AHDB

Soft Fruit Review 2019/20

HORTICULTURE

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Foreword

Welcome to the 2019/20 *Soft Fruit Review*, which summarises the current research AHDB is funding on behalf of soft fruit growers.

In my role as panel chair, I work closely with our soft fruit panel members, growers, agronomists and technical directors in the industry, to ensure that we continue to focus research expenditure in the correct areas for your needs. We receive support from the AHDB crop protection team to identify pending losses from our armoury, enabling us to find alternative control products or to initiate essential research to develop novel management and control techniques. To this end, a significant share of our research budget is allocated to pest, disease and weed control.

One of our principal aims is to maintain and improve the control of spotted wing drosophila. The latest progress in Project SF/TF 145a and associated PhD studentship studies are summarised from page 6. We have made some interesting progress in 2019, developing repellent and bait sprays.

We have also made advances in detecting western flower thrips and controlling aphids in strawberry crops, and we are currently following up positive findings with a push-pull approach to capsid control. Further use and development of the strawberry powdery mildew model has allowed us to demonstrate how a managed control programme can reduce the required number of fungicide applications, compared with a grower's routine spray programme.

We also continue to improve our knowledge of *Phytophthora cactorum* in strawberry and *Phytophthora rubi* in raspberry. We have used the SCEPTREplus project to fund new research into weed control in blackcurrant, capsid control in strawberry and midge control in cane fruit. You can read about all of our progress on page 15.

Our funding of the East Malling Strawberry Breeding Club and the UK Raspberry Breeding Programme at the James Hutton Institute continues to deliver new and improved varieties to the industry and some of these are being demonstrated to growers at the WET Centre at East Malling and raspberry demonstration tunnels at the James Hutton Institute. I am pleased to report that we are now part-funding the WET Centre, which allows us to demonstrate not just precision irrigation and nutrition, but also the results of other AHDB-funded research.

I wish you a successful season in 2020.

Louise Sutherland
Soft Fruit Panel
Chair

Pests and diseases

Finding alternative crop protection solutions

Growers value our work to secure new and alternative crop protection products. In soft fruit, we work closely with the AHDB soft fruit panel of growers and advisers to keep abreast of the highest priority pest, disease and weed problems. We undertake regular 'gap analyses' to highlight where extra measures need to be taken to find alternative products, and where we should be focusing our research and development or knowledge exchange work.

A list is drawn up of pests, diseases and weeds that are dependent on a diminishing number of products – and, in some cases, a single product – for control. Our crop protection team works closely with the government's Chemicals Regulation Division (CRD) and agrochemical manufacturers to keep track of those products that are at risk of losing their approval status. We then use this information to pinpoint likely trouble ahead. We also closely track the EU and UK approvals databases to monitor changes as they occur. By keeping a step ahead, we are able to implement measures to find alternative solutions before products are lost for good.

In some cases, new alternative chemistry or biological control agents become available to the industry. However, the arrival of new products does not keep pace with the loss of approvals so we tend to be firefighting for much of the time as we seek alternatives. We frequently submit Extension of Authorisation for Minor Use (EAMU) and emergency authorisation applications to CRD to secure these alternatives. To achieve this, we have developed very good links and working relationships with the staff at CRD, agrochemical manufacturers, the EU Minor Uses Coordination Facility, overseas regulatory bodies and other foreign minor use facilities such as the USA's Inter-Regional Research No. 4 (IR-4) Project.

Over the years, many growers in the soft fruit industry have benefited from the hard work and efforts of Vivian Powell, who has secured many new approvals for us. Vivian retired from AHDB at the end of April 2019 and we wish her many happy and healthy years of retirement. Her colleagues continue to work tirelessly for us.

In the past year, we have worked closely with CRD and the soft and stone fruit industry – and in particular SWD Working Group chair Harriet Duncalfe – to secure EAMUs and emergency approvals to help us gain control of spotted wing drosophila (SWD). Important examples of products secured for SWD control include the EAMU authorisation for Tracer on outdoor strawberry and emergency 120-day authorisations for Exirel on raspberry, blackberry and blueberry, and Benevia 10 OD on strawberry.

A list of the key products delivered through AHDB activity in the past year is found in the table opposite. Note that some of these approvals will have lapsed by the time of printing this publication.

Growers and grower groups who have concerns about impending losses of crop protection products should contact the AHDB Horticulture crop protection team at **EAMU@ahdb.org.uk**

EAMUs secured in 2018/19

A list of the key products that have been delivered through AHDB activity in 2018/19 are found in the table below. Note that some of these approvals will have lapsed by the time of publication.

Product	Active ingredient	EAMU No.	Crops	Target pest/disease
Serenade ASO	*Bacillus subtilis*	2356/18	Outdoor strawberry	Botrytis
Movento	spirotetramat	0245/19	Outdoor blueberry, blackcurrant, redcurrant and gooseberry	Aphids, leaf curling midge
Decis Protech	deltamethrin	0635/19	Outdoor blackcurrant, redcurrant and gooseberry	Capsid, caterpillar, sawfly, thrips
Decis Protech	deltamethrin	0636/19	Outdoor strawberry	Caterpillar, thrips
Coragen	chlorantraniliprole	0809/19	Outdoor blueberry, blackcurrant, redcurrant and gooseberry	Carnation tortrix, light brown apple moth
Batavia	spirotetramat	1054/19	Outdoor blueberry, blackcurrant, redcurrant and gooseberry	Aphids, gall mite
Fytosave	COS-OGA	1910/19	Protected strawberry, outdoor and protected raspberry and blackberry	Powdery mildew
Ticza	fluazinam	2066/19	Outdoor and protected raspberry and blackberry	Raspberry root rot
Tracer	spinosad	2181/19	Outdoor strawberry	Spotted wing drosophila
Benevia 10 OD	cyantraniliprole	2686/19*	Outdoor and protected strawberry	Spotted wing drosophila
Exirel	cyantraniliprole	2687/19*	Outdoor and protected blueberry	Spotted wing drosophila
Exirel	cyantraniliprole	2870/19*	Protected raspberry and blackberry	Spotted wing drosophila
Exirel	cyantraniliprole	2883/19*	Outdoor raspberry and blackberry	Spotted wing drosophila
Amylo X	*Bacillus amyloliquefaciens*	3147/19	Outdoor and protected raspberry, blackberry, blueberry, blackcurrant, redcurrant and gooseberry	Botrytis, cane blight, Cladosporium, powdery mildew
Flipper	fatty acids	3418/19	Outdoor and protected strawberry, raspberry, blackberry, blueberry, blackcurrant, redcurrant and gooseberry	Aphids, leafhoppers, blossom weevil, thrips, two-spotted spider mite, western flower thrips, whitefly

*denotes article 53, authorisation for 120 days.


Adult male spotted wing drosophila

Developing new control strategies for spotted wing drosophila (SWD)

AHDB project code: SF/TF 145a Development and implementation of season-long control strategies for *Drosophila suzukii* in soft and tree fruit
Term: April 2017 to March 2021
Project leader: Michelle Fountain, NIAB EMR

Since 2013, AHDB has been funding research into the management and control of spotted wing drosophila (SWD) and, in that time, we have greatly enhanced our knowledge and understanding of how SWD behaves in UK growing conditions and the best management and control options available to growers. The work continues in this project to develop novel approaches that may reduce our reliance on traditional crop protection products.

