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CENTENARY EDITORIAL

The centenary of *Annals of Applied Biology* in 2014

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Annals of Applied Biology (*Annals*) has published the results of original research in applied biology for 100 years. The journal was established because of the need for a more efficient distribution of scientific information of applied importance, especially in agriculture and horticulture. Over the years, most papers in *Annals* have reported on crop science, horticulture, pests and diseases of field crops and horticultural plants, and plant breeding. The scope of the journal has remained consistent, although currently the research fields covered in *Annals* can also be described using the terms agriculture and the environment, crop improvement, pest and invertebrate biology, and plant–pathogen interactions. Maintaining high standards of statistical analysis in the papers published has always been emphasised in *Annals*.

The Centenary of *Annals* in 2014 will be celebrated by highlighting some of the most influential papers published in the journal over the 100 years. These papers have been selected by the Senior Editors (the authors of this editorial), following consultation of the Editorial Board of *Annals*, which consists of scientists from all parts of the world. Each issue of *Annals* in 2014 will contain at least one Centenary editorial that introduces an influential paper. Furthermore, the same issue will contain a solicited review article related to the influential paper. The first influential paper introduced in this issue is the study by Chester I. Bliss (1935) on the calculation of the dosage-mortality curve, which has been cited over 850 times and is still regularly referred to today. The editorial has been written by David Finney, who knew Bliss personally and who acted as an unofficial statistical editor of the journal during the period 1942–54. It is noteworthy that this editorial

marks 76 years since David Finney's first publication in 1938 (Finney, 1938). The review article has been written by Roger Payne, who was the Senior Statistical Editor of *Annals* from 1980 to 1989. The editorials, influential papers and review articles will be made available for free access on the home page of *Annals* ([http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1744-7348](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1744-7348)).

The Association of Applied Biologists (Association) will organise a Centenary conference under the title 'Sustainable Intensification' in December 2014. For details of the programme and other details, please refer to the home page of the Association in the near future (<http://www.aab.org.uk/>).

In the following sections we provide some perspectives as to the development of *Annals* as a scientific journal and statistical data on its impact in the field of applied biology.

How it all began

On 29 January 1914, the Secretary of the Council of the Association of Economic Biologists was authorised 'to approach Cambridge University Press (CUP) and to make arrangements for the issue of the first number of the journal, *The Annals of Applied Biology*'. The first Editor of the new journal was Harold Maxwell-Lefroy (Table 1). In his editorial in the first issue, he pointed out that the motivation to establish a new journal reporting results of scientific research in the field of applied biology was the prevailing situation, when 'large problems, in which technical knowledge is required, are settled without the technical expert being seriously consulted and this is the fault... of the applied biologists themselves' (Maxwell-Lefroy, 1914). He emphasised that while applied biologists

Table 1 List of Editors-in-Chief of *Annals of Applied Biology* 1914–2013

Period	Editor-in-Chief
1914–15	H. Maxwell-Lefroy, MA
1916–20	E.E. Green, FES
1921–45	W.B. Brierley, DSc
1921–32	D. Ward Cutler, MA
1933	J.W. Munro, MA, DSc
1934–44	C.T. Gimingham, BSc, FIC
1945–71	R.W. Marsh OBE, MA, FIBiol
1946–64	I. Thomas MSc, PhD, FIBiol
1964–68	F.H. Jacob, MSc
1969–74	W.G. Keyworth, PhD, DIC
1975–76	J.K.A. Bleasdale, CBE, PhD, FIBiol, FIHort
1977–81	G.A. Wheatley, BSc, MIHort
1982–86	L. Broadbent, OBE, PhD, DSc, CBiol, FIBiol, VMH
1987–98	E. Griffiths, MSc, PhD, DSc
1999–2008	M.A.J. Parry, MSc, PhD, DIC
2009–date	J.P.T. Valkonen, MSc, DSc

had indeed formed an association in 1904 ‘to make themselves felt’, a journal was also needed to strengthen the organisation. It was noted that the scientific libraries contained literature on basic science, but ‘scarcely any at all of the applied aspects’ (Maxwell-Lefroy, 1914). For an interesting analysis of the ‘Pragmatism, Patronage and Politics’ in applied/economic biology up until 1920, the reader should refer to Kraft (2004).

