



Royal
Horticultural
Society

Sharing the best in Gardening

RHS Science Strategy 2015–2019



The RHS Vision

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



Welcome



A global knowledge bank for gardening and garden plants



Plant health in gardens



Gardening in a changing world



Plant science for all: people, plants, planet



The future for RHS Science

Welcome

The RHS is an internationally recognised centre of excellence for horticultural science and advice. Scientific evidence influences our practice and we share horticultural knowledge via RHS Gardening Advice, our website, our programme of public events and at our gardens and shows, as well as through RHS publications such as *The Garden* magazine. In doing so we help to enrich everyone's lives through plants and make the UK a greener and more beautiful place.

The RHS is uniquely placed to lead the debate on issues in horticulture and horticultural science. We have 445,000 RHS members, over 2 million visitors to our gardens and shows, over 11 million hits on our website and thousands upon thousands of interested and knowledgeable volunteers, gardeners and plantsmen through organisations including Britain in Bloom, our Plant Committees and Affiliated Plant Societies. In answering hundreds of thousands of gardening enquiries every year through this wide horticultural network, we obtain information on the health of gardens across the country, allowing us to monitor gardening trends and inform both our research and the advice we give, keeping the RHS at the forefront of horticultural science.

Key challenges

The 21st century poses new horticultural and societal challenges for our planet, as well as for the UK's gardens and gardeners. Populations will continue to rise, particularly in urban areas, and questions of how best to use limited resources such as water, energy and materials will become more urgent. The climate is changing and extreme weather events are becoming more frequent: how can gardeners adapt to, or even take advantage of, these new conditions? In an increasingly urbanised world, gardens and plants have the potential to connect people with nature, encourage understanding of the beneficial role of plants, and improve the health and wellbeing of individuals and communities. Against this backdrop, the RHS seeks to build a more resilient gardening community which enjoys gardens, understands the critical role of plants and manages its impact on the environment for the benefit of people, plants and the planet.



Dr Alistair Griffiths
RHS Director of Science & Collections



Sue Biggs
RHS Director General

“This wealth of information keeps the RHS at the forefront of horticultural science.”



The John MacLeod Field Research Facility at RHS Garden Wisley, Surrey.

The new RHS Science Strategy

The founding purpose of the RHS was to improve the science, art and practice of horticulture, with horticulture and science firmly placed at the heart of the Society from the very first day. This strategic vision has guided the RHS's activities through more than two centuries of rapid scientific and technological change, and still provides a sound basis for meeting the challenges faced by gardeners today.

Our new strategy focuses on four key themes and will deliver improvements in plant knowledge, plant health, human wellbeing and good stewardship of gardens and garden plants.

◆ Theme 1 – A global knowledge bank for gardening and garden plants

This will allow us to share knowledge and promote the conservation, cultivation and use of ornamental plants.

◆ Theme 2 – Plant health in gardens

This will help safeguard against the increasing number of pests and diseases and help gardeners achieve an optimal balance between wildlife benefit and horticultural enjoyment.

◆ Theme 3 – Gardening in a changing world

This will develop the evidence base for sustainable resource use in gardens and help us better understand how ecosystem services of plants and gardens can provide benefits for the environment and our health and wellbeing.

◆ Theme 4 – Plant science for all: people, plants, planet

This will ensure that our accumulated expertise and the results of research are made available to gardeners, industry, government, policy-makers and society as a whole through education, publications, social media, training and public engagement, as well as through rhs.org.uk and RHS Gardening Advice.

These four research themes will directly align with the RHS Vision: to enrich everyone's life through plants, and make the UK a greener and more beautiful place.

“Gardens and plants have the potential to connect people with nature and improve the health and wellbeing of individuals and communities.”

