

In Celebration of 100 Years of ASA

Beachell and Borlaug, Two Giants of the American Society of Agronomy's First Century

Murray H. Milford* and E. C. A. Runge

ABSTRACT

On the occasion of the 100th anniversary of the American Society of Agronomy, it is appropriate that recognition be given to two men: Henry M. Beachell, internationally recognized and most long-lived 73-yr member, until his death in December 2006; and to Norman E. Borlaug, who without doubt, is the most widely acclaimed of the Society's members. Both men had scientific accomplishments that were crucial to the Green Revolutions associated with the production of rice (*Oryza sativa* L.) (Beachell) and wheat (*Triticum aestivum* L.) (Borlaug). Their professional careers have much in common and their interactions with each other had significant impact on the careers of both. The purposes of this paper are to gain insight into their thinking and to highlight the accomplishments that make them the most well-known agronomists of the Society's first 100 yr.

HENRY M. "Hank" Beachell and Norman E. "Norm" Borlaug, raised on Midwestern USA farms, educated at land-grant universities, and long-time members of the American Society of Agronomy have received accolades internationally for their contributions to increased food production across the world. Borlaug, widely recognized as "Father of the Green Revolution" for his role in increasing wheat production in Mexico, India, Pakistan, and other countries, received the Nobel Peace Prize in 1970. He has received many other forms of recognition, including the first International Service Award in Agronomy by the American Society of Agronomy in 1968, many (50+) honorary doctorates from universities around the world, the President's Medal of Freedom in 1977, the President's National Medal of Science in 2004, and most recently the Congressional Gold Medal in 2006.

Some years after he received the Nobel Peace Prize, Borlaug (Hesser, 2006) petitioned the Nobel Foundation to establish a prize in the area of agriculture and food. Upon finding that such was not authorized by the bequest that established the Nobel Foundation, he initiated an effort, ultimately successful with the aid of Robert Havener and the generosity of the General Foods Corporation with the help of A.S. Clausi, Senior Vice President, to establish an annual World Food Prize having a monetary award comparable with that of a Nobel Prize at that time (1987). The first award, in 1987, went to M.S. Swaminathan, who had collaborated with

Borlaug from the onset of his efforts in India. In 1990, support for the World Food Prize was discontinued by Philip Morris, which had purchased the General Foods Corporation, but Borlaug, with assistance from Robert Havener and A.S. Clausi, former Vice President of General Foods Corporation, persuaded John Raun, a self-made multimillionaire in the trucking industry, and, like Borlaug, native of a small town in Iowa, to sponsor the World Food Prize. The Raun Family subsequently endowed the World Food Prize Foundation, which ensures the future of the Prize. Hank Beachell, father of The International Rice Research Institute's (IRRI) short-stature, stiff-straw, high-yielding IR-8 rice, played a key role in the Green Revolution in rice production for which he received many awards, including honorary doctorate degrees, the Japan Prize in 1987, and the World Food Prize in 1996.

Beachell and Borlaug have been very generous with their own personal resources as well as funds received from their many awards by establishing scholarships and grants for students in the professional organizations and institutions with which they have been associated.

We had the privilege of visiting with Norm and Hank in Hank's home in Pearland, TX, on Monday, 19 Dec. 2005. We had known both of them for more than 25 yr and thought they merited special attention during the centennial year of the ASA. We wanted to learn more about their interactions with each other and careers that we could share with others in a short article. With their permission, 2 h of our conversation were captured on tape. Most of the direct quotes attributed to each of them come from these tapes.

Hank Beachell, raised in Nebraska, "had no money" when he finished high school in 1924. He was encouraged by Professor Homer Gooding, of the University of Nebraska, whom he had met as a 4-H leader, to attend the University of Nebraska. Hank's father arranged for him to stay with an aunt in Lincoln, telling her that "he will only be here a couple of weeks" before returning to the farm. "I guess I was kinda stubborn," remembered Hank. Later he did drop out of school for a year to work, spending one summer as a member of a four-person team, saying that "we rode around all summer in a model T Ford pickup looking for corn borers in Illinois and we didn't find a single borer." He returned to school, now interested in becoming a wheat breeder, and received a B.S. degree in agronomy "at mid-term of 1930, immediately going to Kansas where I received \$100 per month and stayed 13 mo before going to Beaumont as a USDA rice breeder in 1931." When asked about taking a job as a rice breeder rather than wheat, he said, with a chuckle, "That's better than starving to death." He took leave later

Dep. of Soil and Crop Sciences, Texas A&M Univ., College Station, TX 77843-2474. Received 2 Jan. 2007. *Corresponding author (mmilford@suddenlink.net).

