The GROWER
THE TECHNICAL JOURNAL FOR HORTICULTURE

AHDB

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LIGHTING THE WAY FOR SWEETER GALA APPLES

Keeping your apples tasting better for longer

NEW VIRUS THREATENS UK TOMATO AND PEPPER CROPS

What are the symptoms and how can you prevent it?

A VAMPIRE STRATEGY FOR PEST CONTROL?

How garlic can help to battle aphids in strawberries

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In the previous issue of The Grower (Apr/May 19) we made an error in the article on page 9, 'Making mushrooms a no-fly zone'. It was stated that "Diflubenzuron (Dimilin Flo) is still authorised for use on mushroom". This is incorrect: there is no longer authorisation for this product on mushrooms or other edible crops.

This publication is brought to you by AHDB

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COMMENT

Hayley Campbell-Gibbons,
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Since I joined AHDB in November last year, lots of people ask me if I like a challenge? What with Brexit, the outcome of the Defra review pending, and some very vocal growers leading a petition I'm under no illusion about the enormity of the task ahead.

I've spent the last six months looking at how we're investing your levy and meeting growers to find out where we are delivering value for your money. I have been impressed by the knowledge and expertise of the AHDB team working on horticulture issues, but there are still too many growers who don't know what they get for their money. That has to change.

I see the Defra review as a good opportunity to really take stock of our activity and hear your feedback. I'm starting to shape proposals and recommendations to Defra for areas we can improve.

Change is a constant theme in all aspects of business, and life. But, the scale and pace of change facing food and farming is unprecedented. The important question is 'how is AHDB is helping growers respond to this?'

The main area of spend in horticulture is on Research & KE; over 75% of the budget. The bulk of that is on Crop Health & Protection work such as EAMU's, diseases, pests, weeds, breeding and genetics projects. Our bread and butter work for the industry, if you like.

Being prepared for Brexit, whatever form it takes, is also something businesses are grappling with. We've overhauled our website to signpost helpful sources of information. Take a look **ahdb.org.uk/brexit**

Our sector is entering a phase of unprecedented political and structural change, and I firmly believe that the work we do needs to be more targeted and ambitious than ever before if we are to truly compete with fresh produce and plant imports, and maximise our home market opportunities. All with fewer people and chemicals to do it with.

We need to decide what we want for UK horticulture and get behind a clear vision for the sector. I look forward to working with growers, representing horticulture and to the transformation of food and plant production that we can achieve.

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CONTRIBUTORS

Discover more about the people who have helped to contribute to this issue of The Grower magazine

LOUISSE PAOLA MIRABUENO

Louisse obtained a Bachelor's degree in Genetics and Cell Biology at Dublin City University. During her undergraduate studies, she developed an interest in bacteria, particularly in molecular evolution and host–pathogen interactions. Louisse is currently a first year PhD student in NIAB EMR's Genetics, Genomics and Breeding Department, where her project is being supervised by Dr Michelle Hulin, Dr Emma Cascant-Lopéz and Professor Robert Jackson from the University of Reading. Industry representatives of her AHDB Horticulture-funded research project include Jamie Dewhurst from J&A Growers and Brian Fraser from Oakover.

Louisse explains how her project is helping our understanding of *Xylella fastidiosa* on page 20.

SCOTT RAFFLE

Scott spent 16 years working as a fruit advisor with ADAS, specialising in soft fruit production and fruit storage and providing growers with guidance on crop protection, production techniques and costs of production. Scott has been working for AHDB since 2006, liaising closely with the scientists who undertake our research projects and helping to disseminate the results to our fruit growers, along with their agronomists and technologists. He coordinates the production of our fruit publications, technical events and demonstration sites, with the aim of improving fruit grower uptake of AHDB-funded research and development.

Scott tells us more about the benefits of intercepting light for apple quality on page 30 and, on page 32, explains how the WET Centre is a new way for fruit growers to see research in practice.

ALICE SIN

Alice is a member of the Resource Management technical team at AHDB. Her main responsibility is to oversee AHDB-funded research on soils and crop nutrient management that have a potato focus. She is also involved in revising the Nutrient Management Guide (RB209) and oversees the PhD Studentships scheme for the Potatoes sector. Her background is in environmental management and data analysis.

Alice explains how the physical properties of soil can affect productivity within a rotation on page 24.

IN **BRIEF**

NEW APP TO TRACK BEAN SEED FLY

The incidence of bean seed fly larvae in crops can now be tracked on a map in a new section of the PGRO App. The map will help growers to understand the extent of the distribution of these pests in the UK. The app is available from Apple and Google Play stores – search for **'PGRO Pea and Bean Guide'**.

SURVEY ON ORNAMENTALS SKILLS GAP

A survey is being carried out to investigate the skills that the UK's ornamental sector will need in the future. Results from the survey will help inform a skills strategy that is tailored to the industry and provide data to support funding and resource decisions. Results due in autumn.

NEW PRODUCTS DELIVERED BY SCEPTREPLUS

Following successful SCEPTREplus trials, five new plant protection products are now available.

New herbicides include 'Emerger' as pre-emergence control for carrots, onions and herbs and 'Finalsan' for asparagus and rhubarb. 'Prolectus' and 'Frupica SC' fungicides are available for ornamentals to control grey mould and powdery mildew and 'Mainman' has been secured as a pesticide for aphids on peppers and chillies.

RE-WATCH OUR WEBINARS

We have recently broadcast webinars on a variety of topics, including 'Microbials – keeping fresh produce safe from human pathogens', Tomato brown rugose fruit virus and top tips for labour recruitment. Watch again on YouTube. Search AHDB Horticulture.

MUSHROOM GROWER **GROUP RE-FORMS**

Commercial growers have come together to agree to re-establish the Mushroom Growers Group.

The group aims to guide the use of grower levy through steering the research and development strategy for the mushroom sector. British Growers' Association (BGA) and AHDB, along with other organisations, will achieve this by working closely together and feeding this through the Protected Edibles and Mushroom Panel.

We previously funded the group during 2014–2016. This new proposition by BGA entails growers joining the association and sharing the cost of running the group equally between mushroom growers. External allied trades can also make their contribution but will not have any voting rights.

Steve Tones, Strategy Director, said: "The objective of the Mushroom Conference was to suggest to the industry that we needed a grower forum and the feedback has been very positive. It was agreed that the new group will ensure that we continue to steer our priorities at AHDB so the industry can remain resilient through future challenges."

The industry believes it's not only vital for mushroom growers to have their voice heard but it will also allow the sector to focus their time, money and resources around future innovation for the mushroom industry.

The group was agreed at our Mushroom Conference 2019, held in Warwickshire in April.

For further information on how to get involved in the Mushroom Grower Group contact Nathalie Key at Nathalie.Key@ahdb.org.uk

FRESH PRODUCE GROWERS REMINDED OF **RED TRACTOR WATER TESTING GUIDANCE**

Red Tractor Assurance is reminding members of the Fresh Produce scheme of the guidance available to help them meet standards on testing water used in crop production.

You are required to test water in response to a risk assessment and in line with a water matrix, which was introduced as part of a review of the Fresh Produce scheme back in October 2017.

The matrix enables growers to clearly identify the sampling frequency that is required under the standards in an easy-to-interpret format. Under the water matrix, sampling frequency is dependent on water source and the crops to which water is being applied.

Water testing is a crucial tool for reducing the risk of a food safety issue, the cost of which could be enormous, both in terms of both financial implications and the reputation of British food.

One of the most high-profile food scares in recent times was an outbreak of *E. coli* in German beansprouts, for which Spanish cucumbers were blamed as the source of contamination. Fepex, Spain's fruit and vegetable export body, reported that at the peak of the scare it was costing the industry £175 million per week.

To support growers, Red Tractor has a practical guide on how to take a water sample. The water matrix and other supporting material is also available at: **bit.ly/RedTractorWaterSample**

EVENT **INSIGHT**

SMARTHORT

BEDDING AND POT PLANT **CENTRE AUTOMATION STUDY TOUR**

DATE: 16–18 September 2019

LOCATION: Leiden, South Holland

After successful study tours to the South Coast and the North West of England, the 2019 Bedding and Pot Plant Centre study tour will focus on automation in production and dispatch at some of the leading bedding plant nurseries in the Netherlands.

Based in Leiden over the course of 2 days, the study tour will include visits to several nurseries in the provinces of Flevoland and Westland. Those confirmed so far include Kwekerij Wouters, Kwekerij Baas and Beekenkamp. Further nurseries will be announced shortly.

AHDB will cover the cost of arranging the study tour and the transportation costs in the Netherlands. Delegates will need to cover flight costs to Amsterdam's Schiphol airport and hotel and meal costs for the duration of the study tour.

