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FIRST TEST FOR NEW FLOWER PROGRAMME

Downy mildew has been particularly difficult to control in column stocks this year but research at the National Cut Flower Centre is giving hope to growers

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COMMENT

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NEW BEGINNINGS

I was very pleased to learn of Hayley Campbell-Gibbons' recent appointment as Chair of the AHDB Horticulture Board. In the NFU, Hayley has worked tirelessly for the good of horticulture, and I know that she will bring strong leadership, enthusiasm, energy and valuable fresh insight to the Board.

Hayley's first task, apart from writing this column for the next edition of AHDB's The Grower, will be to chair the November meeting of the Horticulture Board. The main purpose of this meeting is to set the broad priorities for new work commissioned in 2019/20. This involves reviewing work now at an end and assessing proposals from AHDB staff, both for any follow-on work that may be needed and for any new work needed to address the fresh challenges and opportunities identified by the Sector Panels in their autumn panel meetings. AHDB staff will then build a detailed activity plan, which the Board will consider at its March 2019 meeting.

The ultimate outcome is the wide range of projects and activities of the kind you see reported in this and every other edition of The Grower, covering topics as diverse as viruses, crop nutrition and glasshouse management.

As the funding landscape has fragmented over the years, it has become increasingly difficult for growers to know what sources of financial aid they might be eligible for, so in this issue we outline the grants and allowances currently available to horticultural businesses.

Lastly, if you are a progressive grower who would like to be more involved in driving innovation in British horticulture, especially if you think you could help us improve what we do, please consider applying to become a Sector Panel member (page 8). We can only be as good as the people who advise us.

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CONTRIBUTORS

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

DR BARRY MULHOLLAND

Dr Barry Mulholland is Director of Horticulture at ADAS UK Ltd. Barry leads a team of Horticulture experts who cover all sectors of the industry. ADAS Horticulture has core strengths in solution-focused applied R&D and on-farm consultancy. Barry has over 25 years' experience of managing research that has addressed complex biological, environmental and industry production problems. Barry has an excellent grasp of the economic, policy and environmental and technical issues in the horticulture sector and an in-depth understanding of policy and regulatory issues that influence the profitability of the horticulture industry.

Barry helps you switch to responsible media on page 20

WAYNE BROUGH

Wayne Brough is part of the AHDB Horticulture Knowledge Exchange Team covering ornamental crops. He has responsibility for the generation of publications, electronic media and events into the hardy nursery stock, bedding plant, pot plant, cut flower and bulb sectors, along with a specific focus on the use of growing media across horticulture. Wayne joined AHDB in 2010, having spent 22 years with ADAS as an Ornamentals Consultant, specialising in the production of container-grown crops.

Wayne discusses water deficit for added benefit on page 30

SARAH HUGHES

Sarah lives in Denbighshire, North Wales, and has worked in the food and farming industry for the previous 20 years, starting on the technical advisory side as an agronomist, then moving into agricultural marketing. She lives on a farm with her family which has diversified into tourism, with a caravan park and renewable energy, including solar, ground source and a farm-based anaerobic digester plant. She runs a separate business growing edible flowers outside and in polytunnels.

She studied Agriculture and Environmental Science at Newcastle University before training to become an agronomist with Countrywide Farmers, before moving to work in a marketing role for Novartis and then Syngenta Agrochemicals.

Outside of work, Sarah is on an ongoing quest to learn Welsh – Diolch yn Fawr!

Travel the globe with Sarah on page 34

NEWS & **UPDATES**

IN **BRIEF**

DEALING WITH DROUGHT

The hot weather and lack of rainfall has meant a tough growing season for many. AHDB has collated a range of drought resources and interviews with farmers about how they are coping with the season. Access now from **ahdb.org.uk/drought**
An impact assessment report is also available.

SCEPTREPLUS DELIVERS AGAIN

Protected ornamental growers now have access to a new biopesticide, FLiPPER, for the control of a range of pests. The authorisation was sought by AHDB's Minor Use team following successful performance within SCEPTREplus trials to control western flower thrips on verbena. Find out more at **horticulture.ahdb.org.uk/sceptreplus**

REQUEST FOR VIEWS ON AHDB – HAVE YOUR SAY

Farmers, growers, processors and industry representatives are being asked for their views on the future role and remit of AHDB.

This government-led review will look at AHDB's purpose and priorities, its strengths and where improvements can be made. The 10-week exercise covers England, Scotland, Wales and Northern Ireland and is open until midnight on Friday 9 November. For more information and details on how to respond, please visit **ahdb.org.uk/news/request-for-views**

NEW AHDB WEBSITE

A refresh to ahdb.org.uk should provide easier access to our resources, publications, tools and news. The website will continue to evolve and new functionality will be added in the future. Horticulture-specific research information can still be found at **horticulture.ahdb.org.uk**

HAVE YOU **MONITORED** OUR **PEST INVESTMENT?**

More chemistry has fallen foul of the approvals process this year. With some pest targets becoming resistant to what's left and the crop protection pipeline drier than a 2018 summer, it's no wonder interest in integrated pest management (IPM) has peaked. But IPM is a broad church and research funds are limited, so AHDB is asking people to complete a short survey to focus its investment in this area.

The ability to identify pest targets accurately and to know when they have gone, or are likely to go, above economic damage thresholds is at the heart of IPM. In 2014, AHDB published the 'Encyclopaedia of pests and natural enemies in field crops' to help crop walkers identify pests, as well as to inform them about risk factors, life cycle, monitoring, control thresholds, non-chemical control and insecticide-resistance status.

By the time pests have been observed in the field, however, the optimum time to spray could have been missed. This conundrum has fuelled investment in pest forecasts, risk models and monitoring services to provide a 'heads up' warning of what pest pressures might lie ahead. Some pest monitoring services, in fact, stretch back decades. The Rothamsted Insect Survey, for example, has tracked aphid migrations, via its UK network of suction traps, for over 50 years.

TIME FOR A REVIEW

Even though some pest monitoring services have been on the scene for longer than many can remember, it is important to review their relevance. Priorities change and new services appear.

The AHDB-supported Crop Health and Protection Centre (CHAP), for example, is 'updating and enhancing' monitoring activity for pests (and diseases) of wheat, barley, oilseed rape and potatoes. CHAP already uses its weather monitoring network, national pest and disease surveillance data and risk models to provide regular updates via **cropmonitor.co.uk**

Next year, CHAP plans to launch risk forecasting services too – which are likely to form part of a subscription service.

Farmers and growers can also share pest observation data more rapidly than ever before. AHDB Horticulture, for example, has coordinated a network of growers to help monitor diamondback moth populations with resistance to pyrethroids. The internet also provides another powerful sharing network. For example, any pest target, preceded by the hashtag symbol '#', can be entered into the search box of Twitter to reveal 'real-time' information on that pest.

With pests being monitored in so many ways, now is a good time to have your say on how AHDB invests in this area.

A printed copy of the AHDB Pest Monitoring Services Survey has been mailed to you with this edition of The Grower and can be accessed online at **horticulture.ahdb.org.uk/ahdb-pest-bulletin**

AHDB HORTICULTURE APPOINTS NEW CHAIR

Hayley Campbell-Gibbons has been appointed to the role of AHDB Board Member with responsibility for chairing the Horticulture Board.

Hayley brings 15 years' experience in rural affairs, including over a decade as Chief Policy Adviser to the NFU, where she specialised in horticulture.

She has represented farmers' and growers' interests at UK and EU level, spearheading strategic movements including Catalyst for Change, The Code of Trading Practice for Ornamentals and the NFU's campaign for a new seasonal agriculture workers scheme. She was also a board member of the Gangmasters Licensing Authority from 2011–2014.

Hayley said, "I look forward to helping AHDB make a real difference for UK horticulture and agriculture as we manage our way through Brexit and into a new trading environment, and, in particular, to working with the British horticulture sector as it deals with pressures on margins, challenges around labour availability and concerns over crop protection. I also want to listen to growers and work with them to identify ways of maximising productivity and fulfilling our potential as a sector."

Hayley will be taking up the role from 1 November 2018, following her departure from NFU.

FUTURE OF CUT FLOWER RESEARCH CENTRE SECURED

Funding for The Cut Flower Centre has been confirmed for a further five years, with a broadened remit to research crop protection.

The Centre will build on its past record of bringing new commercially successful cut flowers to the UK market and will also now help to address key industry research needs.

New trials for 2018 include research into Fusarium on column stocks, in conjunction with University of Warwick, and weed control, supported by ADAS.

AHDB Horticulture is investing over £300,000 to support the Centre for the next five years in order to continue to drive productivity and innovation in the cut flower industry.

Previous trials at the centre have led to the introduction of 11 new commercially grown crops, with a combined potential farmgate value of £2.9 million over the previous five-year period.

SMARTHORT **2019**

Do you grow crops under LED, move harvested produce in automated trolleys or use robotics to pick or pack your products? We are seeking innovative UK horticultural businesses to showcase their produce on a specially designed menu for a new conference, intended to drive innovation into horticulture.

The exclusive dinner will be part of a two-day conference that will feature guest speakers from around the world, sharing some of the most impressive and exciting technological developments that could change the way we grow. It will also examine the potential of new technologies in light of current labour shortages.

SmartHort 2019 will take place on 6–7 March in Stratford-upon-Avon. It is an opportunity to discover the latest high-tech advancements, meet the people behind the innovations and find out how to invest in the technology that could make a positive impact in your business; connecting innovators with the horticultural industry.

To find out more, contact **gracie.emeny@ahdb.org.uk**

VOICE YOUR OPINION

The AHDB Horticulture panels are looking for new forward-thinking and passionate growers to help steer the work of the levy body in delivering to their sectors

AHDB Horticulture is calling on progressive and inspiring growers to seek nomination to join one of our crop sector panels. The election process is now open and there are currently 18 vacancies across all six sector panels.

Martin Evans, AHDB Horticulture Interim Chair and Field Vegetable Panel Chair, said, "The crop sector panels are made up of growers like me and you and have an important role to help guide AHDB in tackling some of the critical issues affecting our industry.

"The number of challenges we face continues to grow, with the loss of plant protection products, challenges with labour availability, and this year we have been set back with unprecedented weather patterns.

"This is why we need new thinking and new ideas to come in and make positive change. The panels are the best way for AHDB to engage with the industry on what their priorities should be and how we can channel the levy monies to the greatest benefit for all growers.

"I've witnessed, through my involvement with the panels, the vital industry voice we represent, which helps to steer and guide researchers and scientists to ensure their work is of value to growers."

WHAT'S INVOLVED?

