The HIP Ornamental & Landscape Horticulture R&D Strategy 2015 – 2020

Supporting the delivery of The Ornamental Horticulture Roundtable Action Plan 2015 – 2020
The Horticulture Innovation Partnership (HIP) is an independent stakeholder organisation conceived by the industry in 2012 as an innovative ‘think tank’.
Innovation strategy 2015

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Foreword

Whilst I began as a keen amateur gardener and remain so I soon came to realise how important the world of horticulture and the industry it represents is in a much wider context.

There is a much greater understanding now of the value of horticulture in terms of the health and wellbeing of the population. Gardening for individuals can be an effective form of exercise, can foster family bonds and be a wonderful tonic for those suffering from mental illness and those who feel "outsiders".

Our fabulous collection of parks and gardens and even small green spaces provide enjoyment and relaxation for our own people and can certainly improve their health. In addition they make an impressive contribution to UK tourism and our horticulture and landscape experts are in demand around the world.

Without horticulture we would all be exposed to vast acres of brick, stone and concrete softened by greenery — a veritable concrete jungle. Worse still towns and cities would become unbearably hot in summer with the likelihood of flash floods after heavy rain. Mercifully this nightmare scenario has not happened but it behoves us all to recognise how valuable the green environment is and the vital role the horticulture industry plays.

I therefore welcome most warmly the initiative which has brought together the many varied organisations and individuals which make up the horticultural world to produce this ambitious innovation strategy document. It sensibly tries to align the role that horticulture can play with generally accepted national policy objectives. This Strategy will also support the Ornamental Round Table Action Plan 2015 to 2020 published earlier this year which identifies and sets out how to achieve key opportunities for growth.

I hope that this initiative will continue and build a long term co-operative approach since nothing worthwhile is ever accomplished in a short time. As the old saying has it “Rome was not built in a day” but we are laying a firm foundation for the future in which horticulture will play an ever more important role.

Yours very sincerely,

Janet Fookes

Baroness Janet Fookes
Co-Chairman of the All Party Parliamentary Gardening and Horticulture Group
Collectively, our gardens make up the biggest nature reserve in the UK. Greenery makes places happier to live in. Well managed landscapes are likely to lower crime rates. Garden shows & festivals create community celebrations. Social health ranked as tourists’ 4th favourite activity. Wildlife: The industry employs 300,000 people in manufacturing, design & construction, science, retail & other specialist jobs. Economy: The UK plant & cut flower production is a £2bn industry. Interior landscaping boosts workplace productivity. Air pollution & CO2 is reduced by trees & plants. Environmental plants insulate buildings in winter & cool them in summer, saving energy. They also absorb torrential rainfall & reduce flooding. 1/3 of international trips to UK include a garden visit. Gardens & parks are an essential part of the British experience for 12m tourists who spend £7.8bn each year whilst visiting. Gardening activity reduces obesity & heart disease. Access to greenspace makes us feel better. Gardening connects people, combatting loneliness.

List of acronyms

AHDBH  Agriculture and Horticulture Development Board – Horticulture
DCLG  Department for Communities & Local Government
DCMS  Department for Culture, Media and Sport
DBIS  Department for Business, Innovation & Skills
DECC  Department for Energy & Climate Change
Defra  Department for Environment, Food & Rural Affairs
DfE  Department for Education
DoH  Department of Health
DWP  Department for Work & Pensions
FERA  Food and Environment Research Agency
GI  Green Infrastructure
HSE  Health & Safety Executive
HO  Home Office
HTA  The Horticultural Trades Association
HIP  The Horticulture Innovation Partnership
NHS  National Health Service
RHS  Royal Horticultural Society
TEEB  The Economics of Ecosystems & Biodiversity
Value & benefits of ornamental horticulture

Environmental
- Plants insulate buildings in winter & cool them in summer, saving energy. They also absorb torrential rainfall & reduce flooding.

Wildlife
- Air pollution & CO₂ is reduced by trees & plants.
- Plant diversity in gardens feeds & shelters wildlife, including important pollinators such as bees, all year round.
- Collectively, our gardens make up the biggest nature reserve in the UK.

Tourism
- Gardens & parks are an essential part of the British experience for 12m tourists who spend £7.8bn each year whilst visiting.
- 1/3 of international trips to UK include a garden visit.
- Ranked as tourists’ 4th favourite activity.

Economy
- The industry employs 300,000 people in manufacturing, design & construction, science, retail & other specialist jobs.
- The UK plant & cut flower production is a £2bn industry.
- Interior landscaping boosts workplace productivity.

Health
- Gardening activity reduces obesity & heart disease.
- Gardening connects people, combatting loneliness.
- Access to greenspace makes us feel better.

Social
- Greenery makes places happier to live in.
- Well managed landscapes are likely to lower crime rates.
- Garden shows & festivals create community celebrations.

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Overview

The Horticulture & Landscape Industry

Horticulture deals with the art, science, technology, and business of plant cultivation. Ornamental and landscape horticulture is focused on plants and cut flowers grown mainly for aesthetic purposes. It also embraces the construction and management of gardens and designed landscapes, sport and recreation facilities, allotments and domestic gardening. Suburban and peri-urban plantings are included within this definition: these include infrastructure plantings around motorways, railways, business parks and power stations, as well as gardens and parks such as Sissinghurst Castle, St James’ Park and Hopetoun House.

The discipline of horticulture underpins many scientific, ecological and countryside management processes, from micro-propagation for forest and woodland tree production, to planting for biodiversity and landscape management for heathlands and other habitats.

