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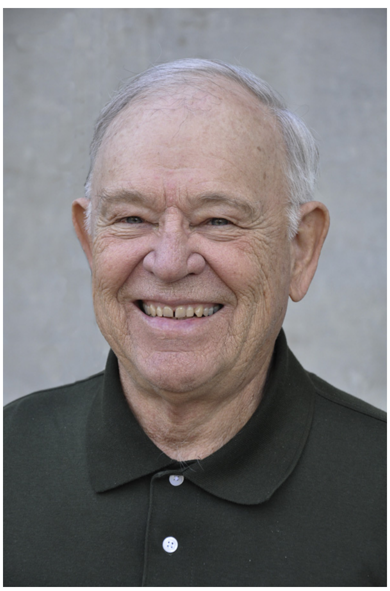
Editorial

Jim Oster: Scientist, editor, and inspired manager of water in irrigated agriculture

The following papers in this Special Issue honor the career and achievements of Jim Oster. As a preface we provide a synopsis of Jims career as a scientist, editor, and inspired manager of water in irrigated agriculture.



1. Outline of career

Jim Oster was born in 1937 in Hazen ND, a farming community located about 100 km northwest of Bismarck, the capital of the Great Plains State of North Dakota in the USA. His parents were first generation descendants of German-Russian immigrants coming from Crimea, near the eastern shores of the Black Sea. They farmed hilly land, where the soils varied from fertile loamy alluvial soils in the valleys to upland soils of poor fertility because of high sand and gravel contents. Jim's interest in soils was influenced by this soil variability, which had major impacts on crop productivity and trafficability. During his college years he experienced farm work as rather monotonous, especially the seemingly endless driving of a tractor with a harrow behind it, as part of traditional summer fallowing. The later introduction of conservation tillage was highly beneficial on the Oster farm. More water was conserved and infiltrability was improved, particularly in the small patches underlain by a sodic, prismatic B-horizon. In such patches you could get stuck during spring plowing. Overall, the farm experience motivated Jim to major in soil science at University and in 1959 he graduated with a BSc from North Dakota State University (NDSU).

In the fall of 1959, Jim moved to West Lafayette, Indiana, to start graduate study in the Agronomy Department at Purdue University. He started as teaching assistant with Anson Bertrand (1923–2014), who taught advanced soil physics, but did his graduate research under the direction of Professor Philip F. Low (1921–1997), resulting in his MSc and PhD degrees. Jim's research at Purdue concerned fundamental aspects of the physical chemistry of clay–water systems. His MSc thesis dealt with activation energy for ion movement in thin water films on montmorillonite (Oster and Low, 1963, UCR1), and his PhD thesis with heat capacities of clay and clay–water systems (Oster and Low, 1964, UCR2). This initial research experience in the early sixties at Purdue University, under the guidance of the highly distinguished soil physical-chemist Phil Low (see Gardner and Roth, 2000) laid a solid base for his career.

As undergraduate at NDSU, Jim was with the Reserve Officer Training Corps, which, on finishing graduate study, resulted in an obligation to complete at least six months active duty. He fullfilled this obligation by serving as an officer with the U.S. Army Chemical Corps. Following a basic training course in the fall of 1963 at Ft. McClellan, Alabama, he worked at the Rocky Mountain Arsenal near Denver, Colorado in the Quality Control Office till October 1965.

Jim's subsequent research career consists of three periods. He was Soil Scientist with the U.S. Department of Agriculture, Agricultural Research Service at the U.S. Salinity Laboratory (USSL) in Riverside, California (1965–1981). Following that, he was Soil and Water Specialist and Adjunct Professor at the University of California Riverside (UCR) (1981–2000). He retired on April 1, 2000, but has remained active as a researcher since then. An important aspect of his career were three sabbaticals: at the Soil and Water Institute, Volcani Center, Bet Dagan, Israel (1975–1976); at the Institute for Irrigation and Salinity Research at Tatura, Australia (1988–1989); at the Instituto de Investigaciones Agropecuarias (Institute for Agricultural Research), Vallenar, Chile (1994–1995)

Apart from these sabbaticals, Jim was also involved internationally in other ways. He was Cooperating Scientist, USDA, OICD, PL480, Soil Reclamation Project, Egypt Ministry of Agriculture (1978–1987). He also was a member of the Pakistan Research

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Program Review Team for the National Academy of Sciences, Office of International Affairs, Board on Science Technology in International Development, Washington, DC (1991–1994).

Jim was involved in the move by the American Societies of Soil Science, Crop Science, and Agronomy from the metric to the SI system of units, his involvement being especially in the area of soil chemistry (Thien and Oster, 1981, UCR29, USSL743; Buxton et al., 1984, UCR39). He served as President of the California Chapter of the American Society of Agronomy (1994–1995). In 1997 he became a fellow of the American Society of Agronomy. In 2010, he was a panel member in an external review of the Integrated Water and Land Management Program of the International Center for Agricultural Research in the Dry Areas (ICARDA).

Jim married Karen Ritchie during the summer of 1958 between their junior and senior years at NDSU. Jim and Karen have three children, born respectively in the States of Indiana, Alabama, and California. For more than twenty years, Karen taught home economics and food science in high schools in Indiana and California. In 1986 Jim donated one of his kidneys to his brother John. John died in 2009, at age 68, of complications resulting from type 1 diabetes.

In the following three sections Jim's major accomplishments in the three periods mentioned above are briefly reviewed. A final section concerns his service as an editor

2. Soil scientist at the U.S. Salinity Laboratory (1965–1981)

In October 1965, Jim Oster joined the USSL physics section, from which the head Ren Richards (1904–1993) had just retired and his successor Wilford Gardner (1925–2011) left for the University of Wisconsin the following summer. At the USSL, soil scientists, plant physiologists, and agricultural engineers were addressing the pressing problems of irrigated agriculture. Jim effectively operated on the border of soil physics and soil chemistry, but leaning toward the chemistry. He bravely faced the difficult problems of conceptualization, modeling, and measurement.

