



Donald N. Duvick

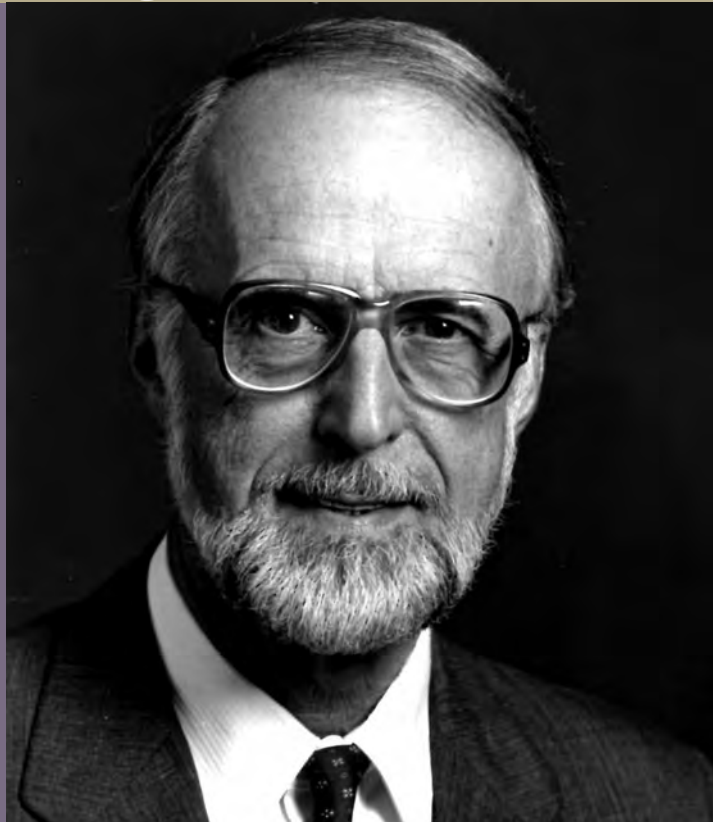
1924–2006

BIOGRAPHICAL

*Memoirs*

*A Biographical Memoir by  
Arnel R. Hallauer*

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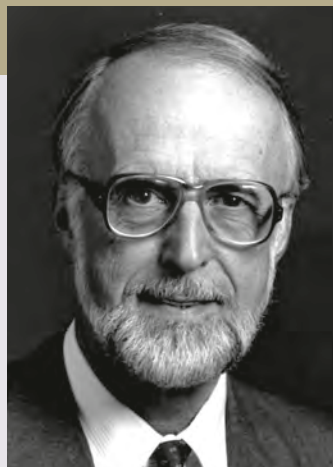
# DONALD NELSON DUVICK

*December 18, 1924—May 23, 2006*

Elected to the NAS, 2002

Donald N. Duvick's forty-year professional career was dedicated to the development of superior seeds for agricultural distribution. His major research interests were in the development and production of hybrid corn, but he also had responsibilities for other crop species sold commercially throughout the United States and the world. Duvick started his career in 1951 at Pioneer Hi-Bred Corn Company as a corn breeder, studying the genetics of cytoplasmic pollen sterility. He advanced within the company to become senior vice president of research in 1984, a position he held until his retirement in 1990.

In order to produce large quantities of high-quality hybrid seed corn for growers each year, vast numbers of people were required to detassel cornfields by hand. Production of hybrid seed corn is seasonal (three to five weeks), so it was difficult to hire an adequate number of detassellers and supervisors to ensure quality control in the yearly production. Hence, it was of interest to develop and identify genetic systems that could reduce the need for these seasonal workers by controlling the inherent fertility of the plants.



*Donald N. Duvick*

*By Arnel R. Hallauer*

Duvick's first assignment upon joining Pioneer Hi-Bred Corn Company was to study different sources of cytoplasmic pollen sterile and genetic restorer systems that could produce double-cross and single-cross hybrid seed corn. Each system permitted the production of high-quality hybrid seed corn with the use of cytoplasmic pollen sterile lines, designated females, which were crossed with pollen fertile lines, designated males. When the males were converted to include genetic restorer genes, the seed produced on the female lines could be made fertile after being grown by the producers.

