A REVIEW OF THE PROVISION OF UK HORTICULTURAL R&D

for the

NATIONAL HORTICULTURAL FORUM

by

Brian Jamieson & Associates

August 2008

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'*Through concentrating too much on the difficulties, we are apt to lose sight of the opportunities that stretch before us'.*

George Jamieson BSc (Agric) 1932

Executive Summary

1. The current Department for Environment, Food and Rural Affairs (Defra) farming and food science programme, introduced in 2006, focuses on public policy issues of climate change, resource use, biodiversity and the sustainability of farming and the food chain. Unlike the horticultural crop science programme it replaced, this science programme has little direct impact on the technical problems growers currently face, though it clearly has some relevance to the medium and long-term sustainability of production horticulture.

2. This change in Defra R&D funding policy has serious implications for national capacity for strategic/applied R&D underpinning production horticulture. Transitional Defra funding to Warwick HRI and East Malling Research (EMR) has delayed the full impact of the shift in funding. But it is now beginning to bite. The deficit of funding for strategic/applied R&D underpinning production horticulture is growing. The result is that the model whereby the Horticultural Development Company (HDC) uses its industrial levy funds to support applied R&D projects that feed off a foundation of Defra-funded strategic R&D in horticultural crop science is no longer functional.

3. Market forces will encourage some R&D providers to respond by adjusting their skills and capabilities to compete for work that addresses Defra's new science priorities. This may help sustain individual institutions, but, overall, it will mean a drift away from strategic and applied R&D capacity relevant to horticulture.

4. Those institutions and R&D groups that have traditionally addressed grower's practical problems and which strive to maintain their expertise and facilities face a bigger challenge. To survive they will have to find alternative sources of revenue and capital funding for strategic and pre-competitive R&D of relevance to growers. Partnerships with other institutions might be one way forward.

5. The Biotechnology and Biological Sciences Research Council (BBSRC) has a responsibility for the health of the UK science base within its mission. In a similar manner, Defra has a general interest in the competitiveness of the horticultural industry, as part of the UK food chain. Though they both provide competitive R&D funding to individual institutions, neither the BBSRC nor Defra appear to accept responsibility for the health of the UK horticultural R&D base. They choose to rely on competitive market forces to meet their needs for scientific knowledge, technology and information, and trained scientists. This position is predicated on the assumption that there will always be sufficient R&D capacity to meet their needs, overseas if necessary.

6. In Scotland the main public funder, the Scottish Government's Rural and Environment Research and Analysis Directorate (RERAD), has historically adopted a slightly different approach. Its commissioning of horticultural R&D is largely designed to sustain capacity for a focussed programme on berry fruits at the Scottish Crop Research Institute (SCRI). It is unclear, however, whether this relationship will continue in quite the same form after RERAD's forthcoming review of its rural, environment and marine research strategy for 2010 and beyond.

7. By default, concern amongst funders for the health of the UK horticultural R&D base, especially in England and Wales, now largely falls to the HDC Clearly it lacks the mission and the resources to assume full responsibility for sustaining the national capability.

8. Yet the demand for strategic/applied R&D for horticulture has not diminished. This study confirms the National Horticultural Forum's (NHF) view that the production horticulture industry has a continuing need for a programme of applied R&D mainly crop-specific, supported by industrial levy and managed by the HDC, and strategic R&D, beyond the scope of levy funding, that addresses the broader challenges of environmental impact and resource efficiency; increased technology capability and infrastructure; and sustaining human health and well-being. Legislative changes (for example, impending EU changes to pesticides legislation) will present further challenges that will require underpinning R&D.

9. What is to be done? Looking ahead, there are several initiatives that, if successful, should improve matters. At a political level, the industry should emphasise that there are undoubted synergies between its priorities for strategic/applied R&D for the horticulture industry and the Government's needs for science and knowledge to inform public policy issues of climate change; biodiversity; sustainable use of resources; the health and well-being of the population. A successful, innovative horticulture industry can help deliver the Government's public policy aims. Recent concerns about food availability and security suggest it is now timely for the industry's collective leadership to present a new agenda to Government to promote R&D for agriculture and horticulture that is also compatible with public policy goals of climate change, the environment, rural sustainability, diet and health and, importantly, food security.

10. The creation of the Agricultural and Horticultural Development Board (AHDB) provides an opportunity for the previously separate levy bodies to work together in a number of ways. For example, by promoting generic crop R&D addressing pervasive topics such as water and soil resources and crop rotations. Encouraged by the AHDB, the levy bodies could also explore more strategic approaches to commissioning and managing R&D, and generally utilising national R&D capacity more efficiently. Moreover, the AHDB, representing combined levy spending on R&D of around £20 million a year, has a powerful voice for discussions with potential partners in R&D, for

instance other sectors of the fresh food supply chain and the Technology Strategy Board (TSB).

11. The HDC itself might consider the following options, not mutually exclusive, in its current R&D Strategy review:

- focusing its funding to sustain selected UK R&D groups, individuals and facilities that are essential to delivering its applied research mission.
- optimising its investment in R&D by exploiting international science, facilities and funding networks.
- addressing a skills deficit in horticultural R&D by supporting short-course training in aspects of practical horticulture.
- strategic commissioning of large programmes of research to give longer planning horizons to selected consortia of contractors.
- seeking efficiencies in managing R&D and KT within the wider AHDB family.
- playing a leadership role, possibly with the AHDB, in exploring new sources of R&D funds, including the regional development agencies and the TSB.
- widening and deepening industrial involvement in strategic and applied horticultural R&D, again with the AHDB, building on the best features of the successful and popular HORTLink scheme.

12. The HORTLink programme for industrial collaboration, funded by Defra, RERAD and the BBSRC, is now the only publicly-funded scheme for supporting applied and pre-competitive R&D of direct value to the horticultural industry. It is equally popular with R&D providers, the HDC and the industry. It achieves industrial engagement in the R&D process and delivers outcomes of direct practical value to growers. R&D providers, the HDC and the AHDB should make the case to Government for the main elements of HORTLink to be maintained, or even further developed, as part of a wider Agri-Food Innovation Platform under the aegis of the TSB.

13. At a tactical level, individual R&D institutions and groups should exploit existing sources of R&D funds more fully and explore new potential sources. Imagination and new approaches will be needed to engage successfully with non-traditional sources such as the regional development agencies (RDAs), whose objects are regional economic development and job creation, not R&D for its own sake.

14. With UK horticultural R&D facing big challenges and so much at stake, greater clarity is needed about the respective roles of the NHF, the National Farmers Union Horticulture and Potatoes Board, the Horticultural Trades Association, the HDC, and now the AHDB in providing collective leadership for horticulture and its R&D needs. There should be agreement on which of the big issues should be handled collectively with a single powerful voice, and which would be more effectively handled by some or all of these bodies acting in concert.

15. A survey has demonstrated that the UK horticultural R&D base is quite strongly concentrated. Less than a dozen major R&D providers – research centres, groups within universities and commercial concerns, constitute the main national capacity. In addition, there are many small groups with relevant expertise, often in universities, that engage in horticultural R&D sporadically, as and when they win R&D grants and contracts.

16. In terms of facilities, the survey shows that the overall health of the UK horticultural R&D base is mixed. Largely reflecting past investment, some institutions still have facilities that are largely fit-for-purpose. Others are suffered from insufficient revenue and capital funding to maintain capacity. Some facilities are beginning to lag behind increasing technical standards in the industry. However, one or two providers have benefited from recent capital investment. If the present trend of insufficient capital investment continues, serious difficulties lie ahead for several UK horticultural R&D providers.

17. As for expertise, the survey confirms that several traditional skills are in short supply, notably agronomy, plant pathology and weed science. Expertise is too often one-deep. Succession planning is universally weak, or even non-existent, because of reduced and uncertain funding. Indeed several providers report they have little hope of recruiting at all in the foreseeable future. The age profile of almost 180 researchers (just over two-thirds are under 50 years old) may not be as immediately discouraging as first thought, but is still a cause for concern.

18. The UK horticultural R&D base has many strengths and should seek to turn present challenges into opportunities to increase sustainability and effectiveness. Positive thinking is needed by all parties, individually and collectively.

15 August 2008

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I. INTRODUCTION

Background

1. In January 2008 the National Horticultural Forum (NHF) commissioned Brian Jamieson & Associates to conduct a study of strategic options for the future capability and delivery of UK horticultural research and development (R&D).

2. The main concern of the NHF was that changed funding priorities by Government and successive re-organisations of the UK R&D base were putting severe pressure on the long-standing paradigm for funding and organising horticultural R&D and delivering outputs to the production horticultural industry. Indeed, some would assert that the model has already broken down.

> *"The loss of a central focus and whole chain integration of horticultural research and technology delivery following the recent rationalisation programme is now beginning to impact on growers as well as researchers. Yet, delivery of advanced science and technology to growers provides a major competitive advantage to their business …."*
>
> Graham Ward OBE, Chief Executive, Stockbridge Technology Centre

3. An important step in this process of change, to which Graham Ward alludes, was the break-up of Horticulture Research International (HRI) by privatisation in 2004 to create two new organisations - Warwick HRI (based at Wellesbourne and Kirton) and East Malling Research (EMR). Another part of HRI, Efford Research Station, was closed as part of this re-organisation. Stockbridge House Research Centre, which had also been part of HRI, had been already privatised (in 2001) to create Stockbridge Technology Centre.

4. Perhaps a more significant event was the decision of the Department for Environment, Food and Rural Affairs (Defra) in 2006 to refocus its R&D strategy. Crop-oriented research, including the Horticultural Crop Sciences programme of direct relevance to the industry, was replaced by a Farming and Food Science programme that addresses Defra's strategic priorities of climate change, environmental impacts and sustainable rural economies.

5. Transitional Defra R&D funding to Warwick HRI and EMR, now tapering and due to end completely by 2012 (2010 at EMR), still provides some sort of link with the funding arrangements of the past. Though clearly important for the viability of Warwick HRI and EMR,

this transitional funding may be masking the full implications of Defra's policy change in research funding.

6. Despite Defra's policy change, the demand for strategic/applied R&D for horticulture has not diminished. The production horticulture industry has a continuing need for a programme of applied R&D, mainly crop-specific, that is supported by industrial levy, and strategic R&D, beyond the scope of levy funding, that addresses the broader challenges of environmental impact and resource efficiency; increased technology capability and infrastructure; and sustaining human health and well-being. Legislative changes, for example, impending EU changes to pesticides legislation, will also present the industry with further challenges that require underpinning R&D.

7. The problem now facing UK horticulture is that no alternative R&D funding models have emerged that effectively provide cohesion and direction for the mosaic of R&D providers, complement the applied R&D funding of the Horticultural Development Company (HDC) and maintain effective arrangements for translating technology to growers – the ultimate beneficiaries of much of the R&D.

Terms of reference

8. The aim of the present study is to address options for future horticultural R&D capability and delivery against issues identified in a scoping study by the NHF. These main issues are:

- The future needs of the production horticulture industry.
- The Government's needs for science and knowledge to inform public policy issues of the day - climate change, environmental impacts and sustainable rural economies.
- Any synergies between R&D supporting the horticultural industry and these major public policy issues.
- The consequences of re-organisation and privatisation of the horticultural R&D base on available skills, on training the next generation of scientists, and on R&D infrastructure.
- Diversification of the provider base in response to the changing priorities of public R&D funders.
- Trends in public funding of horticultural R&D, notably the phasing out of transitional Defra funding of EMR and Warwick HRI.

9. The study was required to address the following key aspects of the UK horticultural R&D base:

- Capacity and capability – now and in future:
    - Facilities and infrastructure.
    - Expertise.
- Extension and training.
- Funding.
- Future co-operation within the R&D community.

Methodologies

10. The main approaches employed in the course of the study were:

- Interviews, some face-to-face, others by telephone, with key funders, R&D providers and stakeholder organisations and with selected individuals (listed in Annex 1).
- A questionnaire survey of the principal R&D providers, including all institutional members of the NHF R&D Providers Group, selected consultants and others.
- A desk-based analysis of reports and other material relating to UK horticultural R&D and its articulation with users.

11. The interview programme painted a picture of a sector in a state of some confusion and anxiety. Growers are concerned about reducing public funding and erosion of the traditional R&D base that has provided practical knowledge and technology. R&D providers are facing a growing deficit of funding for strategic/applied horticultural R&D and uncertainty about the future. Providers are developing their own strategic options for the future, which, for some, include reduced investment in skills and infrastructure for horticultural R&D.

12. The wide range of views expressed during the interviews can be neatly illustrated by the two quotes below.

> *'Size matters'*
>
> *'Small is beautiful'*
>
> Contrasted views of two R&D providers on what makes an effective research centre

13. Another feature of the interviews was a surprising lack of consensus on the practical value to growers of past public investment in strategic research. The polarisation of views on this issue between researchers, on the one hand, and consultants and growers, on the other, was perhaps another reflection of the anxiety the sector is displaying.

14. One or two of those consulted were inclined to glance backward to the Arcadian days of plenty and stability. Like many Arcadian visions, this may be more wishful thinking than reality! In any case, it is not likely that Defra would simply reverse its policies and, for example, resume responsibility for the sustainability of autonomous research centres. Part of the rationale for privatising the component parts of HRI was to enable Government to transfer risk to new owners.

Other relevant studies

15. The following recent and current studies provide context and have informed the present study. More details of each are provided in Annex 3.

- *A Review of Horticultural R & D. [The Spedding Review].* A report to Defra. March 2002.
- *Skills Audit of Horticultural R&D.* Report to the National Horticultural Forum by Brian Jamieson & Associates. November 2003.

- *Economic Evaluation of the Horticultural Development Council*. A Report to the Department for Environment, Food and Rural Affairs by the University of Reading. March 2004.
- *Scientific Skills for Knowledge Transfer in Arable Agriculture in England.* A Survey Report to The Board of the Rothamsted Research Association. Professor Mark Tatchell. 2005.
- A *Case Study Analysis and Overview of the UK Horticultural Production Industry and its Future over the Next 10-20 Years*. Report by Promar International to the NHF. 2006.
- *R&D needs for the UK horticulture industry*. Review by the National Horticultural Forum. 2006.
- *Review of provision for land-based studies*. Final report to HEFCE by JM Consulting and SQW Ltd. May 2007.
- *Skills Audit of Plant Pathology*. Report to the British Society of Plant Pathologists (BSPP) by Professor G A Dixon. November 2007.
- *The Need for a New Vision for UK Agricultural Research and Development.* The Commercial Farmers Group. June 2008.
- *Defra Strategic Knowledge Capability Assessment* and *BBSRC/HEFCE Study of Land-Based Facilities for Research questionnaires* (both in progress).

II. UK HORTICULTURE

Structure of the UK horticulture industry

Table 1: Overall size of the horticulture industry 2006[1]

	Number of businesses	Numbers employed	£billion GDP/Sales Value
Production horticulture	9,646	95,166	1.928
Landscape industries	8,000	139,164	3.000
Garden retail	2,500	50,000	4.800
Total	**20,146**	**28,4330**	***

Notes:

*** *Total value of output is estimated at £9 billion p.a. currently. Differences in definition of GDP and sales for each sub-sector mean that the above figures should not be added. Garden retail includes a retail margin on some production horticulture.*

Production horticulture *includes both ornamentals and food: fruit, vegetables, glasshouse crops, plants, flowers and bulbs, nursery stock, tree production and mushrooms. Potatoes are excluded.*

Landscape industries *includes all hard/soft/interior landscaping, sports, turf and golf green keeping, private/heritage and botanic gardens, commercial grounds, public parks and green spaces.*

Garden retail *includes horticultural stock, garden chemicals and fertilizers, growing media, tools.*

16. The present study is essentially restricted to production horticulture (edibles and ornamentals), but it should be recognised that the boundaries between production horticulture, landscape horticulture and garden retail enterprises are porous. For example, horticultural produce, especially ornamental nursery stock, is frequently sold through garden centres. Equally, ornamentals may often be part of a solution in amenity horticulture projects and developments. Several technical issues, such as water and pesticide use, are common to the production and amenity sectors, as are staffing and skills issues.

Promar International report

17. The Promar International report in 2006[2] emphasized the need for innovation in UK production horticulture and identified the following generic issues where technology and innovation were required:

[1] From *R&D needs for the UK horticulture industry*. National Horticultural Forum. October 2006.

[2] A *Case Study Analysis and Overview of the UK Horticultural Production Industry and its Future over the Next 10-20 Years.* Report by Promar International to the NHF. 2006.

- Research into **alternative energy sources**.
- **Other resource issues**, notably improved irrigation methods and developments in growing compost (particularly peat-based compost).
- Increased mechanisation to tackle **labour costs**.
- Research into **new planting systems** and root stocks to achieve higher yield and ongoing **varietal development** addresses consumer demand for variety and superior taste.
- Developments in **packaging** are being exploited in order to add value to fresh produce and ornamentals. Examples include biodegradable and self-watering packaging and advances in printing.
- Poor planning exacerbates margin pressure: **improved IT systems and enhanced market information** can improve communication and customer relationships.
- **Reducing product wastage** to improve margins (i.e. more effective crop scheduling, improved pest and disease forecasting etc).

18. The main message of the Promar International report was that the UK production horticulture industry needs to evolve and become more professional if it is to survive in a competitive international market place.

> *'This Report should be seen as something of a "wake up call" for players in UK horticultural production that have not already achieved a high level of professionalism through the supply chain. The time has come to address head-on the many serious challenges facing the horticulture sector'.*
>
> Promar International. The Future of UK Horticulture. January 2006

III. HISTORICAL CONTEXT

19. The UK horticultural R&D base we recognise today has undergone considerable organisation and re-organisation over the past 20 years. The main events that have shaped the present pattern of the main horticultural R&D centres, their locations and their capabilities are briefly summarised in the following paragraphs.