Panel members serve a three-year term that starts in January and agree to attend two panel meetings per year, with the occasional teleconference meeting to pick up any pressing matters.

While on the panel you will assess new project proposals for their scientific quality, value for money and potentially how successful they can be for the industry. On an ongoing basis, you will monitor the progress of funded projects, ensuring that they meet their objectives. Panel members also play an important role in determining the strategy for future work being commissioned in their sector.

If you find a specific project of particular interest, you can volunteer as an industry representative for that individual project, which will mean you will receive the latest results first-hand.

ARE YOU ELIGIBLE?

To join the panel, the candidate must be employed by a current horticultural levy payer (meaning the business must have been required to pay levy based on their returns for 2017/18).

Existing panel members can seek nomination for a second three-year term, but no member may serve more than two consecutive three-year terms.

TO APPLY

The deadline for applications is 31 October 2018. You can apply via an electronic submission on the AHDB horticulture website – horticulture.ahdb.org.uk/panel – or complete and post the separate application form in this magazine.

For more information on the vacant positions, please email Hort.Panels@ahdb.org.uk or contact the relevant panel chairman, whose details can be found on the AHDB Horticulture website.

Current Vacancies	
Panel	**Vacancies**
Field Vegetables	Legumes (Peas & Beans)
	Herbs
	Bulb onions
	Production in the East (inc. Organic)
Hardy Nursery Stock	Heathers and Alpines
	Shrubs and climbers (two vacancies)
	Herbaceous perennials, alpines and grasses
Protected Edibles and Mushrooms	Herbs
	Mushrooms
	Organics
Protected Ornamentals and Bulbs and Outdoor Flowers	Bulbs
	Protected cut flowers
	Bedding plants (pack- and pot-grown)
Tree Fruit	Tree fruit production – South East
	Culinary Apples
Soft Fruit	Soft fruit production – Scotland
	Soft fruit production – Kent

Nigel Holmes, Catax

THAT'S A RELIEF

AHDB's Dr Nikki Harrison asks Nigel Holmes, Senior Tax Specialist, Catax, to shed some light on under-claimed R&D tax opportunities for growers

Q: WHAT UK TAX OPPORTUNITIES ARE AVAILABLE FOR THE INDUSTRY TODAY?

Many companies in the agriculture and horticulture sectors are missing out on the UK's generous tax reliefs for research & development (R&D).

Recent statistics published by HM Revenue & Customs (HMRC) show that the industry is not making the most of the valuable reliefs available.

The Agriculture, Forestry and Fishing categorisation (into which horticulture falls) made only 135 of the 26,055 R&D tax relief claims, claiming £5m of benefit, in 2015–16. Furthermore, the same category only made 10 of the Patent Box claims for 2014–15 out of a total of 1,135 claims made.

Q: SO WHAT ARE THESE TAX RELIEFS AND HOW COULD THEY APPLY TO GROWERS?

R&D tax relief, for SMEs, allows costs such as staffing and raw materials to obtain additional tax relief at a rate of 130%. So, for example, £10,000 in qualifying costs attracts £23,000 relief in total (the original £10,000 plus £13,000 additional relief). This can either reduce a company's tax bill or it can create or increase an existing tax loss, which can be given up in return for cash at a rate of 14.5 per cent. In other words, there is an actual cash flow benefit whether the company is profitable or not.

Q: YOU HAVE MENTIONED THE 'PATENT BOX' TAX RELIEF, BUT WHAT IS THIS AND IS IT RELEVANT FOR OUR INDUSTRY?

The Patent Box is a tax relief that lowers a company's tax bill on profits derived from a patented product or process to an effective rate of only 10% (compared to the actual 19% rate). While the definition of a patent for this purpose is quite narrow, it does include any plant breeders' rights granted in accordance with Part 1 of the Plant Varieties Act 1997.

Q: WHY AREN'T COMPANIES CLAIMING THESE TAX OPPORTUNITIES?

Firstly, there is a misconception that R&D tax relief is for pure scientific research. Secondly, there is a general lack of awareness of both reliefs.

Q: HOW DO YOU DETERMINE WHICH BUSINESS ACTIVITIES ARE ELIGIBLE FOR R&D TAX RELIEF?

To qualify for R&D tax relief, the company must be seeking a scientific or technological advancement in their industry where challenges and uncertainties arise and where the solutions to such would not be readily deducible by an industry professional.

Eligible research could include seeking advancements to:

- Reduce waste or inefficiencies
- Improve quality
- Create more environmentally friendly or sustainable growing conditions
- Deal with pest control and disease or changes in climatic conditions

To qualify for the Patent Box, the plant breeders' right must be in the company name and the company must be generating a profit from exploiting those rights.

Q: CAN YOU GIVE ACTUAL EXAMPLES OF HOW R&D TAX RELIEF HAS BEEN USED IN THE FRUIT AND VEGETABLE GROWING SECTOR?

Yes, these are real cases that we have worked on in the last few years in the horticulture sector:

- A company that developed an improved machine to remove spoiled sections of cabbages, generating a cash benefit in the region of £6,000
- A cucumber grower who invented an improved machine to cut cucumbers, speeding up the process and reducing waste, and also developed a new stock management software, generating a cash benefit in the region of £36,000

The latter case shows that the R&D can be software-developed for internal use and not necessarily a product or process that relates to the actual trade.

Q: WHAT ADVICE WOULD YOU GIVE TO GROWERS WHO MAY WISH TO KNOW MORE?

Before making any business decision, you should always speak to a qualified advisor, such as your tax accountant.

> "The industry made only 135 of the 26,055 R&D tax relief claims in 2015–16"

LONG-LIVE **LETTUCE**

Could the dryness of soil and how it is watered be the key to unlocking better lettuce quality and shelf-life?

Anecdotal evidence suggests that growers in warmer EU climates, such as Spain, don't have the same issues with lettuce pinking and wilting that growers in the UK do. One theory abounding is that the dryer conditions, particularly at soil level, coupled with reduced water inputs, in these more temperate locations have a positive effect on the shelf-life and quality of fresh lettuce.

It is known that over-wet soils due to excessive rainfall or ineffective irrigation scheduling can promote post-harvest pinking in some varieties.

So, it was with this in mind that NIAB EMR's Mark Else set out to determine whether techniques such as precision, deficit and alternate wetting and drying irrigation could improve the quality and longevity of Romaine and Iceberg lettuce crops.

SET-POINTS

In the initial phase, Mark aimed to develop scientifically-derived set points for use in precision irrigation, alternate wetting and drying regimes, and deficit irrigation to improve the consistency of leaf quality and shelf-life potential of Romaine ('Actina' and 'Scala') and Iceberg ('Challenge' and 'Etude') lettuce without reducing head fresh weight.

This was tested in peat and silt soils, and achieved by applying a mild and gradual soil drying and measuring the first plant adaptive responses to declining soil water availability. The point of first wilting and widespread wilting was also noted, and the day and night temperatures in the 'GroDome' at NIAB EMR were set to 18°C and 12°C respectively, while relative humidity was left uncontrolled.

To take the measurements, soil matric potential and volumetric moisture content sensors were buried at different depths within the pots, and 'spot measurements' of volumetric soil moisture content, soil temperature, and pore E.C were made at three positions within the pot using a hand-held sensor and meter.

SOIL DRYING

In the pot experiments, Romaine (Actina) first perceived a moisture deficit stress at a soil matric potential between -78 and -84 kPa. Continued and sustained soil drying past this value would likely reduce final head weights and diameters, as well as leaf quality and so the recommended irrigation set point for further testing in field experiments is -59 kPa.

For Iceberg (Challenge), the first moisture deficit stress signs came at between -36 and 50 kPa, and therefore the set points recommended for further testing in field experiments is -27 kPa.

The sensors used also revealed that while leaf responses of Iceberg and Romaine lettuce to drying peat and silt soils were triggered at similar matric potentials, they occurred at very different volumetric moisture content levels.

Romaine (Actina) also showed a small but significant increase in the temperature of the lettuce hearts in plants under the drying down

> **"Photosynthesis was limited at higher matric potentials in Iceberg than in Romaine varieties"**

treatment. This small reduction in transpirational cooling was first noted at a soil matric potential of -63 kPa, corresponding to a volumetric soil moisture content value of 16 per cent.

> **“This highlights the advantage of using matric potentials to schedule irrigation to crops in various soils with different bulk densities”**

Furthermore, photosynthesis was limited at higher (less negative) matric potentials in Iceberg than in Romaine varieties, suggesting that Iceberg varieties are more sensitive to drying soil.

Post-harvest pinking was not detected in any Iceberg and Romaine lettuce varieties grown in peat or silt soil under well-watered or soil drying treatments.

EVERYTHING IN MODERATION

There is of course, a balance to be had. While there is clear evidence that using precision irrigation, alternative wetting and drying regimes, and ‘beneficial stresses’ such as deficit irrigation has a positive effect on leaf quality and shelf-life in cut lettuce leaves, head fresh weights can often be reduced by more severe soil water deficits.

In order to avoid this, access to real-time field data is vital and is perhaps one of the most important elements that is often overlooked when it comes to avoiding unplanned soil moisture deficits, which have the potential to reduce head fresh weight and diameter, as well as lower leaf quality. Therefore, growers must be vigilant when using any of these techniques and ensure they have good in-field data and it is being monitored correctly.

Commenting on the project, lead researcher Mark Else, NIAB EMR, explained, “The project demonstrated conclusively that leaf adaptive physiological responses to drying soil occur at similar values of matric potential in the silt and peat soils, whereas the corresponding volumetric soil moisture contents were very different.

“This outcome was expected since matric potentials are not influenced by differences in soil bulk density, whereas volumetric water contents are.

“These results highlight the advantage of using matric potentials to schedule irrigation to crops in various soils with different bulk densities.”

The next phase will be to test the irrigation set points that were identified in alternate wetting and drying irrigation strategies on commercial farms.

ANOTHER VIEW

Much of the previous work on water use efficiency funded by AHDB focused on reducing the water and fertiliser inputs into a range of crops to ensure efficient resource use and minimise the potential of environmental pollution. However, precision irrigation approaches are now being examined to minimise the impact of physiological conditions on a range of crops. This article describes initial work to determine the impact on lettuce quality (post-harvest discolouration) and shelf-life, while later in this issue (page 30) similar techniques are described to control plant growth and habit in poinsettia.

JARGON BUSTER

Matric potential: A measure of the capillary forces holding water in the soil or growing medium and therefore the force required to remove it.

Volumetric moisture content: The water content of the soil or growing medium expressed as a fraction or percentage of the total volume occupied by water.

