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Water Current

August, 1987 Nebraska Water Resources Center

Research Report

Water-Use Efficiency Improved by Measuring E T

By Pat Larsen

Research at the University of Nebraska has shown that variation in soil temperature in smaller-than-normal lysimeters (buried containers of soil used to measure evaporation and transpiration) compared favorably with that of the surrounding field. However, special management of the mini-lysimeters was necessary to maintain a representative soil-moisture condition.

Derrel L. Martin, agricultural engineer at the University of Nebraska–Lincoln, and Norman L. Klocke, West Central Research and Extension Center, University of Nebraska, North Platte, reported that alternative management strategies for more efficient use of irrigation water should be possible because of these and follow-up studies they are pursuing. The primary objective of their research on "Field Measurement of Evaporation and Transpiration for Irrigated Corn, Sorghum and Soybeans," funded by the Nebraska Water Resources Center, was to develop and evaluate techniques to separately measure evaporation and transpiration.

This objective is instrumental to follow-up research that will examine the varying amounts of evaporation and transpiration under different tillage and irrigation practices—such as conservation tillage and limited irrigation—and with various cropping strategies. To some extent, Martin said, if one reduces evaporation, more water is available to the crop. Such analysis of water use is especially important during the early part of the growing season, when evaporation rates are highest.

Management of irrigation systems becomes increasingly important as water supplies become more costly and less available, the researchers said. With limited irrigation, where crops are stressed during portions of the season, reducing evaporation loss can increase water-use efficiency. Using the measurement techniques they have developed, they expect to create computer models that will simulate the long-term consequences of various cropping, tillage and irrigation practices. Some of these practices will involve limiting evaporation, conserving moisture by leaving varying amounts of crop residue on the soil surface and adapting a trickle irrigation system to a center-pivot sprinkler, thereby cutting the cost of traditional ground-level trickle systems.

Norman Klocke, West Central Research and Extension Center, University of Nebraska, North Platte

(Photo by Jim Peters)

Field and lab experiments evaluated techniques to separately measure evaporation and transpiration of corn, sorghum and soybeans. Large, hydraulic weighing lysimeters measured evapotranspiration. Water loss is measured by weighing the lysimeter periodically.

Another set of lysimeters, equipped with vinyl covers that prevent evaporation but allow crop growth through small openings, measured transpiration. Evaporation rates from bare soil—where the soil is not shaded—and from soil beneath a crop canopy were also measured using the hydraulic lysimeters and mini-lysimeters, the two reported. When using a lysimeter to measure water loss from the soil, if the soil is covered, water loss must be through the plant leaves, they explained. Since the mini-lysimeters are too small to hold a

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Reminder

The University of Nebraska Water Policy Forum meets September 17, 1987 at the Platte River State Park
(See story inside.)

Director's Report

Nebraska Water Resources Center Program FY 1987

by William L. Powers

Seven research projects have been funded by the Nebraska Water Resources Center as of June 1, 1987. These projects address problems of surface-water and groundwater quality, as well as declining water tables and drought.

Management of surface and groundwater supplies could be improved by understanding the interactions between soil type, tillage, precipitation patterns and irrigation systems. The project entitled "Tillage and Precipitation Patterns as Factors Influencing Groundwater Recharge and Surface Water Supplies" is designed to develop a new methodology for obtaining reliable water-resource management information.

Low- and medium-pressure sprinkler packages have been developed for center pivots in order to reduce pumping energy requirements. Higher water-application rates delivered by these low-pressure units could increase runoff from sloping medium- and fine-textured soils. Any practice that would increase infiltration will improve the efficiency of low-pressure irrigation systems. The project "Conservation of Soil and Water Utilizing Interrow Cultivation Techniques" will measure runoff control obtained from interrow tillage techniques on steep slopes and attempt to determine the tillage practice that is most effective in increasing water infiltration.

Drought is a recurring phenomenon in the Great Plains that annually results in substantial crop-production losses. Sometimes government actions to alleviate and mitigate the effects of drought have been untimely, largely ineffective and poorly coordinated. For government to improve its response to drought, the ability to monitor the extent and severity of drought and its probable impact must be enhanced. The project "Assessing Agricultural Drought Impact: The Development of a Crop Specific Index for Winter Wheat" is designed to develop crop-specific drought indices capable of assessing the impact of weather on crop production.

