The Mann Laboratory: A Quarter Century of Postharvest Research

The Davis campus of the Univ. of California (UC) is nationally and internationally renowned for its research, teaching, and extension programs in agricultural and related sciences. This reputation has been earned primarily by scientists and educators in the College of Agricultural and Environmental Sciences and in the Davis component of the Agricultural Experiment Station and Cooperative Extension. UC Davis has the world's largest grouping of plant scientists, and they are distributed among the departments of Agricultural Economics, Agricultural Engineering, Agronomy and Range Science, Botany, Environmental Horticulture, Food Science and Technology, Plant Pathology, Pomology, Vegetable Crops, Viticulture and Enology, and other related departments.

The Davis campus

The diversified 2096-ha (5176-acre) Davis campus was established in 1905 as a branch of the College of Agriculture at the Univ. of California, Berkeley. In 1948, UC Davis held its own graduation commencement ceremonies, and in 1952 the UC Davis College of Agriculture became independent of programs on the Berkeley campus. UC Davis is now one of nine Univ. of California campuses and has continued to expand and broaden its research and educational programs. UC Davis currently serves >24,000 students in its three colleges (Agricultural and Environmental Sciences, Engineering, and Letters and Sciences), in the graduate division, and in the professional schools of Law, Management, Medicine, and Veterinary Medicine. There are >5500 students in 70 graduate programs.

The Univ. of California at Davis is located in the fertile Central Valley of California, 15 miles west of the state capital of Sacramento, and 72 miles northeast of San Francisco. The campus is adjacent to the city of Davis, a friendly community of 45,000.

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Front Cover: The Mann Laboratory. Back Cover: Researchers and students in the Mann Laboratory. Photo credits: Debbie van Blankenship; back cover designed by Pamela A. Lehnert.

The Mann Laboratory

Postharvest research in the Dept. of Truck Crops (later renamed the Dept. of Vegetable Crops) started in the 1920s with the work of J.T. Rosa and O. Smith. The need for larger and better equipped physical facilities became obvious as early as the 1940s. Lobbying and financial support by the Western Growers and Shippers Assn. and grants from the state of California and from the National Science Foundation resulted in the establishment of this facility.

Twenty-five years ago, on 22 Mar. 1967, the newly constructed one-story building was named the Louis K. Mann Laboratory, and was dedicated to the study of the postharvest physiology of fresh horticultural crops, and to the training of students in postharvest biology and technology. The Mann Laboratory is part of the Dept. of Vegetable Crops in the College of Agricultural and Environmental Sciences at UC Davis. The facility was named after Dr. Louis K. Mann, an accomplished scientist and a dedicated scholar and teacher in the Dept. of Vegetable Crops for >20 years. His research included studies on photoperiodism; the taxonomy, morphology, culture, and flavor chemistry of onions and their allies; pollination and fruit development of melons and tomatoes; and the postharvest physiology of onions, garlic, and sweetpotatoes. His untimely death was a great loss to horticultural science.

The Mann Laboratory initially included 16 controlled-temperature walk-in rooms, 8.5 × 12 × 10 ft high, three large access and preparation areas, three research labs, eight offices, a conference/library room, and a large undeveloped area for future expansion. The Mann Laboratory remained almost unchanged for 23 years. In 1991, the building underwent extensive renovation, with the undeveloped space reconfigured into a teaching laboratory, three research laboratories, two workshops, and three offices for students, postdoctorates, and visiting scientists. The secretarial and managerial offices and the conference/library room were also renovated. These modifications have ensured that the Mann Laboratory will remain one of the foremost research facilities in the world to study all facets of postharvest biology and technology well into the next century.

During the past 25 years, many eminent plant scientists from around the globe have been attracted by the facilities and personnel to conduct research at the Mann Laboratory. In the past quarter century, >100 graduate

students and postdoctorates have also studied at the Mann Laboratory. Many of these scientists have become recognized leaders in the field of postharvest biology and technology.