The huge diversity of ornamental plants serves a great range of purposes from a vase of flowers in the house or single-season bedding display to the long-term impact of avenues of trees. They are bought by many different kinds of customers through specialised supply chains operating in a competitive global marketplace. These supply chains include the producers of plants and their suppliers, the food and garden centre retailers supplying the consumer, and the landscaping sector who deliver and maintain public and private landscapes (illustrated on page 26). All are supported by a technically skilled, highly diverse workforce, from production through to the long term management of landscapes.

The Research & Development Opportunity

This strategy aims to set out the wider benefits delivered by the industry and the biological, environmental and social science R&D required to further grow a thriving, productive and profitable ornamental horticulture sector.

Specific near-market research needs (e.g. crop protection, efficient use of resources, delivering customer specification, labour) for sustainable and resilient plant production are set out and partly met by the statutory levy board, the Agriculture and Horticulture Development Board – Horticulture (AHDBH) and for domestic garden and ornamental green spaces some R & D is done by other organisations, including the Royal Horticultural Society. Additionally, the regulatory constraints which add cost to production are set out in the Annex on page 29.

Ornamental plants have significant beneficial effects on human mental and physical health, on wider societal well-being including tourism, and on the health, quality and function of the environment. They therefore have a crucial part to play in the future development of a productive economy and a civilised society. This provides a significant opportunity for growth in the industry and a greater contribution to economic prosperity in part through growth in the production, sales and management of plants, the wider appreciation of their health and wellbeing benefits, and how they can help address key policy areas.

1 Crane et al., 2014
2 AHDBH, 2015
3 RHS, 2015
The industry needs investment in research and innovation to:

- Specify the wider benefits of ornamental horticulture and align the associated challenges to funders’ policies to enable innovative use of funding mechanisms.
- Exploit the wider benefits of emerging markets to deliver market-ready products and services.
- Maximize the use of UK-grown plants through resilient supply chains and in sustainable landscapes.
- Deliver speedy translation of new research findings into practice along the whole supply chain from UK grower to green space.
- Consolidate and share existing knowledge and best practice to create a thriving, profitable and self-sustaining sector, which is less reliant on imports.

The HIP, by working with research funders will:

- Bring together the many groups, organisations and specialisms thus supporting a joined-up research strategy for the whole ornamental and landscape industry enabling them to speak with one voice.
- Work with research funders and policy customers to provide better alignment within and between organisations to help foster innovation and a thriving sector.
- Facilitate and stimulate innovation for business growth within the UK ornamental and landscape sector recognising the additional societal impact and environmental resilience which can be delivered through innovation.
- Provide the horticultural ‘spring-board’ for the Natural Health Service.
We ask that the research opportunities identified in this strategy are supported through funding the underpinning and applied science essential to a collaborative and effective research pipeline. The diagram below shows how the four chosen research and development themes will also help deliver the *Ornamental Horticulture Roundtable Action Plan Asks*.

**Research and development themes**

- **Health & wellbeing**
- **Communities & tourism**
- **Ecosystem Service Delivery, Environmental Resilience & Biodiversity**
- **Improving Sustainable Resource Use & Biosecurity**

**Towards delivery of Ornamental Horticulture Roundtable Action Plan ‘Asks’**

1. Garden tourism
2. Modernisation, efficiency, effectiveness & sustainability of the supply chain
3. Research & development
4. Sustainable resourcing of the horticultural industry
5. Plant health and the National Pollinator Strategy
6. Human health & horticulture
7. Society & horticulture

*The rose gardens built for visitor display at David Austin Roses, Wolverhampton.* Photo credit: David Austin Roses
Introduction

This strategy aims to identify the research and development requirements to underpin the sustainable production of plants and the creation and management of private and public landscapes, including sport and recreation. The outcomes will deliver sustainable wealth-creating opportunities for the UK economy, contribute to the health and wellbeing of the population, and strengthen the environmental resilience of our urban and peri-urban areas.

The industry will support speedy translation into practice through the supply chain from growers to green spaces. This will include developing new products and techniques, as well as building on existing knowledge and sharing best practice to create a thriving, profitable and self-sustaining sector which is less reliant on imports.

There are examples of very effective innovation in the industry delivering economic growth where the supply chain has maximized the delivery of UK-produced plants (Case study: Sainsbury’s win 2014 Home Grown Poinsettia Retailer of the Year) and where the development of products to satisfy both UK and export markets has been successful (Case study: David Austin Roses). There is now an opportunity to drive innovation more widely in the whole supply chain.

Purpose and research themes

This strategy aims to identify the research and development requirements to underpin the sustainable production of plants and the creation and management of private and public landscapes, including sport and recreation. The outcomes will deliver sustainable wealth-creating opportunities for the UK economy, contribute to the health and wellbeing of the population, and strengthen the environmental resilience of our urban and peri-urban areas.

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Case study 1
David Austin Roses

With a reputation for breeding and introducing some of the finest roses in the world, Wolverhampton-based David Austin Roses now sells roses in more than 45 countries. It has spent the past 20 years paying particular attention to disease resistance in their breeding process whilst maintaining their objective to deliver beautiful blooms and great garden plants. One of the benefits of this on-going work is that English Roses are highly adaptable and tolerant to different climates around the world, including the colder climates of Canada and Russia. Very cold winters of course can be challenging to some roses but carefully selecting varieties, means that the English Roses can be grown successfully in more difficult conditions.

As a group, English Roses are healthy, reliable and very easy to grow and this combined with their beauty, fragrance and repeat flowering ability adds to their popularity and appeal. Some famous names have been fortunate to have an English Rose named after them including Alan Titchmarsh (Ausjive) and Darcey Bussell (Ausdecorum).