Delivering the RHS Science Strategy



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

1 A global knowledge bank for gardening and garden plants

Through our new strategy, we will:

- ◆ Provide a single, authoritative source for the naming and classification of cultivated plants
- ◆ Gather and share information that promotes best gardening practices and the use, cultivation and conservation of garden plants
- ◆ Improve identification and description of garden plants

The RHS leads the way in providing a single, authoritative global knowledge bank for gardening practices and garden plants. Our expertise in cultivated plant naming is internationally recognised. We take a leading role in the development of the *International Code of Nomenclature for Cultivated Plants*, and in covering nine major plant groups as part of a worldwide network of International Cultivar Registration Authorities (*Clematis*, conifers, daffodils, *Dahlia*, *Delphinium*, *Dianthus*, lilies, orchids and *Rhododendron*).

All our collections are of international importance, are the largest of their type and are unique in that they are devoted solely to cultivated plants and gardens. These resources enable us to document and provide evidence-based advice, promote the sharing of gardening best practice and support horticultural research. No other organisation has the facilities, scientists, horticulturists, wider network and focus to develop and communicate this critical information.

Our collections

325,000

plant names in the RHS database

40,000

cultivated plants in RHS Gardens

70,000

plants in *RHS Plant Finder*

80,000

plant specimens in the RHS Herbarium

23,000

insect specimens

2,700

living plant pathogen cultures

90,000

books...

30,000

artworks...and

200,000

photographs in the RHS Lindley Library

Cultivated plant diversity

We estimate that there are around 400,000 different kinds of garden plants in the UK. These provide us with significant cultural, environmental and socio-economic benefits. For example, plants can provide localised cooling in urban environments, mitigate flooding and air pollution, and provide health and wellbeing benefits by connecting people to their environment. However, further scientific work is needed to evaluate the full potential of this diverse gene pool. By carrying out in-depth botanical studies of garden plants and how they relate to each other, we can understand how to maximise these benefits to improve the environment, human health and wellbeing.



“Further scientific work is needed to evaluate the full potential of this diverse gene pool.”

Creating a single source for plant naming

The RHS Horticultural Database

Our most important horticultural data and information are brought together in the RHS Horticultural Database. This holds our comprehensive list of cultivated plant names and includes synonyms, trade designations and common names. Attached to this core name list are descriptions, plant ranges, parentage details and RHS hardiness ratings, together with information about awards, suppliers, data references, images, herbarium specimens (including nomenclatural standards) and plants in RHS Gardens.

As well as underpinning the new Herbarium and Garden Flora projects, the Horticultural Database will be central to the creation of new plant profiles. Selected information is used to create the annual *RHS Plant Finder*, while our botanical knowledge produces taxonomic treatments which form the basis of publications such as the recent 8th edition of the *Hillier Manual of Trees & Shrubs*.

It is crucial that this data set is safeguarded for the future, consolidated, developed and shared more widely.



Identifying plants in our gardens

The UK Garden Flora

The UK Garden Flora project will produce an up-to-date, online resource on the UK's estimated 400,000 cultivated plants.

By knowing what is growing in UK gardens, we can better understand the value of this genetic resource, and provide gardeners with the best possible information on the benefits and suitability of specific plants. The key aims of the project include:

- ◆ Producing a unique online reference on garden plants to complement the existing online Find a Plant facility
- ◆ Developing an inventory of cultivated plants in the UK that links to digitised herbarium specimens and photographs
- ◆ Building a record of the ecosystem services provided by different cultivated plants



Gathering and sharing information

The RHS Herbarium

With more than 80,000 dried plant specimens of cultivated and wild plants from the UK and overseas, this is the largest herbarium dedicated to cultivated plants in the UK. Our collection includes many specimens donated by breeders, nurseries and RHS members, as well as type specimens and items from RHS gardens and trials. We are planning new cutting-edge herbarium facilities to house and safeguard this incredibly important international collection, as well as developing a more comprehensive representation of the UK's garden flora. We aim to:

- ◆ Enhance methods of preserving cultivated plant material
- ◆ Undertake an analysis of gaps in the collection to determine where our representation of plants in cultivation could be improved
- ◆ Resume our programme of encouraging breeders and raisers of new plants to deposit reference specimens or images
- ◆ Digitise our specimens and make them available online

Our other taxonomic research

Other research projects include horticultural monographs on *Daphne*, *Kniphofia*, *Hedera*, *Digitalis* and *Narcissus*, a study of the identity of invasive *Gunnera* in the UK, and an investigation of how particular plant traits may provide benefits beyond their aesthetic value (for example, in encouraging pollinators).



