



# RHS Science Strategy Update 2018



## The RHS Vision

**To enrich everyone's life through plants, and make the UK a greener and more beautiful place.**

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## Our four key themes

- 1 A global knowledge bank for gardening and garden plants
- 2 Plant health in gardens
- 3 Gardening in a changing world
- 4 Plant science for all: people, plants, planet

## Welcome



**Professor Alistair Griffiths, RHS Director of Science & Collections**

2018 has been an inspiring year. We have consolidated our research programme with a focus on providing evidence for gardeners to improve the health of the environment, people and plants. The opening of the new National Centre for Horticultural Science & Learning in 2020 will be an amazing opportunity to update our research facilities and to reach more people through improved access to our library and scientific collections. The new, bespoke accommodation will keep our book and art collections in conditions that will help them survive for future generations, and the new atrium and surrounding gardens will provide the public with wonderful new ways to interact with the collections, our researchers and with each other.



Above. Architect's visualisation of the National Centre for Horticultural Science & Learning.

It's an exciting time for all of us, but there remains an enormous amount of work to do.

Over the past year RHS Libraries have been reviewing our collections, selecting the books and archives we want in our new library as an outstanding resource for horticultural scientists, students and gardeners of all levels.

## “We now have ten collaborative PhD projects with universities across the UK.”

The current laboratory is beginning its transformation into an exciting new experience for visitors that will enable them to explore the building for the very first time and find out the history of horticultural research at the RHS. At the same time though our research carries on apace, both within the Lab and at the Field Research Facility. Plant health has been our main focus over the last year because of increasing threats from plant pests and diseases from overseas. Threats which have also been highlighted by HRH The Prince of Wales.

We have responded by reviewing our procedures to mitigate these risks right across the RHS, from how we introduce plants into our gardens, to what plants are exhibited at RHS Flower Shows. We are working closely with government and the wider horticultural industry to ensure that UK gardeners are informed and to create the right regulatory framework post-Brexit.

In horticultural taxonomy we are delivering on Target 13 of the Global Strategy for Plant Conservation and enabling more people to enjoy, use, cultivate and conserve the vast diversity of plants in UK gardens.

Finally, I am proud that we now have ten collaborative PhD projects with universities and industry across the UK. These projects deliver on our pledge to train the next generation of horticultural scientists under the Horticulture Matters agenda, and they add to our growing global knowledge bank.

We are actively supporting gardeners, the horticultural industry and the UK government through sharing our knowledge and developing our research, to answer key questions and make the UK a greener and more beautiful place.