AHDB project code: FV 454

Project lead: Mark Else, NIAB EMR

AHDB contact: Kim Parker

FIRST TEST FOR **NEW FLOWER** PROGRAMME

Downy mildew has been particularly difficult to control in column stocks this year, but the National Cut Flower Centre has already found the cause, reports Spence Gunn

Growers of column stocks are the first to benefit from the change in emphasis of work at the National Cut Flower Centre now AHDB funding has been secured for a further five years. More is being invested in crop protection research, which will see the Centre more able to respond to pest and disease issues as they arise.

Column stocks have particularly suffered this year from downy mildew, a disease usually easily controlled by a range of protectant fungicides.

"Dutch growers have lost hundreds of thousands of stems from the disease this year," explained the Centre's project manager, Lyndon Mason. "In the UK, we didn't seem to have a problem until one weekend in May when I started receiving telephone calls from growers who were beginning to find that their normal spray regime wasn't able to control mildew adequately."

Following a meeting of growers to discuss the outbreak, the Centre was able to allocate funds to commission Fera Plant Pathologist Philip Jennings to undertake laboratory tests on the pathogen's sensitivity to nine different fungicides. Downy mildew samples were collected from crops at five nurseries – two in Norfolk, and one each in Lincolnshire, Cornwall and Northern Ireland.

Jennings applied the fungicides preventively to four-week-old young plants, which were then inoculated with the pathogen.

"None controlled it completely – and all the samples were found to be resistant to the active substance metalaxyl-M, which explains why the disease was proving so hard to keep in check this year," said Mason.

"The products that worked best, giving 80 to 90 per cent control, were Paraat, Percos and Revus. From the results, we will be able to design a spray programme for next season, which will probably have to start as soon as the crop is planted, giving growers confidence that what appears to be a new aggressive strain can be successfully controlled."

Meanwhile, control of fusarium in column stocks continues to be addressed by the Centre, now as part of a wider AHDB project led by the University of Warwick. The soil in one of the Centre's polytunnels at its site at Rookery Farm, Lincolnshire, was inoculated last year with the form of *Fusarium oxysporum* that's specific to the flower crop and planted this year with commonly grown varieties to see whether any showed some resistance to it.

"The replicated trials were planted in week 24, just when temperatures started to increase rapidly," Mason explained. "It took the disease just two weeks to devastate the plants.

"Plots of lisianthus, which is also susceptible to the disease, were untouched, however, confirming the specificity of the different forms of *F. oxysporum*."

With lack of knowledge hindering the development of control strategies for fusarium, NIAB EMR Geneticist Andrew Armitage says the project has already developed a DNA-based test for the form specific to column stocks, which

will also be able to measure levels in a soil sample. That will then allow researchers to find out the levels at which the disease causes economic damage and answer questions such as how the pathogen load changes, for instance, during crop rotations.

The ADAS-run herbicide trials at the Centre this year were focused on larkspur, taking into account the results of previous work three years ago. "That year, phytotoxicity was seen throughout the trial in the form of stunting and distortion to foliage," divulged ADAS Consultant Chloe Whiteside.

> **"The colours of the scabious are fantastic, but cropping is very labour-intensive – we need 20p per stem"**

With treatments and rates refined for 2018, five herbicides have been trialled post-drilling – two in combination with a novel product incorporated before drilling. Sown at the end of May, there was no sign of phytotoxicity within any of the plots by early August.

Whiteside also said that, although there was no significant difference between treatments, three looked promising so far.

For weekly updates and more about the trials visit **thecutflowercentre.co.uk**

STRONGER NECKS ARE KEY TO ZINNIA VASE LIFE

The vibrancy of the zinnias previously trialled at the Cut Flower Centre generated plenty of interest, but a limited vase life is still restricting their market prospects.

This year, the Centre is taking another look at treating zinnias while still growing with weekly foliar sprays of a calcium-rich nutrient product, used to improve the shelf life of edible crops. The idea is to find out whether it can strengthen the cell walls in the neck of the stems, which are the weak point.

"So far in the vase-life trials, we've found no difference between treated or untreated stems, but the trial crop this year has been much stronger anyway, which could be down to the different growing conditions this year," says Emma Bradford of cut-flower treatments company Floralife, who is conducting the vase-life tests.

"There is a big difference in stem length, but because the trial was not replicated it's not possible to conclude that was due to the treatment – but it does look like there has been a foliar feed effect. We'll look again at this next year when growing conditions will hopefully be more as normal."

NOVEL LINES SHOW THEIR WORTH

Danziger's scabious series Scoop is in its third year of trials at the Cut Flower Centre, now with 16 varieties. Picking started in week 28 (from week 18 planting) and, owing to the hot weather, peaked at the end of July. Some plants were subsequently cut down in an effort to rejuvenate them – cutting back to 50cm, compared with cutting back to the base. Their market potential is still deemed good, said Lyndon Mason, commenting that, "The main issue is the cost of harvesting and the specification in terms of stem length, single stem or 'spray' and stage of opening."

Grower Sue Lamb, who has been instrumental in promoting the series to retailers, says it's often the labour costs that decide the fate of a new line. "The colours of the scabious are fantastic, but cropping is very labour-intensive – we need 20p per stem," she revealed. "However, we're still working to get the market interested."

The key issue with the Veronica Skyler series is its narrow flowering window. "There are only two ways of achieving continuity of supply: planting date and pinching," said Mason. "So we made two plantings, in week's 18 and 25, pinching half of each planting two and four weeks later."

Flowers flushed in week 28, with the pinched plants following on in sequence for the white and pink varieties. "Pinching had no effect on the flowering time of the blue in the series," explained Mason, "with the unpinched plants having almost as many breaks as the pinched plants."

Other new lines in the trials this year include astrantia, monarda, the umbellifers Ammi majus*, A. visnaga* and *Daucus carota* as bouquet fillers, and lysimachia as an alternative to Veronica.

Late-planted column stocks are also being investigated to compare the varieties Anytime and Mathilda with newer breeding from Japan which are claimed to stand up better to heat and could extend the season.

EAMU LATEST

PREDICT AND PROTECT

AHDB Crop Protection Scientist Bolette Palle Neve discusses the latest concerns about the future availability of plant protection products

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This year we have seen a number of important active ingredients come under threat of being lost. Most recently, Member States failed to reach agreement on whether diquat, pymetrozine and thiram should gain renewal in Europe. Without this agreement, it is now left to the Commission to decide on the future of these important actives and, as the Commission had already proposed non-renewal, we are concerned that all three actives could be withdrawn by early 2019.

There is uncertainty around other actives too and it is becoming increasingly difficult for us to pick the right products for inclusion in efficacy and residue trials. We want to make sure that we only assess products with a secure future for growers, but the future can be very difficult to predict.

To help our panels and the grower associations, Spencer Collins has developed a new risk register for active ingredients currently in use in the UK. The register pulls together published information such as EFSA opinions, renewal dates and classifications to predict which actives may be at risk in future. This risk register will be used in meetings to facilitate a more informed discussion around research priorities, but it will also be a valuable tool for the EAMU team to inform discussions with manufacturers of plant protection products.

We know that many growers are concerned about the dwindling number of actives available to them. Please do let us know about any areas of concern as early as possible as most EAMU applications take around 12 months from submission, and where residue data needs to be generated, and MRLs amended, this can further delay our efforts to secure alternative products to fill the gaps.

EAMUS IN FOCUS

Botanigard

This Extension of Authorisation relates to the use of 'Botanigard WP' (M17054) for the control of whitefly, aphids, thrips and two-spotted spider mite on the listed leafy salad vegetables and herbs.

"The recent approval of Botanigard WP is an important addition to our crop protection programmes for the control of key pests, particularly with the uncertainty of the future of other approved actives," explained Liz Johnson, LJ Technical Consultancy.

She added; "When used in conjunction with other key actives, all stages of the pest's life cycle can be targeted, helping to ensure that the life cycle is disrupted and creating more effective control of the pest. It will be a very useful product during the high-risk periods for these pests, which often coincide with the shortest growth cycle of leafy vegetable and herb crops, where there is zero tolerance to the presence of pests and pest damage."

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

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WEEDING OUT NEW HERBICIDES

The loss of actives and the high cost of mechanical or hand-weeding means new options for weed control is a priority for many growers. Joe Martin explains how AHDB are working to help secure new effective herbicide authorisations

The withdrawal of the active linuron by the Chemicals Regulation Directorate (CRD) left a big gap in herbicide options for many growers when its authorisation expired in June this year.

The crop protection team at AHDB worked closely with industry, manufacturers and CRD to secure 120-day emergency authorisations for Afalon, with the active ingredient linuron, on carrot, parsnip, celery and outdoor herbs this summer.

The Article 53 authorisations have now expired for Afalon, so work continues within our crop protection research programmes to seek sustainable long-term solutions.

Weed control in a range of crops has been a key priority for SCEPTREplus trials, due to the lack of available herbicides to cover the full weed spectrum.

The first-year trials in 2017 on crop selectivity and efficacy have already led to the authorisation of four new herbicide EAMUs: 'Centurion Max' on herbs, 'Dual Gold' on sweetcorn, 'Gamit 36 CS' on carrot and 'Wing-P' on courgette and squash.

There are eight separate weed-control trials taking place this year in SCEPTREplus assessing alternative treatments: carrots and parsnips, herbs, cucurbits, Brassicas, leeks and onions, lettuce, cut flowers and blackcurrant.

Early indications from the trials suggest a number of useful treatments have been identified and the AHDB regulatory team are working with the manufacturers and CRD to gain further EAMUs to allow growers to be able to use the products as soon as possible.

CARROTS AND PARSNIPS

Four pre-emergence treatments that have provided good weed control include Anthem at 3.3l/ha + Gamit 36 CS at 0.2l/ha, Anthem + Hurricane SC (at 0.1 l/ha), Anthem + aclonifen (at 1.5 l/ha) and Anthem + chlorpropham (at 2.8 l/ha).

Post-emergent products applied at 1–2 true leaves of the crop which gave useful control included Hurricane SC, aclonifen, a coded product AHDB9993 and also Gamit 36 CS. There was some notable damage from some post-emergent applications early after application, but plants were able to regrow. With the limited range of chemistry available, some crop check may occur and growers at a demonstration day in June were willing to accept some crop phytotoxicity if the effect on crop yield was limited.

PUMPKIN

At the pumpkin herbicide screen, the coded product AHDB9987 + Gamit 36 CS, AHDB9898, aclonifen applied pre-emergence gave useful control on the drilled pumpkin crop. AHDB9998 and AHDB9995 although didn't control the fat-hen present were crop-safe and maybe useful for certain specific weed species. Benfluralin when applied at 8.0l/ha was effective on fat-hen but slightly stunted the pumpkins. It did seem safer on planted courgette.