Above. Digitising a specimen. The RHS Herbarium has a unique collection of specimens, with many of historical significance. The specimens have numerous origins, including nurserymen and breeders, public and private gardens, plant trials and plant awards. Currently all our types and nomenclatural standards have been digitised and are available for study online, but we are planning to make images of all specimens available in the long term.

Improving identification to enable better plant cultivation and conservation	Promoting plant selection and breeding for environmental and health and wellbeing benefits	Informing effective management strategies for invasive plants	Safeguarding our important heritage and scientific collections	Making our collections more accessible as learning and research resources
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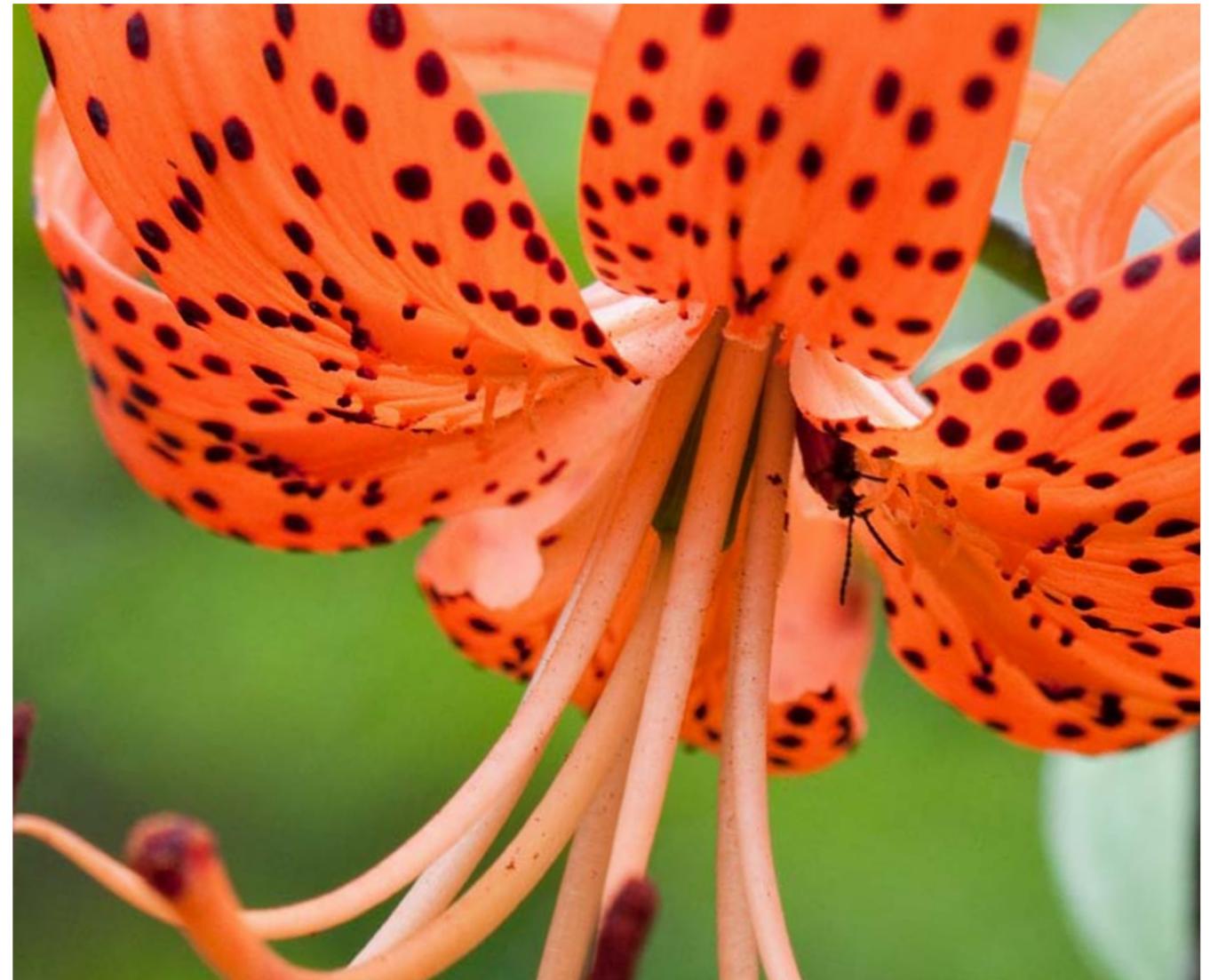
Our global knowledge bank will make a difference by...