Duvick conducted intensive studies of the three types of cytoplasmic pollen steriles (T, C, and S) and the genetic restorer systems required for each of them to restore fertility of hybrid seed produced on the female lines. He also searched for additional types of

pollen sterile cytoplasm, and he made tests for allelism and comparative genetic studies of fertility restoration systems. These basic studies to develop and refine the techniques for cytoplasmic pollen sterile/genetic restorer systems were extended to include the comparative performance of hybrids produced on cytoplasmic pollen sterile and normal cytoplasm. Duvick reported that there were some differences between pairs of hybrids, partly due to cytoplasmic differences and partly due to male sterility. Precise testing was required to ensure that the producer and grower were aware of the possible effects these differences could have on production of hybrid seed corn.

The Texas cytoplasmic male sterile (T) was used successfully and extensively to produce hybrid seed corn from 1950 to 1970. During those two decades, Duvick was prominent in researching the use of cytoplasmic pollen sterile/genetic restorer systems, recognizing possible problems associated with them and suggesting alternative methods for producing hybrid seed corn after 1970. Based on his own research and experiences, he freely shared information with others either by direct communication or by publication of refereed articles in scientific journals. His publications were studied in detail by breeders in both public and private organizations and were considered the seminal sources of information for the effective use of this system in corn production. The use of the T-cytoplasmic pollen sterile system to sterilize female parents was essentially eliminated after 1970 because of susceptibility of the T-cytoplasm to southern corn leaf blight (T-race of *Helminthosporium maydis*) and yellow leaf blight (*Phyllostica maydis*). The serious nature of the problem was recognized quickly throughout the commercial hybrid seed corn industry and was corrected by returning to manual and mechanical detasseling of the female parents to produce hybrid seed corn.

Because of Duvick's keen intellect, broad interests, and vision for plant improvement, he was assigned greater administrative responsibilities at the company, which was renamed Pioneer Hi-Bred International, Inc. His new duties, however, did not stifle his interest and participation in basic and applied research related to the genetic improvement of hybrid corn.

He initiated research projects and participated in their conduct, as well as the analysis and interpretation of data relative to the efficiency of different selection methods for genetic gain, concerns for the erosion of genetic variation available to corn breeders, potential problems for maintaining the corn germplasm available to corn breeders, chemical composition of the corn kernels, the potential for increasing prolificacy of inbred lines, and methods to increase the tolerance of inbred lines to important pests and

One significant incident during Duvick's Army service occurred in 1945 after WWII ended. He applied to a college set up in Biarritz, France, and was accepted for one term. The college was similar to a junior college in the United States and the instructors were American college professors who had volunteered to teach there.

environmental stresses. The results of his research were published in peer-reviewed journals and communicated in either invited presentations at national and international symposia or as invited reviews for book chapters.

After his retirement in 1990, Duvick maintained an active interest in plant research until his death in 2006.

### **Personal history**

Donald Nelson Duvick was born December 18, 1924, the eldest of four boys, on an eighty-acre dairy farm in rural Sandwich, Illinois. His early education was in a one-room school. He attended Sandwich High School and

assisted with the family dairy farm, as well as raising hogs for an FFA project. Duvick graduated from high school in 1941 and received a scholarship to attend the University of Illinois, but family resources were not adequate to permit Duvick to start college, so he continued working for wages on the farm.

Duvick entered the University of Illinois as a freshman the following year, in the fall of 1942. His major was in agriculture because he expected to become a dairy farmer. When Duvick turned 18 in 1942, he was drafted into the U.S. Army and entered the service in July 1943 at Camp Grant, Illinois. He completed his basic training at Camp Hood (now Fort Hood), Texas. After basic training, he qualified to attend the University of Illinois for specialized studies leading to Officers Training in Engineering. However, this program was discontinued in March 1944, and Duvick was assigned to the new 1265th Combat Engineer Battalion in training at Camp Van Doren, Mississippi. Because he was the only one in his company who knew how to type, Duvick was assigned the job of company clerk.

The 1265th Combat Engineer Battalion was transported to England for further training in November 1944, and in March 1945 it moved to France, north through Belgium, and eastward across Germany, repairing roads and bridges. At the end of the war, his unit was billeted in Weimar, Germany, and was a part of the occupation. Duvick was discharged from the Army in April 1946 and spent the summer after doing farmwork and getting reacquainted with his family.

One significant incident during Duvick's Army service occurred in 1945 after WWII ended. He applied to a college set up in Biarritz, France, and was accepted for one term. The college was similar to a junior college in the United States and the instructors were American college professors who had volunteered to teach there. Duvick studied genetics and music composition and theory. His genetics professor was F. D. Keim from the University of Nebraska, who was an excellent instructor, knowledgeable in his discipline, and a very effective advisor for students who wanted to prepare for further study. Reflecting on his experiences of the schools at Biarritz, Duvick wrote in 1995: "My course in genetics pointed me to a career in plant breeding and genetics. I enjoyed it, was stimulated by it, and also learned about the career possibilities in the field."