Six hundred copies were subsequently printed and published in May and the invoice from CUP for production and distribution was £240 and 9 pence. Considering that costs through inflation have risen almost a 100-fold since 1914, this may seem a large amount of money to spend on a fledgling journal, but a similar amount was considered appropriate for the launch of the *Plant Biotechnology Journal* by the Association and the Society for Experimental Biology (SEB) in 2003.

The timing of the initial launch of the journal was unfortunate, as it was on the eve of the First World War, and it was a struggle to keep the journal financially viable for the duration of the war, 1914–18, and for several years afterwards. This was despite securing grants from various august bodies and authors being encouraged to contribute ‘grants in aid of publication’, more commonly known as publication charges today. The size of the journal grew considerably during the 1920s and on into the 1930s due to the increased number of submissions, however, this often caused delays in publication. During World War II (1939–45), publication of *Annals* continued despite considerable difficulties. Publication during this period was primarily limited by the availability of paper and a shortage in printing compositors. In order to mitigate these issues, the quality of paper was reduced and a two column smaller print format was adopted.

Following the end of World War II and into the 1950s, the interval between submission and publication became longer and the financial state of the journal deteriorated. For 4 years, only members of the Association were able to submit manuscripts. In 1961, however, the new treasurer Frank Raw proposed that back issues of *Annals* should be reprinted and made available to new University libraries. This proved to be an extremely successful venture and greatly improved the finances of the Association. In 1963, the single four-part volume was expanded to the current two three-part volumes. In 1969, a Board of Editors was formally established, comprising 20 scientists with a wide range of expertise, which included statistical consultants (today the Editorial Board consists of 60 members and includes several statistical editors). In 1972, the Association in conjunction with The Biochemical Society took over responsibility for publishing the journal, although CUP still carried out the printing. Stimulated by the purchase of an Apple Computer in 1981 (probably worth a lot of money now as an antique), computer typesetting of *Annals* within the office of the Association began in 1984. Shortly after this in 1985, the office took over the distribution and marketing of *Annals* from the Biochemical Society, which required additional staff time and the purchase of more computers. The history of the journal has proved fairly easy to trace as previous Editors have written similar articles in *Annals* to commemorate the 25th anniversary (Brierley, 1939), the golden jubilee of the Association (Marsh, 1953), the first 100 volumes (Wheatley, 1982) and the 75th anniversary (Griffiths (1989); while for the centenary of the Association, a separate volume was compiled (Langton *et al.*, 2004). We are very grateful to these authors for providing the source material for this historical section.

Although the number of papers published was at its highest in the 1980s and well into the 1990s (Fig. 1), the number of library subscriptions for *Annals* fell from 943 in 1990 to 551 in 1999 and to 429 in 2004. Finally, the decision was taken in 2004 for production, marketing, sales and distribution to be undertaken by Blackwell Publishing, although *Annals* was still to be owned by the Association. This was a very important decision and required a considerable amount of negotiation between members of the Council, Blackwell and Martin Parry who was then the Editor-in-Chief. Subsequently, Blackwell Publishing was acquired by John Wiley & Sons and merged to form Wiley-Blackwell in 2007 and it is now known as Wiley. *Annals* first became available online in 2000 and can now be accessed through the Wiley Online Library [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1744-7348/issues](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1744-7348/issues).

Copies of individual papers right back to the first editorial (Maxwell-Lefroy, 1914) are available for purchase.