# 1 A global knowledge bank for gardening and garden plants

## Gathering and sharing information

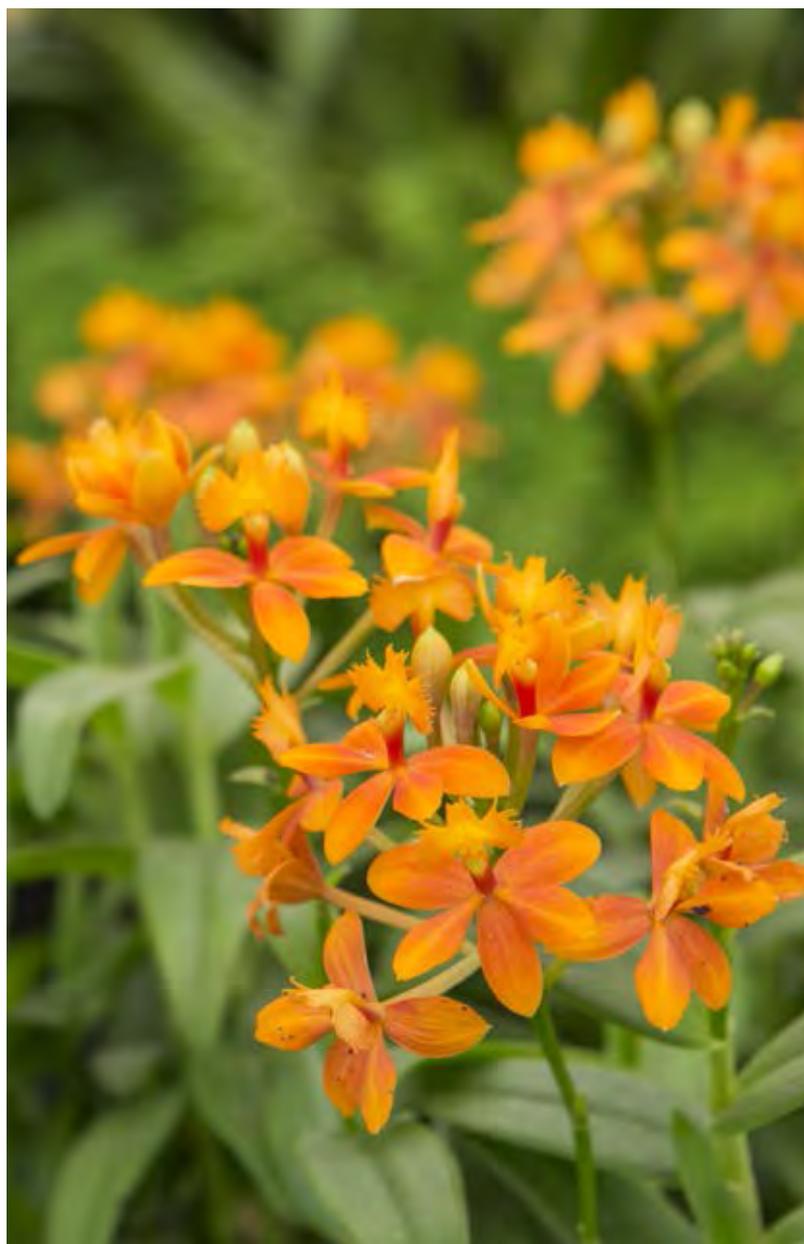
### Online cultivar registration

In summer 2018 we launched our first online system for registering new varieties of cultivated plants. The RHS is International Cultivar Registration Authority for nine plant groups, including orchid hybrids, which is the first to be available to register online. Since the launch, some 25% of all new orchid registrations have come through the online system, including the first hybrid registered on the day of the launch ( $\times$  *Rhyncattleanthe* Teruichi Haneda Matsuzaki grex, from Brazil). Dahlias and daffodils will be next to be made available online, further increasing the ease with which new cultivars can be registered and encouraging registration for the sake of maintaining name consistency and uniqueness.

### RHS plant collectors

RHS Libraries, Archives and Herbarium are bringing the hidden world of RHS plant collectors to life. In work funded by the Foyle Foundation, the plant collector archives are being catalogued and digitised, while exhibitions such as 'Collecting in the Clouds' are capturing imaginations around the world.

Right. *Epidendrum* Comet Valley, one of 163 *Epidendrum* hybrids registered by M. Inamine. More than 2,800 orchid hybrids were registered in the first nine months of 2018; as of the end of September, the International Orchid Register contained 172,585 entries.



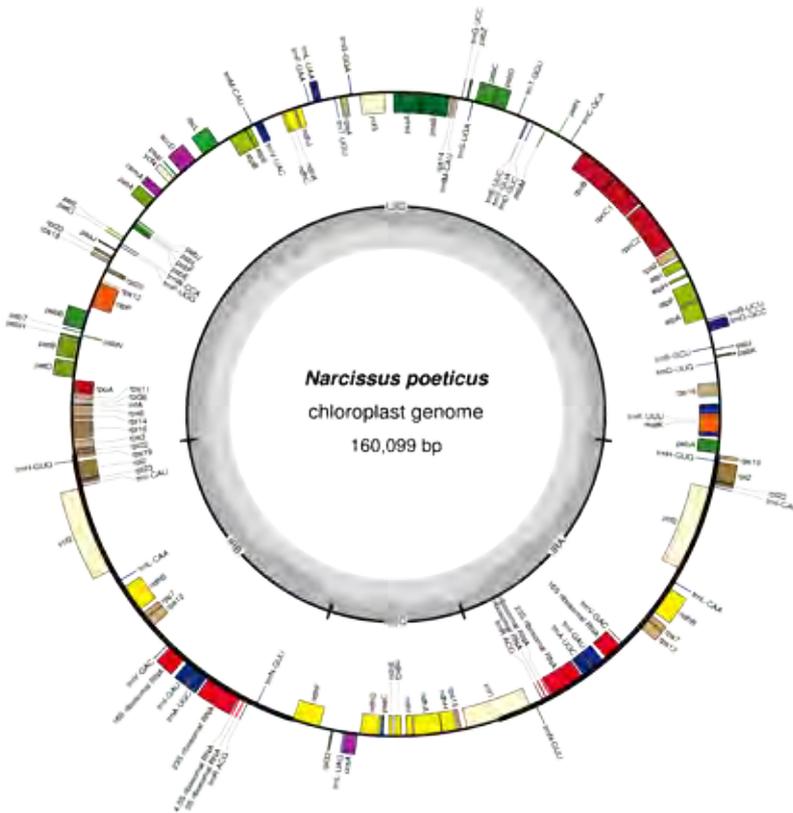
## Identifying and understanding plants in our gardens