David Austin began breeding as an amateur in the late 1940s and people were sceptical of his ambitions because rose breeders had been obsessed for nearly 100 years with producing repeat-flowering hybrid tea roses. These breeders missed the fundamental importance to the consumer of scent and beautiful, fulsome-petalled flower forms, characteristic of the old roses. Austin’s genius has been to combine the best of both.
Sainsbury’s sourced British grown plants for their poinsettia sales for Christmas 2013. The retailer maintained close contact with the growers and benefitted from a robust supply chain. The ‘Home Grown’ initiative has arisen from a nucleus of interested growers who wished to promote their products as Home Grown and to differentiate them from imported produce giving consumers more choice and the possibility to obtain locally produced plants.

Sainsbury’s received the Home Grown Retailer Award in recognition of the fact that 100% of the poinsettias they sold were UK grown and every plant’s protective sleeve carried the logo. Since the event was covered in the press, Co-operative supermarket has also announced it has sourced all its poinsettias in the UK and Asda has also spoken of its high level of local sourcing. Production has risen by 20% this year from around 2.7 million to 3.2 million plants with an estimated farm gate value of £7.5 million.
Health & wellbeing
Towards delivery of Ornamental Horticulture Roundtable Action Plan Asks 8, 11 & 12

Challenges & opportunities
Horticulture provides opportunities to make gardens and landscapes part of our universal health system and this could make substantial savings to the NHS. There are many health and wellbeing challenges facing society, obesity and mental illness being two of the most significant current ones. Horticultural activities and landscapes can improve mental health and reduce obesity. Due to the causal links with obesity, this in turn may help battle cardio-vascular diseases, diabetes and cancer.

Individual benefits sit on a spectrum from the physiological effects of passive association with green spaces (biophilia effect), to physical improvements associated with active participation in horticultural production (gardening tasks) and increased use of green spaces. The benefits encompass social, personal and educational skills development, and the adaptability of the environment and the tasks make horticulture a powerful medium to deliver these. Whilst this is recognised, the industry needs to find innovative ways to integrate into policy thinking and health service delivery.

Mental health currently costs the UK £105 billion a year, and it is estimated that a quarter of the UK population will experience a mental health problem during the course of a year.

Government policies
- Protecting and enhancing our urban and natural environment to improve public health and wellbeing: Defra.
- Reducing obesity and improving diet; Improving care for people with dementia and people approaching the end of their life; Helping more people survive cancer; Increasing research and innovation in health and social care: DoH.
- Making reducing mental health problems a priority: DoH.
- Increasing innovation in health and social care and make mental health services better, more accessible: DoH.
- Giving all children a healthy start in life: DoH and DfE.
- Protecting and improving peoples enjoyment of the countryside: Defra/DCLG.

4 Kaplan, 1995; Pretty et al., 2005
5 Lachowycz and Jones, 2011
7 Van den Berg and Custers, 2010; Cameron, 2014; National Recreation and Park Association, 2015
8 Centre for Mental Health, 2010
9 National Statistics, NHS, 2009
Our strategy

Research required

- Evidence-based approaches to quantify the costs and benefits of gardening and access to green spaces on mental and physical health and promotion of theory into practice.
- Selectively analyse existing genetic stock to select and breed plant material to enhance health and wellbeing character traits and add value.
- Identify the plants, design components and their scale which improve specific physical and mental health and wellbeing conditions and encourage more visits and activity.

Benefits of research

- A healthier, more productive workforce.
- British Medical Association guidelines for GPs and commissioning bodies on how to improve patient health through gardening and the wider use of plants and greenspace.
- To better design and manage greenspace to aid health interventions and to develop gardening activities that reduce obesity and help prevent or counteract certain forms of mental illness.
- Evidence available to policymakers on how, where and what plants can provide health benefits, and how these can be exploited most effectively, and those to be avoided due to any allergic or other harmful effects.
- Widen employment opportunities
- Reduced pressure on social care systems through building skills which support independent living and improve personal and community resilience.

Office atrium, Trondheim, Norway. Photo credit: Biotecture
Case study 1

Thrive, the horticultural therapy charity

Established in 1978, Thrive is the leading UK charity using social and therapeutic horticulture to bring about positive changes in the lives of people who are living with disabilities or ill health, or are isolated, disadvantaged or vulnerable.

Gardens are peaceful and restorative. They provide a special place for rehabilitation and recovery: being given the opportunity to develop an interest in gardening will give a person benefits that can last a lifetime. Thrive uses gardening to help a very wide range of people, including:

- People living with a physical impairment such as sight or hearing loss.
- Those who may be recovering after an accident or ill health.
- People in recovery with mental illness and those with milder mental health support needs.
- People with a learning disability or on the autistic spectrum.
- Those living with age-related conditions such as dementia, heart problems, diabetes or stroke.
- Young people with social, emotional or behavioural difficulties.
- Older people looking for ways to carry on with gardening to benefit their health, maintain independence and age well.

Thrive’s horticultural therapists develop a tailored set of activities for each gardener to improve their particular health needs, and to work on certain goals they want to achieve. Alongside working directly with those living with the challenge of ill health, disability and vulnerability within society, Thrive promote the use of gardening for health and wellbeing more generally by welcoming the opportunity to give advice and guidance to anyone wanting to garden. Thrive’s information services include the distribution of thousands of guides to specific groups and a website full of practical advice. Additionally, Thrive encourages other health, social care and educational professionals and organisations to maximise the use of gardens and gardening within their own services through its training and education programmes. These are accessed by over 550 people and many organisations each year. Thrive promotes inclusive access to its services for all.
Our strategy

Case study 2

The Natural Health Service

Gardening and other pastimes that involve green space are increasingly cited as having positive effects on both psychological and physiological health measurements. Garden activities are thought to fit well with the Attention Restoration Theory. This is the concept that activities performed in natural settings act as an antidote to ‘directed attention’, i.e. long periods of intense concentration. Prolonged or very frequent periods of directed attention result in human physiological stress. Stress is considered a precursor to a number of common mental health problems such as depression and anxiety, which themselves in time can lead to more severe illness such as schizophrenia, or social problems such as domestic violence. Gardening and other ‘green activities’ are increasingly being cited as important interventions in breaking these negative cycles as they effectively help the brain ‘wind down’ from periods of directed attention, thereby reducing the incidences of physiological stress. Importantly, such interventions appear to have application across a wide section of society.

