

## BBSRC / MRC Vulnerable Skills Survey 2014

Submit date: Sep 5, 2014

### A. Respondent details

► **Society or organisation on whose behalf you are responding**

UK Plant Sciences Federation

► **Please provide a web link for this group if possible**

<https://www.societyofbiology.org/policy/ukpsf> <http://www.plantsci.org.uk/>

► **If you are willing to be contacted for further information, please provide details below.**

Contact details will only be used to better understand your responses and will be excluded from any published reports.

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### B. Vulnerable Research Skill

► **Q1. What is the research area or discipline for which you wish to highlight a skills / capability vulnerability? (enter only one area)**

Plant Science

► **Q2. To which funder(s) do you consider this research area relevant?**

- BBSRC
- MRC
- Both BBSRC and MRC
- Other

► **Q3. For the identified area, what is the evidence for its strategic importance?**

- If the area addresses known strategic research priorities, please describe how, highlighting interdisciplinarity where relevant.
- What are the impacts (economic, social, health or academic) of this research skill in the UK?

A strong plant science research base is the foundation for the Cross-Council research priorities: Global Food Security; Energy; Living with environmental change (LWEC); and Lifelong health and wellbeing. The world faces rapid global population growth, climate change and the depletion of natural resources. Improving sustainability and supporting economic growth are global and domestic priorities. Plant scientists have a vital role in developing better food and non-food production systems, biodiversity management and conservation of the natural environment. The need for solutions from them has never been greater. For plant scientists in the UK, the next few decades will be crucial. We need to increase our fundamental understanding of plant biology and the interactions between plants and the environment to conserve botanical diversity, make step changes in the genetic improvement of crops, and develop more sustainable land management practices. These advances will help to support and improve economic growth, ecosystem function, health and quality of life. Sustainable plant science research outputs at laboratory, field and national scale are vital for near-market agri-tech research and the fundamental, blue-skies bioscience that underpins it. The launch of the £160m UK Strategy for Agricultural Technologies in July 2013 reflects the Government's recognition of the importance of the agricultural technology sector to the UK economy. It shows commitment to encourage investment that will place the UK at the forefront of agricultural innovation. The Government has rightly acknowledged that investment in the conduct and exploitation of plant science research will not only benefit the UK's economic performance and sustainability but will also have a positive impact worldwide. We are keen to see this potential realised. The UK is placed second in global rankings of plant science publication impact. Of the five countries with the highest plant science publication impact, the UK is the most efficient. This is true whether expressed as publication impact per capita, or as a function of gross domestic product (GDP). Plant science research has led to a broad array of intellectual properties including plant varieties and novel chemically active compounds. The UK is strong in wheat, barley, forage grass and soft-fruit breeding, with a number of competitive and successful plant breeding companies carrying out commercial research and development (R&D) activities. The annual contribution to the UK economy of wheat, barley and forage maize breeding alone is in the range of £1–1.3bn, producing a 40-fold return on investment. Since 1982, at least 88% of yield increases for the major cereal crops and oilseed rape in the UK are estimated to have arisen through plant genetic improvement. Further examples of UK plant science with wide-reaching benefits include the development of new biotechnology solutions, tools and technologies to advance research, small molecules for crop protection and other purposes, and foods with improved health benefits. One of the UK's top plant science research institutes, the John Innes Centre, produces £30.4m of Gross Value Added for the UK economy each year. The revenue from commercialisation of UK plant science technologies by Plant Bioscience Limited (PBL), a small independent technology management company, totalled nearly £3m in 2012.

► **Q4. Please indicate at what level(s) and in what way(s) you have identified a vulnerability in the research area within the last 5 years.**

Please tick all that apply.

	Undergraduate	MSc	PhD	Post-doctoral researcher	Independent researcher	World leading researcher	Other (please specify below)
Recruitment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Retention	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diversity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Age profile	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Current numbers	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Future supply	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Limited training opportunities	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Lack of career paths to preserve skills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
New / emerging area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify below)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

► Please provide evidence for your answers below, giving as much quantitative information as possible.