For further information and to book your place, visit **ahdb.org.uk/events**

The tour is a collaboration between the Bedding and Pot Plant Centre and our SmartHort campaign to help improve labour efficiencies in horticulture.

A RISKY BUSINESS

Spencer Collins, AHDB Crop Protection Scientific Officer, explains how a new risk register is helping us to spot emerging pest, weed and disease threats and is speeding up the process of bringing new plant protection products to market

Over the last year, we have introduced a new system to monitor and track crop protection priorities across the horticultural sector. The system is based on a risk rating and considers the likelihood of each pest, weed and disease and the potential for crop loss.

Consultations with a variety of grower associations, panels and agronomists are used to set the ratings for each pest, weed and disease for several horticultural crops. The highest priorities for these crop groups are summarised in Table 1.

These crop protection priorities feed directly into projects such as SCEPTREplus, which aims to deliver applied research on high priority target problems to support the authorisation of products and develop integrated pest management (IPM) programmes.

The priorities list is also taken to international meetings, such as the EU Commodity Expert Groups and the Global Minor Uses Summit, to exchange information on important targets that are common worldwide. Information on novel plant protection products are exchanged and methods of control that are used internationally are identified.

High priority targets are also shared at our meetings with crop protection companies, leading to discussions of new products that may be of use to the horticultural sector. With agreement from companies, these products can then be trialled early on and, if suitable, minor use authorisations can be sought early in the life of new products.

Another useful feature of the risk register is that it allows common targets across several crops to be flagged up. For example, root and stem rots are a priority for several crops, including baby leaf and raspberry.

Larger crop protection projects can be set up in response to this, allowing greater understanding of the disease, benefiting all crop group sectors and preventing duplication of research. Later, work can then focus on crop-specific trials, leading to solutions.

The risk register is a constantly evolving document and changes to risks will be continuously updated. Changes in the risks can be tracked over time and increases will be identified to allow early intervention for emerging pest, weed or disease targets. This can be related to loss of actives, potential changes in cultivation or, importantly, it can bring attention to the potential for the development of resistance, leading to failing methods of control. All of this information can be used to try to get a ‘heads up’ on emerging problems, allowing us to respond proactively in delivering solutions for the industry.

HIGHEST PEST, WEED AND DISEASE RISKS FOR HORTICULTURE CROPS

Disease	Bacterial diseases	Brassica, top fruit, mushrooms, hardy nursery stock
	Botrytis	Ornamentals
	Downy mildew	Cut flowers, herbs (basil), onion
	Fusarium	Asparagus, cucurbits, narcissus, lettuce
	Green mould	Mushrooms
	Leaf spots	Asparagus, celery, brassicas, ornamentals
	Monilinia (brown rot)	Cherry
	Powdery mildew	Ornamentals, tomato
	Root/stem rots	Baby leaf, carrot, cucurbits, lettuce (hydroponics), strawberry, raspberry, tomato
	Rust	Cut flowers, leek, plum
	White rot (ramularia)	Narcissus
	Virus	Tomato
Pests	Aphids	Apple, carrot, cucurbits, cut flowers, lettuce, pepper
	Bean seed fly	Alliums, legumes
	Capsid	Blackberry, strawberry
	Midge	Blueberry, blackcurrant
	Mites	Blackcurrant, cherry, raspberry, tomato
	Nematodes	Onions, narcissus
	Slugs	Asparagus, brassica, narcissus, rhubarb
	Spotted wing drosophila	Soft fruit, cherry, plum
	Thrips	Cut flowers, blackcurrant, cucumber, strawberry, leek
	Weevil	Higher value pot plants
Weeds	Grasses and broad-leaved weeds	Alliums, asparagus, baby leaf, blackcurrant, carrot, celery, herbs, legumes, ornamentals, parsnip, rhubarb

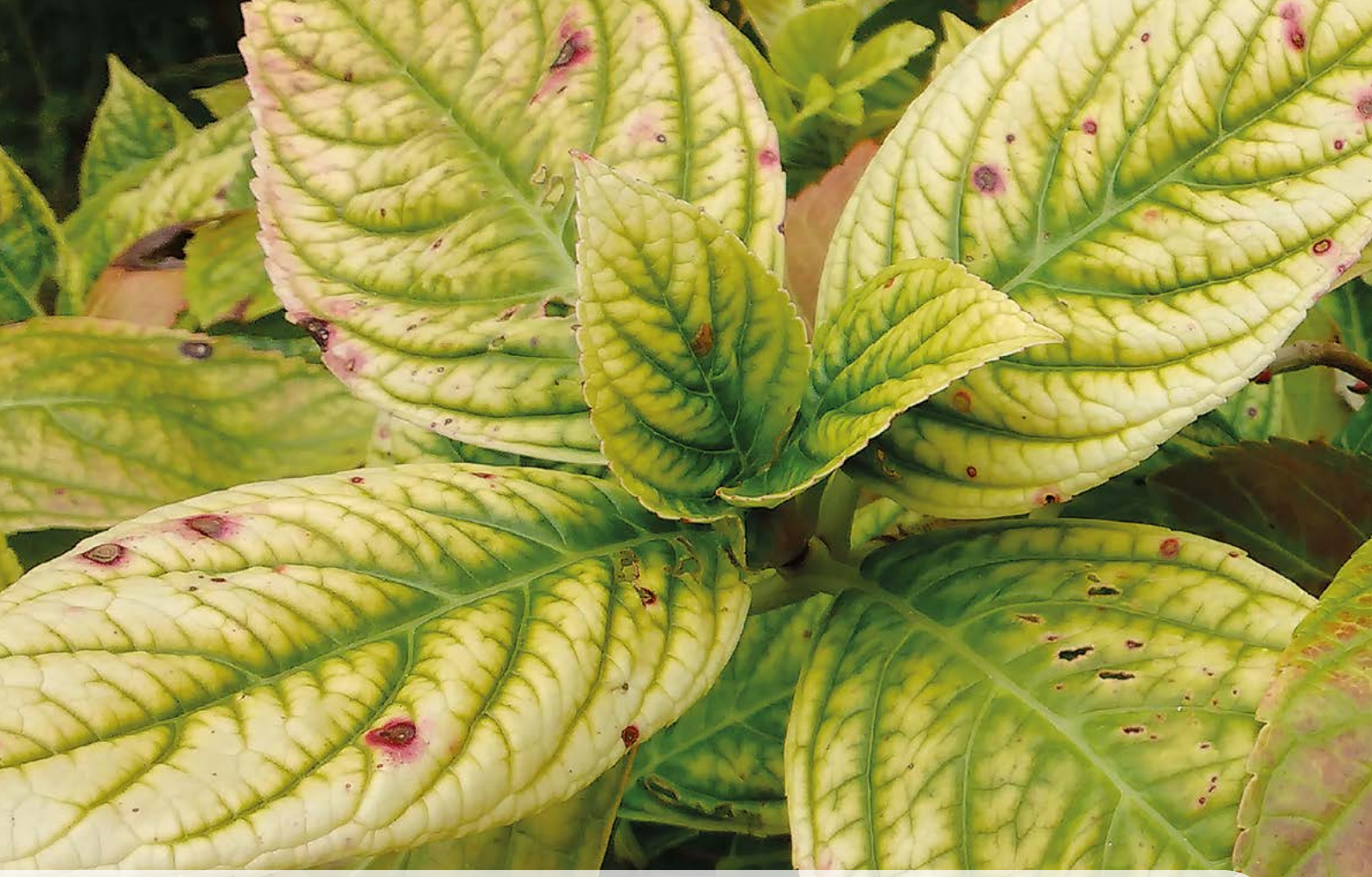
To ensure the risk register correctly reflects the priorities of UK horticulture, we would welcome feedback from growers. Please feel free to get in touch if you have any comments, particularly related to the table of priorities. Email us at **EAMU@ahdb.org.uk**

In the next issue of The Grower, AHDB will cover more detail about the risk register and how we link it to active ingredients and attempt to predict future losses of approvals.

HOW IS THE RISK CALCULATED?

The likelihood of occurrence is rated 1–5, with 1 being rare and 5 almost certain. The crop loss rating is similar: 1 meaning insignificant impact and 5 being catastrophic with 50–100% crop loss. The risk is simply calculated by multiplying the likelihood score by the crop loss score and therefore ranges from 1 for very low risk, to 25 for the highest risk and therefore the highest priority.

There are many crop risks across horticulture and we are currently prioritising action against any risks scores of 15 and above.



NUTRIENT MANAGEMENT **IN HORTICULTURE**

AHDB Resource Management Scientist Georgina Key introduces the first in a new series of articles about nutrient management

Nutrient management is key for efficient production. However, growers are coming under increasing regulatory, economic and social pressures, so nutrient management is not always a priority.