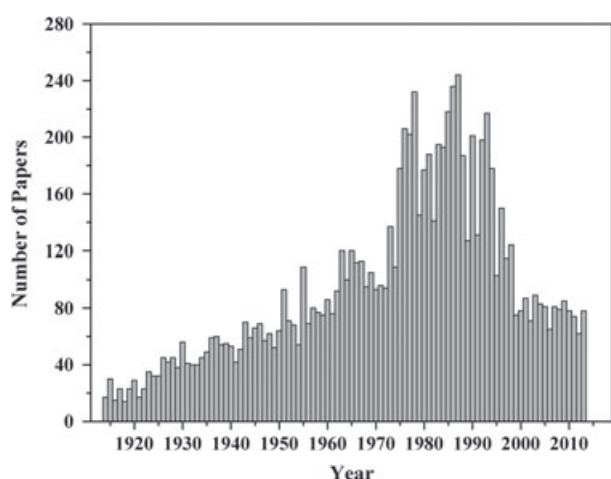


Figure 1 The number of papers published in *Annals of Applied Biology* in the years 1914–2013, data obtained from Web of Science (WoS, <http://thomsonreuters.com/web-of-knowledge>). For the period 1955–60, the numbers have been taken directly from the Wiley online records of the journal ([http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1744-7348/issues](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1744-7348/issues)), as they are not available in the WoS database.

The ScholarOne online system, employed for the submission and reviewing of manuscripts, which has now been in use for over a decade, has proved to be particularly useful and efficient. The Editorial Office of *Annals* is currently run by Carol Millman (Editorial Administrator), assisted by John Andrews, both in the office of the Association at Wellesbourne. The other key persons in producing the journal are the copy editor, Philip Smith at the James Hutton Institute; Felicity Clark at Wiley, Oxford; Paula Alcantara at the Wiley production office in Singapore; and Ramkumar Palani at Laserwords.

Metrics and impact

In order to provide an analysis of the papers published in *Annals* over the 100 years and to enable the preparation of this editorial in time for the first issue of the Centenary 2014, the data used in the following analyses only includes up to the last week of July 2013, and the last two issues of 2013 have not been included. Taking the last two issues into consideration, however, *Annals* had published 8804 papers in the 100 years. The term 'paper' will be used to include all forms of publications, such as research papers, review articles, conference proceedings, etc.

There are a variety of literature databases available that could be used for the analysis, but only Web of Science (WoS), which is part of Thomson Reuters Web of Knowledge (<http://thomsonreuters.com/web-of-knowledge>) covers the whole period of 100 years. Unfortunately, information about papers published in

Table 2 The numbers of different types of papers published in *Annals of Applied Biology* from 1914 until 31 July 2013. Data are from the Web of Science (WoS)^a

Papers	Total	% Total
Research article	7910	90.142
Meeting abstract	463	5.276
Note	148	1.687
Review	102	1.162
Editorial material	58	0.661
Correction addition	31	0.353
Book review	30	0.342
Proceedings paper	22	0.251
Item about an individual	22	0.251
Biographical item	5	0.057
Correction	4	0.046
Reprint	2	0.023
Total	8775	100

^aThe two last issues of 2013, volume 163, contained 24 research articles, 1 review article and 3 editorials, resulting in a total of 8804 papers published in 100 years.

Annals during the period 1955–60 is not available in the WoS scientific literature database, for unknown reasons. Copies of all papers published in *Annals* can, however, be obtained from the journal homepage ([http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1744-7348/issues](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1744-7348/issues)).

The first volume of *Annals* in 1914 contained two issues and a total of 210 pages. In the 'Notes' published in that year, 'The Scope of the *Annals*' as decided at the Association meeting held in London on April 17th and 18th was made available to readers. From that year, *Annals* has been published regularly and still is today. As shown in Table 2, a search in WoS indicates the presence of 8775 publications since 1914 until July 2013 (all papers are in the 'Agriculture – Multidisciplinary' WoS category), of which 90% are classified as research papers. In the recent past, *Annals* has published mainly research articles, reviews and editorials, and other forms of publications have been rare. For example, short communications are no longer published.