In 2014, the UK Plant Sciences Federation (UKPSF) released the results of a consultation with over 300 representatives of the UK plant science community, providing an analysis of activities across this sector: <https://www.societyofbiology.org/policy/ukpsf/uk-plant-science-status-report> 96% of senior personnel from a range of UK public, private and third sector research institutions expressed concerns about gaps in plant science skills within their own organisations. Furthermore, aside from funding issues, insufficient numbers and an inadequate skills base were seen as the greatest barriers to meeting future challenges in UK plant science. According to the 47 organisations we surveyed, the UK needs improved training in-house, as well as through degree, postgraduate and specialised courses, in the areas of: • general plant science • taxonomy and identification • crop science • horticultural science • plant pathology • plant physiology • field studies. Additional shortages were noted in plant ecology, entomology and nematology, genetics and weed science. Applied and field skills are particularly in demand. For example, employers reported difficulties hiring scientists with specialist practical expertise in plant taxonomy, horticultural science, plant pathology and soil science. Without sufficient education and training opportunities in these areas, research bottlenecks will form and outputs will fail to translate into practice. Being prepared for and responding to plant disease outbreaks is a case in point. Although the UK has centres of excellence in the molecular biology of plant disease resistance pathways, there is a major shortage of UK field pathologists. A large proportion of professionals with specialist plant science skills are nearing retirement and there is a shortage of UK expertise available to replace them. • 62% of plant health specialists surveyed were aged 50 or over – only 4% were under 30 years old. • 50% of taxonomists surveyed were aged 50 or over – only 5% were under 30 years old. • 49% of horticultural scientists surveyed were aged 50 or over – only 5% were under 30 years old. Recent reports (by the House of Lords Science and Technology Committee; Royal Horticultural Society; British Society for Plant Pathology; NERC and the Royal Society) have also highlighted concerns about the age profile of the scientific workforce in these areas, as well as in plant entomology, physiology, breeding and soil science. The nation's capacity to teach these subjects has already been compromised and vital skills have been lost from the UK scientific community. If no action is taken, this loss may be irreversible within 10–15 years. It is crucial that education and training strategies are designed to respond to the needs of industry and technology sectors so that scientists are equipped with the necessary expertise for success in employment and to benefit society at large. Reasons for skills shortages in plant science include the following: 1. Low student interest in plant science reduces course availability. Many respondents expressed concerns about the low level of plant science uptake by students at degree level. Previous research carried out on behalf of the Gatsby Charitable Foundation also showed that the majority of UK students beginning biological science courses at university show little interest in, or knowledge of, plants. One reason cited for the low uptake of plant sciences was a perceived lack of clear career options for plant science graduates. Because of the increasing need for plant scientists to tackle major sustainability issues, more effort is needed to communicate the relevant opportunities to students considering bioscience degrees and careers. The relatively low level of student interest in plant science compared with other biosciences has contributed to a decline in the number of UK higher education institutions (HEIs) offering specialist plant science degree courses. Although many UK universities include some plant science within biology degrees, others offer little exposure to it. 2. Changes to biology curricula in schools and colleges Biology is a core part of science curricula across the UK, and the most popular science at A-Level. It has proved difficult to keep the biology curriculum in step with contemporary research as well as reflecting the broad base of core concepts across the many biological disciplines. The current position has left plant science poorly represented in biology curricula compared with biomedical science. This provides little incentive for busy teachers to invest time and energy in plant science education – particularly those who have neither a significant background in plant science from their degree, nor many opportunities to gain professional development in the subject. Furthermore, with plant science less visible at university, teachers may find it difficult to encourage school students to appreciate its importance as a thriving area of bioscience which they should aspire to study. 