Research has shown that gardening or increased access/views of green space can:

- Reduce the human stress hormone, cortisol, more effectively than other passive interventions such as reading (see chart to the right).
- Reduce other physiological symptoms of stress, namely blood pressure, skin conductance and muscle tension.
- Protect telomere integrity (less oxidative damage to DNA strands in human cells).
- Enhance physiological motor performance and maintain mobility in old age.
- Promote positive mood states and improve self-awareness, self-esteem and self-concept.
- Provide pain relief.
- Reduce stress related antisocial behaviour including domestic violence and gun crime.

Gardens are increasingly documented as important places to relax; aspects considered important in off-setting the effects of prolonged stress. They also promote ‘soft fascination’ skills (indirect attention) and can help children and vulnerable adults to develop their self-esteem and self-awareness.

Changes in cortisol (‘stress’ hormone) levels and mood scores as participants are given a stressful task (computer test) and then asked to either undertake allotment garden activities or read magazines indoors.

Gardens can help the young develop self-esteem.

Photo credit: Ross Cameron

References:
10 Cameron, R. W. F. (2014)
Communities and tourism
Towards delivery of Ornamental Horticulture Roundtable Action Plan Asks 3, 8, 11 & 12

Challenges & opportunities

Ornamental planting can deliver considerable ‘social value’ and ‘sense of place’ across a range of time scales from the immediate (e.g. bedding plant displays) to many decades and centuries as trees and plants grow and mature. These plantings, and their management often make a place distinct and ‘attractive’. Managing, capturing and communicating this value to local authorities, developers and landowners for full effect requires new tools.

Horticulture can provide an accessible way to build civic pride and social cohesion, bringing together isolated residents. Growing plants and gardening is a great social and cultural leveller and has strong potential to reduce the widening gap in social equality. Recent cuts to local authority budgets have had a damaging effect on parks and green space in general and there is no statutory requirement on local authorities to maintain them. The reality is this is often seen as the first budget to cut, despite a general acceptance that people love their parks. Taken together, our civic parks and green spaces offer one of the few truly democratic aesthetic experiences.

Garden tourism is already a large contributor to the UK economy and has great potential for growth. A third of visitors to the UK already visit a park or garden spending an additional £7.8bn. Understanding what drives visits to gardens and parks could help their management to maximise the commercial returns from gardens whilst still maintaining them to an impeccable standard. Tourism organisations could develop much more effective targeted marketing campaigns to increase footfall.

Government policies

- Bringing people together in strong, united communities; Increasing the public’s power over their neighbourhoods and helping troubled families turn their lives around: DCLG.
- Improve behaviour and attendance in schools and raise achievements of dis-advantaged children: DfE.
- Reduce/prevent crime and re-offending; Improve rehabilitation: HO.
- Help reduce poverty and improve social justice: DfE/DWP.
- Improving opportunities for older people: DWP.
- Making sure Council Tax payers get good value for money; Improve roads and towns: DCLG.
- Grow UK tourism, creating a lasting legacy from the 2012 Olympic/Paralympic games: HO/DCMS.
- Marking relevant national events and ceremonies: DCMS.

13 Matsuoka and Kaplan, 2008
14 Carney, 2012; Kuo and Sullivan, 2001; Royal Horticultural Society, 2011
15 Visit Britain, 2012
Our strategy

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Our strategy

• Increasing visitor numbers and boosting spend in UK gardens, parks and other planted landscape spaces.

• Best practice guidelines on ornamental planting to improve the amenity value of gardens, parks and other landscape spaces, and inform local planning strategies.

• Measurably happier and more contented, fulfilled, creative, productive communities.

• Improving student attendance, behaviour and academic attainments by disadvantaged children in 'greened' schools.

• Falling crime rates in 'greened' communities.

• More planting and gardens which boost the local economy by increasing property prices and making places attractive for inward investment.

• Measurement tools developed that better define the contribution that horticulture and gardening makes to resilient communities.

• Local Planning strategies adapted to incorporate best practice guidelines for use of ornamental plantings to build on sense of place.

• ‘Market ready’ landscape and garden design interventions developed.

Benefits of research

Research required

- Identify key aspects of the planting, design and management that:
  - attract visitors to gardens and green spaces through creating a ‘sense of place’.
  - create social cohesion and reducing crime.

- Develop the communication tools and ‘language’ to enable stakeholders from diverse backgrounds to better understand the opportunities associated with green spaces.

- Cost-effective community-led landscape management methods for parks, gardens and green space.

- Develop tools to analyse the role of horticulture and measure its value with respect to societal improvement, community integration and ability to create a better ‘sense of place’.

Fountains Abbey and Studley Royal in N Yorkshire has been one of the UK’s top visitor attractions for more than 200 years and is now a World Heritage Site II. Photo credit: Raoul Curtis-Machin
Our strategy

Case study 1


UK horticulture provided the backdrop for the success of the Olympic Games and Paralympic Games of 2012. British based firms were involved in the planning, design, construction and maintenance of the landscapes around the sports stadia, athletes’ village and other facilities. One UK nursery alone supplied more than 2,000 mature and semi-mature trees to the park. The ambitious scheme was designed to delight visitors to the Games and leave a legacy of a permanent park afterwards.

