Seed Science Research

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In Memoriam: J. Derek Bewley 1943–2023

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Obituary

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Dr. J. Derek Bewley, Emeritus Professor in the Department of Molecular and Cellular Biology (formerly Department of Botany) at the University of Guelph, Canada, passed away due to cancer on 24 February 2023. Derek was a towering figure in seed science over the past five decades, making critical research contributions to a wide diversity of topics. In addition, he co-wrote or co-edited the key textbooks and scientific resources associated with seed biology. He contributed to the founding of the International Society for Seed Science and served as its second President-elect and third President from 2002 to 2008. He was a professor, mentor or colleague to a generation of seed scientists and an inspiring, warm and generous person. While it is impossible to do justice here to all of Derek's contributions, we will outline the highlights of his career and impact upon current seed science as a memorial to his achievements.

Academic career and research contributions

Derek was born in Preston, England on 11 December 1943. He completed his undergraduate degree in Botany and Biochemistry at the University of London in 1965 and his PhD with Michael Black at the same institution in 1968. He began his research career investigating the action of phytochrome in relation to gibberellin (GA) in stimulating germination of lettuce seeds, publishing his first paper in *Nature* (Bewley et al., 1967, 1968). He then moved in 1968 to a postdoc with Abe Marcus at the Fox Chase Institute for Cancer Research in Philadelphia. The Marcus lab had developed the *in vitro* wheat germ system for studying the mechanisms of protein synthesis. Derek published several papers concerning the factors associated with initiation of protein synthesis, including one in *Science* (Marcus et al., 1970). He then accepted a faculty position at the University of Calgary, Canada, and continued his work on seeds. Between 1975 and 1979, he and postdoc Peter Halmer published a series of research papers on the composition of lettuce endosperm cell walls (mainly galactomannans) and the identification of a GA-responsive enzyme to break them down during germination (endo-β-mannanase) (described in Bewley and Halmer, 1981). This focus on the molecular and physiological mechanisms regulating the initiation and completion of germination continued throughout Derek's career.

At the same time, Derek became interested in how seeds can tolerate desiccation and resume biological activity upon rehydration. In looking for a model system in which to study this, he identified the desiccation-tolerant moss *Tortula ruralis* (now *Syntrichia ruralis*) (Bewley, 2015). His pioneering work with this plant and subsequently with seeds of a number of species established key concepts in desiccation tolerance that remain fundamental to the field and opened a portal into subsequent exploration of vegetative desiccation tolerance (Bewley, 1979, 1995; Oliver et al., 2020). His interest in desiccation tolerance during seed development included the molecular changes associated with the termination of seed development and the acquisition of germinative capacity (Bewley et al., 1989). This included studies on storage protein synthesis and accumulation during seed development (Bewley et al., 1992) and the regulatory roles of abscisic acid and osmoticum in these processes (Xu and Bewley, 1991).

In 1985, Derek moved to the University of Guelph to become the Chair of the Botany Department. In addition to his administrative duties, Derek continued his studies of the biochemical basis of seed germination by cloning genes encoding endo-β-mannanase in tomato and lettuce (Bewley et al., 1997; Mo and Bewley, 2002) as well as other genes important in cell wall modification during germination (Nonogaki et al., 2010) and during fruit ripening (Bourgault and Bewley, 2002). He also continued to probe the mechanisms associated with the regulation of seed development and germination by gibberellin and ABA (Bassel et al., 2006, 2008). Derek and colleagues also employed *in vivo* molecular markers to demonstrate that germination is initiated by the expansion of cells in the lower hypocotyl region rather than in the radicle itself (Sliwinska et al., 2009). Derek completed his publishing career by

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contributing to an *Annual Review of Plant Biology* article on desiccation tolerance (Oliver et al., 2020), his 275th published paper or book chapter.

