not coincide with your neighbour's planting (four weeks difference in April and two weeks in May)	
Planting a 12-row buffer zone	Highest

Source: University of Reading

What's currently available for the GM grower?



Bayer InVigor hybrid OSR lines have dominated the Canadian National List since 1998.

If the green light was given for GM crops in the UK, it would take at least five years for commercial lines to appear alongside others on farm, and that relies heavily on biotech companies making the necessary investment.

Bayer CropScience is currently the world's leading breeder of hybrid oilseed rape varieties, its InVigor-branded lines encompassing both GM and non-GM types. LibertyLink varieties are tolerant to glufosinate, but all of these are spring sown, so any first step in this area would be to introgress the trait into autumn-sown lines suited to the UK climate, notes the company's Julian Little. But that's the easy bit.

"These would still have to be approved by EFSA, which takes 18 months to two years, and then there's National List trials — the system doesn't currently cater for GM lines, so trial protocols would have to be agreed," he points out.

Having said that, in the year GM lines first appeared in Canada, two of the top five varieties in its national trials were Bayer HT types, and within seven years all the top five came from the Bayer camp, and still are today. "The Bayer OSR breeding programme has always been about bringing ultra-pure hybrids to market — the HT element was almost a by-product," he claims.

Monsanto has Roundup Ready spring and winter-sown OSR, marketed under its Genuity brand, that are tolerant to glyphosate. There's also its corn portfolio, that dwarfs the OSR

Droughtguard maize has now been launched by Monsanto while third and fourth-generation GM lines are in the product pipeline.



range in terms of both traits and varieties.

Mon810 was the Bt maize 'event' (the process of inserting a gene sequence within a particular place in a plant genome) approved in the EU back in 1998, but things have since moved on, explains the company's Mark Buckingham. "Researchers improved on the original traits, and most growers outside Europe are currently growing second-generation GM crops.

"In HT lines, these offer a wider application window of Roundup, for example, while multiple proteins have been introduced in the maize varieties, which now also allow better management of resistance to a wider range of insect pests."

Monsanto's newer lines offer an in-built defence to not just above-ground corn borers, but below-ground rootworms, too. Its Complete range includes 5% non-Bt seed to provide in-field refuge for pests, further reducing resistance issues. Moreover, the IR traits can be stacked with herbicide tolerance. "And our DroughtGard family of products, launched in 2013, bring a drought-tolerant trait to corn."

In the product pipeline are third and fourth-generation GM lines offering improved herbicide tolerance, disease resistance and enhanced yield traits — Roundup Ready wheat is in phase two of a four-stage process.

GM wheat is the technology Julian Little believes has some really exciting potential. "Bayer is investing hugely in this area — around \$1.5bn over the next ten years, which is a sizeable share of its entire R&D budget. For OSR, the potential is limited — there's herbicide tolerance and pod-shatter resistance already out there. But for wheat, there's a whole range of input and output traits that could offer growers and consumers real benefits, including enhanced yield, disease resistance, nitrogen use efficiency and maybe one day the possibility of gluten-free wheat," he enthuses.

"It could be a real opportunity for the UK, which is still one of the best places in the world to grow wheat after all. If the regulatory environment in the EU were to change in favour of GM, our opening gambit would be for wheat, rather than OSR."

And therein lies the rub — while research and progress race on in the Americas, Australia and Asia, things have ground to a halt in the EU, and look set to stay that way for the foreseeable future, notes Julian Little.

"While much of our GM research is carried out in Europe, we've nothing at all in the GM product pipeline for European growers — if it's blocked at one end, why on earth would you want to shove stuff in at the other? We've a good portfolio of non-GM OSR lines and some



GM wheat is the technology that has some really exciting potential.

strong National List wheat candidates, and that's where we're concentrating our efforts as far as the UK is concerned."

Monsanto holds a similar view — the company sells only one sort of GM seed in Europe, almost entirely in Spain, and that accounts for less than 0.5% of its seed sales in Europe. There are no plans to invest in GM traits in Europe, says Mark Buckingham.

"We effectively stopped investing in new GM seeds in Europe years ago. The key challenge for an investor is having the confidence that it's possible to get to market while a patent is still valid to ensure a return on investment. Even in the UK, there's a lack of confidence that a stable route to market would ever exist."

The EC policy to devolve the decision to individual member states has only served to increase the uncertainty, he continues. "In Europe, it's simply not attractive to invest in biotech — the current policy of EU funding for anti-biotech NGOs is driving investment away. Elsewhere, approvals are made on a scientific basis and our biotech programme is flourishing."