Groundwater quality has emerged as the primary environmental concern of this decade. The movement of chemicals toward the groundwater should be assessed early and at the source of pollution. The primary purpose of the project "Development and Evaluation of Improved Methods of Measuring Chemical Leaching" is to develop lysimeters that can be placed in agricultural fields to measure the leaching of water and chemicals. These lysimeters can then be used in field experiments and with computer simulation to more effectively study the pollution potential of various agricultural practices.

Excessive nitrogen applications have caused substantial increases in groundwater nitrate in several parts of Nebraska. Nitrogen management could be improved with better fertilizer recommendations. The project entitled "Reducing Nitrate-N Losses to Groundwater by Improving Field Sampling Accuracy of Nitrate-N" will determine residual variability of soil nitrogen and will improve the ability to make more accurate recommendations.

To assess the threat of toxic organics to potable groundwater based on the rate and magnitude of contaminant movement, information is needed on the nature and retention of these organics by different soils. One existing source of relevant soil chemical and physical data is the national soil survey. The project "Retention of Toxic Organics as Related to Soil Series and Soil Mapping Units" will identify and quantify soil factors that influence the retention of a group of organics by soils and different mapping units.

Surface-water quality in Nebraska must be maintained if optimal recreational uses are to be realized. Technology is needed that can differentiate between contamination due to warm-blooded

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Announcements

Sept. 17—University of Nebraska Water Policy Forum, Platte River State Park near Louisville.

Sept. 23-25—Water Planning and Financing for the 21st Century, Center for Urban Water Studies, Southern Methodist University, Dallas, Texas. Phone (224) 692-3060 for more information.

Oct. 3—Annual fall meeting, Nebraska Water Conference Council, East Campus Union, 7:30 a.m.-10 a.m., Robert Petersen, North Platte, chair. Phone Bill Powers at (402) 472-3305 for more information.

Nov. 1—Deadline for the 1988-89 Fulbright Scholar-in-Residence Program.

Sept. 15, Nov. 1, Jan. 1 and Feb. 1—Deadlines for the Fulbright Scholar Awards. Phone (202) 939-5401 for more information.

Dec. 3-4—National meeting of the U.S. Committee on Irrigation and Drainage on "Toxic Substances in Agricultural Water Supply and Drainage—Searching for Solutions" at the Alexis Park Hotel, Las Vegas. UCOWR is a co-sponsor of the meeting. Phone (303) 236-6960 for more information.

Water Extension Group Has Session on Water Quality

One of the latest concerns about groundwater quality is contamination by "volatile organic compounds" (VOCs), such as gasoline and degreasers, according to Gregg Wright, director of health for the Nebraska Department of Health. Wright chaired a panel on water quality and health concerns that addressed questions often asked of agents at a week-long, Cooperative Extension conference on organizational development in May. In drinking water some of these compounds are known to cause cancer in humans, he said. Other VOCs are suspected carcinogens.

"Health concerns, programs and research are moving quickly in the area of groundwater and health," Wright said.

Also of primary concern, Wright pointed out, are nitrates and their potential for causing "Blue Baby Syndrome" or methemoglobinemia. Infants of six months or less reduce nitrate in the water to nitrite in their digestive tract. This reduction inhibits the transfer of oxygen from the lungs to the blood.

"Groundwater—Its Management, Protection and Treatment for Drinking" was a last-day presentation at the development conference. Moderated by Roger Gold, coordinator of Environmental Programs and chair of the Department of Entomology at UNL, and held at the Nebraska Center for Continuing Education, the session was attended by about 100 persons. Other panelists were Phillip Issenberg, professor at the Eppley Institute for Research in Cancer at the University of Nebraska Medical Center and Dennis Weisenburger, also of the medical center.

