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# REPORT ON A SKILLS AUDIT

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*Undertaken for*

The British Society for Plant Pathology

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This is an edited version of the original report, submitted by Professor Dixon in February 2007, following discussions by BSPP board members Peter Mills, Eric Boa, Nicola Spence and Richard Cooper in May 2007. Formatted by Eric Boa.

## **I**n t r o d u c t i o n

*The British Society for Plant Pathology (BSPP) was founded in 1981 for the study and advancement of plant pathology. The BSPP draws its membership from more than 60 countries and from all branches of plant pathology.*

*The BSPP supports the professional interests of plant pathologists worldwide and provides information to its members via a newsletter, website and annual meeting.*

*As a registered charity the BSPP derives income from members and from two international plant pathology journals, committing expenditure on organization of scientific meetings, travel funds for members and for short term visiting fellowships, student bursaries and innovation projects.*

In 2006, an 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 purpose was to undertake an audit of BSPP members working in the sub-disciplines of plant pathology, to collect information on training and employment records and where possible to draw comparisons with the situation 10 and 20 years previously.

The process involved collection of data through on-line questionnaires for members, phone questionnaires with employers and through a review of job advertisements in New Scientist. More than 120 respondents (approximately 20% of the membership of the Society) completed the on-line questionnaire and 15 organizations took part. Surveys were conducted between September 2006 and January 2007.

The audit was undertaken by Professor Geoffrey Dixon during my tenure as President and I want to express my thanks, on behalf of the BSPP, for the work he has diligently undertaken.

*Peter Mills*

President BSPP 2006



## Summary

### Main findings

**The number of students graduating with a higher degree and entering employment in the discipline of plant pathology has increased over the last 30 years (based on respondents currently employed).**

**Whilst the number of organisations employing plant pathologists has also remained fairly stable over the last 15 years, the distribution of posts across these organisations has changed very significantly. A small proportion of organisations now employ larger numbers of pathologists.**

**Current posts are more likely to require competence and knowledge of molecular biology skills rather than applied skills.**

- **UNDERGRADUATE TRAINING** The number of respondents with degrees entering the profession per decade appears to have remained constant between the 1970s and the end of the 1990s. First degree topics covered a wide range of applied biological or plant science subjects from 31 educational institutions.
- **POST-GRADUATE TRAINING** More than 90% of BSPP members are educated to higher degree level. The total number currently employed in the profession with post-graduate training appears to have increased in each decade from the 1970s onwards.
- **CONTINUOUS PROFESSIONAL DEVELOPMENT (CPD)** More than one third of respondents have undertaken some form of CPD with the British Agrochemical Supply Industry scheme (BASIS) being the most commonly undertaken training.
- **POST-DOCTORAL RESEARCH** More than 60% of respondents have undertaken at least one period of post-doctoral employment of which more than 40% have undertaken 2 or 3 periods.
- **PERMANENT EMPLOYMENT** Approximately 80% of respondents are now employed in 'permanent' posts and based on the year in which these respondents were appointed it would appear that the number of permanent posts continues to increase. These data may however be interpreted in other ways (see main report)
- **EMPLOYERS** Fifteen organisations took part in the survey of employers. The business sectors covered by these organisations included education, research (applied through to basic), regulatory science and service provision. Eleven organisations reported a decline in the number of plant pathologists employed over the last 15 years. Four organisations reported an increase in the number employed over the same period.
- **SKILLS** The fit of skills required by employers and those identified by the respondents is good in terms of academic qualifications. However, more detailed analysis of employer requirements identified some demand for competencies in whole organism biology and also bioinformatics and business skills.

## **C**lient's Brief

The Client's Brief underpinning this Enquiry was encapsulated in the terms of a Special Fellowship Award publicised in BSPP News (Anon, 2006b).

Plant Pathology skills audit:

*BSPP Board wishes to commission a short desk study to undertake a skills audit for plant pathologists in the UK. The study would involve an audit predominantly of those currently working in all of the sub - disciplines of plant pathology in UK Research Institutes, Government Agencies, Universities, the agrochemical industry, consultancies and any other major employers. It may be constructive to draw comparisons with the situation 10 and 20 years ago. It is envisaged that data could be collected through contact with organisations, individuals and through questionnaires.*

(reprinted from BSPP News - The Newsletter of the British Society for Plant Pathology, number 50, spring 2006 page 30).

The Fellowship was awarded to Professor G R Dixon ('the contractor') working under the auspices of GreenGene International. The 'client' was represented by Professor P Mills, then President of BSPP.

## Methodology

Three approaches for information gathering were agreed with the Society.

1. MEMBERS' QUESTIONNAIRE canvassing information on education, careers, employment and interests. This was designed by the Contractor and agreed by the Client. It was posted on the BSPP website ([www.bspp.org.uk](http://www.bspp.org.uk)) by Dr J. Clarkson following an email alert to members. Hard copies were sent by postal mail to those members without access to the website via the Membership Secretary, Dr N. Evans. The questionnaire appears in Appendix 2. The questionnaire was sent out in mid October 2006 with a return date in the first week of November. This allowed three weeks for responses. Emerging findings from the members' questionnaires were provided to Professor P Mills for use in the Jubilee Meeting of the BSPP held at Imperial College, London on 19 December 2006 (Appendix 1).
2. EMPLOYERS' (TELEPHONE) QUESTIONNAIRE canvassing information from senior managers responsible for employing plant pathologists in a range of businesses. Again the format of the Questionnaire was agreed between Client and Contractor before circulation. Employers were sent a copy of the questionnaire by email in advance of a telephone conversation arranged at their convenience. Conversations lasted between 20 and 60 minutes and elucidated views on the current market for plant pathologists, the skill base needed and the availability of suitably qualified candidates. A copy of the questionnaire is given in Appendix 3 and the 15 employers who took part appear in Appendix 4. This survey was completed in the first two weeks of January 2007.
3. REVIEW OF ADVERTISEMENTS to identify the changes in the market for plant pathologists as identified by job advertisements. As the enquiry progressed it became apparent that changing demand and description of plant pathologists could be understood through the advertisements for their posts. Time constraints did not permit more than a very brief and imperfect investigation through this source of information. Advertisements in the *New Scientist* were assessed qualitatively for the first six month periods of 2005 and 1985. In the telephone questionnaire it became apparent that the *New Scientist* is the preferred journal used by most employers to advertise posts for plant pathologists in the UK.



## Results - Membership Questionnaire

The response received was 127 replies; of which 13 were hard copy; 2 direct email and 112 via the website. Approximately 650 questionnaires were sent with a response rate of around 20%.

Responses and comments are arranged in six general areas. The numbers of the questions are shown in brackets. These correspond to information requested in the questionnaire.

- Work, interests (Q1-5)
- Study, first degree (Q6-18)
- Study, MSc (Q19-26)
- Research, PhD (Q27-34)
- Postdoctoral, other qualifications (Q35-41)
- General information (Q42-51)

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### WORK, INTERESTS

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#### *Q1 "Please describe your status"*

##### MAIN CATEGORIES (118)

1. consultant = 12
2. post - doctoral worker = 12
3. postgraduate = 10
4. research manager = 2
5. research scientist = 65 (1 retired)
6. service provider = 4
7. teacher = 13 (1 retired)
8. undergraduate = 0

##### OTHERS (33)

1. administrator = 4
2. advisory pathologist = 1
3. associate professor = 1
4. government official = 2
5. head of university department = 1
6. plant doctor (international devt) = 1
7. professor (retired) = 1
8. project manager = 1
9. purchasing manager (agriculture) = 1
10. retired = 13
11. senior journal editor = 1
12. university/senior lecturer = 6 (1 rtd.)

Grand total = 151 (some double counting where more than one 'status' was quoted). The majority of replies came from 'research scientist category'. These could be either in research organisations (public, private or charity - see the section on the structure of employer organisations) or from universities. Few members claim to be 'teachers' either from the higher education sector or from further education and schools. This possibly reflects the view that members have of themselves particularly emphasising the impact of the Research Assessment Exercises (RAEs) which have discouraged the attitude of being 'a teacher'.