The 250-hectare site was filled with 4,000 trees, 300,000 wetland plants, 15,000 square metres of lawns and more than 150,000 perennial plants. Research and design skills of UK university experts worked in collaboration with the growing and production skills of UK nurseries to develop and produce the unique, flower meadow style plantings with their stunning and memorable range of unusual species. The plantings are a mix of natives and non-natives, adapted to the dry conditions peculiar to the site.

As well as creating a huge impact on the visitors to the Games, the horticultural displays created a strong sense of place and civic pride in the local community and encouraged them to take ownership of the site after the main events had finished. Many of the landscapes continue to provide a vital nectar and pollen resource for urban wildlife, as well as an enjoyable experience for local residents, tourists and park visitors.
Case study 2  
Britain in Bloom and Cultivation Street  

Britain in Bloom attracts more than 1,600 entries each year from communities involving more than 300,000 volunteers in improving and beautifying their local public gardens and green spaces. Started by the British Tourist Board in 1963 it is now run by the Royal Horticultural Society (RHS). There are different categories for different sizes of entry and the main awards are judged on horticultural excellence, environmental responsibility and community participation.  

Cultivation Street is a competition to inspire individuals and communities to build pride in their neighbourhoods by working together to enter their front gardens for large cash prizes. The competition is run in conjunction with The Sunday People newspaper and was started by TV gardener David Domoney in response to a report stating that 7 million UK front gardens now consist of nothing but concrete. David says:

On streets where there are no front gardens, generally there’s very little respect either. There’s a greater sense (visibility) of vandalism, dog fouling, disrespect for others. It makes you think back to the day when cleaning the doorstep of terraced houses was so important – it showed the pride that people had in their own front gardens. Nowadays, people feel that has been lost. So I decided to create a competition that recognises and rewards families and streets that are caring for their front gardens, as well as encouraging other communities to join together and start anew. Creating beautiful front gardens isn’t just about the end result – it’s the feel-good journey. It promotes respect for the community across all ages, from children to pensioners, and I wanted to replicate this experience across the UK.  

16 The Royal Horticultural Society (2014)  
17 David Domoney (2014)
Ecosystem service delivery, environmental resilience & biodiversity

Towards delivery of Ornamental Horticulture Roundtable Action Plan Asks 8 & 12

Challenges & opportunities

The enormous economic value provided by our ecosystems is well known, estimated at £81 trillion per year[^18], as is the very real social and economic costs of their degradation and loss. The 2010 Economics of Ecosystems and Biodiversity study[^19] estimates that globally the degradation of our planet’s ecosystem is costing us £37 billion each year.

Gardens and green infrastructure alleviate flooding[^20], mitigate against extreme temperatures and reduce energy use in buildings[^21], sequester atmospheric carbon[^22], help reduce pollution[^23], and support biodiversity and crop pollination[^24]. Additionally, better planting can improve water, air and soil quality[^25]. Overall green infrastructure adds environmental resilience to our landscapes and communities.

Whilst we have evidence of these basic principles, research is required to determine how existing gardens and green space can be designed and managed to meet these functional requirements. Knowledge of the specific type and quantity of planting is required in relation to delivering specific ecosystem services, in order to optimise the service a landscape intervention provides. With respect to biodiversity, creating green corridors of uninterrupted vegetation can enable animal species to increase their range and avoid populations becoming isolated and thus vulnerable to extinction. We need to understand better, however, how these corridors work in our urban areas, and integrate with rural areas, as well as identify what types and scale of planting are required for individual species[^26].

Government policies

- Adapting to Climate Change and making sustainable development part of all Government policy and operations: Defra.
- Using evidence and analysis to inform energy and climate change policies: DECC.
- Reducing demand for energy from industry, business and the public sector: Defra/DECC.
- Helping households to cut their energy bills: DCLG/DECC.
- Improving the energy efficiency of buildings and using planning to protect the environment: DCLG.
- Making the planning system work more efficiently and effectively: DCLG.
- Improving water quality; Maintaining secure water supplies, high standards of drinking water and effective sewerage services and reducing the threat of flooding and coastal change: Defra.
- Reducing the UK’s greenhouse emissions by 80% by 2050 and encouraging business to manage their impact on the environment: Defra/DECC.
- Sustaining and enhancing trees, forests and woodland: Defra Biodiversity offsetting: Defra.
- Protecting biodiversity and ecosystems at home and abroad: Defra.
- National Pollinator Strategy: Defra[^27].

[^18]: Costanza et al., 2014
[^19]: TEEB, 2010
[^20]: Armson et al., 2013; Ellis, 2013
[^21]: Akbari et al., 2001; Gill et al., 2007; Cameron et al., 2015; Baldock et al., 2015
[^22]: Davies et al., 2011
[^23]: WHO, 2014; Pugh et al., 2012
[^24]: Gaston et al., 2005; Baldock et al., 2015; Defra, 2014a
[^25]: Cameron et al., 2012
[^26]: Salisbury et al., 2015
[^27]: Defra, 2014a
Our strategy

• Planning and design tools and guidelines for indoor and outdoor plantings.

• Value of green infrastructure identified and accounted for in a useful and cost effective way for local authorities.

• Evaluation of the ecosystem services potential of specific plants, products and services, e.g. mixed cut flower farming, attractive edibles for city living, pollination services, pollution absorption, roof and sky gardening.

• New market-ready products developed e.g. commercially viable substrates with enhanced water retention for green roofs.

• Promote and improve horticulture’s contribution to UK biodiversity and better manage risks associated with climate change, pests and diseases.

• Increasing biodiversity in parks, gardens and landscapes.

• Tools to measure green networks and to inform the development of new schemes that maximise biodiversity value.

