Appendix 1

Terms of Reference for the Review Panel

1. The task of the Review Panel is to conduct an independent evaluation of the effectiveness and impact of BBSRC's activities in crop science over the past decade, with particular reference to BBSRC's response to the Crop Science Review (published in April 2004).

2. Specifically, the Panel is asked to review the information presented and to:

    a. assess BBSRC's response to the recommendations contained in the Crop Science Review

    b. comment on the development and effectiveness of BBSRC's strategies relevant to crop science

    c. comment on the balance and coverage of the crop science portfolio

    d. comment on the extent to which BBSRC's investments have built capacity and capability in UK crop science research, and contributed to strong research communities

    e. assess the outcomes and achievements of BBSRC's major investments in crop science research and training, with a particular focus on food crops

    f. assess the economic and societal impacts of BBSRC-supported crop science research and training

    g. comment on the level of interaction with industry and other potential users of crop science research

    h. comment on the level of participation in international activities, including scientific collaborations and addressing the needs of developing countries

    i. consider how BBSRC's support for basic plant science research, including in model systems, has underpinned the crop science portfolio

    j. make recommendations to BBSRC on ways to build on successes and ways to address identified gaps and issues.

Appendix 2

Review Panel membership

Peter Gregory (Chair)
East Malling Research / University of Reading

Steve Barnes
SESVanderHave

Tina Barsby
NIAB

Charles Baxter
Syngenta

Susannah Bolton
HGCA

Catherine Feuillet
INRA

Molly Jahn
USDA / University of Madison-Wisconsin

Sophien Kamoun
The Sainsbury Laboratory

David Pink
Harper Adams University

Appendix 3

Summary of 2004 Crop Science Review recommendations

Priorities

Recommendation 1

The key crop targets and technological priorities set out in paragraphs 3.3 to 3.4 (see below) should be adopted by the BBSRC as the basis of its strategy for crop science research, with appropriate realignment in the priorities of BBSRC's research committees and institutes. Progress towards implementing these targets and priorities should be regularly monitored by Council (see also recommendation 9).

3.3 We identify the following targets:

- improving quality with respect to the whole food chain, including human health and other benefits for consumers
- drought tolerance and water-use efficiency
- durable resistance and/or control strategies for pests and pathogens and control of weeds while protecting biodiversity in the wider environment
- improving efficiency of resource use and minimising waste through:
  - lower input, including nutrient efficiency and lower residue systems
  - increasing yield and quality including seed composition
  - promoting greater crop adaptability to fluctuations in environmental conditions
  - extension of growing season
- broadening the range and number of crop species/varieties including novel crops and products for:
  - extension of growing season
  - bioenergy
  - biopharmaceuticals and nutraceuticals
  - biopolymers

3.4 We identify the following technological priorities:

- develop new strategies informed by genetic and genomic information to accelerate the breeding process
- improve the management, maintenance and utility of national resources for:
  - genomic, proteomic and metabolomic data
  - germplasm collections
  - genomic resources such as BAC libraries
- maintain and balance GM and non-GM approaches, using appropriate technologies to solve practical problems subject to societal acceptability (including mutagenesis and identification of induced and natural mutations)
- understand key processes underpinning plant breeding: heterosis, genome function in hybrids, meiotic recombination, apomixis
- develop techniques for predictive modelling:
  - to scale up from sub-cellular to whole plant functioning
  - to predict crop (i.e. population) performance
  - to assess impacts of change in crop performance on sustainability
- review and revise crop ideotypes to bridge genomic analysis with selection of crop traits for improved crop performance

Recommendation 2

BBSRC should develop a research strategy to exploit genomic information in crops and in models for both non-GM and GM approaches to improving crop performance.

Recommendation 3

BBSRC should ensure the efficient collection and curation of genomic information, together with maintenance of germplasm, for major groups of crop plants (cereals and grasses; *Solanaceae*; legumes; brassicas; non-food crops), through liaison with Defra, SEERAD and international agencies, as appropriate. BBSRC should also adopt measures to ensure the crop science community is aware and makes use of the genomics facilities and germplasm collections that are available.

Recommendation 4

Council should adopt the principle that the BBSRC crop science portfolio, supported through both institute and university investment, should encompass research with application beyond the UK where there is scientific synergy and economic or social incentive.

Recommendation 5

BBSRC should focus future investment in functional genomics in the context of identifying important crop traits in wheat, brassica, legumes, forage *Gramineae*, and *Solanaceae*. Large-scale genome sequencing should only be undertaken through partnership with national and international collaborators and ensuring that sequence data are publicly available.

Recommendation 6

Taking the government-wide Non-Food Crops Strategy into account, BBSRC should develop a strategy for research on non-food uses of crops that fosters an appropriate science base to serve current and future producer and end-user requirements.

Recommendation 7

BBSRC should support genome sequencing and gene functional analysis of pests and pathogens and ensure that this is developed within a population genetic and epidemiological framework to promote durable pest and disease control. Initial organisms for sequencing and functional genomics should be selected from the following candidate organisms: *Mycosphaerella graminicola*, *Peronospora parasitica*, *Blumeria graminis* and *Aphis pisi*.

Recommendation 8

BBSRC should seek to re-balance its plant science research portfolio to place greater emphasis on crop science and to promote the transfer of knowledge from plant science to crop science by implementing recommendations 9 to 13.

Delivery mechanisms

Recommendation 9

Council should establish a high-level steering group, chaired by a member of Council, to maintain a strategic overview of the development of the BBSRC crop science research and training portfolio, including the implementation of recommendations 1 to 8. Council should also consider the need to establish co-ordinated programmes on specific crops or groups of crops. The steering group should ensure co-ordination within BBSRC so that the relevant institute programmes and the university grants portfolio develop in synergy with other national funders.

Recommendation 10

BBSRC should appoint co-ordinators for three areas of crop science, one for monocots, a second for non-food uses of crops, and the third for brassicas, legumes and *Solanaceae*, in order to develop and co-ordinate cohesive programmes of work across BBSRC institutes with the longer-term aim of integrating the work at BBSRC institutes, SEERAD-sponsored bodies and universities.

Recommendation 11

Council should revise the current committee structure with the aim of forming a single committee with responsibility for promoting and focusing responsive mode funding for crop science, plant science and sustainable agriculture.

Recommendation 12

Institute reporting procedures should clearly identify dedicated crop science projects that are distinct from other aspects of plant science and indicate the strategic importance of the project, the total funding of the project and the contribution made from CSG.

Recommendation 13

Council should:

a. seek to increase the proportion of the basic plant science budget that addresses the priority of knowledge transfer from plant to crop science whilst maintaining the current level of support for basic plant science
b. provide additional funding of £12m for new research aimed at the specific crop science objectives set out in paragraphs 3.3 to 3.4
c. ensure that there is flexibility in funding to support large-scale, collaborative projects with external matching funding up to £4m as well as recurrent funding for co-ordination, training and data management.

Recommendation 14

BBSRC should take the lead to establish a national plant breeding initiative, in partnership with other funders drawn from government, charities and the private sector, that would promote public-good plant breeding by establishing crop genetic improvement programmes with the aim of providing improved germplasm and technology for the development of new varieties.