#### *Q2 "What is the broad area of activity of your employer?"*

##### MAIN CATEGORIES

1. college = 4
2. consultancy = 5
3. heritage services = 0
4. manufacturing industry = 6
5. research institute = 41 (1 retired)
6. service industry = 4
7. university = 36

##### OTHERS

1. civil service = 1
2. government (unspecified) = 4
3. government research agency = 1
4. government research policy = 1
5. independent research = 1
6. international development = 1
7. levy board = 1
8. organic charity = 1



4. **blights, spots and blotches = 34**
5. **damping - off pathogens = 22**
6. **downy mildews = 25**
7. foot and collar rots = 18
8. mycoplasma - like organisms = 12
9. **necrotrophes = 28**
10. **powdery mildews = 29**
11. plasmodial organisms = 14
12. **rusts and smuts = 29**
13. **soil borne pathogens = 35**
14. **viruses = 26**
15. water moulds = 13
16. wilts = 18

OTHER (16):

1. ergot = 1
2. hemi - biotrophs = 2
3. nematodes = 5
4. oomycetes = 1
5. phylloplane saprophytes = 1
6. post harvest pathogens = 1
7. potato pathogens = 1
8. quarantine = 1
9. sclerotial pathogens = 1
10. skin blemishes of potato = 1
11. viroids = 1

Grand total = 408. Respondents' interests divided across all the pathogen groups. The largest areas of interest (> 20 claims) are shown in bold.

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### STUDY, FIRST DEGREE

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*Q 6 "Which crop group(s) relate (s) most closely to your work?"*

MAIN CATEGORIES (371)

1. amenity and parkland plants = 8
2. bulbs = 10
3. **cereals, temperate = 35;**  
**tropical = 11**
4. drug and pharmaceutical crops = 4
5. fibres (including cotton) = 5
6. **field vegetables = 29**
7. fodder and forage = 12
8. grass and sports turf = 11
9. hop = 4
10. legumes = 14
11. model plants = 8
12. nuts = 5
13. **oilseeds = 17**
14. **ornamentals, open field = 16;**  
**protected = 17**

15. plantation crops (inc. sugar beet) = 14

16. **potato = 36**
17. **protected vegetables = 18**
18. **roots and tubers = 17**
19. rural and urban trees = 11
20. **soft and berried fruits = 27**
21. **tree fruit, temp. = 23; trop. = 19**

OTHER (7)

1. cucurbits = 1
2. weeds = 1
3. energy crops = 1
4. tomato = 1
5. industrial crops = 1
6. quarantine = 1
7. tropical crops (unspecified) = 1

Grand total = 378. Crop groups of greatest importance (>15) are shown in bold.

*Q 7 "What is your first degree qualification?"*

Agricultural Botany	7	Botany with Geology	1
Agricultural Science	3	Crop Genetics and Plant Breeding*	1
Agricultural Engineering	1	Diplom (Vienna)	1
Agriculture	8	Diplom Biologie (France)	1
Agronomy	1	Diplom Horticulture (Germany)	1
Agronomic Engineering*	1	Ecology	1
Agronomy and Plant Breeding		Environmental Science	2
Applied Biology	6	Genetics	3
Applied Microbiology	1	Horticulture	3
Biochemistry (BA)	1	Horticultural Science (New Zealand)	1
Biochemistry	4	Ingenieur*	1
Biological Science	10	Member of the Institute of Biology	2
Biology	10	Microbiology	5
Biology with Ecology	1	Natural Science 3 (MA degree)	
Biology with Geography	1	Plant Biology	3
Biology with Sociology	1	Plant Pathology (non UK)	1
Biomedical Science	1	Plant Science (Greece)	1
Botany	10	Plant Science	8
Botany & Plant Path. (South Africa)	1	Zoology	1

\* The Netherlands.

The majority of respondents hold first degree qualifications in some form of 'applied biological or botanical science'. A few are qualified by the professional M I Biology route, or hold qualification in atypical subjects such as biochemistry, engineering or zoology. Respondents coming from Europe frequently hold 'Diplom' or 'Ingenieur' qualifications. As a result of the Bologna Process it is now possible to equate these accurately with the Bachelor degrees awarded by British universities. Older respondents hold qualifications in Botany which has now been largely replaced since the mid 1970s by awards in Plant Science often with ancillary subjects attached. British universities went through a period of degree proliferation in the late 1980s and early 1990s that produced an array of qualification titles. Departments were often amalgamated. In this period courses entitled 'Agriculture' or 'Horticulture' tended to lose student numbers but 'Biology' courses maintained or increased their student entry.

*Q 8 "Did your first degree contain aspects of plant pathology / microbiology / virology / crop protection"?*

**Yes** = 107; **No** = 2.

*Q 9 "What were the core subjects?"*

102 respondents. 6 took first degrees which did not contain some relevant aspect of plant pathology and / or related topics as core subjects.

The majority (96 or 94%) received instruction in:- applied microbiology, bacteriology, chemical control, crop protection, diagnosis, disease management, entomology, epidemiology, fungal life cycles, microbial ecology, microbiology, molecular plant pathology, mycology, nematology, oosporic fungi, plant pathology, pest management, pests and pathogens of crop plants, physiological plant pathology, phytopharmacy, plant microbe interactions, resistance breeding and virology. Those whose courses were not related to plant pathology appeared to have taken medical biology courses.

*Q 10 "In which years of the course were these topics taught?"*

Respondents were taught plant pathology and related topics in :-  
Year 1 = 33; Year 2 = 70; Year 3 = 84; Year 4 = 24 and Year 5 = 2.

Plant pathology is taught mostly in years 2 and 3 (linked to honours dissertation possibly). Four year courses are either Scottish degrees or thick - sandwich courses where a 12 month period is (was) spent in industry. These courses were very popular in the 1980s and early 1990. They lost favour once course fees were introduced because the students were required to pay fees during their periods of industrial training.

*Q 11 "How many semesters were devoted to plant pathology and related topics?"*

One semester = 10; two semesters = 14; three semesters = 17; four semesters = 13; five semesters = 2; six semesters = 6; seven semesters = 2; eight semesters = 3; nine semesters = 9; ten or more (max. 12) semesters = 3

The teaching of plant pathology and related topics could legitimately be spread over two to four semesters or concentrated into a single semester and this data tends to support that assertion. Those suggesting that they were taught for longer periods either may be confusing the use of 'semester' with 'term' (semesterisation started to be introduced into British universities in the 1980s) or their studies took place in Continental Europe where until recently courses of 5 to 6 years were commonplace.

*Q 12 "Did you receive practical instruction and was this confined to the laboratory or included field work?"*

Received practical instruction = 96; laboratory only = 83; field work included = 47.

Of the total number of respondents (127) 76% claim to have received some form of practical instruction, 65% received laboratory - only instruction and 37% gained some type of field experience. Included in the latter category are respondents who underwent thin and thick sandwich training during their degree courses. The data reported are not additive because not all respondents answered all the stages of this question.

*Q 13 "Was your dissertation / project related to plant pathology or an allied topic?"*

**99 responses** of whom 64 (65%) said yes.

By year three (or four in Scotland) a majority of students who go on to become professional plant pathologists have already established a basis of knowledge, experience and involvement with the discipline.

*Q 14 "Did you undertake vacation work related to plant pathology or a similar subject?"*

**105 responses** of which 48 (46%) stated they undertook vacation work related to plant pathology or a similar discipline. This may reflect the shortages of part time / vacation work which developed in the 1980s and 1990s and the often inadequate remuneration which accompanied such employment.

*Q 15 "Was there any contact with business and industry during your course?"*

102 responses of which 47 (46%) received no contact with business and industry during their first degree course. Those that did receive contact indicated that it varied from "a little" to substantial periods spent working as sandwich course students.

*Q 16 "In what year did you graduate?"*

- |                       |                      |
|-----------------------|----------------------|
| 1. prior to 1960: = 9 | 4. 1981 - 1990: = 23 |
| 2. 1961 - 1970: = 12  | 5. 1991 - 2000: = 25 |
| 3. 1971 - 1980: = 28  | 6. 2001 onwards: = 7 |

There were a total of **104 responses** to this question, those in the pre 1960 and 1961 to 1970 cohorts represent people who have retired or are very close to doing so. The cohorts 1971 - 1980, 1981 - 1990, and 1991 to 2000 are members actively engaged in careers. On the basis of the small numbers available it appears that there has been no increase in the numbers of plant pathologists in employment who graduated between 1971 and 2000. If anything there is a slow decline in employment. The figure for 2001 onwards represents people just beginning to set out on their careers and who would have graduated up to 2003 (there was one respondent who graduated in 2006). Assuming that there will be 21 plant pathologists in the cohort 2001 to 2010 there are grounds for arguing that the profession is continuing to diminish.