Duvick returned to the University of Illinois and studied agronomy, graduating with honors (Bronze Tablet) in 1948. One of Duvick's professors contacted Edgar Anderson of the Missouri Botanical Garden to determine if there were any possibilities for graduate study in his laboratory, and Duvick was accepted into Anderson's laboratory with a scholarship that was funded by Pioneer Hi-Bred Corn Company. After spending the summer of 1948 working in the company's breeding nurseries at Johnston, Iowa, Duvick returned to St. Louis, Missouri, and enrolled in Washington University as a candidate for an advanced degree. He lived with Anderson and took classes at Washington University and the Missouri Botanical Garden.

Duvick's thesis research emphasized the development of the endosperm of the corn kernel. Initially, his research was designed for a masters degree, but after several months it was expanded to help him qualify for a PhD. Duvick received his PhD degree from Washington University in June of 1951, and his dissertation on corn endosperm development led to his first publication in 1952 in the *American Journal of Botany*.

In March of 1951, Duvick travelled to Des Moines, Iowa, for an interview with Pioneer Hi-Bred Corn Company. He accepted a position as a corn breeder with Pioneer and began working in the corn research nurseries, investigating the potential of using cytoplasmic pollen sterility for producing hybrid seed corn. During the 40 years he worked at Pioneer, Duvick advanced from a bench scientist to become senior vice president of research, which was a position that he held from 1984 until his retirement in 1990.

Duvick had a very successful and rewarding professional career, but he had a family and personal activities that were just as rewarding. He met the woman who would become his wife at a noon buffet while they were both graduate students at Washington University. Selma Elizabeth Nelson (known as Sunny) was born and raised in Palmerton, Pennsyl-

vania, and had graduated from Wilson College in 1948 with an AB degree in biology. Sunny then enrolled at Washington University for the 1948 fall semester as a graduate assistant. Sunny and Duvick began dating and by April of 1950 they were engaged. The two married at Sunny's parents' home in September 1950. During the following years they were blessed with three children: Daniel Nelson (1952), Jonathan Paul (1954), and Randa Jane (1956). Duvick was an attentive father who spent many hours guiding and following his children's activities.

In addition to his family, Duvick was interested in music, gardening, and studying the flora of local prairies. He had a fine tenor voice and sang with a number of ensembles, including the United Church of Christ, of which he was a member, as well as the Des Moines Choral Society and at weddings and other functions. He also played the harmonica, which he learned as a boy at the one-room country school.

On the acreage where their home was located, Duvick loved gardening and landscaping. He always grew a large vegetable garden, planted hundreds of daffodil bulbs, fruit trees, and berry shrubs, and landscaped with trees and shrubs. He also liked to "botanise" local prairies, such as Sheeder Prairie in Iowa, as well as in many other natural landscapes in the United States and in foreign countries. Duvick created a prairie on his own acreage, which permitted him to spend hours observing the change in flora as the prairie developed over time.

Duvick was a trustee with the Iowa Nature Conservancy for many years. He was a compulsive reader in all fields because he had an interest in all aspects of the world around him.

Duvick died May 23, 2006, of glioblastoma, a form of brain cancer. He was cremated and his remains were buried at the Ridgedale Cemetery in Johnston, Iowa.

### **Professional history**

After the completion of his PhD at Washington University, Duvick accepted a position with Pioneer Hi-Bred Corn Company. During his forty-year professional career with Pioneer, his research forty-year professional career with Pioneer, his research nurseries and administrative offices were located in Johnston, Iowa. His initial research responsibilities were working in corn breeding nurseries to study the potential of the cytoplasmic pollen sterile/genetic restorer systems for producing hybrid seed corn.

Duvick's research set standards for the development and use of these systems to produce hybrid seed corn. His research was conducted precisely and analyzed thoroughly, with incisive conclusions. Duvick became the focal scientist for both private and public researchers. He was a willing and effective spokesman on the potential use and possible restraints of the cytoplasmic pollen sterile/genetic restorer systems for the commercial hybrid seed corn industry.