Developing a push-pull system

The aim of this work is to combine the use of repellents and attractants, so that the pest can be pushed away from the crop using a repellent and attracted into a trap containing a fatal component.

Research by NIAB EMR CTP student Christina Conroy has identified at least three potential repellents. These have been laboratory- and field-tested, and promising preliminary work with the repellents in the presence of a strawberry crop is underway.

NIAB EMR entomologists have developed a prototype 'attract and kill' trap, which has compared favourably with a commercially available alternative. Trials have shown that both devices achieve up to a 30% kill of SWD adults within 24 hours. However, a crucial observation made by the researchers is that, in the presence of ripe fruit, the efficacy of both devices decreased by half. This suggests that these traps/devices should be deployed in early spring, outside the crop, when there is no competition from ripening fruit and SWD populations are at their lowest.

Other work has focused on developing a dry formulation of the 'Cha-Landolt' lure that is contained within a sachet. This saves time on weekly changes of the liquid lures while also lasting up to six weeks.

Bait sprays

Using bait sprays in combination with spray control products should help to encourage SWD adults to feed on the spray product, improving the likelihood of control. When compared with a spray control product on its own, it offers the potential to gain the same level of control with a lower rate of product.

Following preliminary laboratory trials, field trials in 2019 compared a yeast (*Hanseniaspora uvarum*), or commercially available Combi-protec bait, combined with the product Benevia (*cyantraniliprole*), with a standard foliar application of Benevia. The baits were applied as a band across the top of the strawberry plant canopy with a specialised nozzle that produced course droplets. Although data is still to be analysed, the baits gave comparable control to the foliar spray. The Combi-protec band spraying (half the rate of the foliar spray) was as good as foliar full-rate application. Additionally, foliar applications of Benevia (full rate) were effective for two weeks after the last application.

Prolonging spray intervals

This work investigates whether growers might prolong their spray intervals beyond 7–10 days.

The scientists compared the use of weekly versus fortnightly spray programmes to control SWD in protected cherry crops. Results demonstrated that fortnightly sprays gave comparable efficacy to weekly sprays in these fruit crops. The work was repeated in 2018 and the results were similar. It was also noted that, where mesh was employed to exclude SWD from the crop, there were fewer adult SWD in the crop. Currently, a fully replicated spray trial is underway in a commercial raspberry crop to test if a similar approach can give comparable results for this fruit. The results will be made available in early 2020.

Reducing winter populations of SWD through precision monitoring

A new concept of reducing overwintering populations through precision monitoring is also being set up. Earlier research has demonstrated that populations of SWD peak in the autumn and early winter, but as available fruits in crops decline in number, adults disperse into hedgerows and woodland for food and protection over the winter period. NIAB EMR entomologists are using a grid of precision monitoring traps within woodlands at six sites through the autumn and winter months to attempt to 'mop up' numbers and thereby reduce the populations of adults emerging from the woodland in spring. SWD populations are being compared to untreated woodlands on the same sites. The team will also test egg-laying incidence using sentinel fruit placed adjacent to all 12 woodlands in the spring. Results of this work will become available in early summer 2020.

Potential organic forms of control

In associated work, which has been part-funded by the grower group Berry Gardens and the Worshipful Company of Fruiterers (a City of London livery company), experts at NIAB EMR have been searching for insects that act as a parasite of SWD. They have been trapping SWD from wild areas and identifying parasitoids (tiny insects whose larvae eventually kill their hosts) emerging from SWD pupae. Five species have been identified and the scientists are currently trying to estimate the percentage parasitism by UK parasitoids in the wild.

Traps to monitor overwintering spotted wing drosophila adults in woodland

Thrips infected with Beauveria bassiana

Further lines of investigation into spotted wing drosophila (SWD)

AHDB project code: CP 171 The use of highly attractive yeast strains for controlling *Drosophila suzukii* (spotted wing drosophila) (AHDB Studentship project)
Term: October 2017 to September 2020
Project leaders: Matthew Goddard, University of Lincoln and Michelle Fountain, NIAB EMR
PhD student: Rory Jones

AHDB Project Code: CTP FCR 2017 1 Developing a 'push-pull' strategy for the management of *Drosophila suzukii*
Term: October 2017 to September 2021
Project leaders: Michelle Fountain/ Charles Whitfield, NIAB EMR and Daniel Bray, NRI University of Greenwich
PhD student: Christina Conroy

AHDB Project Code: CTP FCR 2018 4 Understanding and optimising entomopathogenic fungi for control of spotted wing drosophila
Term: October 2018 to September 2022
Project leaders: Glen Powell, NIAB EMR and Tom Pope, Harper Adams Univeristy
PhD student: Laurence Mason

We are funding a series of PhD Studentship studies that are investigating a series of alternative SWD control strategies.

Yeast attractants as control agents for SWD

Rory Jones at the University of Lincoln, and NIAB EMR, is identifying different species and strains of yeast that attract *Drosophila* species. To date, three that are attractive to *D. suzukii* have been identified; namely, *Hanseniaspora uvarum*, yeast coded 218 and 190. Multiple strains of *H. uvarum* were attractive to *D. suzukii*, so there is much scope to produce attractive and selective baits for this problematic pest. Rory aims to use the best attractant strain, or blends of strains, of yeasts in 'attract and kill' systems, to reduce the reservoirs of overwintering adult flies after the fruits' main cropping period.

Developing a push-pull strategy for control

Christina Conroy is further developing the push-pull principle of control through her work with NIAB EMR and the University of Greenwich. This push-pull principle sees the pest pushed from the crop by insect repellents and pulled into a trap using substances that they are attracted to.

The aim is to optimise SWD attractants and repellents and their deployment in control programmes, which will hopefully reduce soft fruit growers' reliance upon traditional crop protection products. Fourteen potential repellents identified through the insect's anntenal responses have been narrowed down to three. These are repellent in the laboratory, prompting a different level of response in summer and winter forms of SWD. This could equate to a difference in antennal sensitivity between the two – a possible consideration for those developing new SWD control programmes. Christina has carried out an enclosed environment pilot study in strawberry crops, which has shown promising results and this will be followed up in 2020.

Optimising entomopathogenic fungi as control agents for SWD

Laurence Mason is investigating laboratory evidence which suggests that entomopathogenic fungi – that is, microscopic fungi that can infect and kill the pest – have shown promise in controlling adult SWD. The fungi *Metarhizium anisopliae* and *Beauveria bassiana* could both offer potential. The first aim of this project at NIAB EMR and Harper Adams University is to screen several strains of the fungus *Metarhizium anisopliae* for their efficacy in controlling SWD at various concentrations and fly-life stages compared to currently available treatments. The second aim is to improve our understanding of the genetics behind these fungal strains' ability to harm the pest.


Potato aphid

Developing improved and novel control of aphids in strawberry crops

AHDB project code: SF 156 Improving integrated pest management in strawberry
Term: April 2015 to March 2020
Project leader: Michelle Fountain, NIAB EMR
Research leaders: Tom Pope, Harper Adams University and Glen Powell, NIAB EMR
Project collaborators: Keele University, Centre for Agriculture and Bioscience (CABI), Natural Resources Institute, ADAS, Fera

The first four years of this project aimed to find improved aphid control methods because strawberry growers have been finding it increasingly difficult to control these insects, particularly in the lead-up to harvest. Both the potato aphid and the melon and cotton aphid prove to be the most difficult type to contain. Early work on potato aphid showed that the use of Hallmark with or without the wetting agent Silwet in tunnel-covered, field-grown crops gave 100% control when applied by a knapsack sprayer. Calypso gave moderate control initially, but aphid numbers increased after a few days. Chess with or without Silwet gave no difference to the control, which used water.