Some products remain coded on request by the manufacturers to enable the products to be used within the trials and will be uncoded as soon as permission is given.

The first-year trial reports are available from **horticulture.ahdb.org.uk/sceptreplus-trials**

SCEPTREPLUS

> "Early indications from the trials suggest a number of useful treatments have been identified"

TIC AND TOC GOES THE VIRUS CLOCK

UK tomato growers may soon be dealing with two viruses that have the potential to wipe out entire glasshouse crops but previously hadn't managed to conquer our shores. In anticipation of this happening, we look at the key symptoms of TICV and ToCV and what to do should you suspect an infection

Since being discovered in the USA as recently as the 1990s, Tomato infectious chlorosis virus, TICV, and Tomato chlorosis virus, ToCV, have spread worldwide to all of the major tomato-growing areas. The UK, perhaps aided by its island status and high levels of biosecurity, has, however, thankfully avoided infection in those 30 or so years – until now that is. A potential first case has been discovered in Kent in the summer of 2018 and experts believe it is only a matter of time before infection becomes more widespread.

WHAT TO WATCH OUT FOR

Two to three weeks after being infected with either TICV or ToCV, tomato plants start showing symptoms in their lower leaves. Irregular chlorotic mottling (where the green chlorophyll in the leaves appears patchy and mottled, yellowing and lightening in places) and interveinal yellowing (chlorosis) occurs, with the yellowing gradually intensifying and the veins remaining green (see figure 1). As the infection progresses, symptoms move up the plant, affected leaves thicken, start to bronze and redden with necrosis and ultimately exhibit a reduction in vigour and fruit size and number.

The cause of these symptoms can often be mistaken for other issues, such as nutritional deficiencies. Due to this similarity, infection can only be confirmed through diagnostic testing.

Figure 1: Leaves showing characteristic yellowing in a TICV-infected tomato plant (Photograph by kind permission of William M. Wintermantel, USDA-ARS

HOW MIGHT I GET THESE DISEASES?

Transmission of TICV and ToCV is exclusively done by whiteflies in the genera Trialeurodes and Bemisia. While these pests are naturally found in tropical and subtropical regions, glasshouse growing conditions in cooler, temperate regions can prove to be favourable to the pests – which has led to outbreaks in Northern Europe as a result of infected plants and vectors entering glasshouses.

Once either virus infects a host, its movement is restricted solely to the phloem tissue and neither virus can be mechanically transmitted; neither are the viruses known to be seedborne. Whiteflies effectively act like a flying syringe, and they can transmit the viruses for up to five days.

WHAT CAN I DO?

When a plant becomes infected with either of these viruses there is no cure. Therefore, you should take all measures possible to minimise the risk of further transmission. Destroying both vectors and the host plants can probably eradicate isolated glasshouse outbreaks.

Unfortunately, there is no recognised resistance to these viruses in any commercial tomato varieties (though it should also be noted that TICV and ToCV can infect over 50 other species between them – a list of which can be found in AHDB factsheet 18/17, mentioned at the end of this article).

Both viruses are of quarantine significance, so, should an outbreak (suspected or actual) of either virus occur, the findings should be reported to the Plant and Health Seeds Inspectorate immediately (in England and Wales, call 01904 405 138).

WANT TO KNOW MORE?

AHDB has recently produced a factsheet, 18/17, which covers all you need to know as a grower about these serious viruses.
To obtain your copy, visit the AHDB horticulture website **horticulture.ahdb.org.uk/knowledge-hub**

KNOW YOUR ENEMY: PLUM FRUIT MOTH

Both beneficial and harmful pests and diseases may hide among your crops, but when many look the same and exhibit similar symptoms, how do you tell them apart? Our occasional series looks at helping to identify these doppelgangers so you can take the appropriate action to protect your crops

WHO ARE THEY?

Grapholita tenebrosana is often caught on 'Funemone' pheromone sticky traps intended to catch plum fruit moth (*Grapholita funebrana*) as both are attracted to the same lure. This obviously creates difficulty when growers are trying to identify and record plum fruit moth numbers. Due to their similarity, *Grapholita tenebrosana* is frequently wrongly recorded as plum fruit moth.

This becomes important when you consider the implication of having either within your crop; plum fruit moth is a known enemy, particularly of plum and apricot crops, whereas, in contrast, *Grapholita tenebrosana* is actually harmless to these crops as it prefers to feed on dog rose and other rose species.

Common signs of plum fruit moth damage to fruit include an entrance hole, near the stalk on plums, which often oozes brown liquid surrounded by frass.

HOW TO TELL THEM APART

Of the two moths, when compared side by side, plum fruit moth is usually the larger of the two.

While it is usually grey/brown in colour, plum fruit moth has an indistinct darker cross band two-thirds of the way down its back. Conversely, *Grapholita tenebrosana* is a uniform brown or grey/brown in colour. There is also a subtle difference in their wings: plum fruit moths have a rounded end to their wings, whereas *Grapholita tenebrosana's* wings form a 'V' shape at the end (as pictured).

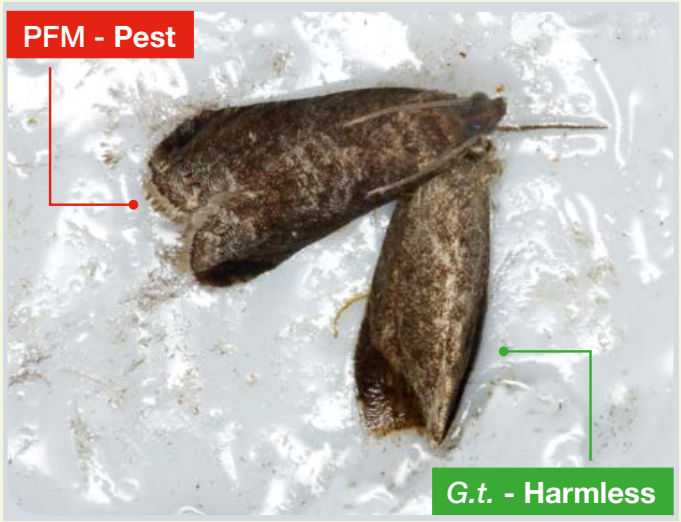
They can be further separated by the colour of the palps: dull greyish brown in plum fruit moth, greyish white on *G. tenebrosana.*

Another identifier is that *Grapholita tenebrosana* is more likely to be caught early in the season.

For more information on plum fruit moth and how to identify it in your crop, download our factsheet from our website **horticulture.ahdb.org.uk**

THE ENEMY: PLUM FRUIT MOTH (*GRAPHOLITA FUNEBRANA*)

OFTEN CONFUSED WITH: *GRAPHOLITA TENEBROSANA*



THERE'S SOMETHING **IN THE AIR**

Roy Kennedy, Pershore College, looks at how we can improve control of the airborne pathogen gummy stem blight in cucumber production

Many plant pathogens spread between and within crops through the air. By detecting these diseases (spores) in the air before they infect the crop, growers can take action at an early stage to minimise infection, through timing treatments at the earliest stage that infection is likely and by applying the most suitable treatment to control the pathogen in question. Field vegetable growers have been successfully using such detection systems to control *Pyrenopeziza brassicae* (light leaf spot) since 2003, *Mycosphaerella brassicicola* (ringspot) since 2008 and *Albugo candida* (white blister).

> "Just one hour of free water on leaves is sufficient for initial infection"

This approach is being developed for *Mycosphaerella melonis*, known as gummy stem rot or Myco. Myco is an economically damaging disease of cucumbers which causes extensive stem and leaf infections which can kill plants, while airborne infection of flowers and developing fruit leads to fruit end rot. Often, disease symptoms are not visible until the fruit is marketed. This leads to rejection and reduced retailer and consumer confidence in the product. Unfortunately, effective control of the disease in intensive production systems is difficult. The most significant contributor to establishing the infection is how long plant surfaces remain wet. Just one hour of free water on leaves is sufficient for initial infection, and continuous leaf wetness is required for subsequent development. Germination and spore production, development of symptoms on stems, and infection of cucumber leaves, petioles and flowers can occur over a wide range of temperatures (5°C to 35 °C), but optimum temperatures are around 24°C to 25°C.

Monitoring this disease in glasshouse production systems should, in theory, be easier than monitoring under field conditions. Stockbridge Technology Centre and Warwickshire Colleges (Pershore College) are working together on project CP 137 to find control solutions for this disease via a range of activities.

Fungicides are used routinely to suppress the disease and prevent plant and fruit losses. The fungicides that are available in the UK for use in cucumber production (primarily for powdery mildew control) provide only a partial suppression or reduction of Myco. No resistant cultivars are available and there is a suggestion that the mildew-tolerant cultivars now widely grown commercially are more susceptible to Myco.

MONITORING THE PROBLEM

By monitoring the air in glasshouse crops, we can detect the Myco pathogen and control measures can be applied before symptoms appear. In the UK, using either laboratory-based analysis or a do-it-yourself test, AHDB Horticulture-funded work has developed systems to monitor air samples and detect Myco on a daily or a weekly basis.

Detection tests developed within CP 137 have been used to detect the ascosporic stage of gummy stem blight. These measure Myco disease pressure in cucumber glasshouse air samples. These tests were used to monitor the air at three UK commercial cucumber production sites during 2015 and 2016, and at two sites in 2017. This was carried out in order to assess the accuracy of the diagnostic techniques being developed. Initially, this was a laboratory test but progressed to a 'do-it-yourself' test which could be implemented directly by the grower as it is for ringspot on vegetable brassicas.