*Q 17 "Where did you study - UK centres?"*

Aberdeen 1994, 1975	Liverpool John Moores 1983
Aberystwyth 1989, 1969, 1970, 1972	London (College unspecified) 1990
Bangor, 1992, 1999, 1991, 1967	Manchester Metropolitan 1988
Bath 1973	Manchester, 1969
Birmingham 1969, 1991, 1978	Nottingham 1998, 1996
Bristol 1974, 1988, 1975, 1960	Oxford 1982, 1997, 1971
Cambridge 1978, 1973 (2), 1964, 1950	Plymouth 1999
Dundee 1982	Portsmouth 1983
East Anglia 1970, 2001, 1994	Reading 1950
Edinburgh 1980, 2004, 2001, 1940	Sheffield 1974, 1987
Greenwich 1990	Southampton 1961, 1966
Hertfordshire 1973	Strathclyde 1973
Imperial (S Ken.) 1981, 1979, 1948	West of England 1992
Imperial (Wye), 1965, 1978, 1955	Wolverhampton 1990
Leeds 1988, 1975, 1998	York 2003
Liverpool 1980	

Years cited in order of processing questionnaires. Institutions cited without the year of graduation included Napier and Cirencester. Relatively few respondents answered this question, one indicated that it could remove the claim to 'anonymity' in the Survey. Mainly the institutions attended are those that are classed as the 'Russell Group'.

*Q 18 "Where did you study outside the UK?"*

Austria 1 (Vienna)	Iran (Shiraz)
Canada 3 (Guelph, Manitoba 2)	Netherlands (unspecified)
China 1 (unspecified)	Netherlands + France
Colombia 1 (National University)	New Zealand (Lincoln) 2
Germany 3 (Aachen, Tübingen, unspecified)	Portugal
Greece 3 (Athens 2, unspecified)	South Africa 1 (Natal)
India 2 (Madra, unspecified)	USA (unspecified)

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**STUDY, MSc**


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*Q 19 "Did you take a taught Masters Degree in plant pathology / microbiology / virology / crop - protection or related topics?"*

**Yes= 49 No= 78**

All respondents (127) answered this question and the majority did not take a masters degree. One respondent who was trying to join an M Res course indicated that this was a difficult process because application numbers do not reach the level required for course viability.

*Q 20 "List the core subjects?"*

14 of 20 respondents said they had studied plant pathology or a closely related topic. These included: Bacteriology, Disease management, Entomology, Molecular plant pathology, Mycology, Nematology, Pesticide science, Plant microbe interactions, Plant protection, Virology and Weed science. Other topics cited included: Agronomy, Biotechnology, Botany, Chordate zoology, Economics, Experimental design, Genetics, Invertebrate zoology, Medical microbiology, Plant breeding, Plant physiology, Statistics and Taxonomy.

*Q 21 "List relevant elective subjects"*

These included: Biochemistry, Biocontrol, Biosafety, Diagnostics, Ecology, Entomology, Genetics, Host - pathogen interactions, Molecular biology, Molecular plant pathology, Parasitology, Plant physiology, Plant transformation, Remote sensing, Resistance genetics, Risk assessment, Vegetable diseases and Virus - insect relationships.

*Q 22 "What practical / field work was involved?"*

Only 3 respondents had no practical or field work during their M Sc course. Some 33 indicated that they did receive such classes but the substance of them varied enormously. Only 9 specified directly receiving both laboratory and field studies. Five appeared to have received field experience but no laboratory work which may indicate they had not completed this question correctly. Work which was specifically cited included: Bacteriology, Bioinformatics, Clover rot surveys, Crop walking, Diagnosis, Farm visits, Field trials, Fungicide efficacy trials, Herbarium studies, Histopathology, Internship, Isolation and identification, Molecular biology, Nematode surveys, Sequence analysis and Virology.

*Q 23 "What was the topic of your dissertation?"*

Abridged titles are cited:-

agrobacterium and molecular genetics	genetics wheat - yellow rust interaction
amino acids in legumes	nematode survey
apothecia formation in sclerotinia	potato blight control
barley haplotypes	potato pathogens
bioassay for potato rot	powdery mildew
biological control	reducing sugar in diseased potato
biological control of citrus pathogens	resistance to clover rot
coat protein of tristeza virus	rhizoctonia;
compost waste used for disease control	rhizoctonia and soil amendment
control strategies for insects	soft rot of Canna lily
diagnostics	spore dispersal
eyespot biological control	statins of Xanthomonas
field assessment of fungicides	sunflower rot
forsythia galls	tomato spotted wilt virus
fungal genetics	weeds in barley crops
fungicides	wheat dwarf virus

*Q 24 "What was the level of business and /or industrial contact / involvement during your course?"*

Twenty respondents indicated that there was some form of industrial or business contact or involvement during their course, 16 had none whatever. Those where there was contact indicated that it varied from research being undertaken at an industrial partner's premises to minimal levels simply consisting of farm visits.

*Q 25 "What was your year of MSc graduation?"*

prior to 1960: = 3	1981 - 1990: = 6
1961 - 1970: = 3	1991 - 2000: = 13
1971 - 1980: = 5	2001 onwards: = 6

Overall total =36. The largest number of graduations at MSc respondents was the 1991 to 2000 cohort (36%).

*Q. 26 "Where did you study for your MSc?"*

UNITED KINGDOM	Imperial College 2
Aberdeen 2	Leeds
Aberystwyth	Newcastle
Bath	Reading
Cambridge	Westminster
Harper Adams 3	Wolverhampton
Imperial (Wye)	

Of **37 responses**, 20 studied in the UK and 17 elsewhere. The non-UK centres included:

ELSEWHERE	Iran 2 (Tehran, unspecified)
Athens (Greece)	Manitoba (Canada) 2
Colombia (unspecified)	Phillipines
Greece (unspecified)	The Netherlands + France
Guelph (Canada)	USA 2 (Cornell, unspecified)
India 3 (Madras, unspecified 2)	Wageningen (The Netherlands) 2

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## RESEARCH, PhD

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*Q 27 " Did you take an M Phil., PhD. or D Phil qualification?"*

127 Responses. **Yes** = 116 **No** = 11 (of which 4 are current students).

The vast majority of BSPP members hold doctorates. Plant pathology is a very highly qualified profession, 91% are educated to second degree level (95% if current students are included).

Q 28 "What was your research area or topic?"

<i>Agrobacterium tumefaciens</i>	epidem. splash diseases	plant physiology and betacyanin
agronomy, hort., plant path. and bacteria	Ergot	plant virology 2
<i>Alternaria</i>	<i>Erwinia</i>	potato blight 4
<i>Armillaria</i>	<i>Erysiphe</i> control	potato gangrene 2
avirulence mapping	ethylene, wilt diseases	powdery mildew
bacterial genetics and molecular biology	fungal metabolism and molecular biology	<i>Pyrenopeziza</i> diagnostics
bacterial systematics	fungal physiology	resistance linkage mapping
barley mildew	fungal reproduction	<i>Rhizobium</i>
biochem. plant path.	fungicides and diagnostics in cereals	<i>Rhizoctonia</i>
biochemical resistance	<i>Fusarium</i> ear blight	<i>Rhizoctonia</i> on rice
biocontrol 2	gene silencing	rhododendron powdery mildew
biocontrol of eyespot	host-path. interactions	root invading fungi
biocontrol of soil borne pathogens	human virology	root lesions on wheat
biocontrol sclerotinia	infection structures	rusts
biocontrol of take all	insect pops. & cytogenetics	<i>Septoria</i>
biotrophy and oomycetes	lettuce pathogens	soil borne pathogens
botanical epidemiology	modelling host - pathogen relations	soil microbiology
botrytis on soft fruit	molecular characteristics of soil borne pathogens	soil sterilisation and biocontrol
<i>Burkholderia</i> diversity	molecular diagnosis	<i>Spiroplasma</i>
canker of rape	molecular plant path. 3	strawberry powd. mild.
cell biology (and fungal structures)	molecular responses to invasion	systems biology
cereal diseases	mosaic virus pigeon pea	take all biocontrol
cob rot of maize	mycological plant path.	theoretical physics
<i>Colletotrichum</i>	<i>Mycosphaerella graminicola</i>	tobacco pathogenesis
cucumber mosaic	nematodes on wheat	proteins
cyanogenetic glucosides	pathogenicity <i>Ralstonia</i>	tomato powd. mildew
denitrification and biocontrol	pathogens of <i>Lolium</i>	tomato wilt resistance
diagnostics of potato diseases	pea powdery mildew	tree pathology
disease control in herbs	phys. plant path. 2	turf grass pathology
disease resist. wheat	physiol. races mildew	<i>Verticillium</i> wilt of tomato
downy mildew	phytoalexins	virology
dutch elm disease	plant pathology 3	virus disease & drought
chemotherapy	plant path. & myc.	virus resistance
epidem. & host resist.	plant physiology	weed biocontrol
		<i>Xanthomonas</i> 3