Organisational change

Institute of Horticultural Research

20. In the mid-1980s the then Agricultural and Food Research Council (AFRC) created a so-called 'super' Institute of Horticultural Research (IHR) by combining management of the previously independent Glasshouse Crops Research Institute at Littlehampton, East Malling Research Station, the National Vegetable Research Station at Wellesbourne and the Hops Research Department at Wye College. This reorganisation was primarily driven by the AFRC's aim of creating large, modern institutes better able to undertake strategic and generic research, but also with an eye to gaining some efficiency from larger management groupings.

Near-market R&D policy

21. Before this reorganisation was completed the new IHR suffered disproportionately from the Ministry of Agriculture, Fisheries and Food's (MAFF) policy decision in the late-1980s to reduce its funding of near-market research. The political theory was that near-market research should increasingly become an industry responsibility, with the Government concentrating more on basic and strategic research in support of its statutory and 'public good' functions.

Amalgamation to create Horticulture Research International

22. Partly in response to this changed funding regime, but also in an attempt to improve communication between researchers and the advisory service, an even larger entity, Horticulture Research International (HRI), was created in 1990. This involved amalgamating under single management the AFRC IHR (based at East Malling, Wellesbourne, Littlehampton and Wye) and three Experimental Horticulture Stations run by ADAS (then part of MAFF) at Efford, Kirton and Stockbridge House.

23. From its creation in 1990, HRI operated as an executive Non-Departmental Public Body under the sponsorship of MAFF. Unfortunately the new organisation proved to be unsustainable in the light of reducing MAFF/Defra funding of R&D for production horticulture. The position was exacerbated by high running costs of the HRI, due in part to the need to obtain a return from almost £20 million of capital investment in the late-1990s and early-2000s.

Stockbridge Technology Centre

24. The Stockbridge Technology Centre (STC) was launched in April 2001 following a plan by HRI to close this outlying centre in Yorkshire on grounds of economy. A grower-led initiative purchased the site to enable its continuation as an independent horticultural centre supported by both the production and supply sectors of the industry.

Privatisation of HRI

25. Despite costly restructuring and reductions in its cost base, HRI was becoming increasingly unsustainable and, following a detailed Quinquennial Review in 2002, it was split up and privatised. The business, staff and physical assets at the Wellesbourne and Kirton sites were transferred to the University of Warwick. A new entity, Warwick HRI, a devolved department of the University of Warwick, was formed on 1 April 2004. Warwick HRI now promotes itself as

the principal UK organisation tasked with carrying out horticultural R&D and transferring the results to industry.

26. East Malling Research also became an independent entity on 1 April 2004. Its mission is to be independent provider of top-class research, development and consultancy serving the food chain and other sectors of the land-based industry. EMR is a company limited by guarantee and a registered charity.

Public funding

Defra funding policy changes

27. In 2006 Defra refocused its research programmes relating to farming and food. Crop-oriented research, including the Horticultural Crop Sciences programme of direct relevance to horticulture and the main source of Government funding for strategic horticultural research (about £11m a year), was replaced by science programmes that inform policies relating to Defra's new strategic priorities of agriculture and climate change, sustainable water management, resource efficient and resilient food chain, sustainable farming systems and biodiversity.

The position in Scotland

28. In Scotland public funding by the Scottish Government and its predecessor agricultural and rural affairs departments has followed a similar, but not identical, course as Defra's over the past 20 years. Funding of near-market research has been reduced and horticultural R&D has increasingly focussed on soft fruit and field brassicas. But the Scottish Government still funds R&D in support of sustainable agricultural and horticultural production, as is demonstrated by the programme of berry research at Scottish Crop Research Institute (SCRI).

29. The policy under which this research is commissioned at SCRI was set out in the Scottish Government's research strategy for environment, biology and agriculture, published January 2005[3].

30. Traditionally, SCRI and the Scottish Agricultural College (SAC) were the only recipients of public funding for horticultural R&D and extension in Scotland. With cut-backs in public funding of the advisory services, SAC has virtually pulled out of horticultural R&D. This leaves SCRI as the only major horticultural R&D provider in Scotland.

[3] *Strategic Research for SEERAD 2005-2010 - Environment, Biology and Agriculture*. Scottish Executive Environment and Rural Affairs Department. January 2005.

IV. PROFILE OF THE UK HORTICULTURAL R&D BASE

31. The scale and scope of the national R&D base for production horticulture lies at the heart of this study. So it is important that there is a common perception on what constitutes today's horticultural R&D base. Unfortunately, it is difficult to define or profile with precision.

Institutional profile

32. There are several possible approaches to describing the horticultural R&D base, for example, by profiling the particular capabilities of the organisations concerned, the scale of their operations or the impact of their research outputs. The approach adopted for this study has been to use competitive R&D income[4] as a proxy measure of scale of activity and hopefully, output and impact. The resultant profile is based on best estimate of institutions' competitive income from the BBSRC, the HortLINK scheme and the HDC in 2007-08.

33. An important qualification is that this approach does not capture income from other UK and overseas funders, nor does it include the Higher Education Funding Council for England (HEFCE) research and teaching funds flowing to university groups. Nevertheless, it gives a useful snapshot of the mosaic of horticultural R&D providers in the UK.

34. The representation of funding levels in Tables 2, 3 and 4 is based on quintiles of the range from the largest to the smallest individual grant receipts; i.e the symbol ***** representing the top quintile (100 - 80%) and the symbol * the bottom quintile (19–0%). The resulting pattern suggests a distinction between three broad groups of R&D provider in the private and public sectors.

Group A. Organisations predominantly involved in horticultural R&D

35. Table 2 lists the few organisations in the UK that are predominantly involved in horticultural R&D, to the virtual exclusion of other R&D. Three of the largest of these centres, Warwick HRI, EMR and STC, all have their origins in the former unified HRI.

36. The contributions of the commercial companies and consultants in Group A are modest in scale in comparison with the main R&D centres. Indeed, a different basket of companies would probably have been captured if the analysis had been done on a year other than 2007-08. Being involved mainly in applied and pre-competitive R&D, commercial companies and consultants tend to win HDC and HORTLink funds. The important point is to recognise the significant contributions that these and other small players make to applied R&D and knowledge transfer (KT).

37. Because Warwick HRI is gradually diversifying its portfolio of research, it only marginally meets the criterion of being predominantly involved in horticultural R&D. The process of diversification at Warwick HRI seems likely to accelerate when transitional funding from Defra finally ends in March 2012. Before then, the institution's future profile will be influenced by the results of the 2008 Research Assessment Exercise (RAE), which will indicate which of the research areas are judged to be internationally and nationally competitive. That is for the future. For the purposes of this study it is appropriate to consider Warwick HRI as a horticultural R&D centre.

[4] Transitional Defra funding to Warwick HRI and EMR and RERAD commissioning at SCRI, though substantial, is not included in this analysis.

Table 2: Horticultural R&D centres

	HDC grants	HORTLink grants	BBSRC grants
Allium & Brassica Centre	*	*	
Cucumber Growers Association	*		
East Malling Research (EMR)[5]	****	****	**
FAST Ltd	*		
Stockbridge Technology Centre (STC)	**		
Vegetable Consultants Association	*		
Warwick HRI[6]	*****	*****	*****
Wight Salads Ltd	*		
Other crop associations	*	*	

Group B. Universities, research centres and companies with minority horticultural R&D activity.

38. Table 3 shows that there is a middle group of institutions which undertake horticultural research, but usually as a minority activity within wider R&D, educational, commercial and other missions.

39. The hallmark of these institutions and companies is that their horticultural capabilities, though quite small in some cases, are permanent features of their overall R&D capacity, at least in the medium-term. In the research centres and commercial organisations, horticulture is generally an essential part of a wider mission and strategic capacity. In universities, on the other hand, the capacity often reflects the research interests and enthusiasm of a single academic or a small research group and is, thus, more susceptible to changes in the careers or circumstances of a few lead individuals.

[5] Not including £2,400k Defra transitional funding in 2007-08.

[6] Not including £5,500k Defra transitional funding in 2007-08, or final £2,100k competitive strategic grant from BBSRC in the same year.

Table 3: Institutions with minority horticultural R&D activity

	HDC grants	HORTLink grants	BBSRC grants
ADAS UK Ltd	*****	**	*
The Arable Group	*	*	
CALU, Bangor	*		
Central Science Laboratory	**	*	
Cranfield University	*	*	*
FEC Services Ltd	**		
Harper Adams University College	*		
Henry Doubleday Research Association	*	*	
Imperial College of Science, Technology & Medicine	*	*	*
Institute of Food Research	*	*	
Natural Resources Institute; University of Greenwich	*	*	
NIAB	**		
PGRO	*		
Scottish Crop Research Institute[7]	*	**	
University of Lancaster	**	*	
University of Reading	*	*	***

Group C. Institutions only occasionally involved in horticultural R&D

40. As Table 4 suggests, there are many institutions with a capacity for some aspects of production horticultural research, but which lack the mission, aims and/or financial incentives to undertake sustained activity. The universities in this group do research relating to horticulture in a rather sporadic and unplanned manner. Their research is generally supported by opportunistic research grants, often from the BBSRC. A few of the Group C institutions, for instance Cranfield University and the Natural Resources Institute (NRI), have a policy goal of increasing involvement in UK horticultural R&D and are investing in facilities and expertise designed to make them more competitive.

41. This third group also includes large research institutes like Rothamsted Research, the John Innes Centre and the NERC Centre for Ecology and Hydrology, with strong backgrounds in plant and microbial sciences and environmental sciences, much of which underpins horticultural R&D.

42. The Eden Project, the Royal Horticultural Society and even the Royal Botanic Gardens, Kew have considerable relevant expertise, but traditionally have not addressed production horticulture. There are opportunities for greater engagement with these institutions.

43. Table 4 clearly demonstrates the success of the HORTLink scheme in engaging partners outside the mainstream of horticultural R&D.

[7] Not including £1,100k commissioned R&D income from RERAD in 2007-08.

44. The existence of this diverse third group of institutions rather undermines the concept of a precisely defined UK horticultural R&D base. Put simply, the base has no fixed perimeter and could change shape, contract or expand depending on financial incentives in the form of research grants, especially for more strategic and basic research. Increased participation by Group C institutions would, on the one hand, increase the diversity of the horticultural R&D base, on the other, it would heighten competition for the available funds.

Applied research

45. Taking the horticultural R&D base as a whole, capacity for applied research is limited to a few centres that are especially vulnerable to reductions in public funding for strategic/applied research. This is a matter of particular concern to the HDC, which depends on a fit-for-purpose UK contractor base to deliver its levy-funded R&D projects. The issue of reduced national capacity for applied agricultural and horticultural R&D is picked up more generally in a policy discussion paper by the Commercial Farmers Group[8] (see paras. 125-128).

[8] *The Need for a New Vision for UK Agricultural Research and Development.* The Commercial Farmers Group. June 2008.

Table 4: Institutions with occasional horticultural R&D activity

	HDC grants	HORTLink grants	BBSRC grants
BioHybrids International Ltd		*	
Centre for Ecology & Hydrology		*	
The Eden Project			
Institute of Biological, Environmental and Rural Sciences		*	
John Innes Centre		*	
Kings College, London			**
Myerscough College			
Open University		*	
PEP Research Consultancy Ltd		*	
Pera International Ltd		*	
Queen Mary and Westfield Colleges		*	*
Royal Horticultural Society	*		
Rothamsted Research		*	***
SAC		*	
Tillett & Hague Technology Ltd		*	
University of Aberdeen		*	
University of Birmingham			***
University of Cardiff	*	*	
University of Dundee		*	
University of Edinburgh			*
University of Hull		*	
University of Keele		*	
University of Liverpool		*	
University of Manchester			*
University of Newcastle-upon-Tyne		*	
University of Nottingham		*	
University of Oxford			*
University of Plymouth			
University of Strathclyde		*	
University of Southampton			***
University of Sussex	*		
University of Swansea	*	*	
University of York			*
Writtle College			

Fragmentation of the R&D base

46. Part of the rationale for this study was concern about the fragmentation and, by implication, weakening of the R&D base. This part of the study, however, has demonstrated that the R&D base is not as fragmented as is sometimes perceived. Currently:

- only three institutions (Warwick HRI, EMR and SCRI) receive block R&D funding from Defra, RERAD and the BBSRC (though this stream of Defra and BBSRC funding is being phased out).
- five institutions (Warwick HRI, EMR, SCRI, ADAS UK Ltd and CSL) together win three-quarters of the competitive research income provided by three of the main funders (HortLINK, the HDC and the BBSRC).
- these five institutions also employ more than three-quarters of the personnel whose details have been captured in the skills survey part of this study.
- fifteen institutions, most of which are members of the NHF R&D Providers Group, win as much as 90% of the competitive R&D funds provided by HortLINK, the HDC and the BBSRC.
- the HDC has only 20 regular R&D contractors, though a few more are awarded occasional research contracts.

47. There is, of course, a long tail of small research groups who make modest, but often significant, contributions. Some are within much larger institutions, like universities, which may make them more resilient to fluctuations in horticultural R&D funding. Smaller institutions are much more dependent on continuity of horticultural R&D funding and are naturally very concerned about current funding uncertainties.

48. In terms of ownership and governance of institutions, the present picture is undeniably one of more fragmentation and diversity than the arrangements between 1990-2004, when HRI provided unified management of several of the centres in England. However, not everyone sees fragmentation of a previously integrated R&D system as a bad thing. Though the centralised HRI management model was soon destabilised by funding cuts and consequently was not fully tested, it did attract criticism for not being sufficiently flexible or nimble.

49. In any case, the industry and funders tend to view issues of concentration and fragmentation of capacity through different lenses. Funders can find themselves faced with a choice between, on the one hand, funding established R&D centres, thus helping maintain national capacity, and, on the other, encouraging a broader provider base to stimulate new approaches and thinking. Historically, the pendulum in this balancing act has swung one way, then the other.

50. The current view of funders and others seems to be that the big challenges faced by growers – technology for production efficiencies, reducing environmental impact and carbon footprints, human health and nutrition - cannot be adequately tackled by traditional horticultural R&D providers alone. New combinations of skills and facilities are needed to provide the necessary inter-disciplinary approaches.

Profile of expertise & skills

51. A questionnaire was sent to all members of the NHF R&D Providers Group and to selected commercial horticultural operations seeking information on the skills they currently employ, with

an opportunity to comment on any shortages or recruitment and retention difficulties. A total of 35 questionnaires were distributed; 16 were returned completed.

52. The results of this audit of skills are set out in Tables 5, 6 and 7.

Researchers

Table 5: Analysis of researcher skills and expertise

Numbers of research leaders						
Discipline	*Nature of science skills*		*Age range*			
	Basic	Strategic/applied	20-30	31-50	51-60	61+
Agronomy						
General	*0.4*	*3.1*	1	2.1	0.4	2
Vegetables	*0.5*	*5*		2	5	
Glasshouse agronomy						
Top fruit	*1.5*	*1*		0.5	2	
Soft fruit		*4*		1	3	
Protected edibles		*3.3*		1.3	1	
Protected ornamentals	*1*	*3*		3	1	
Hardy nursery stock	*0.5*	*3*	1	1	1.5	
Physiology	*5.6*	*9.4*	1	11.8	3.3	
Crop improvement, genetics & genomics	*16.2*	*12.1*	2	21.8	8.5	1
Pathology	*6*	*16.1*		20.4	8.2	
Entomology	*3*	*15*	1	13.6	7.4	1
Microbiology	*2.8*	*7.5*		8	2.2	
Soil science & plant nutrition	*1*	*6.7*		5.7	3	
Biometrics	*1*	*3.3*		2.3	3	
Weed science	*0.5*	*2.1*		3.1	1	
Others (specify)						
Botany, taxonomy, biodiverstiy		*0.6*		2.6	2	
Environmental science			1			
Economics		*2*		3		
Nematology		*0.4*	0.2		0.2	
Horticultural technology		*0.6*		0.6		
Restoration ecology/bioremediation		*1.4*		1.4		
Operational research		*0.3*		0.3		
Quality and nutritional components				2.5		
Post-harvest technology		*1*	2	3	1	
Tropical crops	*0.5*					
TOTALS[9]	***40.5***	***98.9***	**9.2**	**111**	**54.7**	**4**

53. One conclusion from Table 5 is that this is not such an ageing population of researchers as has been perceived. Two-thirds of all the 178 staff surveyed are under 50 years. However, there is some variation between the subject areas. For example, over half the agronomists are over 50.

[9] The totals do not reconcile as not all 178 posts were assigned to the basic and strategic/applied columns.

54. At the other end of the spectrum, only 5% of the total is under 30 years. However, this apparent lack of young people may not be as serious a problem as it appears. It has to be set against the reality that aspiring researchers often have to serve an 'apprenticeship' of two or more spells as post-doctoral researchers on period appointments. Effectively, the entry age to research leader posts with indefinite employment contracts is over 30, though it must be emphasised that such recruitment has been running at a low level over the past decade.

55. The analysis provides confirmation that there are low numbers of researchers with traditional horticultural skills, notably in weed science & agronomy. Indeed, only ADAS, NRI, University of Reading and Warwick HRI report any expertise in weed science. No doubt this is a result of the market reacting to reduced funding opportunities for applied R&D in recent years. But it creates skills shortages for the HDC, who rely on such expertise for much of their applied work.

56. Finally, the returns show the application to horticultural R&D of less traditional skills such as economics, environmental science and the nutritional qualities of fresh produce.

57. On the particular issue of recruitment and retention, relevant comments from the respondents are summarised in Annex 5. Recurring points are:

- Overall, recruitment of researchers is difficult, but possible.
- It is difficult to succession plan because of funding uncertainties.
- There has been a significant loss of experienced crop scientists and agronomists, many of whom are approaching retirement.
- New recruits often have little experience of production horticulture, especially practical plant pathology and agronomy. This requires in-house training, sometimes using BASIS[10] courses.
- Horticultural R&D is not an attractive career option because of the poor public perception of production horticulture, although this is probably not true of amenity horticulture. Some believe this is at the root of the sector's recruitment difficulties.