2 Plant health in gardens

Through our new strategy, we will:

- ◆ Monitor plant pests and diseases in gardens
- ◆ Improve detection and identification of plant pests and diseases
- ◆ Advance control and management strategies for plant pests and diseases in gardens
- ◆ Encourage good stewardship of nature in gardens for environmental benefit

The threat to garden plants and the wider environment from pests and diseases has never been greater, due to the globalised trade in plants, increasing resistance to chemical controls and the reduction in the availability of chemicals to manage pests and diseases. The need to address these threats has taken on additional urgency because of the recent surge of new and unrecognised pests and diseases (including diseases such as ash dieback, and insects such as box tree caterpillar) emerging as significant risks to the wider environment. The extreme weather events associated with climate change may also result in new pest and disease threats and may amplify the impacts of those already here.



The need for greater awareness and action has been recognised at national and international levels. The RHS Gardening Advice service for members provides us with vital intelligence about trends in pests and diseases. In doing so, it informs us about the health of gardens right across the country. We are often the first to identify garden pests and diseases that are new to the UK. The RHS has made a long-term commitment to address risks to plant health and improve plant biosecurity in gardens and the wider environment.

The vital role of gardens as havens for wildlife is well established and with increasing pressure on our natural habitats gardens will become even more important. This role is amplified through the patchwork of public and private green space. There is an urgent need to undertake research and strengthen the evidence base on how best to achieve an optimal balance between wildlife benefit and horticultural enjoyment.

Above. Lily beetle is one of the non-native pests we monitor in our citizen science programme.

“The vital role of gardens as havens for wildlife is well established.”



Encouraging good garden stewardship

RHS Perfect for Pollinators

Flying insects such as bees and hoverflies which visit flowers for their nectar and pollen perform the vitally important service of pollination. However, our bees and other pollinators are in decline.

The Plants for Bugs project is the first ever field study into the effect of the geographical origin (nativeness) of garden plants on the abundance and diversity of invertebrates they support. Undertaken by RHS Science and supported by the Wildlife Gardening Forum, initial findings from the project show that a broad range of plants from different geographic regions is of benefit to flying insects that visit gardens. These findings have enabled us to update and add to our Perfect for Pollinators guidance for gardeners, providing an evidence-based list of plants that attract and support pollinators.

The RHS is committed to helping to deliver the Government's National Pollinator Strategy (NPS). RHS Perfect for Pollinators, which the NPS endorses, is a key part of this commitment. RHS scientists will continue to build on research to underpin Perfect for Pollinators and further findings from Plants for Bugs will provide insights into the effects of plant origin on other invertebrates such as ground-dwelling beetles. This will help further our understanding and support gardeners to be good stewards of their environment and its biodiversity.

Right. Bumblebee on *Nepeta racemosa* 'Walker's Low'.



“Findings from our research will support gardeners to be good stewards of their environment and its biodiversity.”