### Analysing daffodil DNA

Many gardeners will have experienced the surprise and perhaps disappointment of a bulb whose flower is not quite what was expected. Such mistakes can upset a planting scheme and even amount to significant financial loss where a prized bulb does not deliver the expected bloom.

The RHS Horticultural Taxonomy team are looking for molecular markers that distinguish different cultivars of daffodil as a first step towards ending this problem. This year, the team successfully sequenced the full chloroplast genome of *Narcissus poeticus* (below), the first in a series of ten daffodils whose chloroplast genomes will be compared in order to identify the regions of variability where possible markers will be found.

Dr John David, Head of Horticultural Taxonomy, says, “This is the first step in a long road towards a test that will confirm bulb identity and give buyers assurance that they are getting what they want and are paying for”.



The RHS Lindley Library ‘Collecting in the Clouds’ exhibition showcased historic photographs, documents and herbarium specimens from early twentieth-century expeditions to the mountains of western China. George Forrest (left; 1873–1932) collected over 31,000 specimens from China, discovered more than 1,200 plant species new to science and had more than 30 taxa named after him.

“Our work will make a difference by improving plant identification, informing effective management of invasive plants, safeguarding our important collections, and making them more accessible as a learning resource.”  
RHS Science Strategy 2015–2019

## 2 Plant health in gardens



### Encouraging good garden stewardship

#### Understanding slugs and snails

Having completed the second year of the BASF-funded project on slug control, the team are now expanding their work to look at slugs and snails in the garden in a broader sense. Dr Hayley Jones has been working on commonly used barrier methods of control (copper, eggshells, wool pellets, bark and grit), finding that ground-level copper barriers are the most effective control. Her findings will provide the first scientifically backed advice for gardeners on these popular control methods.

Further adding to the slug and snail portfolio, new PhD student Imogen Cavadino has begun work on understanding the diversity of slugs and snails that are found in UK gardens and, perhaps more importantly for gardeners, working out which ones are eating our plants. Imogen will be working with citizen scientists around the country to find and identify slugs and snails. Look out for opportunities to get involved on [rhs.org.uk](http://rhs.org.uk).



RHS Entomologist Dr Hayley Jones on the results of recent BASF-funded research on slug control.

**“We’ve established that organic slug pellets (ferric phosphate) or nematodes can perform as well as traditional metaldehyde pellets when paired with mulch. Given that metaldehyde pellets are known to have a relatively high toxicity to other animals and have been found as traces in UK waterways, we think these findings are significant for the environmentally conscious gardener.”**

## Advancing control and management strategies

### Box tree moth

With over 5,000 reports received in the year to September 2018 and appearances as the number one pest in both the 2015 and 2017 RHS Top Ten Pest and Disease Lists, box tree moth (*Cydalima perspectalis*, right) is a worrying problem for UK gardeners.

Capable of completely defoliating valuable box (*Buxus*) hedges and topiaries, the caterpillars are one of several threats faced by box in the UK. RHS entomologists have been maintaining a breeding colony of box tree moth in a contained environment at Wisley. In work funded by BASF, we have been looking at the efficacy of nematodes in controlling box tree moth caterpillars in garden environments. The nematodes successfully infected and killed box tree moth larvae, but did not completely eradicate the problem. Further work is planned to make the treatment more effective.

Given that nematodes are watered onto leaves, the team also intend to consider how they best fit with an integrated pest and disease management plan for box. Since box blight (*Cylindrocladium buxicola*) is also a threat, and fungal pathogens of this kind are encouraged by the same conditions that increase nematode effectiveness, there is still much to do to provide gardeners with a complete approach to growing box at home.