58. Although the target group was not the same as the 233 KT specialists surveyed by Professor Mark Tatchell[11] in 2005, there is some overlap between the two populations. The conclusions of both surveys are broadly consistent in highlighting the difficulty of succession planning and shortages in areas like agronomy, crop nutrition, weed science and practical plant pathology.

59. Overall, the age profile of researchers is a cause for concern, especially as few R&D providers are sufficiently confident of the future to recruit or even replace staff who leave or retire.

Technical staff

60. The analysis of 204 posts shows a preponderance of laboratory-based technicians, with few dedicated to glasshouses and field work. Several respondents, however, pointed out that most technical staff are deployed flexibly to meet seasonal and other fluctuations in demand.

[10] The British Agrochemical Standards Inspection Scheme (BASIS) is the pesticide industry's self-regulatory scheme set up in 1978.

[11] *Scientific Skills for Knowledge Transfer in Arable Agriculture in England*. A Survey Report to The Board of the Rothamsted Research Association. Professor Mark Tatchell 2005.

61. Several respondents emphasised the difficulty in recruiting technical staff with relevant skills and knowledge of practical horticulture. This imposes a heavy burden of in-house training on employers.

Table 6: Analysis of technical support

Numbers of technical support staff					
Nature of main activity	*Age range*				
	Undiff	20-30	31-50	51-60	61 +
Laboratory - based	80	13.1	21.6	7.6	1
Glasshouse - based	10		4.9	6.4	1
Field trials and farm work	8	6	10	17	
Undifferentiated	4	3.2	7.2	1	1
TOTALS	**102**	**22.3**	**43.7**	**32**	**3**

Training

Postgraduate

62. The trainees captured in the survey are mainly MSc and PhD students. There is marked concentration of three-quarters of these students at just three institutions – Warwick HRI, Cranfield University and NRI.

Table 7: Analysis of trainees

Numbers of postgraduate students			
Discipline	*Numbers*	*of which UK/EU nationals*	*of which UK nationals*
Agronomy	5		1
Physiology	23	4	2
Crop improvement, genetics & genomics	21	13	1
Pathology	16.5	8	2.5
Entomology	11.5	1	2.5
Microbiology	3	2	1
Soil science & plant nutrition	5		2
Biometrics			
Weed science	1	1	
Undifferentiated	13	2	1
TOTALS	**99**	**31**	**13**

63. Another feature is the small number of UK nationals, although it is not always possible from the available statistics to distinguish between UK and other EU nationals; hence 31 individuals recorded in the middle column of Table 7. While the overall picture is one of a minority of UK students, it should not be assumed that all 'other EU' and foreign nationals will automatically wish to return immediately to their native country for their first employment. This represents a window of opportunity for recruiting research and technical staff with some awareness of UK horticulture.

Higher and Further Education

64. In today's competitive HE market, HEIs quickly adjust their teaching provision in response to student demand. Consequently, undergraduate courses with a strong horticultural component have declined in recent years. Now only University of Reading, Harper Adams University College, Myerscough College, Writtle College and SAC appear to offer BSc courses in horticulture.

65. FE training is in a healthier state that HE provision. There is a diversity of full-time and part-time courses, often vocational, mainly provided by FE Colleges.

66. The 2007 review of land based studies provision[12] by the HEFCE should have given an insight into the latest patterns of horticultural course provision by HEIs and FE colleges and of student demand. Unfortunately, the HEFCE study recorded only 39 students in the whole of England in a 'Production horticulture' category, but estimated that actual numbers were ten times higher.

67. This huge discrepancy was attributed to institutions' interpretation of the Joint Academic Coding System (JACS) which leads them to report student numbers at a higher level of aggregation than simply 'horticulture' and its several sub-categories. So what should have been a useful snapshot of training provision in England has turned out to be almost worthless as far as horticulture is concerned. However, the report does provide a valuable synoptic view of training, research and KT in land-based studies as a whole.

Practical and vocational training

68. BASIS Registration Ltd, who have 4,000 individuals of their professional register, report that demand for certification in crop protection is picking up after a lull of several years. Of the 17 categories of their Certificate in Crop Protection, the top three in popularity are:

- Agriculture
- Commercial Horticulture; typically two courses a year amounting to 20 people.
- Field Vegetables

69. BASIS point out that crop assurance schemes requiring professional membership is a powerful driver for registration. They estimate that half of those on their professional register are agronomists (agricultural and horticultural), with an average age of around 55.

70. The overall impression of BASIS is that big companies are hiring qualified agronomists, but that the number of independent consultants is flat, or even in decline.

[12] *Review of provision for land-based studies*. Final report to HEFCE by JM Consulting and SQW Ltd. May 2007.

Promoting training and careers

71. Most of the HE and FE courses are listed in an invaluable Education and Training Courses booklet *What can a career in horticulture offer you?* produced by the Institute of Horticulture (IoH). This 28 page document gives comprehensive lists of qualifications and training providers as well as advice on matching courses with prospective students' needs and aspirations. It is accessible on the IoH website[13].

72. The publication was last revised in January 2007, so is becoming dated. It is important that the IoH gives priority to keeping this invaluable publication up-to-date. If resources were made available to present it in a more attractive format it could become a useful tool in any campaign to promote horticulture and the career opportunities it offers.

73. The IoH's work on careers would benefit if it were integrated with the emerging findings of the Green Skills Careers Marketing Initiative (GSCMI) Steering Group, led by the RHS, on raising the profile of horticulture and 'green skills' as a career for young people.

Training initiatives

74. Primarily to address the problem that recruits lack experience of practical horticulture, STC has proposed a training scheme that echoes the extensive training in agronomy and practical pathology that ADAS used to provide before privatisation. STC advocate that the HDC or other funding bodies should consider the case for funding a practical horticulture training scheme for newly appointed personnel in appropriate subjects throughout the horticultural R&D base.

75. The more applied R&D organisations like STC and ADAS would be well-placed to provide such training, but secondments or 'internships' to growers should also be considered. There could be common cause in developing such a scheme with bodies like Lantra, the sector skills council for the land-based industries, and the regional development agencies (RDAs), with their concern for regional wealth and job creation (see also para.194).

Profile of physical infrastructure and facilities

76. Questionnaires returned by 16 R&D providers give a good insight into the state of physical infrastructure and facilities. The completed questionnaires are reproduced in full in Annex 6 and answers to a strategic question about any deficits developing on a 10 year time horizon are listed in Annex 7.

77. Not unexpectedly, the national picture is mixed. A few providers have benefited from recent capital investment, notably Cranfield University with brand new modern facilities for post-harvest studies. Others, for example, EMR, need redevelopment programmes to replace older laboratories, glasshouses and infrastructure. Overall, the R&D base experienced a good deal of capital investment during the 1990s when, for example, Defra invested heavily in re-equipping Warwick HRI as the hub of the former HRI.

78. The main points emerging from the questionnaires are:

- There are some shortages of glasshouse space, though the distribution is uneven; for instance, Warwick HRI does not utilise all its glass, yet other providers are experiencing shortages of certain types of glass. There are clearly opportunities for more efficient use of glass by sharing and partnerships, which are beginning to happen.

[13] http://www.horticulture.org.uk/IoHEduc.htm

- A tendency to overcapacity as R&D funding has declined, though this is often compensated by decommissioning older facilities.
- An almost universal worry about how replacements for current facilities will be funded, especially if providers becoming increasing reliant on grants which may not allow full cost recovery. Consequently, there is a noticeable lack of strategic development plans and great uncertainty about future capital funding.

79. The HDC, as an R&D funder, expressed concern about the state of facilities in the R&D base. Several of its projects use glasshouses on growers' holdings which are more sophisticated and have technologically advanced management systems. Similarly, the HDC has reservations about the adequacy of crop storage facilities, which are not all fit-for-purpose.

Knowledge transfer (KT)

80. The HDC is a major player in translating R&D findings to growers. The quinquennial economic evaluation of the HDC in March 2004[14] concluded that:

> *'[HDC] achieves [KT] through a range of activities, including the publication of a regular magazine (HDC News), project reports, a weekly e-mail news update, fact-sheets, guides, software, workshops and grower walks. HDC News and Project Reports are highly regarded by levy payers as sources of information on new technology. This is strong evidence that HDC has made very considerable improvements in knowledge transfer since the 1999 quinquennial review. While we noted some very good examples of technology transfer and industry uptake, we also noted some delay in decision making and/or lack of financial investment in the resources required to deliver technology transfer in some projects; we believe that further investment is needed in this area, especially to ensure effective delivery of technology after the R&D project has ended'.*
>
> Quinquennial economic evaluation of HDC. March 2004

81. Today, four years on, the HDC's varied portfolio of KT mechanisms has been maintained. It was beyond the scope of the present study to repeat the survey of levy payers undertaken by the University of Reading for the 2004 economic evaluation. In interviews, however, it was clear that the HDC's KT efforts are generally, though not uniformly, recognised. There are some strongly held views on the relative merits of electronic and traditional methods of disseminating technical information. In reality both will be needed for the foreseeable future.

[14] *Economic Evaluation of the Horticultural Development Council.* A Report to the Department for Environment, Food and Rural Affairs by The University of Reading. March 2004.

82. Issues that the new Board of the HDC might address in any review of KT should include:

- Measuring the impact, and thus cost-effectiveness, of the main methods of disseminating its R&D findings.
- The role of independent crop consultants in adding value to the HDC's KT strategy, based on a relationship built on mutual respect and recognition.

83. In addition, R&D providers are devoting more attention to KT skills and programmes, sometimes at the behest of their funders. And consultancy firms like ADAS UK Ltd and FAST Ltd play a major role in translating technology to individual growers.

Overall resilience of the horticultural R&D base

84. What does this study tell us about the overall health of the UK horticultural R&D base? The summary overleaf (Table 8) summarises conclusions about the intrinsic strengths and weakness of the UK horticultural R&D base and the external opportunities and threats it faces.

85. This SWOT chart is the distillate of all the evidence and opinion that came out of the programme of interviews with stakeholder organisations and individuals. It seeks to give an objective and independent analysis, detached from the inevitable tension between the legitimate concerns of interested parties, which can be caricatured as researchers aspiring to a steady and generous flow of funding to research interesting problems, and growers expecting R&D to concentrate on the imperative of harvesting a healthy, profitable crop in the current year!

86. This analysis is a key output from the present study. The opportunities, in particular, form the basis for the discussion of strategic options for future R&D provision.

Table 8: The UK Horticultural R&D Base

Strengths	Opportunities
▪ **Several platforms of strategic/applied horticultural research expertise**. ▪ **Smaller university groups add diversity.** ▪ **Transferable skills for broader land-use studies.** ▪ **National strengths in underpinning plant & microbial science, ecology, soil microbiology and environmental science.** ▪ **Effective arrangements for applied R&D through the HDC.** ▪ **HortLINK, which cements partnerships between research groups and users.** ▪ **Good KT through the HDC and a cadre of consultants.** ▪ **Collective leadership provided by the NHF, HTA & NFU.**	▪ **Horticultural R&D capabilities can help inform some key public policy issues, such as climate change, environment, sustainable rural economies, health and well-being, all of strategic relevance to growers.** ▪ **Inter-disciplinary links with engineering, economic and social researchers, as well as UK strengths in plant and microbial science, to create broad research teams for these new R&D challenges.** ▪ **A broad Agri-Food Innovation Platform to strengthen interaction with fresh produce supply chains, consultants, grower co-operatives, distributors and retailers, and lever in TSB funds.** ▪ **Partnerships with RDAs to develop local businesses.** ▪ **The AHDB to encourage R&D vision across crops and strategic use of resources.** ▪ **More strategic vision and stronger collective leadership to engage with existing and new funders and address poor public perception of production horticulture.**
Weaknesses	**Threats**
▪ **The HDC near-market funding model of 1990s undermined by withdrawal of Defra from direct support of R&D for production horticulture.** ▪ **Insufficient co-ordination between funders.** ▪ **R&D capacity, especially facilities, now exceeds demand; unit running costs of under-used facilities increasing.** ▪ **Some ageing facilities, combined with uncertainty about future capital investment.** ▪ **Insufficient researcher articulation with basic plant and microbial sciences, engineering, business studies.** ▪ **Funding pressures over two decades have prevented succession planning; skills base becoming attenuated and one-deep; while uncertain career opportunities and poor perception of horticulture are discouraging good new recruits.** ▪ **Narrow industrial funding base; only growers are funding pre-competitive, near-market R&D.** ▪ **Independent crop consultants retiring without succession.**	▪ **Defra's new Farming and Food Science programme further erodes the underpinning base on which the HDC depends.** ▪ **Some centres may fail to adapt quickly enough to the changed public policy agenda and become unsustainable.** ▪ **Intense competition between groups inhibits collaboration, sharing facilities and strong collective leadership.** ▪ **Skill shortages worsen; insufficient experienced personnel for effective applied research and KT.** ▪ **Increasing competition from foreign R&D providers.** ▪ **Failure to address poor public and political perception of production horticulture (and agriculture).** ▪ **Collective failure to adapt to changing environment; silo mentalities frustrate agreement on the key issues and ways forward; risk averse attitudes dominant.**

V. R&D FUNDING

Existing sources

87. The principal public sources of R&D funds for horticultural R&D are the BBSRC, Defra and, in Scotland, RERAD. The HDC levy is the main source of industrial funding. Each is reviewed in the following paragraphs.

i. BBSRC

- **R&D rationale and outputs**
  - Basic, strategic and applied research of high scientific quality and strategic relevance relating to the exploitation of biological systems. As much as 98% of the Council's research portfolio has the primary purpose of advancing knowledge for its own sake.

- **Support for horticultural R&D**
  - **Research grants** captured by searching the BBSRC Oasis database with a horticulture keyword currently amount to £1m a year in value. Almost all of this is awarded to institutions that are part of the UK horticultural R&D base.
  - £11 million[15] a year on **Plant and microbial sciences** in research institutes and universities. Though horticultural application is not a primary aim, this basic/strategic research provides broad underpinning for horticultural R&D.
  - Annual **transitional competitive strategic grant** of £2.1 million to Wellesbourne HRI. This funding ended in 2007-08, after which the institute will look to HEFCE for research (QR) funding.

ii. Defra

- **R&D rationale and outputs**
  - Science is used to provide evidence for policy making, solving problems, and identifying future issues.

- **Support for horticultural R&D**
  - £10.9 million for **Horticulture crop science** in 2004-05 (the last year for which published statistics are publicly available). This includes transitional funding to Warwick HRI and EMR. This R&D programme has now ended.
  - **Transitional funding** to Warwick HRI (until 2012) and EMR (until 2010) amounts to £8 million in 2007-08 then tapers out by 2012. Increasingly these funds are being directed by Defra to non-horticultural R&D topics.
  - The **Defra Farming and Food Science programme** has been running since April 2006 and is based around Defra's strategic priorities.
    - Agriculture and climate change.
    - Sustainable water management.
    - Resource efficient and resilient food chain.
    - Sustainable farming systems and biodiversity.
    - Plant heath.

[15] This is the figure estimated by the Spedding Review.

- Defra expect Farming and Food Science programme expenditure to total £27.6 million in 2008-09, including commitments to Warwick HRI and EMR as well as any LINK activity. Much of the work is cross-cutting and covers all farming and food sectoral interests, including horticulture. After 2012, when transitional funding to Warwick HRI ends, it is unclear how much of the research funded by this programme will be directly, or even indirectly, relevant to horticultural crop production.

iii. Scottish Government, RERAD

- **R&D rationale and outputs**
  - Long-term strategic science in agricultural, biological and related sciences that aims ultimately to meet the needs of a range of end-users, including agriculture and, in selected areas, horticulture.

- **Support for horticultural R&D**
  - **Commissioned R&D on Soft fruit genetics** at SCRI (Work Package 1.3) amounting to £1.1 million a year.

iv. HORTLink

- **R&D rationale and outputs**
  - The **Horticulture LINK Programme** provides grants to industry for collaborative and pre-commercial research of between 25% and 75%, dependent on degree of risk and industrial contributions. The programme aims to support sustainability of the industry consistent with government policies in food and farming and the requirements of the industrial supply chain. Broadly, the objectives are to improve the supply, quality and acceptability of fresh produce, whilst reducing environmental impacts, non-renewable inputs and production costs.

- **Support for horticultural R&D**
  - Since its inception in 1997 the HORTLink scheme has facilitated a mixed public/private investment of £21 million in horticultural R&D – averaging almost £2 million a year. Because industrial contributions vary between individual projects and are frequently paid in kind, it is impossible to quantify the private sector's share of this substantial overall investment.

88. With the ending of Defra support for R&D directed at horticultural production, HORTLink is effectively the only mechanism for public funding of pre-competitive applied R&D in England & Wales. It is widely and equally valued by R&D providers and by industry. However, with so many parties involved in each collaborative project, communication and administration can be sources of frustration for those involved.

v. The Horticultural Development Council

89. A levy on growers with a turnover in excess of £60,000 is the main mechanism for the horticultural industry's support of R&D. The levy is collected and invested in R&D by the HDC.

- **R&D rationale and outputs**
    - The HDC aims to serve British growers by being a top class, efficient and progressive facilitator of near-market horticultural research and development and the associated technology transfer.

