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Contributors

David Baltensperger, Soil and Crop Sciences, Texas A&M University, 2472 TAMU, College Station, Texas 77840, USA

S. R. Bhat, National Research Centre on Plant Biotechnology, Indian Agricultural Research Institute, New Delhi 110012, India

Narinder P. S. Dhillon, Present address: AVRDC-The World Vegetable Center, East and Southeast Asia, P.O. Box 1010 (Kasetsart), Bangkok 10903, Thailand

Xiamin Diao, Lab of Minor Cereal Crops, Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, 12 Zhongguancun South Street, Haidian, Beijing 100081, People's Republic of China

Sangam Dwivedi, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru PO, Hyderabad 502324, AP, India

Kenji Fukunaga, Faculty of Life and Environmental Sciences, Prefectural University of Hiroshima, 562 Nanatsuka, Shobara, Hiroshima 727-0023, Japan

Jordi Garcia-Mas, Institut de Recerca i Tecnologia Agroalimentàries, Centre for Research in Agricultural Genomics (CSIC-IRTA-UAB), Ctra de Cabrils Km 2, E-08348 Cabrils, Spain

I. L. Goldman, Department of Horticulture, University of Wisconsin–Madison, 1575 Linden Drive, Madison, Wisconsin 53706, USA

Charles Hash, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru PO, Hyderabad 502324, AP, India

James D. McCreight, U.S. Department of Agriculture, Agricultural Research Service, U.S. Agricultural Research, 1636 East Alisal St., Salinas, California 93905, USA

Antonio J. Monforte, Instituto de Biología Molecular y Celular de Plantas (IBMCP), Universidad Politecnica de Valencia–Consejo, Superior de Investigaciones Cientificas, Ciudad Politécnica de la Innovación, Edificio 8E, Ingenierio Fausto Elio s/n, 46022 Valencia, Spain

Rodomiro Ortiz, Department of Plant Breeding and Biotechnology, Swedish University of Agricultural Sciences, P.O. Box 101, SE-230 53 Alnarp, Sweden

Sudhakar Pandey, Indian Institute of Vegetable Research, P.B. No. 01, PO–Jakhini (Shahanshahpur), Varanasi 221 305, India

Michel Pitrat, Institut National de la Recherche Agronomique (INRA), UR1052, Génétique et Amélioration des Fruits et Légumes, BP 94, F-84143 Montfavet Cedex, France

Shyam Prakash*, National Research Centre on Plant Biotechnology, Indian Agricultural Research Institute, New Delhi 110012, India

Manoj Prasad, National Institute of Plant Genome Research, Aruna Asaf Ali Marg, JNU Campus, PO Box 10531, New Delhi 110067, India

Kathleen R. Reitsma, U.S. Department of Agriculture, Agricultural Research Service, North Central Regional Plant Introduction Station, Iowa State University, Ames, Iowa 50011-1170, USA

Dipak Santra, University of Nebraska–Lincoln, Panhandle Research and Extension Center, 4502 Avenue 1, Scottsbluff, Nebraska 69361, USA

Senapathy Senthilvel, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru PO, Hyderabad 502324, AP, India

Abhishek Sharma, Department of Vegetable Crops, Punjab Agricultural University, Ludhiana 141 004, India

João Silva Dias, Technical University of Lisbon, Instituto Superior de Agronomia, Tapada da Ajuda, 1349-017 Lisboa, Portugal

Praveen Kumar Singh, Indian Institute of Vegetable Research, Regional Station, Sargatia, Kushinagar 274 406, UP, India

Hari Upadhyaya, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru PO, Hyderabad 502324, AP, India

Xiao-Ming Wu, Oil Crops Research Institute of Chinese Academy of Agricultural Sciences, Wuhan 430062, People's Republic of China

*Deceased

Molly M. Jahn

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Dedication: Molly M. Jahn Plant Breeder and Geneticist

I. L. Goldman
Department of Horticulture
University of Wisconsin—Madison
1575 Linden Drive
Madison, Wisconsin 53706, USA

Volume 35 of *Plant Breeding Reviews* is dedicated to the illustrious career of Molly M. Jahn, Molly is a dynamic leader in plant breeding, and her career is an inspiration to a new generation of students entering this profession.