• More efficient use of energy in the built environment.

• More environmentally resilient places for communities to live in.

• Breeding and selection programmes for new and existing plants to improve pest resistance and to enhance biodiversity.

• Reduce loss of urban biodiversity by increasing and enhancing ecological niche provision within cities e.g. ensuring the viability of pollinator populations.

**Research required**

• Identify, quantify and value the impacts of different types and amounts of plants and landscape on urban and rural ecosystem services. These services include temperature regulation, hydrological flows, flood absorption, storm attenuation, water purification and air pollution absorption.

• Develop new evaluation tools to value and integrate green infrastructure with planning and design.

• Select and breed plant material to enhance character traits, add ecosystem service value and optimise wider biodiversity benefits (eg. pollinators, green corridors).

**Benefits of research**

• Planning and design tools and guidelines for indoor and outdoor plantings.

• Value of green infrastructure identified and accounted for in a useful and cost effective way for local authorities.

• Evaluation of the ecosystem services potential of specific plants, products and services, e.g. mixed cut flower farming, attractive edibles for city living, pollination services, pollution absorption, roof and sky gardening.

• New market-ready products developed e.g. commercially viable substrates with enhanced water retention for green roofs.

• Promote and improve horticulture’s contribution to UK biodiversity and better manage risks associated with climate change, pests and diseases.
Case study 1

Abstract from *Plants as external air conditioning units*, J.E. Taylor, PhD Thesis (University of Sheffield, 2012)

Green walls provide an option for reducing the thermal load on buildings, reducing the requirement for mechanised air conditioning and helping to mitigate urban heat islands. The range and extent of benefits can vary with green wall typology. This research investigated green façades using wall shrubs and climbing plants to reduce air temperature adjacent to, and the surface temperatures of, brick walls. Artificial wall sections were used to provide replicated data sets in both outdoor and controlled environmental conditions. During periods of high solar irradiance outdoors, the presence of live laurel (*Prunus laurocerasus*) plants placed against walls significantly reduced air and surface temperatures compared to blank wall sections. Largest temperature differentials were recorded mid-late afternoon, where air adjacent to vegetated walls was 3 °C cooler than non-vegetated walls. *Prunus* also provided significant wall cooling in controlled environment studies, but was intermediate in its surface cooling capacity of 6.3 °C compared to other species; *Stachys* and *Hedera* providing greater than 7.0 °C cooling.

When evaluated on a per leaf area basis, however, other species demonstrated greater cooling potential with *Fuchsia*, *Jasmine* and *Lonicera* out performing others. Not only was it evident that different species varied in their cooling capacity, but that the mechanisms for providing wall cooling varied between species. *Fuchsia* promoted evapo-transpiration cooling, whereas shade cooling was more important in *Jasmine* and *Lonicera*. The results show that not all plants cool the environment in the same way and plant physiology and leaf area/morphology should be considered when selecting species to maximise cooling in green wall applications.
Case study 2
Recycling grey water for irrigation

The Morley Nurseries site of Hillier Nurseries, near Winchester in Hampshire, grows a wide range of mature, container grown trees from 3m to 10m+ in height, on a 20-hectare site. The trees are all irrigated by drip irrigation with water from the mains. The company has installed a full recycling system that collects rainwater from the whole site and takes all the foul water and surface water from a nearby housing development. This enables the housing development to benefit from a Sustainable Drainage Scheme and the nursery to benefit from a water source that will free up mains water availability for a further 400 homes in an area where mains water resources are heavily committed.

Case study 3
Perfect for Pollinators

This work showcases how scientific R&D and the industry have joined together to better inform the public in choosing garden plants for pollinator and biodiversity benefit, creating a new ecosystem-service product line which has increased plant sales and the economic bottom line for the horticulture industry. Pollination is a key ecosystem service that substantially contributes to the global food supply and human nutrition. The RHS Perfect for Pollinator plant lists and accompanying trade logo have been widely adopted by the horticulture industry. The government’s National Pollinator Strategy (England) was launched in November 2014. It endorses the RHS Perfect for Pollinators logo and encourages gardeners to choose plants that provide resources for pollinators. The logo appears in seed and plant catalogues, on-line in gardening websites and in plant sales displays throughout the UK. The recommended plant lists were compiled from the RHS scientists’ extensive experience, scientific collections, published lists and scientific evidence. While the Perfect for Pollinators lists will continue to evolve and be improved with more research, they represent some of the best cultivated and wild plants for gardeners to grow to attract a wide range of pollinating insects.

29 Defra (2014)
30 The Royal Horticultural Society (2014)
Improving sustainable resource use & biosecurity

Towards delivery of Ornamental Horticulture Roundtable Action Plan asks 6, 9 & 10

Challenges & opportunities

This theme addresses how the industry can adapt to the increasing challenges of resource management in the face of a rapidly changing physical and policy environment. Specifically, it addresses the need to improve the efficiency of resource and waste management and to optimise energy use, soil health, water quality, irrigation delivery, and material use in production systems, gardens and managed landscapes.

Pests and diseases can have a catastrophic impact on our whole landscape, whether open countryside, peri-urban or urban, resulting in significant reductions in income from tourism and affecting our quality of life.31 Recent outbreaks of Chalara (ash dieback) and Thaumetopoea processionea (oak processionary moth) have shown the threat has never been greater. Additionally, the effective control of pests and diseases is a prime challenge on nurseries.

We have the opportunity to develop new landscape management techniques to minimise disease spread, and novel plant husbandry and nursery management techniques to prevent pests taking hold and stock being wasted. The industry currently works closely with government agencies and stakeholders, and will help trial new diagnostics, identification, and monitoring methods across the ornamental plant supply chain. There is also the opportunity for research into pest and disease resistant plants from other countries both for iconic single specimen trees and group plantings.

