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Water Current

Millard W. Hall, Director
Volume 10, Number 4

Karen E. Stork, Editor
July/August 1978

GUEST EDITORIAL

State Water Planning Process to Address Policy Issue Analysis

by

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Since 1965 Nebraska has been involved in the preparation of a State Water Plan. The 1967 Legislature said that the plan would include "an evaluation of (Nebraska's) land and water resources" and "an examination of legal, social, and economic factors which are associated with resource development." The original intent behind the State Water Plan was to provide a flexible framework for water development. Since most water development at that time was undertaken and financed by the federal government, the State Water Plan was an attempt to insure that federal development would be responsive to and consistent with state natural resource goals and objectives.

The Nebraska Natural Resources Commission is the agency responsible for development of the State Water Plan. In 1971 the Commission (then Nebraska Soil and Water Conservation Commission) completed the Framework Study, which included an inventory of Nebraska's land and water resources, and an overview of resource problems and opportunities. Since 1971 the Commission has been involved in the preparation of river basin water quality management plans for Nebraska's thirteen river basins and preparation of river basin water development plans. The Commission was heavily involved in preparation of the Platte River Basin Level B Study, which was completed in 1977 under the direction of the Missouri River Basin Commission.

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NEBRASKA WATER RESOURCES CENTER

Since the State Water Plan was originally conceived, major changes regarding water development have occurred. Congress, in 1972, enacted the Clean Water Act which calls for protection of water quality. In response, Nebraska gave the Department of Environmental Control broad responsibilities for water pollution control. This has been accompanied by a general increased interest in environmental concerns, including water use for recreation, fish and wildlife protection, and maintenance of water quality. Center-pivot irrigation development has increased the rate of groundwater development, which in some parts of the state has resulted in groundwater level declines, conflicts among groundwater users, and conflicts among groundwater and surface water users. At the same time, federal interest in financing water development projects has decreased, while federal interest in protecting environmental values has increased. These factors have led to a general recognition that strict water management is an indispensable part of an overall state water policy.

Because of these and related factors, water policy has been a major topic of discussion in the Nebraska Unicameral. Issues which may need legislative resolution or clarification include:

- (1) conflicts among groundwater and surface water users,
- (2) conflicts among riparian and appropriative water rights holders,
- (3) groundwater management policies,
- (4) interbasin transfers,
- (5) determination of rights to use artificially stored groundwater,
- (6) integration or coordination of groundwater and surface water allocation policy, and
- (7) integration or coordination of water resource and water quality policies.

These issues are complex, not only in that they impact different groups differently, but also in that the nature and extent of these impacts are not clearly understood. In recognition of this need for technical information upon which to base water policy decisions, the Nebraska Unicameral asked the Nebraska Natural Resources Commission to redirect state water planning efforts to include analysis of water policy issues.

In two separate acts the Legislature directed the Commission to place a higher priority on water policy analysis. In Legislative Bill 957, the Commission was directed to cooperate with six state agencies and prepare a work plan for redirecting the state water planning process to include analysis of water policy issues. The other agencies are: Department of Water Resources, Department of Environmental Control, Game and Parks Commission, UNL Conservation and Survey Division, UNL Water Resources Center, and State Office of Planning and Programming. The work plan, which is to

be presented to the Unicameral and Governor on November 15, 1978, is essentially a plan of how the Commission and the other agencies will analyze water policy alternatives (which will be later presented to the Unicameral). The work plan will also describe a mechanism for public participation in the water policy analysis process.

In Legislative Resolution 300, the Unicameral emphasized the need for analysis of alternatives to resolve water policy issues, and directed the six state agencies to cooperate with the Commission in preparing the work plan. The work plan will identify which issues will be analyzed, and the order in which they can be addressed.

The redirection of the State Water Plan coincides with a major shift in federal water policy. After a controversial year-long review, President Carter announced a new federal water policy which emphasizes water conservation and environmental considerations, and deemphasizes the construction of major reservoirs. Whether the President's water policy will be adopted by Congress will not be known for several months. Yet, the President's policy proposals are generally consistent with modifying earlier development oriented programs with the more recent environmental concerns. One of the challenges facing Nebraska and its water planning process is how to reconcile these often conflicting attitudes towards natural resources.