Duvick's keen intellect, broad interests, and contributions to plant improvement were soon recognized by his colleagues and associates with the Pioneer Hi-Bred Corn Company. He was assigned increasingly greater responsibilities and advanced rapidly from a scientist in the corn breeding nurseries (1951–1964) to coordinator of the Corn Breeding Department (1965–1971), then to director of the Corn Breeding Department (1971–1975), followed by director of the Plant Breeding Division (1975–1984) and finally senior vice president of research (1984–1990) for Pioneer Hi-Bred International, Inc.

During Duvick's tenure with Pioneer, his company became the dominant hybrid seed corn producer in the United States (with market share of 40–45 percent) and in most of the major corn-producing areas of the world. As senior vice president for research, he led and coordinated the research activities of two hundred scientists in plant breeding and genetics, plant pathology, plant physiology, entomology, biotechnology, microbiology, and data management. Research that he oversaw was conducted at eighty-seven geographic locations in twenty-eight countries, and it focused on corn, soybeans, wheat, sorghum, alfalfa, sunflower, cotton, and bacteria.

Duvick was dedicated to the improvement of the products that Pioneer developed and sold to the growers. His efforts as a scientist and as an administrator included the following:

1. He encouraged company plant breeders in their development of superior corn hybrids for the United States, European growers, and major corn-producing areas of Latin America and Asia. He also encouraged the development of superior soybean, wheat, cotton, sorghum, and alfalfa varieties for the United States and international growers.
2. He provided leadership and stimulus in the development and use of computer technology to analyze and interpret vast data sets generated from the expanded field evaluation trials conducted in the United States and internationally.

He also emphasized how data generated in specific areas (e.g., the temperate environments) have potential use in other areas with similar environments.



3. He encouraged the development of a strong, comprehensive biotechnology research unit for the application of molecular genetics to enhance classical plant breeding methods.
4. Under Duvick's leadership, Pioneer's global plant breeding activities were reorganized to unify and improve the efficiency of hybrid and cultivar development.
5. Duvick always maintained a personal interest in corn genetics and breeding. His personal research to improve corn provided valuable information to the hybrid seed corn industry through the development of in-house breeding and selection methods.

Duvick's contributions to Pioneer's expansion and development began while he was a field scientist and continued until he was senior administrative leader of the company's research efforts. His professional career was dedicated to developing high-performance hybrids.

Duvick's contributions to Pioneer's expansion and development began while he was a field scientist and continued until he was senior administrative leader of the company's research efforts. His professional career was dedicated to developing high-performance hybrids. He conducted a detailed series of studies to determine yield gains of commercial hybrids available to the producers in central Iowa between 1930 and the 1980s. Yield gains of hybrid corn over these six decades were primarily due to improvements in tolerance to abiotic and biotic stresses of the parental inbreds and their hybrids. Heterosis of the hybrids tended to decrease due to the greater increase of the parental inbred yields.

Duvick was a quiet leader, but his thoughtfulness, his rigorous analyses, his development of clear concepts, and his concise presentations to colleagues and employees were widely accepted. He was successful at all levels of his professional career.

### **Professional service**

Duvick was unique among individuals who spend their entire professional career in the commercial seed industry. He actively participated and accepted leadership roles in professional societies. Although he had increasing administrative responsibilities during his career, he frequently presented either voluntary or invited papers at annual meetings, workshops, and symposia, both nationally and internationally.

His oral presentations were always carefully prepared and clearly presented, with definitive conclusions that were of broad interest to the plant improvement community.



Many of his presentations resulted in publications that were carefully studied by other researchers. He served on committees, boards, and special committees, and he was elected to leadership roles of professional societies and industry-related organizations. He either served or was elected to leadership roles as president of the National Council of Commercial Plant Breeders (1984–1986), vice president (1986) and president (1987) of the Crop Science Society of America, vice president (1991) and president (1992) of the American Society of Agronomy, and chair of the board of directors for the Iowa chapter of the Nature Conservancy (1985–1988, 1994).

Duvick's contributions as a scientist and a leader have been recognized by his peers. He was elected to fellowship in the Iowa Academy of Science (1974), the American Society of Agronomy (1980), the Crop Science Society of America (1980), and the American Association for the Advancement of Science (1984). In recognition of his contributions to science, Duvick received the American Society of Agronomy Agronomic Service Award (1989), the National Council of Commercial Plant Breeders Genetic and Plant Breeding Award (1990), and the DeKalb Crop Scientist Distinguished Career Award (1993). Duvick's peers elected him to membership in the National Academy of Sciences in 2002. His contributions to these professional societies included reporting the results of his research, thoughtful and positive contributions to the goals and missions of the professional societies, and active leadership in the direction of societal activities. Very few scientists have made such comprehensive contributions to their professional societies.