The number of papers published per year show considerable variation (Fig. 1). In 1914, 17 research papers were published, after which there was a steady increase in numbers until 1987, when the highest number of papers (244) per year was recorded. In 1987, however, 88 meeting abstracts were included in the papers published. When research papers alone are considered, the highest number published was 229 in 1986. There were three peaks in the number of papers published between the mid-1970s and the mid-1990s, after which the numbers decreased markedly until 1998 and then remained relatively constant until now.

This trend is in contrast to the number of submitted manuscripts, which has more than doubled. A total of 172 manuscripts were submitted in 2004, compared with 406 papers submitted in 2012. As a consequence, a lower proportion of the submitted manuscripts, that is, only the most novel and significant papers can be accepted for publication and the acceptance rate now stands at 25%. The average time from receipt of a manuscript to first decision is currently 27 days.

Over the years, the number of countries, from which submissions are received, has increased greatly (Table 3). At the time of the launch of *Annals*, the Editor encouraged members of the Association to submit papers from all parts of the Empire (Maxwell-Lefroy, 1914). Today, less than half (42%) of the papers include authors at institutes in the United Kingdom. The 8775 papers published in *Annals* have been written by 9325 different authors from 134 countries and all continents.

Among the 9325 different authors who have published papers in *Annals*, there are 70 authors who have contributed at least 18 papers and 11 authors who have contributed over 30 papers (Table 4). R. Louis Wain (not to be confused with the artist who painted cats) has published by far the highest number of papers (80; 0.912%). Louis Wain has been described as ‘the most outstanding agricultural chemist of the 20th century’ (Fowden, 2002). His initial research was on plant growth regulators, which was extended to the synthesis of a group of highly selective herbicides, some of which are still used today.

Taking into consideration ‘Organisations’ of authors, as indicated in the WoS database, 8775 papers were contributed from 1779 different organisations (Table 5). The actual number of organisations is, however, lower because the WoS analysis does not take into account changes in the name of the same organisation. Despite this, the total number of organisations is still quite high. Furthermore, the term ‘Organisations’ used by WoS includes the name of research institutes, but often also the government departments that are accountable for them. Organisations such as Agricultural Development Advisory Service (ADAS), Agricultural and Food Research Council (AFRC), Commonwealth Scientific and Industrial Research Organisation (CSIRO), Institut National de la Recherche Agronomique (INRA) and Ministry of Agriculture, Fisheries and Food (MAFF) have not been taken into account in our analysis, because they are often responsible for a large number of research institutes.

Most of the research institutes that have contributed the greatest number of papers to *Annals* over the years are located in the United Kingdom (Table 5). Many of them have been closed down or merged in the recent past. For instance, Rothamsted Experimental Station merged

Table 3 The geographical distribution and number of authors who have published papers in *Annals of Applied Biology* (from 1914 until 31 July 2013). The 50 countries with the highest number of authors are listed. Data are from the Web of Science (WoS)

Countries/territories	Total	% Total
England	2733	31.145
Scotland	609	6.940
India	307	3.499
USA	301	3.430
Wales	263	2.997
Australia	251	2.860
Spain	147	1.675
Northern Ireland	139	1.584
Italy	118	1.345
France	103	1.174
Nigeria	97	1.105
Netherlands	96	1.094
Israel	85	0.969
New Zealand	82	0.934
Canada	79	0.900
Germany	79	0.900
China	74	0.843
South Africa	64	0.729
Argentina	47	0.536
Brazil	47	0.536
Ireland	43	0.490
Kenya	35	0.399
Finland	34	0.387
Sweden	34	0.387
Uganda	29	0.330
Greece	26	0.296
Japan	26	0.296
Czechoslovakia/Czech Republic	25	0.285
Switzerland	24	0.274
Mexico	22	0.251
Peru	21	0.239
Ghana	20	0.228
Belgium	19	0.217
Denmark	17	0.194
Norway	16	0.182
Chile	15	0.171
Sudan	15	0.171
Hungary	14	0.160
Philippines	13	0.148
Taiwan	13	0.148
Jamaica	12	0.137
Poland	12	0.137
Portugal	12	0.137
Papua New Guinea	11	0.125
Syria	11	0.125
Ivory Coast	10	0.114
Pakistan	10	0.114
Turkey	10	0.114
Colombia	9	0.103
Tanzania	9	0.103