Recommendation 15

BBSRC should seek to lead rather than respond in the development of international research programmes in crop science by strengthening relationships with INRA and DfID, among others, encouraging international networking and providing funds to facilitate international partnerships.

Recommendation 16

BBSRC should review its training programmes and career development for crop scientists by considering the introduction of targeted schemes for training and recruitment at senior, postdoctoral and postgraduate levels including international secondments.

Recommendation 17

BBSRC should seek to increase publicity for public-good plant breeding and to emphasise the role of genomically-informed but non-transgenic approaches to crop science research.

Appendix 4

Additional Information

The data in this Appendix are intended to complement the information in the main report text. It should be noted that the data presented here are only a subset of the information provided to the Panel.

Contents

1. Crop Science Initiative

1.1 Evaluation methodology

Information was gathered from the following sources:

- **sixteen completed CSI projects** (33 grants)
  - 32 final reports
  - ROS entries associated with 17 grants (52% of total)
  - 22 survey responses (71% of contacted researchers)

- **two current CSI projects** (four grants)
  - one final report (from a component grant which was complete)
  - ROS entries associated with two grants (50% of total)
  - three survey responses

- **BBSRC databases**

- **Publicly available data**

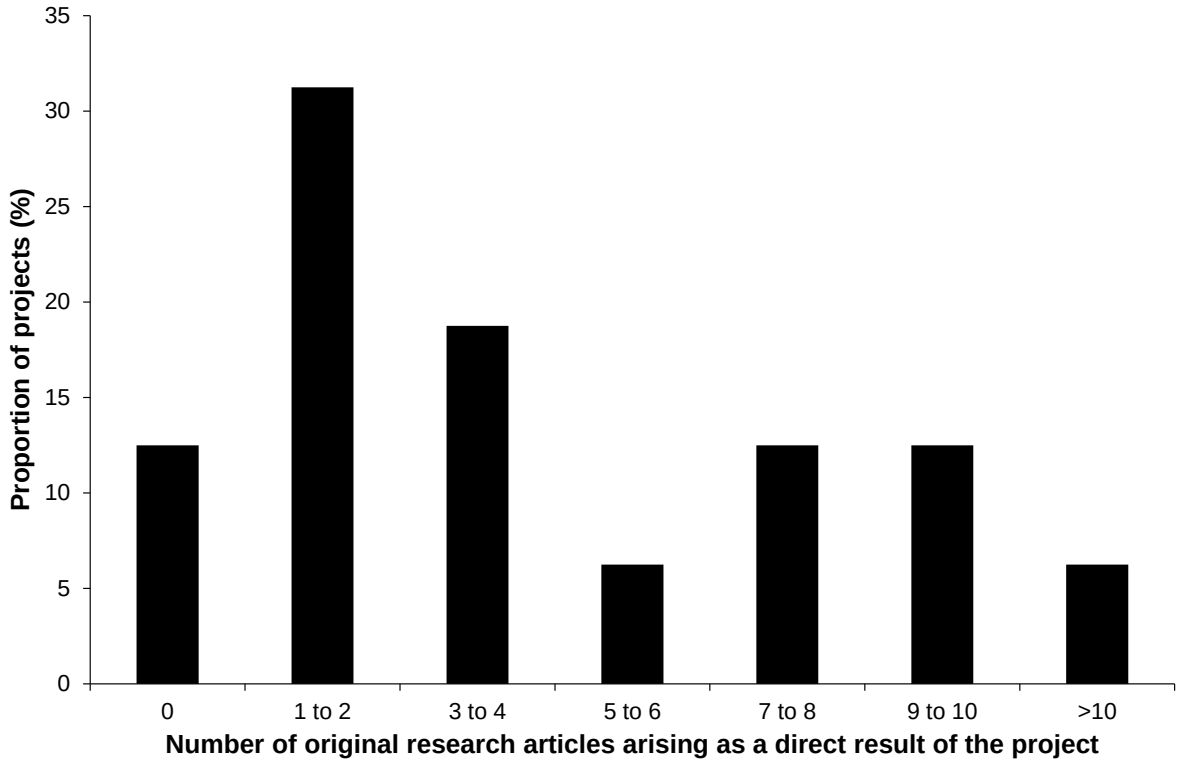
1.2 Research outputs and outcomes

1.2.1 Publications

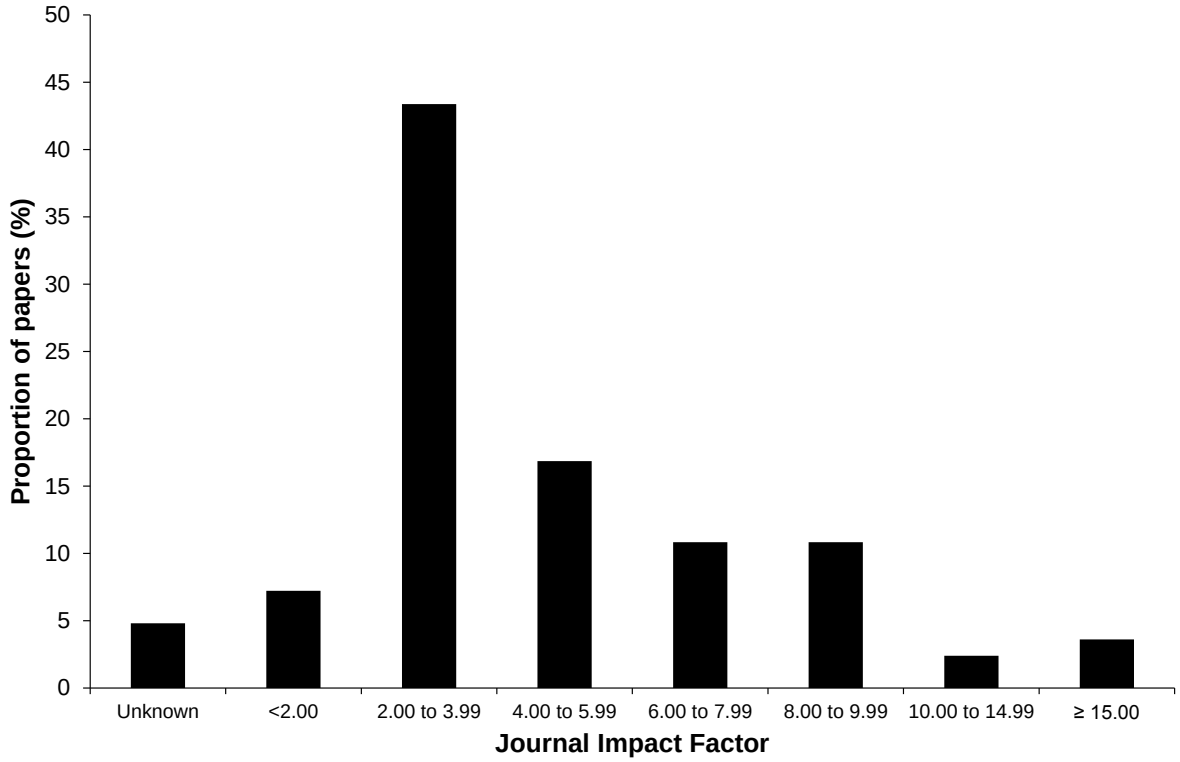
Original research articles arising from CSI projects