### **Public service**

Public service was an integral part of Duvick's interests and lifestyle, whether with his family, his church, or through his memberships in local, national, and international organizations. Although he had extensive administrative responsibilities during much of his professional career, he always took the time for individual visits and was very supportive of his local and professional organizations. He was widely sought to serve on boards and committees because of his input, reasoning, and visions to enhance plant improvement. He was frequently invited to present and discuss his concepts on topics related to genetics plant breeding and how these topics could be integrated with the rapidly expanding field of molecular biology and application to the very successful conventional plant breeding methods. He was a voracious reader and stayed current with the techniques of plant breeding throughout his career.

One aspect of plant improvement that Duvick invested time and effort in was the availability, preservation, and enhancement of plant germplasm resources. Germplasm

is the basic ingredient of plant genetics and breeding, and its conservation, use, and deployment were addressed by Duvick's participation and leadership on committees and boards. His thoughtful analysis and interpretation of available information and research data were valuable in the future directions taken. He served on a committee for the Board of Agriculture for the National Research Council that was charged with investigations of germplasm resources and genetic diversity currently available within our major crop species. Duvick also served on the National Plant Germplasm Resources Board (NPGRB), which acted as the advisor to the U.S. Secretary of Agriculture, and he served on the National Genetic Resources Board, successor to the NPGRB.

He was on a committee for the National Research Council to recommend practices for the deliberate release and use of genetically enhanced plants and microorganisms. After retirement in 1991, he served on the board of directors of two international research centers, the International Maize and Wheat Improvement Center (CIMMYT), located in Mexico, and the International Rice Research Institute, located in the Philippines.

Duvick was also co-organizer of an American Society of Agronomy-sponsored international workshop on plant patenting. He donated his time to serve and advise the United Nations Development Programme, the McKnight Foundation, the Center for International Policy, the International Institute for Tropical Agriculture, and the Food and Agriculture Organization of the United Nations, among others.

In addition, Duvick was a member of the steering committee for the Keystone International Dialogue on Plant Genetic Resources. He was frequently invited to address topics related to germplasm and plant breeding at national and international workshops and symposia. The topics he talked about included genetic diversity, germplasm resources, advances in plant breeding, applications of biotechnology to plant breeding, and the interrelations of public and industry research for developing improved hybrids and cultivars. Duvick was an effective spokesman for both public and private researchers, and his visionary concepts and conclusions were appreciated by both sectors.

### **Foreign service**

Duvick's foreign travel was extensive. There is probably not a major air terminal in the world that he has not either landed in or departed from at some time during his career. Most of his foreign travel, of course, was related to his responsibilities to administer research facilities of Pioneer and to review and advise on the research activities located in foreign countries. Similar to organizations in the United States, organizations in foreign countries sought his advice and counsel, including the international research centers

CIMMYT, located near Mexico City, and the International Rice Research Institute in the Philippines.

Duvick was a plenary speaker at meetings in the United Kingdom, Italy, India, Mexico, Brazil, and the Netherlands. His advice and counsel were widely sought internationally, and his impact on issues related to crop improvement was as significant abroad as it was in the United States.

### AUTHOR'S NOTE

I first met Don in the spring of 1954 and our last contact was at the 2006 annual meeting of the National Academy of Sciences. During those 52 years, I was always impressed by his calm demeanor and keen intellect for a broad range of topics, as well as the conclusions and suggestions he offered freely.

Other primary sources of information for this biographical memoir include the following:

A. R. Hallauer (1997). Donald N. Duvick: Maize Breeder, Geneticist and Administrator. *Plant Breeding Reviews* 14:1–11.

J. S. C. Smith, Duvick's long-time colleague.

Pioneer Hi-Bred International, Inc., Johnston, Iowa, which provided details of his professional career.

Selma (Sunny) Duvick, Duvick's wife of 56 years, who provided details of his personal history and who was his greatest supporter during graduate study and throughout his career.

## HONORS AND AWARDS

- 1974 Fellow, Iowa Academy of Science
- 1980 Fellow, American Society of Agronomy
- 1980 Fellow, Crop Science Society of America
- 1984 Fellow, American Association for the Advancement of Science
- 1989 Agronomic Service Award, American Society of Agronomy
- 1990 Plant Breeding Award (Private), National Council of Commercial Plant Breeders
- 1993 DeKalb Career Award, Crop Science Society of America
- 2002 Member, National Academy of Sciences

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