

The GROWER

THE TECHNICAL JOURNAL FOR HORTICULTURE

AHDB



Issue No. 241
Aug/Sept 18

IT'S A KNOCKOUT

Delivering a fatal blow to
Turnip Mosaic Virus

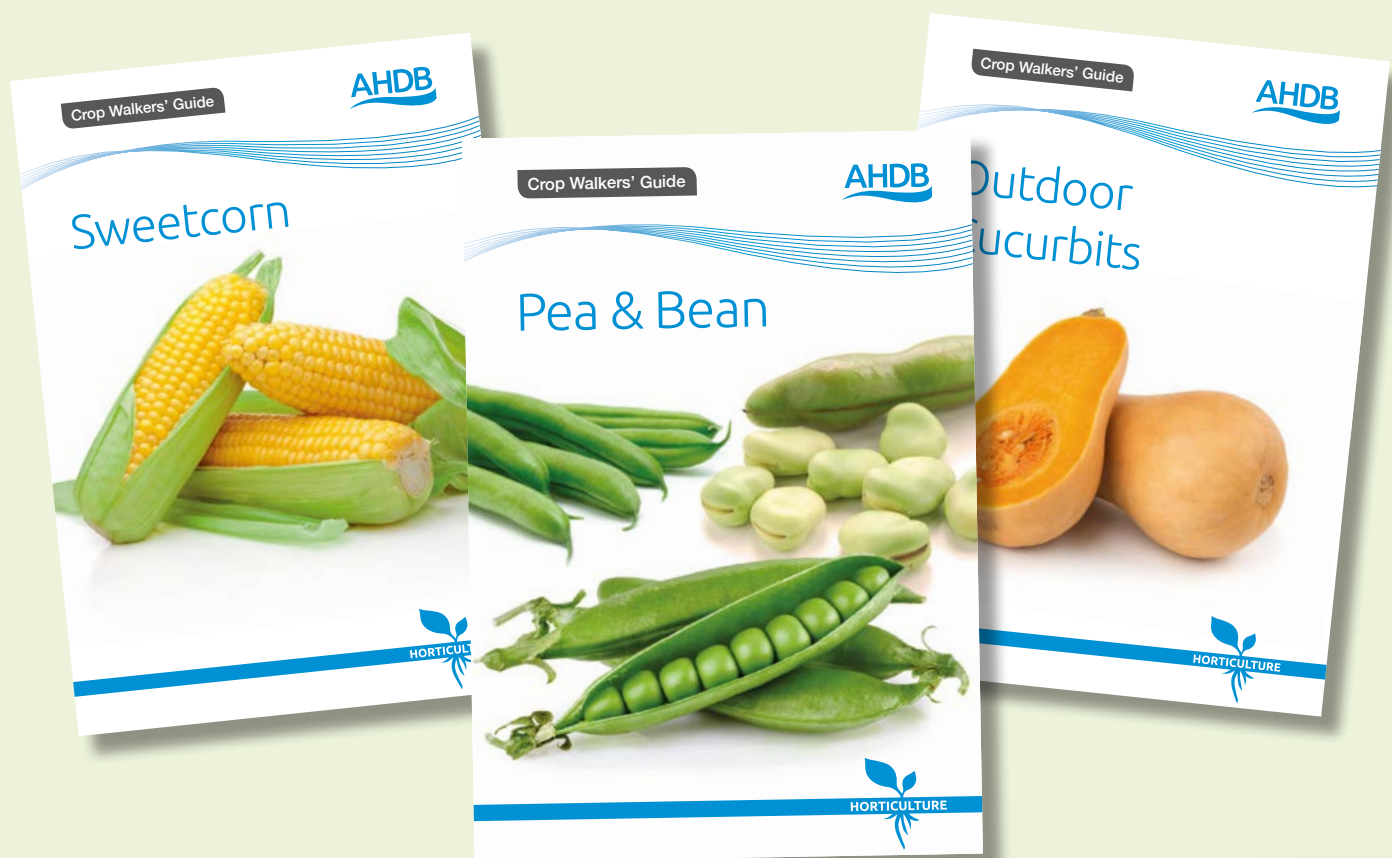


FIT FOR THE FUTURE

MP George Eustice reveals the Government's plans for horticulture on crop protection, labour and more in a post-Brexit world

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One point is awarded per annum for BASIS registered members for reading this magazine. From 1 June 2018 to 31 May 2019, please quote reference CP/67833/1819/j

This publication is brought to you by AHDB

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MEETING INDUSTRY NEEDS

When we consulted stakeholders last year, many criticised us for including market development in the new AHDB Horticulture strategy. Undoubtedly for most horticultural crops, technical needs, particularly on crop protection, override everything else, but for some speciality crops, market development is a genuine priority.

This ability to meet your needs depends on the accuracy of the information we hold on your businesses. This is continually eroding as industry evolves and people change jobs. Occasionally, as now, we need a major overhaul. We will therefore be contacting you over the next few months to update our records. I am sure it will make a big difference to the relevance of our output, so please bear with us.

One benefit of being part of AHDB is that we can draw on expertise from elsewhere in the organisation. So, Kim Parker and I were delighted to be joined by Rebecca Miah and Nicky Dodd from AHDB's Market Development team recently to launch a very different kind of project, which is looking at ways we can engage younger consumers with the wonders of watercress. The watercress growers are extremely positive and work is now surging ahead.

Elsewhere, we closed the Associate Membership scheme in May. Originally intended to restrict website access to just levy payers and key stakeholders, it had instead become a barrier to everyone and was unfairly penalising consultants, who provide a vital link in the communication chain between AHDB and industry.

On a final note, as Brexit approaches, everyone is anxious to understand how government sees the future. I was therefore delighted that MP George Eustice generously agreed to give us his insight, which you can see over on page 8.



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CONTRIBUTORS

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BOLETTE PALLE NEVE

Bolette Palle Neve is a Crop Protection Scientist with AHDB where she has been working since 2010 on the EAMU Programme. Bolette studied Agricultural Sciences in Denmark specialising in crop protection. Since completing an MSc in herbicide resistance, Bolette has worked in crop protection research in Australia and the UK and was also a graduate trainee with the National Farmers' Union. Bolette is involved with the SCEPTREplus project and works with approval holders to obtain plant protection approvals for speciality crops with a particular focus on leafy vegetable crops, vegetables grown under protection and ornamentals. Bolette is BASIS qualified.

Get the latest updates on available EAMUs with Bolette on page 14



MICHELLE FOUNTAIN

Deputy Head of the Pest and Pathogen Ecology (PPE) Department at NIAB EMR, Michelle specialises in the minimisation of pesticide use in fruit horticulture, improving pollination in fruit crops and incorporating modern fruit growing practices with Integrated Pest Management. Her research involves the semiochemical manipulation of insects, optimising the use of biological control agents and enhancing and fostering local landscape ecology to provide the ecosystem service of pest control.

Michelle gets to grips with some mites on page 15



MEHRDAD MIRZAEI

Mehrdad completed his BSc in Horticulture in 1994 and worked as glasshouse grower and crop production advisor in Iran before moving to the UK in 2007.

He continued his studies in MSc and PhD in postharvest and natural resources at Writtle University College and University of Greenwich. He started his job as Technical and Business Development Manager at Landseer Limited in 2009.

Mehrdad combined his academic knowledge and work experience in commercial sectors for conducting many applicable research projects for industry related to postharvest technology. The main areas of his research were related to application of different technologies for controlling ethylene and respiration to increase storage and shelf life of fruit and vegetables and application of chlorophyll fluorescence for identifying the internal disorders and maturity of apples.

Mehrdad helps with apple maturity identification on page 34

NEWS & UPDATES

IN BRIEF

NEW EMERGENCY AUTHORISATIONS SECURED

Emergency authorisations for potato, herb, celery, carrot, parsnip, cherry and plum were secured this summer for UK growers to protect their crops from a range of diseases.

The 120-day authorisations were issued in response to high risks of crop damage from late blight, aphids, spotted wing drosophila and a range of weeds.

AHDB's crop protection team coordinated the applications following serious concerns over available control options identified through close collaboration with industry.

EARLY APPEARANCE OF LATE BLIGHT RAISES CONCERNS FOR TOMATO GROWERS

A recent outbreak of *Phytophthora infestans*, late blight, in UK tomato crops is likely to be a new strain of the disease, as symptoms have been seen early in the season on young plants.

An EAMU for Ranman Top (cyazofamid) was secured by the AHDB crop protection team in March for the control of downy mildew and *P. infestans* in protected tomato crops and appears to be delivering good control. See page 18 for more details on AHDB's efforts to tackle this disease.

NEW CROP WALKERS' GUIDES AVAILABLE NOW

A range of new, easy-to-navigate and visual crop walkers' guides (CWG) have been released. The new guides are for sweetcorn, outdoor salads (lettuce and celery) and outdoor cucurbits.

The CWGs assist growers with the vital task of monitoring crops to accurately identify pests, diseases, nutritional deficiencies and physiological disorders. Images of key stages in the lifecycles of pests and diseases are included, along with short, easy-to-read comments to help with identification.

ASPARAGUS INNOVATION DAY COMING SOON

Cobrey Farms will hold the first asparagus innovation day with updates on the latest crop protection developments followed by field demonstrations on the farm.

The demonstrations will look at the evaluation of companion cropping for sustainable soil management; grassed waterways for erosion control; sensor technologies – potential for crop health assessments; and knowing your root system – importance of root architecture.

To access resources or book onto an event visit: horticulture.ahdb.org.uk

GREATSOILS

IT'S ALL IN FOR SOIL

AHDB's GREATsoils programme has rolled out a host of new resources, factsheets and manuals aimed at informing growers on best practice for soil management.

The release of two new factsheets looking closely at soil water supply and infiltration provide concise tips and advice on understanding how water retention can improve soil health. The use of the drainpipe test as a cheap and simple way to measure the infiltration of water combined with the spade test can help identify compaction at depth.

The earthworm factsheet has been updated and a new soil management in horticulture manual provides information on how to assess soil texture, structure and condition and considers strategies to improve and maintain good soil structure.

To access resources and further content visit: www.ahdb.org.uk/greatsoils



UK GARDEN AT THE BEIJING EXPO

The UK will be participating in the Beijing International Horticultural Expo in 2019 to mark China's 70th anniversary. The six month (April – October) Expo is expected to attract 100 countries and international organisations as participants and 16 million visitors. It will provide an unparalleled opportunity to promote British horticulture, food and the wider agri-tech sector to a global audience. Defra is leading the UK participation and recently issued an invitation to tender for the design and build of the UK garden and pavilion via a government supply framework.

For further information on the tender please contact brenden.hodkinson@defra.gsi.gov.uk or david.birkett@defra.gsi.gov.uk

CO-ROBOTS AND THE FUTURE OF HIGH-TECH HORTICULTURE

SMARTHORT

The rise of robotics that can lend a hand, eyes, or even extra brain-power to growers in high-tech greenhouse production was one of the key themes on show at the GreenTech 2018 exhibition in Amsterdam.

Co-robots, or robots that can help growers improve decision-making through data collection and analysis, was the central theme of a presentation by Jos Balendonck, Researcher of sensing and robotics at Wageningen University and Research, on the first day of the conference.

New camera technology, from hyperspectral to 3D imaging, is enhancing vision systems and adding a new pair of 'smart' eyes to growing systems. These can be used to aid crop protection, and Wageningen projects are exploring their use in detecting diseases like downy mildew on gerbera, finding signs of Botrytis early on tomato and targeting spray applications, or counting specific pests caught on sticky traps.

Many companies internationally are using smart cameras within electric weeders that use images to distinguish between 'good' plants and those that need to be removed.

Fine mechanics, or the development of 'soft hands,' that can handle delicate horticultural crops is also a big trend in engineering development. This was clearly evident at GreenTech, with robots such as Autostix and ISO that were able to graft, take cuttings and transplant both cuttings and rooted cuttings, shortlisted for the high profile GreenTech innovation awards.

Balendonck argued that there are two key areas where high-tech greenhouses can make the biggest difference to productivity.

Firstly, improved monitoring of plant health, from early detection and diagnosis to more accurate spray application and reduced crop protection input that could help save costs through better targeting, reduced yield losses and the benefit of less environmental impact.

Secondly, providing a hands-free 24-hour a day, 7-day a week production capability, with labour that is able to



work in humid climates that is not ideally suited to humans, as well as creating a production system that at its core is true to the established lean production principals you find in automotive engineering systems.

The developments already occurring in glasshouse production to make it one of the most high-tech within the food sector are clear, but the speed of this innovation will need to continue at pace and costs will need to continue to come down to enable UK growers to adopt these technologies to help address the challenge of access to affordable labour in the short-term.

The three day trip included: a visit to GreenTech, an exhibition dedicated to technology in horticulture; technical presentations from leading researchers at Wageningen University with a tour of their robotics lab; and a visit to Bezoek Agriport, the world's largest orange pepper glasshouse.

The tour was part of AHDB's SmartHort programme, tackling the issue of access to affordable labour by improving management practices and facilitating the uptake of new technologies.

