



Royal
Horticultural
Society

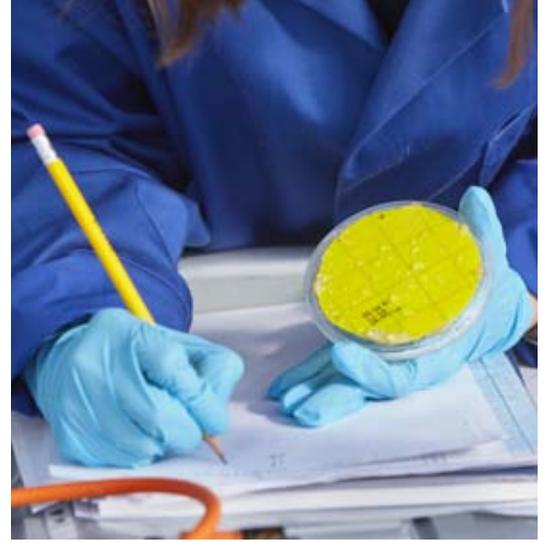
Sharing the best in Gardening

RHS Science Strategy Update 2016



The RHS Vision

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



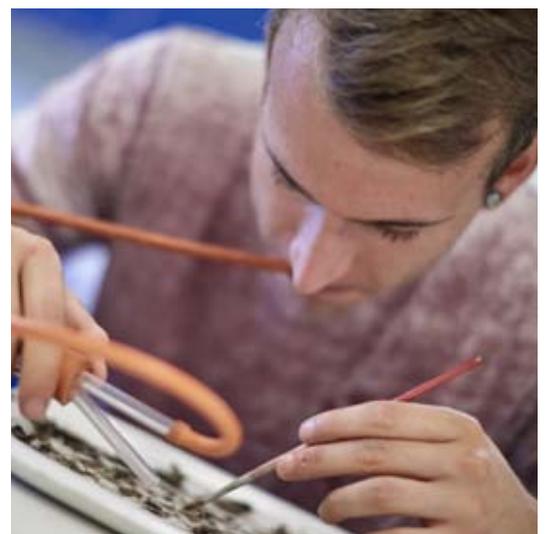
Our four key themes

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



“This new building, and the gardens and digital information associated with it, will help us bring the benefits of RHS science and our collections to new audiences.”

Welcome

Following the launch of our Science Strategy in October 2015, it's been an exciting, challenging and rewarding time at RHS Science & Collections. We've made significant progress with our four strategic themes and I'm proud to bring you this update on all the great work the team has been doing, delivering research and information for gardeners that supports our vision of enriching everyone's lives through plants and making the UK a greener and more beautiful place.

As part of the RHS's wider £160 million ten-year strategic investment plan, planning and fundraising are well under way for the new National Centre for Horticultural Science & Learning at RHS Garden Wisley.

Our scientific research capabilities will be greatly enhanced by these new facilities and they will provide much-needed public space in which we can share our work with visitors, schools and science colleagues from across the UK. The new building, gardens, public engagement and digital information associated with it will help us bring the benefits of RHS science and our collections to new audiences – inspiring and informing them about how plants and gardening can make a difference in their lives.

We need your help to support us with this transformational project, so please spread the word.



Dr Alistair Griffiths
RHS Director of
Science & Collections



Right. Artist's impression of the new National Centre for Horticultural Science & Learning at RHS Garden Wisley.

1 A global knowledge bank for gardening and garden plants



“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



Gathering and sharing information

The RHS Herbarium

The RHS is committed to making its collections more accessible to researchers and gardeners in the UK and internationally. We have now digitised 32,000 (40%) of the RHS Herbarium’s 80,000 dried plant specimens, and all the accompanying collection information has been added to the RHS Horticultural Database. Digitisation of herbarium specimens should reach its halfway stage by the end of 2016, and will be completed before the Herbarium moves to new facilities in Wisley’s purpose-built National Centre for Horticultural Science & Learning. This will provide an international online resource for the identification, naming and study of garden plants.

Left and above. Digitising a specimen in the Wisley Herbarium. New equipment acquired in 2016 has increased the rate of data capture fourfold.