Another issue which will have to be faced by Nebraska water planners is to determine the proper role of water planning. To many, a state water plan should identify where reservoirs can be best located, i.e., water planning for water development. This philosophy may have been appropriate when natural resources were undeveloped and the federal government willing to finance development. Federal policies are changing, however. If the state must make a major financial commitment to water development, state policies may change as well. Given the current interest in limiting government spending at the state and local level, the probability of aggressive state financial support of major water development projects is not high.

The consequences of these policy changes may be that water planning will focus more on managing existing supplies more effectively, for both water supply and water quality purposes. Attention will be given to analysis of conflicts among a variety of water users--those using groundwater and surface water for economic and non-economic purposes--competing in some instances for a diminishing supply. Recommendations will be from among a range of legislative policy options rather than from various project proposals. This does not mean that development of water resources has stopped in Nebraska; rather, that other issues will command more attention than they have in the past.

These and other issues are confronting Nebraska water planners. Regardless of the specifics in the November 15, 1978 work plan, Nebraska's water planning and water policies appear to be in for a major change.

ON THE HOMEFRONT

DEADLINE FOR SUBMITTING MATCHING GRANT PROPOSALS

The deadline for filing a matching grant research proposal for fiscal year 1980 (beginning October 1, 1979) with the Nebraska Water Resources Center is October 1, 1978.

Prospective principal investigators are requested to submit a complete rough draft proposal prior to this date for review by the Director. Meetings with researchers will then be scheduled to discuss their proposal ideas.

For further information, please contact the Director's office, Nebraska Water Resources Center, 310 Agricultural Hall, University of Nebraska, East Campus, Lincoln, Nebraska 68583. Telephone (402) 472-3305.

CONFERENCE ON WATER DATA PROGRAMS AND NEEDS

The Nebraska Water Resources Center is hosting a conference on "Nebraska Water Data--Collection, Storage, Retrieval, Use and Needs" on Friday, September 15, 1978 at the Nebraska Center for Continuing Education. The conference is sponsored by the Nebraska Water Data Coordination Committee and the U. S. Geological Survey.

The objective of the conference is to enable those interested in water data to learn about ongoing federal, state and local data collection programs in Nebraska and to allow data users a forum for expressing their data needs. The conference is designed to provide information and invoke discussion on data availability, storage, cost, access, data analyses that have been completed, and how the data is being and should be used in local and state water resources planning, management and design.

The conference is open to all water interests and should: (1) facilitate communication and coordination among data collecting agencies; (2) provide a vehicle for identifying the data and data analysis needs of public groups; and (3) suggest water data program modifications and innovations to meet the needs of state and local governments and public interest groups.

A panel-audience interactive format is planned. Panel members from various agencies and industries will briefly discuss their programs of data collection related to quantity and quality of atmospheric, surface and ground-water. Participants will then be encouraged to ask questions and discuss the program with the panelists.

Registration fee will be \$10 to include a luncheon and coffee breaks.

For further information, contact: Dr. Gary L. Lewis, Water Resources Center, 310 Agricultural Hall, University of Nebraska, East Campus, Lincoln, Nebraska 68583. Telephone (402) 472-3305.

STAFF MEMBERS TO PRESENT PAPERS

Three staff members from the Water Resources Center and one from the Department of Agricultural Economics will present papers at the Fourteenth Annual Water Resources Conference of the American Water Resources Association in Florida on November 6-10, 1978. The authors and titles of the papers are as follows:

- (1) Millard W. Hall, Director, Water Resources Center, "Mechanics and Potentials of Artificial Groundwater Recharge"
- (2) Donald A. Wilhite, Water Resources Mgmt. Spec., Water Resources Center, Ralph E. Neild, Professor of Horticulture and Phillip W. Harlan, Ass't. Professor of Agronomy, "Pre-plant Soil Moisture Assessment in Nebraska"
- (3) Marvin Damm, Research Associate, Water Resources Center, and Associate Professor of Civil Engineering, "Increased Streamflow by Groundwater Pumpage"
- (4) Raymond J. Supalla, Ass't. Professor, Dorothy A. Comer, Research Associate and James A. Larson, Graduate Assistant, "The Economics of Groundwater Recharge."