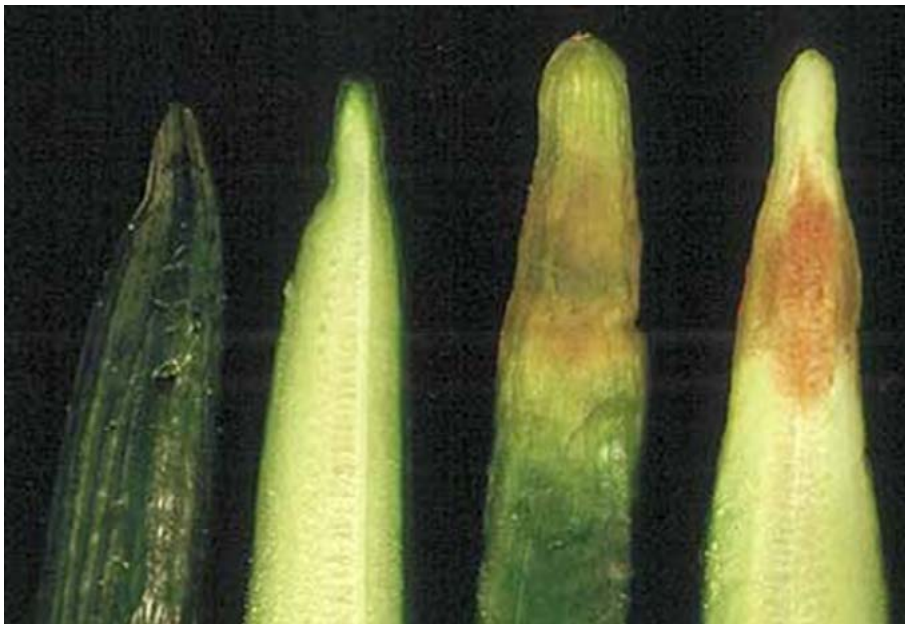
Little disease (*Mycosphaerella melonis* ascospores) was observed in air samples from our two commercial trial sites (Site 1 and Site 2) on the base of the air sampler collection wells until April 2015 from both the traditional microscopic assessment of air samples and from the results of the antibody laboratory test (Figure 1). *M. melonis* ascospores were visible by microscopic analysis from the outset at Site 3 and this coincided with the increased antibody signals recorded. At each of the nurseries, *M. melonis* spore concentration was seen to rise steeply from the end of April into May.

> "Often disease symptoms are not visible until the fruit is marketed"

Timely information on disease concentration in the air should provide growers with capability to identify periods when crops are at risk and improve management of the disease through informed control strategies.

This diagnostic system was extended to include cucumber powdery mildew. Like other powdery mildew diseases, its symptoms are characterised by the talcum-like, powdery fungal growth that develops on leaf surfaces, petioles and stems but rarely on fruits. It was thought that *Podosphaera fusca* (also known as *Podosphaera xanthii*) was solely responsible for the disease in UK cucumber production. However, by DNA analysis of the air samples, *Golovinomyces orontii* has also been identified in UK growers' air samples and cucumber leaf material. In continental Europe, both pathogens are identified as causative agents of cucumber powdery mildew. This is the first report of *G. orontii* in UK cucumber production systems.

At present, growers only know that powdery mildew is present once symptoms are observed and the pathogen is established within the crop. Recent trials have shown that powdery mildew is often present at planting but is undetectable using conventional methods. There are new developments for commercially available biocontrol products, but in general their level of efficacy is not yet up to the standard required by growers for effective control. Knowing when the disease is first threatening the crop through effective diagnostics could help improve this efficacy.



AHDB project code: CP 137

Project lead: Roy Kennedy and Alison Wakeham, Pershore College

AHDB contact: Gracie Emeny

NEW MEDIA TO **BEAT PEAT**

Dr Barry Mulholland, ADAS, provides an insight into the work on transitioning to responsible media in a range of crops

The Government's recent 25-year environmental plan included a voluntary phase-out target for peat use by 2030 for professional growers. The ability and speed at which this will happen largely hinges on the confidence of the industry to change to peat alternatives but at an acceptable level of risk.

CP 138, now in its fourth year, has been designed to communicate the benefits of a scientific approach to designing new growing media blends from responsibly sourced growing media (RSGM). Prediction of plant performance from selected growing media physical properties will help to streamline the selection and production of consistent and high-performing, affordable peat alternative products that can be used routinely and safely in containerised horticulture production systems.

Over the last 10 years, the UK growing media industry has developed coir, wood fibre, bark and green compost raw material streams that can be reliably and consistently sourced and manufactured. These 'peat alternatives' are predominantly formed of plant cell walls – fibrous organic materials that are selected on the basis of having properties that will emulate the industry standard, peat.

The main approach for RSGM development is to blend materials based on the expert knowledge of the growing media manufacturers. This also allows manufacturers to create products that have a comparable price point to peat. A notable exception is coir, which can be used alone, but for some sectors with small profit margins, coir can be too expensive and the supply chain problematic. This has raised uncertainty around the ability to supply a consistent product and in the volumes necessary to satiate the potential demand from UK growers to replace peat.

CP 138 was, however, tasked with understanding how to create high-performing blends from available RSGM materials.

SELECTION OF FIRST-GENERATION PROTOTYPE BLENDS

During 2016, experimental and modelling work set about identifying how best to describe a growing media material. The work was able to demonstrate that a growing media is effectively quantified by using three physical parameters: air-filled porosity (AFP), available water (AW) and bulk density (Db). By doing this we were able to compare the different commercially available raw materials supplied by participating growing media manufacturers, either alone or in combination, by plotting a single average (centroid) point for each. The first-generation prototype blends selected were those that came closest to the peat centroid; interestingly,

we were not able to replicate the peat centroid. An 'outlier' was also included that we assumed would perform poorly. A small number of blends were selected and tested with high replication. Overall, the blends performed well and produced marketable-quality plants and the outlier performed poorly; the acid test was would they work in this way on commercial holdings?

GROWER-HOSTED TRIALS 2017

In 2017, the three first-generation prototype blends that were tested at ADAS Boxworth in 2016 were taken out on to six commercial nurseries and trialled under 'real-life' growing conditions, using a range of crops. At each nursery, the three prototypes were compared against the nursery's standard growing media. Fertilisers were added to the blends as appropriate, using the nursery's standard product as a guide.

RASPBERRY PROPAGATION

Using the varieties Maravilla and Glen Ample, cuttings were stuck into 84-cell trays in week 15, propagated under polythene and then a subsample transplanted into two-litre pots (two plants per pot) in week 21. It was noted that the three prototype blends were producing good-quality young raspberry plants.

Plants were grown on throughout 2017 using outdoor beds and assessed every six weeks until December 2018. Throughout that time, there was very little difference between treatments in terms of cane height and number of nodes. The Glen Ample were placed in cold store in December 2017 and the plants are now being grown on throughout 2018 so that bud development and yield can be assessed.

> "The blends performed well and the outlier poorly; but would they work in this way on commercial holdings?"

STRAWBERRY PROPAGATION

Propagation of the variety Elsanta started in week 28 and the plants were placed within an uncovered tunnel. They were assessed in week 32 and a subsample was planted into 9-cell trays, which were grown on in the same uncovered tunnel. The trial was assessed every six weeks until December 2017; there were no visible differences between treatments during that time. Crown size was measured in December, and the nursery control, plus two of the prototype blends, produced the biggest crown size. The plants were placed in cold store and are now being grown on throughout 2018 so that plant development and yield can be assessed.

TOP FRUIT

Two trials were carried out on top fruit, using Christmas Pippin Apple and Summersun Cherry. These were planted into 12-litre pots in week 12 and grown on outdoor beds until May 2018. The trial was assessed at four-week intervals during flowering and then at eight-week intervals after flowering. Throughout the trial, there were no significant differences between treatments for cherries, although some differences were seen with apple. Branch extension was greater in all three prototype blends, and one of the prototypes gave a significantly larger leaf area. The trials were allowed to overwinter and a final assessment was completed during flowering in May. The trees had all overwintered well and produced a strong root system in all treatments.

MUSHROOMS

Mushroom production requires a very wet, sticky peat, and therefore a slightly different approach was taken for this trial, to try and produce a blend with similar properties to the nursery peat standard. Eight treatments were tested, which comprised the prototypes on their own, as well as in a blend with the nursery standard peat, a 100 per cent peat standard and a peat/aged digestate blend. The performance of the blends was generally variable and the trial took two to three days longer to produce the first flush, compared with the commercial trial located in the same tunnel. Although mushroom quality was relatively good, the mushrooms were smaller than the nursery standard and yields were reduced in all treatments compared with the nursery standard. Overall, the prototype blends did not perform particularly well in this trial, either alone or in combination with 100 per cent peat.

BEDDING

Trials were carried out using Petunia Blue and Pansy Matrix White Blotch, grown under glass in polystyrene jumbo six-packs. Plants were assessed in week 24 – the target marketing week – and all three prototypes produced plants that were of marketable quality. One blend in particular produced a crop that was very similar to the nursery control in terms of plant height and root development, and although the other two prototypes were slightly smaller, the plants were still of good quality.

HERBS

Trials were carried out on basil (seed), chive (seed) and rosemary (plug) in both spring and autumn. The trial was grown on a gutter system alongside a commercial crop, using square 9cm pots. All three prototypes performed well in the pot herb trials, although there were differences between species and season. For basil, in the spring, the prototypes all produced a marketable

> For chive and rosemary, in both the spring and autumn, two of the prototypes were just as good as the nursery control

crop and there were no differences between them. In the autumn, two of the prototypes were just as good as the nursery standard. For chive and rosemary, in both the spring and autumn, two of the prototypes were just as good as the nursery control.

HARDY NURSERY STOCK

Trials were carried out on Choisya 'Goldfingers' and Hebe 'Heartbreaker', which were grown under glass, and Salvia 'Hot Lips', which was grown under polythene. All species were grown in two-litre pots, and the Choiysa and Hebe were grown on until April 2018. The trials were assessed every seven weeks and it was noted that while all prototype blends produced marketable crops, with well-developed root systems, there was one prototype blend that was just as good as the nursery control in terms of crop height and root development. This was evident across the three species.

The Choisya and Hebe were trimmed in week 41 and the plants were allowed to overwinter so that regrowth could be measured in the spring, 2018. At the final assessment in April, plants across all blends were growing well, with plenty of new growth and the roots remained healthy.

SUMMARY

We had identified from experimental and grower trials that, to produce marketable plants, the choice of growing media appears to be confined to a relatively precise triangulated 3D value, which is influenced by water delivery to the root-zone and plant type with adequate nutrient availability. The project also found that short-cycle crops, such as herbs, may require greater precision in terms of growing media selection and management, based on physical characteristics, compared with slower-growing woody taxa in containerised production. There were, however, differences in performance under protected and outside growing conditions. For example, material grown under protected experimental conditions did not produce the same pattern of growth response when grown on commercial sites outdoors (eg apple trees). This is important, as it demonstrates the value and power of commercial testing as a necessary step for horticulture research and development.

CP 138 is evolving a methodology for directed, as opposed to random or intuitive 'look-see,' mixing strategies. It also indicates how mainstream responsibly sourced growing media (RSGM) and the potential introduction of novel materials can be systematically incorporated to generate mixtures having targeted properties.