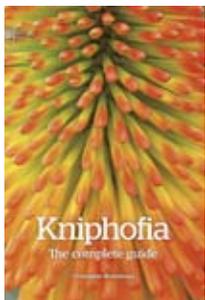
Identifying and understanding plants in our gardens

New resources for gardeners

RHS scientific publishing isn't just for scientists. It should also inspire and inform gardeners, garden designers, breeders and the nursery trade. Our publications in 2016 included:

◆ The 4th edition of the *RHS A–Z Encyclopedia of Garden Plants*, in association with Dorling Kindersley. This continues our tradition of providing definitive reference works for gardeners, bringing together over 15,500 plant entries from *Abelia* to *Zygopetalum*.

◆ *Kniphofia: the complete guide*, the first in our new series of cultivated plant monographs, and the first ever book on the genus. Bringing together all



our knowledge about the history, breeding, botany and cultivation of a particular plant group in an accessible and authoritative way, this new series will not only improve identification and conservation, but also promote wider cultivated plant diversity in UK gardens and landscapes.

◆ The 9th edition of the *International Code of Nomenclature for Cultivated Plants*, published with the ISHS (International Society for Horticultural Science). Often known simply as 'the Code', this publication aids both gardeners and the horticultural trade by providing clarity and supporting consistency in cultivated plant naming.

Managing invasive plants

Accurate and reliable plant identification is essential in the management of invasive plants, and long-term RHS research has included studies of the identity of invasive giant hogweed (*Heracleum*), water primrose (*Ludwigia*) and giant rhubarb (*Gunnera*) species in the UK. The RHS was asked to join a Defra working group to provide evidence to help revise Schedule 9 of the Wildlife & Countryside Act. This Act aims to restrict the establishment of non-native invasive species in the wild. Our research proved essential in informing the group's final report and ensuring that the correct, problematic species were cited.

Right. *Kniphofia* is the first of our new horticultural monographs. The next in the series will be *Hedera*, in spring 2017, followed by *Wisteria*, *Lathyrus* and *Digitalis*.

“RHS scientific publishing isn't just for scientists. It should also inspire and inform gardeners, garden designers, breeders and the nursery trade.”



2 Plant health in gardens

Monitoring garden pests and diseases

Agapanthus gall midge

Through RHS Gardening Advice, we receive approximately 6,000 pest and disease enquiries each year. Typically, two to three of these pests and diseases are new to the UK, and their impact on UK gardens and the wider environment is unknown. The discovery of agapanthus gall midge (*Enigmadiplosis agapanthi*) in 2014 is a real worry for UK gardeners and growers. First described by RHS entomologists, this new pest causes unsightly galling of buds in *Agapanthus* and can cause the whole flower head to collapse. Its significance for other plants is not yet known, and it has now been added to Defra's Plant Health Risk Register. Through a new Agriculture and Horticulture Development Board-funded project, RHS entomologists are studying the midge's biology and lifecycle (right), as well as biological and chemical control methods, in order to understand how best to detect and manage it.



Encouraging good garden stewardship

The Plants for Bugs project

Gardens are known to be a rich habitat for wildlife, but it is unclear how the roles of native and non-native plants compare. The first scientific paper from the long-term Plants for Bugs project at RHS Garden Wisley was published in 2015, and showed that the best strategy for UK gardeners who want to support pollinating insects is to plant a mix of flowering plants from different regions. Our interpretation of this scientific evidence for gardeners won a Garden Media Guild Environmental Award, which recognised both the clear and imaginative quality of our advice and the project's positive benefits for the environment and pollinators. Future papers will report on how other garden wildlife responds to different assemblages of plants and will provide further guidance on supporting wildlife in the garden.

“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

Developing detection and control strategies

Controlling slugs and snails

Slugs and snails are always in the top ten pest enquiries answered through RHS Gardening Advice. However, despite the availability of a wide array of control methods, they are still a persistent problem. In a joint project with BASF, the RHS has launched its first investigation into the integrated management of garden slugs and snails. Twin field experiments have been set up at RHS Gardens Wisley and Harlow Carr to assess five different control methods, as well as their cost effectiveness. The results will be published in a scientific paper, and interpreted to provide UK gardeners with reliable guidance on how best to manage slugs and snails in their gardens.