I. BIOGRAPHICAL SKETCH

Molly Jahn was born June 4, 1959, and raised near Detroit, Michigan. As a child, she was fascinated by nature and field biology. A serious illness that kept her hospitalized in Ann Arbor, Michigan, for a long period gave her time to think, and when she recovered, she was determined to pursue a career as a biologist.[1] A very bright student, Molly was selected as the Midwest Scholar at Swarthmore College. Her start as a geneticist was, however, a humbling one. After failing her first genetics test, her professor, John B. Jenkins, asked her if she had studied. When

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she replied that she had studied diligently for the exam, he replied that students who did poorly either were not very bright or did not know how to study, hoping it was the latter. He allowed her to come to see him once each week with a list of questions, which she did faithfully. Soon he offered her a job doing lab preparations, and later he served as the mentor who encouraged her to apply for a National Science Foundation fellowship to attend graduate school and to apply to at least one graduate school. Numerous examples in Molly's academic career show incredibly successful outcomes emerging from simple beginnings, and these are a testament to her drive, determination, and vision. It is rare to find a scientist like Molly Jahn who combines high intellect and a strong sense of purpose with such an intuitive sense of the future and its possibilities. Throughout this chapter, specific events and turning points in Molly Jahn's career are identified from descriptions she provided in an interview for the book *Democracy and Higher Education* (Peters et al. 2010).

Molly was awarded the NSF fellowship and was admitted to graduate study at the Massachusetts Institute of Technology (MIT), where she set off to pursue her interest in genetics, integrating the avalanche of molecular insights of the time in a system that would have some applied relevance. Several faculty members at MIT were extremely influential in helping her shape her scientific priorities and experimental approaches, notably Phil Sharp and Frank Solomon. But while visiting her parents back in Michigan, she picked up a book about her maternal great-grandfather Saunders and his four brothers, each of whom had made major contributions in plant breeding and related agricultural sciences under the tutelage of their father, William Saunders. Her great-grandfather had a distinguished career as a physicist at Harvard, and the family still met regularly for large reunions at Hamilton College, where one of the brothers had been a chemist and a successful peony breeder. Another brother, Charles, together with his father bred 'Marquis' wheat, a short-season cultivar that opened the western Canadian plains for settlement. When the Canadian Parliament committed to a federal agricultural research system in Canada, her great-great-grandfather served as the founding director of the experiment station in Ottawa, Canada, for agricultural research where her great-grandfather, the youngest son, was raised. Much as Molly was drawn to the rigor and excitement of molecular genetics at MIT, she was also drawn to the practical relevance of genetics toward crop improvement. In 1983, she made the difficult decision to shift graduate programs, bringing the background she had acquired to agriculture. So it was with a combination of heredity, aptitude, and good luck that Molly found her way to Cornell University in 1983 to begin graduate work in plant breeding.

