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AHDB

from theory to field

Next generation innovation

As research and science continues to pave the way for farming, AHDB believes investing in PhD projects is essential for promoting the next generation of innovation. *CPM* finds out more about its studentships programme and some of the projects currently underway.

By Charlotte Cunningham

There’s often discussion in agriculture around how the industry should attract and retain the next generation — whether that be boots in the field or researchers to pioneer innovation and shape the future of farming.

And it’s this notion exactly that’s at the core of AHDB’s PhD studentship programme — a strategic partnership and investment in the young science community which aims to fuel a passion for the industry and, ultimately, set them on a long-term career path in industry, explains Dhan Bhandari, cereal product quality senior scientist at AHBD.

In 2014, the Biotechnology and Biological Sciences Research Council (BBSRC) held a consultation looking at emerging/existing strategic research skills and capabilities that were vulnerable.

With regards to agriculture and food security, the findings revealed a number of issues including a long-term decline and shortages in plant and field-based studies, as well as a gap where ‘niche’ research skills are required. “For example, in plant breeding there’s global shortage and, in the UK around 12 new plant breeders are required every year,” notes Dhan.

Filling knowledge gaps

These problems justify the importance of the investment in PhD projects, he adds. “The cost of the programme (to AHDB) is about £1.4M a year, and on top of that we get additional funding from various industry bodies, universities and food charities.

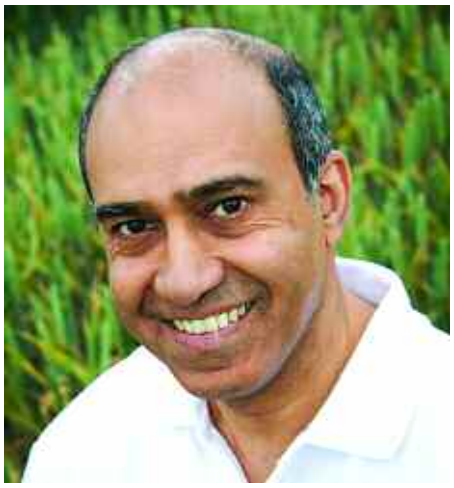
“The rationale behind it is that within AHDB we don’t necessarily have all of the breadth of the technical expertise that’s required in key areas, so by having post-graduate studentships, it’s a way of filling those knowledge gaps to provide solutions for the industry.”

Funding from the Cereals and Oilseeds sector started almost 20 years ago in 2002, with an average of three projects supported each year. Three students formed the uptake last autumn and among those is Harper Adams’ Maria Elisa Leandro — supervised by Dr Tom Pope, reader in entomology.

With the declining availability of pesticide options for aphid control, Maria’s project — titled ‘Improving integrated pest management of aphid barley yellow dwarf virus vectors’ — aims to explore the potential of natural chemicals released by old wheat varieties.

The study is framed around the increasing incidence of BYDV in cereal crops in the UK, with various aphid species — namely the bird cherry-oat and grain aphid — the key culprits in transmission, she explains.

Resistance to pyrethroids is part of the control challenge, as well as the loss of neonicotinoids, leaving an incredibly limited armoury and growers needing to find alternative solutions to stem the transmission of this yield-robbing virus. As such, IPM techniques have become a more important part of the strategy and Maria says she hopes the research will help to bring in a new tool for control. ▸



Investing in PhD studentships is helping to develop a new generation of scientists and researchers, notes Dhan Bhandari.