Assessing box cultivars for responsiveness to different box blight management strategies at the John MacLeod Field Research Facility, Wisley. Box is an important part of our garden heritage and history, and represents a considerable return for the horticulture industry. An important aspect of successful integrated plant health strategies will be to ensure that treatments for pests and diseases on the same plant are compatible.



Integrated management of box problems

Box (*Buxus* species) is a popular plant with gardeners and a much-loved feature of historic gardens such as Hatfield House in Hertfordshire (below). It is now under threat from box blight, which has spread throughout the UK since it was first described and identified by RHS pathologists in the 1990s. Early recommendations for management involved the complete removal of valuable plants. Current RHS research aims to find less destructive methods, and is investigating an integrated set of strategies which combine pruning regimes, the use of less susceptible cultivars, biological controls and manipulation of plant shape to reduce the spread of the disease. We are also assessing the relative cost of these different approaches, and how well they meet gardeners' needs.



3 Gardening in a changing world

“An increasingly urbanised and growing population disconnected with nature is now a reality. According to our Greening Grey Britain campaign, there is a rapid decrease in both quantity and quality of our green spaces. This is leading to unhealthy and unsustainable conditions in our cities. Mental ill-health is increasing, with one in four UK people experiencing a ‘significant’ mental health problem. A crisis point has been reached and we urgently need to generate a better understanding of the health and wellbeing benefits of gardens and gardening and their role in providing a preventative natural healthcare service.”

Dr Alistair Griffiths

RHS Director of Science & Collections





Understanding the vital role of plants

Health benefits of gardening

Gardening has come to the forefront in national media this year, for its potential benefits to our mental and physical health.

The health and wellbeing benefits of urban greening seem obvious, but how can we quantify this effect and maximise the benefits from investment in greening in our UK towns and cities, gardens and green spaces? A new collaborative RHS Science and Sheffield University project is under way and will begin to address these fundamental questions. Over the next three years the health and wellbeing of residents in two streets in Salford will be compared. One street will have been 'greened' and the other left 'grey'. Through this study we aim to inform gardeners, planners and health professionals and enable them to ensure best value from urban greening programmes.

Promoting environmentally responsible gardening

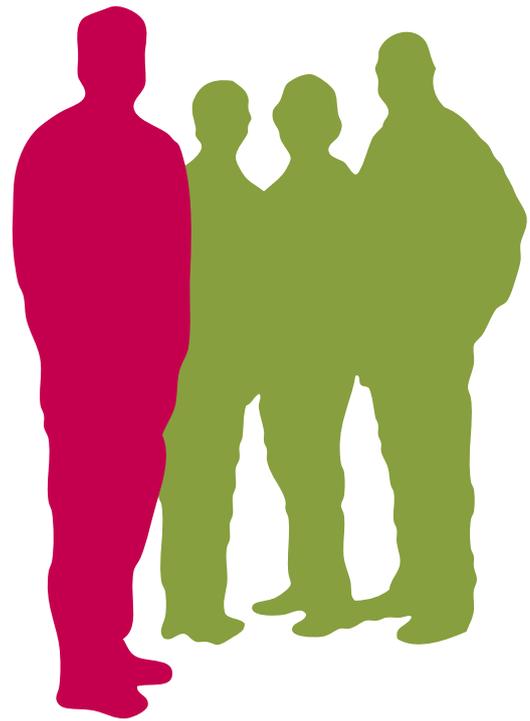
Sustainable resource use

Long-term RHS research into growing media mixes continues to underpin our work with government, environmental NGOs and the UK horticulture industry in promoting sustainable resource use which does not impair plant quality or growth.

One important outcome of our engagement with these partners (which include Defra, the RSPB, B&Q, Homebase, growing media manufacturers, growers and the HTA) has been the development of a scheme known as the 'Responsible Sourcing Calculator' to determine how responsible a particular growing media mix will be.

While the 'calculator' is still a work in progress, it is believed that by providing the user with a detailed assessment, it will in future allow not only manufacturers and retailers, but also growers and gardeners, to make informed choices about growing media.

Ultimately it will allow gardeners to choose products which are both high-quality and responsibly sourced.



1 in 4
people will
experience
a mental
health
problem
during their
lifetime.

Health Survey for England 2014

“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

Ecosystem services are the often unseen benefits people can obtain from plants, such as pollution capture and cooling our cities in hot weather.