Indicator	
Total no. of original research articles reported	83
Median number of research articles per completed project	3.5
Proportion of original research articles with an international co-author	52%
Proportion of original research articles with an industrial co-author	9%
Proportion of CSI projects which resulted in a publication with an international co-author	63%
Proportion of CSI projects which resulted in a publication with an industrial co-author	31%
Proportion of CSI projects with no original research articles reported	13%

Number of original research articles per completed CSI project



Distribution of original research articles by journal impact factor



Proportion of completed CSI projects which resulted in at least one original research article in the journal category (categorised by journal impact factor)

Journal category	Proportion of projects (%)
Cell, Nature, Science	6
IF ≥ 15.00	13
IF ≥ 10.00	25
IF ≥ 8.00	38
IF ≥ 6.00	63
IF ≥ 5.00	69
IF ≥ 4.00	69
IF ≥ 2.00	88
Any	88

1.2.2 Contributions to the production or annotation of genome sequences

CSI projects contributed to production or annotation of five complete genome sequences, often in collaboration with international partners:

- *Acyrthosiphon pisum* (pea aphid)
- *Fragaria vesca* (strawberry)
- *Phytophora infestans* (potato blight)
- *Pythium ultimum* (plant pathogen)
- *Saprolengia parasitica* (fish pathogen)

1.2.3 New intellectual property and spin-out companies

Indicator	
Number of CSI projects which led to applications to secure IP rights	4 (25%)
Number of CSI projects which contributed to the establishment or development of a spin-out company	0 (0%)

1.2.4 Further funding

Indicator	
Proportion of PIs who had obtained further BBSRC funding for crop science since their CSI grant was awarded	61%
Proportion of PIs who had obtained further BBSRC funding for other plant science since their CSI grant was awarded	17%
Proportion of Principal Investigators (PIs) who had obtained further BBSRC funding for crop or other plant science since their CSI grant was awarded	67%

Examples of other sources of further funding included:

- Consultative Group on International Agricultural Research Generation Challenge Programme (CGIAR)
- Department for Environment, Food and Rural Affairs (Defra) (e.g. themed LINK programmes)
- Department for International Development (DfID)
- European Union
- industry
- levy bodies, trade groups and agricultural trusts (e.g. Horticulture Development Company, Yorkshire Agricultural Society)
- NIAB
- Technology Strategy Board (TSB)

1.2.5 Collaborations and partnerships

Academic collaborations and partnerships

Indicator	
Proportion of CSI projects which involved a collaboration between researchers at more than one institution as part of the original application	67%
Proportion of CSI projects which contributed to a collaboration of partnership with international academics	81%

Proportion of completed CSI projects that contributed to a collaboration or partnership with international academics (by country)

Country	Proportion of projects (%)
EU	69
USA	38
Australia	31
China	31
Canada	19
Israel	19
India	13
New Zealand	13
Other[1]	38
Any	81

[1] Includes: Brazil, Chile, Columbia, Japan, Nigeria, Norway, Philippines, Russia, South Africa, South Korea, Switzerland, Taiwan and Thailand. Each country was reported for a single project.

Non-academic collaborations and partnerships

Indicator	
Proportion of CSI projects which involved an interaction with industry (informal or formal)	88%
Proportion of CSI projects classified as Industrial Partnership Awards	22%

Examples of interactions with non-academic organisations included: ADAS; Berry Gardens; BioPotatoes; British Wheat Breeders; Campden BRI; Ceres; Chromatin Inc; Driscolls Genetics; Elsoms; EnviroTech Construct; HGCA; Horticulture Development Company; Igagro Ricerca; KWS; Limagrain; Monsanto; Muntons; Nickersons; Pukekohe Growers Suppliers; RAGT Seeds; Roche Diagnostics; Scottish Whisky Research Institute; Syngenta; Yorkshire Agricultural Society.

1.3 General

1.3.1 Balance and coverage of the portfolio

Distribution of CSI projects by crop

Crop[1]	Proportion of projects which were directly relevant to specific crops (%)[2,3]
Barley	22
Brassica	22
Potato	11
Ryegrass	6
Strawberry	6
Tomato	6
Wheat	50
Willow	6

[1] Includes research on pathogens and pests associated with the crop
[2] Data are based on number of projects rather than the amount of funding
[3] Individual CSI projects may be relevant to more than one crop

Proportion of CSI projects classified as basic, strategic or applied research

Funding scheme	Proportion of projects (%)[1]		
	Basic	Strategic	Applied
Crop Science Initiative		67	33
All BBSRC research spend[2]	69	26	5

[1] Data are based on Frascati codes assigned to projects
[2] Data are for BBSRC research spend between 2007/08 and 2011/12 (excludes capital & buildings and equipment & facilities)

1.3.2 Profile of researchers supported through the CSI

CSI researchers' previous experience of crop science research at the time of their CSI application

Previous experience[1,2]	Proportion of researchers (%)
None	15
Less than five years	4
Five to ten years	12
Eleven to fifteen years	12
Sixteen to twenty years	12
More than twenty years	46

[1] Researchers were asked to consider only their time as an independent scientist (i.e. any crop science experience as a PhD student or postdoctoral researcher was excluded)
[2] The categories are for researchers' previous experience at the time of the CSI application (e.g. 2005). Their crop science experience at the current time would be expected to be greater.

2. Targeted Priority Studentships in Crop Science

2.1 Evaluation methodology

Information was gathered from the following sources:

- **eighteen Targeted Priority Studentships in crop science**
  - 17 survey responses from academic supervisors (94% of total)
- **BBSRC databases**
- **Publicly available data**

2.2 Quality of student training

2.2.1 Research skills, broader science skills and generic professional skills

Supervisors' assessment of the quality of student training

Training area	Proportion of supervisors (%)[1]			
	1 poor	**2** fair	**3** good	**4** very good
Research skills			7	93
Broader science skills			14	86
Generic professional skills			29	71

2.2.2 Crop Science Initiative workshops

Supervisors' assessment of the usefulness of the CSI workshops for student training and development

Proportion of supervisors (%)				
1 not at all useful	**2** somewhat useful	**3** useful	**4** very useful	**student did not attend a workshop**
	7	53	33	7

2.2.3 Interaction with industry

Proportion of TPS studentships with formal or informal interactions with industry or other non-academic users

Interaction with industry	%
Formal partnership with industry or other non-academic users	7
Informal interaction with industry or other non-academic users	60
No interaction with industry or other non-academic users	33

2.2.4 Distinctiveness of the TPS studentships

Supervisors' assessment of the distinctiveness of the TPS studentship for their students and themselves

	Proportion of supervisors (%)			
	1 not at all distinctive	**2** somewhat distinctive	**3** distinctive	**4** very distinctive
For the student	14	43	36	7
For the supervisor	14	50	36	