Q 29 "What taught courses were provided? Were these obligatory?"

advertisement writing	diagnosis methods	genetics
agricultural & rural development	ecology 3	Genstat (specified)
bacteriology	ecophysiology	German
biochemistry	English	information tech. 2
biometrics 2	epidemiology	isotope technology
biometry	essay topics	key board skills
Cambridge (one term)	experimental & theoretical plant path.	mathematics
career development	experimental design 2	microbe interactions
cytology	experimental methods	molecular biology
		mycology

nematology 2	Powerpoint (specified)	soil science 2
pathogenesis	presentation 3	statistics 15
personal skills	research skills 2	teaching methods
physics	Russian	Thesis preparation 2
plant pathology 4	safety	Time management
plant physiology	scientific writing 2	transferable skills
population genetics	social impact of science	virology 2

**112 responses on courses:** 74 (66%) received no additional teaching during postgraduate studies. Statistics is the most important subject. **45 responses on obligatory/voluntary.** 15 said the courses were voluntary, 30 that they were voluntary.

*Q 30 "How were you supported during your PhD studies?"*

Independent mentor: **Yes** = 42; **No** = 67 (n=109)

Postgraduate committee: **Yes**= 26; **No**= 81 (n=107)

62% of postgraduate students had no independent mentor, while 76% had no support and guidance from an outside committee.

*Q 31 "What was the length of your PhD study?"*

36 months\* = 57

37 – 48 months = 40

54 months = 1

60 months = 10 (this included 2 part - time students).

110 responses. Most complete their work within the statutory 3 year period, though 18% required an additional year. \* one person completed in 24 months, two in 27 months.

*Q 32 "What was the level of business and /or industrial contact / involvement?"*

**Little**= 14; **Some**= 18; **Lots**= 27; **None**= 46

Those who received 'lots' of industrial / business contact during their postgraduate studies were either formal CASE students (9) or were employed during the research period. Two CASE students said they had *No* such contacts during their research period.

*Q 33 "When did you receive your PhD?"*

prior to 1960: = 5 (4%)

1961 - 1970: = 7 (5%)

1971 - 1980: = 23 (21%)

1981 - 1990: = 24 (21%)

1991 - 2000: = 32 (29%)

2001 onwards: = 21 (20%)

112 respondents of which 47% achieved their PhDs between 1991 and current, 50 percent achieved this status in the period 1981 to 2000. This might be construed as evidence that the Society's membership is declining slightly. On the other hand membership appears to be being maintained in the most recent cohort (2001 onwards).

*Q 34 "Did you study in the UK or elsewhere for your PhD??"*

UNITED KINGDOM (88)	Imperial 9
Aberdeen 2	Imperial and East Malling
Aberystwyth 3	Imperial and Rothamsted
BBSRC Institute	John Innes (and 1 shared)
Belfast	Lancaster
Birmingham 5	Leeds 2
Bristol 6	Liverpool and Rothamsted
Cambridge 3	Manchester
Derby	Newcastle 2
Dundee (SCRI) 2	Nottingham
East Anglia 3	Nottingham and Rothamsted 2
Edinburgh 4	Oxford
Exeter	Reading 4
Harper Adams 2	Rothamsted (and 4 shared)
Harper Adams and John Innes	Sheffield 3
Hertfordshire 3	Southampton 2
Hull 2	Stirling
IGER Aberystwyth	University College London
Imperial (Wye) 3	Warwick
ELSEWHERE (16)	
Australia 3, Adelaide University	Poland, Jagellonian University
Denmark, Aarhus	Portugal, Lisbon
Germany, Aachen	Rhodesia, University of Rhodesia
India 2 (Madras, unspecified)	Netherlands
Netherlands, Wageningen	USA 5 (Cornell 2, New Mexico, unspecified 2)
New Zealand 2, Lincoln	

88 respondents in the UK, and 16 respondents elsewhere

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**POSTDOCTORAL, OTHER QUALIFICATIONS**


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*Q 35 "Do you hold any other qualifications? If so, please specify".*

**Yes** = 35 **No** = 70 (n=105).

BASIS 7	German
Cambridge MA	Health & Safety qualifications
Chartered Microbiologist	HND Applied Biology
College Diploma in Horticulture (Nottingham University)	Master of Arts
Common Professional Qualification (legal)	Membership of the Institute of Biology / Chartered Biologist 4
Counselling	National Diploma in Agriculture
Diploma in Education	National Proficiency Tests
Diploma of Imperial College 5	Post graduate diploma in computing
DSc 5	Professional Agrologist
Fellow, Institute of Horticulture 2	Teaching English as a foreign language

The most popular additional qualification is BASIS, presumably because it is needed by statute in order to provide advice for the chemical control of plant pathogens.

*Q 36 "Have you undertaken periods of post - doctoral employment? If so, how many?"*

**116 responses. Yes** = 73 (63%) **No** = 43. Only 69 noted the number of periods:

One = 33  
Two = 15  
Three = 14

Four = 4  
Five = 2  
Six = 1.

One person recorded 10 years working in the first post - doctoral employment, presumably this can be interpreted as that contracts were continuously renewed by the same employer.

*Q 37 "Was your post - doctoral employment related to plant pathology?"*

**74 responses** were received of which:- **Yes = 67 No = 7**

More respondents answered this question as compared with the number who recorded that they had been employed as post - doctoral students. Information elsewhere indicates that there are people now employed in permanent / tenured posts whose post - doctoral experience is from outside plant pathology. Consequently, the outcome of responses to the question appears to be correct in that most current plant pathologists have undertaken post - doctoral studies and that these were related to the subject.

*Q 38 "Did you work (as a post - doctoral employee) for a UK based organisation?"*

**Yes = 57 No = 14**

71 responses. Several respondents served more than one period of post - doctoral employment (see Q36). Most postdocs worked in the UK for at least for one contract.

*Q 39 "Did you work (as a post - doctoral employee) for an organisation in another European or EU country?"*

**Yes = 14. No = 48 (n=62).**

*Q 40 "Did you work outside Europe or the EU?"*

**Yes = 16 No = 45 (n=61).** There appears to be a consistent trend in that most post - doctoral employees have not worked outside the UK.

*Q 41 "What were the dates of your post doctoral employment?"*

prior to 1960: = 1  
1961 - 1970: = 4  
1971 - 1980: = 12

1981 - 1990: = 22  
1991 - 2000: = 36  
2001 onwards: = 26

73 responses. The results are expressed using the year cohorts applied to graduation dates for first and second degrees. Where the post - doctoral employment spans more than one cohort period it is recorded in both. Hence the sum of cohort periods exceeds 73. The total numbers recorded for all cohorts is 101, consequently about 30 respondents served periods of post - doctoral studies that spanned two or more cohort periods. As could be expected most post - doctoral periods are in cohorts from 1981 onwards with 26% in the period 2001 onwards ie what is presumably the younger generation starting out on their careers in the profession.