Studies were also carried out on naturally occurring predators for the level of aphid control they achieve. *Aphidius ervi* and *Praon volucre* were assessed in typical weather conditions experienced in early spring. *A. ervi* needs temperatures >8°C and *P. volucre* needs temperatures >12°C to be effective. Both will work early in the season at the part of the day when these temperatures are achieved. At lower temperatures, both are less effective.

A survey of aphids and their natural predators was undertaken on commercial farms. Potato aphid, and the melon and cotton aphids, were found to predominate in the season when it was assessed. The predators found included green lacewing, hoverfly larvae, *Aphidius* and *Praon* species. Aphid numbers peaked in early June, with predators peaking in early July, so the predator numbers caught up with the pest population and suppressed aphid numbers in July. It was concluded that natural predators could be relied upon to gain control by late summer but other control measures would be required early in the season.

In a screening trial to assess aphicides for the control of the melon and cotton aphid, three coded products gave excellent control, as did the insecticide Batavia. Trials on the potato aphid have just completed and the same products were also effective. The AHDB crop protection team will aim to seek new approvals for those coded products offering the best level of control.

In the fourth year of the project, trials were done using garlic planted into bag-grown strawberry crops under tunnels. The garlic leaves were snapped every two weeks and placed in the strawberry crop canopy. Compounds released by the damaged leaves are thought to act as a repellent to several pests. In these trials, strawberry aphid numbers were reduced, but not thrips numbers. There was no effect on numbers of predatory mites. These trials have only run for one year, so it is too early to make bold recommendations on these results but growers who wish to trial this for themselves should refer to the 2019 annual report for more details.

Developing safe integrated pest management (IPM) programmes on strawberry crops

AHDB project code: **SF 156 Improving integrated pest management in strawberry**
Term: April 2015 to March 2020
Project leader: Michelle Fountain, NIAB EMR
Project collaborators: Keele University, Centre for Agriculture and Bioscience (CABI), Natural Resources Institute (NRI), Harper Adams University, ADAS, Fera

A few crop protection products are known to be harmful to the predatory mite *Neoseiulus cucumeris*, which can disrupt integrated pest management (IPM) programmes. In particular, products used for thrips and capsid control can pose problems and it is suggested that repeated applications of fungicide mixes may also have an adverse effect on this predator.

The project

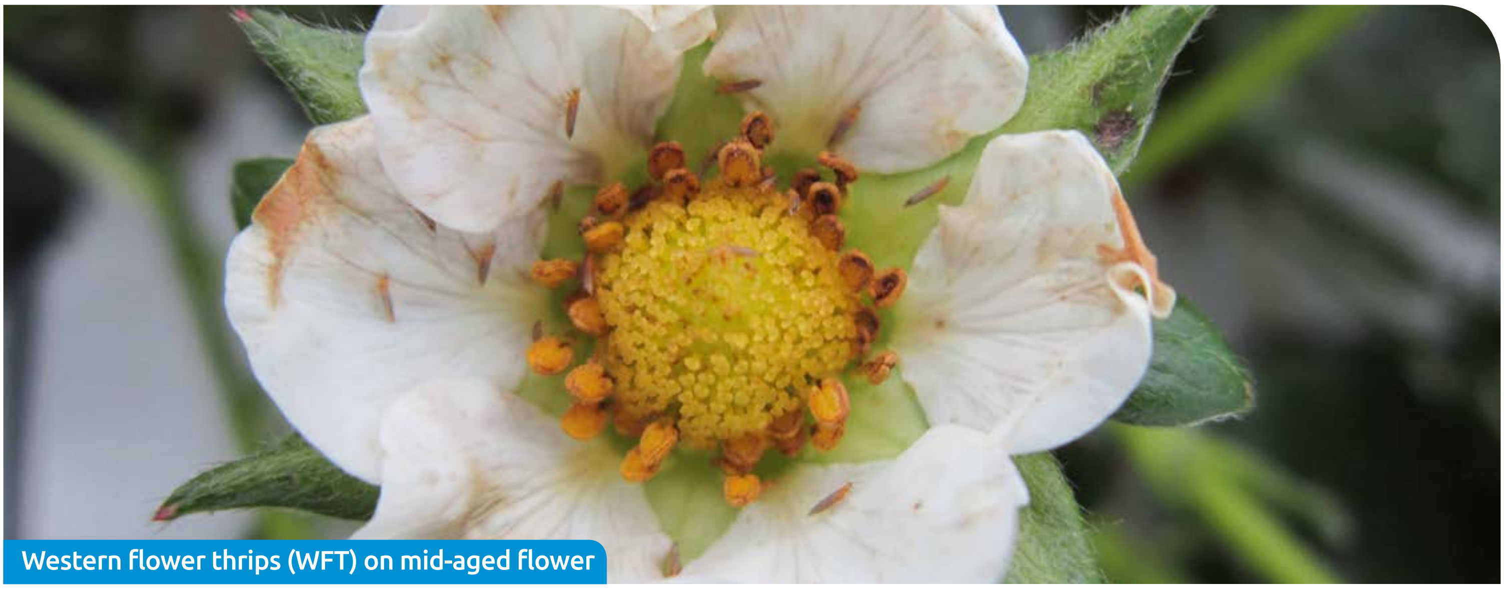
During the life of this project, the effect of a range of crop protection products, applied both singly and in tank mixes, have been assessed for their effect on the predatory mite, *N. cucumeris*.

Results

Early trials showed that a number of fungicide and fungicide/aphicide mixes have negative effects on the populations of *N. cucumeris*. The products Nimrod/Teldor, Signum/Systhane and Aphox/Rovral all reduced *N. cucumeris* after the third sequential application. However, the adverse effects only appeared after the third application and not before. In further trials, Calypso and Potassium bicarbonate + Activator 90 were tested over several applications and compared to Nimrod/Teldor but, in contrast to the earlier results, there was no evidence that any of these products/mixes had an adverse effect in that year of the trials.

A later study examined the effect of spring-applied Hallmark and Calypso for aphid control on the subsequent introduction and survival of the predatory mite, *N. cucumeris*, which was introduced into strawberry crops to control thrips and tarsonemid mites. The establishment of *N. cucumeris* adults, nymphs and eggs was not affected by an application of either Hallmark or Calypso and, indeed, following three releases of *N. cucumeris*, the population increased over time. Hallmark, which is suggested to have a persistence of activity against *N. cucumeris* of between 8 and 12 weeks, did not appear to have an adverse effect on mite releases in the field in this trial, following a single application.

This work suggests that if growers choose to use products that could affect IPM programmes, they should apply them early in the spring, before introducing biological control agents such as *N. cucumeris* thereafter as temperatures begin to rise.



Western flower thrips (WFT) on mid-aged flower

Improving our knowledge of the management and control of thrips in strawberry

AHDB project code: **SF 156 Improving integrated pest management in strawberry**
Term: April 2015 to March 2020
Project leader: Michelle Fountain, NIAB EMR, Jude Bennison, ADAS, Bryony Taylor, Centre for Agriculture and Bioscience (CABI)
Project collaborators: Keele University, CABI, Natural Resources Institute, Harper Adams University, ADAS, Fera

Western flower thrips (WFT) continue to pose difficulties for strawberry growers. It was felt that growers needed more guidance on the levels of thrips populations that are likely to lead to fruit damage and how many predators are needed to keep them below injurious levels. Novel control methods to supplement the predatory mite *Neoseiulus cucumeris* are also required. Growers and agronomists are increasingly finding additional thrips species in strawberries and research is needed to improve our knowledge of how these are contributing to fruit damage, if at all.