2.2.5 Cohort identity

Supervisors' views on the effectiveness of the TPS mechanism in creating a cohort identify among crop science students

Cohort identity	Proportion of supervisors (%)				
	1 not at all effective	**2** somewhat effective	**3** effective	**4** very effective	**Don't know**
Within the host institution	20	40	20	13	7
Within the UK crop science community	13	40	33		13

2.3 Outputs, outcomes and achievements

2.3.1 Completion of the PhD

Proportion of students who submitted their thesis within four years and who were awarded a PhD

Status	Proportion (%)[1]	
	Yes	No
The student submitted their thesis within four years (excluding career breaks)	87	13[2]
The student was awarded a PhD	100	

[1] Data exclude one studentship which started in 2009 and is still active
[2] Two students were granted a short extension of three months because of experimental and health issues, respectively

2.3.2 Publications

Original research articles arising from TPS studentships

Indicator[1]	
Total no. of original research articles reported to date	19
Median number of original research articles per studentship	0
Mean number of original research articles per studentship	1.1
Proportion of students who had authored or co-authored an original research article	41%
Proportion of students who had authored or co-authored an original research article when papers in preparation are also considered	82%
Proportion of students who published a first author original research article from their studentship	24%
Proportion of original research articles where the student was listed as first author	36%
Proportion of original research articles with an international co-author	32%
Proportion of original research articles with an industrial co-author	0%

[1] The publication data should be treated with caution as students had not yet published all of their research at the time of the evaluation surveys. Moreover, publications may take longer to arise from crop science studentships because of the nature of the research (e.g. the length of crop growth cycles).

Distribution of original research articles by journal impact factor

Journal Impact Factor category	Proportion of original research articles (%)
< 2.00	16
2.00 to 3.99	16
4.00 to 5.99	32
6.00 to 7.99	11
8.00 to 9.99	11
10.00 to 14.99	5
>= 15.00	5
Unknown	5

2.3.3 Career development

First destination of TPS students after completing their PhD

First employment destination[1]	Proportion of students (%)	
	UK	Overseas
Higher education – mainly research	47	
Industry and Commerce – research related	27	
School	7	
Career break	6	13

First destination of TPS students by science area

Science area	Proportion of students (%)
Crop science (including the interactions between crop plants and other organisms)	53
Other plant science (including the interactions between non-crop plants and other organisms)	7
Another science area	20
The student's first destination is not science related	20

3. Responsive mode funding

3.1 Evaluation methodology

Information was gathered from the following sources:

- **fifty completed responsive projects** (61 grants)
  - 61 final reports
  - ROS entries associated with 28 grants (46% of total)
  - 31 survey responses (67% of contacted researchers)
  - Four researchers' responses from the 2011 evaluation of BBSRC's Industrial Partnership Award scheme