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## GENERAL INFORMATION

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*Q 42 "Are you now employed in a 'permanent' / 'tenured' / 'superannuated' post?"*

**Yes** = 92 **No** = 26.

118 responses. 6 identified themselves as 'retired' which presumably equates with 'superannuated' and there were 2 replies in the 'Yes' group from outside the UK. It is not clear if any Postdoctoral employees said that they are 'permanent' or 'tenured', reflecting possible ambiguity in terms and conditions of employment.

*Q 43 "Do you consider yourself as a professional plant pathologist?"*

**Yes** = 87 (1 retired) **No** = 11.

*Q 44 "What aspects of your training fit you for this role (professional plant pathologist)?"*

ADAS experience	Laboratory skills
Background in cell biology	Microbiological training
Basic mycology	Molecular biology skills 2
Broad background 3	None
Broad first degree followed by PhD 49	Not trained for current job
Diagnostic and analytical skills 3	Plant science background 2
Ecological and agricultural skills 2	Post graduate and postdoctoral work 2
Education in population biology and statistics	Statistical knowledge
Experience 52	Teaching and research 2
Fungal molecular biology	Technical background
Information technology	Thesis

**89 responses:** Several respondents identified themselves with more than one category but very evidently plant pathologists see themselves as fitted for their careers by their first and second degree education and training and by their subsequent experience 'on - the - job'.

*Q 45 "What gaps / deficiencies can you identify in your education and training?"*

Agronomy knowledge 3	Lack of mentoring
Bacteriology	Limited plant path. in first degree 7
Biochemistry	Limited plant path. in MSc course 2
Biology	Management skills 3
Coping with bureaucracy	Microbiology 2
Crop biology 2	Molecular biology 13
Crop production skills 2	Molecular genetics
Crop walking skills 2	Mycology 2
Diagnostics 2	Narrow field of study 2
Entomology	Plant physiology
Experience overseas	Practical relevance 2
Experimental design and analysis	Statistical analysis in molecular biology
Fungal taxonomy 2	Statistics in general 4
Genetics	Virology 3
Grant acquisition and management	Work based training 2
Industrial contact 2	

**73 responses.** 14 noted no gaps. The largest deficiency was skills for molecular biology but an even larger group were basically satisfied with their education and training. Statistics did not receive enough attention according to several people.

*Q 47 "Are you undertaking Continuous Professional Development?"*

BASIS (including FACTS) 7  
 Certified Agriculturist (Australia)  
 Education (undefined)  
 Employer provided courses  
 Gap year

Management course 6  
 Molecular biology  
 Self guided study 3  
 Taxonomy training  
 Teacher training 1

**Yes:- 33 No:- 55 (n=88).** The BASIS (British Agrochemical Supply Industry Scheme) qualification is essential for working with the agricultural and horticultural industries and making recommendations on use of pesticides. Although several respondents identified skills gaps, few are undertaking CPD.

*Q 48 "In what year were you appointed?"*

prior to 1960: = 7  
 1961 - 1970: = 6  
 1971 - 1980: = 13

1981 - 1990: = 17  
 1991 - 2000: = 27  
 2001 onwards: = 22

92 responses. Includes all appointment including post doctoral studies. The data are collated using the cohorts of years employed above for first and second degrees and for employment periods as post doctoral workers:- The largest cohort is that appointed in the period 1991 to 2000 (29%) followed by that appointed in the period from 2001 onwards (23.9%).

*Q 49 "Have you had several employers?"*

**Yes:- 46 (54%) No:- 39 (46%) (n=85).**

*Q 50 "Did you take a Gap year / Maternity Leave / Paternity Leave/ Voluntary Service Overseas / Erasmus - Socrates study period?"*

**100 responses: Yes:- 41 No:- 39.** Some examples:-

Business development  
 Colonial Service  
 Erasmus  
 Gap year 2  
 Maternity leave 7  
 Overseas Development project 6

Paternity leave  
 Peace Corps 1  
 Sabbatical leave 15  
 Sandwich placement 3  
 Voluntary Service Overseas 3  
 Work at research institute

*Q 51 "Any other comments?"*

Plant pathology is in decline  
 There is a lack of security for post doctorates  
 It was the enthusiasm of degree and subsequent teachers which drove my interest  
 There is a need more practical experience  
 Plant pathology is good educational platform for a career  
 Plant pathology maintains the scientific approach to agricultural questions  
 Lack of practical knowledge  
 There were difficulties of in running motherhood and a career but conditions have much improved since 1980s  
 There is a lack of practical plant pathologists as opposed to molecular biologists  
 Short term funding, separation advisory and research; lack qualified field pathologists

There is job insecurity and the time demands make training new recruits difficult  
 Education too narrow with a lack of ability to link theory to practice  
 Maternity leave slows publications and career progression  
 Need for integrated education  
 Availability crop protection experts declined; the Scottish Mycology and Plant Pathology Club has closed - this gave postgraduates training in public speaking and presentation  
 Need for integration with underdeveloped countries  
 Need for public communication of science; lack of industry posts  
 Lack of plant science teaching in BSc courses  
 University education used to equip students for a varied career, this is no longer the case  
 Plant pathology is disappearing fast all that will remain is a small topic at taught at postgraduate level

Where are new graduates going to find jobs?

Erosion of experienced staff; difficulties in gaining tenured posts

Loss of experienced pathologists; Defra policy fails to address industry needs - we need a catastrophe

Only one MSc course in plant pathology is now available and there is a lack of time for students to go and see crops and their diseases

Lack of training opportunities for new cohorts - could BSPP provide scholarships for training in industry?

Demise of state service, replaced by an ineffective system

UK education is very focused and lacks practical application and experience which leads to career problems later on

My education was excellent; no sources of MSc / PhD training found in the UK

Lack of elementary practical skills in current students and knowledge IS centred on model pathogens of limited practical significance in UK

Loss of practical expertise and competence, this is a political problem with educational implications

In a short career has witnessed large erosion of research capacity

Lack of entrants into plant pathology and hence teachers of the subject, now into self perpetuating cycle of decline

Education about plants in deep trouble in UK

Lack taxonomy skills; limited career structure for new entrants

Lack of practical molecular biology in university courses; worried about being too young

Could BSPP accredit or help train plant pathologists?

There are good jobs available applicants need to be more visible and provide evidence of practical training

Too little practical plant pathology is taught, it is classed as unexciting; - lack of appreciation of experimental design and analysis

The subject dying focus now on molecular biology

It is very hard work teaching and running research group

We need to know how many universities will retain plant pathology

Good grounding in crop production practices and diagnosis is absent

Lack of good postgraduate courses and little interest by universities in plant science

Lack of universities offering plant pathology, would have benefited from hands on pathology experience; now fewer pathologists especially virologists

Erosion of national science base; lack of practical competence; dislocation between industry and academia; administrative incompetence are all current problems

## Results of Employers' Survey

In the telephone survey of employers, 15 organisations were prepared to be interviewed and are listed in Appendix 3. The aim was to gain a spread across types of organisation and in so far as possible the widest possible geographical distribution. No responses were obtained from Northern Ireland or Wales.

### *Q 1 "What is the nature of your business?"*

Several organisations had a mixture of business activities and hence the numbers here exceed 15 in total; sectors of activity in which plant pathologists skills are employed = 9. Multi-tasking required that in the 15 organisations questioned skills were required to cover 39 job variations ie pathologists have multiple tasks to a factor of 2.6 (39/15) within the organisations that employ them. It is likely that this factor grossly underestimates the roles covered by plant pathologists within their employers.

1. Employ plant pathologists via contractors in support of government policy = 1
2. Service components = 2
3. Applied Strategic Research = 9
4. Regulatory science = 1
5. Contractor providing research in support of government policy = 5
6. Pre - competitive development = 11
7. Education = 6
8. Competitive development = 2
9. Public communication = 2;

### *Q 2 "Identify the sector that is most applicable to you: UK public research institution; UK Civil Service institution; UK private / charity research institution; UK university; UK incorporated institution; Agrochemical industry; Consultancy organisation."*

1. Non department public body (NDPB) = 2
2. Registered charity = 6
3. Public research institute = 1
4. University = 3
5. Public listed company = 1
6. Civil service institution / Department = 2

Total = 15. 40% of organisations now describe themselves as 'charities' ie they are controlled by the rules and regulations of the Charity Commissioners. Only two organisations (13 percent of the sample) claimed to be direct civil service bodies. If assessed retrospectively this number might have been far higher 20 years ago.