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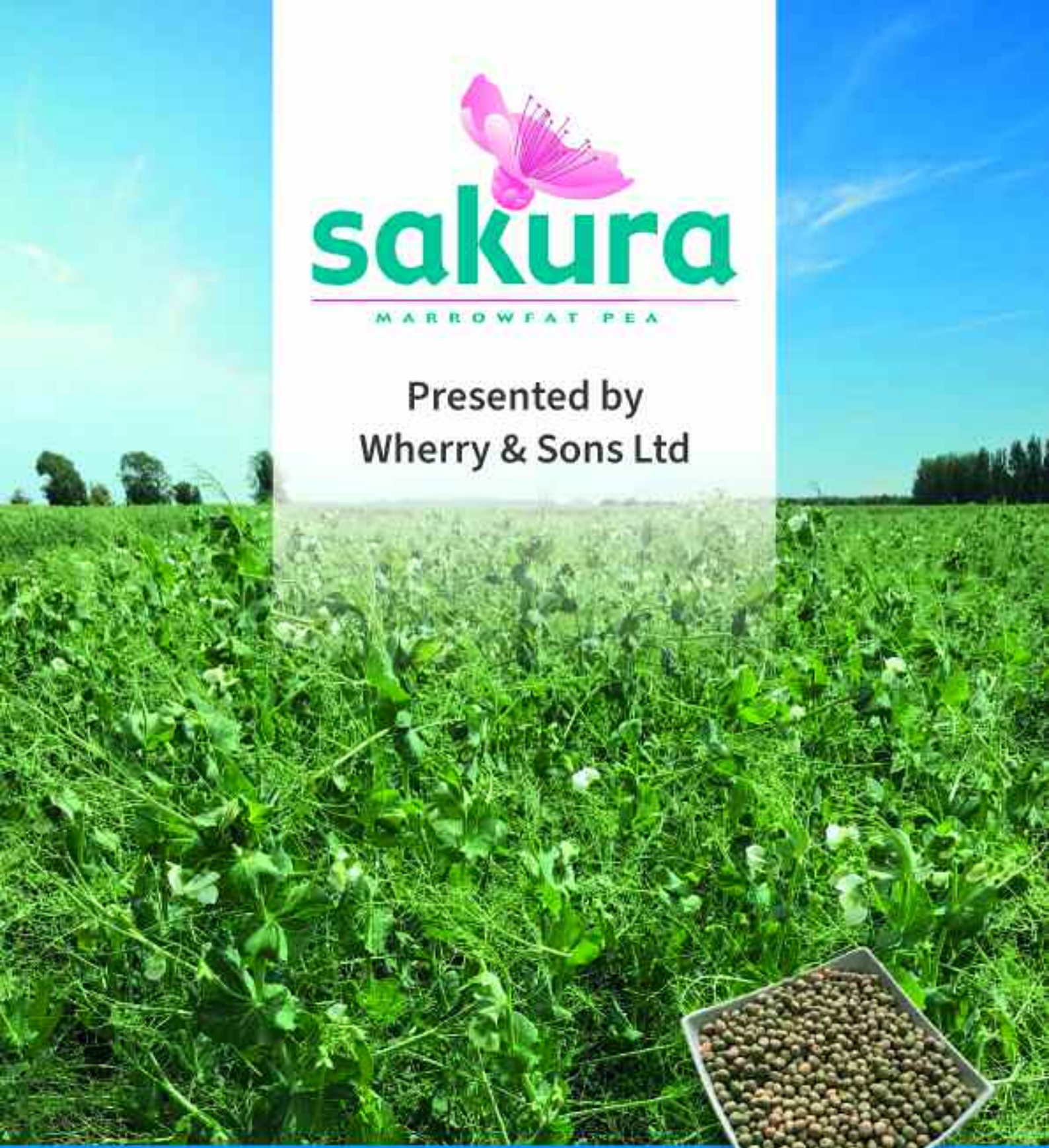

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The initial relationship between Maris Huntsman and its attractiveness to aphids was observed by researchers who now work at Harper Adams, says Tom Pope.

Wheat germplasm for enhanced competition against blackgrass

Headed up by University of Leeds student, Jed Clark, this project aims to establish a system to evaluate the competitiveness of wheat against blackgrass under controlled conditions — in a bid to highlight new routes to competitiveness in wheat and enhance weed suppression.

The study is based around the concept that highly competitive crops can contribute up to 25% blackgrass control. This alone isn't enough to tackle blackgrass burdens but combined with other chemical and non-chemical approaches it can have influence.

The justification for the project is that little is known about this and there have been few controlled experiments to quantify perceived competitiveness — particularly between different crops and individual varieties.