## Monitoring plant pests and diseases

### Honey fungus (*Armillaria*)

Gardeners across the UK have been telling us about their experiences with the ever troublesome honey fungus (*Armillaria* spp.) via the RHS Honey Fungus Hunt. Reports from gardeners confirmed two common types of attack lining up with the two most frequently reported species of honey fungus – a highly aggressive prolonged attack across a number of plants consistent with *A. mellea*, and a more localised attack on a single old or weakened plant consistent with *A. gallica*.

Paired with our work on rapid diagnosis, these findings will support giving more practical advice to gardeners specific to the species they are facing, and may mean that they can avoid the heavy lifting involved with clearance of areas affected by *A. gallica*. The team are now looking in depth at leaving infected stumps in the ground and are also refining the list of susceptible plants to make sure gardeners are armed with the best information about this major garden disease.

“Our work will make a difference by improving plant health in gardens, enabling better detection, identification and control of plant pests and diseases, and safeguarding biodiversity through improved stewardship of nature.”

RHS Science Strategy 2015–2019

# 3 Gardening in a changing world

## Understanding the vital role of plants

### Climate-proofing your garden

In work featured both on the BBC's *Country File Diaries* and *The One Show*, Dr Tijana Blanuša has been investigating the potential of different species and cultivars of popular hedge plants to mitigate localised flash flooding. Species with large and dense canopies such as hawthorn and cotoneaster have been shown to provide up to 20 minutes' grace between rain falling and it reaching the soil, by retaining the rainfall in the canopies. This interval allows run-off from hard surfaces to dissipate before the captured water reaches the ground, working against the saturation that leads to flooding. Her work also looks at the impact of plant choice on air quality.

Working with RHS Gardening Advice, Tijana is now keen to spread the word about these important benefits of garden hedges and to encourage gardeners to see them as a key part of climate-proofing their garden.



#### Plant traits linked to enhanced rainfall capture

- ◆ large leaf area
- ◆ presence of leaf hairs
- ◆ rough surfaces
- ◆ high rate of evapotranspiration (water loss through leaf pores)

**“Urban residents routinely face a range of environmental challenges: air pollution, noise, increased risk of flooding due to paving over. Urban hedgerows and hedges in domestic gardens have a role to play in minimising these risks and improving environmental quality.”**

RHS Principal Horticultural Scientist  
Dr Tijana Blanuša

“Our work will make a difference by improving understanding of the health benefits of plants and gardening, promoting the use of plants for their ecosystem services, reducing resource use and equipping gardeners to meet the challenges of climate change.”

RHS Science Strategy 2015–2019



### Maximising the health benefits of gardening

#### How houseplants can improve health and wellbeing

Houseplants are having something of a renaissance, particularly among those looking to incorporate plants into living spaces in towns and cities, but can they make a difference to our health and wellbeing? Recently published work from PhD student Curtis Gubb (University of Reading and RHS) has shown that choosing vigorous herbaceous houseplants such as indoor ivies and peace lilies and ensuring they are given good light and water, may help against the headaches, lethargy and other symptoms often associated with “sick building syndrome”.

Such plants help regulate the humidity in your home, as well as removing some carbon dioxide from the air. Curtis is now moving on to look at whether similar plants are effective at removing pollutants such as VOCs (volatile organic compounds) and nitrogen dioxide, which further degrade indoor air quality. The results will allow us to give gardeners solid recommendations for houseplant choices that will improve their health and wellbeing.



### Promoting environmentally responsible gardening

#### Water science for gardeners

In collaboration with Cranfield University the RHS has appointed the UK's first water scientist with a focus on domestic gardening. Janet Manning will be part of a new Knowledge Transfer Partnership (KTP), researching innovative, cost-effective and impactful technologies and methodologies to deal with too much or too little water for both amateur and professional gardeners.

# 4 Plant science for all: people, plants, planet



## Involving people of all ages

### National Youth Takeover Day

As part of the development phase of the successful Heritage Lottery Fund bid for Wisley (including the new National Centre for Horticultural Science & Learning), RHS Science colleagues welcomed 36 young people from local schools as part of National Youth Takeover Day (left). Working closely with colleagues from RHS Education and Outreach the team supported young people to create their own social media campaigns and tours of Wisley, taking in the research labs and telling the stories of RHS Science.