### *Q 3 "What is the size of your organisation in terms of number of employees?"*

1. >10,000 employees = 1
2. 1,000 to 10,000 employees = 3
3. 100 to 1,000 employees = 8
4. 50 to 100 employees = 1
5. less than 50 employees = 2

Total = 15. Most organisations (53%) employing plant pathologists in the UK have a total permanent staff compliment of 100 to 1,000 employees and would be classed as 'medium sized enterprises' (MSE).

*Q 4 "How many of these are plant pathologists?"*

1. more than 100 = 0
2. 80 - 100 = 0
3. 60 - 80 = 2
4. 40 - 60 = 2
5. 20 - 40 = 2
6. 10 - 20 = 1
7. less than 10 = 8

Most plant pathologists are employed in small numbers within organisations (53%); there is an even spread of organisations employing between 20 and 80 plant pathologists (40%). The term 'plant pathologist' was defined as those with either first honours degree, foundation degree or higher national qualifications in permanent (tenured post) including post doctoral workers but not students.

*Q 5 "Are plant pathologists an identifiable grouping with their own career pathway or are they dispersed across the organisation?"*

**Yes: 8 No: 7 (n=15)**

There is a slight majority (53%) of organisations that retain a defined grouping of staff called 'plant pathology', this may not be a distinct 'department'. In the other organisations employment is 'programme driven' ie pathologists work within groups of staff possessing a range of disciplines and skills. The tendency is for organisations whose business is concerned with applied strategic research to use the latter model of employment.

*Q 6 "Do you identify plant pathology as a separate discipline when you advertise for staff?"*

**Yes: 12 No: 3 (n=15)**

In the large majority of organisations (80%) where plant pathological skills are required then advertisements specify that requirement. But 20% of employers make no such specification.

*Q 7 "Have you encountered any problems in recruiting plant pathologists, for example: finding people with the right mixture of skills, knowledge and background?"*

**Yes: 7 No: 8 (n=15)**

There is an almost equal split between those organisations that have encountered problems in making appointments to plant pathological posts and those that have not experienced difficulties. In the latter case this may be because they have not advertised for some time (5 organisations) and therefore are not really in a position to make a judgement. Organisations that have experienced problems were quite graphic in the description of the problem eg "horrendous difficulties" was one expression.

*Q 8 "Do you encounter problems in retaining plant pathologists?"*

**Yes: 4 No: 11 (n=15)**

The consensus view was that once appointed into a post then plant pathologists tend to stay and carve out their career both within their profession and within the organisation. Some evidence was offered for the mobility of more junior grades who tend to move around seeking the best opportunities and openings. There appears to be a trend for those who do not stay in the profession to move into school teaching. This possibly reflects the highly advantageous entry terms which are / were on offer for science graduates to move into that area.

*Q 9 "What is your ideal description/characteristics of a plant pathologist?"*

The over-riding view is that a plant pathologist suitable for a professional tenured grade should have a relevant first degree (eg plant science / horticultural science / agricultural botany) linked to PhD and post-doctoral experience of 1 - 2 rounds. Academically they should have knowledge and appreciation of molecular biology *but* with competence in understanding whole organisms and their interaction with the environment. Field experience is a great advantage as is the ability to diagnose causal organisms and the diseases that they cause. Several respondents stressed the need for knowledge of the industry (agriculture / horticulture / forestry).

Linked with these attributes and abilities there are demands for transferable skills in Information Technology (IT), contract and client management / application for and administration of grants, human resource and financial control, ability to formulate a work programme and follow it through with minimal supervision and presentational and demonstration capacities.

One respondent commented that the skills demanded today far exceed anything required a generation ago in their extent and depth.

All respondents identified that there is now a market failure to produce plant pathologists with diagnostic abilities, knowledge of the industries and the capacity to appreciate whole organism (systems) biology. One commented "molecular biologists are two - a - penny but people who can relate hosts / pathogens / disease syndromes / crop loss are priceless".

It was suggested that Academic Charities should consider funding 'field apprenticeships' for laboratory based post graduates to gain field knowledge, competence and confidence. One organisation already uses 'seed corn money' to achieve this by funding staff to accompany some of the few remaining field advisors. The smaller organisations find grave difficulties in providing training for incoming staff. The costs associated with staff providing staff with these skills are too large.

It is strongly recognised that the generation of field plant pathologists competent in diagnosis and with field skills is disappearing fast simply as a function of age and retirement. There appears to be some 'official' recognition of this problem and it has been highlighted in 'Inter - Departmental' discussions between Defra, Dfes and D'TI.

Within the civil service there has been a noticeable decline in programme managers who have scientific knowledge, experience and background. One comment was that plant pathologists used to fill these posts in large numbers. This is not the case currently.

*Q 10 "What other disciplines might be recruited if a plant pathologist was unavailable?"*

- |                                |                             |
|--------------------------------|-----------------------------|
| 1. agricultural economist = 1  | 8. horticulturist = 1       |
| 2. agronomist = 2              | 9. microbiologist = 7       |
| 3. applied biotechnologist = 1 | 10. molecular biologist = 2 |
| 4. bacteriologist = 1          | 11. physiologist = 2        |
| 5. biochemist = 1              | 12. phytochemist = 1        |
| 6. biologist = 3               | 13. virologist = 1          |
| 7. botanist = 4                |                             |

Several respondents listed a series of options that might be acceptable in the place of a plant pathologist. The most popular option is a microbiologist; the use of agricultural economists was a serious option where risk and hazard analyses are required.

*Q 11 "What changes have taken place in the size of your pathology group over last 15 years?"*

1. past 5 years - increase 3: decrease 9: no change; 1
2. past 10 years - increase 3: decrease 10: no change 1
3. past 15 years - increase 4: decrease 11: no change 0

It is evident that for the majority of organisations there has been a decline in the size of their plant pathology complement. A few organisations have experienced growth particularly where they operate outside the traditional 'research station / university / advisory service' sectors. In one specific case a public service organisation has grown by taking on work which other institutions have lost.

MAGNITUDE OF DECREASES

1. moved from 10-15 staff 15 years ago to 2 in 2007
2. 2007 = 30 plant pathology staff in total; 2000 = 45 plant pathology staff in total; 1995 = 50+ plant pathology staff in total; 1990 = 60+ plant pathology staff in total ("long and prolonged decline";)
3. ten years ago there were 80 - 90 plant pathology staff at one UK centre, globally there are only 60 - 70 now in the entire world
4. last 15 years has seen the loss of specialists in areas such as weed science, biocontrol, virology, nematology, pesticide chemistry
5. complete loss of regional structure which provided great support for small geographically isolated organisations
6. ten - 15 years ago there were 15 plant pathologists, this is now reduced to 2;

MAGNITUDE OF INCREASES

1. the plant pathology group has grown but also changed substantially in its skills
2. one unit has increased, elsewhere the number of plant pathologists has fallen by 50%
3. the group has grown substantially from 1 staff member 15 years ago to 5 now
4. growth has been substantial with functions being added as they were lost in organisations elsewhere

*Q 12 "Where do you advertise vacancies for plant pathology staff?"*

- |                      |  |
|----------------------|--|
| 1. Local press; 2    | 5. Trade press; 2                                      |
| 2. National press; 1 | 6. University / research station appointment boards; 4 |
| 3. Nature; 4         | 7. Web sites; 11                                       |
| 4. New Scientist; 13 |  |

*New Scientist* is the most popular place for advertising vacancies. Web sites are seen as the most effective alternative and are much cheaper. One respondent pointed out that *Nature* is now cheaper than *New Scientist*. Local papers and trade press are used for more junior grades and those where field experience is a major prerequisite.

*Q 13 "Were you aware of the existence of the British Society for Plant Pathology?"*

**Yes** = 12 **No** = 3 (n=15)

The majority of respondents (80%) are members of the profession who have risen to senior posts with management responsibilities. Those who were unaware of BSPP have professional interests outside of plant pathology. Each commented that they would have expected that there would be such a professional body.