It's been observed that some varieties are more tolerant to weeds than others — but what is the reason for this?

Gleaning an understanding of this is a major objective of the study, with the ultimate outcome being able to feed information into breeding strategies to produce more inherently robust varieties.

▸ Tom explains that some of the founding principles behind the project stem from patterns detected almost 50 years ago.

If you're old enough to cast your mind back to 1972, you may remember the winter wheat variety Maris Huntsman. It was widely grown and hugely popular due to its 20% yield advantage over the previous market leader.

But it wasn't just growers who were big fans — aphids took a liking to it too, leading to severe population explosions, notes Tom. "This was first identified by researchers who now work at Harper Adams. When Maris Huntsman stopped being grown, these outbreaks largely disappeared and after talking to them it seemed as if there was something peculiar going on that warranted further exploration.

"We wondered whether if we compared Maris Huntsman with modern AHDB Recommended Lists varieties, would the aphids still be attracted to the Huntsman? So we ran a small project here at Harper which confirmed that they do.

"This led to the current project which aims to find out why this was the case, and whether or not we could use Maris Huntsman as a tool in BYDV management."

There are two objectives for the project. One is to explore whether Maris Huntsman — or another highly attractive plant — could be used as a trap crop, explains Maria. "When virus-carrying aphids come into a field, they tend to land around the headlands. So the question was, if we were to grow a crop like Maris Huntsman in these areas, could we intercept the aphids before they come into the main crop, and therefore prevent the spread of virus?"

The second objective was to understand what the reason for this was. "We theorised that there may be a chemical attractant that was associated with Maris Huntsman — though we don't know this yet — then we could identify this and enhance existing aphid monitoring tools."

At the moment, traps are a bit of a blunt instrument, says Tom. "Farmers and agronomists have to first identify whether anything caught is an aphid or another insect, and then have to try and decipher whether it's even a species that may carry BYDV or not. But the hypothesis is that if we could add a chemical lure to the trap, it would make this process much more specific, and this would allow for much more accurate management decisions with regards to aphid control."

While the project is still very much in the early days, having only commenced in October last year, two main assessments have been conducted so far, notes Tom. "In the field, we've established small plots of RL varieties and created buffer strips around a number of them with Maris

Delivering solutions

Russell IPM — a developer of integrated pest management tools — is partnered with Maria's project and the company's role is to assist with the commercialisation of any such tools that are developed from the project.

"This means it won't remain an academic theory, it'll be commercialised and available to farmers which we hope will go some way to providing a solution for a very real problem for cereal growers," explains technical director, Clare Sampson.

The firm specialises in pest-trapping tools and Clare says the aim is to develop a more sensitive trap which will pick up aphids as early as possible to help growers predict risk better.

"The issue with BYDV is that a small amount of aphids can actually cause a huge amount of damage and often growers see the effects on their crops before they notice aphids in traps."

If the chemical stimulis can be identified through the project, this can then be used to enhance attractiveness of current tools, she adds. "We've spent a lot of time looking at different colours and glues used on traps, but it would be really beneficial to add an extra level to that. We don't anticipate chemistry being used over visual stimuli, but instead we believe they could go hand-in-hand to make trapping and assessments much more sensitive and accurate.

"If an aphid attractant is identified that is powerful enough, trap crops could be replaced by synthetic lures and traps (mass trapping), a strategy that would avoid the risk of aphids breeding on the trap crops. This strategy has proved effective against thrips using roller traps incorporated with the western flower thrips pheromone, reducing thrips numbers in flowers by >80%.

"From a commercial perspective, it can be a cost-effective tool that's simple to use and we've proven this with other pests. In the future, there's scope to potentially extend this technology to remote sensing tools and mobile applications, so it's a really exciting project to be a part of."

A model for wheat cultivars and optimisation for climate scenarios

Anisa Aubin, PhD student at the University of Sussex, aims to build a model for developing wheat cultivars which considers varying climatic conditions — aptly named, 'Sim Farm 2030'.