Additional information on this conference is included in the "Conference" section of this newsletter.

NEWSPAPER CLIPPINGS AVAILABLE

The Nebraska Water Resources Center has made an addition to its collection of water resources information which should be of interest to all Nebraskans. Beginning in early 1977, a newspaper clipping service was begun, which provides the Center with articles from newspapers throughout the state on matters pertaining to water.

These articles have now been sorted by major category, compiled chronologically, and filed in looseleaf notebooks for easy access. Among the categories are such topics as: Water Law and Legislation, Drought, Groundwater and Recharge, Transbasin Diversion, Minimum Stream Flows, Irrigation, and Water Projects. The Water Projects category is further divided into four sub-categories: Corps of Engineers, Bureau of Reclamation, Natural

Resource Districts, and Other. For the Bureau of Reclamation's proposed O'Neill Unit (Norden Dam), there is a completely separate category, and articles on the subject now fill one entire notebook.

The collection of newspaper clippings is available to the public, and all interested parties are encouraged to use it. The notebooks are on file in 212 Agricultural Engineering Building on the University of Nebraska's East Campus, and the hours are 8 to 5, Monday through Friday. The only stipulation is that the material must be read at the Center's office.

Dr. M.-L. Quinn, who is in charge of the service, will be happy to answer any questions which prospective users may have. For further information, please call: (402) 472-3805.

WATER RESOURCES CENTER PLANS EXHIBIT AT NEBRASKA STATE FAIR

The Water Resources Center will have an exhibit at the State Fair this year which should be of interest to all Nebraskans. Through the use of a computer, visitors to the exhibit will have a chance to test their knowledge of the state's water resources. This will be done by way of a short question-and-answer game.

In addition, the exhibit is part of a research effort related to the Center's technology transfer program. A record will be kept of all answers given to questions included in the game. At a later date, this information will be analyzed and a report written on the results. The intent is to find out how much Nebraskans really know about the water resources of their state. If it is discovered, for example, that game participants provide incorrect answers to a specific group of questions, then adult education programs can be geared in that direction.

The Water Resources Center exhibit will be located in the University of Nebraska Building on the Fairgrounds. This building is east of the main gate, near the farm equipment displays. The computer game will be in operation from 12:30 to 6:00 P.M. on September 1, from 12:30 to 8 P.M. on September 2, 3, and 4, and from 12:30 to 6:00 P.M. for the remaining days of the fair. Center personnel will be present during these hours to meet with visitors.

WATER RESOURCES IN NEBRASKA

CONSERVATION & SURVEY DIVISION

A multicolor map showing the locations of over 15,000 center-pivot irrigation systems in Nebraska has just been published by the Conservation and Survey Division, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln.

Entitled CENTER-PIVOT IRRIGATION SYSTEMS IN NEBRASKA, 1977, the new map shows in black the 12,609 center pivots installed up through 1976 and in green the 2,434 systems installed during 1977.

In an extended table at the bottom of the map, county-by-county totals are given for each of Nebraska's 93 counties. Totals for each county are shown for 1972 (and prior years) through 1977. The total land irrigated by center pivots is estimated at 2,001,000 acres, which is an increase of approximately 324,000 acres during 1977.

Copies of the map are available at 50 cents each, plus sales tax for Nebraska residents, by telephoning (402) 472-3471 or mailing orders to the Conservation and Survey Division, 113 Nebraska Hall, Lincoln, NE 68588. Mail orders will be filled with folded maps; those wishing an unfolded map sent in a mailing tube should remit \$1.50 plus sales tax.