More information about the SmartHort programme can be found at horticulture.ahdb.org.uk/smarthort

FIT FOR THE FUTURE

With the UK in a state of uncertainty over its direction in the coming years, we speak to Minister of State for Agriculture, Fisheries and Food, George Eustice, to get the low-down on the Government's plans for a fitter future



“ There’s an opportunity for horticulture to get access to support that it perhaps didn’t in the past ”

In 1973, Luke Skywalker was still years away from discovering who his father was, the mobile phone hadn’t yet left its cords behind, and a tweet was just the noise a bird would make. A world without these well-known things would seem strangely alien to most, and yet, after 46 years, the UK is about to emerge into a world that will be wholly unfamiliar to the majority of its residents – namely, a world where it is not a member of the European Union or ECC.

For some, their belief is that Brexit is and will be an unmitigated economic disaster; for others, it is an opportunity to forge new ties and prosper as a strong, proud independent nation. In reality though, until we officially leave on 29 March 2019, nobody truly knows what will lay in store for the UK. One man, however, who might have more insight than most on what the future direction of our country (or at least horticulture’s role within it) may look like is Minister of State for Agriculture, Fisheries and Food, George Eustice. Here, George answers our questions about Brexit, the environment and AHDB’s role in horticulture’s future:

SO, WE’RE JUST OVER HALF A YEAR AWAY FROM THE BREXIT DEADLINE; WHAT IS YOUR ADVICE TO HORTICULTURAL GROWERS AT THIS IMPORTANT TIME?

GE: I think the horticulture industry can face the future with great confidence; there’s opportunities for us to displace imports currently coming from the European Union within the UK, opportunities for us to design a new policy that helps and supports horticulture to invest and grow, and we’ve got to seize the day and seize those opportunities.

WHAT IS YOUR VISION FOR GROWERS AND THE HORTICULTURAL INDUSTRY AFTER BREXIT AND INTO THE FUTURE?

GE: I think leaving the European Union is a great opportunity for the horticulture sector. I think in recent decades the process of European integration means that we have become over-reliant on horticultural produce from The Netherlands and other countries,

and I think there’s a great opportunity to reinvigorate the sector.

Horticulture tended not to be supported by the Common Agricultural Policy (CAP) because it’s historically not been a subsidised sector, and I think there’s an opportunity in the way we’re designing future policy in that we may have support to help people invest in new equipment and new technology. There’s an opportunity for horticulture to get access to that kind of support in the future in a way that it perhaps didn’t in the past.

We’ve got the Countryside Productivity scheme at the moment that has some provision for horticulture and we’re planning to open a second round of the popular Countryside Productivity Small Grant scheme later this year.

WHAT ARE THE THREE BIGGEST CHALLENGES YOU THINK WE’LL FACE IN THE NEXT DECADE, AND HOW WILL WE OVERCOME THEM?

GE: I think a big challenge, particularly for horticulture, is where we are heading on plant protection. For me this is a big challenge of our age. We are losing more and more plant protection products and pesticides as science evolves and highlights further concerns, and as people become more cautious about the use of synthetic chemistry, and I think we therefore need to quite quickly develop complementary approaches, different changes to our agronomic approach to growing certain crops, but also genetic resistance and accelerating genetic technologies. So I think developing a different and more holistic approach to the way we tackle pest and diseases is a really big one.

I’m very optimistic about leaving the European Union, but it will be a period of change. While there are great opportunities for import displacement, it will take us time to get there.

The third and final challenge is that, if we’re going to realise these opportunities we need new people and fresh blood coming into the industry, so there’s a very important role in my view of developing skills so that we’ve got the management capability that we need to take things to the next step.

AS YOU’VE HIGHLIGHTED, AN AREA OF MUCH CONCERN FOR GROWERS IS THAT OF CROP PROTECTION. WHERE ARE WE HEADING ON THAT FRONT?

GE: The model that I’m quite interested in is the model that’s adopted by Canada, the US, Australia and New Zealand. Those four countries have a system call ‘the quad’ and they basically cooperate at a technical level. Their pesticide experts all attend working groups to discuss the evidence and they try to get a common understanding of what the evidence is telling them and a common conclusion from the evidence. But then each of the countries goes off and legislates in accordance with their own parliamentary traditions. For me this is quite an interesting model because it means that we can still attend working groups at a European level and we could share our expertise from the Chemical Regulations Division (CRD), which is probably the leading group of experts in Europe. They would benefit from that and we would also help shape a common understanding of the evidence base. But once we’ve done that we would be able to legislate ourselves without having to endlessly worry about EU decision-making processes. So, that would be the ideal outcome and it remains to be seen how close a partnership the EU is willing to agree. We’re very clear that we want a close working relationship along those lines but we don’t yet know whether the European Union is up for such a discussion.

“ A big challenge is where we are heading on plant protection. For me, this is a big challenge of our age ”



A NUMBER OF BUSINESSES, PARTICULARLY IN THE SOUTH OF ENGLAND HAVE ALREADY REPORTED DIFFICULTY IN SOURCING QUALITY LABOUR SINCE THE BREXIT VOTE. WHAT PLANS ARE THERE TO ALLEVIATE THEIR WORRIES AND MAKE SURE THAT THEY HAVE ACCESS TO SUFFICIENT LEVELS OF LABOUR?

GE: We've been working closely with the SAWS working group and I think it is fair to say that, last year, particularly in the third quarter – a time of the year that is sometimes called 'peak strawberry' – there was certainly pressure on the labour market when it comes to seasonal labour. So, we're in discussion at the moment with the Home Office about the possibility of a future scheme. We haven't got any announcement yet,

but for the time being while we're in the European Union obviously people have access to labour in the EU and the transition period is going to run until the end of 2020. So for the next 2-3 years there's absolute clarity over having access to labour and we will ensure that by the time we come out of that transition period we've got sufficient arrangements in place to make sure we've got the labour that we need.



“ We would be able to legislate ourselves without having to endlessly worry about EU decision-making processes ”

they believe they'll always need people to cut the flowers manually because of the way that the crop comes through, there are things that can be done to mechanise and improve the handling of trays so that pickers didn't have to carry trays up and down the rows manually and to improve and speed up handling more generally. So mechanisation hasn't always got to be complete, it can be partial.

THE UK GOVERNMENT HAS RECENTLY RELEASED ITS 25-YEAR ENVIRONMENTAL STRATEGY. HOW DO YOU SEE HORTICULTURAL BUSINESSES HELPING TO DELIVER ITS AIMS?

GE: One of the key elements in that plan is a new approach to replace the CAP so we are, for instance, looking at schemes that might get more trees on the landscape, not just in woodlands but also along the banks of rivers to prevent soil erosion, so there will be some opportunities given the focus of our future policy for certain producers of trees and woodland in particular.

FINALLY, WHAT ROLE DO YOU SEE AHDB PLAYING IN THE FUTURE PROSPERITY OF UK GROWING AND FARMING?

GE: We're doing a lot of work at the moment with AHDB and I know that your Chairman, Peter Kendall, is very keen on developing a benchmarking role. I think when it comes to market statistics and some of the R&D work done, the AHDB has played a very important role in the past and so we're very much working with the AHDB with some of the thinking for the future.

AND WHAT ROLE DOES ROBOTICS AND AUTOMATION PLAY IN THIS FUTURE?

GE: I think there are opportunities, particularly when it comes to robotics; there's a new generation of technology coming in that will allow a new wave of mechanisation, but also I'm a realist; I can remember when I was studying commercial horticulture myself and I can remember people talking about

machines that might pick strawberries as long ago as 1992 when I was at college. It has remained quite elusive as there are some sectors, such as strawberries, where the risk of bruising of fruit and the fact that fruit matures at different rates, means that a fully-automated approach remains difficult.

I met a flower grower recently who made an important point to me that, while



ROOTING FOR SUCCESS

Felicidad Fernandez, NIAB EMR, explores how the East Malling Rootstock Club is helping to provide new and better rootstock options for the UK's tree fruit growers, and details some of their recent successes

Suitable rootstocks are essential for profitable and sustainable production in tree fruit crops. For the grower, the most important traits are vigour control, precocity and productivity to reach optimal yields with an effective use of a scarce and costly labour force. For a new rootstock to be successful, improved resistance to woolly apple aphid and key diseases such as collar rot, canker and fireblight are also important. Good nursery performance (ease of propagation and good scion-stock compatibility) is also a must.

The East Malling Rootstock Club (EMRC) was created in 2008 to exploit NIAB EMR's existing pipeline and expertise in trialling and breeding rootstocks for apple and pear. Funded by AHDB and the International New Varieties Network (INN), the EMRC aims to develop, test and commercialise worldwide new superior rootstocks from NIAB EMR's breeding, as well as to trial promising rootstocks from other

breeding programmes in the UK.

INN has members in Australia, Chile, France, Italy, Mexico, New Zealand, South Africa and USA. AHDB helps to steer breeding objectives to meet the specific requirements of UK growers and oversees that newly selected rootstocks are sufficiently trialled before release to the industry. Its participation in the EMRC ensures that new rootstocks released from the programme are made widely available to UK levy payers.

TRIALS OLD AND NEW

Two apple trials planted in 2010 (Project TF 172a) came to an end this winter. The first one (EE207) looked at the performance of five NIAB-EMR rootstock selections under conventional orchard management with 'Royal Gala' and 'Braeburn' as scions. From it, the most dwarfing selection (R59) will be a good parent for further breeding as it appears to have useful resistance to canker and woolly apple aphid, as

well as excellent yield efficiency. Two other selections could have commercial promise and are still being evaluated in Europe by INN.

“ The most dwarfing selection, R59, appears to have useful resistance to canker and woolly apple aphid, as well as excellent yield efficiency ”

“It is not unusual for the release of a new rootstock to take 30 to 35 years”

worldwide release. So, it is not unusual for the release of a new rootstock to take 30 to 35 years; one of the main drivers behind the EMRC is to apply novel technology to cut down those timescales.

Some of these tools, such as DNA markers for dwarfing, root-architecture and resistances to apple canker and collar-rot, are being or will be developed by PhD students at NIAB EMR as part of BBRSC-funded projects or the Collaborative Training Partnership for Fruit Crop Research, funded by BBSRC and industry.

You can find more information at www.ctp-fcr.org

AHDB project code: TF 224

Project lead: Felicidad Fernandez, NIAB EMR

AHDB contact: Scott Raffle

The second trial to conclude this year (VF224) looked at four semi-dwarfing NIAB-EMR selections grafted with 'Red Falstaff' in an organic orchard system, though it was less informative. Although VF224 did not show any of the selections to be a particular improvement on M.116, they are all still part of larger INN trials that might shed more light, particularly as one selection – R80 – is performing well in continental trials.

Better trials require more replication and multiple sites sharing data. NIAB EMR has become one of the sites for the new rootstock trial coordinated by the European Fruit Research Institutes Network (EUFRIN) which will evaluate rootstocks in 19 sites from Norway to Spain; six of the 18 apple rootstocks planted in 2017 are from the EMRC and a pear/quince trial is planned for 2019.

The jury is still out on the nine Canadian apple rootstocks being evaluated (since 2014) and, although the trial will be completed, the aim is that participation on multi-site trials will replace less informative, single site trials like this one. All details will be available to growers in the annual report.

Two new first-stage trials (apple and pear) are also starting this year; all trees are currently being genotyped to ensure trueness-to-type prior to planting. The pear trial, as well as new material, includes the best pear rootstocks from the East Malling trial completed in 2014 that are also being evaluated by INN.

NEW ROOTSTOCK RELEASE

The release of a new dwarfing rootstock from the programme is imminent. INN members are very excited by the results of the most promising selection in the pipeline which “consistently induces a higher productivity index than M.9 with 10 to 20 per cent more vigour” according to Bruno Essner, Chief Operating Officer of Dalival, who is most familiar with the EU-wide trials. This selection, which will soon be named, also has better tolerance than M.9 to apple replant disease and fireblight.

The release has been postponed a couple of times in an effort to ensure good stoolbed establishment, not only in Europe but also with INN partners worldwide. This should facilitate uptake of the variety and avoid the delays experienced by M.116 in its early years.

“M.116 is now the first choice for cider growers as a replacement for MM106 and or MM111 in bush orchards. According to Nick Dunn of FP Matthews,

“it accounts for over 70 per cent of our current enquiries and sales thanks to its collar/crown rot resistance, while young plantings on MM106 would certainly be suffering after this very wet spring”. But, despite its good orchard characteristics, M.116 is difficult to propagate and it took the industry a long time establish productive stoolbeds, so sales in continental Europe are only now reaching 100-200K per annum from young stoolbeds, with a similar figure reported for New Zealand. Much-awaited first commercial sales in Chile are expected in 2018, ten years after its introduction to the Chilean quarantine system. Better planning for new releases should see them make a global impact much faster.