DeLynn Hay, extension water-resources specialist in the UNL Department of Agricultural Engineering, explained aspects of domestic water

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Nebraska Water Resources Center

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NAWID Elects Powers Chair

At its annual May meeting in Arlington, Va., the National Association of Water Institute Directors elected Bill Powers, director of the Nebraska Water Resources Center, UNL, to be chairman of that organization. In accepting the office, Powers said that there were two major challenges for the water centers and institutes next year:

—To work for reauthorization of the Water Resources Research Act of 1984; and

—To work for funding of the full amount authorized in fiscal year 1988 by the Water Resources Research Act of 1984.

NAWID is composed of directors of the 54 institutes authorized in 1964 when President Johnson signed the first Water Resources Research Act (Public Law 88-379).

The objectives of this law were:

—To develop new technologies and more efficient methods for resolving local, state and national water-resources problems;

—To train scientists and engineers in water-related fields; and

—To help coordinate water-related research and the application of research results by means of information dissemination and technology transfer.

In addition, since 1964, the 54 centers and institutes have provided funding to help train more than 40,000 scientists and engineers in water-related disciplines; ninety percent of these are employed in water-related fields.

Bills Held Over by the 90th Nebraska Legislature, First Session

Nebraska state legislators held over until spring 1988 the following bills concerned with water or other natural resources, according to Robert Kuzelka, water resources planner, Conservation and Survey Division, UNL:

LB 124—Grasslands Protection Act
LB 383—Amend Nebraska Safe Drinking Water Act
LB 445—Amend Chemigation Act
LB 566—Establish fees for groundwater and surface water users to be used for water-development and water-quality projects
LB 594—Amend Erosion and Sediment Control Act
LB 706—Environmental Response and Liability Act (state Superfund)
LB 766—Wastewater Treatment Facilities Construction Assistance Act.

Water Policy Forum Examines Hazardous Waste Disposal Siting

The chair of the planning committee for the University of Nebraska Water Policy Forum, Bill Powers, has announced that the second Forum program will be on "Water Quality and Hazardous Waste Disposal Siting—How Can We Handle It?" and will be held Sept. 17, 1987. This issue will be examined by the following:

Michael Steffensmeier, supervisor of the Hazardous Waste Section of the Nebraska Department of Environmental Control, who will discuss types of and amounts of hazardous wastes in Nebraska;

Edward Bresnick, director of the Eppley Institute for Research in Cancer and Allied Diseases at the University of Nebraska Medical Center, who will explain the health risks of hazardous wastes in Nebraska;

Marvin Carlson, a UNL Conservation and Survey Division research geologist, who will talk about geological and hydrological considerations when choosing waste-disposal sites;

F. Larry Leistritz, an agricultural economist at North Dakota State University in Fargo, N.D., who will explain the economics of waste-disposal siting from a site operator's and waste generator's viewpoints; and

Ann Bleed, a UNL Conservation and Survey Division research biologist with an M.S. in industrial and management systems engineering, who will speak on the social and political challenges of locating a waste-disposal site.

Powers said that the purpose of the forum is to provide an organization within the university system for the exchange of ideas between faculty interested in water-policy issues.

"Although the main purpose is to have an intellectual experience from open discussion on water-related topics, the forum is expected to enhance the opportunity for interdisciplinary research across the university campuses," Powers said.

The day-long forum will be in Mallet Lodge at Platte River State Park near Louisville. For more information, call Powers at the Nebraska Water Resources Center, (402) 472-3305.

Extension *(From p. 2)*

testing: how to take samples, what test to ask for and what test results mean.

Kathleen Parrot, extension specialist in housing and interior design in the College of Home Economics, spoke on domestic water-treatment systems: what the systems remove and what they cost.

Darryll Pederson, research hydrogeologist with the UNL Conservation and Survey Division and Department of Geology, addressed common questions about movement of contaminants through the soil to groundwater and the general groundwater-quality situation in Nebraska.

J. David Aiken, water-law specialist in the Department of Agricultural Economics, UNL, spoke on state and federal agency structures and programs: who is doing what and which agency to call to get answers.

Contact these people for more information regarding the topics on which they spoke. Resource materials on domestic water quality that were distributed at the conference also are available. Contact Hay for these non-NebGuide and Extension Circular materials.