Developing control strategies

Managing new and existing pests and diseases

As the only organisation carrying out surveillance for pests and diseases in gardens, the RHS is well placed to identify new and emerging plant health issues. Through our citizen science work and engagement with RHS members' enquiries we are able to rapidly detect and identify new pests and diseases and then develop control and management strategies that are practical for gardeners to implement.

Some of the pests and diseases we will focus on as part of this new strategy include:

- ◆ Slugs and snails (left and below)
- ◆ Box blight (below right)
- ◆ Agapanthus gall midge (below left)
- ◆ Box tree caterpillar
- ◆ Rust diseases



Our plant health research will make a difference by...

3 Gardening in a changing world

Through our new strategy, we will:

- ◆ Advance the understanding of the ecosystem service role of plants and gardens in urban and rural sustainability
- ◆ Encourage sustainable resource use in gardens, for environmental benefit
- ◆ Promote the importance of plants and gardening in the health and wellbeing of individuals and communities

Gardening in a changing world poses many new challenges for society, such as improving the health and wellbeing of an increasingly urban population and coping with climate change, extreme weather conditions and the depletion of natural resources.

Gardens form part of our natural landscape. The UK has 22.5 million gardens and 27 million gardeners, so the way in which they cultivate the land plays a significant role in shaping our environment. There is therefore a vital need to develop evidence-based and consistent advice for gardeners on how to enjoy their gardens while minimising the negative – and maximising the positive – impact on the planet. The findings from our research will deliver best-practice advice for gardeners on getting the most environmental, health and wellbeing and aesthetic benefits from their garden while keeping it sustainable.



Promoting environmentally responsible gardening

Sustainable growing media

Our research is using five commonly used raw materials for growing media (peat, coir, wood fibre, pine bark and garden waste compost) and mixing them in different proportions to create bespoke growing media mixes. These mixes are physically characterised to determine their water- and air-holding capacities before being used to pot up plants selected to illustrate how the growing media perform. An industry standard peat-based medium is also included for comparison.

So far, it has been found that these different growing media mixes have little impact on plant quality. This work is showing that a diverse range of materials can support high-quality plant growth and will be used to inform advice for gardeners and industry on the selection of growing media.

Organic matter experiment

In another long-term experiment, on our organic matter plots, we are examining the effects on plant yield and soil quality of repeat applications of the same form of organic matter.

Results so far suggest that while composted bark reduces soil pH (increasing acidity) compared with an untreated plot, all other treatments, such as horse manure, green compost, mushroom compost and composted bracken increase soil pH (reducing acidity). All the tested treatments reduce soil bulk density, with composted bark again having the greatest effect. We are exploring how these changes affect plant growth and the ease with which the soil can be worked.

The RHS is also working in collaboration with the University of Reading to jointly supervise a PhD student who is exploring the effects of these organic materials on soil carbon content. Communicating the findings from this work will help gardeners understand the wider value of their gardening practices in mitigating global climate change.

Left. In 2012 each of the 72 organic matter experimental plots was sown with *Calendula officinalis* 'Neon'. The plant material was harvested in the autumn and weighed to establish individual plot yields. Soil analysis was undertaken regularly for each plot.



Left. Research into ecosystem services will evaluate the impact of green walls on buildings.

Understanding the vital role of plants Ecosystem services

Ecosystem services are the often unseen benefits people can obtain from plants, such as regulation of localised temperature and humidity.