Table 4 Authors who have published at least 20 papers in *Annals of Applied Biology* (from 1914 until 31 July 2013). Data are from the Web of Science (WoS)

Authors	Total	% Total
Wain R.L.	80	0.912
Jones A.T.	61	0.695
Harrison B.D.	56	0.638
Jones R.A.C.	54	0.615
Clements R.O.	45	0.513
Hide G.A.	41	0.467
Wratten S.D.	38	0.433
Bond W.	37	0.422
Murant A.F.	36	0.410
Gibson R.W.	34	0.387
Roberts H.A.	30	0.342
Adams M.J.	29	0.330
Kassanis B.	29	0.330
Mercer P.C.	29	0.330
Tattersfield F.	29	0.330
Whitehead A.G.	29	0.330
Ellis P.R.	28	0.319
Bateman G.L.	27	0.308
Hull R.	27	0.308
Williamson B.	27	0.308
Broadbent L.	26	0.296
Maude R.B.	26	0.296
Boag B.	25	0.285
Jenkyn J.F.	25	0.285
Barnes H.F.	24	0.274
Dixon A.F.G.	24	0.274
Fraser J.E.	24	0.274
Gray D.	24	0.274
Jones D.G.	24	0.274
Fitt B.D.L.	23	0.262
Griffiths E.	23	0.262
Naylor R.E.L.	23	0.262
Roberts I.M.	23	0.262
Valkonen J.P.T.	23	0.262
White J.G.	23	0.262
Evans K.	22	0.251
Burchill R.T.	21	0.239
Crute I.R.	21	0.239
Hollings M.	21	0.239
Trudgill D.L.	21	0.239
Wood R.K.S.	21	0.239
Lewis T.	20	0.228
Malik R.K.	20	0.228
Russell G.E.	20	0.228

with the Long Ashton Research Station and Broom's Barn Experimental Station in 1987 to form the Institute of Arable Crops Research, Rothamsted. The latter name was subsequently changed to Rothamsted Research in 2002. Similarly, the James Hutton Institute was formed by a merger of the Macaulay Land Use Research Institute and the Scottish Crop Research Institute in 2011. The latter was formed in 1981 following amalgamation of

Table 5 Institutes (organisations) which have affiliated the highest numbers of authors who have published papers in *Annals of Applied Biology* (from 1914 until 31 July 2013). Unless the country is shown, the institutes are located in the UK. Data are from the Web of Science (WoS). Some of the institutes have been merged recently

Institutions	Number of papers	% Total
Rothamsted Experimental Station	329	3.749
Scottish Crops Research Institute	286	3.259
National Vegetable Research Station	264	3.009
University of Reading	119	1.356
University of Bristol	113	1.288
East Malling Research Station	112	1.276
Welsh Plant Breeding Station	103	1.174
Glasshouse Crops Research Institute	93	1.060
Horticultural Research Institute	88	1.003
University of London	59	0.672
Queens University Belfast	58	0.661
Aligarh Muslim University, India	53	0.604
Scottish Horticultural Research Institute	52	0.593
Broom's Barn Experimental Station	51	0.581
University of Nottingham	50	0.571
Rothamsted Research	49	0.558
Haryana Agricultural University, India	46	0.524
University of Southampton	44	0.501
University College North Wales	38	0.433
IACR Rothamsted	37	0.422
University of Leeds	36	0.419
University of Adelaide, Australia	35	0.399
University of Wales	30	0.342
Scottish Agricultural College	29	0.330
University of Western Australia	29	0.330

the Scottish Plant Breeding Station and the Scottish Horticultural Research Institute. This makes a detailed analysis of the information available in Table 5 difficult. Taking into account the mergers listed above, the two top institutes contributing the highest number of publications to *Annals* are Rothamsted Research (415; 4.729%) and the James Hutton Institute (384; 4.376%).