AHDB project code: CP 138

Project lead: Barry Mulholland, ADAS

AHDB contact: Wayne Brough

Peat-reduced nursery standard

Prototype 3

Basil performance at a commercial herb production nursery. Prototypes performed as well as the peat-based nursery control

THE SEASONS ARE CHANGING; SO SHOULD YOUR CLIMATE SETTINGS

GrowSave's Ed Hardy reveals what you can do to ensure your greenhouse is winter-ready and you don't waste vital heat, energy and money

Summer may only just be over, but the transition from autumn to winter will soon be upon us. As the days become shorter and the temperature drops, it's important to make sure your climate settings are correct.

Lower temperatures mean greater heat loss. As the temperature difference between inside and outside increases, the greenhouse will emit more heat, leading to longer heating hours and increased fuel costs. Some simple steps can help mitigate this, such as:

- Use of bubble wrap or similar to insulate side walls
- Greater use of screens – close earlier and open later
- Good air movement to ensure an even climate

Shorter days mean less light. Therefore, screens can be kept closed for longer, providing some additional insulation, especially under clear skies. The use of screens not only helps to save energy at this time of year but can also prevent the plant from becoming too cold and at risk of disease. Even if the glasshouse temperature is satisfactory, the plant will still radiate heat to the cold sky if a screen is not in place.

This can cause leaf temperature to drop below dew point, meaning condensation will form. Be aware that this can still occur even once the sun is up. Opening the screen too soon will allow cold air from above to drop down onto the crop, again creating a condensation risk. Consider keeping the screen closed until there is a net gain in radiation (ie incoming is greater than outgoing). Failure to do so will likely require a significant input of pipe heat.

Colder air means drier air. At lower temperatures, the moisture-carrying capacity of the air is reduced. It is quite possible, therefore, that the outside air is significantly drier than the warm glasshouse air. Depending on the desired level of humidity, it may be necessary to vent warm, moist glasshouse air and replace it with colder, drier outside air. Consider using a 'vent then heat' strategy for humidity control, rather than a 'heat then vent' strategy. Much of the energy used to heat up the moist air to reduce relative humidity (RH) will be wasted when the vents are opened (hot air rises) and the incoming air will have to be heated in any case.

Good air movement means a more even climate. Another option to help keep heating costs down is to make sure the glasshouse climate is even throughout. Temperature differences of several degrees can often be observed between the top and bottom of the structure resulting in different humidity levels. The use of fans to help mix the air can create a more even distribution and homogenous climate. The upside is not only improved growing conditions but also better energy efficiency, especially where only one measuring box is used. Controlling on one measurement location can lead to unnecessary heating (for example, the crop may be warmer than the measurement box) or excessive venting if RH at that location goes above the set point.

Measurement boxes and sensors should be kept clean, well-maintained and properly calibrated all-year round, but the change of seasons can be a good excuse to double-check everything is working as it should. It may also be worth considering installing some additional sensors for better and more targeted control.

For energy saving tips and knowledge, visit **growsave.co.uk**

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helping horticulture save energy

EQUIPPED TO **MANAGE**

In the second part of our look at the FERTINNOWA project, AHDB's Georgina Key discusses the latest technology available for meeting your water sustainability obligations

Water sustainability is a current hot topic in Europe. Dutch growers, for example, now have to have pesticide-free discharge water and have to recycle 90 per cent of their waste water back into their production systems. While this is not something UK growers have to contend with, it will set the 'sustainability' bar very high for nutrient and water management and will no doubt start to influence the standards expected here in the UK as well. Some UK growers already operate as semi-closed systems, and for those of you who don't, it is worthwhile taking a look at some of the technology and management options coming down the line.

WHAT ARE THOSE OPTIONS?

Fertigation equipment is any equipment used for irrigation and nutrient addition. It includes everything from the pipes you have on site, through to fully automated systems. Most, especially in the protected sectors, will have pipes, drippers, fertiliser and/or mixing tanks, and pumps, whether they are injection pumps or more advanced magnetic drive-injection pumps, which can cope with high flow rates while using very little energy and be automated. Many bigger businesses have started to capture and recirculate their drainage water. If you are a smaller business, this doesn't mean you have to run out and buy ebb and flood benches; elements of a recirculation system can be scaled down to suit you, for example improving water storage or the water cleaning process.

Working up the 'investment cost' scale, the nutrient film technique is less commonly used, where crops are grown in a shallow stream of water containing the nutrient solution and recirculated through the crop continuously using gravity and pump pressure. It can be used for crops from fruit through to potato mini-tubers and lends itself to a range of business sizes. On a larger scale, the deep flow technique is a large pool of water which has a stable water temperature and nutrient level. Plants are grown on floats. It works well for crops such as lettuce, but previous AHDB-funded work showed that ornamental crops such as stocks require very high oxygen saturation levels in the water, which could be a limitation for other crops too.

Sometimes innovation is about tweaking the technology you already have. Two such examples are subsurface drip irrigation and antimicrobial and anti-root additives. Subsurface drip irrigation does exactly what it says on the tin – drip irrigation is applied directly to the root zone, increasing precision and reducing losses from evaporation. It is important to get the installation right as it is underground and costly to rectify mistakes. Antimicrobial additives and anti-root additives are being trialled to prevent clogging of, and microfilms developing in, pipes and drippers, but will need to pass strict plant protection product standards as they could get washed into surface or ground water.

FERTIGATION MANAGEMENT – WATER AND NUTRIENTS

Across Europe, a range of techniques are used to manage water. Some growers have an overall system approach, such as water deficit irrigation, where crops are exposed to mild water stress, or partial root drying, where only half of the root system is irrigated one day, and the other half the next day. This has been used successfully in potatoes and vineyards with no adverse effect on yield. Crop water use can be anticipated using weather forecasting tools, or looked at retrospectively using previous season data or UN Food and Agricultural Organization statistics, for example.

For soil water status, tensiometers are tubes which measure the draw of water from a substrate, or you could go all out with a neutron probe (emits neutrons which are slowed down by water – the quicker they slow, the more water in the soil/substrate). There are also granular matrix sensors, time domain reflectometry sensors, capacitance probes and digital penetrating radar, all of which are described in the Fertigation Bible (see 'Useful links' box). To measure crop water status, dendrometers (they measure the shrinkage and expansion of plant stems due to water uptake/loss) can be used, or thermal infrared sensors, or leaf turgor sensors, to name but a few. Decision support systems can help simplify the calculation of crop water requirements, which take into account precipitation, solar radiation, transpiration losses from crops and substrates and overflow. Some of these tools also allow you to enter your own business parameters into the model to make the calculation bespoke to your needs.

With regards to nutrient management, soil or growing media analysis, leaf tissue or plant sap analysis are established ways of monitoring the nutrient status of your crop. For advice on sampling and interpreting the analysis, type 'sampling' into the AHDB horticulture website and follow the links to videos and factsheets.

Information about types of fertiliser can be found in the updated Nutrient Management Guide, available to order or download for free through AHDB. In addition to established agronomic approaches, there is now a wave of sensor technology filtering through the horticulture industry, with optical sensors available to measure crop nitrogen status (see AHDB project HNS 193) and sensors being used to monitor and manage salinity.

WHAT NEXT?

The main advantage of fertigation is the potential for much more precise control over irrigation and nutrient application. Information about the equipment mentioned in this article and more can be found in the Fertigation Bible. It gives a comprehensive overview of different equipment options. If you already know about a technology, the bible can be used to find out additional information. It is also possible to work your way up technical and cost gradients to suit your needs.

USEFUL LINKS

The Fertigation Bible can be downloaded for free at **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 **fertinnowa.com/technologies-exchanged/**

> “Sometimes innovation is about tweaking technology you already have”

SMART THINKING

AHDB's SmartHort campaign has been created to help growers tackle current labour-shortage issues. But what is it, and how can it help you in your business? Gracie Emeny explains more

SMARTHORT

With Brexit just around the corner and many horticultural businesses already reporting shortfalls in availability of quality labour, it is imperative that growers not only find ways to encourage new sources of labour into their businesses but also get the maximum potential out of their current workforce. With that in mind, AHDB's SmartHort campaign is looking to tackle these issues head-on and provide growers with the tools they need to not only keep their businesses running smoothly but also to help them prosper and push onwards during these uncertain economic and political times for the UK.

WHY HAVE AHDB LAUNCHED THE SMARTHORT CAMPAIGN?

SmartHort has been launched as a result of the concerns from growers over the labour shortages in horticulture.

Estimates put the current season shortfall of staff in horticulture at 15 to 17 per cent. The NFU Labour Providers Survey revealed there was a 29 per cent shortfall in seasonal labour in September 2017 and levels were expected to dip as low this autumn too. We need to work with growers to address this issue and ensure that businesses have the tools they need to remain competitive and resilient.
The SmartHort campaign will give us the opportunity to do that.

WHAT AREAS DOES SMARTHORT FOCUS ON?

The campaign has two clear strands: to look at improving management practices for the existing workforce and to identify

new technologies and innovation, such as robotics and automation, which could play a role in providing longer-term solutions.

HOW CAN IT HELP MY BUSINESS?

SmartHort will give businesses the opportunity to assess their current labour situation and consider the ways in which they make changes in light of labour shortages and rising wage bills. Our online labour-efficiency tool that is being developed will help businesses to identify training and skills gaps, with our workshops and best-practice guides helping to ensure businesses are getting the very best out of their available labour.

WHAT SHOULD I DO TO HELP DEAL WITH THE LABOUR CHALLENGES I'M HAVING IN MY BUSINESS RIGHT NOW?

One of the key things you can do is to fully understand all of your labour-related costs – doing this will enable you to identify areas where there might be possible savings. Have you got process maps for different areas of your business? Is everyone working to standard operating procedures? Have you got a comprehensive induction process that all of your supervisors follow? Incorporating management practices such as Lean and Champion into your business could see big increases in labour-related productivity. There are a series of Grower articles available on these topics – have a look and see what ideas you could try in your business.

WHAT DO YOU THINK ARE THE LONGER-TERM SOLUTIONS TO THE LABOUR CHALLENGE?

Following our first SmartHort study tour to the Netherlands to look at automation and robotics for glasshouses, it was clear that, realistically, the majority of the technologies are still a long way from commercial reality to have any impact in the short term on labour shortages. Instead, what we're seeing is a move towards partial mechanisation, using robotics and automation to support the more complex horticultural tasks such as harvesting. This concept of humans working alongside robots, or 'cobots', is something that we see having a long-term effect on the labour challenge and highlights the need for both strands of the SmartHort campaign.

I ONLY WANT MY LEVY SPENT ON CROP RESEARCH, WHY HAS AHDB AGREED TO FUND THIS PROJECT?

While crop protection research remains at the heart of our activity at AHDB, we understand from talking to growers that access to affordable labour has become one of the biggest concerns for nearly all horticultural businesses. As a high-priority area, it's important that we support appropriate work in this field and collaborate with growers to increase their resilience and productivity during this period of extreme challenge with regard to labour shortages.