LOOKING TO THE FUTURE

Rootstock breeding is a long and complex process. Selection of parental material, crossing, seedling selection and first-stage trialling, which are carried out at NIAB EMR, take around 10 to 15 years. Promising material is then propagated and released for second stage trials, with AHDB-funding (within the EMRC) for the UK and led by INN at appropriate sites worldwide which can often take a further 10 to 15 years. As trial results accumulate to identify the most promising selections, nursery material is built up and intellectual property protection sought in different territories to co-ordinate effective



EAMU LATEST

SUMMER RAINS

The British summer has brought yet another deluge, but this time it's raining EAMUs, to the delight of growers. AHDB Crop Protection Scientist Bolette Palle Neve reveals more



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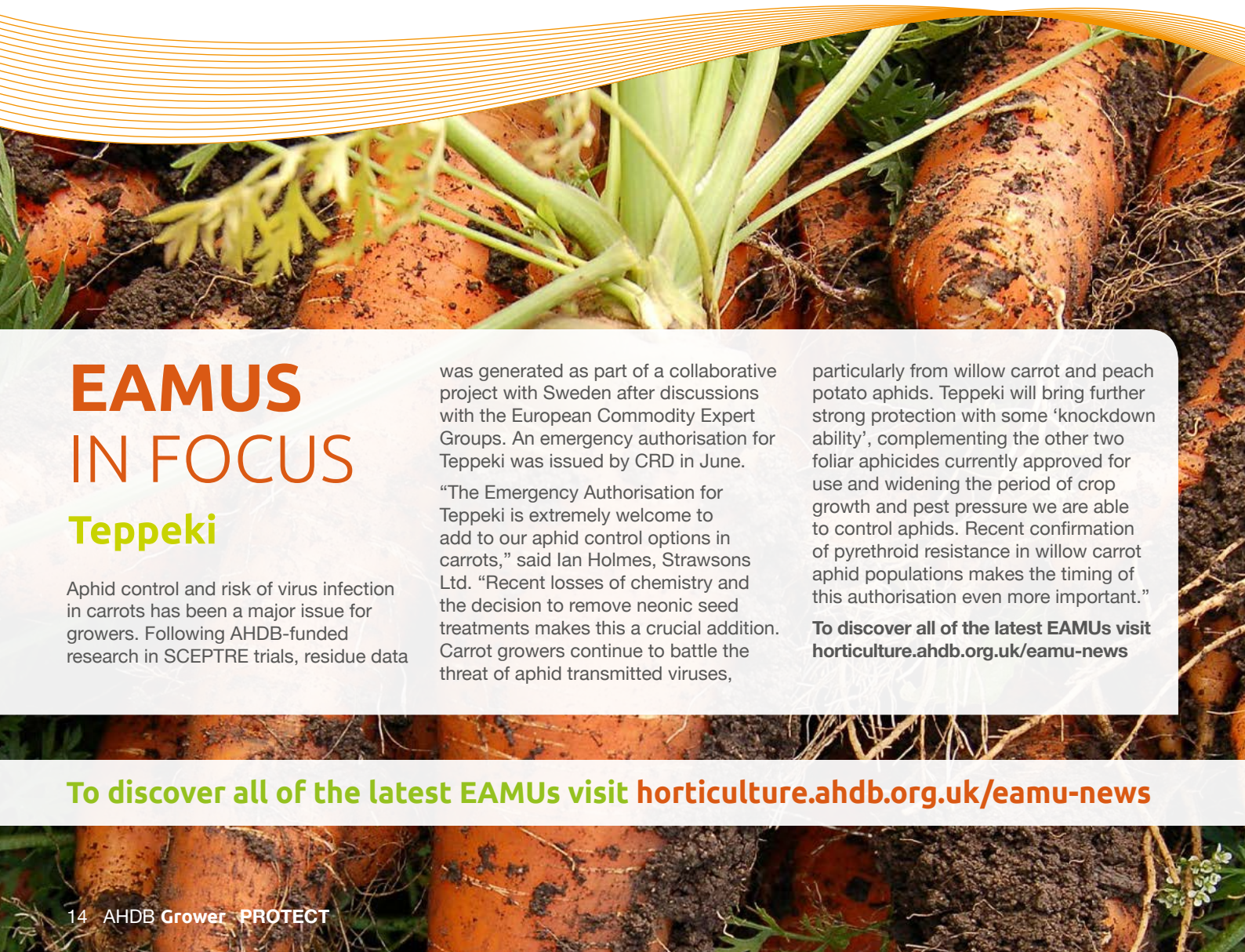
As growers are put under increased pressure due to a lack of plant protection products, we at AHDB get an increasing number of requests for Emergency 120-day authorisations. Such authorisations can be issued by Chemicals Regulation Division (CRD) under certain circumstances for a limited and controlled use where a pest, weed or disease cannot be contained by any other means. Obtaining emergency authorisations is a difficult and costly process and we work hard to minimise

the number of emergency applications we submit each year. One way of doing this is through the SCEPTREplus project where we conduct trials looking for suitable alternatives where we know important active ingredients are likely to be lost in the future. This year we are doing trials looking at control of celery septoria, lettuce root aphid and weeds in various crops for that very reason.

Our hope is that the trial will identify alternatives which we can take forward for regular EAMU applications giving growers suitable alternatives.

Unfortunately, there are still situations where emergency authorisations are required and this year we have submitted 20 applications for emergency authorisations. The applications cover a range of crops including ornamentals, potato, herbs, brassicas, leek, onion, celery, carrot, parsnip, cherry, plum raspberry, blackberry, blueberry and strawberry.

So far, nine of our 120-day Emergency Authorisations have come through for growers this year in response to high risks of crop damage from late blight, aphids, spotted wing drosophila, bacterial diseases and a range of weeds. We are grateful to the growers and manufacturers who have helped provide information for these applications and to CRD for working with us to help growers.



EAMUS IN FOCUS

Teppeki

Aphid control and risk of virus infection in carrots has been a major issue for growers. Following AHDB-funded research in SCEPTRE trials, residue data

was generated as part of a collaborative project with Sweden after discussions with the European Commodity Expert Groups. An emergency authorisation for Teppeki was issued by CRD in June.

“The Emergency Authorisation for Teppeki is extremely welcome to add to our aphid control options in carrots,” said Ian Holmes, Strawsons Ltd. “Recent losses of chemistry and the decision to remove neonic seed treatments makes this a crucial addition. Carrot growers continue to battle the threat of aphid transmitted viruses,

particularly from willow carrot and peach potato aphids. Teppeki will bring further strong protection with some ‘knockdown ability’, complementing the other two foliar aphicides currently approved for use and widening the period of crop growth and pest pressure we are able to control aphids. Recent confirmation of pyrethroid resistance in willow carrot aphid populations makes the timing of this authorisation even more important.”

To discover all of the latest EAMUs visit horticulture.ahdb.org.uk/eamu-news

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THE FIGHT FOR THIRIPS CONTROL

Following reports of resistance to traditional control products, can a solution to the problem pest Western Flower Thrips be found? Dr Michelle Fountain, NIAB EMR, investigates

Western flower thrips (WFT) is a highly damaging pest of strawberry; the immature stages feed on the plant cells and cause damage to leaves and flower petals, while economic damage is caused by feeding on the flowers and fruitlets leading to bronzing of the fruit, rendering it unmarketable and resulting in crop losses. In addition, WFT has become resistant to traditional control products so growers now need to rely primarily on the use of natural enemies, including *Neoseiulus cucumeris* and *Orius* releases. The latter is recommended for release later in the season when the weather is warmer, but the predatory mite *N. cucumeris*, which was demonstrated to be successful in controlling WFT (AHDB project SF 120, Defra Horticulture LINK Project HL01107), can be released from slow-release sachets very early in the season, even before flowering. *N. cucumeris* feed on the eggs and early stages of thrips and control has generally been successful in most crops if regular releases are made and crops are carefully monitored for the presence of the thrips and the predatory mite.

TESTS IN THE FIELD

However, on occasion, some growers report control with *N. cucumeris* failing and reasons for this need to be determined to prevent future breakdowns in control. In an AHDB project led by the University of Keele in 2014, 11 growers were surveyed to determine their success with WFT control. This was then compared to their pest and disease control programmes. Results from this survey suggested that tank mixes of multiple plant protection products, including fungicides, were related to a breakdown in thrips control.

As part of AHDB project SF 145, NIAB EMR investigated whether tank mixes of fungicides were detrimental to the numbers of *N. cucumeris* in the crop. In year one we tested common tank mixes applied to strawberry, but over multiple applications. Tank mixes of Nimrod/Teldor, Signum/Systhane and Aphox/Rovral reduced numbers of *N. cucumeris* – but only after the third spray application.

In the second year we tested Calypso (two applications) and Potassium bicarbonate+Activator 90 (three applications) as there were concerns from the industry that these may be harmful to *N. cucumeris* over multiple applications. These were compared to repeated applications of the Nimrod/Teldor treatment from the previous year. We also tested whether a second release of *N. cucumeris* into the crop could mitigate the effects of spray treatments.

Numbers of *N. cucumeris* were not affected by any of the spray treatments in the second year. However, a second release of *N. cucumeris* to half of the plots after the second spray application, led to an increase in *N. cucumeris* in those plots compared to plots where no second release was made.

Clearly there is no straightforward answer to whether tank mixes cause consistently harmful effects on *N. cucumeris* in strawberry crops. However, growers should be mindful that repeated sprays of plant protection products can be an extra stress on *N. cucumeris* populations in the crop and, therefore, the choice and mix of products should be considered carefully. The persistence of the products in the crops and the reported harmful effects of individual products (data from side effects

biological control companies) should be determined before use. Alongside weekly monitoring of thrips and predatory mites careful consideration can be given to the types of products used and the amount of time required before a reintroduction of *N. cucumeris* can be made.

MORE IS BETTER?

Another part of the grower survey undertaken by the University of Keele suggested that where multiple approaches to thrips control were used, (i.e. use of additional predators to *N. cucumeris*), control was more likely to succeed. In particular, growers who had achieved good control of WFT had made a release of *Stratiolaelaps scimitus* (previously known as *Hypoaspis miles*) between March and May, in addition to other biocontrol agents such as *N. cucumeris*. This would seem sensible, as *N. cucumeris* only feed on the immature stages of thrips in the plant canopy. Hence targeting all life stages including adult thrips with *Orius* and thrips pupae with soil dwelling predatory mites is more likely to succeed in combination with *N. cucumeris*.

In AHDB project SF 146, NIAB EMR conducted controlled temperature laboratory studies and demonstrated that the soil predatory mites *S. scimitus* and *Macrocheles robustulus* reduced numbers of WFT adults in coir substrate. Hence *S. scimitus* and *M. robustulus* can be used to complement introductions of *N. cucumeris*, as part of integrated WFT control strategy.

More information on WFT control can be found in the AHDB Factsheet 14/15 'Western flower thrips control in strawberry', available on the AHDB website: horticulture.ahdb.org.uk

AHDB project code: SF 156

Project lead: Dr Michelle Fountain, NIAB EMR

AHDB contact: Scott Raffle



RESPONDING TO CRISIS

AHDB Crop Protection Senior Scientist, Joe Martin, reveals what AHDB is doing to combat some of the important crop protection challenges UK horticulture is currently facing

The horticultural industry is currently facing many challenges, such as the relentless downward pressure on margins and future uncertainty about labour availability when we leave the EU. However there is another very serious threat, the loss of effective crop protection treatments, which has been building over a number of years and is having a major impact on both horticultural producers and the wider farming industry here and now. Growers have been able to manage some of the problems that have arisen from this threat thus far through the selection of alternative treatments, but this is difficult when the remaining key treatments disappear. This, combined with the arrival of new crop protection problems, is providing the industry with some critical challenges which may result in some crops becoming non-viable.

AHDB has responded to the challenges that growers are facing by creating the SCEPTREplus project to identify threats and hopefully find solutions before it is too late. The response to some of the latest crises, such as the loss of neonicotinoids and linuron

and the arrival of two new diseases that are outlined below, highlights the importance of this programme. The ability of the AHDB SCEPTREplus team to work with all stakeholders to develop rapid responses to the arising threats provides some hope that solutions will be found before the problem becomes terminal for the grower. There are no easy answers in this space, but the coordinated activity of SCEPTREplus and its partners provides growers with the best chance of finding solutions in an increasingly challenging area.

LETTUCE FUSARIUM WILT

Fusarium wilt of lettuce, caused by *Fusarium oxysporum f. sp. lactucae* (FOL), has spread to most production areas globally, causing severe economic losses in protected and field crops. Several races occur, the most widespread being race 1 which affects both field and protected crops. FOL was first reported in the UK in October 2017 affecting protected lettuce crops in Lancashire and also in Ireland; however, no outbreaks have been reported in field grown lettuce. Genetic analysis

of isolates from these sites at Warwick confirmed the causal agent as FOL race 4 (FOL4). FOL4 was first reported in the Netherlands in 2013 and so far has been confined to protected crops. However, anecdotal evidence suggests it is more aggressive than FOL1, especially at low temperatures.

Control of FOL is particularly challenging as it produces long-lived soilborne chlamydo spores and there is no known varietal resistance available. The outbreak of FOL4 therefore represents a significant threat to the UK lettuce industry.

In response to this within the SCEPTREplus programme in 2018 we will be working with Warwick Crop Centre and manufacturers to identify chemical, physical, and biological treatments that can reduce the impact of FOL4. These will be tested in both pot experiments and polytunnel experiments using artificial inoculation. This will ensure a consistent disease pressure required to identify effective treatments and ensure biosecurity and containment.