- **Support for horticultural R&D**
    - £3.5 million on a mixed portfolio of applied R&D projects in support of R&D strategies and priorities determined by each of seven sectoral panels.

vi. The Waste and Resources Action Programme

90. The Waste and Resources Action Programme (WRAP), funded indirectly from landfill tax receipts, is becoming a significant funder of R&D into recycling, composting and waste disposal generally.

vii. Other industrial funded R&D

91. By its nature it is not possible to estimate the quantum of commercially sensitive R&D funded by companies in the fresh produce supply chain, ranging across the larger growers, distributors and importers, and the retail sector. A few larger companies have their own R&D capability; others commission projects from institutes and universities.

92. Professor Simon Bright of Warwick HRI has pointed out that if companies took greater advantage of R&D tax credits this would both reduce their R&D costs and provide a basis for quantifying the (possibly significant) amount of R&D that industry funds.

vii. Charities

93. Finally, we should not overlook the contribution that charities make to R&D funding. The East Malling Trust for Horticultural Research gives £0.8 million annually to support the activities of EMR.

94. Other charities make occasional small grants, often for quite specific projects.

Future funding patterns

95. Continuing transitional Defra funding of Warwick HRI and EMR and the gradual phasing out of horticultural R&D projects in the pipeline have partly obscured and mitigated the impact of the sea-change in public R&D funding that occurred when Defra rolled out its new Farming and Food Science programme in 2006.

96. This new programme is quite explicitly shaped by public policy objectives. It seems to reflect a Government view that market failure in the horticulture and agriculture industries is not now in itself a compelling argument for public funded R&D designed to increase efficiency and competitiveness. Industry, especially big players, should do more if that is what is needed.

97. The Scottish Government's Rural and Environment Research and Analysis Directorate (RERAD) has already begun planning its next research strategy and is clearly anticipating a change in emphasis for the content of the research to be commissioned. It has proposed four themes for discussion by stakeholders, as follows:

- Local responses to global change.
- Sustainable communities.
- Sustainable environments.

- Support for nationally important rural, environmental and marine capability and resource.

98. The prospects, therefore, are that the Scottish Government will move in the same direction as Defra by prioritising environmental change and sustainable rural communities. It is much too early to predict the impact of a new research strategy on the soft fruit research currently commissioned at SCRI, but it seems likely that in future R&D underpinning agricultural and horticultural production will have to be set in broader economic, social and land use contexts.

The position five years from now

99. What then is the likely overall impact of these changing funding policies for the UK horticultural R&D base by, say, 2013? Will more or less cash be available for horticultural R&D? And will it be the sort of R&D that the HDC and growers can relate to?

100. By 2013, transitional Defra and BBSRC funding to Warwick HRI and EMR, which peaked at £10 million in 2007-08, will have ceased. What is less clear are the contributions of existing funding streams to the overall resource input to horticultural R&D, notably:

- The extent to which Warwick HRI, (as a first-time player), and all the other university providers win HEFCE research (QR) funds in the 2008 Research Assessment Exercise (RAE).
- What share existing horticultural R&D providers can win of the Defra Farming and Food Science programme funding (£27 million in 2008-09), taking into account of the breadth of the new programme, covering the whole of farming and food (Annex 4), and the current skills and facilities of the traditional horticultural R&D base.
- Success in winning BBSRC research grants for basic/strategic research.
- Success in increasing funding from other existing public sources like the EU.

101. Putting all these factors together, it is difficult to escape the conclusion that by 2013 the net result will be less funding for horticultural R&D from traditional public sources. In particular, it seems inevitable that there will be substantially less funding for the strategic R&D that the HDC feeds off. Unless alternative funding can be secured, less funding overall means reduced capacity – in terms of both expertise and facilities. It is not possible to predict where the shrinkage in the R&D provider network might occur as much will depend on the business strategies adopted by individual institutions[16].

102. The HDC is already anticipating a reduction in capacity in its traditional UK R&D base and is developing scenarios that include broadening its provider base in the UK, contracting with overseas R&D providers, more efficient R&D management within the AHDB levy body family and tapping new sources of funding.

103. Alternative funding will be essential if the horticultural R&D base is to retain anything like its present size. Two possible alternative sources of funding for strategic and applied horticultural R&D – the regional development agencies (RDAs) and the Technology Strategy Board (TSB) - are described in the following paragraphs.

[16] In early August 2008 Warwick HRI announced its intention to close its Kirton site in February 2009.

Regional Development Agencies

104. The RDAs are a potential new source of funds for innovation in the horticultural sector. This is particularly true of RDAs like the East of England DA (EEDA) and South East of England DA (SEEDA) that have developed explicit strategies for rural development, agriculture and horticulture, food chain and the environment.

105. It has to be recognised at the outset, however, that the ultimate aim of all RDA funding is local business development. RDAs will not support a R&D project for its own sake. The outputs of projects must directly promote business development, thus contributing to regional job and wealth creation.

106. For example, the EEDA recently awarded a £1.85 million grant to the universities of Cambridge and Cranfield to establish an academic presence at Colworth Science Park in Bedfordshire. Based in a state-of-the-art science and innovation hub being developed at Colworth by Unilever, academic staff will work with a range of companies in a commercial setting with the full support of modern, shared facilities, amenities and equipment.

107. Closer to the world of horticultural R&D, Advantage West Midlands has made a contribution of £610k through the Birmingham Science City initiative towards the cost of converting an under-utilised mushroom research facility at Warwick HRI into a demonstration bio-reactor.

108. The third example of winning RDA funds owes much to the initiative of the HTA, which has facilitated the award of five small SEEDA grants, totalling £90k, to horticultural businesses under SEEDA's priorities of water, transport and cost reduction, as follows:

- Transport hub for SE growers (Contractor: Freight Transport Association)
- Marketing and sales expertise (Contractor: EFFP)
- Water audits of nurseries (Contractor: ADAS UK Ltd)
- Waste reduction; recycling (Contractor: White Young Green)
- Carbon calculator for nurseries (Contractor: White Young Green)

Rural Development Programme for England

109. The new Rural Development Programme for England (RDPE) started in January 2008 and will run for five years. It is managed regionally by the RDAs, each of which will have set its own priorities within the overall RDPE framework. The RDPE, jointly funded by the EU and the UK Government, provides support for capital projects and training for farmers, growers, foresters, food businesses and rural communities.

110. The themes of the RDPE are:

- Business efficiency.
- New markets and products.
- New businesses and enterprises in the rural economy.
- Resource protection.
- Conservation of the natural built and historic environment.
- Access and recreation.
- Rural community capacity.

111. The short descriptors and objectives of several of the above themes suggest there are opportunities for the R&D base, including consultants, to act as contractors delivering the necessary outputs on RDA grants that would be awarded to individual enterprises in the fresh produce supply chain or, more probably, to consortia or co-operatives.

112. There are potential challenges. The (limited) record so far suggests RDAs have a preference for capital rather than revenue grants. And they generally do not support 100% of the costs of a project, so matching funds would be an important consideration. These could be companies' own funds. There is also the possibility of the HDC levering out RDA funds for the benefit of its levy payers, though bids themselves would have to be led by a horticultural producer.

113. Because of the RDAs' business focus, R&D providers are unlikely to win grants in their own right. But they will have opportunities to act as contractors. However, both companies and R&D providers will have to show imagination and flexibility to demonstrate clear business benefits to degree that is not required or expected by their traditional R&D funders.

114. Quite significant funds are available to realise the RDPE. For example, the EEDA RDPE budget is £64 million over five years to 2013; the SEEDA budget is £65 million.

The Technology Strategy Board

115. The Technology Strategy Board is an executive non-departmental public body (NDPB), established by the Government in 2007 and sponsored by the Department for Innovation, Universities and Skills (DIUS).

116. The TSB's role is to stimulate technology-enabled innovation in the areas which offer the greatest scope for boosting UK growth and productivity. One of its delivery mechanisms is the innovation platform. The idea here is to pull together policy, business, government procurement and research perspectives and resources to generate innovative solutions by UK businesses to the challenges facing today's society.

117. The TSB is currently considering the business case for establishing an Agri-Food Innovation Platform. Superficially at least, the challenges facing UK food production - climate change, environmental issues and the nation's health and well-being - are just the sort of societal changes that should interest the TSB.

VI. STRATEGIC OPTIONS FOR FUTURE R&D PROVISION

Context

118. The model of applied R&D funded by the HDC feeding off a foundation of Defra-funded strategic R&D in horticultural crop science is no longer working. What are the implications of this for R&D providers, for the HDC and for the industry?

119. Traditional horticultural R&D providers like Warwick HRI, EMR and STC, who won the bulk of the Defra horticultural R&D funding[17] will feel the greatest pressure. They will have to re-position themselves by diversifying their skill bases, possibly at the expense of traditional horticultural skills, if they wish to compete effectively for R&D funding from the new Defra Farming and Food Science programme.

120. The implications for growers and the HDC are more complex. There is a growing gulf between growers' R&D needs, as expressed, sector by sector, in the HDC's comprehensive R&D Strategy, and Defra's R&D priorities for science relating to farming and food. How should the HDC react? Its main consideration must be to maximise the return from levy funds it invests in R&D. What are the HDC's options for ensuring the effectiveness of levy-funded R&D?

121. Not surprisingly, there is no 'silver bullet' solution that would deal with all current difficulties and uncertainties. The situation is, however, far from intractable. Interviews and analysis point to several strategic options for future provision, not mutually exclusive, that should help improve the sustainability and effectiveness of a UK horticultural R&D base.

[17] Which totalled £10.9 million as recently as 2004-05.

Strategic options

122. The recommended strategic options discussed in the remainder of this section are listed in Table 9.

Table 9: Recommended strategic options

Initiative	For consideration by
i. Present a new agenda for R&D in support of agriculture & horticulture	NHF, HDC, AHDB/AHRF[18], NFU & HTA
ii. Forge provider partnerships	R&D Providers, NHF & HDC
iii. Exploit existing funding sources	R&D Providers, HDC, AHDB/AHRF
iv. Explore new funding sources.	R&D Providers, HDC and Growers
v. Broaden industrial engagement	R&D Providers, HDC & AHDB/AHRF
vi. Increase the efficiency and effectiveness of R&D delivery	R&D Providers, HDC, AHDB/AHRF
vii. Review HDC R&D strategy	HDC
viii. Strengthen collective leadership	NHF

i. Present a new agenda for R&D in support of agriculture & horticulture

123. The wider policy context has changed quite dramatically even since 2006 when Defra stopped funding R&D for production agriculture and horticulture. With the recent rises in global food prices and worries about the medium-term impact of climate change on food production, food security has moved sharply up the political agenda. The Government Chief Scientist, Professor John Beddington, has spoken publicly about the issue.

124. The recent Government decision to re-appraise the amount of land that should be committed to (non-food) biofuel production is another example of current strategic uncertainties.

125. In a timely move, the Commercial Farmers Group (CFG) has recently published a review of the relationship between UK agricultural productivity and public investment in agricultural R&D over the past 20 years. The report argues that a continuing decline in agricultural R&D has contributed to a reduction in the competitiveness of the UK agricultural industry[19] and is putting food security at risk.

126. According to the CFG's analysis, loss of applied R&D limits the ability to put advances in basic scientific knowledge into practice. Simply increasing the funding for 'knowledge transfer' aimed at translating basic science into practice will not bridge the gap. That would fail to engender the close connectivity between science and practice provided by applied scientists. The CFG conclude that a new vision is urgently required to develop innovative UK agricultural systems that are competitive, reduce reliance on food imports, and deliver the required environmental benefits.

[18] At this early stage in the AHDB's life it is difficult to predict the extent to which matters concerning R&D will be left to the Agriculture and Horticulture Research Forum (AHRF) – which previously operated as the Applied Research Forum (ARF).

[19] In the CFG paper 'agricultural industry' includes both agriculture and horticulture.

127. This description of the wider agricultural scene matches the picture in horticulture where capacity for strategic & applied R&D, both skills and facilities, has been progressively eroded over the past decade.

128. The CFG's new vision for strengthening applied research, and thus innovation, in agriculture, includes several quite radical measures:

- Action by the higher education councils and the BBSRC to elevate the status of applied R&D in appropriate agricultural university departments and research institutes, together with the provision of career opportunities and rewards comparable with other scientists.
- Provision of studentships for PhD training in applied agricultural research.
- A re-balancing of existing research budgets in universities and research institutes with an increasing proportion of the total directed towards applied research.
- Government and the agricultural industry seeking to develop additional agricultural research funding streams from both public and private sources.
- The Agriculture and Horticulture Development Board taking a leadership role on behalf of the industry in addressing the 'market failure' in agricultural R&D, with the objective of establishing a fully functional and integrated R&D chain.

129. There now seems to be recognition within Defra that there is an issue about the translation of R&D findings to the agricultural sector. Whether this is ineffective translation or a refection of the agricultural and horticultural relevance of basic R&D is unclear. The Department's Chief Scientist, Professor Bob Watson seems to have an open mind. He has been quoted as saying:

> '*There is some concern in the agricultural sector that the BBSRC, whilst world class, is very fundamental and academic and doesn't relate to the average farmer in the field. Research is not being translated into the sort of information the farmer needs to be productive. Defra has also moved away from production research in recent years'.*
>
> from Research Fortnight. 23 April 2008

130. Professor Watson convened a high-level meeting on 30 July 2008 to discuss agricultural R&D issues with interested parties. This occasion provided an excellent opportunity for those concerned about the erosion of strategic and applied R&D capacity to begin to advance their case in a constructive and persuasive manner. The important point is not the outcome of this single meeting, but the fact that a dialogue between industry and government on R&D issues has been renewed.

131. Taking a cue from the CFG report, it would be prudent for the industry not to appear to be advocating the re-creation of old structures and arrangements, but to present a new agenda to Government about improving outcomes for horticulture (and agriculture) that are compatible with changing public policy priorities, including food security.

132. One strand of the case should be that a successful, innovative horticulture industry has the potential to contribute to several of the Government's public policy objectives, notably adapting to the impact of climate change and conservation of water and other resources, as well as diet, health and general well-being of the population.

133. It is important that the NHF, the HDC, the HTA, the NFU and the AHDB/AHRF collectively engage in the coming dialogue with Defra and do this in co-ordinated way. The aim should be to make a convincing argument of the value of the UK horticultural industry to the public interest. This will require a carefully prepared new agenda promoting R&D for agriculture and horticulture that is also consistent with public policy goals of climate change, the environment, rural sustainability, diet and health and, importantly, food security.

ii. Forge partnerships between R&D providers

134. The trends of the past few years have created a more competitive research market, but somewhat paradoxically, one which favours partnerships between R&D providers. There is now a realisation that capabilities and competitive strengths can be enhanced through greater collaboration and by more sharing of facilities and infrastructure.

135. There is some pressure from funders on providers to collaborate and form partnerships. For example, Defra have doubts about the ability of the traditional horticultural R&D base to contribute to delivering their new scientific priorities, which they consider require better links between plant/soil scientists and social scientists, economists and other disciplines. Defra regard the Rural Economy and Land Use (RELU) programme, jointly-funded by the BBSRC, ESRC and NERC, as an exemplar of the multi-disciplinary approaches now needed.

136. Similarly, the HDC believes in the importance of multi-disciplinary approaches and, through its grant awards, has been tapping into non-traditional skills and expertise wherever it is located by encouraging national collaborations and exploiting international science networks.

137. In an interesting development in Scotland, the Scottish Government has announced that it would encourage SCRI and the Macaulay Land Use Research Institute (MLURI) 'to come together' in order to strengthen Scotland's research capacity and its international competitiveness. This is surely another signal that a range of skills across the natural and social sciences, as well as critical mass, is necessary to make an impact on the challenging issues in environmental and rural research.

138. Horticultural R&D providers thus find themselves under pressure to access expertise that goes beyond their long-established skills in plant pathology and agronomy and their newer strengths in molecular biology and genomics. Engineering, social science and economic skills will be needed to take account of practical, social and business contexts of translating relevant research into application in agriculture, horticulture and other uses of land resources.

139. In the skills and facilities questionnaires, the RHS and the Eden Project report capabilities that so far have been little applied to production horticulture. Could synergies be created by drawing these two institutions, with their considerable relevant skills and experience, more closely into collaborations with traditional horticultural R&D providers?

140. At another level, strategic partnerships between institutions could make smaller R&D providers more resilient, as exemplified by the metamorphosis of the former HRI Wellesbourne and Kirton into Warwick HRI, a department of the University of Warwick. Such mergers depend on perceived mutual benefit and are normally the outcome of bilateral discussions between the parties concerned.

141. Partnerships are developing in response to funders' policies. There is probably little need for bodies like the NHF to become actively involved.

142. As for the more effective use of facilities, the questionnaire exercise has confirmed a general impression that there is a mismatch between supply and demand for some physical infrastructure. A rationalisation plan would be one way of making more efficient use of these facilities and reduce costs. Could a national body like the NHF play a role by facilitating rationalisation?

143. However, experience has proved that rationalisation of capacity is easier in theory that it is in practice. Despite robust business cases, neither HRI in 2000 nor Defra in 2002 were able to proceed with plans to withdraw funding from the now independent operations at STC and EMR respectively. Rightly or wrongly, strongly expressed local arguments overcame considerations of national provision. In any case, in what is essentially a market economy, it is very doubtful whether the facilities of autonomous research providers could be managed or rationalised at a national level.

144. There are, nevertheless, opportunities for more tactical approaches to making more efficient use of national facilities, and these are beginning to happen. Research providers with complementary facilities are getting together to use each others' facilities. For example, ADAS have a Memorandum of Understanding with STC, who have surplus glass. Myerscough College have forged a mutually beneficial partnership with University of Lancaster on water relations, with Myerscough providing and managing the field trials.

145. The completed facilities questionnaires in Annex 6, which cover much of the horticultural R&D base, could be a catalyst for discussions about more extensive sharing. The NHF could either attempt to facilitate particular sharing or rationalisation initiatives, or limit itself to promoting the principle of shared facilities. Experience suggests detailed arrangements are probably best left to bilateral, or multilateral, discussion between the institutions and research groups directly concerned.

iii. Exploit existing funding sources

The BBSRC

146. The BBSRC has a well-developed Technology Strategy and invests a total of around £15 million a year in collaborative research and research training with industrial partners. Two of the priorities in the BBSRC Technology Strategy are :

- Crops and crop production.
- Food research for diet and health.