Books authored

While Derek's research alone would ensure his recognition as a foundational plant biologist, his authorship of books has added substantially to his reputation and his impact on the field. This began with his collaboration with Michael Black to publish two volumes of the *Physiology and Biochemistry of Seeds in Relation to Germination* in 1978 and 1982 (Bewley and Black, 1978, 1982). These books presented a comprehensive review of the seed physiology literature to date, but more importantly, they provided a critique of the strength of evidence for various concepts or hypotheses and identified where additional research was most needed. As such, these books introduced a generation of seed biologists to both the history of their field and its future directions. While these books received universal acclaim, the authors also realized that a less research-oriented textbook was also needed. They, therefore, produced *Seeds: Physiology of Development and Germination* in 1985 and updated it with a second edition in 1994 (Bewley and Black, 1985, 1994). Derek subsequently organized the writing of a third and somewhat expanded edition of this book with additional focus on seed dormancy and longevity (Bewley et al., 2013). Michael Black declined to join this effort, but graciously allowed some of his prior work to be included, while Kent Bradford, Henk Hilhorst and Hiro Nonogaki joined as co-authors. Collectively, these books have provided a basic introduction to these topics for a global audience for almost four decades.

Seed science also has a strong connection to agriculture and the breeding, production and technology of delivering crops to the field via high quality seeds. Michael Black and Derek Bewley also contributed to applied seed science through their organization and editing of *Seed Technology and Its Biological Basis* (Black and Bewley, 2000). With contributions from invited experts in the field, this book highlighted the biological basis of seed quality attributes and how they could be enhanced to improve seed performance in crop production. Derek and Michael then invited Peter Halmer to join them in a major editing and publishing effort, resulting in *The Encyclopedia of Seeds. Science, Technology and Uses* in 2006 (Black et al., 2006). This work was truly encyclopedic in its scope, including articles contributed by 112 authors and running more than 800 pages. There is hardly a topic in seed science and technology that is not clearly described in this book, providing a lasting testament to Derek and his collaboration with Michael Black, Peter Halmer and a global community of seed scientists.

Contributions to education and professional societies

During his career, Derek supervised 46 students to a postgraduate degree, many of whom continued in academic or research professions, and mentored 54 postdoctoral fellows and visiting scientists. There is no doubt about the impact that Derek's mentorship and example have has had upon the development of modern seed science and related fields of research. In addition, Derek contributed his time to manifold administrative responsibilities and service activities, both at his home institutions and internationally. At the University of Calgary, he served as the Graduate Administrative Officer in charge of graduate studies in his department, on the Research Committee of the Faculty of Science and on numerous other committees and roles. He came to the University of Guelph as the Chair of the Department of Botany and greatly expanded its research and teaching activity and international reputation. He also served on the Dean's Council and on multiple committees and councils supporting both research and educational goals. Nationally and internationally, Derek served as President of the Canadian Society of Plant Biologists and as a Corresponding Member of the American Society of Plant Biologists. He is recognized as a Pioneer Member of the latter organization and also received its Charles Reid Barnes Life Membership Award. Derek, along with his mentor and colleague Michael Black, played critical roles in the establishment of the International Society for Seed Science (ISSS) in 1999. Derek was President-elect from 2002 to 2005 and President from 2005 to 2008, and his leadership during this period is evident in the adoption of the ISSS Constitution, Statutes and Rules. His outstanding service to this society is recognized by the J. Derek Bewley Career Lecture, which is an invited lecture at the triennial ISSS Workshop named in recognition of his illustrious career and multiple contributions to seed science. This lecture invites a late career or newly retired seed scientist to provide a retrospective presentation on the field and her/his career with a view to lessons learned and implications for the future. He was also honoured in 2011 with the initial Lifetime Membership Award of the ISSS.

In Memoriam

This short summary of Derek Bewley's achievements cannot do justice to the scope of his contributions as a researcher, educator, author and institutional leader in seed biology and related disciplines such as desiccation tolerance. Nonetheless, the magnitude and breadth of his contributions is evident, for which all of us who had the privilege of knowing Derek as both a human and a scientist can attest. For coming generations of seed biologists, take the time to read a number of his books and papers, both to understand the history of our field and to enjoy the breadth of knowledge and the craft of an outstanding scientific writer. As beneficiaries of our personal and professional relationships with him, the authors acknowledge their debt and appreciation to Derek Bewley on behalf of all plant scientists.

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