After moving to Ithaca, New York, Molly, following the example of one of her mentors at MIT, looked for a system where she could study mutations that conferred resistance to plant viral disease with the idea that these mutations likely would occur in genes of both fundamental and practical interest. She was particularly focused on genes or gene clusters that appeared to control resistance to sets of viruses, and all paths led to the largest family of plant viruses, the Potyviridae. Because of the role that vegetables play in the developing world and because of their genetic and botanical diversity, she was interested in finding an example of this phenomenon in a vegetable species and eventually settled on the *I* gene in *Phaseolus vulgaris*. To work on this problem, she became the student of Michael H. Dickson, a noted breeder of *Phaseolus*, *Brassica*, and carrots. From her very earliest days at Cornell, Henry Munger was a key mentor, co-chair of her graduate committee. Ultimately it was his position at Cornell that she filled, appointed in the spring of 1987 as an assistant professor in the Department of Plant Breeding. She received her Ph.D. from Cornell in early 1988 and was allowed to defer her faculty appointment to accept a prestigious postdoctoral fellowship, the Life Sciences Research Foundation fellowship, which she took to the laboratories of Drs. T. J. Morris and A. O. Jackson in the Department of Plant Pathology at the University of California—Berkeley and S. H. Howell at the Boyce Thompson in Ithaca, New York, prior to joining the Cornell faculty in 1991. Although Molly's primary appointment was in the Department of Plant Breeding, eventually she also held a faculty appointment in the Department of Plant Biology. She assumed responsibility for the germplasm that had been developed by Henry Munger and was an outstanding steward of this important legacy in U.S. vegetable breeding, eventually releasing dozens of varieties, parents, and breeding lines with Munger. Molly and her students and staff worked primarily on *Cucurbita*, *Cucumis*, and *Capsicum*, conducting field-oriented plant breeding and basic laboratory research. Her research laboratory grew to include more than 30 scientists, staff, and students and was supported by a wide variety of funding sources, including federal agencies, contracts, and gifts from seed companies, royalties, private foundations, and significant gifts from individual donors with whom she developed close ties. Special among these were Paul H. Todd, a Cornell graduate and gifted chemist who was interested in her work on peppers, and Charles M. Werly.

Molly's research programs were widely recognized for their breadth and depth and were an ideal training ground for a large number of students, many of whom went on to careers in plant breeding in both the public and private sectors. Her work in plant breeding and plant genetics led to pioneering discoveries related to plant disease resistance and

quality traits. Furthermore, germplasm releases from her program are now grown commercially on six continents under approximately 60 active commercial licenses. 'Cornell's Bush Delicata,' for example, was named an All America Selection. This achievement was especially notable in that this open-pollinated cultivar combined the best characteristics of an heirloom on a compact, disease-tolerant, highly productive squash and was recognized because it outperformed the best hybrids on the market at the time for both yield and quality. More recently, a cucumber cultivar was noted with the MGA Green Thumb award, and Molly's licenses now generate royalties that help support the breeding program now led by her student, Dr. Michael Mazourek, an assistant professor at Cornell University.

Always committed to ensuring that her work benefited agriculture, Molly worked closely with Cooperative Extension where possible and filled this role herself where budget cuts had resulted in gaps.

Because of this commitment to ensuring growers and seed companies had the full benefit of her work, she learned early how important detailed communication and strong partnerships were to her success. As she established herself in basic research, she consistently directed major grants in genomics towards outreach and impact.

Molly's long-term partnerships with George Moriarty, a Research Support Specialist in Plant Breeding and Genetics, and Henry Munger, Professor Emeritus, have been key to the development of so much useful germplasm in the Cornell program along with many key long term staff notably Mary Lyons Kreitinger.

Under Henry Munger's influence with strong support from long-time department chair Ronnie Coffman, Molly committed early to international engagement and has had active research relationships in many countries including Afghanistan, Argentina, Austria, Bangladesh, Brazil, Burkina Faso, Chile, China, Costa Rica, Egypt, Ethiopia, France, Ghana, Greece, Honduras, Hungary, India, Indonesia, Israel, Jordan, Kenya, Mali, Mexico, the Netherlands, Pakistan, Portugal, the Philippines, South Korea, Spain, Sweden, Thailand, Taiwan, Tunisia, Turkey, and South Africa.

She welcomed international scholars and students and strongly encouraged U.S. students to acquire international experience. Many have continued their commitment to international engagement and agricultural research. These efforts have resulted in the transfer of many important traits from the Cornell program for use in national programs and seed companies all over the world and sparked ongoing interest in underinvested and indigenous types and species. Molly also worked with the McKnight Foundation for a decade as a charter member of the Oversight Committee of Collaborative Crops.