REGULATORY

Good nutrient management can help growers adhere to requirements set out by the Water Framework Directive, Farming Rules for Water and in Nitrate Vulnerable Zones (NVZs). The Government is currently reviewing whether to extend the area covered by NVZs.

ECONOMIC

Although fertiliser costs may be a relatively small proportion of a grower's costs, any nutrients and their delivery need to have a good return on investment.

SOCIAL

Michael Gove has laid out a plan to shift from the current subsidy scheme to one in which farmers will be paid to deliver 'public goods,' such as improved soil health and better air and water quality. Direct payments under the CAP scheme will be phased out between 2021 and 2027 and the money reinvested into transitional support for farmers and the new Environmental Land Management scheme. Good nutrient management could help meet the requirements of some of these public goods.

> “Basal rot incidence in narcissus may be affected by high nitrogen rates”

For many crops, recommended nutrient management practices can be found in documents such as Nutrient management guide (RB209), published by AHDB. For example, the Cereals sector has in-depth information on recommended nutrient amounts to apply, in what form (organic and inorganic) and the effect on yield. For a variety of horticultural crops, however, there is currently no independent national guidance on nutrient management. This is particularly the case for crops for which the agronomy has changed significantly, or where the crop sector is particularly diverse, such as hardy nursery stock (HNS), protected ornamentals and bulbs.

To fill this knowledge gap, growers working with AHDB have commissioned work to address specific nutrient management issues in these sectors.

RHUBARB

In outdoor-grown rhubarb (known as green rhubarb), growers now harvest up to three times from the same plant in a season, where they used to harvest just once. This is because the market for rhubarb has increased – not just in size, but also in length of season. Rhubarb is a hungry crop and work over the next 4 years will establish how much nitrogen is left in the field after harvest, whether additional nitrogen and potassium application is needed and whether this can increase yields and marketability. Also of interest is whether the timing of that additional application affects harvest during current and subsequent seasons. Considerable investment is required to establish this perennial crop and improving nutrient management could affect the economic returns over its lifetime.

CUT-FLOWERS, BULBS AND PROTECTED ORNAMENTALS

Basal rot incidence in narcissus may be affected by high nitrogen rates. The trials will look at optimal nitrogen application to balance crop need and disease control. Top-dressing narcissus bulbs with nitrogen is often required in winter, but falls within the NVZ regulation ‘closed window’ in many UK regions, so the optimal amount will be explored and refined. Bedding flowers (pansies, primroses, etc.) are often grown in glasshouses with ‘one-size-fits-all’ systems to deliver nutrients. In this situation, problems linked to nutrient deficiency can occur, such as primrose leaf edge scorch. It is difficult to cater to the nutritional requirements of plants at different growth stages, let alone be able to ‘hold’ different plug plants to enable a steady supply to market. The trials will look at practical techniques to facilitate better nutrient management in these environments and also the uptake of particular nutrients, such as calcium and boron. There is also increasing interest in using hydroponics systems in cut flower production; however, managing the interaction and balance between nutrients in these systems is complex. Worldwide approaches to hydroponics will be reviewed to inform specific crop requirements, as well as methods for accurate nutrient dosing. Different types of fertiliser (nitrate versus ammonium-based fertilisers) will also be tested on multiple species at different growth stages.

HARDY NURSERY STOCK

For HNS, there is no independent baseline information available on the nutrient levels that required by a variety of crops, which means it is difficult to recognise and avoid nutrient deficiencies. This baseline information will be developed for field-grown and container-grown HNS. As HNS is such a diverse sector, crops will be categorised into low, medium and high vigour crops in both growing situations. This will allow the recommendations to be applied to other species that are not included in the trials, but which fall into one of those categories. Different timings, application rates and modes of application will be explored for both field and container-grown HNS, taking into account environmental restrictions and market specifications for the crop and reviewing products such as controlled-release fertilisers to get the best out of them while also reducing leaching.

The next article in this series will focus on the research done on calcium in outdoor cucurbits.

EAMU LATEST

WORKING TO SECURE MORE APPROVALS FOR GROWERS

Bolette Palle Neve explains how we're working behind the scenes with the Chemicals Regulation Division (CRD) to protect authorisations.

Bolette Palle Neve,
Crop Protection Scientist, AHDB
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You may have noticed that some more recent EAMUs for protected crops have been issued with a new requirement for managers to carry out a thermal comfort checklist. This restriction has come about following a move by CRD to include full-length work wear as a mitigating factor for worker exposure assessments.

In the past, CRD has assessed worker exposure by assuming that workers in protected crops are not wearing any clothing. This has led to several discrepancies, whereby some products are approved for protected crops in the rest of Europe but not in the UK. With the change to allow full-length work wear as worker protection, the thermal comfort checklist has been introduced to ensure workers' comfort is not compromised.

Another change, which we have been working on with CRD, is the introduction of new subgroups for ornamental crops. Currently, approvals for ornamentals are assessed for the whole group of ornamental crops. This is an extremely diverse group of crops and it often results in refusals of EAMU applications, or authorisations being issued with several odd restrictions imposed.

One problem we have had in the past is the lack of data available to show the level of ground cover provided by ornamental crops. This lack of data has meant that CRD has assumed a 0% ground cover for all ornamentals and, as growers will know, this is far from the reality.

Last year, we worked to collate descriptions and images for various crops and, following careful consideration by CRD, we have now managed to agree on four new potential subgroups.

The groups are still being finalised but are likely to be split as pot and bedding plants (pots less than 10 cm); container-grown ornamentals (pots more than 10 cm); field-grown ornamentals, including non-bulb cut flowers; and bulb cut flowers. This is a positive move, which should help more EAMUs to be approved for ornamentals crops.

EAMUS IN FOCUS

Emerger

Following successful trials within the SCEPTREplus programme for the active Aclonifen, we have secured two new authorisations for Emerger as a pre-emergence herbicide on carrots, parsnips, onions and herbs.

Sam Rix, Technical Director, P.G. Rix Farms, said: "Onions are very poor weed competitors because of their leaf habit. The loss of Totril (Ioxynil) in 2016 has had a massive impact. The alternatives simply aren't as crop-safe and are very unpredictable in terms of performance. Although only for pre-emergence use, Emerger will be very useful for improving control of small nettle and mayweed in particular."

To discover all of the latest EAMUs visit **horticulture.ahdb.org.uk/latest-eamus**

IMPROVING MANAGEMENT OF VIRUS CARROT DISEASES

Adrian Fox, Fera, explains how understanding the timing of disease transmission by aphids holds the key to better control strategies for the main carrot viruses

Plant viruses are transmitted by vectors, which are often invertebrates, such as aphids. Once a plant is infected with a virus, it cannot be treated and this could lead to the infection of other plants.

Understanding key vectors and the timing of transmission will help to develop more targeted control strategies – something that is becoming increasingly important with the decrease in the availability of pesticides.

AHDB-funded projects have revealed previously unknown viral infections of UK carrot crops. One of these, carrot yellow leaf virus (CYLV), was strongly associated with internal necrosis in carrot roots. Subsequent investigations showed CYLV to be as prevalent in crops as the viruses that have historically caused concern for growers, with some crops infected up to 100% incidence.

Traditionally, carrot virus management has focused on the control of willow-carrot aphid (*Cavariella aegopodii*), thought to be the main colonising aphid in carrot crops.

However, recent reports have suggested that the peach-potato aphid (*Myzus persicae*) may also play a role in carrot virus transmission. Both of these aphid species are known to have resistance to some aphicides. To better target insecticide treatments, the relative importance of each aphid species needs to be determined.

Fera Science Ltd, York, and Warwick Crop Centre, University of Warwick, will be working together to investigate the timing of transmission of the main carrot viruses, CYLV and carrot red leaf virus and to correlate this with the identity and relative abundance of the different aphid species present in yellow water traps. This data will also be combined with historic aphid monitoring data to improve forecasting systems for carrot viruses.

A variety of control strategies, including insecticide programmes

informed by the revised forecasting system, will be trialled to investigate their effectiveness in managing viral carrot diseases.

Find out more in our Virus diseases of carrots factsheet on horticulture.ahdb.org.uk

AHDB project code: FV 460

Lead researcher: Adrian Fox, Fera Science Ltd

AHDB contact: Dawn Teverson

GETTING INTO THE WEEDS

The continued loss of actives for weed control is a concern for many horticultural growers. Joe Martin, Crop Protection Senior Scientist, explains how SCEPTREplus is using novel approaches to plug the gaps

Weed control has been a high priority across several horticultural crops, particularly with the loss of actives such as Linuron. Extensive work has been carried out by SCEPTREplus to seek new applied solutions for the industry and will continue in the final 2 years of the programme.