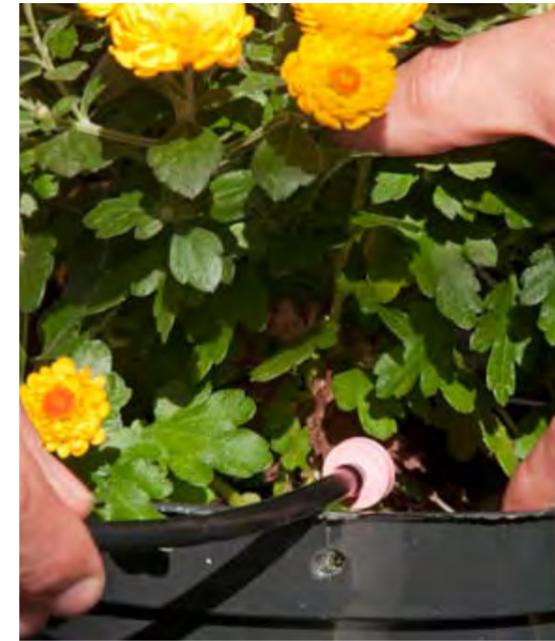
In this series of projects, we are exploring the effect of different plant species and cultivars on local air temperature, water cycling and air pollutants. Research will include the impact of 'green walls' on buildings and will evaluate the ecosystem services of hedging plants. Additional work with schools and community groups may examine issues around domestic urban food production, and how it interlinks with urban pollution and water use.

This research will help develop environmental information for the RHS online Find a Plant facility, helping people identify plants that provide both beauty and important ecosystem services.

This research is complemented by a PhD project exploring whether existing ecological knowledge about plants can be used to predict their tolerance of fluctuating weather patterns.

Health benefits of gardening

In a new collaboration we are working with Coventry University and their motion capture laboratory to better understand the impacts of different gardening tasks on the human body. We are also undertaking a collaborative project with the University of Sheffield to investigate the influence of gardens on human health and wellbeing.



Improving the understanding of the physical, mental, and health and wellbeing benefits of plants and gardens

Promoting the urban and rural use of plants and gardens for their ecosystem services

Reducing resource use and improving waste management in gardens

Equipping gardeners to be more resilient to a rapidly changing climate and environment

Building understanding of the social and cultural importance of UK plants and gardens

Our gardening in a changing world research will make a difference by...



4 Plant science for all: people, plants, planet

Through our new strategy, we will:

- ◆ Inspire and inform people about the importance of plants and gardens
- ◆ Involve people of all ages in plant science and gardening through education, training and interpretation
- ◆ Provide excellent advice for gardeners through RHS Gardening Advice on our website, at shows, through our publications, and in our gardens and exhibitions

With a membership of more than 445,000 gardeners and welcoming over 2 million visitors to our gardens and shows each year, the RHS is a trusted brand for accurate, authoritative gardening advice. RHS Science underpins this advice, sharing the findings of research and addressing key issues raised by gardeners. High-quality, reliable, accessible advice is crucial in helping individuals and communities garden successfully and get the maximum benefits from their plants and gardens.

Left. The RHS Invisible Garden exhibit at RHS Hampton Court Palace Flower Show was designed to introduce visitors to the world of microscopic organisms.



Inspiring, informing and involving people

Gardening know-how at rhs.org.uk

The RHS is already the 'go-to' place for those seeking plant information and gardening advice, and around two thirds of all visits to the RHS website are to our plant and advice profiles. By building on this strong foundation, guiding plant choice and providing accessible 'how to' information, we will help more people garden successfully and inspire them to explore the possibilities around growing plants.

What we will do:

- ◆ Grow the number of detailed plant and advice profiles at rhs.org.uk
- ◆ Tailor how we deliver our information to different people, including providing more information for novice gardeners and using video and social media to reach new audiences
- ◆ Engage with RHS members and website users to understand their needs and benefit from their experience
- ◆ Deliver the results of our research, including information on the ecosystem services plants provide, to the wider gardening community

Providing excellent advice

RHS Gardening Advice

RHS Gardening Advice provides RHS members with free, personalised gardening advice on the phone, by email and in person at the Members' Advice Centre at RHS Garden Wisley and at special events held at RHS Gardens Hyde Hall, Harlow Carr and Rosemoor.

As our membership grows and diversifies, it is crucial that the service meets the changing needs of members and that we continue to provide the highest possible quality advice.