II. RESEARCH PROGRAM

Beginning with her dissertation research, Molly's focus on genetics of disease resistance in plants resulted in many publications with two pronounced themes. First, she provided key evidence of the importance of the host translation factor, eIF4E, in virus resistance and provided the first example in plants of a bimolecular interaction whose outcome determined infectivity. This work began with the classical identification and revision of known genes for recessive disease resistance in pepper and concluded with isolation of a series of allelic variants at this gene that varied in the range of isolates controlled. This work was based on a murine model, further establishing the relevance of mammalian model systems for crop improvement. A key observation that defines another important first in plant genetics and plant virology was that eIF4E variants driven by a strong promoter could confer dominant negative disease resistance, despite the presence of a wild-type allele in the cell.

A second theme was focused on the organization of disease-resistant genes in the genome. In contrast to prevailing ideas that suggested that the evolutionary pressure on disease resistance loci would lead to rapid diversification and scrambling of these regions of plant genomes, Molly's laboratory showed conservation of these positions across genera in the *Solanaceae*, culminating in a definitive study published in 2009 that demonstrated that these loci are conserved across wide evolutionary distances while diversification of specificity occurs frequently even within narrowly defined germplasm pools. The significance of her fundamental research into both the structure and the function of plant disease-resistance genes earned her a berth on the *Plant Cell* Editorial Board in 2004 and service on the executive committee and as chair of the Plant-Microbe Subcommittee.

Another area of fundamental inquiry and significant impact has been her efforts to identify the molecular basis for quality traits in *Capsicum*, notably color and pungency. She and colleagues used a candidate gene approach to efficiently identify genes with both qualitative and quantitative effects on fruit color in *Capsicum*, resulting in a widely cited publication. More notable, however, is the definitive work from her laboratory over a decade that defined and mapped loci responsible for both qualitative and quantitative variation in pungency including the *C* or *Pun1* locus for presence/absence of pungency. Capsaicinoid biosynthesis in pepper represents an ideal model to study the appearance of unique and evolutionarily significant metabolic capacities in plants with significant implications for the culinary and pharmacological uses of a number of *Capsicum* spp.

In addition to research, student training, and teaching, Molly pioneered a number of new models for public-private partnerships at land grant institutions. These models were based in part on her own experience at Cornell with the licensing of plant germplasm to commercial companies. Those companies became fewer and fewer by the late 1990s, as consolidation whittled the vegetable seed industry down to several major players in the global marketplace. Molly and her colleagues created the Public Seed Initiative (PSI), a mechanism for bringing smaller seed companies and growers together with public sector germplasm. The PSI was, in a sense, a traditional model of cooperation among growers and public sector researchers and allowed for both conventional and organic producers to source public seed. Through the efforts of the PSI, greater connections have been made between smaller-scale growers and seed companies, facilitating the marketplace for specialized seed. This has been accomplished through farm-based trials of public sector cultivars and enhanced relationships with Extension educators, who then translate the information to growers in new ways.

As part of this project, Molly became aware of an important market in the northeastern United States that was almost entirely underserved by the public sector research establishment, namely organic agriculture. She was a public sector pioneer in the area of breeding and selection in and for organically managed production systems. In 2004, she was awarded the largest federal grant of its kind at the time to establish the Organic Seed Partnership, an effort to integrate public and private sector research efforts with large participatory networks for selection in organically managed production environments and trialing. This effort involves hundreds of farmers across the country connected to public and private sector research programs with particular emphasis on smaller companies with limited research capacities.