Trials of 80 weed control products have been conducted on crops, including carrots and parsnips, alliums, herbs, sweetcorn, rhubarb, celery, cucurbits, narcissus, brassicas, salads, cut flowers and blackcurrant.

Various treatments have been included across the trials – investigating existing products, but using them in a different way or on different crops to those for which they currently have approval. Nineteen companies have supplied products across the 2 years. These have included some novel products that are being developed in arable situations, but which may have benefits for horticultural production.

CARROTS AND PARSNIPS

Seven promising treatments for carrots and six treatments for parsnips have been identified so far. In addition to the two EAMUs secured so far, three further applications are in progress. Trials have looked at finding residual products, as well as post-emergence contact action. Promising treatments coming through include Aclonifen, Clomazone and mixtures of trial products with Pendimethalin.

In addition, because carrots and potatoes are grown on similar land, control of volunteer potatoes has been trialled. In 2018, although few products gave good control of volunteer potatoes,Diflufenican has shown some promise

and this will be explored further in 2019. Further work on post-emergence application continues, looking at a similar approach to the 'little and often' method used in sugarbeet weed control.

HERBS

Because of the wide variety of herbs grown in the UK, a multicrop screen of different species was conducted on both transplanted and drilled crops. Herb species included basil, coriander, chives, dill, fenugreek, parsley, mint, sage, thyme, tarragon, oregano and chamomile.

Centurion Max was found to be safe to all herbs, depending on the rate applied. For selective herbicides, there was at least one pre-emergence and one post-emergence product deemed to safe to use for each herb species.

For pre-emergence control, Aclonifen was safe for use on many herb species. Devrinol was safe on basil and fenugreek when applied pre-emergence to drilled herbs.

For post-emergence control, Ethofumesate was safe for sage, tarragon and oregano, with two other trial products also giving useful control.

Further data is needed for parsley, coriander and chives and work continues this year across various sites in conjunction with Claire Donkin and British Herbs.

SECURING APPROVALS FOR USE

The regulatory team at AHDB has progressed and secured several EAMUs for weed control, using the data and results generated from the trials and support from manufacturers (see Table 1).

> "For selective herbicides , there was at least one pre-emergence and one post-emergence product safe to use for each herb species"

Table 1. EAMUs secured for weed control from SCEPTREplus trials

Product	Active	Company	Crop	EAMU Number
Flexidor	Isoxaben	Corteva	Carrot	0020/2018
Wing-P	Dimethenamid-p + Pendimethalin	BASF	Courgette	0619/2018
Gamit 36CS	Clomazone	FMC	Carrot	0776/2018
Centurion Max	Clethodim	Arysta	Herbs	2729/2017
Fresco	Metobromuron	Belchim	Narcissus	2737/2018
Dual Gold	S-metolachlor	Syngenta	Sweetcorn	2834/2017

Further applications are in progress.

FUTURE TRIALS

Additional weed targets have been identified for Year 3, including broad-leaved weeds in legumes, weed control in asparagus and new orchard plantations. We will also be looking at herbicide performance in ornamentals when using different media blends.

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

SCEPTREPLUS

NEW VIRUS THREATENS UK **TOMATO AND PEPPER** CROPS

A newly emerging virus, tomato brown rugose fruit virus (ToBRFV), has been identified in mainland Europe, which poses a potential and significant risk to UK tomato and pepper crops

ToBRFV was first described in tomato crops in Israel in 2014. From there, the virus spread almost nationwide in tomato greenhouses within a period of one year after the first outbreak reports. The virus has since been reported in Jordan, Mexico and Italy – including the island of Sicily – and is present but under eradication in Germany, following outbreaks in several glasshouses.

SYMPTOMS OF TOBRFV

The virus is named after the characteristic brown wrinkled (rugose) patches that can develop on the fruit of infected plants. However, symptoms of infection canvary with variety and, in tomato, can include mild-to-severe mosaic and discolouration of leaves, with some leaves becoming narrower. Fruits can be discoloured, misshapen, turning yellow or brown, with crinkling of the skin. The virus can readily spread to all plants in a crop. The nature of the symptoms mean the fruits of infected plants lose market value or are unmarketable.

COMMON SYMPTOMS

- Mosaics (chlorotic or pale patches) develop on younger leaves in the head and side shoots
- Leaves may be crumpled (puckered) and deformed, in some cases leaves may be narrowed
- Brown (necrotic) streaks may develop on stems
- Fruit can develop chlorotic marbling, which can appear similar to infection with pepino mosaic virus
- Fruit may develop brown wrinkled (rugose) patches

PLANT HOSTS AND SPREAD

Tomato is a primary host of ToBRFV, but inoculation trials have demonstrated that sweet pepper (*Capsicum annuum*), as well as the experimental host plant *Nicotiana species, Solanum nigrum, Chenopodium quinoa, Petunia hybrida* and *Chenopodium murale*, can act as minor hosts, showing slight symptoms.

ToBRFV is a tobamovirus, which is stable outside of its host. The main routes for transmission of ToBRFV are through propagation material (cuttings and grafts) or mechanical means and physical contact(plant to plant as well as human/machinery).

Once an outbreak of ToBRFV occurs, normal glasshouse working practices can quickly spread the virus via movements of contaminated tools and equipment, on workers hands and clothing, via picking trollies and crates, stringing and twisting and on glasshouse structures. It has also recently been reported that the virus may be transmitted by bumblebees when visiting flowers.

Following an outbreak, the virus could remain viable in leaf debris, seeds or contaminated soil/substrate for several months.

Once the virus is introduced in an area, potential control measures are very limited and rely mainly on elimination of infected plants and strict hygiene measures. However, many of these hygiene measures can also be used as a preventative measure to minimise the risk of entry, spread and impact of this virus.

HYGIENE BEST PRACTICE

Hygiene best practice procedures should be followed as a precautionary measure to minimise the impact of an outbreak, should one occur. The primary strategy is prevention.

- Restrict access to production sites
- Where possible, prohibit sorting/ packing of produce from other locations
- Ensure that reusable picking crates, which are returned from a packhouse packing fruit from other locations, are sanitised before returning them to any production site
- Educate staff to recognise plant diseases and ensure best practice in terms of biosecurity on production sites
- Limit movement of staff between facilities
- Prohibit consumption of susceptible hosts on the premises
- Wash hands on arrival on site and throughout the working day, as appropriate
- Use disposable gloves, clothes and overshoes
- Clean and disinfect equipment and tools

IN THE EVENT OF AN OUTBREAK

The main advice is to implement good hygiene measures as a matter of course, be vigilant for any unusual symptoms in the crop and report any symptoms to a manager if suspected.

Suspected outbreaks of a viroid or virus in a tomato crop, or in any other non-native plant pest, should be reported to the relevant authority.

For England and Wales, contact your local APHA Plant Health and Seeds Inspector or the PHSI Headquarters, Sand Hutton, York. Tel: 01904 405138

Email: planthealth.info@apha.gsi.gov.uk

For Scotland, contact the Scottish Government's Horticulture and Marketing Unit:

Email: hort.marketing@gov.scot

For Northern Ireland, contact the DAERA Plant Health Inspection Branch. Tel: 0300 200 7847

Email: planthealth@daera-ni.gov.uk

A PARTNERSHIP APPROACH TO TACKLE TOBRFV

AHDB's Dr Nikki Harrison and British Tomato Growers Association Dr Philip Morley, are coordinating the newly formed tomato brown rugose fruit virus (ToBRFV) steering committee, which includes growers and research scientists. The team has been monitoring the global spread of ToBRFV over the last 12 months and has carefully considered the impact through the AHDB Crop Risk Register. You can read more about how the risk register is helping to proactively develop research and knowledge exchange programmes on page 8.

Further information on the disease is available on our websiteand will be updated regularly. It includes:

- **A webinar detailing latest information**
- **A symptom awareness poster**
- **A good hygiene practice guide**

ahdb.org.uk/knowledge-library/tomato-brown-rugose-fruit-virus

A VAMPIRE STRATEGY **FOR PEST CONTROL?**

Are garlic and coriander the perfect accompaniments for sustainable integrated pest management? Michelle Fountain and Adam Walker, NIAB EMR, explain why you might consider planting garlic among your strawberry crops

With increasing legislative pressure to reduce the use of chemical pesticides in horticulture, there is rising interest in botanical alternatives. Although garlic sprays are used in some crops, it is possible that inter-planting garlic in strawberry crops could give a more persistent effect. This method has been shown to reduce some invertebrate pests in cabbage and mustard crops and even spider mite in strawberry.