FEDERAL HIGHLIGHTS

MRBC GOVERNORS ADOPT THREE RESOLUTIONS

At their third annual conference in Great Falls, Montana on May 24, 1978, the Missouri River Basin governors adopted three resolutions: (1) supporting a Missouri River Basin hydrology study; (2) endorsing review and update of the nation's basic water resources planning and coordination programs; and (3) supporting full compensation to owners of state water rights which may later be reclaimed by the federal government.

The purpose of the hydrology study would be to develop a cooperative water data system adequate for assessing the current and future water uses within the ten-state Missouri River Basin region. The study would attempt to establish a uniform data base so that each state could use data gathered by the others. This study has been identified by the Missouri River Basin Commission as the number one priority for fiscal year 1980.

The resolution on national water programs endorses passage of a comprehensive water resources management act along the lines drafted by the Missouri River Basin Commission state caucus. The proposed National Water Resources Management Act would strengthen the U.S. Water Resources Council, continue river basin commissions in those regions where desired by the states, and would provide dependable financial support for the states to integrate water and related land resources management activities.

The resolution on water rights asks that "federal legislation be developed to provide for full compensation to the owners of water rights vested under state law if (1) those rights are later taken by the United States or Indian tribes, or (2) the exercise of those rights is precluded by actions of the United States."

ANTARCTIC MOUNTAIN PEAK NAMED FOR USGS SCIENTIST

A 6,680 feet high peak in the Thiel Mountains of Antarctica has been named Mount McKelvey in honor of Dr. V. E. McKelvey, research geologist of the U.S. Geological Survey, Department of the Interior. McKelvey, 61, has been a career scientist with the USGS since 1941, and was the Survey's Director from December 1971 to January 1978.

The new name was officially designated by action of the U.S. Board on Geographic Names on April 26, 1978. The interagency Board is responsible by law for maintaining official geographic names throughout the federal government as well as approving new names and reconciling differences in name usage. The Board's decisions are reviewed by the Secretary of the Interior.

In a recommendation to the Advisory Committee on Antarctic Names, it was suggested that a prominent feature in Antarctica be named in honor of McKelvey for his outstanding contribution in administering the U.S. Geological Survey Antarctic Mapping Program from 1971 to 1978. During the seven-year period while McKelvey served as USGS Director, numerous Survey geologic and topographic expeditions, for which he had administrative responsibility, were carried out in Antarctica. During that period, 25 maps in the topographic reconnaissance series were published and made available to support the U.S. Antarctic Research Programs.

McKelvey is internationally recognized for his investigations into problems related to long-range energy and mineral resource needs, and for his analyses and assessments of seabed resources of the world. He was the recipient of the Interior Department's highest award--the Distinguished Service Award--in 1963. In 1968, he was the Henry Krumb Lecturer for the American Institute of Mining Engineers on subsea mineral resources, and in 1971, he gave the Seventh McKinstry Memorial Lecture at Harvard University. He received the National Civil Service League Award in 1972, and the Rockefeller Public Service Award in 1973. In 1977, McKelvey received a special meritorious service award from the American Association of Petroleum Geologists, and earlier this year, the same organization granted McKelvey its Human Needs Award.

Currently, McKelvey is serving as a research geologist with the Survey and as senior scientific advisor to the United States Delegation to the Law of the Sea Conference and deputy representative of the United States.

CONFERENCES

WATER LAW SHORT COURSE

A water law short course is being planned for September 19-21, 1978 in Lincoln, Nebraska. Sponsored by the Cooperative Instream Flow Service Group of the U.S. Fish and Wildlife Service, in cooperation with the Water Resources

Center at the University of Nebraska-Lincoln, the U.S. Fish and Wildlife Service Area Office in Pierre, South Dakota, and the Council of State Governments, the course will be an intensive review of the basic principles involved in the regulation and management of surface waters. Special emphasis will be given to the protection of the instream uses of water

Some of the topics to be covered will include: Introduction to Water Law, Riparian Rights and the Appropriation Doctrine, Federal Reserved Rights, Indian Water Rights, and the Struggle for Certainty in Water Management. Presenting the topics will be a number of attorneys and other professionals expert in western water law.