WHERE CAN I GO TO FIND OUT MORE ABOUT THE CAMPAIGN AND WHAT RESOURCES ARE AVAILABLE TO ME?

There's lots of information on the AHDB website, where you can find out more about SmartHort, including upcoming events, news items, articles and links to the AHDB skills information that sits alongside our labour-efficiency work.

For automation and robotics, we'll be exploring their role in the industry at SmartHort 2019, a two-day conference dedicated to driving innovation into horticulture. Guest speakers from around the world will be sharing some of the most impressive and exciting technological developments that could change the way you grow. It is also an opportunity to discover the latest high-tech advancements, meet the people behind the innovations and find out how to invest in the technology that could make a positive impact in your business. The conference takes place in Stratford-upon-Avon on 6 and 7 March. You can book your place at **horticulture.ahdb.org.uk/events**

HOW CAN I GET INVOLVED WITH THE CAMPAIGN?

You can get involved with SmartHort in numerous ways: engage with us on twitter **@AHDB_Hort** using #smarthort, contact Grace Emeny on **gracie.emeny@ahdb.org.uk** or come and talk to us with any ideas and feedback at upcoming AHDB events.

> "Estimates put the current season shortfall of staff in horticulture at 15 to 17 per cent"

THE RISE OF THE **HEALTH-CONSCIOUS** CONSUMER

Steven Evans, AHDB Consumer Insight Manager, shares some of the valuable trends for fresh-produce growers

At the recent AHDB Consumer Insight Conference, held in Stratford-upon-Avon, research and insights company Kantar presented a piece exploring how health has become a key motivator for consumers' food choices. It was apparent that there was a tension between the growth in obesity as a social challenge and the growing interest in health.

Twenty-seven per cent of the UK population are now classed as obese and this costs the British economy £47 billion per year. These people aren't choosing healthy foods: they are more likely to drink sugary soft drinks and eat ready meals and takeaways. On the other hand, there is a real will to seek out healthier ways of living. Vegetarian meals are growing in popularity, more people are choosing to cut down on alcohol and 16 per cent of the population now owns a fitness tracker.

Enjoyment and practicality remain the key lynchpins for the majority of meal choices, but over the last year, health as a reason for choosing food has grown at a faster rate than both of these well-established motives and, according to Kantar Worldpanel, is up 14 per cent on five years ago.

Amid this background, there are key opportunities for horticulture. The need to increase fruit and vegetable consumption is a key health need and as a society we're not very good at it. The average intake of fruit and veg is a mere 3.1 portions per day. People want healthy foods with several benefits – it has to be healthy but also tasty, filling and easy to prepare. This highlights opportunities for innovation among farmers, growers and processors to produce products that tick more of these boxes and help people to achieve their health goals.

TARGETING 'YOUNG CONSUMERS'

Consumers often retain the habits that they build up early on in life as they age. There is an argument that younger generations are living differently to the generations before them and it is therefore important that young consumers' needs and attitudes are understood. They will form an increasingly important sector of the grocery market and will ultimately become the older generation of the future.

AHDB's research was focused on those between the ages of 18 and 34 years old. It was clear that there are a wide range of factors which influence choices made by young consumers – a combination of practical and cultural dynamics which impact their eating habits.

Practical influences include time availability, money and biological

restrictions which impact diet. Cultural influences include ethical beliefs, nationality and widespread use of social media and portable technology. Modern technology provides a constant stream of information to users, increasingly making it difficult to distinguish between fact and fiction. This was found to cause distrust and confusion, particularly when mixed messages exist regarding what is and isn't healthy.

> **"The average intake of fruit and veg is a mere 3.1 portions per day"**

It was suggested that although many young people enjoy cooking and some would like to cook from scratch, many feel restricted by time or a lack of knowledge or confidence with cooking. Awareness of different health and lifestyle diets (such as clean eating or meat reduction) was high among people in this age group, although participation seemed relatively low.

Overall, it was highlighted that in order to communicate effectively with this audience it is important to promote product usability and utilise the social media channels which young people use.

THE INTERNATIONAL CONSUMER

Market access, trade deals and exchange rates all have a big impact on our ability to export British produce to different countries, but, once trading in a new market, understanding consumer buying behaviour and the drivers around purchase decisions is fundamental if we are to reap the rewards of overseas trade.

This prompted us to ask how much do we really know about shoppers in other parts of the world and how well does 'Brand Britain' translate in complex and diverse markets?

In our International Consumer Buying Behaviour Horizon report, we have explored these questions by looking at exporting from a consumer perspective – something we have never done before. We compiled the views of more than 4,500 consumers in nine countries, from our key markets in North America, Europe, the Gulf States and Asia, around what motivates and drives them to choose the food they buy.

We discovered that behaviours, motivators and perceptions differ greatly across the globe – although the key themes that came through touched on price, quality, health and food safety. In seven out of the nine countries surveyed, 'quality' was branded the most important factor, but the first very notable variation came from the two countries that differed – China and Japan – where 'food safety' came out as critical. Shoppers in both of these countries would benefit from key assurances on the standards of produce, and providing further details on traceability and welfare could put British products in a much stronger position with consumers.

WHAT DO SHOPPERS ABROAD VALUE?

The combined scores across the countries highlighted that for fruit and vegetables three variables feature most commonly, these being quality, price and appearance.

When asked to think about associations with British food, the most common response was 'Don't know', suggesting that awareness of British produce specifically is low and many people throughout the countries studied have no clear opinion. There are great products to export – providing consumers know the key selling points beyond the country it comes from.

This report is an important step to understanding the needs of international consumers. Our next steps will be to gain more detail about individual category trends in different countries and go beyond the data to build a picture of who the end consumer is within different markets. This will be key to unlocking export opportunities as we move into a post-Brexit world.

AHDB'S RETAIL AND CONSUMER INSIGHT TEAM

AHDB's Retail and Consumer Insight team actively tracks, monitors and evaluates consumer behaviour.

We would love to get your thoughts on the topics covered and would be more than happy to help with any consumer-related questions.

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NON-CHEMICAL GROWTH CONTROL IN POINSETTIA CROPS – A VIABLE ALTERNATIVE?

Neil Bragg, Bulrush Horticulture, and Wayne Brough, AHDB, explore the potential of water deficit irrigation as a future method of growth control in commercial poinsettia production

One of the key issues facing growers of ornamental crops is the availability of a sufficient number of plant protection products to achieve the necessary control of pests, diseases and weeds, and also for the management of plant growth and habit, to maintain the level of plant quality currently demanded.

Residue testing is increasingly being deployed by the supply chain as a means of monitoring plant protection product use and this is now being extended to ornamental crops. In the case of ornamental crops, maximum residue limits (MRL) are often based on corresponding edible crops or limits based on the current level of detection achievable in the laboratory. For plant growth regulator products, this is important, as many are only used on ornamentals, and even where they are used on other crops, they tend to be outdoor 'broad acre crops', such as wheat (chlormequat), or top fruit and grapes (prohexadione). This could result in MRLs being set which are difficult, if not impossible, to comply with and still maintain the desired level of growth control and plant shape.

Therefore, other methods of control to supplement, or eventually even replace, the use of plant protection products are required. As there are already a diminishing number of plant growth regulator products available to industry, an investigation of alternatives commenced some time ago. Both physical and cultural methods have previously been examined on ornamental crops, including brushing the tops of plants, alternating or dropping growing temperatures, the use of phosphate buffers in the growing media and also by restriction of irrigation water. The latter option has traditionally been viewed with a level of caution by growers when applied to poinsettias, as the plants are easily damaged by relatively low levels of applied stress. The objective was to find a suitable method of applying and closely monitoring the stress to achieve growth control while minimising the risk of crop damage.

TESTING METHODS

In 2016, a commercial crop of poinsettias was grown at Neame Lea Nursery near Spalding, on ebb-and-flood-type benches, using irrigation water as the main means of controlling plant growth and keeping the crop within the height parameters indicated by the graphical tracking software employed by the business. Based on the apparent success of this work, it was decided to repeat the commercial production in 2017, this time measuring the volumetric moisture content (VMC) of the growing media, via a monitoring procedure previously developed at NIAB EMR by Dr Mark Else, as part of project PO 021a.

In this system, moisture probes were linked via a hardwire system to a data logger which generated moisture content data in real time. For this particular trial, a single poinsettia variety was used, 'Infinity Red', and three different growing media blends were examined. Each blend was calibrated ahead of the trial, and during the growth period, from July through to the end of November, plants were assessed at different times to calculate their permanent wilting point (PWP). This latter point is particularly important as knowledge of the exact value of PWP for the crop at different stages of growth is vital to avoid the occurrence of visible stress damage (in this case the PWP was around 7 per cent VMC).

During the trial, a reduction of VMC to 17 per cent or less was recorded on two separate occasions between weeks 39 and 43, and it was this stress (while avoiding any visible symptoms of leaf stress) which produced the growth control. According to Mark Else, the ultimate objective is to provide exact values in terms of stress application. Based on previous Defra-funded work, stress levels between 17 per cent and 12 per cent VMC will control growth, providing a margin of at least 5 per cent before visible wilting occurs. Applying a stress episode, followed by rewetting back to container capacity, on three or four sequential occasions within a three-week period, during rapid stem elongation, should provide growth control. The exact time period will be determined by prevailing weather conditions, stage of crop growth etc, and irrigation frequency should be made in relation to vapour pressure deficit measurements.

The rewetting episodes are important not only to avoid stress but also to ensure nutrient uptake by the roots is not impacted. The rehydration process also permits the plant hormones which build up in the roots as a consequence of the induced stress to be transported back up into the shoots to deliver the growth control response.

CHALLENGES TO OVERCOME

At the end of the 2017 trial, it was felt that it had been possible to quantify the 'dry regime' imposed by the grower, the data collected supporting previous Defra-funded work, and that the commercial objectives had been met.

However, the trial had also highlighted two issues:

- The sensors used in the trial were all hardwired to the data loggers, and only then was the data wirelessly transmitted to the remote computers. This proved extremely time-consuming when plant spacing was undertaken and would practically cause a problem if not contained to a single ebb and flood bench. (The 'hardwired system' was originally developed for use in the soft fruit industry on static bags used for strawberry production.)
- While the system had been demonstrated to work on ebb and flood benches, many poinsettia crops are grown on the glasshouse floor, utilising a number of capillary matting and irrigation tape systems. There was no indication from the trial work that water deficit irrigation could be used in such a commonly used production system to successfully manage growth, as the matting essentially acts as an extra water reservoir beneath the crop.

