ISSN 1479-2621
Plant Genetic Resources: Characterization and Utilization (2018) **16**(5); 483–487
doi:10.1017/S147926211800031X

Short Communication

David Bond and Jean Picard: Two pivotal breeders of faba bean in the 20th century

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Received 10 September 2018; Accepted 14 September 2018

Abstract

David Bond and Jean Picard, two leaders of European legume breeding, died within a few months of each other. On the basis of their agronomic and genetic training, they both met the challenge of breeding faba bean, a protein-rich species that had received little attention from breeders before the 1950s (Picard, 1953; Bond 1957). Both made great strides at modernizing their chosen crop by developing and applying new ideas and techniques, as well as generating new methods and genetic materials.

Biographical details

David Arthur Bond, 10 June 1929–14 April 2017

David Bond was born and grew up in the English county of Norfolk, a region known for its flatness of land and its distinctive accent. He attended the village school of Alburgh, Bungay Grammar School in neighbouring Suffolk, then went to King's College Newcastle, then part of the University of Durham, to study agronomy and plant breeding until he finished his Ph.D. in 1955.

After a year at the National Institute of Agricultural Botany, he started work at the Plant Breeding Institute, Cambridge (PBI) in 1957 and developed the country's largest faba bean breeding programme. During the 1970s, when protein crops received the support of the EU, he became a strong actor within the UK and a recognized expert for EU programmes. He retired in 1992 while PBI was owned by Unilever. He released many cultivars of both spring and winter beans, and virtually all of the UK area sown to winter beans was under PBI cultivars. After official retirement activity, he remained active as a scientist, writing and reading papers, and as a breeder in his home garden at Stapleford, Cambridge (Fig. 1). His target then was to combine frost tolerance and large seed size in winter-hardy broad bean cultivars that he named for Robin Hood and his merry men. David had a great affection for the workhorses of his youth, along with other aspects of 1930s farming, and many of his cultivars were named for breeds of horse. He was a wonderful and inspirational mentor to junior scientists and breeders. He married Marcia in 1958 and they had two daughters and four grandchildren who brought him great joy.

Jean Picard, 25 October 1924–16 April 2016

He attended the village school of Neuvy-Pailloux Indre, France and in tertiary education, earned the Ingenieur Diploma of the Senior School of Agronomy (ESA) at Grignon, France, in 1948. A detailed biography is given (in French) at http://www7.inra.fr/archorales/t14-4-Jean-Picard.pdf.

He got a position of research scientist as plant breeder at INRA Versailles in 1948 where he started a programme on clover. In 1955, he moved to INRA Dijon when the site of

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Fig. 1. David Bond in his garden, still cross-pollinating beans in his 80th year.

INRA Domaine d'Epoisses was developed by INRA. There, he developed large breeding programmes on red clover and faba bean. He became director of the INRA Dijon plant breeding Unit in 1963 and held that role until his retirement in 1986 (Fig. 2). As a director of the unit, he favoured innovative approaches, which explains the large programmes on mutagenesis, *in vitro* culture and transposable elements on the model species *Petunia hybrida* by researchers in the Unit between 1965 and 1995. UNIP, the inter-professional French structure on grain legume crops, was created in 1978, and he supported it as a national general coordinator of INRA programmes on grain legumes. He was among the founding members of the AEP, the European Association of Protein Crops, in 1991, and was elected as its first President at its conference in Angers, France, in the following year. He married Henriette on 29 July 1948 and they had one son and two daughters, who later provided six grandchildren and four great grandchildren of whom he was very proud. After his retirement, he lived in his home village at Neuvy-Pailloux, a charming village of the Champagne Berrichonne, taking care of his garden and bees.

Career accomplishments

Both founded as early as 1976, a strong collaborative EU network on faba bean

For both countries, UK and France, after the Second World War, the faba bean was a minor crop, an orphan of any breeding activity and very much neglected in the modern and simple animal husbandry systems based on maize–soybean inspired from US models. The severe world soybean crisis of 1973, with a stop on the US soybean exports, initiated a new EU policy on grain legumes (pea, faba bean, lupin), supporting productions by farmers and also research on these crops. David and Jean in their respective counties were identified as major experts and correspondents for the first two symposia aiming at launching these networks: Dijon, France in November 1976 and Bari, Italy, in April 1978 (Bond, 1976b; Bond and Lowe, 1978; Picard, 1976a, 1978).

They were involved in numerous European projects and contributed to the orientation of programmes at the International Centre for Agricultural Research in the Dry Areas (ICARDA), then based at Aleppo, Syria. Concerned by misunderstandings around the term of 'field bean', which referred to both *Vicia faba* and *Phaseolus vulgaris*, they participated in the launching of the new scientific term 'faba bean' (Bond, 1979).

Through 40 years of work and interdisciplinary collaborations on this then-minor crop, far from classical roads, far from private company investments and big contracts, they significantly contributed to knowledge on it. One striking characteristic in their work is that they shared many common visions on research priorities that they jointly explored in collaborative programmes, exchanging plant material, ideas and students.