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to finish the M.S. degree in plant breeding at Kansas State University. He said that John Parker, his major professor, “taught me what a plant breeder should be.” Of his early years in Beaumont, Beachell said, “I had excellent relationships with farmers. They are the only excuse for being a plant breeder. I was dumb enough to tell farmers what I could do, but all we have is this little weed patch.” Subsequently, with the aid of farmers, the Texas Rice Improvement Association, which derived funds for research from the marketing of seed rice, was formed and 600 acres of land was obtained at the present location of the Texas Agricultural and Extension Center near Beaumont. Hank Beachell spent 32 yr in Beaumont and released nine varieties of rice (Agricultural Research and Extension Center, 2006). The last (cv. Belle Patna) was eventually grown on more than half the cropland devoted to rice in the USA. In 1963, he went to the newly formed IRRI in the Philippines where he participated in the development and release of IR-8. It lacked somewhat in grain quality; however, it had a much greater yield potential than the varieties in use at the time and led to dramatic increases in rice production. Borlaug’s recollection of Beachell’s response to those who were critical of IR-8 was, “Yeah, but it’s better than all the rest. We’ll use it until we correct some of the things—you can’t eat potential.” Subsequently, the quality concerns were corrected by release of newer varieties. Beachell and Borlaug, believing that there are no perfect varieties, released improved varieties without waiting for an even better one or the elusive perfect one. Both men knew that variety releases without changes in economic policies and improved cultural practices (e.g., fertility and weed control) would not correct the food deficits in developing countries. In 1972, Beachell moved to Indonesia to continue rice development research until 1982 when he returned to Texas to work on hybrid rice development for RiceTec, Inc., in Alvin, TX, where he continued to consult into his 100th year.

Norm Borlaug, raised in Iowa, was educated at the University of Minnesota, where he received a B.S. degree in forestry and M.S. and Ph.D. degrees in plant pathology. As an undergraduate he was an intercollegiate wrestler and worked in a student dining hall where he met his wife, Margaret. After spending more than 2 yr as a microbiologist with the DuPont de Nemours Foundation, Borlaug was released by the War Manpower Department to go to Mexico. He then accepted the job of organizing and directing the Cooperative Wheat Research and Production Program of the Rockefeller Foundation in 1944. Borlaug “was hired as a plant pathologist in the corn and wheat programs.” He said, “I came through the back door into agronomy by way of forestry and plant pathology. I never really got interested in plant breeding until I went to Mexico in 1944.” “My work to combat hunger started in Mexico with the Rockefeller Foundation. Inspired by Henry Wallace, it was the first ever attempt to help food deficit nations by a foreign organization.” On Borlaug’s arrival he found a small professional staff and soon faced turnovers; for example, three changes in the agronomist position in 8 yr. “That first year I worked on three crops

and that is when we made the first crosses on wheat.” He was aware of the wide crosses being made by Edgar S. MacFaddin at Texas A&M University, for which he was criticized as being unorthodox by some. Borlaug indicated that there was no professional organization for agronomy or soils in Latin America in 1944. Subsequently, scientists from several of the countries met every 2 yr. Discussions in this group of stem rust, which caused major losses in the USA and Canada in the early 1950s, led to adaptation studies along with those associated with rust. Mexico had become self sufficient in production of wheat in 1956, only 12 yr after Borlaug began his work there. Borlaug and co-workers began to look for ways to harvest two crops annually while avoiding frost damage early and high temperatures at the end of the season. He learned of a little-used experimental location in Sonora which he believed he could use between the seasons near Mexico City. Later, on a visit to Mexico, H.K. Hayes, who had been Borlaug’s professor in a basic plant breeding course in Minnesota, asked Norm where the seed were grown that were being planted. Borlaug told him, “In Sonora, at 28 degrees latitude, 100 m elevation under irrigated conditions and here we are at 18.5 degrees latitude, 2200 m elevation, under rain-fed conditions.” His now well-recognized shuttle-breeding program produced two crops per year, accelerated variety development, and led to daylength-insensitive wheat varieties that were widely adapted to other wheat growing areas. Borlaug remembers that Hayes responded, “You don’t understand the first thing that I tried to teach you in that first plant breeding class.” At this point, Beachell told of planting single rows of 20 different lines of rice at intervals throughout the growing season and observing the time to maturity for each. Beachell observed sharp differences in time to maturity in a Japonica line, which led to development of shorter-season varieties that made possible more harvests per year and also a ratoon crop in places like Texas. He also developed daylength-insensitive rice varieties that matured in shorter periods of time regardless of the time of the year.