Results

Populations of *N. cucumeris* predatory mites are best assessed by examining young button fruits (fruits which have just set and the petals have recently withered). Populations of WFT adults are best assessed on mid- and old-aged flowers. Thrips larvae are found on both button fruits and flowers. The fumigant, methyl isobutyl ketone (MIBK), was successfully used to extract *N. cucumeris*, thrips adults and larvae, and *Orius* from flowers and button fruits.

A prototype extraction device has been designed by NIAB EMR and uses MIBK to extract pests and predators from flowers and fruits. In field tests, it recovered 27% of predatory mites from fruit and 5% from flowers. It recovered 68% of WFT from button fruit and 81% from flowers. The MIBK dispenser can be used at least 60 times before it needs replacing. The device helps in the detection of pests in the crop and improves the detection of predators, especially *N. cucumeris* and *Orius*, giving confidence that controls are working. The device requires further commercial development before it is available for growers to use.

In distribution trials, it was found that where WFT are present, significantly more *N. cucumeris* are found on flowers and fruits. Where WFT is not present, the predators, which had been introduced, were spread more evenly across the plant. In one of the field trials, as temperatures increased, the distribution of *N. cucumeris* and WFT larvae declined in the device. Conversely, the numbers of WFT adults and *Orius* adults increased. When sampling, if *N. cucumeris* or WFT larvae numbers are low, it is worth trying again when temperatures have decreased.

In trials to assess Met 52 as a control agent for WFT, lab tests showed that Met 52 sprays killed up to 60% adult WFT. Further lab work showed that Met 52 had minimal effect on natural enemies.

Apart from *Frankliniella occidentalis* (WFT), increasing numbers of different thrips species are appearing in strawberry, notably *Frankliniella intonsa* (flower thrips), *Thrips fuscipennis* (rose thrips), *Thrips tabaci* (onion thrips) and *Thrips major* (rubus thrips). It is not certain that *Orius* offers control of all species, but this may be temperature-dependent. It is speculated that the predatory banded-wing thrips also offers some control of these thrips species, but this is difficult to test in commercial crops. *N. cucumeris* continues to be used by growers to control WFT, although it is not certain that *N. cucumeris* can control other species. The teams at ADAS and NIAB EMR are in the process of identifying adult thrips from strawberry flowers. They will begin to identify thrips larvae to establish whether 'other' thrips species can breed in strawberry flowers. *N. cucumeris* is likely to prey only on their eggs and larvae. This work has continued into 2020.

Figure 1. Dipping and drenching trial to assess the effect of fungicides for crown rot control

Developing a push-pull system for control of capsids in strawberry

AHDB project code: SF 156 Improving integrated pest management in strawberry
Term: April 2015 to March 2020
Project leader: Michelle Fountain, NIAB EMR
Project collaborators: Keele University, CABI, Natural Resources Institute, Harper Adams University, ADAS, Fera

The European tarnished plant bug (*Lygus rugulipennis*) and the common green capsid (*Lygocoris pabulinus*) both affect strawberry crops. The practical problem for growers is how to control them without disrupting biological control programmes.

The project

A push-pull system for managing capsids was assessed for three seasons. It is set up to repel the pest from the crop (the push) using a behaviour-altering chemical that causes an alarm response in the insects. It attracts, or lures the pest out of the crop (the pull) using the sex pheromone monitoring traps.

Results

A field experiment was set up and four treatments were compared:

- Push treatment sachets every two metres
- Pull treatment using the Lygus sex pheromone
- The push-pull treatments combined
- Control plot with no traps or repellents

In year one, there were significantly fewer adult and nymph *L. rugulipennis* where the 'push' was applied, compared with where the 'push' was not applied. Differences were not statistically significant for *L. pabulinus* adults and nymphs, although overall numbers were lower where a treatment was applied. There was no significant effect of the 'pull' only treatment when used alone. There was also significantly less fruit damage where both the 'push' and 'pull' treatments were combined, compared with no treatment.

Seeking solutions to hidden crown rot infection

AHDB project code: SF 157 Improving integrated disease management in strawberry
Term: April 2015 to March 2020
Project leader: Xiangming Xu, NIAB EMR
Project collaborators: ADAS, University of Hertfordshire

The principal *Phytophthora* diseases of strawberry are crown rot and red core. The latter has been less of a problem of late but crown rot still causes significant plant losses, in both soil and soilless substrates.

The project

The aim of the work is to quantify the extent of hidden *Phytophthora* infection in initial planting material and identify treatments to reduce plant losses due to these hidden infections.

Results

A survey of runner material in propagation looked for the presence of dormant infection by *P. fragariae* and *P. cactorum*, the causes of red core and crown rot, respectively. The level of hidden diseases varied greatly among batches of material; up to 5% and 30% of samples were found to have hidden infection of respective *P. fragariae* and *P. cactorum*. The levels showed no correlation with different varieties. Dormant infection does not necessarily translate into yield-reducing disease, but the disease can develop and cause symptoms in plants, particularly those under stress.

Research in container-grown strawberry plants where the substrate was amended with arbuscular mycorrhizal fungi (AMF) – which boosts plants' ability to absorb nutrients and plant growth-promoting rhizobacteria (PGPR), showed that both could reduce the severity of red core disease but not crown rot.

A dipping and drenching trial was undertaken to assess the effect of fungicides and biological control products on the control of Phytophthora diseases at planting time. Fenomenal, Prestop, T 34 and a biological coded product significantly reduced the development of *P. cactorum*. It was found that just applying these products as a dipping treatment at planting time was sufficient to achieve this, rather than both dipping and drenching.

Managed approach to mildew control reduces fungicide use

AHDB project code: SF 157 Improving integrated disease management in strawberry
Term: April 2015 to March 2020
Project leader: Xiangming Xu, EMR
Project collaborators: ADAS, University of Hertfordshire

Strawberry powdery mildew continues to cause a major problem for growers, particularly under protection.

The project

This project has aimed to reduce the reliance upon traditional fungicides, using the mildew risk model developed earlier by AHDB.

Results

An initial experiment demonstrated that the biofungicide AQ10 (*Ampelomyces quisqualis*) and a coded biocontrol product from Bayer, applied in admixture with the wetting agent Silwet, were as effective as a seven-day routine fungicide spray programme.

A separate series of trials was done on products both currently approved for use on strawberry and a biological (coded) product. The effective protectant, curative and anti-sporulant properties of each were assessed.

Later in the project, a standard seven-day fungicide programme was compared to a managed programme. The risk of past and future mildew infection (which employed the NIAB EMR strawberry powdery mildew model based on recorded and forecast temperature and humidity) was also measured – as was the strawberry growth stage. The managed programme employed both conventional fungicides and a bacterial-based biocontrol agent, either with or without routine applications of Cultigrow (a biostumulant not approved for use as a plant protection product) or silicon, which helps boost plants' defence mechanisms. The standard programme included Silwet and the conventional fungicides Luna Sensation (protectant and curative action), Takumi (protectant and curative action) and Talius (protectant action) – all of which have good anti-sporulant activity.