## **R**eview of Advertisements in *New Scientist*, 2005 and 1985 (January to June)

The time available to undertake a survey of advertisements for posts in plant pathology was very limited. The outcomes are therefore a series of qualitative impressions:-

1. Advertisements in 1985 were very specific in asking for a 'plant pathologist'
2. There were apparently more advertisements of this nature in 1985 as simply judged by scanning pages
3. Opportunities for plant pathologists in 2005 still exist (but to a lesser intensity) but the applicant has to read further into the advertisement to realise that he / she would be qualified for the post
4. Advertisements in 2005 tend to be for a mix of skills which may include plant pathology but will also demand ecological, molecular, statistical and management abilities
5. Much more is expected of plant pathologist by employers in 2005 than was the case in 1985 and the rewards in terms of job security and pension provision are less
6. There is a wider range of employers looking for applicants with plant pathological skills in 2005 compared with 1985, avenues in non governmental bodies (private business) have appeared where they did not exist in 1985. This is counterbalanced by a loss in the public sector.

No doubt more information could be extracted from a more thorough search of job advertisements covering a larger span of years and more than one magazine.

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# Appendix 1

## EMERGING FINDINGS

Sent to The BSPP President for 25th Anniversary Meeting 2006 (19th December 2006, Imperial College, London).

Total returns = 127 (114 electronic; 13 postal mail). Number of replies to individual questions varied and is shown in the first section (results of members' questionnaire). There was a majority of replies from research scientists followed by university staff with smaller numbers in other categories.

1. **Career interests.** Major foci in: airborne pathogens, diagnostics, genetics and pathogen resistance, molecular biology, mycology, pathogen virulence / avirulence, soil borne pathogens
2. **Members' interests.** Across all the pathogen groups. Aerial pathogens, blights, spots and blotches, downy & powdery mildews, rusts & smuts, soil borne pathogens and viruses figure highly.
3. **Crop groups.** Major examples include Cereals (temperate), field vegetables, potato, soft and berried fruit, tree fruit (temperate) but others are included.
4. **First degree.** Mainly in botany / plant science / applied biology / agricultural botany / horticulture; a few biochemists and geneticists; sprinkling of European (Ingenieur) degrees.
5. Only 2 (1.5%) indicated there was no plant pathology in their first degree course.
6. Most plant pathology teaching was delivered in year 2 and, mainly, year 3.
7. **Length of tuition:** students mostly received tuition for 3 semesters.
8. The vast majority of students received laboratory practical work, less so field practical experience (includes those on sandwich courses).
9. **Undergraduate projects:** most students said these were related to plant pathology.
10. The majority did not undertake relevant vacation work related to plant pathology.
11. 50% of respondents had contact with business and industry.
12. Year of graduation spans from 1940 (Betty Gray) to 2006. Responses can be (not done yet) separated into decade cohorts.
13. Places of learning: most attended universities in the 'Russell Group' but younger respondents indicated newer universities providing courses.
14. Good spread of overseas graduates mainly from Europe and elsewhere: includes USA, Colombia and India
15. The majority of respondents did not take a masters degree.
16. Most MSc respondents gained laboratory and field experience.
17. Approximately 50% had business and industry contact.
18. MSc graduation year spans from 1950 to 2004. Institutions were mainly Russell Group with Harper Adams and Wolverhampton also cited.
19. Several MSc students studied overseas (mainly Europe).
20. The vast majority of BSPP members hold doctorates - this must be one of the most highly qualified professions (less than 10% are NOT qualified to this level and that includes respondents who are current postgraduates).

21. There were few taught courses for PhD students. Of those available 'statistics' figures highly. Courses are mostly taken on a voluntary basis.
22. A minority of students received the services of an independent mentor or were supported by a postgraduate committee.
23. Most PhDs were completed in 36 months (8% required 60 months).
24. Most students had some contact with business & industry; one CASE student had no contact at all.
25. Year of PhD graduation is 1953 to 2006. Institutions awarding doctorates are mainly in the Russell Group; with a few students working at Harper Adams.
26. Overseas doctorates were mainly from Europe. Other countries included USA and India.
27. Amongst a minority who had gained a further qualification after their PhD (or MSc), the most popular was BASIS accreditation (can give official recommendations on use of pesticides).
28. A majority of respondents (60%) had taken post - doctoral posts. One post doctoral period is the norm, undertaken mostly in the UK.
29. Employment dates span from 1957 (possibly an error) to now.
30. Overwhelmingly members appear to have tenured posts, though this needs further investigation: some post-docs may wrongly claim to be tenured.
31. Only 9% of respondents do not claim to be professional pathologists.

## Appendix 2

### QUESTIONNAIRE FOR MEMBERS

Dear Member,

To provide effectively for the needs of current members of the Society and lobby with confidence for the future education and training of plant pathologists, the BSPP has commissioned a Skills Audit. It seeks to:-

- Identify your career pathway
- Establish the education and training that you received
- Determine needs in the provision of education and training for future plant pathologists
- Seek your views on improving the support education and training provides for career pathways.

*Please help your Society to serve you and our profession by completing this short questionnaire.*

- Your identity is *not required* and all replies will be treated in the *strictest confidence*.
- Once this Audit is completed all copies of the Questionnaire will be destroyed.
- Information supplied will be used solely for the purposes of this Skills Audit and not made available to any third party.
- *Dates are only requested in order to determine your educational cohort.*

This Questionnaire is designed to be answered quickly using ms word.

#### 1. About You

- 1.1 Please describe *Anonymously* your current status - ie undergraduate / postgraduate / post - doctoral worker / research scientist / service provider / teacher / consultant / other (please specify)
- 1.2 If you are employed please identify the broad area of activity of your employer - eg university / college / research institute / manufacturing industry / service industry / heritage services / consultancy / other (please specify)
- 1.3 If you are self - employed please identify broadly your area of activity eg consultancy to primary producers / consultancy to secondary suppliers / media / authorship / legal services / other (please specify)
- 1.4 Please identify your career pathway so far
- 1.5 What sub - discipline(s) of plant pathology best describes your professional interests:- agrochemical chemistry and development, airborne pathogens, bacteriology, biocontrol, callus and tissue culture, compost biology, crop consultancy, diagnostics, education, epidemiology, forest and arboreal pathology, genetics and pathogen resistance, microbial biochemistry and physiology, microbial ecology, microbiology, molecular biology, mycorrhizae, mycology, mycoplasma - like organism biology, pathogen virulence / avirulence, population biology and ecology, postharvest pathology, seed pathology, soil borne pathogens, sports turf and grassland pathology, theoretical and modelling pathology, virology, other (specify); (delete as appropriate)?
- 1.6 What pathogen group(s) are you involved with:- aerial pathogens, bacteria, biotrophes, blights, spots and blotches, damping - off pathogens, downy mildews, foot and collar rots, mycoplasma - like organisms, necrotrophes, plasmodial organisms, powdery mildews, rusts and smuts, soil borne pathogens, viruses, water moulds, wilts, other (please specify) (delete as appropriate)?
- 1.7 Which crop group(s) relate(s) most closely to your work:- amenity and parkland plants, bulbs, cereals (temperate/tropical), drug and pharmaceutical crops, fibres, field vegetables, fodder and forage, grass and sports turf, hop, legumes, model plants, nuts,

oilseed crops, ornamental crops (open field), ornamental crops protected, plantation crops, potato, protected vegetables, root and tubers, rural and urban trees, soft and berried fruit, tree fruit (temperate), tree fruit (tropical), other (please specify) (delete as appropriate)?