Molly and her colleagues at Cornell were also instrumental in creating and maintaining the Vegetable Breeding Institute (VBI). The VBI works to assure the continued development of improved vegetable breeding lines and varieties to meet future needs of the vegetable industry and the general public. Through the VBI, which includes faculty from Cornell and, more recently, the University of Wisconsin—Madison, vegetable breeding programs train graduate and undergraduate students to become capable vegetable breeders of the future. The VBI currently has more than two dozen member companies that help support these objectives and participate in yearly field days to exchange information with public sector breeders.

Molly Jahn has been a strong advocate for funding and support of plant breeding activities in the public sector. While many public plant

breeders have lamented the lack of funding for their work, Molly always challenged this notion by arguing that if the work is worth doing and can intersect with strong science and the private sector, resources should be available. Her advocacy helped foster support for plant breeding programs at Cornell and later at the University of Wisconsin—Madison as well as nationally through her work at the United States Department of Agriculture. Molly's influence has also been to encourage plant breeders and other agricultural scientists to think about the societal impacts of their research and to consider the vitality of the rural economy when planning their work.

III. TEACHING

Molly's core teaching was focused around plant genetics, and the class she taught for many years in that subject at Cornell was a mainstay for graduate students in the field. Plant genetics has become a remarkably active field in the last several decades due to an infusion of insights gained from molecular biology and molecular genetics. Molly was able to incorporate these elements into her courses and bring the best of modern plant genetics to her students. Molly is widely known for thinking far ahead for solutions to problems, and she brought this perspective to her teaching. Characteristic of Molly's approach was the integration of information gained from other fields, such as mammalian biology, physical sciences, and ecology, into her core subjects. This syncretic format had great benefits for her students, who broadened and deepened their learning and gained valuable insight into the pursuit of knowledge. Molly also taught sophomore plant genetics and many other courses in plant biology during her years at Cornell and is widely regarded as a challenging and beloved instructor by graduate students. She also mentored 14 postdoctoral scientists, 13 international visiting scientists, and served as the major advisor to 19 graduate students during her years at Cornell. As testament to her tireless efforts at mentoring, her former students and mentees characterize Molly's fierce support of their learning and research projects as absolutely transformative in their education.

IV. ADMINISTRATION

In 2006, Molly Jahn was recruited to be dean of the College of Agricultural and Life Sciences and director of the Wisconsin Agricultural Experiment Station at the University of Wisconsin—Madison. Her faculty

affiliations at Wisconsin are with the Department of Genetics and the Department of Agronomy. Her work there has focused on revitalizing the partnership between the research powerhouse in the College of Agricultural and Life Sciences and the highly varied constituency the college serves. She has been incredibly effective at increasing the resource base of the college, presiding over a substantial increase in extramural funding during her deanship. She also was a driving force behind modernizing administrative and departmental structures and introducing new concepts aimed at improving the efficiency of the use of state resources. Molly is also very well known for serving as an advocate for production agriculture, forestry, the life sciences and higher education in the state. She developed new models for bringing rural students to study at Madison and has championed the cause of curricular reform to capitalize on efficiencies and natural alliances among the sciences. Toward this end, new models for biology instruction, a new major in environmental sciences, a simplified and streamlined degree structure, and reaccreditation of all college-accredited degree programs and animal research were secured. New initiatives in global health, internationalization of curriculum and pre-professional advising in health sciences were launched, and 50 new faculty members were hired, many of whom were recruited to fill new faculty roles. During her deanship, major capital commitments to update facilities and expand infrastructure were secured, including major renovation of Babcock Hall, new construction for the Wisconsin Energy Institute, and a plan for a new Meat and Muscle Biology Laboratory. Emphasizing responsiveness and a strong sense of the land grant mission, Molly has established herself as an important voice in the nearly $60 billion agricultural industry of the state of Wisconsin. Molly also played an instrumental role in developing the Great Lakes Bioenergy Research Center and the Wisconsin Bioenergy Initiative, which together represent close to $200 million in federal and state investment in bioenergy research and outreach. These efforts began in 2007 and are already paying large dividends for the state of Wisconsin and the nation as researchers investigate the potential for biomass-derived energy and the potential trade-offs and synergies, should relevant technologies be commercialized and implemented at scale.