In this project, we planted garlic cloves directly into the coir bags in several protected table-top strawberry crops and compared the pest incidence to crops on the same farm that did not have inter-planted garlic.

The garlic leaves were broken every fortnight and the leaves placed in among the strawberry plants. In total, 160 garlic plants were established in each 16 x 16 m plot. The grower continued with their routine crop husbandry, treating the garlic-treated and control plots the same.

DETERRING APHIDS

Strawberry plantings included first-year and second-year plantings and pest assessments were made every fortnight.

The numbers of aphids, which were primarily the strawberry aphid, *Chaetosiphon fragaefolii*, were significantly fewer in the second-year planted garlic plots than in the untreated control strawberry plots.

Fewer aphids were observed in first-year strawberry than in second-year plantings, likely because the aphids were overwintering. The way in which garlic reduced the numbers of aphids in the crop is unclear because the aphids were already in the plants at the time of garlic planting. However, prior to the garlic treatment there were similar numbers of aphid, suggesting that the garlic plants deterred aphids. This is supported in other published literature in mustard but, to our knowledge, this is the first time it has been recorded in strawberry.

Breaking garlic leaves releases repellent compounds (e.g. diallyl trisulfide and diallyl disulfide), which, along with the continuous presence of garlic plants, may maintain a persistent repellent plume in the crop.

The garlic did not appear to repel aphid parasitism and the numbers of parasitised aphids (mummies) was similar in garlic and control areas of the strawberry crops.

Unfortunately, the garlic inter-planting had no effect on numbers of thrips (adult and larvae).

NATURAL PREDATORS

Encouragingly, the introduced thrips predator *Neoseiulus cucumeris* was not deterred from strawberry flowers by garlic plantings. Natural enemies, including hoverflies, lacewings, ladybirds and predatory thrips, were not negatively affected by garlic.

Numbers of parasitised aphids and spiders were higher in the second year compared to first-year plantings; possibly responding to higher numbers of aphids and more dense plant architecture in the second-year plantings. Oddly, spiders were also more abundant in the garlic-planted strawberry crops.

Further studies should look at the effects of garlic on other problematic aphid species, for example, the potato aphid, *Macrosiphum euphorbiae*, along with thrips.

More recently published research by PhD student Dylan Hodgkiss (supervised by NIAB EMR and

important natural enemy of aphids. It is postulated that the adult lacewings were attracted to feed on the coriander flowers and then laid eggs near to nearby aphid colonies.

WEIGHING UP THE COSTS

The estimated cost of applying this garlic treatment was £263–395/ha per year. This includes purchase, splitting, planting, breaking leaves, harvesting and labour.

In our trial, there was no loss to the grower in terms of spaces taken up in grow bags for garlic, because two spaces were free in each bag. However, growers need to weigh up the cost of inter-planting garlic against the benefit to crop yield and quality.

The latter were not assessed in this one-year study.

Undoubtedly, with losses of conventional pesticide products and a higher emphasis on integrated pest management, coupled with recent declines in the world's insect populations, inter-planting with beneficial plants to attract and harness the pest-controlling behaviour of beneficial arthropods requires further attention – not only in strawberry, but also in various other crops.

> "The numbers of aphids…were significantly fewer in the second-year planted garlic plots compared to the untreated control strawberry plots"

AN OLD AMERICAN PEST BECOMING A GLOBAL THREAT

In response to the rising risk of *Xylella fastidiosa* from mainland Europe, AHDB has funded PhD student Louisse Paula Mirabueno to help improve our understanding of the bacterium. Her project aims to establish how the bacterium can affect such a broad variety of plants and why disease symptoms occur in some plants and not others

First identified as causing Pierce's disease (PD) in grapevine in California in the late 1800s, *Xylella fastidiosa (Xf)* has been found to cause leaf scorch, stunting and other symptoms in over 350 different plant species. This plant-associated bacterium affects many different edible crops and ornamentals. Some potential host plants include blueberry, rosemary and lavender. A regularly updated list of host plants is found on the European Commission's Plant Health and Biosecurity Website. Search on ec.europa.eu

The bacterium is native to the Americas, where it has been causing economic havoc for the past century. In mainland Europe, it is most notorious for causing outbreaks of leaf scorch, stunting and plant dieback in olive farms in Italy, almond orchards in France and Spain and, most recently, cherry orchards in Spain. In Italy alone, economic loss has amounted to almost £1 billion since the first outbreak in 2013. There is no treatment available for diseased crops. Current APHA disease outbreak management approaches in the UK involve the destruction of potential host plants within a 100-metre radius and a demarcation order of 5 km for 5 years, limiting the movement of plant material to avoid the spread of the disease. *Xf* is transmitted between plants through insects; in particular, spittlebugs and sharpshooters. *Xf* is harmless to these insects, but they play a major role in the spread of the bacterium. In Europe and the UK, the meadow spittlebug *Philaenus spumarius* is the main insect of disease spread.

Xf is difficult to study because of the large number of non-pathogenic cases of the disease, in which the bacteria live inside the host plant without causing any visible symptoms. Of the 350 different host plants in which *Xf* has been isolated, most are symptomless when infected with the bacteria. The number of asymptomatic hosts is interesting and researchers do not fully understand why this is the case. A major part of this AHDB-funded research project, undertaken at NIAB EMR and the University of Reading, will try to understand what makes the bacterium harmful to plant A but not to plant B – a trait we call a pathogen's host specificity. In addition, we are also trying to understand how *Xf* has such a broad host range. Understanding the fundamentals of how *Xf* causes disease and what determines host specificity will be beneficial to those who have to deal with the loss of affected plants.

The outcome of this research project could help develop a treatment strategy that directly targets the bacterium, rather than the plant itself.

Symptoms typical to *Xf* include leaf scorching/browning, loss of foliage, stunted shoots, reduced fruit size and dieback of the plant over time. These symptoms are often confused with other diseases and environmental stresses, such as nutrient deficiencies, because they are very similar. Because of this, only DNA detection methods can be used to confirm the presence of the bacterium.

Since the first outbreak caused by *Xf* in Europe, the bacterium has posed a threat to global food production, affecting valuable agricultural productions in Europe, such as almond, grapevine and olives. Globalisation has increased the risk of introducing non-native plant diseases to countries that are not ready to manage them. With isolated cases of *Xf* on imported plants already reported in the Netherlands, Belgium, Germany and Portugal, efforts are being targeted to avoiding the entrance of the bacterium into the UK. Undoubtedly, a disease outbreak of *Xf* in the UK would affect many different sectors of the horticultural industry, especially the tree and soft fruit sectors producing blueberries, cherries and grapes and the wholesale and retail ornamentals sectors.

As the introduction of the bacterium to the UK is most likely to occur through importing affected plant material, growers and importers need to remain vigilant of the symptoms of *Xf*. Importing plants from affected regions should be avoided, because this represents the first line of defence for preventing the bacterium from entering British flora.

“The outcome of this research project could help develop a treatment strategy that directly targets the bacterium, rather than the plant itself”

AHDB project code: CP 178

Lead researcher:
Rob Jackson,
University of Reading

AHDB contact: Georgina Key

SOFT FRUIT GROWERS BENEFIT FROM GROWSAVE

Ed Hardy reports for NFU Energy on how our GrowSave project is extending 10 years of protected cropping energy knowledge for growers of soft fruit crops

You may recall that GrowSave celebrated its 10th anniversary back in 2017. While we didn't have any big celebrations, we are proud to have been helping horticulture save energy for over a decade now and we feel we have made a positive impact during that time. Although we aren't growers or plant physiologists, we do understand horticulture and energy and it is this combination that has allowed us to use our expertise for the benefit of the industry. Traditionally focused around protected edibles (PE) and protected ornamentals (PO), because these were the sectors funding the programme through AHDB Horticulture, GrowSave now also incorporates soft fruit (SF).

This is not completely uncharted territory for GrowSave, however. We have worked with the soft fruit sector on several occasions, including a GrowSave study tour that took a group of UK growers to Belgium and the Netherlands in 2017. The group gained valuable insight to some of the latest SF research and growing practices and the tour identified a few areas in which the UK industry might take a lead from its European counterparts – particularly around investment in technology, such as lighting, water recycling and air movement. A report on the influences of energy was written and can be downloaded from the AHDB website

During the last 12 months, GrowSave has continued to inform growers and decision-makers about the options open to them with respect to energy saving and efficiency practices and has held workshops on heating, lighting and climate control.