And it's not just UK or even European farmers who are losing out, says Julian Little. "UK farmers are the most innovative in the world — give them a problem and they not only develop a solution but disseminate what they've learnt to the rest of the world. This isn't just about being competitive — this is about starving innovators of the tools and the opportunity to bring a whole new realm of agricultural productivity to the world."

Julian Little confirms there's nothing at all in the GM product pipeline for European growers.



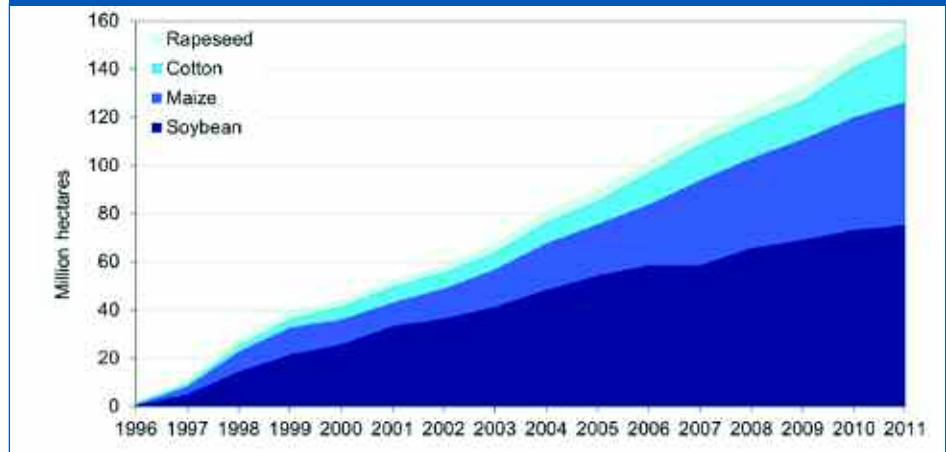


Growers with crops under severe weed or pest pressure would gain most benefit from GM crops.

▶ and insect resistance, for example. Equally, UK growers will have a lot of catching up to do, and we'll need to ensure future research is focused in areas that bring real insight into the true potential of the technology."

The team at the University of Reading that carried out the study has considerable

Area of GM soybean, maize, cotton and rapeseed grown



Source: ISAAA

experience in this area, notes the university's director of the Centre for Agricultural Strategy, Richard Tranter. "We were keen to be involved as we have a number of experts who'd worked on GM issues in the past. In particular, we've been involved in

the EU-wide PRICE project (Practical implementation of coexistence in Europe)."

A systematic literature review pulled in around 170 publications. "We screened out less reliable studies, and looked at both quantitative and qualitative approaches

Easy-grow canola reduces risk on Canadian farms

By mid-March, snow melt is underway for Green Atlantic Farms in East Central Saskatchewan, Canada. Franck Groeneweg is preparing to establish his crops and in particular the spring-sown GM canola.

"The fact it's herbicide tolerant is just part of the game now — canola would be a very difficult crop to grow if it wasn't. It just doesn't compete against weeds, so unless you fallow the field the year before to start clean, and you're prepared to accept weeds in the following crop, a conventional variety just isn't an option," he says.

With 3000ha of arable crops, he's grown the business since 2003 when he and his wife, Kari moved from Iowa in the US to take on their first 730ha. They follow a three-year rotation of durum or spring wheat, followed by flax, peas or fava beans, followed by canola. There's around

The canola is drilled direct with a whopping 26m SeedMaster seeder unit that puts down a line of fertiliser beside each row, placed 28cm part.



20cm of topsoil over a "fairly permeable" yellow clay. This allows reasonable moisture retention, which is crucial as it's not uncommon to have just 100mm of rain between drilling and harvest.

"In Canada, there's a choice of three main systems for canola. 45% of growers go for LibertyLink, 45% for glyphosate-resistant canola — Roundup Ready and off-patent types — and the rest choose Clearfield. We choose LibertyLink because we use a lot of glyphosate outside the crops to burn off weeds, and I don't want to run into resistance issues. The varieties also perform well yield-wise."

The canola is drilled direct with a whopping 26m SeedMaster seeder unit that puts down a line of fertiliser beside each row, placed 28cm part. "What GM does is reduce the risk associated with growing the crop — it's made canola a very easy and predictable crop."

Drilled around 10 May, he aims to spray with glufosinate in the last two weeks of June. "The best time according to research is when the crop is at the 2-4 leaf stage — that's when you'd lose the least yield, but you may have to come back with a second application. So we tend to aim a little later and achieve a cleaner crop with just one pass. There'll then be a fungicide at early flowering, and that's about it for inputs."