A good sign that a paper has been of scientific value is that it is cited in other publications. The citations of the 8775 papers published in *Annals* and documented in the WoS (Fig. 2) reveal a clear, almost linear increase in the number of citations since 1961. There are many reasons for this, but a key factor is that the number of journals and papers published has increased considerably over the last 50 years, which has naturally increased the overall numbers of citations. It is interesting to note that most papers reporting results from original experimental research in the first volumes of *Annals* contain no literature citations at all. This could indicate that there had not been any previous research in the subject, thus demonstrating how early *Annals* started publishing, or that the practice of citing work published by others has increased considerably over the last 100 years.

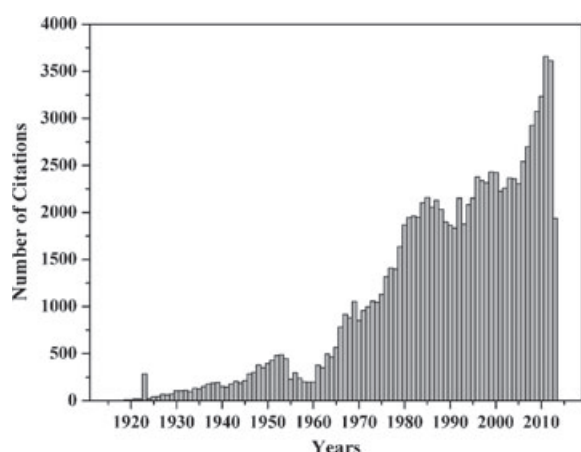


Figure 2 The number of citations for papers published in *Annals of Applied Biology* from 1914 until 31 July 2013 [data are from Web of Science (WoS)]; 104 760 citations were listed for *Annals* papers by using the 'Citation Report' tool in WoS. The citations for papers published in 1955–60 are included. In contrast, an additional 14 174 citations were identified using the 'Cited Reference Search' analysis system, but these citations were not included in the Citation Report because of the mistakes made in papers that cited the papers of *Annals*. Spelling errors of author's names, volume numbers, issue numbers, page numbers and the year of publication were some of the mistakes most frequently encountered. The combined data indicate a total of 118 934 citations for *Annals*.

Citation analysis based on data in WoS shows that altogether, papers published in *Annals* have received a total of 104 760 citations (Fig. 2), that is, on average 11.94 citations per paper resulting in a *h*-index of 85. Only 15.2% of the papers published have never been cited. The most cited paper was written by Chester Bliss (1935) on the calculation of the dose-mortality curve and has been cited 856 times.

The Impact Factor (IF) of a journal is based on the average number of citations received per paper published in the journal during the two preceding years. The *Journal Citation Reports* (JCR; <http://thomsonreuters.com/journal-citation-reports>) publishes the IF in June each year. The development of the IF of *Annals* is shown in Fig. 3. The data show an increasing trend of IF, since it was first published in 1992, from 0.567 to 2.147 in 2012. The IF value passed 1.0 in 2004 and 2.0 in 2011. If we consider the IF value as an indicator of the relative scientific importance of a journal within its field, *Annals* has been ranked continuously third to fifth among the journals in the Agriculture – Multidisciplinary subject category since 2004 (Table 6). It is important to note that in 2004 there were 29 journals in the subject category, whereas since then, the number of journals has almost doubled and reached 57 in 2012. These developments have caused a continuous increase in the number of citations and IF values of journals, but also an increase in the overall quality of the