For additional information, contact Ms. Kathy Chilcutt, Executive Director, Natural Resources Law Institute, 10015 Terwilliger Boulevard, Portland, Oregon 97219.

NATIONAL WATERWAYS ANNUAL MEETING

The 1978 Annual Meeting of the National Waterways Conference, Inc. will be held September 20-22, 1978 in Birmingham, Alabama. With the theme, "Waterways and Public Policy: Adapting to New Realities," the conference will examine developments and issues affecting national inland navigation and water resources policies. The meeting will involve four panel discussions involving some 20 speakers.

Panel topics will include: (1) "Regional Economic Development: Water Resources Programs as a Complement to Growth," which will examine the role of waterways and other modes in economic progress; (2) "The Waterway User Charge Controversy: Looking Beyond H.R. 8309," where Congressional and White House aides will share their views with waterway industry leaders; and (3) "Emerging National Waterways Policies: Some Lingering Questions About New Directions," which will focus on the implications of new national water policies.

For additional information, contact: Convention Manager, National Waterways Conference, Inc., 1130 17th Street, N.W., Washington, D. C. 20036.

ASAE CALL FOR PAPERS

The American Society of Agricultural Engineers is seeking papers for its Summer Meeting June 24-27, 1979 in Winnepeg, Canada. The theme of the meeting will be "International Dimensions in Engineering."

Papers are invited on such topics as sediment transport, erosion control, chemical transport (fertilizer and pesticides) by surface and subsurface processes, and coupling between quantity and quality factors.

A 200-300 word abstract should be submitted no later than September 1, 1978 to: Dr. Allen R. Overman, Dept. of Agricultural Engineering, University of Florida, Gainesville, Florida 32611. Abstract proposal forms may also be obtained from Dr. Overman.

14th ANNUAL WATER RESOURCES CONFERENCE

The American Water Resources Association (AWRA) announces its Fourteenth Annual Water Resources Conference entitled "Water and-- Energy, Environment, Economics" to be held November 6-10, 1978 at the Dutch Inn, Disney World Village, Lake Buena Vista, Florida.

Approximately 165 papers will be presented during the various concurrent technical sessions. Topics for some of the technical sessions include the following:

- | | |
|--|--|
| -- Coastal Zone Management | -- Urban Water Conservation |
| -- Water Resources and the 208 Program | -- Flood Plain Management |
| -- Water Resources Legislation and Public Opinion | -- Numerical Modeling of Surface Water Resources |
| -- Data Collection Means, Methods and Reliability | -- Recreational Use of Water Resources |
| -- Groundwater Use and Environmental Impact Assessments | -- Agricultural Water Use |
| -- The Role of Water Resources in Solar Energy Development | -- Hydroelectric Power Developments |
| -- Remote Sensing | -- Stochastic Models in Water Resources |

The AWRA is also sponsoring a National Symposium on Wetlands to be held in conjunction with the above conference. The purpose of the symposium will be to review the state of the art of all technical aspects of wetlands.

For additional information, contact Dr. Melvin W. Anderson, General Conference Chairman, Dept. of Structures, Materials and Fluids, College of Engineering, University of South Florida, Tampa, Florida 33620; or write direct to the American Water Resources Association, St. Anthony Falls Hydraulic Laboratory, Mississippi River at 3rd Avenue, S.E., Minneapolis, Minnesota 55414.

AWWA PAPERS SOLICITED

The American Water Works Association (AWWA) Research Committee is seeking papers on research work in the water supply field for presentation at the 1979 Annual Conference to be held in San Francisco, California, June 24-29. Two sessions at the Annual Conference have been requested for presentation of research papers.

Papers will be chosen from abstracts received no later than December 4, 1978. Research papers dealing with water quality control, distribution, management and water resources are being sought.

Eight copies of both an information sheet and a 300 to 1,000 word abstract of the research paper should be submitted to: E. F. Spitzer, Secretary, American Water Works Association, T&P Research Committee, 6666 West Quincy Avenue, Denver, Colorado 80235. Abstracts information sheets can be obtained from the same source.