This year we have published research on subjects as diverse as managing ivy to optimise its use as green insulation, retrofitting ‘green roofs’, the unseen benefits of urban hedges, and how urban plantings can mitigate the ‘urban heat island’ effect.

Understanding the vital role of plants

Ecosystem services

The importance of ecosystem services (e.g. food for pollinators, mitigating flooding and pollution and improving the health of people) is increasingly recognised in national and international decision-making. Our work this year to promote better understanding of the unseen benefits of plants and gardens has led to publication of scientific papers on our research, with summaries made available for gardeners and the horticulture industry. This evidence base informs our Greening Grey Britain campaign. Findings have also been shared through conferences, trade events and RHS publications such as *The Garden* and *The Plantsman*.

We aim to have a beneficial impact on as many different audiences as possible, reaching policy-makers, horticulture professionals and gardeners throughout the UK who wish to use our scientific evidence to make informed choices about the services that gardens and plants can provide.



Our ecosystem services research informs our Greening Grey Britain campaign.



4 Plant science for all: people, plants, planet

“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

Involving people of all ages

Rocket Science: inspiring the next generation of scientists

In the summer of 2016, 600,000 children became space biologists as they began a scientific plant experiment to sow and grow rocket seeds that had travelled to the International Space Station and back. Rocket Science was a nationwide initiative, with the RHS Campaign for School Gardening and RHS Science collaborating with the UK Space Agency. This project was one of 30 educational initiatives designed to engage and inspire young people in scientific investigation and careers in science – in this case horticultural science – throughout the duration of British ESA astronaut Tim Peake’s Principia mission to the International Space Station.



Training and supporting the plant scientists of the future

Through the jointly funded RHS and Agricultural and Horticultural Development Board (AHDB) fellowship, Dr Grace Barrett (right, monitoring a sustainable resource use experiment at the John MacLeod Field Research Facility, Wisley) is developing her career as a professional horticultural scientist and making an important contribution to the RHS Science Strategy. Combining training and mentoring from RHS scientists and industry professionals with support to build a professional network and reputation ensures that Grace gets the best start in her career.

Former RHS-supported PhD students Dr Kálmán Könyves (below, using new equipment to extract plant DNA in the RHS Plant Pathology lab) and Dr Stephanie Bird (bottom, collecting box moth larvae, inset) are now part of the RHS Science team, building their careers and contributing to the RHS Science Strategy.



The RHS supported 10 PhD students during 2016, working on the following theses:

- ◆ Towards a monograph of *Narcissus*: problems and challenges in section *Pseudonarcissus* (University of Reading)
- ◆ Diversity, distribution and diagnostics of the powdery mildews (University of Reading)
- ◆ Can we use soil microbes to help produce novel, sustainable growing media? (Royal Holloway College)
- ◆ Pathogen-induced changes in plant–insect interactions in the genus *Solanum* (University of Cambridge)
- ◆ Removing the barriers to retrofitting of ‘green walls’ in an urban domestic setting (University of Reading)
- ◆ Garden plants within a changing landscape (University of Sheffield)
- ◆ Soil carbon (University of Reading)
- ◆ Gardening tools for an ageing population (University of Coventry)
- ◆ 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)

“The future of excellence in UK horticultural science lies in the hands of today’s students and early career scientists. Through our financial and professional support for PhD students from universities across the UK, internships and involvement in STEM (science, technology, engineering and mathematics) education programmes, we are building a strong foundation for that future.”

Dr Gerard Clover

RHS Head of Plant Health



Inspiring and informing

RHS Gardening Advice & know-how

We are committed to helping people garden better and inspiring them to explore the possibilities around plants. In 2016 we have focused on understanding the information needs of gardeners and on making our service more efficient so that we can maximise the time we spend helping them. Successes so far this year have included:



A series of **5** new 'how to' videos in support of Greening Grey Britain to help novice gardeners easily green up a grey space at home

★★★★★
4 or 5 out of 5
helpfulness rating from
89%
of users of plants and
advice pages on
rhs.org.uk



A
full list of
Perfect for
Pollinators
plants



150
AGM
vegetables

added to *RHS Plant Finder 2016* bringing extra value to this much-loved print and digital publication

37.5 million
views of plants and
advice pages on
rhs.org.uk

95%

customer satisfaction rating from members using one-to-one RHS Gardening Advice along with some informative feedback about how we need to develop in the future



Over 700
brand new, fully detailed plant
and advice profiles added to
rhs.org.uk to support gardeners
in choosing the right plants for
their gardens and in building
horticultural skills



Promoting the health and wellbeing benefits of plants

At Hampton Court Palace Flower Show 2016 the RHS hosted the UK Ornamental Roundtable's first ever Health & Horticulture Conference.