LETTUCE ROOT APHID

AHDB are aware that growers are very concerned about the resurgence of lettuce root aphid with the loss of neonicotinoid seed treatments. Plans were in place to conduct this work in 2019 but due to the loss of seed treatments and the need to respond quickly, trials are now being planned in 2018. Additional funding was provided by the Field Vegetable Panel to help with these trials.

“ The loss of effective crop protection treatments is having a major impact on horticultural producers here and now ”

The trials are being conducted in time to catch the migration of the aphids from poplar trees and aim to determine the efficacy of novel treatments for the control of lettuce root aphids. A number of treatments are being testing including seed treatment, sprays, phytodrip and drenches.

As well as testing the efficacy, residue samples will be taken to give some evidence for product approval holders that MRLs will not be exceeded.

PHYTOPHTHORA INFESTANS (NEW STRAIN) IN TOMATO PRODUCTION

A new strain of *Phytophthora infestans* has been found in tomato production with symptoms affecting roots and stem rather than the classic leaf symptoms. There is concern that, even if visually cleared up, the infection may remain systemic and occur again in later season. There are limited current plant protection products which are capable of controlling this strain. Hence the need to include this high priority target in Year 2 of the SCEPTREplus programme and additional support has been provided by the Protected Edible Panel. Trials are anticipated to take place either on commercial sites or under controlled conditions, looking at protectant fungicides including the propagation stage as well as planted crops.

WEED CONTROL IN CARROT AND LOSS OF LINURON

The loss of linuron in carrots is leaving growers limited choices for weed control. SCEPTREplus continues to fund and carryout trials in Year 2, looking at potential alternatives for weed control in carrots and parsnips.

Year 1 identified several products, though unfortunately one is no longer able to be progressed and therefore there is still a need to look at further alternatives.

The trial this year will compare a number of herbicide tank-mixes with the commercial standard (pendimethalin + clomazone) at two application timings pre-emergence and two application timings post-emergence for selectivity (crop safety) and efficacy with a total of 20 treatments.

For more information about SCEPTREplus, visit: horticulture.ahdb.org.uk/sceptreplus

SCEPTREPLUS

IT'S A KNOCKOUT

Dr Guy Barker and student Luca Illing, University of Warwick, discuss their work on delivering a knockout blow to Turnip Mosaic Virus

Turnip Mosaic Virus (TuMV) affects a wide variety of crop species causing losses in yield and increasing production costs. Several Brassica species are among those affected. There is currently no durable resistance to TuMV in Brassica oleracea, although a natural resistance to TuMV is found in a genotype of Oilseed Rape (OSR). The basis of the resistance is a 'knock out' gene. This gene is required by the virus to infect the Brassica. If knocked out, the virus is not able to infect the plant and the plant variety gains resistance.

The virus can hijack mechanisms within the plant in order to proliferate. Previous work has identified one gene within the plant genome, eIF(iso)4E, which can confer broad-spectrum virus resistance to *Potyviridae* within horticultural Brassica crops due to alternative splicing within the gene. In order to further understand this mechanism of resistance and identify new sources of resistance, comparative genomic analysis of the genes within the complex has been performed.

The aim of Luca's research is to transfer the 'knock out' gene found in OSR to the germplasm of veg Brassicas. With certain caveats this process does not count as genetic. The European Court of Justice ruled on the use of 'New Plant Breeding Techniques' (NPBTs) in

done via natural breeding routes, which would take seven to eight years, rather than using the new methods which could allow benefits to be usable in two to three years. The next stage is to develop a marker for this gene, to speed up the introgression of the gene into

existing vegetable Brassica varieties.

The University of Warwick is confident that the techniques would lead to improved seed commercially available to Brassica growers. The evidence

“ If knocked out, the virus is not able to infect the plant and the plant variety gains resistance ”

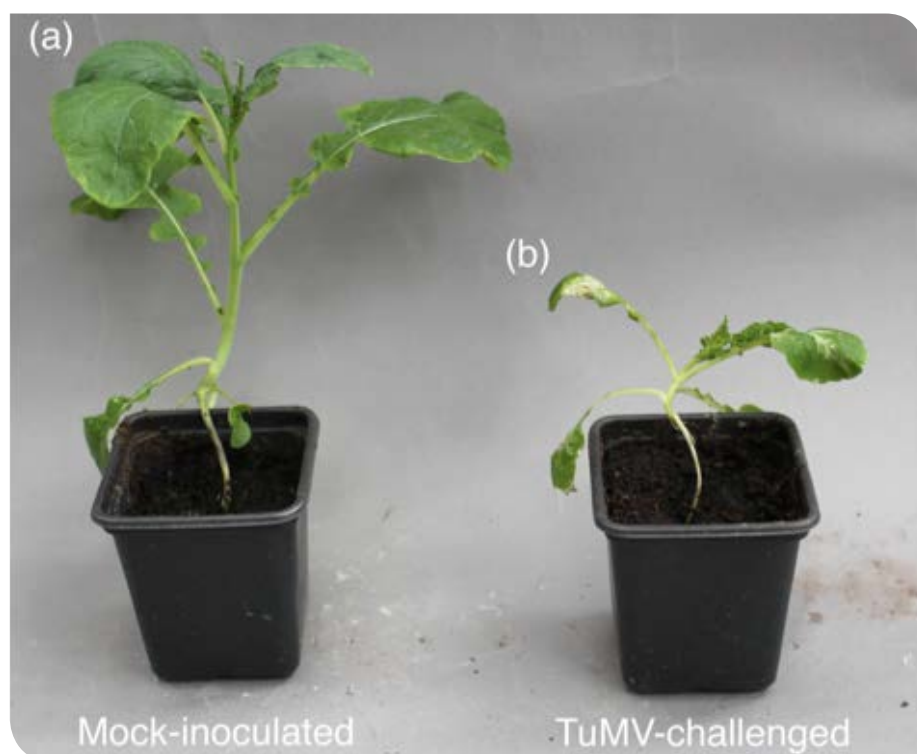
is that the University of Warwick has already developed resistance to turnip mosaic virus in Chinese Cabbage, the patent has been bought by Syngenta and the seeds should be on the market in 2017. The value of the work initially is to enable resistance to TuMV to become available to growers. TuMV is only a sporadic problem, but resistance would still be of use to Brassica growers. The greater long term benefit will be if the same approach can be applied to identify resistance genes to turnip yellows virus, in conjunction with the HAPI project on that disease (AHDB CP 144). Luca's studies continue until the end of September 2019. During the latter part of this year he will be undertaking a three-month industry placement so that he can gain a better understanding of the issues faced by Brassica growers in the UK.

May and will publish their findings in June this year. The main concern among dissenters is that the altered plants are Genetically Modified Organisms, however as no novel material is inserted into the plants, rather genetic material is removed or 'knocked out' this could make a difference to the discussion. Additionally, all such alterations could be

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AHDB project code: CP 175

Project lead: Dr Guy Barker and Luca Illing, University of Warwick

AHDB contact: Cathryn Lambourne

TACKLING TURNIP YELLOWS VIRUS FROM ALL ANGLES

As the list of controls available to growers dwindles, AHDB's Cathryn Lambourne reports on the HAPI project hoping to find new alternatives to tackle Turnip Yellows Virus on Brassica crops

Turnip yellows virus (TuYV – previously known as Beet western yellows virus) is transmitted by aphids, primarily the Peach Potato Aphid (*Myzus persicae*) and can cause foliar damage to a wide range of crops. In veg Brassica crops the virus can result in reduced yield and post-harvest tip-burn symptoms in cabbage.

The veg Brassica crop in the UK is worth around £200M (Hort Stats 2016) and relies heavily on seed treatments for the control of pests, particularly those that act as vectors for virus. Foliar insecticides and seed treatments are used for controlling the virus vector in this crop. However, due to the development of resistance, pirimicarb and pyrethroid insecticides are not recommended for control and the latest ruling on the ban of the three main neonicotinoid active ingredients in all field crops will result in very limited options for control following the use-up period for neonicotinoid seed treatments. It is estimated that growing Brassicas without seed treatments to control TuYV could cost the UK Brassica industry around £58M annually.

The team working on this project are tackling the problem from multiple angles with the hope of finding viable alternatives.

MONITORING OF MYZUS PERSICAE NUMBERS AND VIRUS INCIDENCE

In 2017, an average of 68 per cent of the aphids trapped across two sites were carrying TuYV.

Field trials looking at developing an integrated strategy for TuYV control assessed the effect on virus incidence of different planting dates, a seed treatment, different sprays and resistant and sensitive varieties at two sites over three years.

Data collected so far shows that crops are becoming infected with TuYV in the first six weeks post-planting. There was some indication of improved yields with resistant varieties. Additional analysis of the data is ongoing.

“ Growing Brassicas without seed treatments to control TuYV could cost the UK Brassica industry £58M annually ”

PRE-BREEDING LINES

The team are also seeking pre-breeding lines with resistance to TuYV in a large range of accessions from the VEGIN genetic resource that can be shared with breeding companies for potential future development.

Testing of Brassica accessions indicates that there are lines with a wide variety of tolerance to TuYV. The genes responsible for the resistance are being mapped in one resistant Brassica accession. Support and interest from seed producers involved in the project is on-hand to exploit the resistance and molecular markers that will be developed at Warwick will dramatically accelerate the development of new virus-resistant Brassica varieties.

The project will continue until September 2019.

AHDB project code: CP 144

Project lead: University of Warwick, Rothamsted Research and Allium and Brassica Agronomy

AHDB contact: Cathryn Lambourne



TACKLING THE **NEW** **FACE** OF AN OLD ENEMY

A 2018 outbreak of *Phytophthora infestans*, or late blight, in UK tomato crops is likely to be a new strain of the disease, as symptoms have been seen unusually early in the season on young plants. With the help of David Cooke from the James Hutton Institute and Tim Pettitt at Worcester University, AHDB have compiled some best practice advice for growers to help manage the problem

“ The use of *Gliocladium catenulatum* strain J1446 is assumed to have some protective action – but it has no curative activity ”

Late blight is caused by the pathogen *Phytophthora infestans* and is one of more than 170 species of this genus causing serious diseases on thousands of plant species worldwide. It is in the same group of pathogens as Pythium and downy mildews.

Generally, late blight in tomatoes is a disease that affects leaves, young shoots and both green and ripe fruits and, under favourable conditions, it is capable of causing heavy losses in terms of blighted shoots destruction of leaves and damaged fruit.

SYMPTOMS

Typical symptoms in tomatoes start with small brown lesions. These are quite often greasy looking/‘water-soaked’ and found on both leaves and stems. Under favourable humid conditions between 10-20°C, these lesions expand and can coalesce. If left unchecked, they will cause extensive leaf and young shoot death which has the appearance of extreme chilling damage.

2018 SEASON

Symptoms of the 2018 outbreak of *P. infestans* in UK crops have been slightly different, having been first spotted early in the season on young plants. Some leaf spotting has been seen but stem

lesions were prominent in all affected plants, usually starting just above, or near the graft union.

These early symptoms resulted in significant plant losses, though some plants survived while still exhibiting brown stem lesions. To date, the browning on the stems has not been deep, and doesn't appear to penetrate to the level of the vascular tissues. The browning spreads right around and then along affected stems and bears a superficial resemblance to Botrytis stem rot, although generally stems of plants that have survived the initial stages of the disease do not wilt and die off like Botrytis-affected stems. Nevertheless, affected shoots have shown much reduced vigour, with the green shoots above the affected area being thinner and bearing a reduced yield.

DIAGNOSIS AND TESTING

In May 2018, Tim Pettitt was commissioned to visit an affected nursery to make assessments and take samples for diagnostic testing. All symptomatic plants were

exhibiting symptoms at a comparable stage, with no visible evidence of secondary infection, although the browning was still extending at a rate of several centimetres per week. Immunodiagnostic tests were carried out to compare swab samples from plant surfaces and various surfaces within the greenhouse, with stem tissue scrapes and leaf samples. These tests showed strong presence of *P. infestans* in the brown lesions and no presence in any green tissues tested.

Two infected plants were sent for testing by The James Hutton Institute (JHI), who identified the isolate of blight affecting them both as belonging to the EU 39 A1 genotype. JHI can offer isolate testing for any growers wishing to send samples in. More information on this can be found in the online AHDB *Phytophthora infestans* technical update.

HOW THE SPORES SPREAD

Sporulation is favoured by moderately warm, moist conditions; Relative Humidity >90 per cent and temperatures 10-20°C, and require very light surface

wetness (like dew). Under these conditions, sporangiophores grow. This can be identified by grey to whitish fluffy growth on the surface, usually on the underside of infected leaves, and on the brown stem lesions where it often appears at the edges of the brown areas at first. These sporangiophores bear many lemon-shaped sporangia, which are sometimes referred to as conidia or sporangia.

Sporangia can break off and be carried by wind for comparatively long distances. If they arrive on host tissues under favourable conditions, there are two ways in which they can germinate:

- Directly, producing a germ tube which can penetrate the host tissues and cause infection
- Indirectly in water, producing swimming zoospores which can swim towards a host target and infect the plant. Zoospores have another trick up their sleeves: if after swimming for a bit they don't find suitable host tissues, they can still form into cysts without germinating. Cysts in this situation, so long as they remain in water, can remain 'resting' for days until they receive a suitable stimulus (e.g. very dilute plant exudates, sugars or amino acids) when they will release a new swimming zoospore able to infect new plant material.