- **BBSRC databases**

- **Publicly available data**

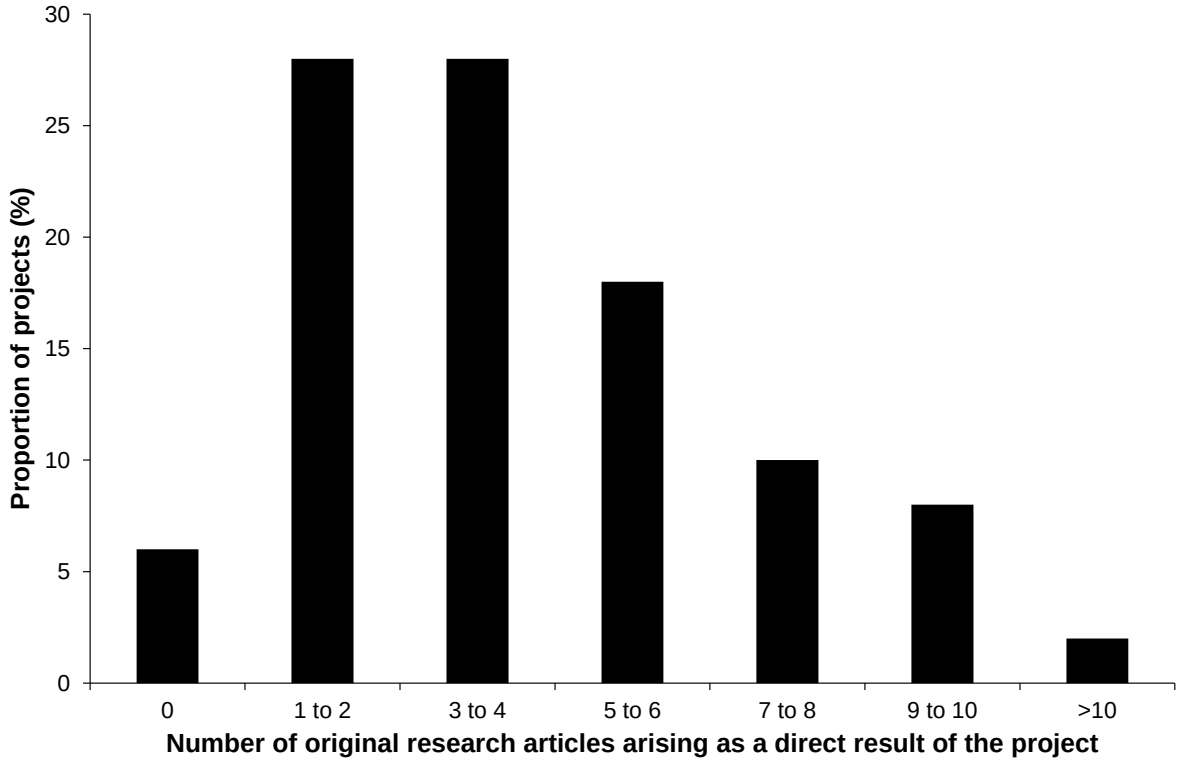
3.2 Research outputs and outcomes

3.2.1 Publications

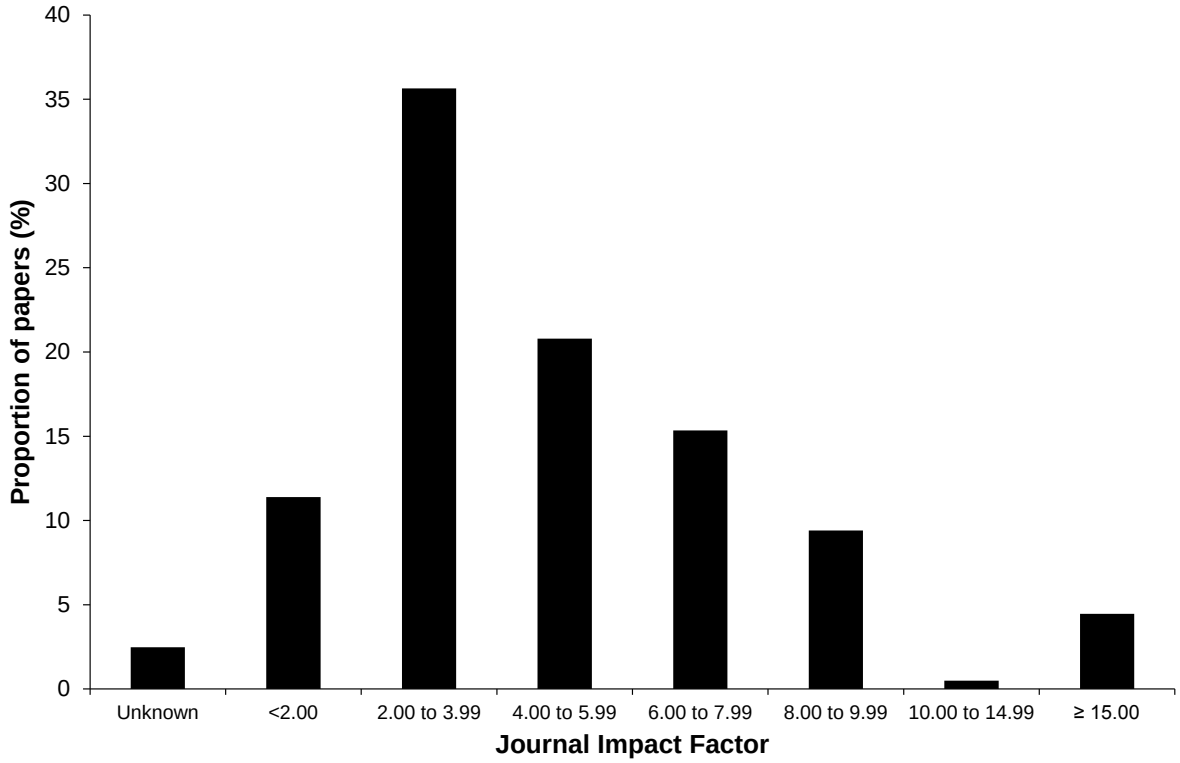
Original research articles arising from responsive mode projects

Indicator	
Total no. of original research articles reported	202
Median number of research articles per completed project	3
Proportion of original research articles with an international co-author	46%
Proportion of original research articles with an industrial co-author	9%
Proportion of projects which resulted in a publication with an international co-author	72%
Proportion of projects which resulted in a publication with an industrial co-author	24%
Proportion of projects with no original research articles reported	6%

Number of original research articles per responsive project



Distribution of original research articles by journal impact factor



Proportion of responsive mode projects which resulted in at least one original research article in the journal category (categorise by journal impact factor)

Journal category	Proportion of projects (%)
Cell, Nature, Science	14
IF ≥ 15.00	18
IF ≥ 10.00	18
IF ≥ 8.00	40
IF ≥ 6.00	60
IF ≥ 5.00	68
IF ≥ 4.00	84
IF ≥ 2.00	94
Any	94

3.2.2 Contributions to the production or annotation of genome sequences

The sample responsive mode projects contributed to production or annotation of six complete genome sequences, often in collaboration with international partners:

- *Blumeria graminis* (barley powdery mildew)
- *Hyaloperonospora arabidopsis* (downy mildew)
- *Solanum lycopersicum* (tomato)
- *Solanum tuberosum* (potato)
- *Erysiphe pisi* (powdery mildew)
- *Golovinomyces orontti* (Arabidopsis powdery mildew)

3.2.3 New intellectual property and spin-out companies

Indicator	
Number of projects which led to applications to secure IP rights	8 (16%)
Number of projects which contributed to the establishment or development of a spin-out company	1 (2%)

3.2.4 Further funding

Indicator	
Proportion of PIs who had obtained further BBSRC funding for crop science since their responsive mode grant was awarded	62%
Proportion of PIs who had obtained further BBSRC funding for other plant science since their responsive mode grant was awarded	23%
Proportion of Principal Investigators (PIs) who had obtained further BBSRC funding for crop or other plant science since their responsive mode grant was awarded	69%

Examples of other sources of further funding included:

- Bill & Melinda Gates Foundation
- British Council
- Chemical Regulations Directorate (Health and Safety Executive)

- Department for Environment, Food and Rural Affairs (Defra)
- Department for International Development (DfID)
- Engineering and Physical Sciences Research Council (EPSRC)
- European and Mediterranean Plant Protection Organisation
- European Union
- European Science Foundation
- Fungicide Resistance Action Committee
- industry
- levy bodies, trade groups and agricultural trusts (e.g. British Potato Council, HGCA, Horticulture Development Council, Teagasc)
- New Zealand government
- Pesticides Safety Directorate (Health and Safety Executive)
- Slovenian Research Agency
- Technology Strategy Board (TSB)
- Worldwide Universities Network

3.2.5 Collaborations and partnerships

Academic collaborations and partnerships

Indicator	
Proportion of projects which involved a collaboration between researchers at more than one institution as part of the original application	30%
Proportion of projects which contributed to a collaboration of partnership with international academics	78%

Proportion of responsive projects that contributed to a collaboration or partnership with international academics (by country)

Country	Proportion of projects (%)
EU	56
USA	40
China	14
Canada	10
Japan	10
India	6
New Zealand	6
Argentina	4
Australia	4
Mexico	4
Norway	4
Philippines	4
Russia	4
South Korea	4
Switzerland	4
Other[1]	16
Any	78

[1] Includes: Brazil, Chile, Israel, Kenya, Pakistan, Peru, Singapore, Sri Lanka and Taiwan. Each country was reported for a single project.

Non-academic collaborations and partnerships

Indicator	
Proportion of projects which involved an interaction with industry (informal or formal)	56%
Proportion of projects classified as Industrial Partnership Awards	14%

Examples of interactions with non-academic organisations included: ADAS; Advanced Technologies Cambridge; BASF; Bayer CropScience; Biogemma; Biolog; British Potato Council; Cereal Partners Worldwide; CropDesign; Defra Science Advisory Council; Dow Agrosciences; DuPont; Food Safety Agency; GCIRC; General Motors Powertrain; GlaxoSmithKline; HGCA; Higgins Agriculture; Keygene; KWS UK; Leatherhead Food International; Life Technologies; Limagrain; Marks and Spencer; Mendel Biotechnology; Monsanto; PepsiCo; Perry Foundation; Plant Impact; Potato Processers Association; Prospero Therapeutics; Roche Applied Sciences; Sainsbury's; Seminis Vegetable Seeds; Shamrock Seed Company; Syngenta; Teagasc; Tesco; UK Cereal Pathogen Survey; Unilever; United Biscuits; Verdia; Vitacress Salads

3.3 General

3.3.1 Balance and coverage of the portfolio

Distribution of responsive mode projects by crop

Crop[1]	Proportion of projects which were directly relevant to specific crops (%)[2,3,4]
Barley	9
Beet	1
Brassica	9
Celery	<1
Legumes	8
Lettuce	2
Maize	2
Miscanthus	<1
Mushroom	<1
Oat	1
Pepper	<1
Poplar	<1
Potato	9
Rice	8
Rye	<1
Ryegrass	1
Tomato	8
Wheat	16
Wormgrass	<1
Other[4]	35

[1] Includes research on pathogens and pests associated with the crop
[2] Data are provided for 210 responsive mode projects classified as crop science. The projects had start dates between January 2004 and May 2011.