Jim's first research topic was testing a salinity sensor, designed by Richards (1966, USSL419) and based on equilibration of the salinity of the water in the soil with that in a conductivity cell made out of ceramic, thus giving the electrical conductivity of the soil water, ECsw. Sensors where inserted at several depths in a soil column with a pepper plant growing on it, resulting in an early introduction of Jim to spatial and temporal variability of soil salinity in the rootzone (Oster and Ingvalsen, 1967, UCR3, USSL443). The calibration curves of the sensors were fairly stable (Oster and Willardson, 1971, UCR8, USSL496). With the Dutch visiting scientist Jans Wesseling (later the founding Editor-in-Chief of *Agricultural Water Management*), Jim analyzed the response time of the ceramic salinity sensor. They found it adequate to infer ECsw from sensor readings when they changed rapidly (Wesseling and Oster, 1973, UCR13, USSL528). Jim also early explored using the combination of tensiometers and salinity sensors as a dual feedback system for irrigation control (Oster et al., 1976, UCR17, USSL561).

With his colleagues Steve Rawlins, Bob Ingvalsen and Glen Hoffman, Jim made independent measurements of the matric and osmotic components of the soil water potential by combining the thermocouple psychrometer with either the porous plate apparatus (Oster et al., 1969, UCR5, USSL463), or the salinity sensor (Ingvalson et al., 1970, UCR6, USSSL482).

The work with the salinity sensor opened up chemistry issues that needed further work. Could one calculate the EC of a salt solution from its chemical composition? And if so, could one calculate ECsw using the water content of the saturated paste and the chemical composition of the saturated paste extract? With Brian McNeal, Jim evaluated several models for calculating the change in soil solution composition and electrical conductivity as water content is changed by evaporation or extraction by plant roots. McNeal et al. (1970, UCR7, USSL485) verified that the EC of a mixed salt solution could be calculated with considerable accuracy (±4%) in the range 0–100 dS/m. Oster and McNeal (1971, UCR9, USSL497) confirmed that the composition of the water and ECsw could be calculated as function of the soil water content, using a computer code that accounted for the multiphase equilibria between gypsum, calcite, cation exchange, partial pressure of carbon dioxide (P_{CO_2}), and ion pair association. Their work built on that of Gordon Dutt and Ken Tanji of the University of California Davis, and like them, they assumed that the Debye–Huckel equations to calculate activity coefficients of ions dissolved in water could be used for the ions dissolved in soil–water that is always in close proximity to charged soil particles. Charles Bower, a soil chemist and the Director of the USSL, questioned this assumption, but nevertheless approved submittal to a journal.

Later, with Jim's colleague Jim Rhoades, closely related computations were done of drainage water compositions and the salt burdens resulting from irrigation with river waters in the Western USA (Oster and Rhoades, 1975, UCR16, USSL541). For this a simpler code was developed to calculate ECsw in the rootzone and the electrical conductivity of drainage water, ECdw, as a function of leaching fraction, i.e. the ratio of the volume of drainage water to the volume of the irrigation water. If the leaching fraction remains relatively stable over long periods of time, its effect on ECsw and ECdw does not involve cation exchange equilibria. Drainage data obtained from a multiyear lysimeter study conducted at the USSL were used to verify the code (Oster and Rhoades, 1975, UCR16, USSL541). A long-standing outcome of this work is the computer program WATSUIT (Wu et al., 2012, UCR89), originally written by Rhoades and Merrill (1976, USSL565), with which one can assess the potential salinity hazard for crop growth of an irrigation water as a function of the composition of the irrigation water and leaching fraction. The utility of WATSUIT is limited since it involves the assumption that leaching fractions are relatively stable over the long term. Where this is not the case, a transient-state, soil–water-chemistry model named UNSATCHEM (Suarez and Simunek, 1997, USSL1472) should be used (Oster et al., 2012, UCR88). UNSATCHEM accounts for the effects of both salinity and matric stress on crop growth resulting from transient changes in soil water contents and ECsw within the rootzone as a consequence of irrigation and of crop water uptake. Also taken into account are chemical reactions involving precipitation and dissolution of calcite and gypsum, cation exchange and changes in P_{CO_2}.

Miller et al. (1965) reported that saline soil reclamation was more efficient with intermittent water application than with continuous ponding. To explore this further, Jim Oster teamed up with two agricultural engineers, Lyman Willardson of the Imperial Valley Conservation Research Center near Brawley, California, and USSL colleague Glenn Hofman. A field at Brawley was divided into three, 0.11-ha plots and these were used to compare three leaching treatments: continuous ponding, intermittent ponding, and sprinkler irrigation. The time required for a 50% reduction of ECsw measured with salinity sensors at depths of 55 and 86 cm was the same for all three treatments, but leaching by intermittent ponding or sprinkling required less water than continuous ponding (Oster et al., 1972, UCR11, USSL523). The data were used by Hoffman (1980, USSL734) to develop graphs that can be used to estimate water requirements for reclamation of saline soils as a function of soil depth. Their most recent republication is in a chapter written by Keren and Miyamoto (2012).

In the 1970s, Jim Oster became heavily involved in a large project on water management in irrigation agriculture, aiming to reduce environmental impacts stemming from disposal of drainage water. In 1972 Jan van Schilfgaarde (1929–2008), later the second Editor-in-Chief of *Agricultural Water Management*, became Director of the