It's important to note however, that even under environmental conditions which are not favourable for the development of infectious spores, the pathogen will remain viable in the plant for as long as the plant is alive. Only complete destruction of the plant will remove the risk of future activity.

CONTROL OPTIONS

The control of *Phytophthora infestans* is currently covered by the use of azoxystrobin on tomato and aubergine – this has protective and curative activity and is restricted to three applications per crop. However, use in 2018 has proved ineffective in slowing the development of the disease probably due to the aggressiveness of the strain. The use of *Gliocladium catenulatum* strain J1446 is assumed to have some protective action – but it has no curative activity. Mancozeb is also approved on tomato as a protectant with five applications per crop but with no curative activity. In the past the limited number of applications would have been sufficient as the disease would not appear until later in the year.

In order to address this shortfall, an urgent EAMU was granted in early 2018

for the use of cyazofamid providing a new protectant mode of action for protected tomato, cucumber and aubergine, and at the time of writing was showing good results.

The concern with the current situation is the early appearance – and the lack of a product with useful curative activity. AHDB's crop protection programme, SCEPTREplus, has responded quickly to the outbreak and will be conducting a trial this year to identify new potential options to control the strain.

Cathryn Lambourne, AHDB Crop Protection Scientist, said, "We were alerted to the issue in young plants in late March, the disease was confirmed and the genotype identified by David Cooke at The James Hutton Institute. We are working quickly to raise awareness of the emerging problem and also to help with seeking approvals for crop protection products for growers."

The full technical article is available to read at horticulture.ahdb.org.uk/phytophthora-infestans



ACTIONS FOR GROWERS

STOPPING THE SPREAD:

- Remove fallen leaves from the glasshouse floor – they can be a potential route for disease spread
- Dispose of any infected plant material as far away from healthy crops as possible
- Take extra care not to disperse spores during removal, especially as the season progresses and the risk of prolonged periods of high RH are greater
- Position skips containing effected material away from glasshouses
- If infected plants are suspected, seek a diagnosis and protect surrounding crop with suitable fungicides

CULTURAL CONTROL:

- Conditions to avoid for *P. infestans* development are a combination of 10-20°C and high RH and/or surface wetness.
- Manage canopy environment using factors such as minimum pipe temperature and venting
- At times when potentially high humidity cannot be avoided, extra vigilance is needed to make sure sporulation is not occurring
- Avoid standing water and surface wetness

Detailed hygiene information can be found in the 'Biosecurity in protected edibles' guide which also links to other useful resources, including a series of Oomycete factsheets written by Tim Pettitt. These are available on the AHDB Horticulture website, horticulture.ahdb.org.uk

GUARDIANS OF THE GLYPHOSATE GALAXY

The loss of the herbicide glyphosate would be an unwelcome development for the many UK growers who rely on it, so how can we ensure we safeguard its future? Joe Martin, Crop Protection Senior Scientist, explains

The herbicide glyphosate has been commercially available for 40 years. It is one of the most frequently used herbicides in the UK in all crop production systems, including annual and perennial crops, and non-cropped areas. There are currently no known cases of glyphosate resistance in the UK, however, globally, resistance to glyphosate has evolved as a result of repeated use and over-reliance.

Glyphosate forms an essential component of grass-weed and perennial weed management strategies and ensuring it is effective for many more years is critical to all production systems.

Current changes in usage patterns in the UK are potentially increasing the risk of glyphosate resistance development. An over-reliance on a limited group of herbicide modes of action has accelerated the development of herbicide-resistant grass weeds, particularly black-grass (*Alopecurus myosuroides*) and Italian ryegrass (*Lolium multiflorum*). This has been mainly due to a lack of new herbicides, regulatory policy changes, a limited crop rotation and the under-exploitation of cultural control practices.

Perennial crops can pose a high risk of glyphosate resistance developing due to repeated use within one growing season and a lack of any other integrated control methods such as cultivation or other non-chemical methods. Often glyphosate is the sole option for weed control in these crops which is a highly dangerous management strategy!

Within a number of horticultural crops, annual and perennial, glyphosate use is often very high and with a lack of alternative actives there is an increasing risk of glyphosate resistance developing in these cropping systems. In particular

REDUCING THE RISK OF GLYPHOSATE RESISTANCE

Specific risks of glyphosate resistance can be summarised as:

MONITOR SUCCESS

- Consult your agronomist or supplier
- Remove survivors to prevent spread
- Test seed samples of survivors

PREVENT SURVIVORS

- Repeat application to surviving plants presents the highest risk

USE ALTERNATIVES

- Use cultivation or other non-chemical control when practical
- Use other herbicides in sequence (or mixture only if recommended)

MAXIMISE EFFICACY

- Use the right dose for the target weed on actively growing plants
- Reduced rates increase risk of reduced efficacy

Agronomic factor	Higher risk	Lower risk
Cropping system	Continuous monoculture or perennial crops	Varied rotation- winter and spring cropping
Cultivation	None or insufficient to kill weeds	Thorough disturbance to kill weeds
Weed infestation level	High	Low
Control method	Glyphosate only	Mixed use of glyphosate with effective use of other modes of action and cultural control
Number of glyphosate applications pre-drilling	More than two applications and no cultivation	Fewer than two applications and sufficient cultivation
Target weed size for glyphosate dose	Weeds too large for dose rate; reduced or less-effective dose rates used	Weeds at correct growth stage; full and effective dose rates used



perennial crops such as bush and cane fruit, vine yards and orchards generally have high glyphosate use, often multiple times in one season. More control due to inadequate dose for target weeds, wrong weed growth stage or poor conditions at application can all accelerate the glyphosate resistance risk.

Guidelines on the risk of glyphosate resistance developing and how to prevent it have been produced by the UK Weed Resistance Action Group (WRAG) focussing on perennial and annual crops.

This can be found in the 'media' section on AHDB's cereals website, cereals.ahdb.org.uk



MAXIMISING THE EFFICACY OF GLYPHOSATE

To maximise glyphosate efficacy spray at the right dose rate, at the right growth stage and in the right conditions. Ideal conditions are:

Dose rate: Get dose rate right for the weed and growth stage. Annual grasses typically require 540 g a.i./ha for seedlings up to six tillers and 1,080g a.i./ha when flowering.

Growth stage: In perennial horticultural crops there may be a range of different annual and perennial weed species present. The timing of glyphosate must reflect the species present and aim to control those weeds within the best growth stage for those weeds. For annual grasses the dose must be increased if grasses are tillering. Ideally, spray when plants are at least 5cm but before the start of rapid stem extension. Apply prior to 'shading' from other plants.

Conditions: Apply to actively growing plants, in warm conditions (15-25°C), with at least six hours before any rainfall.

Choice of nozzles, spray quality, water volume (80-250l/ha) and the addition of water conditioner can also be influential so must be considered to get maximum efficacy on your target weeds.

To manage the risk of glyphosate resistance development follow these simple steps:

- Avoid over-reliance on a single herbicide (e.g. glyphosate). Use mixtures of herbicides whenever possible

- Consider non-chemical control measures (e.g. hand weeding, cutting, flaming, steam treatments) as a supplement or alternative to herbicide treatment
- Monitor and assess herbicide efficacy after spraying to detect any loss of control
- If resistance is suspected, act quickly to prevent it spreading. Use a strategy involving alternative herbicides and non-chemical methods and continue to monitor
- Consider collecting and testing seed samples to confirm resistance
- Good record keeping and assessment after spraying is essential in the early detection of herbicide resistance

See Defra-funded project PS2802 for more information on integrated control on hard surfaces.

WHAT TO DO IF RESISTANCE IS SUSPECTED?

Contact your agronomist or adviser.

Alternatively, contact ADAS via weeds@adas.co.uk or 01954 267666 who will be able to discuss your specific issue and test for resistance if required

Essential points

- We can and will get glyphosate resistance in the UK!
- Following the WRAG guidelines can prevent resistance developing
- The highest risk is in amenity use
- There is a high risk in perennial crops, e.g. horticulture, which is highly likely where it will first be detected

WHAT GOES AROUND, COMES AROUND

Horticulture could benefit from a circular economy, argues GrowSave's Ed Hardy

In commercial horticulture, and specifically GrowSave, many of us have been advocates of using energy only when we need it and not wasting it. We also have some great examples of where energy 'waste' from industry is used to good effect to produce crops. Increasingly, the thoughts of growers and consumers are turning to the sustainable use of other resources including packaging and wastes, the consideration of which, alongside energy, is included in a concept termed the 'Circular Economy'. In October, GrowSave intends to hold an informative conference on how circular economics can be applied to and benefit horticulture, tackling some of the issues the industry currently faces.

To give this some context, the world's global food production system creates 600 million tonnes of organic waste annually, and has been described as 'the mother of all systemic problems'. In essence, this can largely be attributed to the linear way in which the global food system works. Not only does it include the production of waste, but also the one-way flow of inputs (nutrients, fuel, etc.), which goes into producing food in the first place, and everything in between. Such a linear approach is not limited to horticulture by any means, but rather is evident across most sectors of industry and economics. So, what's the alternative? Implementing the principles of a circular economy has been touted as an option for making better use of resources.

“ The world's global food production system creates 600 million tonnes of organic waste annually ”

During her record-breaking, solo, round-the-world sailing voyage, Ellen MacArthur honed her skills in resource management, having to take everything she needed for survival for three months at sea. In her TED talk from 2015, MacArthur explains, "No experience in my life could have given me a better understanding of the definition of the word 'finite'. What we have out there is all we have. There is no more." Once back on dry land, the Ellen MacArthur Foundation was born. The key aim of the foundation is to help society move away from a linear economy of take (raw materials), make, dispose (at best, recycle), in favour of a more circular approach. The Circular Economy aims to design waste out of the system, with end-of-life products being broken down into raw materials to act as inputs somewhere else. This is much like in nature, where vegetation decomposes to provide fertile ground for new growth.

Within agriculture and horticulture some 'waste' is inevitable, but perhaps with a small shift in perspective it could become a resource, for example, a readily available fuel for an anaerobic digester. Closing the loop in other areas could be achieved by recycling irrigation water with its high fertiliser content, a practice already carried out by growers. Then there's the packaging used to distribute produce to market; single-use plastics continue to make the headlines for the wrong reasons. Even if recyclable, the raw materials used in their manufacture are usually finite. Packaging materials can instead be produced from a compostable alternative, repurposing an existing waste product, offering another stream of income in the process.


The driving force behind circular economics is, ultimately, sustainability. By definition, the use of finite resources is unsustainable. Careful design of products, processes and systems is required, therefore, to move away from the current methodology. As with many new technologies or approaches, initial cost is often higher than the established options. Without advancement though, increasing demand of finite materials will gradually outstrip the diminishing supply, causing prices to increase anyway. Reducing reliance on ever-scarcer resources can only be a good thing.

Renewable energy is rapidly becoming mainstream, allowing generation of heat and electricity using the sun, the earth or sustainably produced renewable fuels. Government incentive schemes have gone a long way towards making these technologies affordable, and there has been a strong uptake within horticulture, either directly using renewable energy, or supplying waste organic matter as fuel for anaerobic digesters, for example.

Systemic problems cannot be solved overnight, but by addressing the complex issues associated with linear processes, we can make a start. The horticulture sector is forward-thinking and willing to adopt new ideas and technologies with longer-term benefit and returns. Given the familial nature of many horticultural businesses, owners don't want to hand on a liability to the next generation. The wider economy would do well to adopt a similar approach, and recognise that we are rarely paying true cost today for our unsustainable use of resources, as we leave our descendants to deal with the problems we have caused.

Fortunately, most of us will never have to endure such extreme living conditions and limited supplies as Ellen MacArthur did on that incredible journey, but we should try to remember that most of our conventional resources are just as finite – we can only use them once.

For more information and advice on saving energy in your business visit the GrowSave website: www.growsave.co.uk



“ Within horticulture some ‘waste’ is inevitable, but perhaps with a small shift in perspective it could become a resource ”



HOW GOOD IS YOUR WATER?

As FERTINNOWA, an EU-wide project aiming to improve water sustainability in fertigated crops, enters its final year, AHDB's Georgina Key kicks off our series on fertigation with a look at water quality

Here in the UK, and in the northwest of Europe more generally, water comes from boreholes, mains, through extraction from rivers, and rainwater is increasingly used due to its neutral pH and lower levels of particles. However it is a mistake to think that rainwater is free – effective storage can require

“ It is a mistake to think that rainwater is free ”

a lot of investment. Although we live in a country with abundant rainfall where good quality water is available, more irregular weather patterns and a warming climate are already having an impact; growers in Kent have had drought restrictions regularly enforced over the last five years, for example. Therefore it is important to be smart and efficient with your water collection and storage. But how can this be achieved?

SMART STORAGE

Most growers are familiar with water silos and often have several on site. Most of you probably already cover the water to prevent particles getting in or algae growing. What is perhaps less common knowledge is that fixed covers are not the only option (or not an option if your water silo is above a certain size). Floating covers can be used instead, whether solid or something that can move, such as inflatable balls.