For those who missed them, there are some important points to take away. Bearing in mind what was seen on the study tour, the economic viability of supplementary lighting for UK-grown soft fruit remains questionable; those considering LED setups should certainly carefully calculate expected savings and payback time. Heating, on the other hand, has many benefits, including its use in climate control and extending the growing season, while potential subsidy through the Renewable Heat Incentive scheme can help offset costs. Of course, there is more to climate control than just heating, with air movement, humidity regulation and the evenness of conditions all playing a role. Full event write-ups can be found on the GrowSave website and a summary of all of our recent workshops features in the latest edition of GrowSave News.

Anyone wanting to delve a bit deeper into some of the more technical aspects of growing should check out the full back catalogue of Technical Updates, which cover a wide array of subjects. These can be found online at **growsave.co.uk/technical-updates**

Although originally targeted at PE and PO, much of the content can also be applied to SF. Anyone adding heat to their crop, for example, may also be interested in supplementing carbon dioxide and should read conventional and alternative sources of CO_2. Similarly, for those wanting to understand how best to control their climate, our information on sensors can help to ensure that accurate measurements are obtained.

In addition to updating several resources for SF, we will also be publishing new material targeted at the sector. A new, standalone Technical Update on adaptation of greenhouses for soft fruit production is set to be published in the coming months. This will be available on our new SF-specific website, **softfruits.growsave.co.uk**

There you will find tips on energy saving and climate control, energy price trends and a whole lot more. The original GrowSave website will continue to be updated with PE and PO content and may still be a useful resource for SF growers, with its extensive archive of materials and information. Both sites will operate in parallel, containing the latest news, GrowSave publications and details of our upcoming events.

So as not to miss anything, you may also like to sign up to our mailing list!

To ensure we provide the most relevant content, the GrowSave team has regular contact with the Soft Fruit Steering Group, made up of four industry representatives. They are:

- Scott Raffle, AHDB Horticulture
- Richard Harnden, Berry Gardens
- Sandy Booth, New Forest Fruit
- Salih Hodzhov, WB Chambers

We will soon be planning next year's programme, so if you have any ideas or suggestions for content you would like to be included, please contact one of the steering group, or email info@fec-energy.co.uk

For more information, visit softfruits.growsave.co.uk

GETTING TO THE ROOT **OF VEGETABLE ROTATIONS**

A large-scale research study is hoping to understand how the physical properties of soil can affect productivity within a rotation. Alice Sin, Resource Management Scientist, reports on our progress so far

Our research partnership with a consortium of leading researchers is taking an integrated approach to soil and water to optimise productivity and the sustainability of rotations.

ROTATIONAL CONSTRAINTS IN ROOT VEGETABLE CROP PRODUCTION

The Partnership is using two approaches to better understand some of the rotational constraints to root vegetable crop production.

The first is to gather survey information that documents the performance of crops in the context of inputs, such as organic amendments, fertiliser use and irrigation. It is also looking at land use within the rotation, including previous cropping and use of cover crops. Detailed grower surveys on rotations have been completed for around 70 fields so far, covering a variety of soils, climatic conditions and rotation types. Initial analysis of the composition of rotations and interventions has started and economic analysis of rotations will also be included.

The second approach is to undertake replicated field trials and to engage with collaborating growers to set up simple, on-farm trials that test the effects of cover crops or use of organic amendments on soil physical properties, crop yield and quality.

So far, the Vegetable Consultancy Service (VCS) has collected data from annual experiments that have been investigating the effects of cover crop species on the yield of parsnip and on the yield and incidence of *Fusarium* in onion crops.

A longer-term experiment is also underway. This will investigate the combined effects of cover crops and organic amendments on the root crop productivity in a rotational experiment, to include cereals, onions, potatoes and carrots.

RISK OF COMPACTION

A model of compaction risk from machinery loading is being developed and optimised for British soils. It has been adapted from the 'Terranimo®' model hosted by Aarhus University, with validation from the James Hutton Institute. Currently, the available version is linked to the Scottish Soils Database and there is work to integrate the corresponding English and Welsh soils information in the near future. Soil texture and other data can also be entered manually.

The model will help inform operation decisions relating to machinery (for example, the choice of tyres), to mitigate the risk of compaction and to identify the most beneficial trafficking system for the grower's particular situation. Factors that users should consider include soil water content, axle loads, tyre type and pressure, which can all affect stresses on the soil profile.

The model could potentially be used to assess the impact of soil interventions, such as organic amendments on the risk of compaction. This work complements another strand of the project on the development of a model to optimise the use of organic matter amendments in potato and root vegetable rotations.

The use of organic amendments, such as compost, may help to increase the soil's resistance to damage from compaction. Tracked or wheeled tractors caused similar amounts of soil damage; soil compaction could be reduced by reducing tractor tyre pressures during seedbed cultivations. The different organic treatment effects on the soil physical properties will be examined later in the project, when further experiments have been conducted.

EFFECTS OF SOIL MANAGEMENT ON ROOTING

The key to understanding the effects of changes in farm management on soil function and crop productivity is to characterise the soil structure produced by management processes and to understand the effects of these changes on the behaviour of roots in the soil.

Plants need a good root system to thrive; hard and/or dry soils can limit root growth. At the other end of the scale, very wet soils can also limit root growth because of a lack of oxygen when water fills all the available pores.

Recent experiments to characterise soil strength, pore structure and water conditions have shown differences in the root responses of carrot and parsnip crops based on their preferred soil density and water requirements. There were also significant differences between cultivars within the crop types.

In addition, the maximum root growth rates in optimum conditions were found to be highly dependent on seed batch. These experiments were performed using homogenous packed soils; however, previous research on cereal roots has shown that roots grow faster in hard soils if a suitable pore network is available, mitigating against the soil hardness.

Therefore, current research is exploring how carrot and parsnip respond to soil structural differences produced by managing soil in different ways to give different pore distributions. Trials will look at traditional inversion plough versus long-term compost addition and reduced tillage and following different crops within a rotation.

If you have potatoes in your rotation and would like to be part of the rotations research programme, you can take part in our Grower Platform Survey: **niab.com/ahdb-rotations-survey**

If you'd like further information about the project, please contact me at alice.sin@ahdb.org.uk

GREATSOILS

> "Very wet soils can also limit root growth because of a lack of oxygen when water fills all the available pores"

SMARTHORT

ARE WE GOING TO SEE A TECHNOLOGICAL REVOLUTION IN HORTICULTURE?

Why are automated harvesters always 5 years away and what can you do to speed up the availability of new innovation for your business? Grace Emeny explains how she thinks we can all play a role in transforming horticulture

What is our 'moon shot' idea? What single revolutionary idea are we going to focus on to drive investment to transform our industry?

That was the question posed by Simon Pearson, Professor of Agri-food Technology Research, University of Lincoln, at the SmartHort 2019 conference back in March.

When it comes to robotics and automation, the fragmentation of the research and development landscape in horticulture is something that I also believe is holding back the adaptation of new technology.

Sources of funding are available for growers to tap in to – for example, through the likes of Innovate UK, KTN and BBSRC – and there are, according to Professor Matthew Howard from Kings College, London, plenty of hungry robotics and automation students seeking projects to develop new ideas.

Fumiya Iida, Reader in Robotics at the University of Cambridge, also believes that as a result of robots getting cheaper, easier and faster, the agri-food robotic revolution is happening right now. He argues that we now where we were with computers around 30 years ago. Computers were very expensive and only for big businesses, but eventually reached smaller businesses and now can be found in every home.

So why does new technology for horticulture always seem to be 5 years away and how can growers without huge financial reserves invest to bring this technology into their business?

That is where I hope our SmartHort campaign can help.

COLLABORATION AND NETWORKING

We want to create a network to enable you to connect and communicate challenges with other growers, researchers, engineers and robotic experts. Seeking solutions shouldn't be left exclusively to the bigger players in the industry, particularly as the technology is becoming more accessible.

Alistair Frew, Operations Manager for Cheviot Trees, who attended the conference, said: "The biggest take-away for me was that I need to be working with fellow growers to look at suitable technologies and the central need that we all have. We need to see if we can pull something together. It's a big operation."

Earlier this year we launched the SmartHort Automation Challenge with automation systems experts from the University of Warwick's WMG. We were overwhelmed with the quality of ideas and applications submitted. So many of the problems were relevant to a variety of horticulture businesses, including vision systems to help automate the transport of products around nurseries and sensors for precision overhead irrigation. You can follow the progress of the winning project online, but we will also be trying to find solutions for the other applications received.

Some of the answers seem to be about connecting you with the technology already out there. We will be organising study tours to show you what is already commercially available. With the scale of the challenge our industry faces, there is no room for reinventing the wheel.

SEEKING ANSWERS ABROAD

Of course, one thing we've learnt is that the labour shortage and lack of quality labour isn't a problem that is exclusive to the UK. It's a global issue being faced by first world countries, including Australia, New Zealand, France and the USA, so we need to be looking across borders to find technological solutions and sharing our own challenges with producers and researchers in other countries.