Weed resistance is a threat he recognises he has to stave off. "Some US states have HT crops throughout the rotation and are in a horrible mess. In Canada, we've only one crop and we've learnt from others' mistakes — that's why I wouldn't want Roundup Ready wheat.



Herbicide tolerance takes a lot of the risk out of growing canola for Franck Groeneweg and makes his life easier.

But it's not the fault of the GM system — it's the fault of farmers."

And he dismisses suggestions farmers are under pressure from seed companies. "The seed is more expensive, but all GM varieties are quite competitively priced. What's more, the companies invest in the hybrids, so we get the benefit in terms of varietal improvement and better traits.

"The system is quite tightly regulated and I'm glad it's not overrun with regulation because that would select out only the largest seed companies who could afford to remain in the market. As it is, we've promising traits to look forward to, such as drought tolerance and the big one — nutrient-use efficiency. These are the just the kind of features that'll reduce the risk and allow us to farm better," he points out.

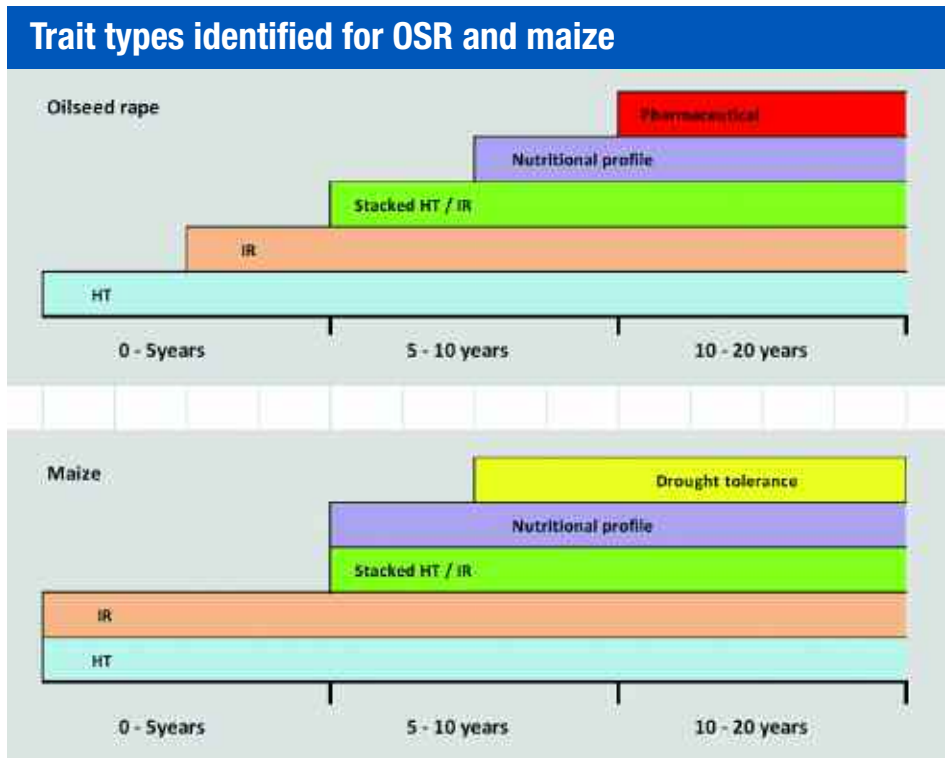


Coexistence measures are an important consideration for European growers.

to assess GM crops for UK farmers. We also carried out a consultation with farmers and supply chain representatives.”

At the heart of the research is an economic model that was adapted for use in the study. “It’s a bio-financial model,” explains Richard Tranter. “It looks at the impact of GM adoption for a suite of scenarios on crop yields, costs of production (including coexistence measures), market returns and enterprise gross and net margins.”

Three specific scenarios were chosen



Source: University of Reading

— using Bt maize as a single crop, HT OSR as a single crop, and HT OSR as part of a four-crop rotation (wheat, 2nd wheat, OSR, barley). “These were the ones agreed with HGCA, although it’s a sophisticated model and can be used for many other scenarios.” (See chart on p46).

There was no shortage of literature available to make the assessments, he notes. Of the total worldwide area of OSR (also known as canola) of 34.2M ha, 8.2M ha is estimated to be grown with GM varieties. Only four countries currently grow it — Canada, USA, Australia and ▶

Advert Removed



The University of Reading team was staggered at the speed with which growers around the world have adopted the technology.