The managed programme used approximately 50% less spray applications than the standard seven-day fungicide programme and it was equally effective. With fewer applications in the managed programme, a number of permitted sprays were still available, should late mildew development occur.

In 2020, the work is focusing on the combined management of strawberry mildew and fruit rotting diseases.

Seeking alternative solutions to Phytophthora root rot

AHDB Project Number: SF 158 The advancement and optimisation of integrated pest and disease management in cane fruit production systems
Term: April 2015 to March 2020
Project leader: Erika Wedgwood, ADAS
Project collaborators: NIAB EMR, Fera, University of Worcester

Phytophthora rubi causes root death and die-back of raspberry canes. A soil/substrate-borne fungal pathogen, it attacks the roots and spreads rapidly through soil water. Despite many growers now growing in sterile soilless substrates, infection and damage continue to occur in some crops.

The project

During the first three years of this project, the work investigated the effects of a range of novel plant treatments. Since then, the work has focused on root health in long cane raspberries and the use of biofungicides, while also assessing the effects of cold storage on the incidence and severity of *P. rubi* infection. A country-wide survey of wilting raspberry plants is also now underway.

Results

In year 3, the biofungicide Prestop and coded products were compared to the chemical fungicide, Paraat, for control. However, no plants died and so no conclusions could be drawn. Further trials have been done comparing potted raspberry plants that were either cold-stored over winter or held in ambient conditions. Both were treated with Prestop, the biofungicide Serenade ASO, or Paraat, either in the autumn or in the spring before being artificially inoculated with *P. rubi*.

In both the autumn-treated canes and the spring-treated canes, there were significantly more red roots (a symptom of Phytophthora infection) in cold-stored canes than those held in ambient conditions.

In both the autumn-treated canes and spring-treated canes, there were significantly more Phytophthora cane disease symptoms in cold stored canes than those held in an ambient environment.

Cold stored canes appear to be more prone to developing Phytophthora than those held in ambient temperatures. An additional survey has been done to assess the levels of inactive infection in raspberry crops across the country.

> “The practical problem for growers is how to control them without disrupting biological control programmes”

Compatibility between control methods for spotted wing drosophila (SWD) and two-spotted spider mite in raspberry

AHDB project code: **SF 158 The advancement and optimisation of integrated pest and disease management in cane fruit production systems**
Term: April 2015 to March 2020
Project leader: Erika Wedgwood, ADAS
Project collaborators: NIAB EMR, Fera, University of Worcester

Over the past decade, raspberry growers have increasingly developed biocontrol programmes to control two-spotted spider mite. However, with a recent increase in the use of SWD sprays that may be harmful to predators, spider mite control could be compromised and solutions are required.

The project

The project aims to address the problem by first investigating the effects of SWD control strategies on two-spotted spider mite populations – and then developing compatibility strategies for controlling both pests together.

Results

Investigations were made on the effects of SWD control sprays in raspberry crops on the populations and control of two-spotted spider mite. Trials at one site demonstrated that sprays commonly used for SWD were having a detrimental effect on predator populations and that spider mite populations were increasing as a result.

Research using overhead spray applications of control products on primocane raspberries from horizontal gantries using larger droplet sizes led to higher numbers of natural enemies. This resulted in lower populations of two-spotted spider mite. It was concluded that the larger droplet sizes created refuges on the undersides of raspberry leaves for the natural enemies – allowing them to survive.

Further spray deposition work was done to identify whether currently available spray machine settings can be used to provide refuges to beneficial insects. It investigated deposition on leaves using commercial practice of 50% and 100% air-assistance and very fine spray quality compared with medium spray quality. Greatest coverage, which was less than 50%, occurred at the top of the canopy and lowest coverage, 10%, occurred in the inner and lower crop canopy. No 'stand out' spray setting was identified. Very low volumes of spray deposits were found in the inner and lower crop canopy and it was concluded that these areas provide possible refuges for beneficial insects.

Research on a commercial crop in 2017 found that when *Phytoseiulus persimilis* predators were introduced in late May to protected primocane raspberry crops, spider mite populations were under control by early August, thanks to both *P. persimilis* and a community of natural predators including *Amblyseius andersoni*. Although Decis and Calypso (applied in early August for control of SWD and blackberry leaf midge, respectively) reduced predator numbers, effective control of two-spotted spider mite had already been achieved. It should be remembered that *P. persimilis* will only thrive earlier in the season if used in conjunction with compatible spray products.

Work in 2018 on commercial, protected, primocane raspberry crops tested whether or not adding pollen (Nutrimite) over the crop canopy before flowering to feed *A. andersoni*, might help to boost their populations. It was found that the numbers of released *A. andersoni* in tunnel-grown primocane raspberries did increase on some dates where pollen had been added, but there was no impact on the level of two-spotted spider mite control. As in 2017, spider mite was controlled by both *P. persimilis and A. andersoni* by late July when the SWD spray programme began. The use of A. andersoni with or without supplementary pollen on a propagation crop, and its ability to overwinter and gain effective early control the following season, is being further investigated in the final year.

Amblyseius andersoni on raspberry

Common green capsids on strawberry

AHDB Project Code: **CP 165 SCEPTREplus**
Term: April 2017 – March 2021
Project lead: Ed Moorhouse, Agri-food Solutions Ltd.

SCEPTREplus was set up to fund screening trials and to identify new and alternative plant protection products. Here is an update on some of the latest soft fruit projects in the programme:

Residual herbicides in blackcurrant

Blackcurrant growers are finding it increasingly difficult to control a range of weeds, with grasses and black nightshade being particularly concerning. The latter is difficult because it germinates in late spring and early summer, at a time when many of the winter-applied residual products have lost their activity. This trial was set up to screen alternative residual herbicides (those that are preventatively applied to the crop) in established blackcurrants for their safety and efficacy, when applied at a later than normal date. Four coded products were compared with a grower standard residual programme (Artist + Stomp Aqua) and an untreated control. All the treatments were found to be safe to the crop, despite the later than normal application date (20 April). Furthermore, each treatment – including the grower standard – resulted in significantly lower weed cover compared with the untreated control plots, and improved control of black nightshade. Three of the products' performances stood out and so require further evaluation.

Alternative control options for raspberry cane midge and blackberry leaf midge

Chlorpyrifos effectively controlled raspberry cane midge and blackberry leaf midge but, since its withdrawal in 2016, growers have been restricted to using products such as Calypso, Decis and Hallmark. However, the efficacy of these products in controlling these pests is limited and the latter two are disruptive to integrated pest management (IPM) programmes. This desk study and consultation set out to identify some alternative control measures. No biocontrol methods are currently available for these pests, although the use of permeable, nylon, fabric sheeting offers a cultural control option. When laid on the ground around the crop or under pot-grown crops, the fabric helps to limit pupation and disrupts the pests' life cycle. The report identified a number of chemical active ingredients not currently approved for midge control in cane fruit crops that are worthy of screening in future trials. These include spinosad (Tracer), spinetoram, cyantraniliprole (Exirel), spirotetramat (Batavia, Movento), azadirachtin A, Bacillus subtilis and Met 52 OD.