This conference brought together 150 key stakeholders, including experts from the world of horticulture and gardening, health professions, science and government. As well as sharing their knowledge, conference participants created a Health & Horticulture Charter framework with the aim of making gardening part of everyone's life and achieving national benefits for our mental and physical health.

This Charter framework contains a set of actions for the Ornamental Roundtable Health & Horticulture Forum to support horticulture-based health interventions, and to demonstrate the health, wellbeing and economic benefits of embedding the health-horticulture connection in planning and decision-making at all levels.

Selected RHS Science publications 2016

Horticultural Taxonomy

- ◆ Armitage, J. *RHS Practical Latin for Gardeners*. London: Mitchell Beazley.
- ◆ Brickell, C., *et al.* International Code of Nomenclature for Cultivated Plants (ICNCP), 9th edn. *Scripta Horticulturae* 18. Belgium: ISHS.
- ◆ Könyves, K., David, J.C. *et al.* Microsatellite Markers for Hoop-Petticoat Daffodils. *Applications in Plant Sciences* 4(4).
- ◆ Shaw, J.M.H. Proposal to reject the nothogeneric name \times *Laburnocytisus*. *Taxon* 65(4).
- ◆ Whitehouse, C.M. *Kniphofia: a complete guide*. London: RHS.

Plant Health

- ◆ Ellingham, O., Denton, G.J., Denton, J.O., Robinson, R.J. First report of *Podosphaera macrospora* on *Heuchera* in the UK. *New Disease Reports* 33: 23.
- ◆ Ford, K.L., *et al.* A reliable *in vitro* fruiting system for *Armillaria mellea* for evaluation of *Agrobacterium tumefaciens* transformation vectors. *Fungal Biology* 119: 859–869.
- ◆ Ford, K.L., *et al.* A native promoter and inclusion of an intron is necessary for efficient expression of GFP or mRFP in *Armillaria mellea*. *Nature Scientific Reports* 6, article 29226.
- ◆ Harris, K., Salisbury, A., & Jones, H. *Enigmadiplosis agapanthi*, a new genus and species of gall midge damaging *Agapanthus* flowers in England. *Cecidology: Journal of the British Plant Gall Society* 31: 17–20, 25.
- ◆ Malumphy, C. & Salisbury, A. First incursion in Europe of bamboo white scale, *Kuwanaspis howardi* with a review of *Kuwanaspis* species detected in Britain. *British Journal of Entomology and Natural History* 29: 97–10.

Horticultural & Environmental Health

- ◆ Barrett, G.E., Alexander P.D., *et al.* Achieving environmentally sustainable growing media for soilless plant cultivation systems – a review. *Scientia Horticulturae* 212: 220–234.
- ◆ Blanuša, T., Vaz Monteiro, M., *et al.* Planting Choices for Retrofitted Green Roofs. In: *Green Roof Retrofit: Building Urban Resilience*. UK: Wiley.
- ◆ Cameron, R., & Blanuša, T. Green infrastructure and ecosystem services – is the devil in the detail? *Annals of Botany* 118 (3): 377–391.
- ◆ Thomsit-Ireland, F., Blanuša, T., *et al.* Controlling ivy attachment to wall surfaces by applying paints, metal meshes and sheets. *Journal of Living Architecture* 3 (1): 1–14.
- ◆ Vaz Monteiro, M., Blanuša, T., *et al.* Relative importance of transpiration rate and leaf morphological traits for the regulation of leaf temperature. *Australian Journal of Botany* 64(1): 32–44.

Horticultural Information & Advice

- ◆ Armitage, J., Cubey, J., Edwards, D., Könyves, K., Lancaster, N., Marshall, R. (eds). *RHS Plant Finder 2016*. 30th edn. London: RHS.
- ◆ Brickell, C. (ed). *RHS A–Z Encyclopedia of Garden Plants*. 4th edn. London: DK.



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