What we will do:

- ◆ Review and improve our enquiry management systems to ensure we can dedicate resources to responding to enquiries and engaging with members
- ◆ Explore new avenues for members to make enquiries including introducing an online enquiry tool
- ◆ Understand key areas of member interest and strengthen our capability to support members with these enquiries

Our other projects

Working with colleagues across the RHS we will draw together our online plant, advice, science and collections information to make it easier to find. We will also create a more interactive digital space for our members and the gardening public. By showcasing an exciting range of knowledge – from digitised herbarium specimens to plant selection guidance – we will inspire people to engage with plants and gardens, and encourage the next generation to consider a career in horticultural science.



Our work to bring plant science to all will make a difference by...

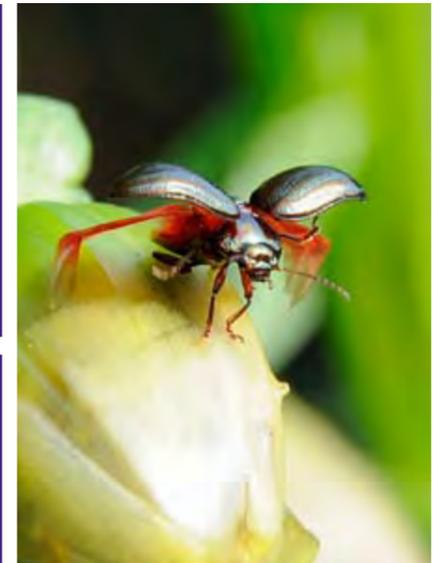
Fostering greater public understanding of plants, gardens and gardening

Training the next generation of horticultural scientists in horticultural taxonomy, plant health and horticultural science

Enabling more people to garden for the benefit of themselves, their environment and their communities

Inspiring children and young people to garden and to consider a career in horticulture

Providing scientific evidence to support effective government policy-making



The future for RHS Science

Through this strategy, RHS Science will become a highly visible, internationally recognised centre for horticultural science that works to increase public engagement and deliver tangible benefits for individuals and the UK.

By providing high-quality, accessible, evidence-based advice for gardeners, we will promote environmentally sound gardening practices and inspire people to garden and to enjoy the benefits for themselves and their communities.

Through unlocking our heritage collections and sharing our knowledge with other researchers and organisations, as well as with RHS members and the public, we will strengthen understanding of the environmental and economic benefits of plants and gardens, as well as their positive effect on people's health and wellbeing.

In making a commitment to horticultural science training and education through schools, colleges and the RHS, we will ensure that the next generation of horticultural scientists is equipped to tackle the enormous challenges gardeners face now and in the future.

The RHS is planning a new building at RHS Garden Wisley that will be the first UK centre of excellence dedicated to horticultural taxonomy, plant health and horticultural and environmental science. This investment will provide new facilities to enable the delivery of the four Science Strategy themes and will create an inspiring public venue where we can share the knowledge from our research at Wisley and across the UK for the benefit of gardeners and horticulture.

This is a challenging programme of work that reaches further than ever before to deliver the RHS Vision: to enrich everyone's lives through plants, and make the UK a greener and more beautiful place.



Where you will see the results

- ◆ **RHS website**
We will be adding to and improving the science, plants and advice sections, including opportunities to get involved and support our work
- ◆ **National and RHS media**
We will be sharing our research findings and recommendations for gardeners with more audiences
- ◆ **UK and EU policy**
We will be providing expertise and input into policy and legislation development
- ◆ **RHS shows and events**
We will be showcasing our work and engaging with the public on science, plants and gardening
- ◆ **Peer-reviewed scientific papers**
We will be publishing our findings and sharing them with the scientific community
- ◆ **Horticulture Matters**
We will be leading the way by improving training and opportunities in taxonomy, plant health and horticultural science
- ◆ **UK gardens and public spaces**
We will enrich everyone's lives through plants, and make the UK a greener and more beautiful place

rhs.org.uk

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'Northern Star') 16, 25 Mike Ballard (snail, rosemary beetle).

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