The Mann Laboratory houses some of the many postharvest scientists in the UC Davis Postharvest Program for the Biology and Technology of Horticultural Crops. This program includes 25 faculty in eight departments and an additional six faculty in four departments at UC Riverside. UC Davis postharvest scientists offer 14 upper division and graduate courses that can lead to an MS degree offered by individual departments or to a PhD degree in the interdepartmental graduate groups of biochemistry, genetics, or plant biology. The program also hosts visiting scientists and postdoctorates through a postharvest biology fellowship and coordinates a quarterly graduate level seminar on postharvest biology and technology.

Postharvest studies

The benefits of postharvest research are readily apparent to producers, shippers, and consumers. Any grower or producer who has suffered an economic loss during marketing or any consumer who has disposed of tasteless or poor-quality fruits and vegetables can readily appreciate the importance of preserving high quality from harvest to consumption. California grows a large proportion of the fruits, vegetables, and ornamentals marketed in the nation and ships a substantial quantity of fresh produce to distant national and foreign markets. Traditional postharvest storage and evaluation studies have been instrumental in delineating conditions required to maintain quality in the storage, transport, and marketing of perishable crops. The Mann Laboratory was specifically given the charge to supplement these traditional investigations with physiological and biochemical studies to develop a basic understanding of postharvest changes, as well as applied recommendations to maintain the quality of fresh produce.

Mann Laboratory faculty

All but one of the original five faculty in the Mann Laboratory have retired. Shang Fa Yang, a plant biochemist and physiologist, is the only original faculty member still housed in the Mann Laboratory. The other original faculty include Robert F. Kasmire, Leonard L. Morris, Harlan K. Pratt, and Lawrence Rappaport. The extension specialist position, held by Kasmire, was separated into two positions that are now filled by M. Cantwell de Trejo and M.J. Ahrens. The physiologist positions held by Morris and Pratt were filled by M.E. Saltveit and A.B. Bennett. Some years after the Mann Laboratory was built, Rappaport

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reoriented his program toward hormone physiology and moved from the Mann Laboratory. A few years later, J.M. Lyons moved to the Mann Laboratory from the Univ. of California, Riverside. He later assumed an administrative post outside the department.

Over the years, basic studies have been applied to practical problems and the results communicated to growers and marketers by our excellent extension specialists. Kasmire worked closely with growers, shippers, transporters, and wholesalers to bring research results to the benefit of consumers through lower cost and higher quality fresh vegetables. His work is being continued and expanded by our current extension specialists Ahrens and Cantwell. They are among the eight postharvest faculty in the Univ. of California system who devote a large part of their time and efforts to extension activities.

Ahrens, the newest member of the Mann Laboratory, maintains an internationally recognized program concentrating on identifying and solving problems encountered by packers, shippers, receivers, distributors, and retailers in marketing fresh vegetables. He is actively involved with the marketing and transportation of California produce across the nation and overseas. Cantwell focuses on identifying and solving problems related to harvesting, cooling, storing, and handling of fresh-market vegetables. Her program emphasizes the quality and postharvest behavior of vegetables as affected by variety, preharvest cultural practices, and postharvest handling procedures. She is internationally recognized for her work with small-scale growers and on the storage requirements for specialty vegetables.

The physiological changes associated with postharvest stresses and fruit ripening were studied by Morris and Pratt. Morris and colleagues made some of the first extensive studies of chilling injury. Over the years, a number of researchers in the Mann Laboratory, including Morris, studied postharvest disorders of lettuce, especially russet spotting, which is caused by postharvest exposure to ethylene. Pratt extensively studied the ripening of melon fruit and was one of only a few scientists in the 1950s and '60s to fully appreciate the importance of ethylene in fruit ripening and general plant physiology. He was instrumental in making ethylene a major focus of research in the Mann Laboratory through his own research, his interaction with faculty and students, and his construction of a state-of-the-art gas chromatography to measure the minute amounts of ethylene that are biologically active.

The use of state-of-the-art techniques and instruments continues to be one of the strengths of research in the Mann Laboratory. The powerful techniques of molecular biology and genetic engineering are being

used to clarify many of the previously intractable problems in postharvest physiology. Sophisticated instruments have been built to monitor rapid responses to stress and altered storage environments.