Alternative control options for capsid control in strawberry

The incidence of capsids and subsequent damage to strawberry crops has increased over the past decade. The increase is partly due to the loss of broad-spectrum products and the need to find IPM-compatible controls. This desk study and consultation aimed to identify alternative control measures sympathetic to IPM programmes. Good weed control was highlighted as being imperative because weeds harbour capsid pests, particularly species such as nettles and mayweed. There is a widely held (but not experimentally validated) belief that the presence of the predatory bug *Orius* in crop areas helps to control capsids. Some synthetic actives with more specificity against sap-feeding pests than those we currently use in the UK have been identified and could resolve future control. Incorporation of salt additives to selected synthetic actives has been shown to enhance their efficacy overseas and is now used for controlling capsid pests in cotton. A novel 'attract and kill' system has been developed in Germany, which may have potential in the UK. The push-pull system of control (see page 12) may also become available to growers in future. All of these ideas offer future routes of investigation.

Strawberry grown in coir reduced substrate

Production systems

Designs on sustainably sourced growing media

AHDB project code: CP 095 Sustainable resource use in horticulture: a systems approach to delivering high-quality plants grown in sustainable substrates, with efficient water use and novel nutrient sources
Term: November 2012 to November 2017
Project leader: Paul Alexander, RHS Wisley
Fellowship trainee: Gracie Barrett, RHS Wisley

AHDB project code: CP 138 Transition to responsibly sourced growing media use within UK horticulture
Term: January 2015 to December 2019
Project leader: Barry Mulholland, ADAS

In response both to customer pressure and government policy, the horticulture industry has invested heavily over the past 20 years in finding ways to source its professional growing media responsibly and more sustainably, while reducing the amount of peat it uses. A huge range of materials considered as 'peat substitute' ingredients has been whittled down to just four: bark, coir, green compost and wood fibre.

The projects

A horticultural fellowship project, CP 095, was established in 2012, in which researcher Gracie Barrett reviewed the chemical, physical and biological properties of growing media materials and undertook trials investigating how nutrient management using organic and inorganic fertilisers was affected by varying the proportions of ingredients in media designed for nursery stock.

Her work dovetailed neatly with CP 138, a five-year project funded by Defra, AHDB and the horticulture industry. The project was commissioned in response to the Sustainable Growing Media Task Force's report in 2012 that highlighted the need for research to demonstrate the technical and commercial viability of new growing media blends and help growers overcome barriers to using them. It takes a different approach from past research by creating and using a model based on the physical characteristics of the raw materials to predict their performance in blends, followed by extensive trials on crops, including vegetable transplants, bedding plants, nursery stock, raspberries and strawberries.

Results so far

Barrett used her review of ingredients to create 14 peat-reduced and peat-free experimental blends. She analysed their physical, chemical and biological characteristics and, in trials at RHS Wisley, assessed how well they performed with viburnum and hebe. While the properties of the blends varied widely, all but one proved capable of producing both crops to a good and uniform quality in the trial, demonstrating that a wide range of media could be used commercially.

In a subsequent trial on nutrient management, using only viburnum, the amount of nutrient leached from the different blends varied significantly, with up to five times more being lost from some, compared with others – most of this occurred within the first 14 days after potting. The amount leached was not predictable and could not be related to any one physical property such as water-holding capacity. Some of the blends proved to be overfertilised due to the inherent nutrient content of the materials, reinforcing the need to modify fertiliser rates when using them.

A trial looking at a possible alternative source of phosphorus tested biochar infused with phosphate from sewage sludge. Barrett found no significant differences, either beneficial or detrimental, between this and conventional phosphate fertiliser in the five growing media blends with which it was trialled.

In the early stages of CP 138, air-filled porosity, available water and bulk density (which measures the compaction of growing media) were identified as the three key physical parameters governing growing media performance. Air-filled porosity is the proportion of a soil's volume that is filled with air. If the soil has a low air-filled porosity, water drainage can be affected. Accurate procedures to measure these attributes in growing media materials were then developed. The measurements were used as the basis for a model that could predict the materials' performance in varying proportions in blends.

As part of Project CP 138, specific trials on soft fruit crops have been running since 2016 to evaluate alternative substrates to the standard coir that is used for both fruit production and soft fruit propagation. Strawberry production was initially assessed on a commercial farm in Staffordshire in 2016–2017, where coir was compared to coir-reduced and coir-free products. Root development in all substrates was excellent and there were no observable differences in root health. Fruit yields were variable over two years and across different substrates, but the evidence suggested that similar yields could be achieved without using 100% coir. Similar trials have been done on a soft fruit propagation nursery in Berkshire in 2017–2018, on both strawberry and raspberry. In both cases, the initial growth of plants for propagation showed little difference between 100% coir and coir-reduced substrates. Plants propagated in 2018 were grown on in 2019 at the commercial farm in Staffordshire, using both 100% coir and a number of coir-reduced and coir-free blends. While the final results detailing raspberry and strawberry yield from this stage of the work are not yet available, plant growth was exceptionally good in all blends used and, as before, there were no observable differences in root health.

Raspberry root development in coir

Strawberry breeder Adam Whitehouse presenting the most promising selections to industry members

Breeding

Progress in delivering the next Malling Centenary

AHDB project code: SF 096a Membership of the East Malling Strawberry Breeding Club
Term: June 2013 to May 2023
Project leader: Adam Whitehouse, NIAB-EMR

The main objective of the East Malling Strawberry Breeding Club is to develop new and improved June-bearing and everbearing strawberry varieties with increased yield, larger fruit size, an extended season of production and greater resistance to fungal diseases. AHDB is a part-funder of the Club, ensuring that new releases such as Malling Centenary are available for use by all UK growers.

Two new selections were launched in 2019, the June-bearer Malling Allure (EM2157) and the everbearer Malling Champion (EMR564). Malling Allure is a late Malling Centenary-type selection that has a similar season to Florence, but with better fruit size, Brix scores (which measure sugar content), appearance and plant habit. Malling Champion has an early season of production with a high Class 1 yield and large fruit size. Fruit is glossy and attractive with uniform colour, and firm skin and flesh. Flavour has been judged to be pleasant, with an average Brix score of 7.9. Fruit is displayed on long trusses. Initial assessments indicate that Malling Champion shows resistance to Verticillium wilt, and with moderate resistance to powdery mildew and crown rot. Both varieties are now commercialised and available for all growers to buy.

In addition, EM2464 is now undergoing commercialisation for potential release in 2021. It shows promise as an early-mid, Malling Centenary-type selection, with excellent fruit quality, but also useful resistance to crown rot, based on preliminary tests at East Malling. It is currently undergoing agronomic trials with Delphy, along with another interesting June-bearer, EM2547. This is a very early selection, with a season similar to Flair, but with attractive berries, a larger fruit size and high Brix score.

Consideration will also be given to some interesting everbearers including EMR704, EMR721 and EMR796. EMR704, tested in large-scale trials in 2019, is an early, high-yielding, large-fruited selection with useful resistance to crown rot and mildew. EMR721 and EMR796 will be in EMSBC large-scale growers' trials in 2020. EMR721 has exceptionally high fruit quality and has also produced a high percentage of Class 1 fruit with good resistance to powdery mildew. EMR796 was the star of the 2018 everbearer preliminary trial, and has been fast tracked due to its high yield of large, attractive, tasty fruit.

Figure 2. New selections being assessed by the East Malling Strawberry breeding team


Glen Carron

On the trail to an improved raspberry

AHDB project code: SF 035c UK raspberry breeding programme
Term: April 2014 to March 2024
Project leader: Nikki Jennings, James Hutton Institute

The AHDB soft fruit panel has been part-funding the UK raspberry breeding programme at the James Hutton Institute since it was set up in 2009. Initially, the breeding focus included creating varieties suited to machine harvesting for processing. Currently, its aim is to breed new summer fruiting (floricane) and later-fruiting (primocane) varieties suitable for low-input systems with reduced labour costs to help extend the season.