> "Seeking solutions shouldn't be left exclusively to the bigger players in the industry"

In Australia, start-up company Agerris, which was set up by Professor Salah Sukkarieh, University of Sydney, has secured $6.5 million in funding to commercialise the automated farm equipment developed over the last 15 years at the university. We'll be keeping up to date with this initiative as it progresses and facilitating links to growers here where possible.

In September, organised by our Bedding and Pot Plant Centre, we'll be heading to Holland to look at some of the automation in practice in leading Dutch ornamental producers. You can book your place at **ahdb.org.uk/events**

GETTING FUNDING

Unsurprisingly, one of the most common questions I'm asked is how businesses can get involved with innovative projects and secure funding. In short, there isn't a simple answer to this, but there are definitely opportunities out there.

The Knowledge Transfer Network (KTN), which is predominantly funded by Innovate UK, has a clear remit to support business-led advances through collaborative R&D. It is well placed to support companies that are rich with ideas for technology but don't necessarily know the best ways to apply them.

Precision agriculture and smart technologies are priority areas for the Biotechnology and Biological Sciences Research Council (BBSRC) as part of its agriculture and food security strategic framework. They often have calls open and I would recommend you to have a look at the funding area of their website to see if any are relevant for your business and ideas.

Please get in touch if you have questions about SmartHort or if you would like to get involved: grace.emeny@ahdb.org.uk

PODCAST

The podcasts include interviews with Jacob Kirwan, G's, Calum Murray, Innovate UK, Andrey and Dr Vishuu Mohan, Tiptree and University of Essex and Chris Danks, KTN. Download from ahdb.org.uk/smarthort

HOW TO STAY SMART **AND GROW GREEN**

Elizabeth Allen, University of Lincoln, profiles the SMARTGREEN project, which aims to help growers improve their energy efficiency through the use of technology

Interreg North Sea Region SMARTGREEN
European Regional Development Fund

EUROPEAN UNION

> “SMARTGREEN aims to help growers make long-term changes that will improve productivity and profit”

WHAT IS SMARTGREEN?

The SMARTGREEN project aims to reduce energy consumption, generate significant environmental benefits and introduce innovative new technologies, without compromising quality and production time, but perhaps even creating crops with better quality and taste.

The project is led by Professor Carl-Otto Ottosen from the Department of Food Science at Aarhus University in Denmark, with the University of Lincoln spearheading research efforts in the UK. At Lincoln, Professor Simon Pearson, Director of the Lincoln Institute for Agri-food Technology, explains more:

"Greenhouse production of fresh fruit, vegetables and ornamentals is a successful, innovative component of the North Sea Region (NSR) economy, with an output of £7.75 billion annually and directly employing more than half a million people. It embraces more than 10,000 very diverse small and medium enterprises (SMEs) with a high value supply chain and provides sustainable and healthy food to millions of consumers.

"However, all the producers in the NSR are facing challenges, such as high reliance on energy and water and a low use of renewable energy in some areas of the region. The greenhouse production systems are also extremely varied across the NSR – the energy supply and management systems differ and so do the organisation, types and the sizes of the SMEs.

"By increasing the understanding of greenhouse resource use, SMARTGREEN aims to help growers make long-term changes that will improve productivity and profit, while also delivering major environmental savings – less pollution, lower resource use and reduced CO_2 emissions."

Since the EU suggested specific goals for lowering CO_2 emissions (see box), the importance of improved environmental performance is greater than ever for growers in the NSR. It is widely agreed that new CO_2 emissions targets might be difficult to reach for the greenhouse industry, which is why SMARTGREEN suggests introducing new technologies developed in different parts of the NSR.

The SMARTGREEN project combines analysis of Big Data on climate and production with practical demonstrations at SMEs to illustrate how growers can reduce energy consumption. Development and application of sensors and measuring systems, as well as energy efficient control of greenhouses, will contribute to fulfilling the goal of improving energy efficiency by approximately 10%.

MAKING USE OF BIG DATA

Experts at the University of Lincoln are leading SMARTGREEN's focus on Big Data. They are developing a new analytics platform that can combine and analyse huge amounts of information collected from growers, which in turn can help them gain valuable insights into energy use, all with the goal of increasing yields, cutting operational costs and improving energy efficiency.

The data collected by the system comes from external sources (such as weather forecasts and electricity prices), the environment (for example, temperature, light and sound levels) and machine sensors (including boilers and energy storage controls). This is measured in conjunction with the production goals of growers and information on the yield, health and growth of crops and can be used to pinpoint energy efficiency opportunities and incorporate renewable energy sources.

SMARTGREEN is also utilising existing knowledge of LEDs in several European countries to make light consumption in greenhouses more intelligent. Professor Carl-Otto Ottosen explained, "We are investigating the possibilities for using specific light spectra from LED lamps to optimise crop growth. The colour of light can affect plant growth in different ways. For example, red light results in elongation growth, which means the plants grow taller, while blue light results in more compact growth.

"Through our work we hope to understand how the right light combination can help growers achieve shorter production periods and therefore reduce their costs."

Growers who are interested in providing information for the University of Lincoln's Big Data work, or who have general queries can contact Professor Simon Pearson at spearson@lincoln.ac.uk or phone 01522 835227.

For any wider project queries, contact Professor Carl-Otto Ottosen at coo@food.au.dk

KEY EU TARGETS FOR 2020:

- **20% cut in greenhouse gas emissions compared with 1990**
- **20% of total energy consumption from renewable energy**
- **20% increase in energy efficiency**

KEY EU TARGETS FOR 2030:

- **At least 40% cut in greenhouse gas emissions compared with 1990**
- **At least 27% of total energy consumption from renewable energy**
- **At least 27% increase in energy efficiency**

LONG-TERM GOAL:

By 2050, the EU aims to cut its emissions substantially, by 80–95% compared to 1990 levels, as part of the efforts required by developed countries as a group.

LIGHTING THE WAY FOR SWEETER GALA APPLES

Scott Raffle, Knowledge Exchange Manager, explains how our research is hoping to keep your apples tasting better for longer

Recent international research has confirmed that good eating quality of apples, particularly sweetness, is linked to high dry matter content of fruit at harvest. Consignments going into store with a high dry matter content should retain their eating quality for longer. However, better understanding of this relationship is needed so that growers can manage it in their production and storage regimes.

The planting area of English Gala continues to increase and the industry estimates that around 30% of harvested English Gala fruit will need to be kept beyond April.

This project set out to improve our understanding of how to optimise the long-term storage potential of the variety.

DETERMINING PICKING DATES

Growers could now have 7–10 days advanced warning about the optimum picking dates of Gala ahead of traditional starch/iodine testing. The tool developed in this project uses chlorophyll fluorescence to predict when it is best to harvest for long-term storage. Further commercial testing is currently being conducted by Landseer.

INFLUENCE OF LEAF, FRUIT AND SOIL MINERALS

'Meta-analysis' computing techniques have been used within the project to examine historical orchard data and determine the influence of leaf, fruit and soil mineral composition on fruit dry matter content.

LIGHT INTERCEPTION AND ORCHARD MANAGEMENT TECHNIQUES

A pruning trial was set up at NIAB EMR to assess the effect of light interception. It compared fruit from tall spindle trees in a conventional fruit wall with fruit from trees pruned using the latest 'centrifugal pruning' strategy developed in France. Centrifugal pruning is a way of improving light penetration into the canopy while suppressing extension growth by increasing competition between the laterals.

Existing tall spindle trees in a Gala fruit-wall orchard were converted to centrifugal trees in winter 2016/17. Both tree types were compared with or without a white reflective ground cover laid on the orchard floor.

AHDB project code: TF 225

Lead researcher:
Julien Lecourt, NIAB EMR

AHDB contact: Scott Raffle

In 2017, when the pruning systems were compared, the centrifugal system (CS) recorded higher light penetration than the tall spindle system (TS). There was a reduction in yield in the CS of 45 kg/plot compared with 61 kg/plot in the TS, but this was expected in the first year given the restructuring of the trees over the previous winter. Crucially, there was no significant effect of pruning system on either fruit sweetness (% °Brix) or fruit dry matter content (% FDM). The reflective covers applied at fruit set improved light interception in the canopy of both pruning systems and this resulted in yield increases compared with trees with no reflective cover (CS, 5% increase; TS, 19% increase). The reflective covers had no significant effect on % °Brix or % FDM.

In 2018, weather stations were placed in the orchard trial to measure the effect of the reflective covers on the air temperature, calculated as accumulated growing day degrees (GDD). The reflective covers increased temperatures within the crop canopy and the GDD by 5.5 days. The covers also reflected 29.4% of received light back up towards the canopy compared with just 4% from the uncovered. The covers increased fruit expansion rates compared with those with no covers.