The project aims to address current issues with cultivar assessments as the 'low-cost' approach doesn't often fully account for variation in crop performance — particularly with regards to variation linked to weather and soil.

This is a very data-driven research project, with proof of concept established during the pilot work which developed a very simple US maize yield model with preliminary testing on UK wheat cultivars too.

The end goal is for the model to have enough validation — incorporating machine learning, satellite data and information from the Met Office — to be used in crop breeding and decision-making in a bid to create a selection of wheat cultivars which are specifically optimised for UK conditions.

Huntsman to compare with the 'unprotected' plots. We're looking to see whether we're trapping more aphids within the buffer strips compared with the plots which don't have Maris Huntsman around them.

"There's no headline data here yet, but this is certainly an ongoing area of development."

Aphid landing preferences have so far been analysed on old varieties, including Maris Huntsman, as well as the ancient wheat, Einkorn, and modern wheat varieties including the BYDV tolerant RGT Wolverine. Preliminary findings have shown a clear preference, with adults and nymphs found in greater numbers after seven days on the ancient and heritage varieties, explains Maria.

The other work is looking at any differences in behaviour between the two key BYDV vectors — the bird cherry-oat and the English grain aphid. "We don't know currently whether the preference for Maris Huntsman is the same for both of the species.

"The work we've done at the moment suggests that the English grain aphid prefers to land on Maris Huntsman, but we don't yet know if the same is true for the bird cherry-oat aphid."

Maria has an experiment running at the moment where she's looking to see if the behaviour is the same in both species of aphids, or whether it's primarily the grain aphid which is attracted to the heritage variety.

The bird cherry-oat aphid and grain aphid are the key culprits in BYDV transmission.

Extra complications

There's an extra level of complication here, as it's also unknown whether the preference for Maris Huntsman changes when the aphids are carrying the virus, or when they're not — essentially, it's unknown whether being infected with the virus changes the behaviour of the aphid, she explains.

However, something researchers have identified is that when the plants are infected with BYDV they become more attractive to aphids — another area which is being further explored.

So what's next?

"One thing we're going to be doing is scaling up the trap cropping work," explains Tom. "We want to move from the trial plots at the university to a commercial scale to see how these trap crops work in practice on a field scale.

"Initially this will probably be just with Maris Huntsman, but then we'll be taking that one step further to see whether or not that's the best trap crop variety, or whether there are other options which are more attractive to aphids."

This will help researchers get a better handle on what is it — or indeed isn't — about such varieties that aphids are attracted to. "We'll be looking to identify what the key chemical is that aphids respond to, and there's some neat work we can do here which essentially involves hooking an aphid up to an electrical circuit to see what it can smell and therefore, which chemical it responds to."

Maria Leandro has the long-term goal of being able to develop a new tool in the IPM armoury to help growers tackle BYDV in cereal crops.

Tom concludes by noting how valuable the AHDB funding and investment in projects such as Maria's is for both farmers and the wider industry. "A PhD is a period of training to develop the next generation of researchers, but in doing so, we hope to develop tools that farmers and agronomists can use to provide real outputs for the industry in a very tangible way." ■

Research roundup

From Theory to Field is part of AHDB's delivery of knowledge exchange on grower-funded research projects. *CPM* would like to thank AHDB for its support and in providing privileged access to staff and others involved in helping put these articles together.

For further information:

AHDB Project No 21120186 Improving integrated pest management (IPM) of aphid BYDV vectors' is led by Harper Adams University and runs from November 2020 to 31 December 2023 at a cost to AHDB of £74,100

AHDB Project No 21120187 'Wheat germplasm for enhanced competition against blackgrass' is led by University of Leeds in partnership with ADAS, and runs from October 2020 to September 2024 at a cost to AHDB of £74,100 (total £84,100)

AHDB Project No 21130071 'A model for wheat cultivars and optimisation for climate scenarios – Sim Farm 2030' is led by University of Sussex and runs from October 2020 to March 2024 at a cost to AHDB of £74,100 (total £84,100)