With the success being demonstrated with wheat in Mexico and rice in Texas, interest developed within the Rockefeller Foundation to address food production problems on a much wider international scale. The year 1963 was of monumental significance to the future production of wheat and rice, especially in Southeast Asia. The IRRI, established in 1960 in the Philippines, hired Hank Beachell and The International Maize and Wheat Improvement Center (CIMMYT— El Centro Internacional de Mejoramiento de Maiz y Trigo) was formed in Mexico. Hank went from Texas to IRRI and Norm took wheat seed from varieties he and colleagues had developed in Mexico to Pakistan and later to India. By 1970, when Dr. Borlaug received the Nobel Peace Prize, these two scientists and their colleagues had revolutionized the production of two of the world’s most important food crops, rice and wheat.

Beachell and Borlaug, though both knew of the other’s work, first met in Beaumont, TX, in 1957. Both attribute much of their success to the discovery of the dwarf gene for wheat and rice. The dwarf gene for wheat was brought

to Washington State from Japan by Orville Vogel, another agronomist with noteworthy accomplishments, and that for rice came from Taiwan to IRRI. Both Beachell and Borlaug quickly visualized the potential of semi-dwarfs because these varieties would be less susceptible to lodging when grown under increased soil fertility conditions. Also, there was a good possibility that a greater percentage of photosynthetic product would go into grain.

Giving credit to John Parker, his major professor at Kansas State University, Beachell said that his first three priorities in a breeding program were the farmer, the customer, and the commercial interests. Borlaug said that these were the things that most impressed him when he visited Beachell. He noted that Hank had established a grain quality testing laboratory and a Rice Seed Improvement Foundation with membership of farmers and commercial interests had been formed to grow foundation seed and to finance research. Also, Borlaug observed that Beachell had very close working relationships with farmers and the service industry.

Both men were hands-on researchers who did most of the work in the field themselves, making thousands of crosses per year while teaching others to participate in all aspects of the research effort. Both were driven to reduce the number of hungry people in the world, and to do it quickly. Borlaug is famous for sayings such as, "You cannot build peace in the world on hungry bellies" and "The first essential component of social justice is adequate food for all mankind." Beachell and Borlaug (Fig. 1) visualized that success, in terms of avoiding potential starvation for millions of people, depended on the rapid development of high-yielding, good-quality, disease-resistant varieties that would respond to improved cultural practices, particularly increased fertility, without the plants lodging. Both believed that, by making thousands of broad crosses and aggressively discarding early segregating generations, a few of the resulting plants would have many of the desired characteristics. They released varieties without hesitation when they had something that clearly outperformed anything else available even though they knew that further improvements were possible.

Both men got their varieties into the hands of producers, large and small, by way of hundreds of test and demonstration plots, taking care to see that their recommended cultural practices were followed. As Borlaug

said, "When the grass roots catch on fire, those in government feel the heat."

These men, with the varieties they developed in collaboration with their many collaborators and trainees, had major impact in the dramatic increases in rice and wheat production that occurred in the second half of the 20th Century. Mexico, India, Pakistan, Indonesia, the Philippines, and other countries which were deficient producers of grain for their people in 1950s were self-sufficient grain producers or nearly so by 1970 despite large increases in population. (China joined these countries a bit later.) Land spared for nature resulted from these dramatic increases in rice and wheat yields.

When we met with Beachell and Borlaug in December 2005, Beachell opined that the next great challenge, while maintaining other desirable traits, is to develop varieties that require less water while being just as productive. The somewhat younger Borlaug, only in his early nineties, is still traveling the world, taking his knowledge of plant materials, proven cultural practices, and ways of gaining the support of those in decision-making positions to bring about change to countries not self sufficient in grain production. Borlaug is fond of saying "The fear of change is an obstacle to progress." His dream is to see the successful transfer of rust resistance in rice to wheat. Since 1986, Dr. Borlaug has provided technical leadership for the Sasakawa-Global 2000 Project, a cooperative venture between the Sasakawa Africa Association and the Carter Center to bring to the African continent the kinds of change effected in South-east Asia earlier in his career.

As if he has not been busy enough otherwise, Borlaug joined the faculty of Texas A&M University as a distinguished professor of international agriculture in the Soil and Crop Sciences Department in 1984, where he has been in residence each fall semester. For the first decade at TAMU, he taught a graduate course. Since then he has offered himself as a guest lecturer on several topics of his choosing; thus, he has reached many more students, both undergraduate and graduate, with his amazing success stories, keen intellect, boundless enthusiasm, and presentation of challenges for future generations.

Beachell died on 13 Dec. 2006, nearly 3 mo after his 100th birthday, a goal that he was determined to reach. He was, as Borlaug is, a humble gentleman, with great energy, determination and vision. Both men exhibited a real zeal for helping the people of the world to feed themselves. Both developed approaches to breeding that went against the conventional approaches, but showed promise of getting improved materials to farmers sooner, thus averting famine in much of the world. They were successful, almost beyond belief. They are certainly two of the giants who have been served by membership in the American Society of Agronomy in its first 100 yr.

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Fig. 1. Runge, Beachell, and Borlaug, December 2003.

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