In 2018, 19.8% of incident light penetrated the CS canopy compared with 12.5% in the TS canopy. The pruning system showed no difference in effect on fruit expansion rates.

There was no significant effect of either reflective covers or pruning system on tree yields, fruit firmness, sweetness (% °Brix) or % FDM content in 2018.

RESULTS SO FAR

Over the last 2 years, we have been unable to manipulate FDM content with either reflective covers or pruning manipulation. However, it should be remembered that trees are still recovering from the change in pruning technique and 2018 was a season of very high sunshine hours and light levels, which was not typical of the long-term average. The work will continue in 2019.

CENTRE WHETS APPETITE FOR **LATEST SOFT FRUIT RESEARCH**

The WET Centre aims to accelerate the uptake of innovation and new research by demonstrating the commercial value for soft fruit growers. Scott Raffle, Knowledge Exchange Manager, reveals his hopes for a new way of sharing information with the industry

FARMEXCELLENCE

We are always looking for new ways to improve the adoption of our research and development. When new EAMUs and emergency authorisations for crop protection products are released as a result of our research trials, their adoption by growers is automatic. It is not so straightforward for all of our research.

One new approach we are developing is to set up 'Strategic Horticulture Centres', where research results can be demonstrated in practice to help speed up their adoption by the industry.

We had previously helped to fund a series of water use efficiency projects on substrate-grown strawberry and raspberry crops at NIAB EMR, but neither the results nor the technology developed had been adopted to any extent by UK soft fruit growers. This was particularly disappointing given that the research had developed precision irrigation practices that reduced water and fertiliser use by up to 30%, while maintaining – and sometimes improving – fruit yields and quality.

To address the low level of uptake by growers, Paul Dracott and the team at NIAB EMR created the Water Efficient Technologies (WET) Centre, which brings together leading irrigation equipment and sensor suppliers and researchers to:

- Develop and commercialise an integrated portfolio of leading-edge irrigation technologies for the horticultural sector
- Demonstrate on a commercial scale how applying these technologies can enable growers to improve their water use efficiency, yields, berry quality and financial returns
- Provide growers with crop-specific workshops, training and one-to-one technical support to enable them to successfully adopt these technologies

As part of this final point, a 'Precision Irrigation Package' (PIP) is available to strawberry and raspberry growers as a commercial service.

We are now co-funders of the WET Centre, to not only promote best practice in water use, but we also envisage that it will evolve to share knowledge about growing systems, crop protection, labour saving and other new technologies.

CURRENT TRIALS

Data from sensors measuring coir moisture, electrical conductivity (EC) and temperature, air temperature, humidity and photosynthetically active radiation can be viewed on smartphones, tablets or desktops in real-time, with a grower-facing dashboard developed by Innovate UK. This allows growers to continually monitor the moisture content of their bags and other key environmental conditions, 24 hours a day. Growers who buy the PIP are supplied with this technology and are trained in how to use it.

Early demonstration work at the Centre has compared and contrasted white and black strawberry coir-filled grow bags, coir formulations, numbers of drippers per bag, use of wetting agents and the effects of row position on fruit development and final yields.

Work on harvesting and using rainwater to irrigate the crop continues and the potential of this approach to improve water security and move towards water self-sufficiency is being determined.

FUTURE PLANS

In 2019, further demonstrations will be established to compare the effects of bag colour on plant light interception and the distribution of water in the coir bags from x5 standard 1.2 L/h emitters or x8 ultra-low flow emitters. The new everbearing strawberry variety Malling™ Champion will be used and irrigation set points and volumes of run-off will be optimised. Such information will be extremely helpful to all growers who will start planting the variety in the coming seasons.

WET Centre Manager Dr Mark Else is also planning to expand the site to include automated venting polytunnels for the new primocane raspberry varieties Malling™ Bella and Malling™ Charm. The intention is to demonstrate irrigation and fertigation technologies for raspberry crops covered by the modern Haygrove Pioneer tunnels and using sensors to measure zonal phytoclimates within them.

We hope our involvement in the WET Centre will ensure the results and information reach more soft fruit growers. We will provide regular updates on the activities of the Centre through our website, as well as reports, videos, podcasts and details of open events.

The future of the WET Centre is exciting and offers the industry a focal point for discussing and showcasing new soft fruit technology and growing systems.

We look forward to bringing you news of both the WET Centre and other Strategic Horticultural Centres as they develop over the coming months and years.

Visit thewetcentre.com to find out more.

> "A focal point for discussing and showcasing new soft fruit technology and growing systems"

MEET THE **'FELLOWSHIP-ERS'**

To grow the next generation of leaders, six young horticulturalists have seized the opportunity to join the LSA Fellowship Scheme, a 2-year programme to build knowledge and leadership skills to germinate their future careers.

Three months since starting the scheme, we met with fellowship member and Research & Development Officer at Vitacress, Libby Rowland, to find out how she is progressing.

Q: WHY DID YOU JOIN THE FELLOWSHIP SCHEME AND, SINCE IT STARTED, HOW HAVE YOU BEEN GETTING ON?

I joined the Fellowship Scheme because I saw it as a fantastic networking opportunity. Conferences and technical meetings are great for meeting and talking to people with different backgrounds and experiences to learn from. Equally, visiting other growers can be both interesting and informative.

Since the scheme officially kicked off in January of 2019, I have already attended some good events and there are probably half a dozen more available for the rest of the year, with more to be confirmed. It's great to already be getting out and meeting people in the industry who can help to shape my future career.

Q: HOW DOES THE SCHEME FIT WITH YOUR BACKGROUND AND HOW DO YOU THINK IT WILL HELP YOUR FUTURE GOALS?

I joined the horticulture industry fairly recently, having come from an academic background, where I carried out research into the effects of precision irrigation on the quality and shelf life of potted culinary herbs.

The Fellowship allows me to expand my knowledge of the logistical and practical elements of horticulture, as well as develop my understanding of different horticultural systems.

Q: HAVE YOU DISCOVERED ANYTHING SIGNIFICANT AND HAS IT HELPED YOUR COMMUNICATION SKILLS?

So far, the most important lesson I have learned is to go for whatever opportunity is made available to you and to just put yourself out there.

The organisers of the Fellowship Scheme have been excellent at introducing us to others in the industry. As a result, my communication skills and confidence have already improved and it's been a good foot in the door for connecting with people.

Name:
Libby Rowland

Company:
Vitacress

Job title:
Research and Development Officer

> "The most important lesson I have learned is to go for whatever opportunity is made available to you and to just put yourself out there"

Q: DO YOU INTERACT WITH OTHER MEMBERS OF THE FELLOWSHIP SCHEME?

I was able to meet a couple of the cohort at the Brassica and Leafy Crops Conference in January and we were all together at the recent SmartHort conference. They're a really nice group of people and we're all from very different backgrounds, with different roles within our companies, so we've got plenty to say and learn from each other.

HOW WILL THE SCHEME HELP YOU TO DEAL WITH SOME OF THE CHALLENGES HORTICULTURE IS FACING?

Well, I'm not sure anyone knows if they are in good stead to deal with Brexit just yet – ask again when we have a deal.

In other areas, I think the knowledge exchange benefits from the Scheme will help all of us to deal with challenges faced by the horticulture industry because it encourages us to discuss these topics and share ideas.

Our collaborative interaction is good for the industry as a whole because there are some things – for example, the challenges of labour and access to new technology – that acting together as an industry could help us to address.

Q: HOW EASY IS IT TO FIT THE SCHEME AROUND YOUR OTHER BUSINESS COMMITMENTS AND WOULD YOU RECOMMEND IT TO OTHERS?

I would absolutely recommend taking part to other people. Having the costs covered so that you can meet interesting people, at interesting events, is a no-brainer.

I am also fortunate enough to have good support from my employer, Vitacress, so taking part in events and activities isn't generally too much of a problem. It might mean I have a couple of days either side of an event that are a bit busier than usual, but it's definitely worth it for the experience. In addition, the months that tend to be busier for a 'typical' horticultural grower are those that are quieter in the Scheme, for that very reason.

To apply for the LSA Fellowship Scheme, visit lsactfellowship.org

LSA Charitable Trust
Fellowship Scheme

AHDB

Listen to our podcast to discover farming news from across the UK

We have launched a podcast channel to keep you informed about the latest research, news, events and innovation to support UK horticulture.

Over the next few months you will hear updates on:

- SCEPTREplus and the EAMU programme
- New Strategic Horticulture Centres
- The AMBER project on biopesticides

You can now subscribe and listen on iPhone and Android: audioboom.com/channels/4937761

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