147. Growers often dismiss research council research as 'blue sky' and irrelevant to the horticultural industry. In HORTLink, only a few projects have involved BBSRC sponsorship and funding. Yet, on the basis of LINK scheme projects listed on the BBSRC website, the arable and livestock sectors have done rather better in attracting research councils as project partners.

148. The BBSRC also has an Industrial Partnership Awards scheme for funding science based, responsive mode grants where an industrial partner contributes in cash at least 10% of the full economic cost of the project. The BBSRC funding covers the remainder of the award. This is a mechanism whereby the HDC could potentially achieve 10 times gearing on its R&D funds.

149. Of course, these BBSRC industrial engagement schemes strike a stronger chord with industries like pharmaceuticals that are dominated by big companies with their own research capacity and an interest in strategic research. And there is a worry that, despite its intention of engaging with industry, the BBSRC still relies too heavily on scientific peer review to decide which projects to support within its industrial partnership schemes.

150. At the very least, R&D providers and the horticulture industry ought to identify how they can more effectively bid for HORTLink funding from the BBSRC and other research councils.

151. More strategically, as part of a fresh look at funding and partnership opportunities, it would be sensible for the industry and the levy boards to re-examine what is on offer in the research councils' technology and innovation policies. This might include a dialogue with research councils about the appropriateness of their selection criteria for research grants involving innovation and partnership with industry. Discussions with the BBSRC might be initiated within the AHRF.

Defra

152. The Defra Farming and Food Science programme includes topics as diverse as: Energy in agriculture and food; Waste reduction in the food chain; and Mitigating nitrogen and carbon emissions to air. Inevitably, the base of potential providers for this programme will be broader than that of Defra's former horticulture crop sciences programme.

153. As Defra funding of horticultural crop science declines, the main R&D providers have made cautious assumptions of future levels of horticultural research income from Defra in their latest business plans and are seeking to increase other funding streams. That is not to say they are seeking to distance themselves from traditional horticultural R&D. It is simply that they have to respond to the realities of changed public-funded R&D priorities.

154. Although the new Defra Farming and Food Science programme is less relevant to their day-to-day problems, growers should not view it as irrelevant to their needs. It is this sort of research that enables innovative leaps, as distinct from incremental improvements, to longer-term challenges such as alternatives to chemical pesticides, conserving water and other resources, lowering carbon footprints & adapting to the pest and disease and other consequences of climate change.

155. Research providers will have to re-position themselves to be competitive contractors for the new Defra Farming and Food Science programme. This will require new multi-disciplinary approaches and partnerships. These changes are likely to dilute the HDC's traditional UK contractor base.

The European Union (EU)

156. The Food, Agriculture and Biotechnology collaborative programme in Framework Programme 7 has a budget of €1.9 billion for the period 2007 – 2013.

157. The overall aim of this programme is the advancement of knowledge in the sustainable management, production and use of biological resources to provide the basis for safer, eco-efficient and competitive products and services for agriculture, fisheries, feed, food, health, forest-based and related industries.

158. Research activities potentially relevant to horticulture include:

- Sustainable production and management of biological resources from land, forest, and aquatic environments: enabling research on sustainable production systems, including exploitation and sustainable use of their biodiversity.
- The integrity and control of the food chain 'fork to farm', addressing food, health and well-being.

159. EU funds are traditionally hard to win and require networking and patient building of relationships with potential partners in other member states. And the EU generally does not fund the full costs of research. Clearly, increasing EU funding is not a quick fix, but effort invested in creating pan-European groups can be rewarded with useful additional R&D income. Warwick HRI currently has annual R&D income of £400k from the EU – a welcome addition to the budget and to international networking.

160. The HDC is already active within Europe through its membership of a network for pesticide minor uses. This gives it access to minor crop screening done by other members of the network and avoids duplication within the HDC Specific Off-Label Approvals programme (SOLA). This is a small, but good, example of the potential for working together within the Europe.

161. R&D providers will continue to pursue EU funding in line with their individual policies and funding priorities. The HDC, or perhaps the AHDB/AHRF representing all primary producers, should strengthen the dialogue with the Commission to explore opportunities for industry-led participation in R&D in Framework Programme 7 and in other initiatives.

iv. Explore new funding sources

Regional Development Agencies

162. The prospect of RDA funding is not just aspirational. Although it is still early days, there are already records of success. The HTA has been successful in facilitating funding from the SEEDA for several, admittedly modest, horticultural development projects. The universities of Birmingham and Warwick successfully won a capital grant £610k from the Advantage West Midlands towards the costs of a bio-reactor at Warwick HRI.

163. The new Regional Development Programme for England (RDPE), which started in January 2008 and will run for five years, will provide support for capital projects and training for farmers, growers, foresters, food businesses and rural communities. At face value, it would seem to provide opportunities for growers, individually and collectively, to win grants for business development through innovation and for the R&D base, including consultants, to be awarded contracts to deliver the necessary outputs.

164. As the ultimate aim of all RDA funding is local business development, the explicit commitment of local businesses would always be an essential element of any such bids. This indicates that enterprises in the horticultural industry, collectively or individually, would have to take the lead in any funding proposals.

165. As RDAs generally do not support 100% of the costs of a project, HDC's levy funds might be used to lever out RDA funds for the benefit of its growers. Capital grants may be easier to win than revenue grants.

166. As representatives of levy payers, the HDC and the AHDB are in a good position to develop dialogue with the RDAs, as the HTA has already done with the SEEDA. Initially it might be sensible to target SEEDA or EEDA as they have developed policies for agriculture and food. Grant applications should be initiated by industry, not R&D providers.

Technology Strategy Board

167. The Technology Strategy Board (TSB) is currently considering the business case for establishing an Agri-Food Innovation Platform (IP). In a consultative paper issued in February 2008, Defra raised the possibility of transferring responsibility for HORTLink to a TSB Agri-Food IP, were it to be established. Initially, the proposal was not well-received by the horticulture industry, who were concerned at the prospect of losing a popular and successful grants scheme.

168. Closer examination suggests, however, that horticulture could derive benefits from an Agri-Food IP and the idea should not be dismissed too quickly or lightly. An Agri-Food IP could:

- Engage more of the fresh produce chain in funding R&D.
- Draw in a wider range of scientific, engineering, economic and business skills.
- Lever in significant TSB funding.

169. Representing levy bodies with a combined levy income of £20m for R&D, the AHDB/AHRF would be in a strong position to influence the nature and agenda of an Agri-Food IP. Provided the individual levy bodies retained sufficient influence over their 'contribution' to the IP, they might expect the TSB to match those 'contributions' on a £1 for £1 basis. Retaining the best elements of the Agricultural and Horticultural Link programmes might be an issue for the levy bodies in any negotiations.

170. There are potential difficulties in the levy bodies working in partnership with the TSB and commerce. These include the current designation of levy funds as public funds, despite their origin in the private sector, and the HDC's policy that all levy payers should have equal access to the outcomes of levy-funded R&D. These issues should be viewed as challenges, not obstacles.

171. The potential benefits of an Agri-Food IP would also have to be balanced against risks that:

- Horticulture might lose out to other elements of the IP, which would include agricultural production as well as food processing, distribution and retailing.
- The positive features and benefits of HortLINK might be diluted.
- Any levy funds committed to the IP would mean fewer funds available to the HDC for its traditional applied sectoral research.

172. Overall, the TSB is a speculative source of funding for horticultural R&D, but the potential gains are high. It is important that the AHDB, as the voice of primary producers, seizes the opportunity to influence the agenda.

173. Whatever the outcome of the TSB's analysis of a business case for an Agri-Food IP, there is strong argument for HORTLink to continue and, indeed, to be expanded. It is as an effective mechanism for industrial engagement in applied R&D and KT. The TSB appears to be a natural home for LINK programmes.

Charities

174. The horticultural R&D base has a record of winning occasional modest grants from small charities, often with horticultural objects[20]. But there have been no instances in recent memory of major awards[21].

175. Though very speculative, some imaginative thinking about working with the big national charities could lead to big prizes. For instance, the Gatsby Charitable Foundation includes in its objects:

- To encourage effective technology transfer from universities and other research centres to productive industry.
- To develop basic research in fundamental processes of plant growth and development and molecular plant pathology, to encourage young researchers in this field in the UK; and to support improved introduction to the world of plants within school science teaching.

176. The Gatsby Charity has a record of investing in the UK science base, notably through major grants to establish and run Sainsbury Centres for plant science research, though the emphasis here is on molecular biology and genetics.

177. Other major charities that could be approached by R&D providers include the Leverhulme Trust and even the Wellcome Trust. Imaginative, broad projects that integrate local horticultural production and socio-economic issues such and healthy eating and environmental impact might stand the best chances of success.

178. The RDAs, the TSB and major charities are just three suggestions of novel funding sources, not an exhaustive list Accessing these and other new funding sources will require R&D providers and industry to be imaginative, flexible and persistent, especially when trying to understand the culture and values of unfamiliar bodies. R&D providers should understand the objectives of these potential funders, which are unlikely to be simply funding good science. Applying for support will be different from the submitting grant applications in familiar formats to Defra and the BBSRC. And industry is likely to have to play a strong up-front role in schemes involving RDAs and TSB.

v. Broaden industrial engagement

179. A feature of horticulture is that only growers, at the production end of the fresh produce supply chain, pay the levy. This contrasts with the arrangements of the Home Grown Cereals Authority (HGCA) and the Potato Council (PC) where buyers and processors also pay a levy, albeit on a lower scale than producers.

180. Although extra levy from marketing and distribution companies and would be a useful addition to the HDC income pot, equally important would be the engagement and commitment of these downstream businesses to the applied R&D agenda. Unfortunately, it would almost certainly require an Order in Council, if not enabling legislation, to extend the R&D levy in this manner. And the complication of some of the distributors handling imported produce weakens the analogy with domestic cereal and potato production.

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[20] Many of whom are members of the AgriFood Charities Partnership - http://www.afcp.co.uk/index.html

[21] The £0.8 million that the East Malling Trust for Horticultural Research donates annually to EMR to some extent reflects the annual rent the Institute pays to the Trust.

181. The larger marketing and distribution companies and the supermarkets do commission R&D, usually confidential in nature, where there is a 'point of difference' issue that can confer commercial advantage. Details are consequently almost impossible to obtain and it is difficult to account for these contributions to the national horticultural R&D effort.

182. One attraction of exploiting new funding sources like the TSB and the RDAs is that they could open the way to engaging companies downstream in the fresh produce supply chain in the wider R&D agenda.

183. As another strategic option, it could be timely for the AHDB/AHRF to start a high-level dialogue with the big supermarkets, the British Retail Consortium and the IGD, possibly using Agri-Food IP proposal as a lever, to explore whether there are common issues. One common theme might be threats to the collective reputations of the supermarkets, such as healthy/unhealthy eating, food safety, waste management, carbon footprints and biodiversity. Is it possible that the big retailers might agree a common approach to these sorts of issues and help fund appropriate R&D?

vi. Increase the efficiency and effectiveness of R&D delivery

R&D centres

184. Since most of the centres and facilities for horticultural R&D now have different owners, it is difficult to see how any strategic rationalisation of centres or facilities could be realised. And recent history has taught us that creating larger organisations with multi-site management structures is not a solution. Consolidation may even reduce efficiency. However, the cost base of some R&D could be reduced by sharing facilities, as proposed earlier, through partnerships.

The HDC and the AHDB

185. The new levy company structure provides a golden opportunity to provide new strategic direction to the R&D activities work of the levy boards.

186. One consideration is whether increasing funding for generic R&D would produce better technical outputs and outcomes for levy payers. At present most of the R&D is specific to one crop or enterprise. The potential for a more strategic return on R&D investment could be realised if the levy bodies were to fund more generic R&D; i.e. R&D applicable across two or more levy bodies. Over the past 18 months the Applied Research Forum (ARF)[22] has been addressing this issue through the technical directors of the individual levy bodies. Cross-sector programmes across the AHDB could include crop rotations, soil management, integrated pest and disease management, water relations and implications of climate change.

187. Secondly, the levy bodies are significant funders of R&D at applied research centres, notably STC, Kirton, Sutton Bridge and EMR. Is there scope for a more co-ordinated approach to R&D commissioning to make better use of applied research centres and better co-ordination of any future capital investment by the levy bodies and others? Potato storage facilities is a topical issue; there could be others in future.

188. Thirdly, the creation of the AHDB provides an opportunity to re-consider how R&D is commissioned. The HDC's approach continues to attract some criticism from R&D providers. HDC projects are often perceived as too small and there is still a tendency to micro-management. This increases the administrative overhead, explicitly or implicitly.

[22] Now the AHRF.

189. The HDC and the AHDB/AHRF should consider options for a much more strategic approach to commissioning R&D and managing the projects. For example, why not commission much larger chunks of work – perhaps a single commission each year for each commodity sector. Then invite competitive bids from consortia of R&D providers for three year contracts to deliver agreed outcomes. These R&D programmes, or commissions, could be specified in considerable detail to meet particular needs of a sector – for instance, the inclusion of specific expertise, industrial engagement, foreign collaborators and so on. They could be managed by a lead contractor for each commission.

190. Sub-contracting out R&D programmes in this way would provide longer planning horizons for all the R&D providers in a successful consortium, enabling them to plan more effectively and to counter the present state of uncertainty and instability. And with less hands-on management of projects, it should give the HDC more resource to concentrate on KT and on evaluating outcomes, thereby feeding into future R&D commissioning.

191. Whether or not the opportunity of a more strategic approach to commissioning is adopted, there should be a scoping study of the costs and benefits of combining the back-office administration of R&D grants awarded by, at least, the three crop-oriented levy bodies, if not all six organisations.

192. The AHDB/AHRF should continue to explore opportunities for co-ordinating the R&D strategies of the individual levy bodies, for example by supporting generic research and co-ordinating the use of costly facilities. A more strategic approach to commissioning could bring efficiency savings to the HDC and give R&D providers increased stability and certainty. There might also be efficiency gains if back-office administration of research grants and contracts were merged under the AHDB.

vii. Review the HDC R&D strategy

193. The HDC has for some time been aware of the impacts of public R&D funding on its mission. Its latest risk map includes the following two major risks to achieving its aims:

- A decline in the research base limiting the availability of suitable UK research contractors.
- Insufficient matching public R&D funds to provide a foundation to sustain the HDC's applied R&D.

194. This study has confirmed that both are very real risks to the HDC. Current trends seem set to continue so, without some adjustment to the HDC's strategy, these risks will simply increase. In the current review of its R&D Strategy the HDC Board might consider the following, not mutually exclusive, options for the future.

- *Maintain the existing applied R&D portfolio with a strong sectoral orientation.*

  The HDC has already recognised that 'business as usual' would be an inadequate response when the environment in which the HDC operates has already changed so much. With the decline of the UK strategic horticultural R&D base this option would become progressively unsustainable.

- *Broaden the contractor base.*

  Within the UK, the HDC already has a policy of widening its contractor base to access the full range of expertise it needs, wherever it is located. It already commissions a small

volume of its R&D overseas, especially when this is part of an international science or a funding network and there is a 'gearing' dividend. The HDC has itself raised the question of increasing the use of overseas R&D contactors to mitigate an increasing R&D capacity deficit in the UK. There are no doubt willing contractors in EU members states like the Netherlands, Germany, France and Spain, as well as more distant horticultural R&D centres in the USA, Australia and New Zealand. However, the implications for the practicalities and effectiveness of KT from remote locations should be considered in any HDC decision to fund more of its R&D off-shore. Collaboration between UK and overseas providers may be the best way forward for the HDC.

- *Focus on preferred contractors or groups, to help sustain those parts of the R&D of greatest value to the HDC.*

This is being advocated by some R&D providers who are struggling to maintain long-term strategic capacity for applied R&D with short–term funding. With its finite levy income, the HDC would have to strike a difficult balance between maintaining the continuity of selected established research groups and supporting new groups with different ideas, skills and approaches.

- *Support more generic R&D jointly with HGCA and PC.*

This has already been flagged in para. 186 above. The primary consideration should be the value of the generic research outputs rather than the modest cost savings that might accrue in delivering them

- *Use levy income to lever further R&D resource from the BBSRC, the RDAs, and, possibly a TSB Agri-Food IP.*

There are several opportunities for using levy funds for leverage through joint-funding agreements with other funding bodies. The AHDB can now speak for primary producers with a single voice and bring considerable clout to any discussions. The idea of Agri-Food IP is still at an early stage and the TSB is just starting a feasibility study. There is an opportunity for the AHDB could exert a major influence on these discussions. The current designation of levy income as public funds may be an issue; some flexibility may be required.

- *Invest in practical training.*

The HDC could help promote a scheme for practical training, or 'internships' in agronomy and practical pathology for new entrants to horticultural R&D, as proposed by STC (para. 74) and designed to address recurring concerns about the lack of practical skills of new science graduates embarking on careers in R&D. This could be in addition, or as an alternative, to the HDC's current postgraduate training programme.

195. In reviewing its R&D Strategy and priorities for the next five years, the new HDC Board will need to respond to the new environment brought about by changes in Defra R&D funding, the consequential changes in the R&D provider base and the opportunities opened up by the establishment of the AHDB. In seeking an R&D strategy that reconciles its aim of providing maximum benefit to its levy payers with changing UK R&D capacity, the HDC might be guided by some or all of the suggestions above.

viii. Strengthen collective leadership

196. Since its inception in 2002 the NHF has done valuable work, both in providing a forum for stakeholders to discuss common issues and in commissioning specific studies like the review of the industry by Promar International. At the present time of uncertainty and change the Spedding concept of a strong voice for horticulture is as necessary as it was when proposed in 2002.