► Chile — with Canada the world leader at 8.4% of the total global OSR area, 97.5% of which is now HT. More than 90% of US plantings are now GM.

“What we found staggering was the speed with which growers in these countries adopted the technology,” remarks Richard Tranter. “In Canada, for example, the area of HT OSR rose to half a million ha in just five years — that’s a speed of adoption almost unprecedented in agriculture, and we think it would be taken up equally rapidly here if the right varieties were available to UK growers.”

Yield effects

At the farm level, the main differences found were yield effects of around 6-11% and input cost savings of as much as 30%, due to lower frequency and doses of herbicide application. “Initially in Canada, cost savings were more than offset by the cost of the technology. But by 2004, growers were realising net cost savings that currently average Can \$16-17/ha (£8.50-9/ha). The rapid adoption was probably more down to the fact that Canadian growers found life so much easier with HT OSR.”

In production terms, maize is the most important cereal grain worldwide, and the third most important in terms of area grown. Of the 170M ha global crop, 46.8M ha is estimated to be GM, grown mainly in the USA, China and Brazil. Both IR

and HT maize are grown, and often the technology is ‘stacked’ in the same variety.

In the UK, maize is a comparatively minor crop, with 194,000ha grown in 2013, mainly for forage. Across Europe, the European and Mediterranean corn borers are two significant pests, and there’s currently around 130,000ha of Bt maize grown, predominantly in Spain, that expresses an insecticidal protein to protect against attack.

Around 30% of maize grown in Spain is Bt maize, but this rises to over 90% in the Aragon and Catalonia regions where pest pressure is particularly severe. Adoption rates around the world of GM HT maize have been lower than for Bt maize, with the US leading the way at 91% of the global HT maize cultivated area.

On the farm, Bt maize has achieved higher yields (ranging from 0.4t/ha in Canada to 2.1t/ha in the Czech Republic), but no consistent yield increase was found for HT maize, where a lower cost of production was the key advantage. The net effect has been an economic benefit with few exceptions, notes the research team, with an average gross margin increase in Spain for Bt maize of \$266/ha (£178/ha) in 2010, for example.

For the financial modelling, the team considered just those GM traits likely to be suitable for the UK, with a detailed, quantitative analysis of those already in commercial use

Advert Removed

and that could be adopted in 5-10 years. "We also took a qualitative approach for suitable traits that are likely to come to market over the next 10-20 years. It's worth noting around 9000 applications for field-trial testing of GM cereals have been made in the US alone," adds Richard Tranter.

These include many applications for GM wheat, although to date none have actually got as far as commercial reality. Consumer acceptability of the technology is one of the reasons holding back commercial adoption, notes the report. "In contrast to maize — a hybrid, with established annual sales of high-value seed — wheat and rice are self-pollinating and the value of seed is relatively low. A GM variety could in theory be saved by the farmer for growth in subsequent years," points out Richard Tranter.

Nonetheless, the report notes a wealth of input-trait work underway, encompassing not just herbicide and pathogen tolerance (including fusarium), but also tolerance to drought and salt, or nitrogen and phosphate deficiency. A significant body of work is focused on enhancing yield traits. Output traits range from improved protein for bread-making to nutritional benefits such as low gluten or high fibre.

The research team drew on

Maize resistant to the European corn borer is grown in Spain, and it's the only GM crop that's been approved in the EU.



Current GM research ranges from input trait-work, such as on drought and salt tolerance and enhancing yields, to output traits such as low gluten or high fibre.

its involvement with the PRICE project to accurately assess the impact of co-existence on UK farmers. "This is required in Europe in order to ensure a product declared as GM-free has a level of contamination below 0.9%. While most EU countries have already developed these, the UK has yet to do so," explains Richard Tranter.

Contamination

"Interestingly, our research found that most contamination occurs in the mill or during transport. So any on-farm contamination is more likely to occur in the store than in the field."

Based on measures currently adopted in a number of member states, likely coexistence measures were assumed for the UK (see table on p46) and the extent of the burden to farmers assessed.

"On the whole, coexistence measures aren't seen as too onerous. It's interesting that growers on the Continent are more open to working with their neighbours than UK growers," notes Richard Tranter.

The biggest cost was seen as planting a 12-row buffer zone between GM and any contiguous non-GM crops of the same species. This would be sown with conventional varieties, with the produce treated as GM. "It's worth noting that the cost would come down considerably or the need evaporate altogether if large blocks of GM crops are planted in co-operation with neighbours," he adds.

● For the full report and more information on GM, go to www.hgca.com/genetics ■

Advert Removed