[3] Data are based on the number of projects rather than the amount of funding
[4] Individual responsive mode projects may be relevant to more than one crop
[5] Includes projects which were not directly relevant to a specific crop (e.g. where the research was relevant to a broad variety of crops, underpinning research). It also includes projects where there was not sufficient information within the title and abstract to assign a specific crop category.

Proportion of responsive mode projects classified as basic, strategic or applied research

Funding scheme	Proportion of projects (%)[1]		
	Basic	Strategic	Applied
Responsive mode (crop science only)	41	53	5
All BBSRC research spend[2]	69	26	5

[1] Data are based on Frascati codes assigned to projects
[2] Data are for BBSRC research spend between 2007/08 and 2011/12 (excludes capital & buildings and equipment and facilities)

3.3.2 Profile of researchers supported through responsive mode

Researchers' previous experience of crop science research at the time of their responsive mode application

Previous experience[1,2]	Proportion of researchers (%)
None	26
Less than five years	9
Five to ten years	22
Eleven to fifteen years	22
Sixteen to twenty years	30
More than twenty years	17

[1] Researchers were asked to consider only their time as an independent scientist (i.e. any crop science experience as a PhD student or postdoctoral researcher was excluded)
[2] The categories are for researchers' previous experience at the time of application (e.g. 2003 to 2008). Their crop science experience at the current time would be expected to be greater.

Appendix 5

Questionnaires

- Survey of Crop Science Initiative grantholders
- Survey of Targeted Priority Studentship supervisors
- Survey of responsive mode grantholders
- Survey of researchers who have received longer-term BBSRC support for crop science

Survey of Crop Science Initiative grantholders

A: You and your research programme

Your grant application

1. At the time of your Crop Science Initiative grant application, had you previously received funding to conduct crop science research?

Please consider funding from BBSRC or other funders.

Please note: BBSRC includes the interactions between crop plants and other organisms within its definition of crop science

Yes	
No	

If yes, please indicate how long you had been working in the field of crop science at the time of your application.

Please only consider your time as an independent scientist (i.e. do not include your time as a PhD student or postdoctoral researcher).

Less than five years	Five to ten years	Eleven to fifteen years	Sixteen to twenty years	More than twenty years

Crop science and your research programme

2. Please indicate whether the main focus of your research programme currently relates to:

- **crop science**
- **other plant science**
- **another science area?**

Please select one option

Focus of research programme	✓
Crop science *(including the interactions between crop plants and other organisms)*	
Other plant science *(including the interactions between non-crop plants and other organisms)*	
Another science area	

Comments

3. Where applicable, please indicate how easy (or not) it is has been to incorporate crop science into your existing research programme.

For example if you have moved from another field to crop science research, you may wish to consider any challenges associated with: identifying new collaborators; engaging with the existing crop science community; experimental or technical issues; obtaining funding for the research; other barriers or incentives.

Please select one option

1 very difficult	**2** difficult	**3** neither easy or difficult	**4** easy	**5** very easy	**Not applicable:** crop science has always been the focus of my research

B: The Crop Science Initiative

In 2007 BBSRC committed over £13M to support excellent plant science research that is aimed at solving the practical problems faced by plant breeding and agriculture. The Crop Science Initiative funded 18 projects across the UK, with the aim of applying the principles of sustainable development to future crop production.

4. Please comment on the strengths and weaknesses of supporting crop science research through the Crop Science Initiative compared with responsive mode funding.

Strengths

Weaknesses

Crop Science Initiative workshops

BBSRC ran three workshops as part of the Crop Science Initiative.

5. How useful were the Crop Science Initiative workshops for:

- **you**
- **your research staff?**

Please select one option for each item

	1 not at all useful	**2** somewhat useful	**3** useful	**4** very useful	**Don't know**	**Did not attend a workshop**
You						
Your staff						

C: Training and career development for crop scientists

Staff recruitment

6. Please indicate how easy (or not) it was to attract high-quality postdoctoral researchers for crop science grants:

- **at the time you were recruiting for the Crop Science Initiative grant**
- **at the present time**

Please select one option for each item

	1 very difficult	**2** difficult	**3** neither easy or difficult	**4** easy	**5** very easy
At the time of the CSI grant recruitment					
At the present time					

7. Please comment on any specific skills areas where it is currently difficult to attract high-quality postdoctoral researchers for crop science grants

Sustainability of the UK crop science community

8. Please indicate whether the current number of researchers being trained and retained in crop science is sufficient to ensure the long-term sustainability of the UK crop science community.

Please select one option for each item

	1 far too few	**2** slightly too few	**3** just right	**4** slightly too many	**5** far too many
Doctoral students					
Postdoctoral researchers					
Early-career scientists *(e.g. fellows, newly appointed academic staff)*					
Mid-career scientists *(e.g. established academic staff)*					

BBSRC support for training and career development

9. Within the context of a fixed amount of funding, how might BBSRC improve its support for training and career development in crop science?

Please consider doctoral students, postdoctoral researchers, and early- and mid-career scientists.

D: The Crop Science Review

In 2004, an independent panel chaired by Professor Chris Gilligan published a review of BBSRC-funded research relevant to crop science. The 'Crop Science Review' made a number of recommendations to BBSRC regarding its support for crop science research.

As part of this evaluation we are interested in your views on how the Crop Science Review has influenced the UK crop and plant science research communities.

10. To what extent, if any, did the Crop Science Review have a positive influence on:

- **you and your research programme**
- **the UK crop science community**
- **the UK plant science community?**

Please select one option for each item

	1 no positive influence	**2** minor positive influence	**3** positive influence	**4** strong positive influence	**Don't know**
You and your research programme					
UK crop science community					
UK plant science community					

11. Please comment on how the behaviours of the UK crop and plant science communities have changed in response to the Crop Science Review

E: BBSRC support for crop science

12. Please comment on the strengths and weaknesses of BBSRC's current support for crop science research

For example, you may wish to consider: BBSRC's strategies relevant to crop science; BBRSC's response to the 2004 Crop Science Review; the variety of available funding opportunities; the balance and coverage of the crop and plant science portfolios; the overall level of investment; interactions with the international science community etc.

Strengths

Weaknesses

13. Within the context of a fixed amount of funding, how might BBSRC improve its support for crop science research?

Support for community resources and infrastructure

BBSRC provides a variety of support which aims to help foster a strong UK crop science community. This includes investments in tools, resources and facilities, as well as support for community building activities.

14. Please rate BBSRC's support for the following areas relevant to the UK crop science community:

- **tools and resources** (e.g. databases, genome sequences, microarrays, seed collections, new technologies etc.)
- **facilities** (e.g. metabolomics, phenomics, proteomics, sequencing facilities etc.)
- **community building activities** (e.g. networking, workshops, support for travel)

Please select one option for each item

	1 poor	**2** fair	**3** good	**4** very good	**Don't know**
Tools and resources					
Facilities					
Community building activities					

Exploitation of crop science research

15. What are the barriers which limit the exploitation of crop science research by those outside the academic community (e.g. industry, plant breeders, farmers, policy makers) and how might these barriers be addressed by BBSRC?

