

OBITUARY

Norman E. Borlaug (1914–2009)

Plant scientist who transformed global food production.

“More than any other single person of this age, he has helped provide bread for a hungry world. We have made this choice in the hope that providing bread will also give the world peace.” These were the words of the Nobel committee when presenting the 1970 Peace Prize to Norman Borlaug. Borlaug died on 12 September. His brilliance as a plant breeder, and life-long dedication to taking scientific innovations to farmers without delay, were driving forces behind what came to be known as the Green Revolution.

He was born on 25 March 1914, and his upbringing on an Iowa farm and experience of hardship during the early 1930s gave him a first-hand view of the ills of low farm productivity, poverty and hunger. After completing his PhD degree in plant pathology at the University of Minnesota in 1942, he joined the Rockefeller Foundation's agricultural programme in Mexico, which led to the birth of the International Maize and Wheat Improvement Center (CIMMYT). There he began his work with wheat, with special emphasis on controlling the fungal diseases called rusts. He introduced a multi-pronged approach, including the development of composite varieties of wheat characterized by phenotypic identity but genotypic diversity in resisting different species of the pathogen.

Drawing on the availability of the Norin 10 dwarfing gene from Japan, in 1953 Borlaug launched a programme to breed semi-dwarf, high-yielding varieties of wheat that responded well to irrigation and fertilizer application. Traditional wheat varieties are tall, and tend to topple over if grown in highly fertile soil. Conditions for good crop growth are also conducive to the spread of pathogens, however, so he intensified his research on combining high yield potential with disease resistance.

Borlaug decided to adopt a ‘shuttle’ programme that involved growing different generations (F₂, F₃ and so on) under two diverse conditions — a summer crop in the cooler highlands near Mexico City and a winter crop in the warmer conditions of Sonora in northwest Mexico. This procedure led to the breeding of semi-dwarf, disease-resistant wheat strains with broad adaptation, such as Sonora 63, Sonora 64, Lerma Rojo 64 and Mayo 64. These were varieties with a yield potential of 5–6 tonnes per hectare that in the 1960s transformed wheat productivity in Mexico, then in India and Pakistan.

In 1966, in a strategy supported by Borlaug, India imported 18,000 tonnes of seeds of Lerma Rojo 64-A and a few other varieties from Mexico. The result was a



jump in wheat production from 12 million tonnes in 1965 to 17 million tonnes in 1968. Similar results were obtained in rice, as a result of the introduction of the Dee-gee-woo-gen dwarfing gene from China into tall varieties of *indica* rice at the International Rice Research Institute in the Philippines. This Green Revolution, a term coined in 1968 by William Gaud, remains an astonishing phenomenon that not only boosts productivity but also saves land resources. For example, in 2009 India produced 80 million tonnes of wheat from 26 million hectares of land. At pre-Green Revolution yield levels, 80 million hectares would have been needed.

Africa, however, did not witness the same success. Beginning in 1986, Borlaug organized a programme known as Sasakawa-Global 2000, in which numerous small-scale farmers were helped to double and triple their yield of maize (corn), rice, sorghum, millet, wheat, cassava and grain legumes. Unfortunately, the spectacular results in demonstration plots were not reflected at the national level owing to the lack of effective systems of irrigation, roads, seed production, remunerative marketing and other elements of infrastructure.

In 1984, Borlaug accepted a part-time professorship at Texas A&M University, where for more than 15 years he taught a graduate course in international agriculture. Aware of the lack of recognition for scientists working in food and agriculture, he had the World Food Prize established in 1986, which he hoped

would come to be regarded as the Nobel prize for these subjects. Throughout his career, he devoted time to training young scholars and researchers. This led him to promote the World Food Prize Youth Institute programme, which helps high-school students to work in other countries, a life-changing experience for them.

Borlaug's seminal research involved traditional breeding methods, but he was a great supporter of biotechnology research, including the use of recombinant DNA technology. He believed firmly in exploiting the new opportunities for creating novel genetic combinations to meet the challenges arising from climate change. He was also an advocate of ‘public good’ research, and argued for the free exchange of genetic material and the continuous development of germ plasm by approaches such as hybridization between winter and spring wheats. In 2006, the Norman Borlaug Institute for International Agriculture was set up at Texas A&M to promote science-based solutions for the challenges facing global agriculture.

Norman Borlaug was a remarkable man who was supported by a remarkable woman, his wife Margaret, who died in 2007. To my mind she is the unsung heroine of the Green Revolution: without her unwavering support, Borlaug might not have accomplished nearly so much in his long and demanding career. He is survived by a daughter and a son.

Towards the end of his life, he received two especially notable honours. In 2004, to mark his youthful prowess as a wrestler, he was inducted into the Iowa Wrestling Hall of Fame. And in 2007 he was awarded the Congressional Gold Medal. On that occasion he pointed out that between the years 1960 and 2000 the proportion of “the world's people who felt hunger during some portion of the year” had fallen from perhaps 60% to about 14%. The latter figure, he went on, still “translates to 850 million men, women and children who lack sufficient calories and protein to grow strong and healthy bodies”, and that “the battle to ensure food security for hundreds of millions of miserably poor people is far from won”. This is the unfinished task that Norman Borlaug leaves to scientists and political leaders worldwide.

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