2. What is your first - degree qualification?
3. Did your first - degree course include modules (units) in plant pathology / microbiology / virology / crop protection or related topics? If Yes please answer the following in as much detail as possible:-
  - 3.1 list the core subject(s)
  - 3.2 were these taught in Years 1, 2 or 3 (or 4 in Scotland)?
  - 3.3 how many semesters were used?
  - 3.4 what practical laboratory / field work was involved?
  - 3.5 was your project / dissertation related to plant pathology or a related subject?
  - 3.6 did you undertake vacation work related to plant pathology or similar subject?
  - 3.7 was there any contact with business & industry (in the broadest sense) during your course?
  - 3.8 year of graduation?
  - 3.9 did you study at a UK institution of higher education?
  - 3.10 if you studied outside the UK please specify?
4. Did you take a taught Masters Degree in plant pathology / microbiology / virology / crop protection or related topics Yes / No; if Yes please answer the following in as much detail as possible:-
  - 4.1 list the core subjects
  - 4.2 list any relevant elective subjects
  - 4.3 what practical laboratory / field work was involved?
  - 4.4 what was the topic of your dissertation?
  - 4.5 what was the level of business & industrial contact / involvement during your course?
  - 4.6 year of graduation?
  - 4.7 did you study at a UK institution of higher education?
  - 4.8 if you studied outside the UK please specify?
5. Did you take an M Phil., Ph D., or D Phil qualification Yes / No; if Yes please answer the following:-
  - 5.1 research area / topic?
  - 5.2 what taught courses were provided?
  - 5.3 were these voluntary or obligatory?
  - 5.4 were you supported by an independent mentor?
  - 5.5 were you supported by a postgraduate committee?
  - 5.6 length of study?
  - 5.7 what was the level of business & industrial contact / involvement?
  - 5.8 year of graduation?
  - 5.9 did you study at a UK institution of higher education or other organisation (please specify)?
  - 5.10 if you studied outside the UK please specify?

6. Do you hold other qualification(s) Yes / No?
  - 6.1 specify the qualification(s)
  - 6.2 identify their relevance to your career
7. Have you undertake periods of post - doctoral employment Yes / No? if Yes please answer the following:-
  - 7.1. number of periods of post - doctoral employment
  - 7.2. is / was your employment related to plant pathology Yes / No? if Yes please provide more details
  - 7.3. do (did) you work for a UK based organisation?
  - 7.4. do (did) you work for an organisation in another European or EU country?
  - 7.5. do (did) you work outside Europe or the EU?
  - 7.6. dates of employment
8. Are you now employed in a 'permanent' / 'tenured' / 'superannuated' post ...Yes / No? if Yes please answer the following:-
  - 8.1 do you consider yourself as a professional plant pathologist?
  - 8.2 what aspects of your education and training fit you for this role?
  - 8.3 what gaps / deficiencies can you identify in your education and training?
  - 8.4 are you undertaking some form of Continuous Professional Development (CPD). If Yes please provide details
  - 8.5 year appointed
  - 8.6 have you had several employers Yes / No? if Yes please provide details for each period of employment.
9. Did you take a Gap Year / Maternity Leave / Paternity Leave / Voluntary Service Overseas / Erasmus - Socrates study period Yes / No? if Yes please provide details and indicate the effect on your career.
10. Please provide any further relevant information and observations on the education and training provided within the United Kingdom. It would be especially useful to receive information and comment from those now self - employed as independent consultants.

PLEASE RETURN NO LATER THAN Wednesday 15<sup>th</sup> November 2006

Results from this Survey will be consolidated with case studies and interviews.

THANK YOU for the time and effort that you have invested in this Skills Audit; this will aid the Society to continue providing relevant services to members as it enters its second 25 years .

## Appendix 4

### EMPLOYERS (TELEPHONE) QUESTIONNAIRE

#### Introduction and Background Statement

- The British Society for Plant Pathology was founded in 1981 from the Federation of British Plant Pathologists (FBPP) developed under the aegis of the Association of Applied Biologists (AAB) and British Mycological Society (BMS) in 1968.
- The BSPP is affiliated to the International Society for Plant Pathology (ISPP).
- The Society has about 700 members in the United Kingdom and internationally.
- BSPP is the voice of British plant pathology and seeks to promote national and international recognition of the importance of plant pathogens and the damage they cause. Approximately 25% of all crop production on a world scale, is lost due to the ravages of pests and pathogens attacking plants and their products pre - and -post - harvest.
- The Society publishes three peer review journals: *Plant Pathology*, *Molecular Plant Pathology* and *New Disease Reports*.
- The cause of Plant Pathology is promoted as an Affiliated Society of the Institute of Biology (IoB) and by association through the Bioscience Federation (BSF). The latter represents 70+ learned and professional societies and 300,000 biologists across the spectrum from medicine to agriculture. Through the science policy initiatives of IoB and BSF plant pathology is promoted in Whitehall, Westminster and Brussels.
- Scientific meetings are organised covering all aspects of the discipline by the Society acting alone and increasingly in collaboration with other learned bodies that have similar interests and objectives. Collaboration is especially fruitful with the European Society for Plant Pathology with whom jointly organised meetings at locations around Europe are becoming a frequent feature of the Society's calendar.
- In collaboration with ISPP the Society has organised two International Plant Pathology Congresses (London 1968 (inaugural) and Edinburgh 1988) from the eight (London, Minnesota, Munich, Melbourne, Kyoto, Montreal, Edinburgh, Christchurch; with Turin to come) run so far.

#### Objectives of telephone survey

- The Society recognises that if it is to continue to serve its members effectively then it must remain in a position to affect their career and salary prospects by enhancing the perceptions in the public and private sectors of the need for a well trained, knowledgeable cadre of plant pathologists.
- This demands:-
  - An understanding of the requirements which employers have for their plant pathology staff in terms of their qualifications, experience and competence.
  - The job descriptions that employers feel are suited to plant pathologists.
  - The grades of staff that can be classed as plant pathologists and their career pathways.
  - Information on the problems employers have in finding and retaining plant pathologists.
  - Changing needs of employers.

Targets for the telephone survey will be 'senior management / human relations personnel' ie those who recruit:-

EMPLOYER GROUPS:-

- UK public research institutions: Rothamsted, John Innes, IGER, SCRI, NIAB
- UK Civil Service institutions: Central Science Laboratory, East Craigs
- UK private / charity research institutions: Royal Horticultural Society, PGRO, STC, East Malling
- UK universities: Warwick HRI, Cambridge, Oxford, Imperial, Reading, UEA, Bristol, Bath, Edinburgh, Newcastle, Queens Belfast
- UK incorporated institutions: Harper Adams, Writtle, Myerscough, Royal Agricultural College
- Agrochemical industry: Syngenta, Bayer
- Consultancy organisations: ADAS, FAST, SAC

Limit 20 (25 uppermost - allows for unwillingness to be contacted / discuss issues).

Disclaimer Individual answers to these questions will be treated as confidential although ultimately BSPP wishes to use the generic information gained to promote the cause of plant pathology and its practitioners and encourage students to join this profession.

Q1. What is the nature of your business?

Q2. Identify the sector that is most applicable to you: UK public research institution; UK Civil Service institution; UK private / charity research institution; UK university; UK incorporated institution; Agrochemical industry; Consultancy organisation.

Q3. What is the size of your organisation in terms of number of employees?

Q4. How many of these are plant pathologists?

Q5. Are plant pathologists an identifiable grouping with their own career pathway or are they dispersed across the organisation?

Q6. Do you identify plant pathology as a separate discipline when you advertise for staff?

Q7. Have you encountered any problems in recruiting plant pathologists, for example: finding people with the right mixture of skills, knowledge and background?

Q8. Do you encounter problems in retaining plant pathologists?

Q9. What is your ideal description in terms of education, skills and competence of a plant pathologist?

Q10. In the absence of a plant pathologist being available what other disciplines might be recruited to fill a vacancy?

Q11. Where do you advertise vacancies for plant pathology staff?

Q12. Before this Survey were you aware of the existence of the British Society for Plant Pathology?

Thank you for your co-operation and help

## Appendix 5

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### EMPLOYERS WHO TOOK PART IN SURVEY

1. Agricultural Development and Advisory Service (ADAS), Arthur Rickwood, Cambridgeshire
2. Central Science Laboratory, York
3. Cranfield University, Bedfordshire
4. Department for the Environment, Food and Rural Affairs (Defra), London
5. East Malling Research, Maidstone
6. National Institute of Agricultural Botany (NIAB), Cambridge
7. Processors and Growers Research Organisation (PGRO), Peterborough
8. Reading University, School of Biological Sciences, Reading, Berkshire
9. Rothamsted Research, Harpenden, Hertfordshire
10. Royal Botanic Gardens Edinburgh
11. Royal Horticultural Society, Wisley, Surrey
12. Scottish Crop Research Institute, Dundee
13. Stockbridge Technology Centre, Cawood, Yorkshire
14. Syngenta, Jealott's Hill, Berkshire
15. Warwick University - Horticulture Research International (Warwick - HRI), Wellesbourne

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