General

16. Please provide any other comments relevant to this evaluation.

Survey of Targeted Priority Studentship supervisors

A: Training and skills development

The following questions refer to the training and skills development provided to your student. In particular, we are interested in three major areas of training:

- **research skills** *(e.g. technical or practical skills, scientific writing, critical thinking)*
- **broader science skills**, including multi-disciplinary skills which underpin modern bioscience research *(e.g. mathematics and bioinformatics, ethical awareness, commercial and entrepreneurial awareness, public engagement)*
- **generic professional skills** *(e.g. communication skills, time management)*

When answering, please consider training provided through formal and informal mechanisms (e.g. training courses, 'hands on training').

1. Please rate the quality of training provided to your student

Please select one option for each item

	1 poor	**2** fair	**3** good	**4** very good	**no training provided**
Research skills					
Broader science skills					
Generic professional skills					

Comments

2. With specific reference to the development of <u>crop science skills</u>, what were the strengths and weaknesses of the training provided during the studentship?

Strengths

Weaknesses

Crop Science Initiative workshops

TPS students were invited to attend two workshops which were being run as part of BBSRC's Crop Science Initiative.

3. How useful were these workshops for your student's training and development?

Please select one option

1 not at all useful	**2** somewhat useful	**3** useful	**4** very useful	**don't know**	**student did not attend a workshop**

Interactions with industry and other non-academic users of research

4. Did your student interact with industry or other non-academic users of research (e.g. farmers, levy bodies) as part of their studentship?

When answering, please do not include public engagement activities which involved a general audience (e.g. open days, schools visits, science fairs etc.)

Please select all that apply.

	✓
Yes: the student participated in a formal partnership with industry or other non-academic users (e.g. a CASE studentship)	
Yes: the student participated in an informal interaction with industry or other non-academic users	
No	

If yes, please provide brief details on the interaction(s), including any benefits to the student's training or research project

Distinctiveness of the TPS studentship

5. To what extent did the TPS studentship provide a distinctive experience compared with other PhD studentships you have supervised? Please consider the experience for:

- **your student**
- **you (as a supervisor)**

Please select one option for each item

	1 not at all distinctive	**2** somewhat distinctive	**3** distinctive	**4** very distinctive
Your student				
You (as a supervisor)				

B: Outputs, outcomes and achievements

Completion of the PhD

6. Please indicate whether:

- **the student submitted their thesis within four years of the studentship start date**
- **the student was awarded a PhD?**

Please select one option for each item

	Yes	**No**
The student submitted their thesis within four years (excluding career breaks)		
The student was awarded a PhD		

Career development

7. Please indicate your student's first destination after completing their PhD

Please ignore any brief period of time (e.g. up to six months) the student spent in your laboratory after completing their PhD.

Please select one option, distinguishing between employment in the UK or overseas

Sector	UK	Overseas
Higher education – mainly research *(e.g. Postdoctoral researcher)*		
Higher Education – academic *(e.g. Lecturer)*		
Higher Education – other		
Industry and Commerce – research related		
Industry and Commerce – not research related		
Government & Public Sector – research related		
Government & Public Sector – not research related *(e.g. Civil Service)*		
School *(e.g. teacher training)*		
Other employment		
Career break		
Not employed		
Don't know		

8. Where applicable and known, please indicate whether the student's first destination is related to:

- **crop science**
- **other plant science**
- **another science area?**

Science area	✓
Crop science (including the interactions between crop plants and other organisms)	
Other plant science (including the interactions between non-crop plants and other organisms)	
Another science area	
The student's first destination is not science related	

Please provide brief details of your student's first destination

9. Where applicable and known, please provide details on the student's career development beyond their first destination

Please note: we are particularly interested in learning whether your student has pursued a career in crop science

Publications

10. Please list any publications authored or co-authored by your student as a direct result of the studentship

Please distinguish between original research articles and review articles.

Please note, for this evaluation we are not collating information on books, book chapters, conference papers or other publications.

Original research articles

Review articles

11. Please provide brief details on the most notable achievements to arise from the studentship

As a guide, please list up to four achievements, but do not exceed an average of fifty words per achievement.

Examples of achievements might include: scientific discoveries; prestigious publications; prizes and awards; new products, processes, tools or technologies; new intellectual property; interactions with industry or other non-academic organisations; knowledge exchange; further funding; exploitation of

the research; economic or societal impacts; or wider benefits to the public good arising from the postgraduate research and training.

12. Overall, how successful were the training and research supported by the TPS studentship?

Please select one option for each item

	1 not at all successful	**2** somewhat successful	**3** successful	**4** very successful
Student training				
Student research project				

C: General

The Targeted Priority Studentship mechanism

13. Please comment on the strengths and weaknesses of supporting doctoral training through the Targeted Priority Studentship mechanism

Strengths

Weaknesses

14. How effective was the Targeted Priority Studentship mechanism in creating a cohort identity among crop science students:

- **within your institution**
- **within the UK crop science community?**

Please select one option for each item

	1 not at all effective	**2** somewhat effective	**3** effective	**4** very effective	**Don't know**
Within your institution					
Within the UK crop science community					

Student recruitment

15. Please indicate how easy (or not) it was to attract high-quality applicants for crop science studentships:

- **at the time you were recruiting for the TPS studentship**
- **at the present time?**

Please select one option for each item and provide brief comments if you wish

	1 very difficult	**2** difficult	**3** neither easy or difficult	**4** easy	**5** very easy
At the time of the TPS studentship recruitment					
At the present time					

Sustainability of the UK crop science community

16. Please indicate whether the current number of researchers being trained and retained in crop science is sufficient to ensure the long-term sustainability of the UK crop science community.

Please select one option for each item

	1 far too few	**2** slightly too few	**3** just right	**4** slightly too many	**5** far too many
Doctoral students					
Postdoctoral researchers					
Early-career scientists *(e.g. fellows, newly appointed academic staff)*					
Mid-career scientists *(e.g. established academic staff)*					

BBSRC support for training and career development

17. Within the context of a fixed amount of funding, please comment on how BBSRC might improve its support for training and career development in crop science

18. Please provide any other comments relevant to this evaluation

Survey of Responsive Mode grantholders

A: You and your research programme

Your grant application

1. At the time of your responsive mode grant application, had you previously received funding to conduct crop science research?

Please consider funding from BBSRC or other funders.

Please note: BBSRC includes the interactions between crop plants and other organisms within its definition of crop science

Yes	
No	

If yes, please indicate how long you had been working in the field of crop science at the time of your application.

Please only consider your time as an independent scientist (i.e. do not include your time as a PhD student or postdoctoral researcher).

Less than five years	Five to ten years	Eleven to fifteen years	Sixteen to twenty years	More than twenty years

Crop science and your research programme

2. Please indicate whether the main focus of your research programme currently relates to:

- **crop science**
- **other plant science**
- **another science area?**

Please select one option and provide brief comments if you wish

Focus of research programme	✓
Crop science *(including the interactions between crop plants and other organisms)*	
Other plant science *(including the interactions between non-crop plants and other organisms)*	
Another science area	

Comments

3. Where applicable, please indicate how easy (or not) it is has been to incorporate crop science into your existing research programme.