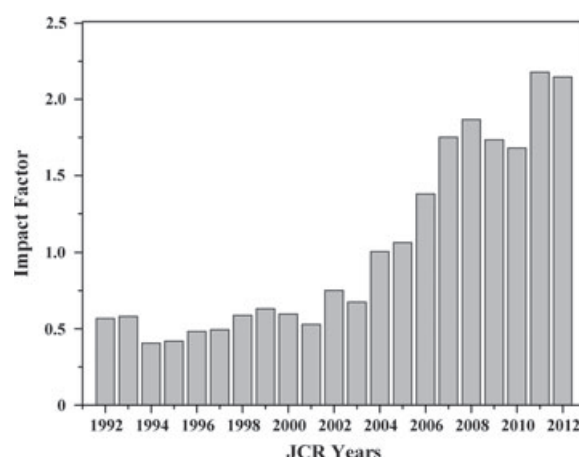


Figure 3 Impact Factor (IF) of papers published in *Annals of Applied Biology* between 1992–2012. Data are from the *Journal Citation Reports* (JCR, <http://thomsonreuters.com/journal-citation-reports>)

papers and journals. For instance in 2004, only 2 of (6.9%, *Annals* included) 29 journals in the subject category had an IF value above 1.0 and only one journal (3.4%) had an IF above 2.0. Data from the current version of the JCR (2012) show that presently 14 (24.6%) of 57 journals in the subject category have IF values above 1.0 and four journals (7%) have IF values above 2.0, *Annals* included.

Annals publishes results of applied research, or research whose applications in agriculture are obvious. Therefore, the IF value is not the only indicator of usefulness of the information published in the journal, because many users of information are not research scientists, but specialists in agriculture and other fields of applied biology. They may frequently study the papers published in *Annals*, but do not write and publish scientific papers in journals included in WoS and hence do not contribute to the IF. A large number of readers of *Annals* belong to this important other category of users. This is indicated by the 93 881 full text article downloads from *Annals* in 2012. As *Annals* became available on-line, the numbers of full papers downloaded has increased by 10–15% per year.

Today, *Annals* is available in 4300 institutions worldwide, including 2645 institutions in the developing world via philanthropic initiatives.

The future

The results of applied research in various fields of biology are needed no less now than they were 100 years ago when *Annals* was first established. There are few individuals who are unaware of the great global challenges faced in food production and the supply of fresh water as a result of the continuously increasing world population. The trends indicating changes in

Table 6 Rank of *Annals of Applied Biology* in the *Journal Citations Reports* subject category Agriculture – Multidisciplinary

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Rank (position in table/number of journals)	3/29	3/31	3/31	3/35	3/35	4/44	5/55	4/57	5/57

climate will make such challenges even more difficult to overcome. Many important applications are based on the results of basic research carried out in molecular biology, and many current key issues relate to the impact of agriculture on the environment, as predicted by Griffiths (1989) at the time of the 75th anniversary of the *Annals*. In many traditional fields of applied biology, for example, the diagnostics of plant pathogens, the use of molecular techniques, such as the polymerase chain reaction (PCR), is now commonplace. Understanding the interactions between plants, insects, microbes and abiotic factors is essential if we are to be able to manage crops in the field and greenhouse. It is not the methodology, but the applied aspects of research from agricultural and horticultural perspectives, that will continue to define the scope of *Annals* in the future.

Electronic publishing has changed many technical aspects of the production of manuscripts and scientific journals within a short period of time. Preparing, submitting and handling papers are now much easier, and the published information is available more readily than ever before. *Annals* has taken advantage of all these positive developments, with invaluable support obtained from the publisher, Wiley. The basic principle of using peer review, as the means to ensure quality and originality of the information published has, however, not changed. It is therefore our belief that journals paying proper attention to such quality aspects will continue to be popular and readers will rely on them as sources of reliable information. *Annals* has a long tradition in publishing qualified papers in applied biology, and the Editors and the Association are committed to maintaining good scientific practice. In this way, the journal will continue to disseminate novel, interesting and useful results to the global readership.

We would like to extend our gratitude to the whole production team and the Editorial Board of *Annals*,

the authors who have submitted their interesting and significant papers to the journal, the reviewers of *Annals* for their dedicated work on the manuscripts, and all subscribers of *Annals* for your continuing support.

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