> *An independent National Horticultural Forum should be established to create and update an overview, or vision, of the horticultural industry, which would identify the major R&D needs, and the important contributions that the industry could make to all its stakeholders, and to society generally.*
>
> A Vision for Horticulture [Spedding Review] March 2002

197. It is therefore a good time to evaluate the first six years of the NHF in terms of mission, the impact of its outputs, membership and organisational structure. What has worked well? What has been less successful? What should be its future role and influence?

198. Such a review should take account of the roles of the National Farmers Union Horticulture and Potatoes Board, the HTA, the HDC, and now the AHDB/AHRF in providing collective leadership for horticulture and its R&D needs. The aim should be agreement on which of the big issues should be handled collectively with a single powerful voice, and which would be better handled by some or all of these bodies acting in concert.

199. More immediately, taking forward agreed action flowing from this study could be a useful test of effective collective leadership.

Finally

200. The environment in which horticultural R&D has traditionally operated has changed and will continue to evolve. The end of transitional funding to Warwick HRI and EMR is in sight; the Defra science agenda has moved away from supporting production horticulture, a shift that might be repeated by the Scottish Government; and the industry continues to consolidate and generally seeks to decrease inputs and cut costs.

201. A passive reaction to pressures currently being experienced by the R&D base would be a weak and disappointing response, though it is clearly the default. The encouraging thing is that several players and stakeholders are already pursuing some of these options. The optimism and forward-looking attitudes of some need to spread to all. The trick is to adapt to keep ahead of the game through imagination, flexibility and a record of good delivery.

August 2008

ANNEX 1

INDIVIDUALS INTERVIEWED DURING THE COURSE OF THE STUDY

Face-to-face

Dr Chris Atkinson	East Malling Research (EMR)
Martin Beckenham	HDC
Tim Biddlecombe	FAST Ltd
Dr David Bott	Technology Strategy Board
Neil Bragg	HDC
Dr Rex Brennan	Scottish Crop Research Institute (SCRI)
Tim Briercliffe	Horticultural Trades Association
Professor Simon Bright	Warwick HRI
David Cole	HORTLink Programme Manager
Dr Pat Croft	Stockbridge Technology Centre (STC)
Professor Ian Crute	Rothamsted Research
Julian Davies	Stockbridge Technology Centre (STC)
Professor Geoff Dixon	GreenGene International
Dr Julie Graham	Scottish Crop Research Institute (SCRI)
Professor Peter Gregory	Scottish Crop Research Institute (SCRI)
Dr Colin Gutteridge	East Malling Research
Professor Maggie Gill	RERAD, Scottish Government
Professor Paul Hadley	University of Reading
Colin Harvey	HDC
Richard Hirst	NFU Horticulture & Potatoes Board
Professor Graham Jellis	Home Grown Crops Authority
Cathryn Lambourne	Stockbridge Technology Centre (STC)
Dr Martin McPherson	Stockbridge Technology Centre (STC)
Ross Newham	HDC
Dr Bill Parker	ADAS UK Ltd
Graham Pitkin	Scottish Crop Research Institute (SCRI)
Dr Sue Popple	Defra
Dr Jonathan Snape	Mylnefield Research Services
Dr Bill Spoor	Scottish Agricultural College (SAC)
Dr Derek Stewart	Scottish Crop Research Institute (SCRI)
Graham Ward	Stockbridge Technology Centre (STC)
Dr Doug Yarrow	BBSRC

By telephone

John Adlam	Dove Associates
Jeremy Bolas	SEEDA
Professor Nigel Brown	BBSRC
Kerrin Buckler	Centre for Alternative Land Use (CALU), Bangor
Dr John Colvin	Natural Resources Institute (NRI), University of Greenwich
Professor Bill Davies	University of Lancaster
David Elphinstone	Myerscough College
Dr Ruth Finlay	HDC
Dr Susan Gallacher	RERAD, Scottish Government

Brian Harris	BBSRC
Clive Ireland	Writtle College
Dr Rob Jacobson	Independent consultant (Vegetable Consultants Association)
Simon Kerr	NIAB
James Lewis	Independent consultant (Vegetable Consultants Association)
Dr Andrew Marchant	Hennock Consulting
Dr Jim Monaghan	Harper Adams University College
David O'Connor	Allium & Brassica Centre
Dr Steve Roberts	Independent consultant (Plant Health)
Rob Simpson	BASIS Registration Ltd
Dr Nicola Spence	Central Science Laboratory (CSL)
Dr Mike Storey	Potato Council (PC)
Dr Mark Tatchell	Royal Horticultural Society (RHS)

June 2008

ANNEX 2

SKILLS & FACILITIES QUESTIONNAIRES

Completed questionnaires were received from:

HEIs and research centres

ADAS UK Ltd
Centre for Alternative Land Use (CALU), Bangor
Central Science Laboratory (CSL)
Cranfield University
East Malling Research (EMR)
The Eden Project
Harper Adams University College
National Institute for Agricultural Botany (NIAB)
Natural Resources Institute (NRI), University of Greenwich
Royal Horticultural Society (RHS)
Scottish Agricultural College (SAC)
Stockbridge Technology Centre (STC)
University of Plymouth
University of Reading
Warwick HRI

Consultants and industry

Meiosis Ltd

June 2008

ANNEX 3

OTHER RELEVANT STUDIES

Several recent and current studies provide context and have informed the present study.

A Review of Horticultural R & D. March 2002 [The Spedding Review] (commissioned by Defra)

Recommended the creation of an independent National Horticultural Forum to produce a vision for horticulture, which would guide and inform the industry, its stakeholders and Government. The industry's R& D needs should be an important issue for the Forum, but it should also keep broader issues in view, including the important contributions that the industry could make to all its stakeholders, and to society generally

Skills Audit of Horticultural R&D. Report to the National Horticultural Forum by Brian Jamieson & Associates. November 2003

This review identified specific skills shortages, assessed the impact of skills shortages on the links between R&D and practical horticulture, and made recommendations regarding training and education.

Economic Evaluation of the Horticultural Development Council. A Report to the Department for Environment, Food and Rural Affairs by the University of Reading. March 2004

This report provides a comprehensive assessment of the HDC's performance in R&D delivery and in communications and technology transfer. It includes an economic evaluation of the benefits of 14 selected R&D projects. The evaluation was informed by the results of a survey of levy payers.

Scientific Skills for Knowledge Transfer in Arable Agriculture in England. A Survey Report to The Board of the Rothamsted Research Association. Professor Mark Tatchell 2005.

A survey of the skills and age profile of 233 specialists delivering knowledge across eleven primary specialist areas to arable land managers in England. The survey suggests that there may be sufficient specialists overall, but analysis of the eleven specialist areas shows the considerable fragility in the system.

- The age profiles of individuals differed considerably between specialist areas. More than 50% in the categories of soil science/agri-environment, application/engineering and storage were aged 50 or more. Thirty three percent of storage specialists were aged 60 or more.
- There is an immediate shortage of specialists in spray application and crop storage.
- Capabilities to identify pests, diseases and weeds in the field have declined considerably. Plant clinics previously provided training in diagnostic skills, but the loss of plant clinics will make it difficult to train the next generation of specialists.

A lack of succession suggests that there is likely to be a shortage of independent knowledge transfer specialists in soil science/agri-environment, plant diseases, pests, weeds, crop nutrition and water utilization within a small number of years.

The newly emerging subject of habitat creation and farmland ecology is populated by young specialists with 38% aged 40 or less.

Some organisations have put in place succession plans for specialists within the constraints of what the industry will pay. The research institutes and universities are less well placed to deliver this succession due to the routes through which they receive their funding and the lack of encouragement given to young scientists to pursue knowledge transfer as a primary function.

Case Study Analysis and Overview of the UK Horticultural Production Industry and its Future over the Next 10-20 Years. Report by Promar International to the NHF. 2006

The report the pressures being experienced by the UK horticulture industry and outlined some of the key issues relating to labour, policy changes, technology, production methods and global trading affecting the future of the UK horticulture industry. Failure to address these challenges would erode the competitiveness of UK production horticulture and have an adverse impact on the UK economy. Producers must adopt a more proactive and innovative approach, with all stakeholders working together towards a more efficient and market-focussed horticultural sector.

The report emphasised that improvements in technology could play a central role in addressing major areas of concern within the horticultural sector.

R&D needs for the UK horticulture industry. Review by the National Horticultural Forum. 2006

The future needs of the production horticulture industry were identified by the NHF, as:

- A continuing programme of applied R&D mainly crop-specific, supported by industrial levy and managed by the HDC.
- Strategic R&D, generic in nature, which constitutes a substantial research agenda beyond the scope of levy funding, addressing:
    - Environmental impact and resource efficiency
    - New technology capability and infrastructure
    - Sustaining human health and well-being

The review concludes that secure and continuing public funding support to address these generic issues is required for a competitive, innovative and robust industry.

Review of provision for land-based studies. Final report to HEFCE by JM Consulting and SQW Ltd May 2007

The review identified at least 12,000 full-time equivalent students following land-based studies (LBS) programmes. Thirty institutions account for around 75% of provision, and further education colleges around 40%. There was no widespread evidence of a general threat to the sustainability of LBS provision, although some of the strategic provision is vulnerable.

Because of institutions classifying HE and FE courses to a higher level national code than might be appropriate, the review identified only 39 out of an estimated 400 students studying horticulture.

Skills Audit of Plant Pathology by Professor G A Dixon. November 2007 (commissioned by the British Society of Plant Pathologists (BSPP))

The Audit was commissioned by the BSPP Board in response to a perception by members that the nature of employment within the profession was changing and that employment opportunities were declining.

The Need for a New Vision for UK Agricultural Research and Development. The Commercial Farmers Group. June 2008.

The report argues that continuing decline in agricultural R&D is reducing the competitiveness of the UK agricultural industry[23] and putting food security at risk. A new vision is urgently required to develop innovative agricultural systems that are competitive, which reduce reliance on food imports but which also deliver the required environmental benefits.

The Commercial Farmers Group argue for new approaches to strengthen applied research and thus innovation in agriculture, including:

- Action by the higher education councils and the BBSRC to elevate the status of applied R&D in appropriate agricultural university departments and research institutes together with the provision of career opportunities and rewards comparable with other scientists.
- Provision of studentships for PhD training in applied agricultural research.
- A re-balancing of existing research budgets in universities and research institutes with an increasing proportion of the total directed towards applied research.
- Government and the agricultural industry seeking to develop additional agricultural research funding streams from both public and private sources.
- The Agriculture and Horticulture Development Board taking a leadership role on behalf of the industry in addressing the 'market failure' in agricultural R&D, with the objective of establishing a fully functional and integrated R&D chain.

Defra Strategic Knowledge Capability Assessment and BBSRC/HEFCE Study of Land-Based Facilities for Research questionnaires (In progress)

Information for these two, related studies is being captured on a questionnaire. Returned questionnaires are still being analysed by consultants, ADLittle. Discussions with ADLittle indicate that the level of aggregation by institutions responding to the questionnaire is frequently at too high a level to provide information that would be consistently of value to the present study. Hence the need to undertake a selected questionnaire exercise addressed to the horticultural R&D base.

June 2008

[23] In this paper 'agricultural industry' includes both agriculture and horticulture.

ANNEX 4

DEFRA FARMING AND FOOD SCIENCE PROGRAMME

Science is used to provide evidence for policy making, solving problems, and identifying future issues. The current programme has been running since April 2006 and is based around Defra's strategic priorities. This is a significant programme of work, totalling some £34M in 2007-08.

Defra's sustainable farming and food science is delivered within five broad scientific areas:

1. Agriculture and Climate Change
The work is divided into six sub-programmes:

- Emissions from agriculture to air
- Mitigating nitrogen and carbon emissions to air
- Climate change impacts and adaptations
- Energy in agriculture and food
- Bioenergy
- Renewable materials

2. Sustainable Water Management
The work is divided into two sub-programmes:

- Water Quality: minimising the adverse impacts of UK agriculture on water quality
- Water Use: optimising water use by UK agriculture and food production industries

3. Resource Efficient and Resilient Food Chain
The work is divided into three sub-programmes:

- Efficient manufacturing and distribution
- Waste reduction in the food chain
- Quality foods for healthy eating

4. Sustainable Farming Systems and Biodiversity
The work is divided into two sub-programmes:

- Integrated farming systems
- Organic farming

5. Plant Health
Largely intra-mural. Plant Health Division, based at York manages the science programme for Plant Health and Bee Health, which mainly involves the provision of diagnostic and science consultancy services from Defra's agency, the Central Science Laboratory.

June 2008

ANNEX 5

COMMENTS ON RECRUITMENT AND RETENTION

- *We have a general issue with staff succession. This is partly related to the uncertainties of the business climate which means it is difficult for us to 'carry' people in training positions, but also finding suitable people with the right level of skills and experience is extremely difficult, whether these be agronomists or scientific specialists.*

- *Most in 31-50 range are at the top end of this range.*

- *ADAS has crop improvement, genetics & genomics expertise and lots of soil science and plant nutrition expertise, but not currently deployed in horticulture.*

(ADAS UK Ltd)

- *Lack of recruits with practical experience of horticultural industry.*

- *CSL has relied on ADAS pipeline in the past. We now have to provide our own training incl. BASIS.*

(CSL)

- *No problems. However, out of 19 members in the group only 5 are from the UK.*

(Cranfield University)

- *No problems (so far) with retention. Recruitment since 2004 has been low but satisfactory.*

(EMR)

- *None experienced at this time - we are building the area with a new Post-Doc appointment his year and a PhD studentship. Both these posts are in the area of crop physiology in leafy salads.*

(Harper Adams University College)

- *At present staff skills meet requirements. Mike Day is nearing retirement and we are training a replacement but the high degree of experience and knowledge with Mike will be difficult to replace and may mean a reduction in our ability to service customer requirements.*

- *Recruitment and retention at a lower grade is an issue in attracting people with the relevant training and skills.*

(NIAB)

- *We have recently invested in two PhD students, both of whom have topics based on problems raised by UK horticultural growers - these are funded by NRI and represent a strategic decision to try to develop/grow links and expertise in UK horticulture, as well as to bring in younger R&D people into the organisation.*

(NRI)

- *Difficult to recruit in all disciplines with suitable skills. In-house training and development. Also use some freelance staff at peak seasons.*

(RHS)

- *We find it hard to find and recruit good young staff with an interest in horticultural research.*
- *Shortage of technical support in some areas eg. entomology. Also, long-standing lack of agronomic expertise.*
- *Direct replacement of retiring staff not usually implemented.*

(SCRI)

- *Yes, significant difficulty recruiting and retaining suitable personnel with appropriate skills sets in all applied disciplines.*
- *Before ADAS was privatised new entrants went through a three year training period but cost of this now prohibitive and we require project leaders who can 'hit the street running'. Unfortunately, people with applied knowledge of specific disciplines (e.g. Entomology/Plant Pathology) across the breadth of horticulture are lacking.*
- *There is an urgent need for new training opportunities and would like to see recommendation that HDC (or other funding bodies) explore opportunities for applied organisations like STC & ADAS to train new personnel in applied subjects for the future needs of the industry.*
- *Essential that we differentiate between those who are driven by delivery of scientific papers (e.g. University groups, government laboratories etc as growers unlikely to benefit from these in the short-term as they don't have ready access to this type of information), and applied scientists whose role it is to keep abreast of scientific developments in their respective disciplines on behalf of industry, interpret the science and apply it through innovative but practical 'commercial' work to improve the short- and long-term profitability of UK horticulture.*
- *Recruiting good quality technical support continues to be a problem due to the general lack of knowledge of the scientific disciplines and/or basic crop agronomy. A protracted or lengthy induction/training period is usually necessary to get individuals 'up to speed'.*

(STC)

- *There is not likely to be any recruitment in the Plant Science Area in the short - medium term.*

(University of Reading)

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ANNEX 6

SURVEY OF FACILITIES CURRENTLY USED FOR HORTICULTURAL R&D

Attached are returns from the following institutions:

ADAS UK Ltd
Centre for Alternative Land Use (CALU), Bangor
Central Science Laboratory (CSL)
Cranfield University
East Malling Research (EMR)
The Eden Project
Harper Adams University College
National Institute for Agricultural Botany (NIAB)
Natural Resources Institute (NRI), University of Greenwich
Royal Horticultural Society (RHS)
Scottish Agricultural College (SAC)
Scottish Crop Research Institute (SCRI)
Stockbridge Technology Centre (STC)
University of Plymouth
University of Reading
Warwick HRI