For smaller growers, an unlined reservoir is probably all that is needed, however you can still minimise drainage losses by lining the reservoir. Costs for construction of any reservoir depends not only on size, but the material used for the lining, its thickness, any protective covers, and whether it is aboveground, or underground. Although costly, the latter may be a good option if space on site is at a premium.

At the top end of the cost spectrum are dynamic (or adaptable) water buffers. One example is the Klimrek Water Buffer, which is built below a glasshouse whose floor floats on top of it. Storage is split into two compartments – the upper one holds rainwater, and the lower holds water from other sources (Figure 1). When lots of rainwater is available, water from the lower compartment storage drains out, allowing more rainwater to be stored instead in the upper compartment. This means that you can adapt to changing rainwater availability with no change to your productive area.

More sophisticated models are now available to calculate the size required for water storage. These models tend to be based on long-term climate data (rainfall, solar radiation etc.). Some newer systems also include transpiration losses from plants and overflow of nutrient solutions. 'Waterproof' is a tool which includes the daily water consumption of the crop based on solar

radiation. These models are being tested to figure out rainwater storage to wash vegetables, and also whether flood risk can be included as a factor. The main advantage of these models is that each farm or nursery can plug in their own specific measures.

Not all innovative technology has to be so high-tech or expensive. Simple changes such as investing in a floating pump instead of a housed or submerged pump can improve the quality of the water you use. As you take water from the middle depths of the reservoir with a floating pump you avoid sucking up sediment or algae.

OPTIMISING WATER QUALITY

You can improve the quality of water whether fresh, stored or recirculated. Methods to adjust the chemical composition of your water range from cheaper, low-tech methods, such as adjusting pH, through to technology that requires more investment, such as electrophysical precipitation, which passes water through a tank containing ‘sacrificial electrodes’. When an electrical current passes through, the electrodes dissolve, releasing their metal ions. These bind to particles in the water and precipitate out, leaving clean water behind. Forward osmosis uses osmosis to draw water into a concentrated nutrient solution. Reverse osmosis uses pressure to override osmosis and force water out of salt-laden solutions, providing clean water. It is usually used to remove salt from brackish

groundwater for drinking water, but tests are showing good results in horticultural applications.

Of the many filtration methods available, which one you choose depends on how much water needs filtering over a given time, and how much money you have to invest. Band, sand and sieve bend screen filtering rely on gravity, and will be slower than when pump pressure is applied, or if you invest in disc or drum filtering (in both cases, water flows into a tank where rotating discs or a drum retain the particles while allowing water to escape). Hydrocyclone filters work on a similar basis, but suck water upwards, separating it from particles using centripetal force. Self-cleaning filters are now also a reality. As the particles are captured, pressure builds to a particular threshold, which then triggers a self-cleaning function.

Covering water storage is a first step in addressing algae issues, but there are multiple options for reducing algae. Chemical products can contain enzymes which dissolve proteins in algae. Adding blue food dye to water blocks the light wavelengths needed for photosynthesis, killing the algae. Biological options can be relatively cheap, for example Daphnia (water fleas) released into water will eat algae. Grass or silver carp can also be used to eat algae and weeds and they feed without stirring up sediment at the bottom of a reservoir. The Fertigation Bible (see box out) gives appropriate stocking densities dependent on type

of water body, weed species present and temperature, for example if the target weed species is at a high level, the recommended stocking density is 20 carp per acre. If high-tech is your thing, ultrasound can be used to disrupt the vertical movement of blue-green algae and some green algae – which ranges from £300-£5400.

Many of you are familiar with adding hydrogen peroxide in calculated doses to disinfect water. Ultraviolet treatment can make fungi, bacteria, nematodes and even viruses harmless. There are also exciting prospects coming out of research, such as photocatalytic oxidation (PCO). This uses inexpensive catalysts with oxygen, water and daylight to generate hydroxides to break down almost 90 per cent of pesticides and 99 per cent of pathogens. Currently, PCO can remove 80 per cent of crop protection products from water in 10 minutes.

“ Adding blue food dye to water blocks the light wavelengths needed for photosynthesis, killing algae ”

TAKE AWAY MESSAGES

All of this information can be found in the Fertigation Bible. It gives a comprehensive overview of different options, and includes estimated costs, whether the technology is commercially available, its advantages and disadvantages, the supporting systems required, and any legislative restrictions, so you get a full picture of what is available and how costly or easy it would be to implement on your site.

MORE INFORMATION

The Fertigation Bible can be downloaded for free at www.fertinnowa.com/the-fertigation-bible

On the FERTINNOWA website there is also information on technology that has come from other sectors or industries, but which can be applied in horticulture. Find out more at www.fertinnowa.com/technologies-exchanged/

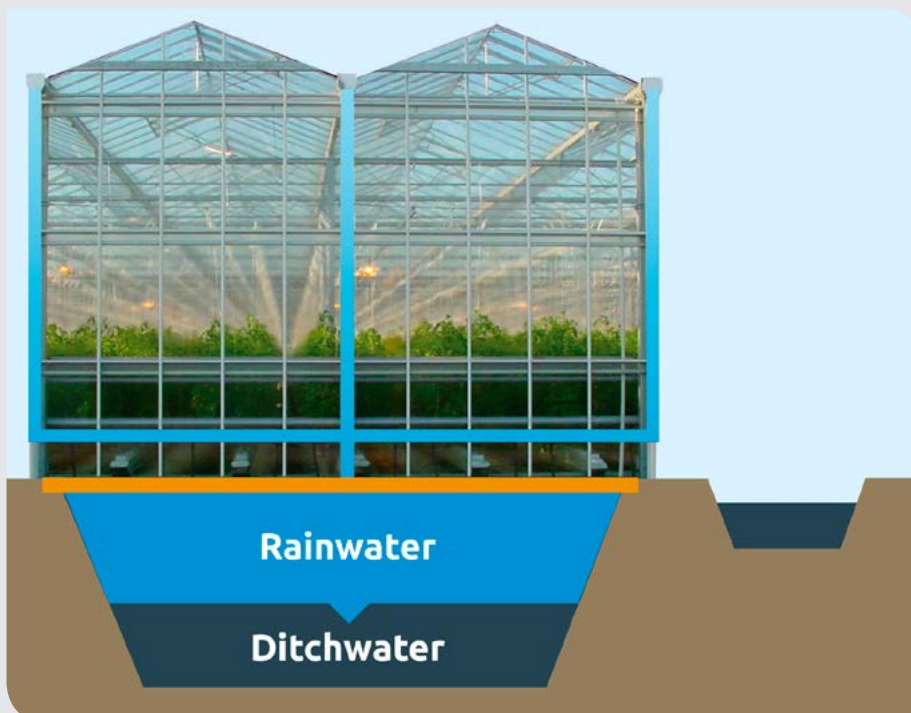


Figure 1: The Klimrek Water Buffer

ARE YOU AN UNWITTING SLAVE MASTER?

Might you be inadvertently aiding labour abuse? Roger Bannister, CEO of the Gangmasters and Labour Abuse Authority, explains why businesses need to be vigilant against organised crime



Would you be happy working 15-hour days, seven days a week, and not getting the National Minimum Wage? Would you be happy sleeping in the same van you drove to work in that morning? Would you be happy being repeatedly abused or attacked by your supervisor, simply for doing your job?

If this sounds like some horror story from a country far away from 21st-century

Britain, sadly you would be mistaken.

At the Gangmasters and Labour Abuse Authority (GLAA) we are determined to stamp out these inhumane working practices, from nail bars to hair salons and car washes, and we are relentless in our ambition to protect vulnerable workers from abuse.

A lot of our work revolves around the agricultural and horticultural sectors.

I was brought up in Lincolnshire and served with Lincolnshire Police for 25 years, so I understand the challenges facing rural communities. I have good memories of policing in Skegness, Boston, Holbeach and Spalding for several years in uniformed and CID roles. I recall strong and productive relationships with local businesses.

Just last month, the GLAA published a report on the nature and scale of labour exploitation across the UK, which I would highly recommend you take a look at as it is well worth a read.

The report revealed that in the agricultural and horticultural sectors, people are charging workers (often Romanian and Bulgarian) up to £50

“Much of this is controlled by organised criminal gangs, who are only too aware of the profits they can make from using people as commodities”

for fruit, flower and vegetable picking jobs. These seasonal workers regularly live in caravan parks or in vans, with overcrowding and unsanitary conditions a serious problem.

Working conditions are often appalling, with some employees refusing to work and even leaving their job. Some contracts reportedly have clauses stating workers will not be provided with more work if they decline hours.

Much of this is controlled by organised criminal gangs, who are only too aware of the profits they can make from using people as commodities.

CHANGE IS ON THE HORIZON

If this report makes for pretty grim reading, don't be disheartened; one year ago, the GLAA expanded after being handed new police-style powers by the government. Our broader remit allows us to tackle abuse across the labour market, search and seize evidence, and investigate modern slavery in the workplace. We now also have the ability to go after repeat labour market offenders and rogue businesses.

Over the last year, we have recruited dozens of highly skilled individuals to our organisation. We have experienced analysts, investigators and intelligence managers.

The results speak for themselves. Since April 2017, we have arrested nearly 100 people, identified over 1,140 employees suffering direct abuse and recovered more than £150,000 for workers.



Roger Bannister, CEO, Gangmasters and Labour Abuse Authority

This is real progress in the fight against modern slavery and labour exploitation, achieved with only around 125 members of staff in the entire organisation. Clearly though, with such finite resources, we are reliant on our partnership work with the police, local and central government, charities and employers.

However, it is also important to remember that businesses that carry out such appalling practices are in the minority, and that the vast majority of businesses in the sector set a good standard.

HOW CAN YOU HELP?

You might be thinking 'What can I do? I'm not a modern slavery expert.' And while spotting modern slavery and labour exploitation might not be easy, there are some useful signs which will help when you are using workers.

Firstly, please check your labour provider is licensed. It is a criminal offence to supply labour without a licence or use an unlicensed labour provider. We have an online public register where you can check to see if your provider has a current GLAA licence.

Aside from this, there's plenty of common sense things you can do to check that you are using workers from a licensed provider. You can carry out an audit of your labour provider and make sure you have a list of all workers on the site.

We are here to help legitimate businesses comply with the necessary licensing regime. Please contact us if you need any guidance, and inform us of any breaches to the licensing standards. We recognise exploiters want to infiltrate business for their own financial gain and undermine your ability to conduct legitimate activity. We have effective and proven protocols to protect organisations working with us.

SPOT THE SIGNS

Moving on to actually spotting the signs of modern slavery and labour exploitation, there are a number of key indicators we use which can be broadly divided into six sections: restricted freedom, behaviour, working conditions, accommodation, finances and appearance.

Restricted freedom can encompass everything from victims not being in possession of their passports, having no access to medical care, being subjected to threats against family members, or never speaking about normal activities outside of work – sometimes the absence of normality is a sign.

Behaviour can be something as relatively innocuous as a worker being unable to speak English fluently. However, it also includes workers having a distrust of the authorities, never leaving their place of work without their boss, and resorting to crime for money or food.

Working conditions and sub-standard accommodation have been explored in depth in our report, and are both areas we are particularly concerned about.

In terms of financial exploitation, victims may receive little or no payment, have no access to their earnings, or be disciplined through punishment and fines. They can be charged for services they do not want, be forced to open bank accounts and sign documents to receive benefits or loans.

Appearance is probably the easiest sign to spot. Has someone suffered injuries that appear to be the result of an assault? Have they suffered injuries that could be related to someone having control over them? If so, they could be a victim of modern slavery.

The most important thing is to make sure you actually act if you spot any of these signs. I know this sounds clichéd but one call to us really can change people's lives forever. Doing nothing is not an option as the exploitation will continue and probably worsen.

If you have any suspicions speak to our intelligence team on 0800 4320804 or email intelligence@glaa.gsi.gov.uk

Our website – www.gla.gov.uk – has more information on labour exploitation and best practice for businesses.

“ Since April 2017 we have identified over 1,140 employees suffering direct abuse and recovered more than £150,000 for workers ”



“ Provide an environment that enables staff to care for their own monkeys as you have to concentrate on yours ”

monkeys (responsibilities). To be an effective manager you need to provide an environment that enables staff to care for their own monkeys as you have to concentrate on your own monkeys. And let's be honest, your monkeys can make or break the business.

When a member of your team comes to you with a problem and you respond with a simple, “Leave it with me, I'll get back to you,” the monkey is jumping from their back to yours. You are now responsible for the monkey's care until you can pass it back. The original owner can't do anything, so the task is left in limbo. Every time this happens, you end up feeding other people's monkeys – at the expense of your own. In real terms, you end up heading to the office to start your day as the rest of the team head off home. Sound familiar?

So how do I keep their monkeys off my back?

- Carry out a time log, keep it simple and be honest. Then ask yourself: “How long do you spend feeding and caring for other people's monkeys? What have you not achieved as a result of doing somebody else's job? What have they not done while they are waiting for it to return?”
- Develop a plan to ensure that the owners don't need to hand over their monkeys regularly
- When someone brings you their problems, help the owners work out for themselves how to care for and feed the monkeys
- Resist the urge to care for all monkeys; develop, support and trust your staff – you employed them because you thought they were capable of taking responsibility

WHO'S FEEDING THE MONKEY?