### Careers in science

Professor Alistair Griffiths (Director of Science & Collections) engaged with 200 students aged 14 to 18 at this year's St Paul's Way Science Summer School on the theme 'Your Future In STEAM (science, technology, engineering, art and maths)'. Alongside Professor Brian Cox, Alistair spoke about the importance of horticultural science in their future world and encouraged students to consider the valuable contribution they could make by pursuing a career in plant science.

### Amazing apples

Apple growing is a key part of RHS Garden Wisley's heritage, and the growing and eating of apples appeals to children and experienced gardeners alike. RHS Libraries, working with RHS Gardening Advice and colleagues in RHS Education and Events, have been sharing the RHS's apple-related collections and know-how through a series of displays at RHS Gardens and Libraries, including the family-friendly 'Amazing Apples' installation in the orchard at Wisley.



## Inspiring and informing National Insect Week 2018

In June 2018 Wisley hosted the launch of National Insect Week with the Royal Entomological Society (RES). The launch event included the unveiling of 'Insect Isles', an artwork by Carim Nahaboo, as well as photographs from the National Insect Week Photographic Competition. "The RHS and its team of entomologists based at Wisley have supported National Insect Week since the very first one in 2006," says Royal Entomological Society Chief Executive Dr Luke Tilley. "They are a fantastic partner organisation, and one of the most common places that people encounter insects in their lives is in the garden, so it is an excellent match and an honour to have the launch at RHS Garden Wisley."



"Our work will make a difference by fostering greater understanding of plants and gardens, training the next generation of horticultural scientists, enabling more people to benefit themselves and their communities through gardening, inspiring young people to garden, and providing evidence for effective policy-making."

RHS Science Strategy 2015–2019

Top. Damselfly. Above left. Artist Carim Nahaboo with his artwork 'Insect Isles', which features dozens of drawings of insect species found in the British Isles. Above right. As well as posters about different aspects of insect life and displays from the RHS insect reference collection, the event included an array of microscopes, where visitors could view the fine detail of butterfly wings, galls on leaves, and specimens such as the European hornet.



## Providing excellent advice

### New advice service at RHS Garden Hyde Hall

This summer RHS Gardening Advice trialled a weekly face-to-face advice service (left) at RHS Garden Hyde Hall. Although we started small with just a couple of hours a week through spring and summer, the service has been warmly welcomed by local members who have brought a total of around 400 gardening questions to be answered in the six months of the pilot. Building on this success the service will expand to two sessions a week in 2019.



## Ask the experts – online

RHS members are now able to send their gardening questions to an RHS advisor via the new Gardening Advice Online tool on rhs.org.uk. This new service means that gardeners can now both ask a question online and log in to see the answers in their own personal advice logbook, making it easier to refer back to answers and to ask follow-up questions. Since launching the service in July 2018 we have received more than 1,000 online enquiries.



**“The online system stores members’ past enquiries, allowing them to log in at any time to revisit the answers and build up a comprehensive picture of their garden’s health.”**

RHS Horticultural Advisor  
Rebekah Mealey



Left. Popular subjects for online advice so far have included pruning, collecting seed, and vegetable growing. Right. PhDs supported by the RHS include work on rosemary (bottom) and plant resources for pollinating insects (top; bumblebee on *Eryngium planum* ‘Blaukappe’).





## Training the next generation of horticultural scientists

### RHS support for new PhD students

The RHS welcomed a wide range of new PhD students this year to explore key questions for UK gardeners.

New projects include two in the slug and snail portfolio of research – Kerry-Lyn McDonald-Howard (Liverpool John Moores University), looking at improving survival rates of nematodes used to control slugs and snails, and Imogen Cavadino (Newcastle University) on slug and snail diversity. Work on soil biology-derived eco-system services from Rachel Hasler (Cranfield University) further enhances our ability to provide gardeners with the best advice on maintaining a healthy garden ecosystem.

The Horticultural Science team also welcomed Letizia Pondini (Warwick University) studying pollution degradation by leaf micro-organisms and Susan Gritton (University of Reading) looking at climate proofing of domestic gardens. Professor Alistair Griffiths is also supervising Emily Leggatt (Royal Holloway) looking at production of rosemary for taste and aroma.

### Student successes

Former PhD student Dr Sarah Duddigan has joined the University of Reading as a soil science research fellow on the RECARE collaborative project, focusing on remediating and protecting soil against a variety of soil threats. “A big part of my job now is engaging with local stakeholders and the general public,” says Sarah. “The experience I gained completing my PhD with the RHS, working with the RHS at shows and conducting my citizen science project is invaluable for this.”