The programme is employing marker-assisted selection, which has benefited from several previous research projects funded by AHDB, Defra Horticulture LINK, the Scottish government and Innovate UK. These identified molecular markers – that is, identifiable fragments of DNA – on the raspberry genetic map, which are linked to resistance to *Phytophthora rubi* and quality traits such as colour and firmness. Work also found markers for combinations of traits controlled by more complex genetic relationships, to help breeding for fruit flavour and pest and disease resistance, concurrently.

To date, the floricane varieties Glen Fyne and Glen Dee have been released for fresh market production, while Glen Ericht has been released for the processing market. It is well suited to machine harvesting and exhibits strong field tolerance to *Phytophthora rubi*. Most recently, the early/mid-season floricane variety, Glen Carron, was released (2018) through this breeding programme. This variety produces very high quality fruit and is well suited to long-cane production for the fresh market. It has resistance to cane Botrytis and spur blight.

Growers may be pleased to learn that, based on on-farm trials' results, three promising selections are in the process of being commercialised. Selection RBC16F6 is looking particularly promising as an early floricane type – producing high yields of consistently large, good-quality fruit over a long season. Furthermore, it has shown no symptoms of *Phytophthora* root rot in an infested plot after six years, despite repeated flooding. Happily, it possesses the root rot resistance marker Rub118b.

Two new primocane selections with attributes desirable for commercial growers have also been identified. RBC16P5 produces an early crop, with a start date similar to Imara, in mid-late summer. Large fruit picks easily filling punnets quickly, and producing a consistent sweet flavour, with vanilla notes. RBC16P4 picks in mid-autumn, between Kweli and Kwanza, producing a high yield of flavoursome fruit, with the potential to double crop.

These genotypes and more recent promising selections are grown in demonstration tunnels at the James Hutton Institute – allowing growers to view their performance during the harvest season.

Improving yield stability in blueberry crops

AHDB project code: SF 160 Improving yield stability in UK blueberry production (Innovate UK Project 102130)
Term: October 2015 to September 2020
Project leader: Julie Graham, James Hutton Institute

Lack of yield stability is a major problem for UK blueberry growers, preventing accurate profit prediction and maximisation, and causing volatility of UK supply. The problem is now well recognised within the industry, though the causes of significant season-to-season yield variation are unknown.

The project

This project aims to look at every aspect of the plant, to identify the causes of this yield unpredictability in blueberry crops. This includes an investigation of the physiological (namely, all the different parts of the plant, such as the leaves and stem), biochemical and genetic processes of the crop. An examination of the impact of the growing environment and management of yield is also being undertaken, to aid the development of predictive yield maps and models. It is also hoping to develop molecular markers (identifiable fragments of DNA) for yield stability that can be used to breed improved blueberry varieties.

Results so far

It has been found that fruit is lost progressively across the entire developmental period of the crop – and this loss is not associated with catastrophic environmental events such as frost damage to flowers. This indicates that more subtle environmental variation must be linked to yield instability and highlights the need for the development of predictive yield maps and models that can support crop management.

Interestingly, it has been discovered that at moderate light levels, equivalent to a mildly overcast day, photosynthetic activity of blueberry bushes becomes saturated. This means that an increase in light will no longer cause an increase in photosynthesis. The rate of photosynthesis at saturation is highly temperature-dependent. For example, saturated photosynthetic rates were approximately 25% lower at 15ºC than they were at 25ºC. On heavily overcast or cooler days, the plant is not able to achieve its full photosynthetic potential. However, it is also unable to compensate by photosynthesising more on sunny days. This shows that – even if they are interspersed with strong sunshine – too many heavily overcast days are likely to have a negative impact on yield.

These findings are being used to build a model that, in conjunction with a user-focused interface, can be used by growers to aid yield prediction. The work is also relevant to soft fruit breeding programmes, providing insights on gene markers, which could be deployed to improve yield stability in future.

Understanding the causes of crumbly fruit in red raspberry

AHDB project code: SF 167 Understanding the causes of crumbly fruit in red raspberry (AHDB Studentship project)
Term: October 2016 to September 2019
Project leader: Julie Graham, James Hutton Institute
PhD student: Luca Scolari, James Hutton Institute

Uneven berry formation results in the development of crumbly fruits, which often renders the crop unmarketable. Sometimes, adverse weather conditions during the pollination period have been blamed and, at times, evidence of genetic instability in a specific cultivar has thought to have been implicated.

The Project

Each raspberry fruit is an aggregation of multiple, fertilised ovaries, which form drupelets – the bead-like pieces of the berry. In an evenly formed berry, every stigma in the flower acts like a platform – receiving pollen that germinates down the corresponding style (a tube-like structure connecting the stigma and the ovary) and fertilises an ovary. Each fertilised ovary develops at the same rate to produce drupelets of the same size.

Student Luca Scolari has based his research on the hypothesis that the synchronisation and growth of all the fertilised ovaries is coordinated and regulated by a hormonal process. He, therefore, designed a series of trials to interfere with this hormonal regulating system. This was done by mechanically damaging the flower receptacle before pollination, which successfully induced the development of crumbly fruit. This result helps to support the hormonal regulation hypothesis.

Subsequent work has developed an analytical method to identify a profile of the hormones involved in the regulation process. The work detected many compounds and at least four of them can be quantified. A great tranche of samples is being analysed. Based on the results of the analyses, a potential chemical treatment to cure crumbly fruit at the onset of fruit development could be tested.

Figure 3. Different clones of Tulameen exhibiting contrasting fruit formation

Developing Genome selection to aid strawberry breeding

AHDB project code: CP 163 Next generation berries – implementing genome wide selection approaches
Term: October 2016 to March 2020
Project leader: Richard Harrison, NIAB EMR

Traditional strawberry breeding is a lengthy process and the time taken from making crosses to release of a new cultivar can be between seven and twenty years. Genomic selection, on the other hand, is an advanced breeding technique that can more accurately select desired traits from parents when making crosses, thus ensuring that the progeny contain these traits. It also allows the progeny to be assessed more quickly to detect whether they contain the traits. This speeds up the whole breeding cycle – allowing cultivars to be released sooner.

The project

The aim of this piece of research is to improve the use of genomic selection in commercial strawberry crops – a particularly difficult subject because this type of crop is octoploid, which means that it contains eight versions of each chromosome in every cell, rather than the two versions present in woodland strawberries.

Results

An imaging platform was developed using a camera and computational algorithms to capture data in 3D and quantify seven visible fruit quality traits such as berry shape and colour. This allows the physical characteristics of the progeny (the phenotype) in the breeding programme to be assessed rapidly and objectively – a process known as 'phenotyping'. The genetic material contained within the progeny is known as the genotype. The assessment of this material is called 'genotyping'. Work is being done in this project to investigate technology to speed up the genotyping process, so the breeder can rapidly assess the genetic composition of the progeny. Breeders can use a range of genomic selection models, but, as yet, there is no consensus on the optimum model for octoploid strawberry crops.

"Work is being done in this project to investigate technology to speed up the genotyping process, so the breeder can rapidly assess the genetic composition of the progeny"

Labour and automation

Smart ideas to labour challenges

Our SmartHort campaign to help horticulture address the challenge of accessing affordable labour continues to grow, with the launch of three new Strategic SmartHort Centres and a challenge to help bring automated solutions into the production line.