> "A reduction of VMC to 17 per cent or less produced the growth control"

To address these issues and collect more data in terms of the stress levels applied, a further trial for 2018 has commenced. Earlier discussions with 30MHz – a smart-sensing company for horticulture – culminating in a visit to their trade stand at the GreenTech Tradeshow, resulted in the identification of sensors which could send information back to the remote computer via a wireless interface. Avoiding the need for any wired connection in a production environment obviously improves both the practicality and flexibility of the method.

In the trial this year, the moisture sensors are tracking the moisture content of the growing media and generating real-time data to determine the irrigation frequencies required to apply the actual stress episodes. A comparison will be made with crops managed by a grower. In the trial, three different poinsettia varieties have been grown, using a single standard growing medium, to see if there are varietal differences in any stress response.

To test whether such a system would work with a crop grown using capillary matting and trickle tape, the wireless monitoring system has also been employed within a parallel trial undertaken on another commercial nursery to gather information.

SEE THE TRIAL IN ACTION

At present, the trial is up and running and there will be an open day at Neame Lea Nursery, Spalding, on 22 November 2018 to view the variety trial, to see how the water deficit irrigation method has progressed and how the wireless interface sensors have performed on the capillary floor system. Following this, a second meeting is scheduled for 17 January 2019 at University of Lincoln, Holbeach Campus, to review the variety shelf-life results and obtain a more complete picture of the effectiveness of the methodology. To book your free place, visit **horticulture.ahdb.org.uk/events**

SCOUTING ROBOTS AND DATA-DRIVEN CROP PRODUCTION

A new wave of technology will bring an unprecedented level of data, information and analysis to horticultural crop production. Wayne Brough, Knowledge Exchange Manager, describes some of the new advancements coming from the Netherlands that may soon be helping you grow your crops

The advancement of sensors, smart cameras, artificial intelligence and 'deep learning' is creating a new generation of robotics that puts data gathering and analysis at the heart of horticulture crop production systems.

Scouting robots that can monitor for a range of physiological, pest and disease issues, as well as provide yield predictions, were one of the key trends seen as part of an AHDB SmartHort study tour to the Netherlands this year. These robots offer detailed information and a decision support system to provide growers with plant-scale information in large-scale production systems.

The IRIS Scoutrobot, winner of the GreenTech Innovation Concept Award 2018, is able to detect pests, diseases and deficiencies in pepper and tomato crops. Fully automated, it can assess the number and colour of the fruit in crops, as well as measure microclimate in different parts of the plant canopy.

Experts at Wageningen University and Research (WUR) have also developed scouting robots that can work within glasshouse crops of gerbera and tomatoes to both detect disease and predict crop yields. The PhenoBot scans tomato crops using a 3D lightfield camera to predict the number of fruit per plant and measure the quantity and weight of harvested fruit. It also uses chlorophyll fluorescence imaging to detect botrytis and can target fungicide treatments directly to the affected areas.

A scout for gerbera crops, which can be fitted to a harvest trolley or spray boom, uses high-tech sensors and data management systems to monitor crops for growth, pest and diseases. Near-infrared image cameras can detect powdery mildew and image analysis can predict bud and flower yields to aid cut-flower production.

It is hoped eventually that the robots can identify disease outbreaks prior to any visual symptoms on the leaf surface, which should result in both more effective plant protection as intervention can be done at an early stage of the infection, and also enable only the affected areas of the crops to be treated.

The ability to predict and monitor flower development and crop yields could transform the relationship between the farm or nursery with its customers, by being able to give accurate information about supply levels and timings, as well as helping to inform when best to harvest.

USING DATA AND GPS

In another new system developed by WUR, technology is being used to generate data and information to provide an understanding of the productivity of orchards. They have fitted a GPS unit to fruit-harvesting equipment to provide spatial yield information within the orchard. The data is then combined with information on fruit quality, level of fruit rots, etc to create 'heat maps' of the orchard. These data maps not only show productivity by individual row but also relative disease susceptibility, which is then used to amend future spray programmes to target specific problem areas within the orchard.

One of the ultimate goals for Erik Pekkeriet, Business Development Manager for Agro Food Robotics at WUR, is to address the challenge of developing a 'self-cultivating glasshouse', where the human element involved in production is reduced or even eliminated. In such glasshouses, the computer will decide about optimum climate set-points, based upon a wide range of information from sensors and cameras, while self-learning software will partly take over human decisions.

> It is hoped eventually that the robots can identify disease outbreaks prior to any visual symptoms

AUTONOMOUS CHALLENGES

This is no simple pipe dream; WUR are part of an international challenge in 2018, sponsored by Tencent (a Chinese conglomerate specialising in various internet-related services and products), to boost protected edibles production by using artificial intelligence (AI) and autonomous processes to improve production. It's an interesting challenge, one combining cutting-edge companies in software and hardware design, environmental control, sensing and research.

One exciting development resulting from this initiative is the involvement of representatives from companies such as Microsoft and Intel bringing new thinking to the aim of showing the benefits of AI to horticultural production. The five teams chosen to participate in this challenge began their data-driven management of a cucumber crop in glasshouse compartments at WUR in September.

Taking the concept further, WUR are also leading on a collaborative project testing the capacity for data-driven urban-farm-style crop production, but this time in a simulated space station. Already in place in the Neumayer III Antarctic station, the container is comprehensively monitored by a range of sensors, with scientists at WUR remotely steering management of the crop, which is implemented by a non-crop specialist.
While 'out of this world', the project is a true test of data-driven crop production.

The three-day trip to the Netherlands 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 campaign, tackling the issue of access to affordable labour by improving management practices and facilitating the uptake of new technologies.

To find out more about SmartHort, visit **horticulture.ahdb.org.uk/smarthort**

Progress for the Autonomous Greenhouse Challenge can be followed here: **autonomousgreenhouses.com**

SMARTHORT

THE ONLY WAY IS UP

Scientist and farmer, Sarah Hughes, unveils the amazing studies and results she encountered while travelling the world on an AHDB-funded Nuffield Scholarship, focusing on vertical farming

The Nuffield Scholarship is open to any person who works in farming, food, horticulture, rural and associated industries or is in a position to influence these industries. The idea behind the funding is to allow a scholar to expand their and the industry's knowledge about their chosen subject which will ultimately benefit both their career and the industry. One such person who undertook a recent Nuffield scholarship is Sarah Hughes, who owns the popular edibles company 'Eat My Flowers' (**www.eatmyflowers.co.uk**). Her project took her across the globe to try to discover how vertical farming works from a viable economic perspective. We spoke to Sarah to discover why she undertook the 18-month project and what happened along the way.

Q: HOW DID YOU COME UP WITH THE IDEA FOR YOUR SCHOLARSHIP PROJECT?

Sarah: I run an edible flower business and we also farm sheep and beef in North Wales. I have been interested in controlled environment agriculture (CEA) for some time and wanted to investigate further the breadth of opportunities, business models and crops that it could achieve. I started the journey looking to see if we could grow hydroponic animal feed economically, or energy crops, and ended it looking into how the market for vertical farming and CEA, covering the whole range from high-value crops like micro-herbs to plantceuticals, is developing. I also tried to look into more detail at what were the start-up costs, running costs, what investors looked for and which type of businesses are using this technology.

Q: WHERE DID YOU VISIT AND WHAT DID YOU LEARN FROM EACH OF THESE PLACES?

Sarah: I visited Brazil (Contemporary Scholars Conference and study tour), Japan, the Netherlands, California, Dubai and Germany. I also visited some projects closer to home to see where the UK is at currently. I roughly split my topic into four sections: technology; scale and automation; crop types; and practical application. Some countries such as Japan have very advanced technology, the Netherlands have lots of automation on a large scale, while Brazil, Japan and California have crops not grown in the UK, and Dubai has a more extreme climate.

Q: WHAT WAS THE MOST SURPRISING THING YOU LEARNED? WAS THERE ANYTHING DIFFERENT TO WHAT YOUR INITIAL EXPECTATIONS WERE?

Sarah: Apart from the fact that Californians love Brussel sprouts?! On a serious note, I found my travels really made me open my mind to different ways of growing horticultural products. I found my preconceptions about the industry

> "It allows you to look at your business with fresh eyes and to really focus on something specific"

Name:
Sarah Hughes

Company:
Eat My Flowers

Scholarship title:
Vertical Farming – Does the economic model work?

were challenged and I was amazed at the breadth of businesses using controlled environment agriculture. I was really interested to compare CEA and what is currently available in the 'conventional' glasshouse model and found the differences weren't as much as I had imagined.

Q: IS THERE ANYTHING THAT YOU SAW THAT YOU THINK WOULD TRANSLATE WELL TO THE UK MARKET OR THAT YOU WILL TAKE BACK WITH YOU TO YOUR OWN BUSINESS?

Sarah: I was really impressed at the positive and open-minded attitude of a lot of the business owners, many of whom didn't have a conventional horticultural background. They looked very much at what the customer wanted first (sometimes too much so!), then worked backwards from there. I was also impressed with some of the projects I saw using robotics and supplementary lighting. Perhaps for current glasshouse growers, a hybrid model could be the way forward.

Q: AFTER VISITING OTHER PLACES, HAS YOUR OPINION OF UK GROWING CHANGED AT ALL? DO YOU THINK WE ARE WELL SET FOR THE FUTURE OR HAVE SOME CATCHING UP TO DO?

Sarah: In many ways, I have been amazed how sophisticated the horticulture (particularly glasshouse) industry is in the UK. Compared with arable and livestock (sheep and beef), they are way ahead when it comes to embracing technology and really knowing their growing system in detail. I was also pleased to hear that the UK has one of the best climates for glasshouse growing in the world (it's cheaper to add heat than take it away, one professor told me). However, I have been impressed in countries such as the Netherlands at their willingness to work together as growers to form co-operatives or develop new technology. They seem to think that although they may be growing the same product as someone locally, by collaborating, this will give them a competitive advantage worldwide, which for them is the greater goal.

Q: WOULD YOU RECOMMEND A NUFFIELD SCHOLARSHIP TO OTHERS?

Sarah: Gaining a Nuffield Scholarship has been one of the best things I have done. It opens so many opportunities for both personal and business development. It allows you to look at your business with fresh eyes and to really focus on something specific, an opportunity not available in the business of daily life. The contacts worldwide you make doing a Nuffield Scholarship will be with me now for life and I hope that it will also provide some up-to-date knowledge to the wider industry which will be of use too. There is a great opportunity for other people working within the UK horticulture industry (flowers/fruit/veg) to apply and I really would recommend it to anyone.

AHDB

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