Tess Howe, AHDB Senior Skills Manager, reveals the tips that will help you to get the monkey off your back and free up more time at work for the important tasks

As a manager, how often do you jump straight in and solve your team's problems for them? When this happens we stop building their confidence to make effective decisions. Is this really helping in the long run?

On the AHDB Professional Managers Development Scheme (PMDS), one of the first tasks delegates perform is a time log: breaking their day into 30-minute blocks, noting the activities

performed and whose responsibility they were. The results, without fail, always shock people.

We use the concept of ‘monkey management’ to help managers understand where time can be lost. In simple terms, monkeys are part of someone's responsibilities, and often they come to the manager as a problem. Members of your team are paid to care for their own group of

THE BENEFITS

One of the biggest benefits delegates of AHDB's PMDS claim is better time management, meaning they work smarter, more proactively, have employees that use their initiative and generally have a better work/life balance. Stop taking on other people's monkeys and see the benefits for yourself.

For more information, visit ahdb.org.uk/skills



THE NEXT LINK IN THE CHAIN

Johnsons of Whixley Group Managing Director, Graham Richardson, discusses the importance to the business of succession planning

Succession is a significant issue for every business and it's a particularly important factor for a family business like ours, where you are not only trying to plan for business continuity, but also for the personal direction and livelihoods of your loved ones.

Johnsons has always been proud of its low staff turnover and our ability to identify, recruit and develop staff members who go on to give 20, 30 or more years of service. I believe this says a lot about us as a business, but it doesn't address the fact that the clock is ticking on many of our stalwarts, nor how fundamentally important it is that we find comparable replacements.

Many of the staff that came to us did so because they were eager to secure work in their immediate locality, not necessarily because they wanted a lifelong career in horticulture. As lifestyles and economies change, many of the obvious replacements don't live locally any more, mainly because they cannot afford the £270k average price for a house in Harrogate, and our industry can't afford to pay a salary that would support those levels.

Our approach to solving this issue is incremental. Johnsons was one of the first employers in agriculture to adopt a group pension scheme in the 1960s, but the level of personal contribution – due mainly to the relatively low industry wage scale – hasn't been sufficient to yield a comparable final salary.

As a result, and perhaps fortunately for us in the current climate, our current managers can't afford to just stop work. Instead, our managers tend to bow out gradually as we bring in replacements in the same gradual way.

This process of finding replacements is aided by initiatives like our 'Rising Stars' programme, which aims to engage with and train staff members identified by the business as having the potential to take on senior roles in the future.

In terms of the family aspect of our business, there is no right of entry for anybody – however, we need them. The family members that work for Johnsons have entered the business having experienced a lifetime exposure to the way things work, and as a result they are driven, motivated and experienced.

We are currently establishing a family charter, which recognises the fact subsequent generations will join the business and that they should be encouraged to do so, while providing an insight into where it will lead. This includes education, external and internal experience, expectations in terms of the role, its rewards, as well as business ownership, meetings and participation, and dispute resolution.

This is not the perfect succession planning strategy, but it at least provides a blueprint for the future, instead of leaving us to rely on hope alone.



FIVE TIPS FOR FAMILY SUCCESSION SUCCESS

Sian Bushell, Sian Bushell Associates, provides her top succession planning tips for family businesses

Plan for succession as soon as your children are born. This means that there is time to ensure that all children are treated fairly without endangering the core business.

1. Review succession at least once a year to ensure that everything is on track and consider any changes that may have happened.
2. Talk about succession with the family frequently and openly so that it does not become a taboo subject. Include all family members who are linked to the business, including in-laws.

3. Have a proper plan for retirement. What does retirement mean to you? Put a date on when you will be stepping back from the responsibility of running the business. Where will you be living? Have you enough pension?
4. Everyone should have a will – no excuses! The contents of the will should be discussed with the beneficiaries.

GROW YOUR OWN CHAMPIONS

Anyone can cost-effectively improve worker performance in their business. In this, the second of two articles on getting maximising your workforce performance, Chris Rose from Chris Rose Associates, reveals how you can too

In the previous issue of The Grower I defined a champion as 'one who achieves superb results (e.g. very high output), consistently (day in, day out) while meeting required standards (e.g. picking to supermarket specifications, not missing or leaving any ripe product) without needing constant supervision.

WHAT IS 'CHAMPION' FOR YOU?

From this generic description you firstly need to define what 'superb results' are. In most cases this is likely to be very high output of an acceptable quality; in some cases the quality may come above output, when supplying high-end restaurants, for example.

I have seen many instances of field supervisors and packhouses demanding 'quality, quality, quality' when in practice the product only needs to meet a standard – albeit an exacting one. Any time and energy spent going above that standard is wasting money.

For each major job or task define what champion performance level is. You may have an amazing picker, cutter, packer or team that exemplify champion performance for you. Alternatively it may be an amalgam of more than one person. Either way it needs to be clearly defined and will be significantly above the average performance.

SMARTHORT

FINDING CHAMPIONS

Premier league football teams with billionaire owners can buy champions; the rest of the league have to grow their own talent. There is no transfer system in horticulture and essentially all talent has to be grown, developed and nurtured.

“ Any time and energy spent going above that standard is wasting money ”

As growers you source the best plants you can, you give them the best conditions you can – growing medium, water, nutrients, light and heat – and you nurture them to keep them healthy and productive. We need to think of labour in the same way. New workers are the raw material and they will only reach their potential with the very best treatment – including good facilities, fair treatment, pastoral care, thorough induction and training, and proper remuneration.



TEACHING CHAMPION

The role of the supervisor in enhancing performance can be broken down into three stages:

1. Induction and initial training
2. Teaching to competence
3. Coaching to excellence

Most supervisors are good at numbers one and two, but many then see themselves as having a policing, rather than coaching role. Achieving the required quality consistently is a fundamental part of the supervisors role; however once workers are competent they should not need constant policing. When the business has a robust disciplinary procedure for those who cheat, a few will get caught and pay the price and the vast majority will get the message and not cheat. There is always a need for some quality control but it should be a minor part of the role of a supervisor.

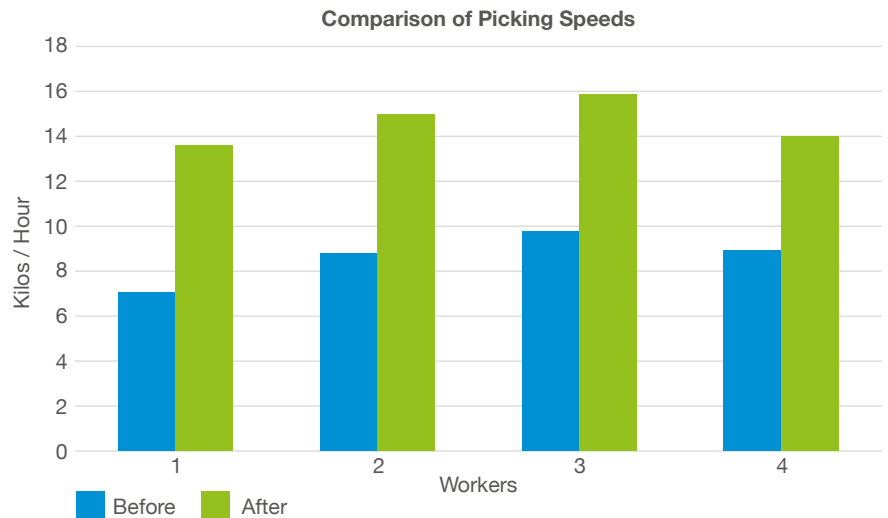
Once workers are competent in the task being undertaken, the coaching role involves helping people reach their potential. This involves understanding the individual and knowing what they need to improve. It may be helping motivation, teaching better techniques or helping them believe in their potential.

THE CHAMPION SUPERVISOR

The very best supervisors and team leaders achieve a far higher success rate. They have very few who don't make the grade and they have many more who reach their potential and excel.

The champion supervisor does not need to have been a champion picker; it is more important that they have good people skills.

Champion supervisors make every effort to connect with each and every person in their team. They achieve connection through intention; i.e. the supervisor genuinely wants to help the individual meet his or her needs as well as meeting the requirements of the job. They naturally want to coach their workers to achieve great results and so use a nurturing, supporting and caring approach. Through teaching and coaching they successfully instil a strong work ethic and standards into their team.



Another hallmark trait is that they have belief in the potential of everyone. If you judge a new worker to be in some way inadequate at the outset, you are far less likely to put the effort into developing them. When they fail the supervisor says "I knew from the start that they would fail". Supervisors who don't judge will make an extra effort to help the slower developers. They understand that slow developers can become champions too.

THE CHAMPION BUSINESS

Just as pickers, cutters and packers need great supervision to reach their potential, so supervisors need great management to reach their potential.

Choose your supervisors carefully. Often the only selection criteria seem to be 'good worker with good English'. Take a look at AHDB-funded project CP 059 – The Development of a Champion Supervisor Model and Training Programme to Improve the Selection and Training of Key Staff. In it the hallmark traits of champion supervisors are defined and explained. The action points for growers are more relevant than ever today:

- Look for the key hallmark qualities when recruiting supervisors. These are self-confidence, self-motivation, trustworthiness, loyalty, good observation, effective communication, empathy, assertiveness, flexibility and willingness to learn and adapt
- Ensure your management embodies the key hallmark qualities; lead by example
- Provide the training and support to enable supervisors to develop their skills, including teaching and coaching other employees

- Liaise closely with supervisors so that the entire management team has bought into procedures, targets, expectations and is fully aware of any developing situations
- Give supervisors authority to take action and back them up so that the management team is seen to be united and working together

To the above I would also add to incentivise supervisors by rewarding them for achieving agreed performance targets and that targets should be based on improvement in output achieved rather than purely on output.

In summary, champion pickers are grown by champion supervisors who are grown by champion managers. How champion managers are grown is beyond the scope of this article.

“ Supervisors who don't judge will make extra effort to help slower developers. They understand that they can become champions too ”

MEASURING FRUIT MATURITY WITH CHLOROPHYLL FLUORESCENCE

Mehrdad Mirzaee, Landseer, provides an insight into the method that will allow apple growers to know when their crop is ready for harvesting up to ten days sooner

In recent years the production of Gala in the UK has expanded rapidly, so much so that between 2009 and 2017 production more than doubled. To accommodate this additional volume, it is estimated that around 30 per cent of this harvest must be aimed at a later market window, beyond April. Significant growth in volumes dictate that it is now imperative to extend the market window, otherwise a forced sales scenario to clear fruit could be expected.

The first step in satisfying this later sales period is to identify the orchards suitable for long-term storage. This can be achieved by choosing the right fruit with high dry matter content and balanced minerals that are picked at the right time. If this process is carried out correctly then UK Gala should compete effectively with Southern hemisphere fruit both on fruit firmness and, more crucially, taste.

Improving pre-harvest cultivation practices can help eating quality; however, harvesting at the right time and maintaining correct storage are paramount. Volatiles decline rapidly during the first two- three months of storage, but this decline can be suppressed by high carbon dioxide in CA storage conditions.

Dry matter content (DMC) represents what is left after all the water is removed from an apple and is made up of structural carbohydrate sugars and the acid contents of fruit. Although dry matter content is closely related to firmness and starch conversion, it does not change significantly during the ripening process. Traditionally, SmartFresh (1-MCP) has been a valuable tool used to maintain fruit quality and firmness but needs to be timed correctly for maximum benefit in long-term storage.

“ An early warning of 7-10 days could be a valuable logistical and planning tool to help growers ”

Landseer has been monitoring non-destructive methods for Gala fruit maturity since 2013. They are now one of the research partners in AHDB Project TF 225 involved in developing an improved method to identify the optimum picking dates for long-term storage of Gala.

EARLY WARNING

The current method for predicting the optimum harvest date does work, but it is based on visually assessing 80-75 per cent starch coverage. Once this is reached, picking should commence immediately, but this system offers no advance warning to growers and little time to deploy labour for picking.