Efficiency *(From p. 1)*

crop, water loss must be by evaporation from the soil surface.

With proper management the mini-lysimeters are more representative than more conventional hydraulic lysimeters for evaporation measurement since the moisture content can be better controlled and more accurately measured in mini-lysimeters because of their smaller size (about 1 gallon).

Results showed that the bulk density and temperature of soil inside the mini-lysimeters were slightly higher than for the surrounding soil. The moisture content in the mini-lysimeters was similar to the moisture content of the surrounding area for bare-soil conditions. However, the soil in the mini-lysimeter was wetter than surrounding soil when a soybean canopy shaded the soil surface. Thus, the key to using mini-lysimeters to determine evaporation under a crop canopy is to place them all across the row, not just in the middle or under the canopy's shade, Martin said.

Field research sites were at the University of Nebraska's Sandhills Agricultural Laboratory near Tryon and the Rogers Memorial Farm near Lincoln. Lysimeter readings were taken daily. The authors said that the difference between the two locations served as a good test for the separation techniques to measure evaporation, transpiration and evapotranspiration.

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animals and contamination due to soil bacteria. It would also be advantageous to have a method that would differentiate between human and animal fecal pollution. The project "Assessment of the *Bacteroides fragilis* Group and Their Bacteriphages as Indicators of Human Fecal Pollution of Surface Waters" will identify and evaluate the use of alternate indicators of fecal pollution that could differentiate between human, animal and environmental sources of pollution.

These projects were funded with $105,130 of federal funds and were matched with $191,590 of non-federal funds.

Water Management in South-Central, Southwest Nebraska Theme of Summer Nebraska Irrigation Tour

by Pat Larsen

The management of water and other natural-resources in south-central and southwest Nebraska was the theme of the 1987 annual summer Nebraska Irrigation Tour held Aug. 11 through 13.

Tour director Leslie F. Sheffield, University of Nebraska extension farm management specialist, said that this year the Four States Irrigation Council co-sponsored the tour with the Nebraska Water Conference Council and the UNL Institute of Agriculture and Natural Resources.

Headquartered at North Platte, the tour had an itinerary that included the following:

Day 1:

—A talk by Roy Frederick, director of the Nebraska Department of Agriculture, at a luncheon at the North Platte Holiday Inn. Tour Chairman Michael Jess, director of the Nebraska Department of Water Resources, presided.

— A stop at the Steve Hanson farm to see crops of chickpeas (garbanzo beans) and dry edible beans;

—A visit to Regier's Potato Processing Co., Madrid;

—A program of Western history and songs called "Listen to the Land" by Dr. Robert Manley of Grand Island, historian and entertainer, after a steak-fry dinner at Bufffalo Bill's Scout's Rest Ranch.

Day 2:

Tour stops included visits to:

—The Floyd Wahlgren farm at Gothenburg;

—Central Nebraska Public Power and Irrigation District (CNPPID) office at Gothenburg to see computerized water controls in the Tri-County distribution area;

—Johnson Lake;

—The location of a proposed dam on Plum Creek. The reservoir would supply water for multi-purpose uses such as minimum flows in the Platte River at critical habitat periods for migratory birds;

—The Lloyd Erickson farm, Funk, featuring an explanation of Nebraska's chemigation law by DeLynn Hay, extension irrigation specialist, Department of Agricultural Engineering, UNL;

—Medicine Creek and Harry Strunk Lake for a history of the development of the dams in the area; and,

—After dinner, a Frontier Revue from the Nebraskaland Days Celebration at North Platte.

Don Schaufelberger, general manager of the Nebraska Public Power District at Columbus, explained "Challenges of Obtaining Federal Energy Regulatory Commission Relicensing of Nebraska Hydro-Power Plants," at the second day's dinner.

Day 3:

The tour visited Prudential Farms, North Platte; George Janning, manager Prudential Insurance Co., Kearney, described the operation. Also, the tour stopped at the irrigation-research plots at the NU West Central Research and Extension Center at North Platte, where its staff explained other irrigation-related research activities.

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