This summer Horticultural Taxonomy welcomed back George Garnett to work with Dr John David on a new phylogeny of *Hyacinthinae* (*Scilla sensu lato*) using molecular analysis. George first came to RHS Science as a senior school work experience student and is now studying for a degree at Reading University and pursuing his interest in botany.

“My work experience at Wisley certainly cemented my enthusiasm for pursuing a career in plant systematics,” says George. “Through the University of Reading’s Undergraduate Research Opportunities Programme, I was lucky enough to work with RHS Science again this summer, this time on the molecular analysis of 32 species of *Scilla* and related genera. Molecular phylogenetics plays an important role in modern plant systematics, and this was an excellent opportunity to learn the skills I needed.”



### The RHS supported 17 PhD students during 2018, working on the following:

- ◆ Towards a monograph of *Narcissus*: problems and challenges in section *Pseudonarcissus* (University of Reading)
- ◆ The accumulation of regional diversity in the Anthropocene: insects on plants (University of York)
- ◆ Pathogen-induced changes in plant-insect interactions for crop and ornamental species in the genus *Solanum* (University of Cambridge)
- ◆ Do front garden landscapes Influence wellbeing? (University of Sheffield)
- ◆ Investigating the impact of plants on indoor air quality: a multi-scale cross-disciplinary approach (University of Reading)
- ◆ Benign enhancement of natural defences: BEYOND (University of Sheffield)
- ◆ Plant resources for pollinating insects (University of Bristol)
- ◆ Mycorrhizae II (Royal Holloway, University of London)
- ◆ Varietal & environmental factors optimising rosemary quality (Royal Holloway, University of London)
- ◆ The impact of climate change on UK garden plants – can we avoid a new Japanese knotweed? (University of Reading)
- ◆ *Armillaria* (University of Bristol)
- ◆ Rose rosette virus (Newcastle University / Fera)
- ◆ Nematodes other than *Phasmarhabditis hermaphrodita* as slug biocontrol agents (Liverpool John Moores University)
- ◆ Gastropod diversity in UK gardens (Newcastle University)
- ◆ Improving soil biology-derived ecosystem services through organic material applications (Cranfield University)
- ◆ Leaf surface micro-organisms & bacterial – potential for pollution degradation (University of Warwick)
- ◆ Modular approach to climate-proofing urban domestic gardens using small trees and perennial vegetation (University of Reading)

# RHS Libraries

## Bringing our collections to life

Over the past year we have staged five exhibitions at our Lindley Library, including exhibitions on heritage apples, plant collectors, garden designer Humphry Repton, conservation challenges with rare collections and modern botanical artworks.

The London Library team also ran popular curator tours of our collections during each of the RHS London Shows.

To further share our collections and events with new audiences, we have created the RHS Libraries twitter account @RHSLibraries

## Preserving our gardening heritage

We are doing everything we can to preserve our rare and unique items for future generations.

Key conservation projects this year have included:

- ◆ Conservation of Humphry Repton's "red book" on Waresly Park completed.
- ◆ Completed a major project with funding from The Pilgrim Trust and the Charles Hayward Foundation to conserve the collection of fruit drawings by William Hooker.

Significant acquisitions in the collections this year included:

- ◆ Yokohama nursery catalogues 1900–1910
- ◆ New watercolour of *Dahlia* 'Twynings After Eight' plus sketches from Heidi Venamore.
- ◆ *The Art of Simpling* by William Coles, 1656.



## RHS Libraries in numbers

**81,000**

**library users a year**

**16,500**

**general enquiries**

**220**

**researchers accessing  
specialist collections**

**11,000**

**book loans to RHS members**

**184,000**

**people saw 5 exhibitions at  
the RHS Lindley Library  
and 4 displays  
at RHS Gardens**

## Advancing learning and research

All our libraries give expert support to horticulture students and researchers. The Lindley Library also runs popular short courses for gardeners and garden enthusiasts. Courses such as 'Discovering Victorian Gardens' offered students in-depth insight into the collections and are a great opportunity to learn and experience the unique collections first-hand. We also ran study days at the Lindley Library on topics including historic book bindings and Victorian glasshouses. This year we ran a Botanical Art Seminar which attracted over 70 delegates to enjoy talks, artist demonstrations and tours.