3. Insufficient and unstable funding UK plant science receives a total investment of approximately £125m per year from Government, levy boards and charities. This includes research and capital investment of £75m from BBSRC and £23.3m from the Gatsby Charitable Foundation, the two major funders of plant science research in the UK. Smaller contributions are also made by the Technology Strategy Board, Defra, Agriculture and Horticulture Development Board, Natural Environment Research Council (NERC) and Engineering and Physical Sciences Research Council (EPSRC). However, plant science receives less than 4% of UK public research funding. Funding fashions and patterns strongly influence which areas flourish or remain as richly skilled. Changes in political priorities and persistent erosion of funding for undervalued areas inevitably lead to skills shortages in certain areas. The withdrawal of Government funding from near-market research in the 1980s, followed by annual cuts to Defra's R&D budget since 2005, have led to a decline in applied plant science skills. The combination of costly infrastructure requirements (e.g. controlled plant growth facilities) and restricted funding opportunities for plant sciences, can encourage narrower faculty recruitment concentrated in specific areas. This in turn exacerbates the risk to vulnerable plant science topics and leads to degree courses with gaps in these areas. Having one major public funding agency for plant science has potential merits in creating a coherent, overriding investment strategy. However, it has placed plant science at a disadvantage relative to other areas of biology that can obtain funding from multiple public sources. BBSRC continues to run competitive research funding calls, allocating grants to a percentage of applications submitted to a committee. This method may not be the most appropriate for small fields of research as it can have disproportionate effects on the future of the discipline. Non-strategic grant applications must compete for a very limited pot of BBSRC money (12–15% of BBSRC's responsive mode budget) and plant science research that does not fit easily within BBSRC's remit has few other opportunities to receive funding. The inability to take grant applications to other funders creates reticence over submitting plant science proposals. This result in fewer the submission of fewer plant science applications, which in turn means that fewer grants are awarded. Although UK plant scientists maintain their world-leading reputation with relatively low investment, research outputs are decreasing. The annual number of UK plant science publications has decreased since 1996. In contrast, publication outputs from 18 of the 19 other leading countries increased during this period, as did the annual number of UK papers published across all scientific disciplines. Given the scale of the research challenges that plant scientists must address, greater public investment will be needed to achieve a critical level of outputs in plant science. 4. Uneven distribution of skills The distribution of expertise across UK research institutions is less even in some plant science specialisms than others, with the majority of skilled scientists concentrated in non-teaching organisations: • Most field plant pathologists in the UK are based within a small number of research institutes. • UK crop research tends to be focussed within research institutes and companies because universities often lack the finances and facilities to carry out this type of work. In areas where the majority of expertise resides outside of the academic community, the capacity of UK HEIs to teach particular specialist topics is potentially compromised and many such topics are not represented well in undergraduate courses. 5. Lack of employer-based training For non-educational organisations it does not make economic sense to provide in-house training to graduates lacking particular expertise if there is a supply of suitably trained staff from overseas. Companies therefore recruit from elsewhere in the world so as to obtain the skills they need at minimum cost. Nevertheless, even for highly skilled scientists, the stringency of immigration restrictions makes this increasingly difficult.