While crop protection research remains at the heart of AHDB activity, we understand that access to affordable labour is one of the biggest concerns, particularly for the soft fruit sector.

The SmartHort programme was launched in 2018 to increase industry resilience to labour challenges, from rising wage costs to difficulties in recruiting and retaining staff. Changes in the language and dexterity skills of staff now applying for work in the sector have also added to the challenge. SmartHort 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 provide longer-term solutions.

Smart labour management

Management techniques such as Lean, Champion and Continuous Improvement can improve labour efficiency in businesses of all shapes and sizes and can be applied throughout the production system, from picking to packing. These techniques are about helping businesses to get the best out of their workers.

To help demonstrate the benefits of implementing Lean and efficiency techniques, and to support growers adopting them into their own businesses, we have launched three new Strategic SmartHort Centres.

The centres are located in Cambridgeshire (Volmary), Herefordshire (Haygrove) and Perthshire (Thomas Thomson). Each business has offered to implement Lean to improve their labour management and demonstrate their progress with local growers as a live case study for productivity improvements.

Local businesses attending the three workshops at each centre are also being guided by training specialists Fedden USP to develop their own labour-efficiency plans. Businesses that invest time and effort to complete and implement the activities covered during the workshops should expect to see labour and productivity improvements of between 25–40%.

Neil Fedden, the productivity consultant running the strategic centres, explains: “We are taking the host centre, as well as the workshop attendees, through the Lean process, which is really about identifying, and then cutting out or reducing, those activities that don’t add value to the business. When you reduce waste and use your resources more efficiently, you can add significant value to the business.”

The workshops cover:

- Process mapping and waste identification
- Practical problem-solving using a technique called Plan, Do, Check, Act
- Encouraging continuous improvement across the whole organisation
- Visual management boards and metrics to check improvements have worked

Francis Mizuro, operations manager of Volmary, said: “We’re delighted to have been chosen as one of the first SmartHort Centres. We’re very excited to bring the investigative trial work to our site and to be a key part of the development of systems and technologies that will help both the industry as a whole and our own business.”

Smart technology

The ultimate solution to the shrinking pool of available labour is automation. Our survey in 2017 showed that over 84% of businesses planned to invest in automation or robotics to offset labour challenges. However, no growers yet have end-to-end automated processes. This is most likely due to a combination of poor fitting ‘off-the-shelf’ solutions for the diverse production systems many growers work with and an unfavourable cost/benefit ratio for the current trading climate.

To help accelerate automation in horticulture, AHDB launched the pioneering SmartHort Automation Challenge. This offered a UK horticulture business the opportunity to work collaboratively with experts to deliver an applied automation prototype solution to their production system. This new initiative, managed by experts from the WMG department of the University of Warwick, will adapt and assemble off-the-shelf solutions to function effectively within live commercial systems.

In response to our call, we received ideas from 22 different growers across horticulture, ranging from correcting the position of pots on potting lines for smoother operation, through to developing smarter irrigation booms for precision application of water and pesticides, and autonomous guided vehicles (AGVs) in different nursery situations. Solving any of these problems would reduce labour inputs and improve productivity for each business.

Thanks to the large pool of postgraduate students at WMG, this initiative will additionally address several projects, by feeding the challenges set by growers through to student projects.

At the time of writing, final decisions were being made, but the current lead project, based around AGVs, has the potential to meet the needs of three different businesses, all of which posed similar challenges. We also expect the final solution to be suitably adaptable so that it can meet the needs of a large number of horticultural businesses.

Finally, our SmartHort 2019 conference in March explored the future of automation and robotics, with the aim of driving innovation into horticulture. Guest speakers from around the world shared some of the most impressive technological developments that could change the way you grow. If you missed the conference, you can watch it again online.

To find out more about the SmartHort campaign and how it could help your business, visit **ahdb.org.uk/smarthort** or contact **grace.emeny@ahdb.org.uk**

Mark Else presenting the latest information at The NIAB EMR WET Centre

Resource management

The WET Centre

The Water Efficient Technologies (WET) Centre aims to accelerate the uptake of innovation and new research by demonstrating the commercial value for soft fruit growers.

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

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

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

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

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

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

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

Current trials

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

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

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

Future plans

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

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

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

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

We look forward to bringing you news of both the WET Centre and other Strategic Horticultural Centres as they develop over the coming months and years. Visit **ahdb.org.uk/farm-excellence** to find out more.

Project roundup

AHDB project code: CP 176 Selection and improvement of insect pathogenic fungi for the control of multi-resistant aphids

Term: October 2018 to September 2021
Project leaders: Ben Raymond, University of Exeter
PhD student: Zoltan Erdos

A number of aphids and, in particular, the peach-potato aphid (*Myzus persicae*) have developed resistance to traditional aphicides used by growers. Entomopathogenic fungi (that infect and kill insects) are largely unexplored for use in controlling aphids. This project will assess whether the aphid clones displaying resistance to chemical aphicides are susceptible to fungal infection. Further work will employ novel selection techniques to develop more virulent strains of the pathogenic fungi so growers can improve the control achieved in the field. Ultimately, the aim is to produce clones of pathogenic fungi with increased killing power in multi-resistant clones of aphids.

Aphid infected by an entomopathogenic fungus

AHDB project code: CP 185 Role of auxin in Phytophthora root rot disease development in soft fruit

Term: October 2019 to March 2023
Project leader: Eleanor Gilroy, the James Hutton Institute
PhD student: Raisa Osama

Raspberry root rot, caused by *Phytophthora rubi*, continues to be a major research priority for raspberry growers, both in soil- and substrate-grown systems. The James Hutton Institute has previously compared the susceptible raspberry variety Glen Moy with the resistant variety Latham and found that levels of root rot had a negative effect on root vigour. Further work has shown that plant genes that are responsive to the plant growth hormone auxin are closely related to the root rot resistance marker genes. This project will further explore the effects of auxins on Phytophthora pathogens, with a view to using the findings to combat raspberry root rot disease.

Figure 4. Varying levels of infection by Phytophthora rubi in raspberry

AHDB Project code: CTP FCR 2018 5 Investigating durable resistance to Phytophthora cactorum in strawberry and apple

Term: October 2018 to September 2022
Project leaders: Charlotte Nellist, NIAB EMR and Jim Dunwell, University of Reading
PhD student: Matteo Luberti

The oomycete (fungus-like) pathogen *Phytophthora cactorum* damages both strawberry and apple crops, causing crown rot and leather rot in strawberry plants, and crown rot, collar rot and root disease in apple trees. Extensive work has, therefore, been carried out at NIAB EMR to pinpoint genetic markers (identifiable segments of *DNA*) showing resistance in strawberry plants, while also sequencing the genes of 19 isolates of *P. cactorum* from both strawberry and apple plant samples. In this project, investigations will seek to understand why samples of the pathogen taken from apple are unable to cause disease in strawberry and, equally, why isolates from strawberry cannot cause disease in apple. Screening apple rootstock for resistance to the pathogen, and mapping the genes behind any resistance, will also be carried out. The results will enhance our understanding of the molecular basis of resistance to this damaging pathogen and, ultimately, lead to the production of disease-resistant breeding material.

Figure 5. Strawberry plant showing symptoms of Phytophthora cactorum infection

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