## Informing and inspiring all gardeners

Our libraries in RHS Gardens are the main way we support general gardeners with inspiration and information. The Library teams at RHS Gardens Wisley and Harlow Carr have run a programme of attractive book displays covering topics such as women in horticulture and 'Gardening Is Good For You', highlighting the links between gardening and mindfulness. Both Harlow Carr and Wisley Garden libraries offer popular Story Time sessions for under fives.



“The Library collections provide a unique global knowledge bank on gardening, gardens and cultivated plants, underpinning the RHS’s status as a learning and research-based society.”

RHS Libraries Strategy  
2016

Left. Watercolour by William Hooker of apple 'Dutch Codlin', 1820, from a set of ten volumes known as 'Hooker's Fruits', commissioned by the RHS to help reform the nomenclature of cultivated fruit. Far left. Helen Venamore's *Dahlia* 'Twynings After Eight'.

## Selected recent RHS Science publications

### Plant Health

- ◆ **Beal, L., Waghorn, I., Scrace, J., Henricot, B.** (2018). First report of *Phytophthora tentaculata* affecting *Santolina* in the UK. *New Disease Reports* **37**: 8.
- ◆ **Clover, G.R.G.** (2018). How to keep foreign pests away from the UK's natural treasures. *New Scientist* 9 March 2018.
- ◆ **Greenwood, P., Halstead, A., with the RHS Plant Health team** (2018). *RHS Pests & Diseases*. London: Dorling Kindersley.
- ◆ **Salisbury, A.** (2018). Garden insects. *Instar 2*: 25–26.
- ◆ **Silva, G., Lecourt, J., Clover, G.R.G., Seal, S.E.** (2018). First record of *Grapevine Pinot gris virus* infecting *Vitis vinifera* in the United Kingdom. *New Disease Reports* **38**: 7.



### Horticultural Information & Advice

- ◆ **Armitage, J., Cubey, J., Edwards, D., Könyves, K., Lancaster, N., Marshall, R.** (2018). *RHS Plant Finder 2018*. 32nd edn. London: RHS.

### Horticultural Taxonomy

- ◆ **Harvey, Y., Swindells, C., Simmons, J.** (2018). A lure to take the biscuit: a *Stegobium paniceum* pheromone trial at the Royal Horticultural Society herbarium. *Journal of Natural Science Collections* **5**: 13–20.
- ◆ **Könyves, K., Bilsborrow, J., David, J. & Culham, A.** (2018). The complete chloroplast genome of *Narcissus poeticus* L. *Mitochondrial DNA Part B: Resources*.
- ◆ **Wei, Zhang & Shaw, J.M.H.** (2018). New *Pleione* hybrids from China. *Orchid Review* **126**(1321): 32–35.
- ◆ **Donald, D.** (2018). *The International Clematis Register & Checklist, Sixth Supplement*. London: RHS.
- ◆ **Edwards, D.** (2018). Split peas off the menu. *The Plantsman*, n.s. **17**(2): 121–123.

### Horticultural & Environmental Science

- ◆ **Blanuša, T., & Vaz Monteiro, M.** (2018). Green streets: classifications, plant species, substrates, irrigation and maintenance. In:

Above. **Asparagus beetle (*Crioceris asparagi*)**. Newly revised by Pippa Greenwood and Andrew Halstead, the 2018 edition of *RHS Pests & Diseases* draws on the expertise of the RHS Plant Health team, and is designed to help home gardeners make a correct diagnosis of pest and disease problems find effective solutions.

Perez, G. and Perini, K. (eds) *Nature Based Strategies for Urban and Building Sustainability*. Oxford: Butterworth-Heinemann Elsevier.

- ◆ **Gubb, C., Blanuša, T., Griffiths, A., Pfrang, C.** (2018). Can houseplants improve indoor air quality by removing CO<sub>2</sub> and increasing relative humidity? *Air Quality, Atmosphere & Health*.



**Clematis 'Dazzle', an Early Large-Flowered Group cultivar registered in 2016 and included in the 6th Supplement to the *International Clematis Register*. This supplement includes the Historical Checklist of Clematis Groups, which is a major nomenclatural survey and part of an international effort to revise *Clematis* Group classifications.**

**rhs.org.uk**

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