► **Q5. Why does this skill need to be enhanced in the UK, rather than by recruiting individuals from abroad? What would be the impact of losing UK expertise in this area?**

The supply and retention of skills from overseas can not be guaranteed. Other countries are also experiencing skills shortages in some of the vulnerable areas of plant science. For example, in France a high proportion of plant entomologists are over 50. In the US there is concern about the natural history side of plant science declining. The stringency of immigration restrictions makes it increasingly difficult to recruit from abroad. The plant science work force needs to grow considerably to meet the scientific challenges outlined above, so it is particularly important to continually produce home-grown talent to meet this skills demand sustainably.

► **Q6. Please tell us about any relevant interventions (that you are aware of) by institutions, companies or professional societies.**

Please be as specific as possible and consider all appropriate intervention methods, including for example training courses and positions, workshops, networking events, Continuing Professional Development (CPD), summer schools, etc. Please indicate the scale of the intervention if possible (e.g. numbers of training positions available per annum).

Evidence suggests that exposing first year undergraduates to high quality plant science teaching can be successful in stimulating greater interest and uptake of plant science courses in their second and final years, and can increase the number of graduates selecting plant-based PhDs. In 2004, the Gatsby Charitable Foundation began an annual summer school that selects 80 high-achieving first year undergraduate students from 26 UK universities. It immerses them in a week-long series of lectures, tutorials, practical classes and careers sessions, covering a broad range of cutting-edge plant science topics. A five-year study on the impact of the summer school demonstrates that participants show a significantly greater and sustained interest in plant science afterwards. Many changed their degree course selection to contain more plant science modules and those who went on to study for PhDs were nearly four times more likely to choose plant science topics than biology graduates who had not attended the school. Reference: Levesley, A. et al. Plant Cell 24(4), 1306–1315 (2012). <http://www.slcu.cam.ac.uk/outreach/gatsbyplants> The Nottingham Summer School in Plants and Crops was created to show Year 11 students the importance of plant and crop science in feeding the growing world population, and what it would be like to study a plant or crop degree at university: <http://www.nottingham.ac.uk/biosciences/community/summer-schools/plants-and-crops-summer-school.aspx> A leaflet produced by the Society for Experimental Biology and the UKPSF in 2013, titled 'Your Future with Plant Science', aims to communicate to students considering bioscience degrees and careers, the range of opportunities in plant science. The Institute of Education take their trainee biology teachers to Kew for a week where they do a range of plant science activities. Science and Plants for Schools (SAPS) also run two day events for those who train teachers, where they have practicals and talks from plant scientists. The UKPSF has established a plant science training and skills working group to address some of the priority skills issues outlined. We would be happy to work together with BBSRC and MRC. Should you wish to discuss anything with us, please contact [mimitanimoto@societyofbiology.org](mailto:mimitanimoto@societyofbiology.org)

▶ **Q7. For the identified area, describe what actions could be taken forward by BBSRC / MRC (in partnership with others, where appropriate) to support the efforts identified in question 6.**

Useful training opportunities could be created by funding apprenticeships, employer-led training, industrial studentships and teaching fellowships. Support for a young plant science ambassadors scheme for students and postdocs to go into schools to teach children about plants and talk about careers. Increasing the number of funding sources for plant science would help to grow the plant science community. MRC could consider funding plant science work relating to nutrition, food safety, diet, medicine and plant metabolic pathways. Cross-Council funding streams could also be considered. Time scales for funding must also be realistic. In practice, it is difficult for researchers to obtain sequential grants for long-term projects, so group leaders have three to five years to turn basic research into an applied concept that attracts industrial investment. This is a very short time frame for plant scientists who often need to create several sequential generations of plants to obtain results, particularly those working on tree and crop species. A funding scheme that reflects the long term nature of plant science research relating to BBSRC/MRC strategic priorities could be considered. There is an urgent need for more crop science research and teaching in universities but the high cost and infrastructure requirements are a major barrier, as mentioned. A fund to support this infrastructure in universities could make a big difference.

▶ **Are there any other skills / capability research areas that you wish to highlight?**

Yes

No

▶ **If you have any further comments you wish to make, please do so in the box below.**

Much of this evidence and relevant references can be found in our report: UK Plant Science: Current status and future challenges. A report by the UK Plant Sciences Federation (January 2014). <https://www.societyofbiology.org/policy/ukpsf/uk-plant-science-status-report>

Thank you for your input. **Please click on the Submit button below to send your response.**

The information you submit in this survey will be treated in confidence. It will be reviewed by BBSRC and MRC staff and their strategy advisory panels, but will not be passed on to others without your permission. Aggregated responses will be published in a report.