For example if you have moved from another field to crop science research, you may wish to consider any challenges associated with: identifying new collaborators; engaging with the existing crop science community; experimental or technical issues; obtaining funding for the research; other barriers or incentives.

Please select one option

1 very difficult	**2** difficult	**3** neither easy or difficult	**4** easy	**5** very easy	**Not applicable:** crop science has always been the focus of my research

B: Training and career development for crop scientists

Staff recruitment

4. Please indicate how easy (or not) it was to attract high-quality postdoctoral researchers for crop science grants:

- **at the time you were recruiting for the responsive mode grant**
- **at the present time**

Please select one option for each item and provide brief comments if you wish

	1 very difficult	**2** difficult	**3** neither easy or difficult	**4** easy	**5** very easy
At the time of the grant recruitment					
At the present time					

5. Please comment on any specific skills areas where it is currently difficult to attract high-quality postdoctoral researchers for crop science grants

Sustainability of the UK crop science community

6. Please indicate whether the current number of researchers being trained and retained in crop science is sufficient to ensure the long-term sustainability of the UK crop science community.

Please select one option for each item and provide brief comments if you wish.

If you completed the Targeted Priority Studentship survey, please skip this question.

	1 far too few	**2** slightly too few	**3** just right	**4** slightly too many	**5** far too many
Doctoral students					
Postdoctoral researchers					
Early-career scientists *(e.g. fellows, newly appointed academic staff)*					
Mid-career scientists *(e.g. established academic staff)*					

BBSRC support for training and career development

7. Within the context of a fixed amount of funding, how might BBSRC improve its support for training and career development in crop science?

Please consider doctoral students, postdoctoral researchers, and early- and mid-career scientists.

If you completed the Targeted Priority Studentship survey, please skip this question.

C: The Crop Science Review

In 2004, an independent panel chaired by Professor Chris Gilligan published a review of BBSRC-funded research relevant to crop science. The 'Crop Science Review' made a number of recommendations to BBSRC regarding its support for crop science research.

As part of this evaluation we are interested in your views on how the Crop Science Review has influenced the UK crop and plant science research communities.

8. To what extent, if any, did the Crop Science Review have a positive influence on:

- **you and your research programme**
- **the UK crop science community**
- **the UK plant science community?**

Please select one option for each item

	1 no positive influence	**2** minor positive influence	**3** positive influence	**4** strong positive influence	**Don't know**
You and your research programme					
UK crop science community					
UK plant science community					

9. Please comment on how the behaviours of the UK crop and plant science communities have changed in response to the Crop Science Review

D: BBSRC support for crop science

10. Please comment on the strengths and weaknesses of BBSRC's current support for crop science research

For example, you may wish to consider: BBSRC's strategies relevant to crop science; BBRSC's response to the 2004 Crop Science Review; the variety of available funding opportunities; the balance and coverage of the crop and plant science portfolios; the overall level of investment; interactions with the international science community etc.

Strengths

Weaknesses

11. Within the context of a fixed amount of funding, how might BBSRC improve its support for crop science research?

Support for community resources and infrastructure

BBSRC provides a variety of support which aims to help foster a strong UK crop science community. This includes investments in tools, resources and facilities, as well as support for community building activities.

12. Please rate BBSRC's support for the following areas relevant to the UK crop science community:

- **tools and resources** (e.g. databases, genome sequences, microarrays, seed collections, new technologies etc.)
- **facilities** (e.g. metabolomics, phenomics, proteomics, sequencing facilities etc.)
- **community building activities** (e.g. networking, workshops, support for travel)

Please select one option for each item

	1 poor	**2** fair	**3** good	**4** very good	**Don't know**
Tools and resources					
Facilities					
Community building activities					

Exploitation of crop science research

13. What are the barriers which limit the exploitation of crop science research by those outside the academic community (e.g. industry, plant breeders, farmers, policy makers) and how might these barriers be addressed by BBSRC?

General

14. Please provide any other comments relevant to this evaluation.

Survey of researchers who have received longer-term BBSRC support for crop science

A: Your research funding

A list of your BBSRC-funded research grants and institute projects from 2002 onwards is shown in Annex 1.

1. Please estimate what proportion of your research funding has come from BBSRC over the past ten years.

Proportion (%)	

2. What other funding sources have supported your research over the past ten years?

Funding source	✓	**Approximate proportion of your overall funding (%)**
Other UK Research Councils (*e.g. EPSRC, MRC, NERC*)		
Technology Strategy Board		
Other UK government funding *(e.g. Defra, DfID)*		
European Union		
Industry		
Charities *(e.g. Gatsby, Bill & Melinda Gates Foundation, Wellcome Trust)*		
Host institution		
Other – please specify		

Comments

B: Research outcomes and impacts

Publications

3. The original research articles which you have published over the past ten years are shown in Annex 2. Please indicate which of these publications are directly attributable to BBSRC support.

Intellectual property

4. A list of your patents is shown in Annex 3. Please indicate which, if any, of these patents are directly attributable to BBSRC support.

Collaborations and partnerships

5. Please provide brief details of your most significant collaborations and partnerships over the past ten years

Please distinguish between academic and non-academic collaborations and partnerships

Academic collaborations and partnerships

Non-academic collaborations and partnerships

Research impacts

We anticipate that the evaluation will provide significant evidence for the next Government Spending Review. Information on the non-academic impacts and exploitation of your research is particularly useful to help us secure future funding from government for the research base.

6. Please provide brief details on the impacts of your research programme.

Please distinguish between scientific achievements, other academic impacts and non-academic impacts

Scientific achievements

Other academic impacts

For example: worldwide academic advancement; innovative methodologies, equipment, technologies and cross-disciplinary approaches; contributing to the health of academic disciplines; training highly skilled researchers; improving teaching and learning; enhancing the knowledge economy

Non-academic impacts (i.e. economic and societal impacts)

For example: knowledge exchange with industry or other non-academic users; commercialisation and exploitation; wealth creation, economic prosperity and regeneration; improving health and well-being; environmental sustainability, protection and impact; enhancing the effectiveness and sustainability of organisations including public services and businesses; enhancing the research capability, knowledge and skills of public, private and third sector organisations; evidence based policy-making and influencing public policies; increasing public engagement with research and related societal issues

Annex 1: Your BBSRC funding

A list of your BBSRC grants is provided

Annex 2: Your publications

The table below shows your original research articles from 2002 onwards. The data were obtained from Web of Science.

Please indicate which of these publications are directly attributable to BBSRC funding

Publications recorded in your final reports are shaded.

Annex 3: Your patents

The tables below show patents where you are listed as an inventor. The data were obtained from Espacenet Patent Search.

Please indicate which of these patents, if any, are directly attributable to BBSRC funding

The sample researchers were also asked to complete relevant questions from the Crop Science Initiative, Targeted Priority Studentship and responsive mode grantholder questionnaires.