Government policies

Our strategy

Research required

- Improve the efficiency of resource and waste management, including optimised energy use, soil health, water quality, irrigation delivery, labour and material use in production systems, gardens and managed landscapes.

- Optimise ornamental plant production and management to minimise spread of pests and disease, including invasive species.

- Exploit technology to optimise efficient growing systems throughout the supply chain from propagule to gardens and landscapes.

- Development of new practical bio-control and integrated pest management approaches, designed with industry input for UK gardens, nurseries and landscapes.

- Improving resilience to pests in existing cultivated plant stock and the industry supply chain; explore potential for breeding in enhanced traits.

Benefits of research

- Improve the efficiency of resource use in the industry, enabling the expansion of UK production.

- Better control of diseases and pests of ornamental plants in public spaces.

- Increased take-up of integrated pest management systems for the control of diseases and pests of ornamental plants in public spaces and supporting biosecurity, and on nurseries.

- Protocols and best practice along supply chains to reduce incidences of pest and disease outbreaks.

- Fewer breaches of biosecurity in ornamental plant production and landscapes.

- Industry support and take-up of biosecurity measures. This will strengthen the resilience of UK biosecurity strategies.

Case study

New supply chain systems – Flowers from the Farm

Launched in 2011 and with 230 members, Flowers from the Farm (FFTF) is a network of Small to Medium Enterprise (SME) growers across the UK working to promote locally grown, seasonal flowers. Members grow many cut flower varieties which are no longer found in the mainstream market because they are not resilient enough to withstand the long distance transport common in the industry today.

The FFTF website helps the public and florists find local growers. Regional co-ordinators organise meetings to exchange knowledge and ideas. Members run courses on social media, growing for cutting, and floristry. FFTF is strongly aligned with the concepts of sustainable, slow and artisan which have underpinned the resurgence of the British food industry over the last 20 years. It offers an alternative model for cut flowers, where growers may also arrange, market and sell mixed flowers direct to the public and florists, aided by a strong online presence rather than a high street shop.

Seasonal British flowers produced in August.
Photo credit: Gill Hodgson
Supply chain of whole plants

Whole plant supply & growing

Home grown

Imported

Garden retail

Online & mail order
Independent retail incl. florists

DIY stores
Supermarkets
Garden centres

Landscaping

Highways
Railways
Leisure & tourism (RHS, NT, etc.)
Local councils
Golf courses (management & design)

Turf (sports)
Construction
Green walls & roofs
Woodland & hedging
Interior architecture
Parks & gardens

Consumer

Garden retail

Garden designers (small gardens)
Media (TV, books, shows)

Landscape & environmental services

Service & benefits

Aesthetic
Noise reduction
Land stability
Security

Biodiversity
Low maintenance
Thermal Insulation
Health & wellbeing

Pollination
Water filtration
Windbreak

Heat & pollution mitigation
Flood & storm mitigation

Government policies
Garden retail supply chain

Horticultural supplies
- Glasshouse
- Agrochemicals
- Growing media
- Plastics
- Machinery
- Plant labels
- Lighting
- Florists supplies

Plant reproductive material
- Seeds
- Propagules
- Cuttings
- Budwood
- Plugs
- Liners

Producers & finishers
- Packhouse

Products
- Cut flowers
- Foliage
- Herbs
- Whole plants
- Seeds

Wholesale

Garden retail
- Online & mail order
- DIY stores
- Supermarkets
- Independent retail incl. florists
- Garden centres

Consumer

Imports

Exports of intellectual property & home grown material

Exports of home grown products
Rainfall being captured by Aeonium plant foliage.

Photo Credit: Raoul Curtis-Machin
At primary plant production level, the industry is working hard to resolve several issues in regulatory areas which are relevant to the R&D strategy. In all areas the industry seeks to be compliant and sees itself as part of the solution, especially in areas of environmental concern. For example, the industry is actively working with government and non-governmental organisations to create an auditable scheme for the responsible sourcing of growing media. Working together is the key to keeping a successful balance between business and regulation. Some of the main areas of regulation which have the most significant impact on the industry are described in the following sections.

1. Crop protection and pesticides

Plant producers always seek to minimise the risk around using chemicals. The Anderson Report\(^{32}\) outlines the balance that needs to be struck between the industry’s productivity and the loss of key plant protection products through legislative change. The report has gathered information for individual crops to arrive at the effect on the agricultural and horticultural industry as a whole, and is then extended to look at the wider economic effects on the country.

Three quarters of the active substances have recently been lost from crop protection, going down from around 1,000 to 230, due to an EU directive aimed at harmonising pesticide approvals across the EU (91/414). This placed a much higher importance on those substances which remain, but which are being reduced again under EU Directive (1107/2009). This one has more stringent requirements for active substance approval and it covers both the approval of new active substances and the renewal of existing substances. The main change brought in was the move from a risk-based to a hazard-based approvals system.

The Sustainable Use Directive of the Thematic Strategy on Pesticides addresses the strategies of climate change, biodiversity, health and resource use. It creates a framework for the sustainable use of pesticides and aims to reduce risks and impacts of their use, promote Integrated Pest Management use and best practice in storage, use and disposal of pesticide packaging. It places the burden of responsibility on the business to ensure suitable training of staff, equipment testing and restricts pesticide use in conservation areas.

Prevention: inappropriate regulation for horticulture

With the main thrust of crop protection products being targeted at arable food crops over the last 20 years, there have not been many product label approvals for horticulture. A continual programme of producing and researching ‘off-label’ approvals to ensure adequate product availability for horticultural pests and diseases is an essential part of any on-going research funding. With very few new products being developed commercially it is even more important that horticulture is given support when product availability is being drastically reduced. The risk of resistance is greater in this sector than in others because of the huge variety of plants grown (approx. 5,000 genera).