They questioned the floral biology of faba bean with a strong interest in pollinating insects

In order to apply modern plant breeding methods to faba bean, the floral biology had to be clarified. In his thesis in 1957 and numerous papers then followed, David and his team investigated pollination mechanisms, their genetic and morphological basis, the pollinating insect species and frequency (Kambal *et al.*, 1976; Bond and Poulsen, 1983; Rowland *et al.*, 1984; Stoddard and Bond, 1987; Bond and Kirby, 1999). On his side, Jean evaluated the extent of natural outcrossing rate using hilum markers on spring or winter genotypes, demonstrating that the outcrossing rate could range from 19 to 79% (Picard, 1953)

https://doi.org/10.1017/S147926211800031X Published online by Cambridge University Press

Fig. 2. Jean Picard in his field plots, aged about 40.

and also evaluating the relation between ovule fertilization and pod setting (Rowland *et al.*, 1984, 1986).

They analysed the problem of yield instability and the effect of the variety type

In the exploration of possible faba bean cultivar types in Europe (pure lines, populations and synthetics, hybrids) David and Jean promoted several international trials that evaluated genotype × environment interactions. They also evaluated the positive effects of heterosis in these various cultivar types (Bond, 1974, 1987, 1989; Picard, 1960; Picard *et al.*, 1982) which supported the use of synthetics and populations that exploit heterozygosity. Diverse breeding schemes were then proposed (Bond, 1987; Picard, 1960).

They evaluated an ambitious strategy of hybrid variety breeding

Early in his work, David discovered a progeny with 100% of outcrossing that appeared to result from cytoplasmic male sterility. Managing this cytoplasm, named 447, to allow use of the considerable heterosis of faba bean on-farm, occupied much of his effort for several years (Bond *et al.*, 1966) and it was generously distributed to other European breeding programmes. Similarly, The French group of Berthelem and Picard found two other cytoplasms that they named 350 and 421 (Picard *et al.*, 1982; Duc *et al.*, 1985). Neither system proved sufficiently stable to be used on a commercial scale, as both reverted to fertility under certain growing conditions such as rising temperature during flowering. The collapse of this dream was a great disappointment for both, but they rebounded and found other ways to increase yields and yield stability. Bond developed an inbred line of winter bean that was remarkably high yielding and carried a useful level of resistance to both Ascochyta blight and chocolate spot disease. It was a component of several composite cultivars.

They worked on seed protein content and seed digestibility for monogastric animals

Both investigated the genotypic and environmental factors involved in the variability of grain protein concentration and proposed parents for breeding for high values of this important trait (Bond and Toynbee-Clarke, 1968; Picard, 1976a). Picard (1976b) showed the association between the white-flower character and absence of tannin in the seed. Since tannins reduce protein digestibility in monogastric animals by 8–10%, this trait was immediately included as an objective in the breeding programmes of both INRA and PBI (Bond, 1976a,b; Picard, 1976b). In France, this led to the release by Jean of the first zero-tannin cultivar, Blandine, in 1985. White-flowered winter bean cultivars Polar, Glacier and Silver were released from 1980 onward, but there was a yield penalty associated with low tannin, so they did not become widespread. Other potential antinutritional factors were evaluated in both countries, particularly vicine–convicine in order to explore the possibility of reducing them by breeding (Bond and Duc, 1993).

They were convinced of the role of faba bean in crop rotations

They were convinced of the complementarity between spring and winter faba bean cultivars in order to enlarge cropping system options in the UK and French agricultures. Consequently, both programmes used sources of frost hardiness, with contrasted earliness and plant architectures, in order to develop new autumn-sown germplasm. In the agriculture of the 19th century in both France and the UK, winter faba beans were important (Bond and Crofton, 1999), and some remarkably highly frost-resistant material developed, such as the population 'Côte d'Or' (Picard *et al.*, 1985). This population has been used as a parent in many European breeding programmes. This work resulted especially in the UK, in the release of many winter cultivars, many named for dog or workhorse breeds.

https://doi.org/10.1017/S147926211800031X Published online by Cambridge University Press

They left many valuable genetic resources for future breeding programmes

Throughout their work they explored many traits of interest in faba bean breeding, such as aphid or disease susceptibility (Bond and Lowe, 1978; Picard, 1978; Bond *et al.*, 1994). They retired just at the time when molecular biology tools were entering the breeding work but from discussions with them, we know that they were interested in the potential of these new tools. David wrote several book chapters about faba bean breeding, and both breeders left rich collections of genetic resources, a spirit of collaboration, strong data and cogent arguments about the value and potential of legumes (including faba bean) for European agriculture. They launched the careers of several young scientists who have sought to carry on their work and develop this crop in new ways that will continue to feed the world. We remain grateful for all that they generously built for the legume research community that continues today in our various networks.

David and Jean were strongly involved in the national registration system of cultivars in their respective countries, and also when the European catalogue was launched in interaction with national ones. They were key contributors to the criteria that are used to distinguish or evaluate agronomic performance and nutritional values of new faba bean cultivars (Crofton and Bond, 1998; Crofton *et al.*, 2000).

They trained a number of students, including the authors of this paper, and worked with many international visitors. Their crop is in better shape around the world because of their efforts.

Acknowledgments

We thank Sylvia Bond and Mervyn Pope for useful information about David Bond's life and career.

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