June 2008

Organisation	**ADAS UK Ltd**
Laboratories	Approx. areas:
	*All ADAS sites where at least some horticultural work is done (**Rosemaund, Boxworth, High Mowthorpe**) have access to basic laboratory facilities; these are not dedicated to horticulture, but are part of the general ADAS facility. We have a dedicated and appropriately equipped horticultural plant pathology lab now located at ADAS **Boxworth** (approx. 11 m x 9 m). Specialist soil pest extraction laboratory at ADAS **High Mowthorpe** (cyst nematodes, free-living nematodes; also does strawberry Verticillium wilt tests). Additional facilities at Boxworth: seven controlled-temperature rooms; Insect rearing facilities and expertise in rearing both pest and beneficial species.; Precision spray application equipment including Potter Tower and Mardrive pot sprayer; equipment for extraction of invertebrate pests from soil, compost and plant material, facilities and expertise for working with pests, biological control agents, non-target organisms and IPM.*
	Approx. age:
	*Main horticultural pathology lab (now at ADAS **Boxworth**) is approximately 10 years old.*
	Any specialised features:
	Hortic Pathology lab contains 5 incubators (3 purchased in 2008), 2 Sanyo Fitotron controlled environment cabinets (>5 years old), 3 laminar flow cabinets, autoclave for media preparation etc.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	***Boxworth**: Five research glasshouses (each 25m2), with computer-controlled heating, irrigation, ventilation, shade screen, blackout facilities; insect screening. One research glasshouse (60 m2) with computer-controlled heating, irrigation, ventilation, shade screen; rolling benches.* ***Arthur Rickwood**: Two research glasshouses (143 and 72 m2) with heated floor, computer controlled heating and ventilation; shade screens; liquid feed facility (no horticulture staff at this site now so of limited use)*
	Heated & ventilated glass. Number and/or area:
	There are other small glasshouses at other ADAS sites, but not generally used for horticultural work.
	Unheated glass or cubicles. Number and/or area.
	1 x 1000sq m polycarbonate house (currently without a roof cladding and hence used as a standing out area for wind protection only).
Poly tunnels	Number and/or area:
	***Boxworth:** 4 x 140 sq m polytunnels with overhead & mist irrigation and electricity supply (currently under construction, May 2008). 1 x 70 sq m poly tunnel and 1 shade tunnel with irrigation and misting* ***Rosemaund:** 1 x 60 sq m polytunnel with drained sandbeds.* *Two other tunnels at **Arthur Rickwood** with overhead irrigation & mypex floor still in use. Also large drained mypex/gravel hard-standing areas at **Boxworth** (currently under construction) and Arthur Rickwood.*
Field trial capacity	Area & crops:
	Unlimited. We have the capacity to do field trials on grower's holdings in most locations in England & Wales, and because of the specialist nature of many of the horticultural
Storage trial facilities	Capacity & crops:
	We have a shelf-life study room at ADAS Boxworth.
Other specialised facilities	Techniques and crops:
	***Boxworth**: GC-MS; HPLC (with multiwave and refractive index detectors), distillation & extraction equipment. These have been used for horticultural work in the past, but not currently. Farm/Pesticide stores (including Sentinel unit for waste pesticide disposal).* *We hold a Defra Plant Health licence that enables us to work with certain specified non-indigenous plant pathogens.*

Other relevant facilities: e.g germplasm of other collections and/or data sets	*Not strictly horticultural, but we do have the national collection of Miscanthus germplasm at **Arthur Rickwood**.*
Quality Assurance	If so, which accreditation?
	ORETO certification for horticultural work; ADAS also has ISO 9001 accreditation.
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	*We actually have a chronic shortage of glass and polytunnel capacity at **Boxworth.** Although we hope to utilise facilities at STC (and we are actively working with STC to develop proposals that would utilise their facilities), we do also need more of our own local glasshosue capacity to cope with our workload. This may include renting under-utilised commercial glass locally if it proves to be suitable for our general needs. This highlights the fact that staff (e.g. ADAS) and facilities (e.g. STC) are not anything like geographically matched!*
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	As indicated above, we are short of glasshouse capacity, particularly compartmentalised glass with control of temperature etc in individual compartments. We have looked at the cost of building new glass, but the investment required (>£250,000) could only be justified if work to fill the facility were guaranteed over at least a 5 year period. Under the current business climate, this is impossible to guarantee.
Any further comments?	*The above probably understates ADAS's overall capability as obviously we do a lot of arable research work as well which utilises more facilities - but also the same facilities to some extent.*

Organisation	**Centre for Alternative Land Use (CALU), Bangor**
Laboratories	Approx. areas:
	Chemical lab = 112sq metres; Chemberlain lab = 200sq metres.
	Approx. age:
	Chemical lab = built 1997; Chamberlain lab refurbished in 2005.
	Any specialised features:
	Equipment for proximate analyses (protein, fat, fibre, digestibility); clean area with laminar flow.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	2 x full environmental control 112sq metres and 280sq metres.
	Heated & ventilated glass. Number and/or area:
	14.5sq metres - heated, no lights; 178sq metres (lights, vented, limited heating).
	Unheated glass or cubicles. Number and/or area.
	Caged area, rabbit proofed - 75sq metres.
Poly tunnels	Number and/or area:
	4 @ 20m x 5.5m (plastic); 1 @ 7.6m x 6m shaded (1/2 width 75% shade, 1/2 50% shade).
Field trial capacity	Area & crops:
	Sustainable area for horticultural trials - 4 hectares. This year - potatoes 0.4ha, berries 0.1ha; veg 0.2ha; miscanthus 0.1ha; cereals 2.3ha.
Storage trial facilities	Capacity & crops:
	Cereals - 20 - 30t; potatoes - 20t; cold room 9sq metres.
Other specialised facilities	Techniques and crops:
	Demonstration bed of fruit bushes; two meeting rooms, one with fully automated AV suite.
Other relevant facilities: e.g germplasm of other collections and/or data sets	*Weather data since 1980; global barley seed collection; proximate analysis; drying, milling, ashing.*
Quality Assurance	If so, which accreditation?
	FAWL.
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	Underused glasshouse / lab facilities due to low demand / low grant capture.
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	Growth cabinets for microprop, incubation facility, GM certified glasshouse, precision drill
Any further comments?	*Rationalisation of glasshouse facilities needed at a College wide level - this has now started to happen.*

Organisation	**Central Science Laboratory (CSL)**
Laboratories	Approx. areas:
	Total = *43 labs with a total area of approx. 1,480 m^2.* ***Approx. 20% of this used in horticultural R&D.***
	Approx. age:
	12 years.
	Any specialised features:
	Licensed for quarantine organisms CL2.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	Total = *54 cubicles x 15m^2.* ***Approx. 20% of this used in horticultural R&D.***
	Heated & ventilated glass. Number and/or area:
	54 cubicles x 15m^2.
	Unheated glass or cubicles. Number and/or area.
	None.
Poly tunnels	Number and/or area:
	Two.
Field trial capacity	Area & crops:
	3.700m^2 cereals/potatoes/oil seed rape + alternative crops.
Storage trial facilities	Capacity & crops:
	None.
Other specialised facilities	Techniques and crops:
	Controlled environmental rooms with various crops.
Other relevant facilities: e.g germplasm of other collections and/or data sets	*Apiary for honey bee health work.*
Quality Assurance	If so, which accreditation?
	ISO9001 / ISO14001 / UKAS 17025 for diagnostic methods. *ISTA (applied for).* *GLP for honey bee R&D.*
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	a) Nno - full utilization of facilities *b) Quarantine glass demand exceeds capacity.*
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	May need replacement of quarantine glass.
Any further comments?	*Lack of commercial scale glass so rely on other partners eg W-HRI, EMR, STC.*

Organisation	**Cranfield University**
Laboratories	Approx. areas:
	Post-harvest laboratory space = 255m2 + new glasshouse space = 230m^2.
	Approx. age:
	0 years (brand new in June 2008) as part of a £38 millions investment by Cranfield University. New glasshouse opened in December 2007.
	Any specialised features:
	Only UK-university based group that is solely focussed on fresh produce post-harvest technology. The lab is brand new and will open in June 2008. We have had a post-harvest group here in Silsoe since 1974. Silsoe campus is closing. New lab will be in purpose built building on Cranfield campus.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	None.
	Heated & ventilated glass. Number and/or area:
	230m^2
	Unheated glass or cubicles. Number and/or area.
Poly tunnels	Number and/or area:
Field trial capacity	Area & crops:
	150 acres available
Storage trial facilities	Capacity & crops:
	6 brand new controlled temperature rooms (0-30C+/-1C) + 4 brand new VT rooms. Full list on link: http://www.cranfield.ac.uk/health/researchareas/foodquality/page5651.jsp
Other specialised facilities	Techniques and crops:
	HPLC X 3 (new agilent 1200s) with PDA, FD, ELSD, RID. LC MS/MS, (Waters). 2 x GC (brand new agilent), freeze driers. *Full list of facilities, projects and clients on the following links:* *http://www.cranfield.ac.uk/health/researchareas/foodquality/page5592.jsp* *http://www.cranfield.ac.uk/health/researchareas/foodquality/page5651.jsp* *http://www.cranfield.ac.uk/health/researchareas/foodquality/page6719.jsp* *http://www.cranfield.ac.uk/health/researchareas/foodquality/plantscience.jsp*
Other relevant facilities: e.g germplasm of other collections and/or data sets	*See above links*
Quality Assurance	If so, which accreditation?
	Working toward Defra Code of Practice. Iso14001.
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	No. The group is still growing rapidly and so have plans to expand further.
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	None as all brand new.
Any further comments?	*Concerns are that Defra will try to terminate HortLink programme.*

Organisation	**East Malling Research (EMR)**
Laboratories	Approx. areas:
	20,000 sq ft of laboratory space - two main buildings and a number of out-buildings
	Approx. age:
	The main laboratory building was constructed in 1954 and has had a number of modest refurbishments over the years ; our newest building is the post-harvest research facility which was opened in 1991
	Any specialised features:
	The post-harvest facility which was designed for storage trials
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	Approximately 9,000 sq ft of modern(ish) glasshouse space
	Heated & ventilated glass. Number and/or area:
	Approximately 5,000 sq ft of heated small glasshouses
	Unheated glass or cubicles. Number and/or area.
Poly tunnels	Number and/or area:
	10 polytunnels on a nursery area of varying sizes; polytunnels used in the field as appropriate
Field trial capacity	Area & crops:
	150 hectares available for fieldwork; established tree fruit orchards; experienced at growing all tree fruit and soft fruit crops and farm woodland species; beds for hardy nursery stock production
Storage trial facilities	Capacity & crops:
	Storage facility allows trials on stored tree fruit up to 5 tonne scale ;facility is generally under-capacity and has been used for some small scale vegetable trialling; total capacity is probably 20-30 tonnes but facility is really set up for small scale trials
Other specialised facilities	Techniques and crops:
	1. Water centre for studying water utilisation by hardy nursery stock crops *2. GroDome specialist facility for studies requiring (a) containment and (b) environmental control*
Other relevant facilities: e.g germplasm of other collections and/or data sets	*Several germplasm collections supporting breeding programmes in strawberries, raspberries, rootstocks, stone fruit, apples and pears*
Quality Assurance	If so, which accreditation?
	Assured Produce for the farm plus accreditations for fieldwork such as efficacy testing; internal quality system (EMQA) used for all project management
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	Most facilities at EMR are underutilised as the research programme at the Institute has been in long term decline; specifically we only have about 50 hectares of active fieldwork so there is over capacity of land; there is a practically unused nursery area and a number of older glasshouses have been mothballed; the post-harvest facility typically works at 25% of capacity; conversely there is a shortage of top quality glasshouse space and this can be over-capacity at key times

Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	1. We would like to build new laboratories and offices for EMR - this would put our research facilities on a modern footing and also have a significant impact on our overheads at the East Malling site - this project is being discussed with the East Malling Trust who own the site - it is far from clear how it could be financed *2. the post-harvest storage facility will have to be updated as storage technology is improved* *3. new research glasshouses will have to be built at some point*
Any further comments?	*The site has a modern Conference Centre which is a considerable resource both for generating finance and also for allowing meetings and technology transfer activities to take place in professional surroundings*

Organisation	**The Eden Project**
Laboratories	Approx. areas:
	50m^2 of laboratory space.
	Approx. age:
	8 years old.
	Any specialised features:
	Germplasm storage. *Basic plant pathology & microbiology..*
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	2 x 250m^2 isolation houses (One is Defra licensed PHSI).
	Heated & ventilated glass. Number and/or area:
	550m^2.
	Unheated glass or cubicles. Number and/or area.
	500m^2
Poly tunnels	Number and/or area:
	100m^2
Field trial capacity	Area & crops:
	400m^2,, for vegetable pathology trials, novel food crops & ornamental horticultural crops and conservation.
Storage trial facilities	Capacity & crops:
Other specialised facilities	Techniques and crops:
Other relevant facilities: e.g germplasm of other collections and/or data sets	*Biomes attract visiting researchers. Very strong capacity for knowledge/technology transfer and for showcasing scientific/horticultural research and development.*
Quality Assurance	If so, which accreditation?
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	Considering relocation of nursery and science facilities to main site.
Any further comments?	

Organisation	**Harper Adams University College**
Laboratories	Approx. areas:
	10 teaching labs for ~30 students each - 3 research labs.
	Approx. age:
	10 years.
	Any specialised features:
	Cat 2 lab.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	2 bays (25 msq each) with air conditioning.
	Heated & ventilated glass. Number and/or area:
	4 bays (25 msq each)
	Unheated glass or cubicles. Number and/or area.
Poly tunnels	Number and/or area:
	2 x 30 msq
Field trial capacity	Area & crops:
	Approx 30 hectares of land available for crop trial work (to fit in with extensive commercial and research arable trials).
Storage trial facilities	Capacity & crops:
	Limited controlled temperature storage. Fridge based, not cold rooms.
Other specialised facilities	Techniques and crops:
	Array of 8 convirons for physiology trials.
Other relevant facilities: e.g germplasm of other collections and/or data sets	
Quality Assurance	If so, which accreditation?
	PSD accredited.
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	Heavy demand on facilities for field trials.
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	Cold store for post harvest shelf life trials.
Any further comments?	*We are well set up for field trials of vegetable crops. Local farms are very helpful in letting us use their kit for planting etc. We are a small horticulture (fresh produce) focussed group working within the crops department at HAUC. There is a lot of transferable skills amongst colleagues that are drawn on.*

Organisation	**National Institute for Agricultural Botany (NIAB)**
Laboratories	Approx. areas:
	2000sq m
	Approx. age:
	The main laboratories are housed in a '60 building but have been refurbished over the years the latest being completed in 2008.
	Any specialised features:
	NIAB has laboratories carrying out a range of activities: seed testing, produce quality, plant breeding, biotech research.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	250 sq m of spore proof glass and growth rooms.
	Heated & ventilated glass. Number and/or area:
	2,500 sq m. Some with black outs and night break lighting.
	Unheated glass or cubicles. Number and/or area.
	2 houses totalling 500 sq m.
Poly tunnels	Number and/or area:
	As required.
Field trial capacity	Area & crops:
	250 ha of owned land, capacity to conduct field trial on commercial sites across East Anglia and East Midlands. Regional centres at eight sites in England at which field trials can be run with a range of crops.
Storage trial facilities	Capacity & crops:
	Onions - controlled temperature store for up to 15 tonnes. Potato chitting stores and cold rooms (about 100 sq m).
Other specialised facilities	Techniques and crops:
	Laboratory and glasshouse facilities are used for a range of crops including cereals and ornamental crops. These could be used for horticultural crops if the need arose.
Other relevant facilities: e.g germplasm of other collections and/or data sets	
Quality Assurance	If so, which accreditation?
	ISO 9001:2000 registered to GEP trials.
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	All facilities fully utilised at present.
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	As part of a major sire development new glasshouses will be built on our Cambridge farm at the other side of the site near to Histon. This will largely replace existing facilities with no expansion planned.
Any further comments?	*Existing facilities are used for horticultural research as required. This work has reduced in recent years although we maintain a relatively large programme in variety evaluation of onions and additional work for individual clients on lettuce, carrots, sweet corn and miscellaneous crops. NIAB is a major provider of services to Defra and the European Community Plant Variety Rights Office (CPVO) in Dinstinctness Uniformity & Stability tests for Plant Breeders' Rights. We have programmes with chrysanthemums, roses, dahlias and a range of hardy nursery stock as demand dictates.*

Organisation	**Natural Resources Institute (NRI), University of Greenwich**
Laboratories	Approx. areas:
	Two molecular labs, approx area = 200m^2. Three bioassay labs. used for pesticide and entomo-pathogen work, approx area of 200m^2. Plant physiology lab, approx area of 100m^2. General practical labs, approx area of 200m^2. Plant and insect chemistry labs, approximate area of 200m^2.
	Approx. age:
	The age of all these facilities dates from our move to Chatham and so they are all approx 18 years old.
	Any specialised features:
	Our facilities were designed to handle plant pathogens and pests from the tropics and so they may differ from other UK labs in this respect.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	We have two glasshouses, both environmentally controlled to a limited degree. One is classed as quarantine, which enables us to import plants with suspected pathogens. The other is non-quarantine. Both have an approx area of floor space of 750m^2 and misting facilities
	Heated & ventilated glass. Number and/or area:
	See above.
	Unheated glass or cubicles. Number and/or area.
	Small glasshouse of 15m^2.
Poly tunnels	Number and/or area:
	One poly tunnel, approx area of 750m^2.
Field trial capacity	Area & crops:
	We carry out our field trials on growers properties and so do not have this capacity.
Storage trial facilities	Capacity & crops:
	Small scale storage trials (-5C to +35C) are conducted in incubators (10 single upright). At temperatures of 15C and above trials are also be conducted in controlled environment rooms (see other specialised facilities). Small scale controlled atmosphere trials use flow-through systems and chambers up to 20 L capacity. Larger scale facilities for standard and CA storage are occasionally rented from East Malling Research. A wide range of fruit and vegetables of tropical and temperate origin have been studied.
Other specialised facilities	Techniques and crops:
	We have a suit of 16 controlled environment rooms in a large insectary. Most of these rooms are normal light intensity rooms, where insects can be reared under designated conditions. Three of these rooms are equipped with high intensity lighting (20,000 lux) to enable plants to be grown in them. The area of this insectary is approx 600m^2. We also have a wind-tunnel room for testing the response of insects to odours - approx area 200m^2.
Other relevant facilities: e.g germplasm of other collections and/or data sets	*We have collections of plant pathogen isolates from the tropics, as well as populations of the associated vectors.*
Quality Assurance	If so, which accreditation?
	We operate using a Quality Management System - ISO9001.
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	Due to the volume of our overseas work dropping off, our current facilities are probably slightly underutilised. This is one of the reasons we are interested in expanding our UK-based horticultural work.

Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	We are continuously updating/improving our facilities, although some aspects of it are showing signs of aging. The major facilities that may need replacing in the next decade is the plant that maintains the controlled environmental conditions in the insectary.
Any further comments?	*Our labs/set-up has been used for plant tissue culture in the past. The facilities necessary for this could be put back into use, if new work in this area arises.*

Organisation	**Royal Horticultural Society (RHS)**
Laboratories	Approx. areas:
	350M²
	Approx. age:
	Last refurbishment approximately 5 years ago.
	Any *specialised* features:
	Herbarium.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	None.
	Heated & ventilated glass. Number and/or area:
	None.
	Unheated glass or cubicles. Number and/or area.
	1 x 33M²
Poly tunnels	Number and/or area:
	1 x 60M²
Field trial capacity	Area & crops:
	HNS and Ornamentals area at Deers Farm = 9,690 M². *Also have RHS variety trials facility = 1.78 ha - though these are not true randomised trial areas.*
Storage trial facilities	Capacity & crops:
	None.
Other specialised facilities	Techniques and crops:
	None.
Other relevant facilities: e.g germplasm of other collections and/or data sets	*Herbarium of cultivated plants includes >80,000 specimens and >50,000 photographic transparencies, prints and paintings.*
Quality Assurance	If so, which accreditation?
	None.
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	a. All fully utilised. *b. Pathology diagnostics oversubscribed.*
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	Research glasshouses in planning (short term) 1-3 years). *Laboratory replacement in larger term site plan (3-10 years)*
Any further comments?	*All facilities are currently delivered through RHS core funding.*

Organisation	**Scottish Agricultural College (SAC)**
Laboratories	Approx. areas:
	Full range of laboratories to carry out research from molecular investigations to whole plant physiological studies- includes extensive facilities for host pathogen investigations.
	Approx. age:
	Varies between 20 -50 years old but all facilities have been upgraded in the last 10years
	Any specialised features:
	The increasing use of molecular techniques has necessitated a major investment in appropriate facilities.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	One major glasshouse facility at KB, Edinburgh plus additional resources at Craibstone, Aberdeen.
	Heated & ventilated glass. Number and/or area:
	7 Compartments . Total area 205m^2
	Unheated glass or cubicles. Number and/or area.
	None
Poly tunnels	Number and/or area:
	2 - 6x20m^2
Field trial capacity	Area & crops:
	Have access to substantial range of field trail sites using own land resources but this is greatly expanded using extensive contacts within the farming community. Note: for major field crop, SAC uses 3 other, commercial farm sites as part of the comprehensive trialling facilities used by current researchers
Storage trial facilities	Capacity & crops:
	SAC farms are run as part of the R&D Division, they come equipped for normal crop storage facilities and in addition there are some specialised potato store facilities constructed in the last 20 years.
Other specialised facilities	Techniques and crops:
	None.
Other relevant facilities: e.g germplasm of other collections and/or data sets	*Germplasm related to cereal studies, but we collaborate with SASA over some specialist crops such as Shetland cabbage.*
Quality Assurance	If so, which accreditation?
	ISO 9001
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	b. Controlled environment growth rooms.
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	Nothing specific in order to maintain capability to undertake Horticultural Research over and above the need to maintain general facilities upgraded to keep abreast of research methodologies.
Any further comments?	

Organisation	**Scottish Crop Research Institute (SCRI)**
Laboratories	Approx. areas:
	Laboratory facilities occupy approx 8,366 sq m and located in about 15 buildings.
	Approx. age:
	Buildings range from 20 to 40 years old but there is a rolling programme of refurbishment to modernise laboratories.
	Any specialised features:
	The increasing use of molecular techniques has necessitated a major investment in appropriate facilities.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	AN Containment: 990m^2 Venlo over 24 cubicles (large, medium & small); *AO: 1,600m^2 Venlo over 37 cubicles (large, medium & small);* *AG: 800m^2 Cambridge over 18 cubicles (large & medium);* *AH: air-conditioned 110m^2 Cambridge over 6 medium cubicles.*
	Heated & ventilated glass. Number and/or area:
	AA-AD: Four large Cambridge houses, each of 325m^2; *AG west: 300m^2 Cambridge over 5 cubicles;* *I: 260m^2 Hartley house;* *H: 770m^2 Cambridge over 6 cubicles (large & medium);* *N: 1,350m^2 Cambridge over 20 cubicles (large, medium & small);* *O: 220m^2 Cambridge over 12 large cubicles.*
	Unheated glass or cubicles. Number and/or area.
	W: 480m^2 - 3 bays.
Poly tunnels	Number and/or area:
	1,938m^2 net & 13,501m^2 poly.
Field trial capacity	Area & crops:
	Farms: *Mylnefield/Bullionfield - 85 ha;* *East Pilmore Holding/Lonsdale - 14 ha;* *Gourdie - 62 ha;* *Balruddery - 116 ha.* *Soft fruit - blackcurrants, raspberries, hybrid berries, blueberries; Potatoes; Cereals - spring/winter barley & wheat.*
Storage trial facilities	Capacity & crops:
	Potato - 2 stores, cold & ambient - each 50-tonne capacity; Cereals - 2 ambient stores.
Other specialised facilities	Techniques and crops:
	Controlled environment rooms - 21; *CE cabinets - 39;* *Tissue culture cabinets - 7;* *Cold stores – 19.*
Other relevant facilities: e.g germplasm of other collections and/or data sets	*Potato - Commonwealth Potato Collection;* *Soft Fruit - Nuclear stock collection of Rubus, including commercial varieties in current use in UK. Collection of Ribes cultivars, mainly from SCRI breeding programme.*
Quality Assurance	If so, which accreditation?
	ISO 14001:2004 - Environmental Management System Certification; *ISO 9001:2000 - Quality Management System Certification;* *OHSAS 18001:1999 - Occupational Health & Safety management System Certification.*

Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	Replacement of three glasshouse complexes currently heated by steam from a central boiler. Plans have been produced & submitted for replacement of two complexes. Awaiting funding.
Any further comments?	

Organisation	**Stockbridge Technology Centre (STC)**
Laboratories	Approx. areas:
	Plant Pathology Laboratory: 100 sq m + clean/containment room facilities for handling quarantine organisms. *Entomology Laboratory: 60 sq m + controlled environment room for insect culturing.* *Agronomy Laboratory : 75 sq m.*
	Approx. age:
	Approx. age: 10-15 years.
	Any specialised features:
	High level security with card only entry, video surveillance and out-of-hours security.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	Multi-factorial unit 4 blocks each containing 4 compartments ca 200sqm each (16 units in total). Some are now benched out + lighting for ornamental or similar trials work. *4 x 1000sq m modern tall glasshouses (4.2m to the gutter) suitable for most soil or hydroponic crops. Full computer control with lighting & vent/thermal screens.* *2 x 200sq m modern tall units suitable for most soil or hydroponic crops. Full environmental control with Priva Integro computer.* *3 x small 25sqm modern bio-control glasshouses.*
	Heated & ventilated glass. Number and/or area:
	10 x Fairfield glasshouses (ca. 150sqm each.). Computer controlled and heated but aged glass in need of modernisation/replacement. *2 x 1000sq m aged glasshouses with full environmental control suitable for a variety of crops e.g. protected lettuce. In reasonable order but will need to replaced in next 5 years.* *1 x 350sq m glasshouse. Sloped concrete floor suitable for NFT or similar production. Old glass with environmental controls but in need of replacement.* *4 x propagation glasshouses each 220sqm with concrete floors. Full environmental control but old glass in need of replacement in next 5 years.* *2 x 200sq m vegetable propagation glasshouses (benched). Full computer control & heated.*
	Unheated glass or cubicles. Number and/or area.
	1 x 1000sq m polycarbonate house (currently without a roof cladding and hence used as a standing out area for wind protection only).
Poly tunnels	Number and/or area:
	5 x large (3-4 year old) Haygrove tunnels each one covering an area of ca. 1000sqm. *6 x 300sqm polytunnels.*
Field trial capacity	Area & crops:
	65 ha (160 acres) Grade 1 Vale of York land suitable for most arable and horticultural crops. Excellent road access and full irrigation facilities.
Storage trial facilities	Capacity & crops:
	Cold store facility (lorry body).
Other specialised facilities	Techniques and crops:
	10 acres organic certified land. *Shelf life room.* *Farm/Pesticide stores (including Sentinel unit for waste pesticide disposal).*
Other relevant facilities: e.g germplasm of other collections and/or data sets	*Meeting room./conference facilities.*

Quality Assurance	If so, which accreditation?
	GLP compliance for field phase residue studies with crop protection products. *Official Recognition compliance for crop safety & efficacy studies with crop protection products.* *LEAF Innovation Centre & Member of the Countryside Stewardship Scheme.*
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	Glasshouse unit underutilised at certain times of the year. However, increasing commercial demand (not R&D) likely to require further investment in glasshouse capacity during the next 5 years. Farmed land not used to anywhere near full capacity for field trials though is used for commercial production of cereals, potatoes, beans/peas etc. The organic area is under-utilised.
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	We will need to replace some of the aging glasshouses to maintain the current capability. In terms of priorities the 10x Fairfield units are a high priority though some of the other older glasshouses will also need replacing over time. The heating boiler is expensive to maintain and run and we are currently investigating alternative heating sources/technologies at the current time. Further investment in glasshouse facilities will be required to enable us to cater for the wider demands of the different cropping sectors e.g. deep water hydroponics.
Any further comments?	*It is important to differentiate between applied facilities that industry recognise as comparable to their own and university/institute facilities that, whilst important scientifically, are less likely to be credible from a commercial 'grower' perspective. Such applied facilities are therefore very important as they assess university, institute and other scientific groups in cost-effectively validating and implementing technology as a 'stepping stone' to full commercial practice. As an applied R&D organisation we therefore actively encourage partnership with science organisations to deliver collaborative projects for the ultimate benefit of the UK horticultural industry. as well which utilises more facilities - but also the same facilities to some extent.*

Organisation	**University of Plymouth**
Laboratories	Approx. areas:
	150m^2 of laboratory space.
	Approx. age:
	25 years.
	Any specialised features:
	Full range of plant physiological measuring equipment.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	Heated & ventilated glass. Number and/or area:
	12, totalling 150m^2.
	Unheated glass or cubicles. Number and/or area.
Poly tunnels	Number and/or area:
	2, totalling 120m^2.
Field trial capacity	Area & crops:
Storage trial facilities	Capacity & crops:
Other specialised facilities	Techniques and crops:
Other relevant facilities: e.g germplasm of other collections and/or data sets	
Quality Assurance	If so, which accreditation?
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	50%
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	1 New glass *2. Refurbished labs.*
Any further comments?	*Most of our labs and glass are used for multiple purposes; e.g undergraduate student projects.*

Organisation	**University of Reading**
Laboratories	Approx. areas: 1. *Crops lab 96m^2* 2. *Field lab 24m^2* 3. *Field Lab (Field Unit) 12m^2* 4. *Molecular Biology Lab. 32m^2* 5. *Tissue Culture Lab + Culture Room 21m^2* 6. *Teaching Labs 143m2 + 63m^2*
	Approx. age: *1 – 3: 35 years* *4: 2 years* *5: 10 years*
	Any specialised features: *1 -3: Whole Plant Physiology, Growth Analysis* *4: Molecular Biology, Molecular Genetics* *5: Cryopreservation*
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area: *1: Factorial temperature/photoperiod/hydroponics 608m^2* *2: Controlled Photoperiod 60m^2* *3: Cocoa Physiology 400m^2 (Tropical)*
	Heated & ventilated glass. Number and/or area: *26 Compartments (including 1 + 2 above) 2331m^2*
	Unheated glass or cubicles. Number and/or area. *1 Glasshouse 35 m^2* *5 Coldframes 20 m^2*
Poly tunnels	Number and/or area: *7 Span Spanish Tunnel 3255 m^2* *Cocoa Quarantine (2 x 3 Span + 2) 1000m^2 (Heated)* *Polytunnel Cladding Test Facility - 10 Mini Tunnels - 50 m^2* *4 Polytunnels - 320 m^2*
Field trial capacity	Area & crops: *Plant Science Building - Caged Areas Mini Plots - 3082 m^2* *Fruit Cages (2) - 527 m^2* *Harris Garden - 8 Hectares* *Field Unit*
Storage trial facilities	Capacity & crops:
Other specialised facilities	Techniques and crops: *6 High Spec Walk-in Growth Rooms* *6 High Spec (Saxil) Growth Cabinets* *9 Small (Sanyo Gallenkamp) Growth Cabinets*
Other relevant facilities: e.g germplasm of other collections and/or data sets	*Cocoa Quarantine Collection* *National Fruit Collections*

Quality Assurance	If so, which accreditation?
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years? *Glasshouse facilities are very old (35 years +) - in need of urgent replacement*
Any further comments?	

Organisation	**Warwick HRI**
Laboratories	Approx. areas:
	3,600 sq m
	Approx. age:
	2500 sq m 12 years old, 1400 sq m refurbished last year.
	Any specialised features:
	Full range of genomics and molecular biology labs through to specialised pathology and insect areas; imaging, bioinformatics and tissue culture facilities.
Glasshouses	Sophisticated glass (Contained & environmentally controlled). Number and/or area:
	6,000 sq m glass in total; ~80% in this category.
	Heated & ventilated glass. Number and/or area:
	~20% in this category.
	Unheated glass or cubicles. Number and/or area.
	12 small & two large, mostly used for specialist pest/ disease rearing.
Poly tunnels	Number and/or area:
	~20, 3 new ones erected this year.
Field trial capacity	Area & crops:
	Field veg ~12 Ha; *Arable cereals ~70 Ha;* *Outdoor bulbs/ flowers ~10 Ha;* *Organic area ~20Ha;* *Pest and disease plots ~3 Ha horticultural crops we work with.* *Often the only viable place to do the work is on grower premises.*
Storage trial facilities	Capacity & crops:
	Vase life x 3; Cold store at least 6
Other specialised facilities	Techniques and crops:
	Crop Genomics Centre with marker, sequencing and expression array facilities. *Crop DNA resources (libraries, EST's, markers);* *Bioconversion unit with large (<30 tonne) capacity for composting, solid state fermentation and mushroom production.*
Other relevant facilities: e.g germplasm of other collections and/or data sets	*WHRI Genebank and genetic diversity collections of Brassica, Onion, Carrot/ Parsnip. Collections, databases, seed curation and distribution. Seed storage and regeneration.*
Quality Assurance	If so, which accreditation?
	Joint Code of Practice of BBSRC & Defra
Utilisation	a. Any facilities underused because of low demand or insufficient running costs? b. Any notable demand in excess of capacity?
	Glasshouses being rationalised to increase occupancy and decrease maintenance costs; probably end up as about half of current space.
Facilities deficit	What major replacement or new facilities would you need to maintain your capability for horticultural R&D over the next 10 years?
	Generally in reasonable shape with modern facilities.
Any further comments?	*Facilities supported by experimental design and biometrics to provide robust answers.* *Facilities are located at Wellesbourne and Kirton and not entirely interchangeable.*

ANNEX 7

COMMENTS ON FACILITIES DEFICITS

- *We are short of glasshouse capacity, particularly compartmentalised glass with control of temperature etc in individual compartments. We have looked at the cost of building new glass, but the investment required (>£250,000) could only be justified if work to fill the facility were guaranteed over at least a 5 year period. Under the current business climate, this is impossible to guarantee.*

(ADAS UK Ltd)

- *Growth cabinets for microprop, incubation facility, GM certified glasshouse, precision drill.*
- *Rationalisation of glasshouse facilities needed at a College wide level - this has now started to happen.*

(CALU, Bangor)

- *May need replacement of quarantine glass.*
- *Lack of commercial scale glass so rely on other partners eg W HRI, EMR, STC.*

(CSL)

- *None as all brand new.*

(Cranfield University)

- *We would like to build new laboratories and offices for EMR - this would put our research facilities on a modern footing and also have a significant impact on our overheads at the East Malling site - this project is being discussed with the East Malling Trust who own the site - it is far from clear how it could be financed.*
- *The post-harvest storage facility will have to be updated as storage technology is improved.*
- *New research glasshouses will have to be built at some point.*

(EMR)

- *Considering relocation of nursery and science facilities to main site.*

(The Eden Project)

- *Cold store for post harvest shelf life trials.*

(Harper Adams University College)

- *As part of a major sire development new glasshouses will be built on our Cambridge farm at the other side of the site near to Histon. This will largely replace existing facilities with no expansion planned..*

(NIAB)

- *We are continuously updating/improving our facilities, although some aspects of it are showing signs of aging. The major facilities that may need replacing in the next decade is the plant that maintains the controlled environmental conditions in the insectary.*

(NRI)

- *Research glasshouses in planning (short term) (1-3 years).*
- *Laboratory replacement in larger term site plan (3-10 years).*

(RHS)

- *Nothing specific in order to maintain capability to undertake Horticultural Research over and above the need to maintain general facilities upgraded to keep abreast of research methodologies.*

(SAC)

- *Replacement of three glasshouse complexes currently heated by steam from a central boiler. Plans have been produced & submitted for replacement of two complexes. Awaiting funding.*

(SCRI)

- *We will need to replace some of the aging glasshouses to maintain the current capability. In terms of priorities the 10x Fairfield units are a high priority though some of the other older glasshouses will also need replacing over time. The heating boiler is expensive to maintain and run and we are currently investigating alternative heating sources/technologies at the current time. Further investment in glasshouse facilities will be required to enable us to cater for the wider demands of the different cropping sectors e.g. deep water hydroponics.*

(STC)

- *New glass*
- *Refurbished labs.*

(University of Plymouth)

- *Glasshouse facilities are very old (35 years +) - in need of urgent replacement*

(University of Reading)

- *Generally in reasonable shape with modern facilities.*

(Warwick HRI)

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