Research in the areas of postharvest stresses and fruit ripening have been continued by Saltveit and Bennett. Many of the stresses that plants experience during harvest and transport to consumers are similar to naturally occurring stresses (e.g., mechanical injury and temperature stress), while other abiotic stresses are artifacts of the handling, storage, and transport technology (e.g., fumigation and controlled atmospheres). Saltveit and colleagues are actively studying the physiological and molecular bases of chilling injury, the rapidly induced physiological responses to wounding, and the physiological response to modified atmospheres. Recent studies revealed the involvement of prior temperature exposures, such as heat-shock and conditioning, in chilling sensitivity and the inhibition of tomato fruit ripening by ethanol. Bennett's group is vigorously investigating the mechanisms of fruit softening with the goal of developing molecular genetic strategies to modify changes in firmness as a means of improving quality. Additional studies include protein targeting within the endomembrane system and the molecular basis of membrane transport. Recent studies revealed the complex role of carbohydrate-degrading enzymes in fruit softening, while studies of carbohydrate transport may offer strategies to manipulate soluble solids content in ripening fruit. While housed in the Mann Laboratory, Rappaport took a special interest in the study of dormancy in storage crops, root crops, and flowers. He subsequently became an international authority on the plant hormone gibberellin.

Lyons moved from UC Riverside to the Mann Laboratory about 5 years after its construction and continued his seminal work on low-temperature stress in crop plants. Horticultural and agronomic losses from chilling injury (injuries that result when crops indigenous to the tropics and subtropics, like avocados, bananas, cucumbers, corn, soybeans, sugarcane, and tomatoes, are exposed to cool, nonfreezing temperatures) remains substantial, while the solution to this intractable problem remains elusive. Lyons examined the hypothesis that a temperature-induced phase transition of the membrane lipids was the primary event in chilling. His research stimulated renewed interest in chilling and was the focus of vigorous debate for over a decade.

Shang Fa Yang and colleagues have made outstanding contributions to our basic understanding of the mechanism and regulation of ethylene biosynthesis and action, and to the development of techniques to manipulate ethylene biosynthesis and action in the process of plant senescence and in relation to

environmental stress. Ethylene is a gaseous plant hormone that is intricately involved in plant growth and development, especially in fruit ripening and plant senescence. Yang has received national and international recognition for his fundamental discoveries in ethylene biochemistry and physiology; specifically for elucidating the metabolic pathway for ethylene biosynthesis. Recently, Yang was elected a member of the National Academy of Science and received the Wolf Prize in Agriculture. He is currently studying the molecular role of ethylene in fruit ripening, leaf senescence, and postharvest physiological disorders, and environmental factors that modulate ethylene synthesis and action.

Kent Bradford is also housed in the Mann Laboratory. His research focuses on the physiology of seed development, germination, and deterioration. The postharvest storage life of seeds is an important consideration in the production and distribution of seeds for planting, and the majority of the world's germplasm resources is preserved in the form of seeds. Understanding the basis of seed longevity and deterioration has practical application in both of these areas and can contribute to fundamental knowledge of senescence and aging.

Postharvest researchers at UC Davis maintain a close working relationship with researchers studying crop production and with extension personnel and U.S. Dept. of Agriculture researchers. Over the years, state and federal funds have been augmented by support from commodity groups that have organized to financially support research. Many of the postharvest studies are multidisciplinary, involving agricultural economists, agricultural engineers, and plant pathologists.

Mann Laboratory rededication

To commemorate a quarter century of postharvest research in the Mann Laboratory, a half-day symposium is being planned in connection with an International Symposium on the Physiological Basis of Postharvest Technologies. The symposium will be held at UC Davis from 9–14 Aug. 1992. It is sponsored by the International Society for Horticultural Science Working Groups on Postharvest Handling of Vegetables, Fruit Storage, and Vegetable Quality, and by the ASHS Postharvest Working Group.

For further information about the Mann Laboratory, the Postharvest Biology Program, or the 1992 international symposium please contact the author.

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