In late 2009, Molly took a leave of absence from the University of Wisconsin to serve on a formal loan to the federal government to provide interim leadership at U.S. Department of Agriculture in Washington, D.C., in the mission area of Research, Education, and Economics, initially as Deputy Under Secretary and, effective as of the departure of Dr. Rajiv Shah, subsequently as Acting Under Secretary for

Research, Education, and Economics. Her work in Washington brought together many of her skills and talents to help advance the science agenda for agriculture, forestry, food safety, nutrition, and environmental sciences during the early phase of the Obama administration. Molly returned to the deanship in Madison on June 1, 2010, and continued through the end of December, 2010. In January, 2011, she took on a brand-new challenge as she transitioned from the deanship to Special Advisor to the Chancellor and Provost for Sustainability Sciences. In this role Molly returned to a more substantial focus on the science that will support decision making with respect to land management strategies, the deployment of innovations on landscapes and our food and energy future.

V. AWARDS AND RECOGNITION

Molly Jahn has received numerous awards in her career, among them fellowship in the American Association for the Advancement of Science, the Vegetable Breeding Award of Excellence from the American Society for Horticultural Science, the Wisconsin Dairy Communicator of the Year from the Wisconsin Dairy Business Association, the Service to Industry Award from the Wisconsin State Cranberry Association, a major teaching award at Cornell University, the National Garden Bureau Gold Medal for the winter squash cultivar 'Bush Delicata', and the MGA Green Thumb award for her cucumber variety Salt and Pepper. She is widely recognized as a leader in the fields of vegetable breeding and sustainability science and is considered one of the country's most important voices on the continued relevance of the land grant university in today's world.

VI. THE WOMAN

Molly Jahn is widely known as a visionary leader in the areas of plant breeding, sustainable agriculture and sustainability sciences, and international development, and has been a national and international presence in these fields for many years. She exhibits limitless energy, intellectual brilliance, and a vision for the future that set her apart from her peers. She has served as an inspiration to students, visiting scientists, and colleagues in both science and policy, and her opinions are sought by leaders across a wide spectrum of agriculture and agricultural science fields. Her advocacy for plant breeding education, improved quality and disease resistance in vegetable cultivars grown worldwide, advocacy for small-scale vegetable and seed production in the United States and

abroad, her work in organic agriculture, and her creation of novel models for public-private partnerships place her among the most widely respected voices for the future U.S. agriculture as a diverse, highly productive, balanced system. She has long been an advocate for the role that vegetables in particular, and improved, stabilized yields of crops and livestock in general will play for human welfare around the world.

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GERMPLASM RELEASES AND PATENTS

Plant Variety Protection Certificates

Bugle, powdery mildew–resistant butternut squash awarded September 2001. Molly Jahn and George Moriarty
Cornell's Bush Delicata, powdery mildew–resistant winter *Cucurbita pepo* awarded May 2002. Molly Jahn and George Moriarty

Cornell Open-Pollinated and Hybrid Squash Cultivars

Cucurbita pepo

Cornell's Bush Delicata (2002) All America Selection
Harlequin F1 (2002)
Celebration F1 (2004)
Success PM (2004)
Romulus PM Zucchini (2005)
Sweet REBA winter squash (acorn type) (2005)
Three inbred PMR pumpkin parent lines used in three hybrid pumpkin varieties
One parent of three commercial hybrid summer squash varieties

Cucurbita moschata

Bugle (2002)
Parents of two leading commercial hybrids
Bright Eyes (NY07-140A) (2009)
Little John NY-05-130 (2009)
Oro Verde NY07-131C-N (2009)
Honeynut (NY07-134A)

Cucumis melo

Hannah's Choice F1 (2005)
PMR Delicious 51 (2005)
Farmer's Daughter (2009)