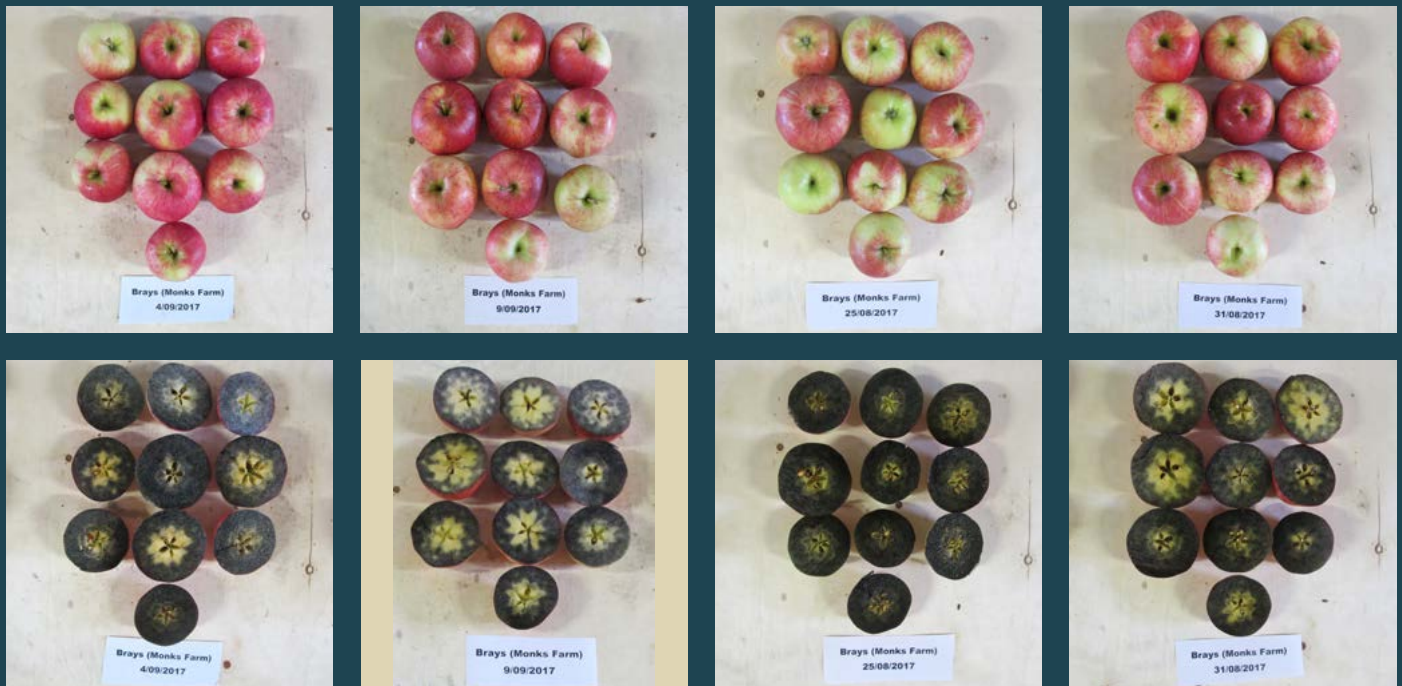
Scott Raffle, AHDB Knowledge Exchange Manager, explained, “While the current test for predicting the best harvest date is reliable, it offers very little advance notice for growers. We hope this research will lead to a commercially viable device that will mean growers can better mobilise staff and equipment to the right orchards, at the right time, for a more efficient harvest.”

The method being investigated in this project employs a device which uses chlorophyll fluorescence (CF) to monitor chlorophyll degradation in the apple skin. This provides an indicator of progress with ripening. This measurement tracks changes during fruit maturity. This technology has been applied in other countries, including on Honeycrisp in USA and Gala in Italy, for example. However, there is evidence that values are not directly transferable to English conditions which is why CF profiles need to be developed for varieties grown in UK conditions.

It was decided to compare two devices in the first year of this project: the ‘PEA pocket’ (Hansatech/UK) and the ‘DA meter’ (Turoni/Italy). The results in 2016 showed inconsistent warnings from the DA meter in different orchards, so the decision was taken just to focus on the Pocket PEA (Hansatech/UK) in 2017 (Figure 1).

From a total of four years’ work conducted by Landseer, including two years as part of this AHDB project, an outline decision tree process has been developed. The process starts four weeks after blossom when fruitlets (25-30mm) across the farm are analysed for dry matter and mineral content (DMC). On receipt of the results, around 40 per cent of these orchards are selected for possible long-term storage. Samples from the selected orchards are then tested for CF using the Pocket PEA.

Samples should be taken from each compass point on a tree



Iodine being used to test the maturity of gala apples by assessing their starch levels.

(North, East, South and West), with samples consisting of four fruitlets per tree and all samples being picked from the middle height of trees. Samples are taken in a 'W' pattern across the orchard.

The second assessment is made when fruit size increases to 55-60mm. After analysing the results, orchards with the highest DMC are selected. These orchards can be from different Gala clones (e.g. Mondial, Galaxy and Schniga). Selected orchards are monitored for two to three weeks before commercial harvest. Labour and time constrains mean that chlorophyll fluorescence testing is more suitable for long-term storage (high DMC) where accurate harvest prediction is essential.



Figure 1: Pocket Pea (Hansatech/Uk) with blue light (wavelength 400 Nm) was used for Gala apple.

During trials a comparison of CF outputs, standard starch, firmness and per cent Brix readings were made for each pick date. Results of the Pocket PEA in 2016 and 2017 showed that changes in CF readings provided an earlier (7-10 days) warning than starch clearance patterns.

Fruit chlorophyll fluorescence decreases during fruit growth and maturity.

NEXT STEPS

Two samples were collected from each orchard, one at the moment of prediction (CF Pick) and one at the standard practice of 80 per cent starch plus three days (Starch pick). These samples were stored in different commercial regimes. Samples are being kept in commercial stores for long-term storage (nine months) and the storage monitoring results will be available later.

An early CF warning of 7-10 days could be a valuable logistical and planning tool to help growers in the harvest strategy decision making process. The challenge is to generate a robust model that can incorporate seasonal and orchard variation that allows this technology to be commercialised.

Data validation will continue in the final phase of this project during season 2018-19. Once TF 225 is completed, it is hoped that a practical, applicable and affordable method for growers can be developed for use on their own farms.

AHDB project code: TF 225
Project lead: Mehrdad Mirzaee, Landseer
AHDB contact: Scott Raffle



IMAGE IS EVERYTHING

Julie Graham, James Hutton Institute, provides an insight into the work aiming to develop image sensors to detect the changing environmental conditions experienced by soft fruit as it grows

Plant phenotype (morphology of the plant) results from the interaction between the plant genetic background (i.e. genotype) and the biotic and abiotic conditions experienced by the plant in its growing environment. There has been a lack of methodologies for accurate and high throughput plant phenotyping under natural conditions, which limits the ability of breeders to introduce desirable stress resilience traits and also limits accurate trait measurements that would allow genetic evaluation. The lack of accurate phenotyping tools also prevents growers from identifying areas of a plantation suffering from abiotic and biotic stress at an early stage, which could otherwise be treated selectively before symptoms are well established and so reduce inputs.

DEVELOPING A SOLUTION

To address this we recently developed a field-based hyperspectral imaging platform that can be used as a means of detecting plant stress before visible symptoms develop. This can be utilised in breeding programmes to identify genotypes with particular spectral signatures related to plant stress resilience and the underlying genetic loci responsible for the trait. Additionally, the platform can be used for genotype identification and, importantly for growers, the knowledge and technology can be utilised for on farm plant monitoring.

In this project, a field- and glasshouse-based phenotyping platform was developed using both infrared thermography and hyperspectral

imaging. The platform incorporates visible and near-wave infrared (VNIR) and short-wave infrared (SWIR) hyperspectral imagers and a thermal camera. It can be towed behind a tractor or pushed manually on a trolley system in a glasshouse. The platform has been tested in glasshouse and field experiments established with a range of separate and combined water stress regimes and pest and disease burdens. Imaging protocols were developed for use of the platform in glasshouse, polytunnel and field situations. Image data has been captured and analysed from glasshouse and field trials of blueberry and raspberry plants. Various manual measurements of plants were taken over the same period. This provided a data set that was exploited to find relationships between spectral data

Automated image analysis techniques were developed to analyse the images. These used spectral ratios to identify the plant material in the image and split the images into separate plants. The relevant spectral data for each plant was extracted. A reference tile was used to account for changing light levels during the imaging period. These light levels are affected by changing conditions in the field both from changing cloud levels and also the position of the sun in the sky. Additionally, areas of plant material detected that corresponded to grass and other plants in the background were removed by detecting the boundary in the images between the plants of interest and background plants.

JARGON BUSTER

CONFUSED BY SOME OF THE TERMS CONTAINED IN THIS ARTICLE? HERE'S A QUICK EXPLAINER TO HELP YOU TO UNDERSTAND SOME OF THEM:

Genotype: the genetic constitution (make-up) of an individual organism

Phenotype: the set of observable characteristics or behaviours of an individual organism resulting from the interaction of its genotype with the environment.

Morphology: a particular form, shape, or structure.

The ultimate project exploitation is to use the knowledge developed to provide an on-farm monitoring tool as well as a research and plant breeding platform to enable identification of stress-resilient germplasm.

"It is not that long ago that this type of technology seemed very far removed from the commercial soft fruit grower, but it now appears possible to use it to hasten the delivery of new and improved raspberry and blueberry varieties to the field. Looking further ahead, this technology could be very useful on the farm to aid in the early detection of stresses and diseases," explained Peter Thomson, Thomas Thomson, Blairgowrie Ltd.

AHDB project code: SF 155

Project lead: Julie Graham, James Hutton Institute

AHDB contact: Scott Raffle

and plant condition. It was also possible to exploit this data set to find key wavelengths for discriminating between plants experiencing different abiotic and biotic stresses.

Image data was captured for a genetic mapping population of raspberry plants grown in field conditions under a variety of stress treatments. This created a data set that could be exploited to detect links between spectral data and genotype. Our analysis has shown that spectral signals collected using the platform can be used to distinguish plant varieties and stress conditions, which would allow growers to identify and deal with problems as they develop. Genetic variation in spectral signals has been quantified in the field trial and associations of the spectral data with particular parts of the plant's

chromosomes have been identified. Spectral signature data was validated for the root rot trait against previous research which identified genetic loci responsible for control. The spectral signatures collected in the root rot trials co-located to the same chromosome regions as the previous research which scored root rot symptoms across a five-year period. The co-location of the spectral signatures with root rot resistance controlling gene regions confirmed the technology was useful.

DATA OVERLOAD

One of the challenges faced when carrying out imaging of plants in the field is the large number of images and large volume of data created. Manual annotation of the images would be prohibitively time consuming.

FOLLOWING THE COCA-COLA MODEL

Development Manager at Waitrose, Hendrik Mans, chats with The Grower about why he decided to join the AHDB protected edibles and mushrooms panels and why mushrooms and Coca-Cola have a lot in common

Originally I joined the panel as a means of networking with other growers. However, while this has been possible, since joining it has been more about listening to growers and taking their concerns to the panel and ensuring that growers are being appropriately represented at the meetings.

Generally in my day-to-day I'm working on product and process development on new existing products as well as new and existing processes in areas of mushrooms, cold pressed rapeseed oil and milk processing, with the bulk of that spent on mushrooms. I became involved as part of attending the mushroom growers group. There are two seats per crop on the panel and when one became available and there wasn't a nomination, I stepped in, volunteered, and got voted in successfully.

I think it is important that growers engage with the panels because they contribute by way of the levy and so their engagement is critical in steering the use of funds so the system works for individual growers and the industry. Quite simply, their engagement underpins that we all get value for the money that we pay.

An example of this in practice, and perhaps my biggest achievement on the panel to date, is that we successfully worked to get an extended use of sporegone. We also managed to get the use of spent mushroom compost as biomass/soil remediator for agricultural purposes sanctioned.

As for what the panel involves, it requires asking a lot of questions,

whether that be of other growers in other sectors, for example, or when finding out about technical studies concerning other industries to see what we can learn from them and apply to our industry.

I think it is a really interesting time to be on the panel. Over the next few years there will be a number of challenges that we will need to work together as an industry to overcome. Firstly, there's the obvious looming issues that Brexit will cause; the industry is already finding it difficult to recruit enough harvesters and the only way to overcome this problem is to increase harvesting efficiency or introduce a very high level of automation. I feel that the UK should adopt an approach where producers are more open about their process and instead compete on the product offering and not on the process. Sure, it will mean giving up secrets but it will prevent monopolisation of the industry (it is arguably too late for this, but there's my solution).

Secondly, the price of mushrooms will cause consternation to many. The selling price of mushrooms continues to decline, which means growers must adopt a strategy where they can occupy the highest volume of the market possible. This favours the larger producers and undermines the smaller producers' ability to compete, and so inducing monopolisation of the industry.

If the price of product drops and the optimisations available upstream and downstream in the process reach points of diminishing returns then it is time to

“ Why do you think Coca-Cola has an orchestra of drinks products? ”



Name:
Hendrik Mans

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Leckford Estate,
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“ The industry really needs to embrace other kinds of mushrooms ”



YOUR PANEL, YOUR VOICE

Want to be heard and have your say on AHDB's work in your sector? You can see all of our current panel members and contact them with your ideas, concerns, or general thoughts on the AHDB horticulture website. Simply search for 'panel' to find your relevant sector.

Our panel elections are taking place soon. If you want to become a member of the panel you can find more details and check out any current vacancies at horticulture.ahdb.org.uk/panel

introduce a new product. Why do you think Coca-Cola has an orchestra of drinks products? Every time a drink's profitability and market saturation hits a point of limited future returns it has to make another product in order to keep growing and satisfy shareholders.

The industry therefore really needs to embrace other kinds of mushrooms and work hard to get those mushrooms into the mouths of UK consumers. This will be far from trivial but the potential gains would dwarf the industry's current output on a nominal basis.

In short, we should get other kinds of mushrooms into the mainstream, let the cheap mushrooms be cheap and introduce higher volumes, and work towards saturating the market; then rinse and repeat.

Going forward, when thinking about the mushroom industry and AHDB, I would also like to see AHDB work more with the leading universities both in the UK and internationally – and of course that is something we will look to progress through the protected edibles and mushrooms panel.



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