Kenneth J. Boote

How did you spend your career?

I grew up on a farm in Iowa and initially wanted to be a farmer, but I was the oldest of nine children and knew that opportunity was not likely, so I studied for a BS degree in agronomy at Iowa State University, thinking I would be an extension agronomist. However, I soon realized that I loved the science of crop physiology. So I went on for an MS and PhD in crop physiology at Purdue University with Don Holt. This was interrupted by nearly three years in the Army, but when I returned, I completed my PhD in two and a half years. My PhD research focused on photosynthetic uptake of $^{14}CO_2$, C partitioning among carbohydrate pools in leaves, and C storage in sucrose and starch pools in taproots of alfalfa.

In 1974, right out of graduate school, I was fortunate to find a job at the University of Florida in a newly created position called Theoretical Crop Husbandry. It was a job description written by W. G. Duncan (one of the forefathers of crop modeling) and Darrell McCloud, who wanted to emphasize crop modeling. It was prophetic, but it took me 10–15 years to develop fully into that role. Like many new scientists, I wanted to do the same type of research as my PhD, but the budget was not there for expensive liquid scintillation counters and other equipment, so I collaborated with agronomists and plant breeders to study growth and yield physiology of peanut and soybean cultivars under drought stress and other factors.

Three crucial events in my career led to a slow change of focus from only crop physiology to crop modeling plus. (1) In 1976 I joined the S-107 regional project on soybean production and management modeling, which continued for 15 years; I was one of the physiologists giving input to the agricultural engineers who were supposed to do the modeling. (2) In 1977, James W. Jones, an agricultural and biological engineer and crop modeler, came to the University of Florida, and that led to a 40-year period of collaboration on crop modeling. (3) In 1981, I took a one-week course on crop modeling at Wageningen Agricultural University. I was thoroughly hooked, and this led to a seven-month sabbatical in 1983 at Wageningen with F. W. T. Penning deVries and H. H. van Laar.

Jim Jones and I collaborated on many research projects, and we developed our own soybean crop model, SOYGRO, which was released in 1983. We collaborated to build portable canopy chamber systems to measure CO2 exchange in the field and soil–plant–atmosphere (SPAR) systems for measuring continuously the CO2 and water vapor exchange of crop canopies (at five-minute time steps over the full crop life cycle). Another important colleague, Hartwell Allen at USDA–ARS, took over management and operation of the SPAR systems in about 1982, leading to collaboration with him that continued until my retirement in 2009.

During that time, we used the SPAR systems to investigate responses of soybean, rice, peanut, common bean, and sorghum to elevated CO2, elevated temperature, and drought. The field and SPAR chamber research provided important knowledge for modeling leaf-to-canopy assimilation, and especially for modeling the responses of crops to elevated CO2 and elevated temperatures. In the two decades from 1990 to 2010, Allen and I, with postdocs such as Jeff Baker, Russ Gesch, and Vara Prasad, documented and published cardinal upper temperature thresholds for physiological processes of rice, soybean, peanut, common bean, and sorghum. We learned that photosynthetic response at quite high temperature is not the problem; rather, underelevated temperature pollen viability and grain-set success are the much larger problem.

During the past 20 years, on the basis of my expertise in crop modeling, grain legume physiology, forage physiology, and crop

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response to climate change factors, my career shifted toward international activities. These activities included peanut and rice research and modeling with CGIAR Research Centers (https://www.cgiar.org/research/research-centers/), providing agronomic advice on United States Agency for International Development peanut projects with scientists in Africa, conducting crop modeling courses (United States and internationally), hosting scientists on perennial forage crop modeling, and assisting the Agricultural Model Intercomparison and Improvement Project (AgMIP). Although I am retired (encouraged by an early retirement incentive at 63 years of age), I continue grant-supported projects, host visiting scientists, and engage in international collaboration. My role in AgMIP over the past 10 years is coadviser for crop modeling, in which I give advice to crop modeling teams on using and improving their models for response to climate change factors and projecting climate change impacts. I interact with maize, rice, soybean, and crop water–evapotranspiration teams that have 29, 16, 10, and 30-plus modeling groups, respectively.

What do you consider to be your most important contributions to plant science?

My most important contributions to plant science are in four areas: (1) investigating and documenting the response of important grain crops (rice, soybean, peanut, common bean, and sorghum) to elevated CO_2 and elevated temperature; (2) incorporating those findings and physiological principles into mechanistic crop growth models for simulating crop response to weather, management, soils, and climate change factors; (3) mentoring students, postdocs, and young scientists in crop modeling and crop physiology research; and (4) providing advice to world modeling communities such as AgMIP and the Intergovernmental Panel on Climate Change as they attempt to simulate climate change impacts on agriculture and food production.

When did you become a member of ASPP/ASPB?

I joined ASPP in about 1974, when I graduated from Purdue and took my first job in the Agronomy Department at the University of Florida. Because my discipline and position are in agronomy, my primary societies are the Crop Science Society of America and the American Society of Agronomy. For that reason, I have attended relatively few meetings of ASPP/ASPB, but I value the Society for its published research on plant physiology, which I used as a resource for teaching my graduate crop physiology course.

How did the Society impact your career, and what motivated you to become a Founding Member of the Legacy Society?

As stated above, I value ASPP/ASPB for its published research on plant physiology, which I used as a resource for teaching my graduate crop physiology course. I admit that I am an "ASPB-want-to-be" scientist, as I deeply respect member scientists for their rigorous in-depth research in all mechanisms of plant physiology. ASPB is a highly professional scientific organization. I am an integrationist type of scientist and want to put knowledge together to benefit production of food to feed the planet. So I am a user of ASPB-generated knowledge. I had the choice in about 1990 either to go molecular (genetics) with my crop physiology or to push toward more whole plant modeling and application; I took the latter path, but I am now seeing potential connections with gene-based modeling even in whole-crop models.

My motivation for becoming a Founding Member of the Legacy Society is to give back. I have had an amazing and satisfying career, a pathway that I would not change even if given the chance. I believe in sustaining future scientific research in all ways possible by encouraging young scientists to attend meetings and mentoring them, which I continue to do even though retired. It feels good to give back to organizations such as ASPB that have helped me.

What important advice would you give to individuals at the start of their career in plant science?

Remember that your education does not end once you attain your PhD. Continue to read and learn deeply, especially during the early part of your career. Do not try to duplicate your PhD research, but keep your eyes open to new possibilities in your field, especially triggered by the mission of your job

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or position and as you write grant proposals. Avoid staying narrowly in your field and try to diversify. Go to professional meetings and listen to seminars by presenters in other fields who discuss new methods or approaches. Develop collaborators in your approximate age class (within 10 years) whom you trust and in research fields that complement your skills. Collaborators can help you see potentials and risks in your research and provide another set of eyes in writing proposals and papers. Don't be afraid of change, but seize new opportunities when they come. If you can, try shifting directions in your research every five years or so to stay fresh and renewed.

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