With ever increasing demands from the plant distributors for accurate scheduled deliveries, the need for disease prevention products in protected...
crop production has become critical. Many of the agricultural products do not have protected crop approvals and the industry has funded the protected ‘off-label’ approvals through the AHDBH levy. Increased funds are necessary to extend this service to the protected crop industry.

Ornamental horticulture crop husbandry is more intensive than agriculture. Broad acre crops in the main are grown using fully mechanised operations, whereas horticultural crops often require repeated crop access to carry out routine manual husbandry. Trees and plants grown in amenity situations also require husbandry operations near to public movements such as footpaths or sitting areas. The criteria for worker re-entry exposure assessment of pesticides for ornamental crop approvals in the UK is currently gauged\(^{33}\) on the hand picking of bulb flower crops into uncovered arms and is wholly inappropriate to modern ornamental and amenity production processes.

Research funding is needed to carry out specific work in calculating the Acceptable Operator Exposure Level (AOEL) for ornamental container and field grown crops separately. This would require extensive work on the exposure assessment of: product dose rate; concentration of active ingredient; duration of spray application period; frequency of spray operation. Further work is needed on risk characterisation, which would compare predicted exposures to AOEL, predicted exposures above AOEL, and consider the potential for irritation and sensitisation. Some of this work has been undertaken in looking at the use of gloves by workers during husbandry, which has resulted in a publication by HSE of new arrangements for the use of gloves to reduce skin exposure.\(^{34}\)

Further essential work is needed to quantify the Dislodgeable Foliar Residue (DFR) levels on a range of container and field grown crops to ensure accurate and relevant data is used in the calculation of substance approvals. Much work has been carried out on this in the US\(^{35}\) which demonstrates the levels of DFR for container grown crops are considerably lower than those used in the UK and EU computer models. Research work is needed to verify the DFR levels to be used for UK ornamental crops. This will allow an improved level of product availability to the protected, amenity and ornamental crop protection sectors to maintain effective pest and disease control.

\section*{2. Water}

Water is essential for plants, especially plants grown in containers which can need watering every day in hot dry weather. The Water Framework Directive brings in many changes to the availability of water for irrigation purposes. The licensing of water abstraction from both ground water and surface water will change as all licences become time-limited. It is also expected that present licensed volumes could be reduced in some areas of the country. This would result in horticultural businesses having less water available for crop use. This in turn makes them rely on research to develop improved methods that use less water, alternative substrate water holding characteristics and accurate control systems. The process of using recycled water and previously unusable sources also now becomes more critical. Research into water treatment processes and systems is required.

The quality of river and groundwater is embedded within the Water Framework Directive. The control of potential pollution from horticultural operations to meet compliance is a high priority with the authorities. The application of nutrients to crops requires considerable research to ensure there are no nutrient laden discharges from sites.

\begin{footnotesize}
\begin{enumerate}
\item Health and Safety Executive (2008)
\item Health and Safety Executive (2014)
\item US Environmental Protection Agency (2008)
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3. Invasive species

The industry plays a vital role in stopping the spread of invasive species into the countryside, preventing their sale and educating the public in garden centres and through the media. We work closely with government on the definitions of invasive species and their potential impact. The Review of Schedule 9 of the Wildlife and Countryside Act 1981 places potential restrictions on the production and sale of the plant species. Twelve genera that are sold and distributed commercially for gardens, parks and amenity area planting are on the listing of the Act. As the current proposals are for ‘all hybrids of the genera’, many traditional garden plants of the cotoneaster, rhododendron and roses genera for example would all be banned. Work is required to educate the legislators on the value of garden plant diversity. In Scotland this legislation differs slightly. New EU legislation is currently being implemented which could bring other plants into scope for sales restrictions.

4. Plant health

There are many pests and diseases that can seriously damage crops and plants in the UK. To protect plant health, Defra sets policy and enforces controls and restrictions on the import, movement and keeping of certain plants, plant pests and other materials such as soil. The Plant health legislation controls the import and movement of certain plants, seeds, including fruit, potatoes, vegetables, cut flowers, foliage and grain. The controls differ according to the species – and whether or not they are classified as quarantine organisms – but could include the need for classification, a phytosanitary certificate, a plant passport and/or inspection requirements. The published list of plant species covered by the legislation is well recognised and adhered to by all EU Member States, through the Plant Passport system.

The Animal and Plant Health Agency publishes a UK Plant Health Risk Register which details pest and diseases that have the potential of being brought into the UK through plant material imports. This list is routinely updated with the names of the pests and diseases and the species of plants that can affected by them.

Based on the present arrangements, if a pest species from the list is identified on a UK import then those plants must be destroyed, any other plants found to be infected are also destroyed. Those other plants surrounding an infection point are not allowed to be sold or moved from the nursery until a period set by a Statutory Plant Health Order Notice issued by a Plant Health Officer.

Diagnosis

The list of fungal, viruses and bacterial Notifiable Diseases that can currently be detected by Lateral Flow devices is low and more disease subjects should be researched. The process of bringing out new disease subjects is not complex and takes only a few months. This would enable rapid detection of problems and pest free proof for sales purposes from buffer zones. Research funding should be available to produce a wider range of disease subjects.

Monitoring

The use of computer modelling to predict disease outbreak has been available for powdery mildew, downy mildew and aphids and delivered through the MORPH (Methods of Research Practice in Horticulture) programme through work funded by both the HDC and Defra. It would benefit the industry to have an increased range of disease prediction models and decision support tools made available to producers through a national alert service.
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