ENVIRONMENTAL EFFECTS OF HYDRAULIC ENGINEERING WORKS

An International Symposium on Environmental Effects of Hydraulic Engineering Works is scheduled for September 12-14, 1978 at the University of Tennessee in Knoxville. The conference is sponsored by the Tennessee Valley Authority, International Association of Hydraulic Research, University of Tennessee and the Oakridge National Laboratory. Registration fee for the conference will be \$85.

For further information and to obtain a copy of the conference program, contact the University of Tennessee, Conferences and Institutes, 432 Communications and Extension Building, Knoxville, Tennessee 37916; or contact Mr. Ely Driver, Conference Chairman, TVA Hydraulic Laboratory, Norris, Tennessee 37828. Telephone (615) 632-4460.

HUSKER HARVEST DAYS

Coming this fall for the first time is the first new major farm show planned especially for the western Corn Belt and the Great Plains. Husker Harvest Days is planned for October 10-12, 1978 near Grand Island, Nebraska. The show is being sponsored by the Nebraska Farmer magazine and the Agricultural Institute of Nebraska, a non-profit affiliate of the Grand Island Chamber of Commerce.

Husker Harvest Days is being planned as a working farm show where manufacturers can actually demonstrate equipment in a farmlike setting. It will be a show where farmers can actually see, in a hands-on situation, how a machine or tool will perform. Crops will actually be harvested during the show. Grain drying and handling equipment will be in operation. Tractors and tillage tools will be operating. There will also be acres of show area where exhibit booths can be set up.

The show is planned to be an annual affair, held each year on the same site. Development the first year includes a corner-watering center pivot system, a linear move irrigation system, an automatic surface irrigation system with reuse pit, two smaller center pivot systems, plus traveling guns and gated pipe systems.

The site for Husker Harvest Days is located on nearly 1,000 acres in the southwest corner of the U.S. Army Ammunition Plant just west of Grand Island, Nebraska. There will be free admission to the show site all three days.

For additional information, contact Jim Kanter, Nebraska Farmer magazine, P. O. Box 81208, Lincoln, Nebraska 68501. Telephone (402) 489-9331.

PUBLICATIONS

GREAT LAKES REGION HAS ABUNDANT WATER BUT FACES PROBLEMS

The Great Lakes Region has abundant water supplies, but faces many water-related problems, according to a new U.S. Geological Survey report.

The USGS report estimates that more than 6,300,000 billion gallons of water is available to the region. This includes nearly 6,020,000 billion gallons of water contained in the Great Lakes, plus an estimated 263,000 billion gallons of potable groundwater available from storage in the U.S. portion of the region.

"Most of the region's water problems involve aspects of water quality and supply. The full potential of groundwater in solving these problems has not been tapped," said William Weist, USGS hydrologist, Indianapolis, Indiana, and author of the report.

The report notes that, while all states in the region have some groundwater regulations, these regulations are not as comprehensive as those dealing with surface water. The report also discusses the role of groundwater in the water-related problems of the region, examines groundwater management practices, and identifies future data needs and the developmental outlook.

The Great Lakes Region report is the tenth report in a USGS program designed to develop and publish regional assessments of the Nation's groundwater resources. As they are completed, these assessments provide the first broad-scale analysis of the quantity and quality of groundwater in each of the Nation's 21 water resources regions. In addition to the Great Lakes Region, reports have been published for the Texas-Gulf, Upper Colorado, Ohio River, Rio Grande, Upper Mississippi, California, Arkansas-White-Red, Great Basin, and Hawaii regions.

Copies of the 30-page report, "Summary Appraisals of the Nation's Ground-Water Resources--Great Lakes Region," by William G. Weist, Jr., published as USGS Professional Paper 813-J, may be purchased for \$1.50 each by prepaid mail order (checks or money orders payable to the U.S. Geological Survey) from the Branch of Distribution, USGS, 1200 South Eads St., Arlington, Virginia 22202.

POSITIONS AVAILABLE

WATER QUALITY ENGINEER SOUGHT

The Environmental Studies Institute, Drexel University, is seeking a water quality engineer. The person selected will be expected to teach graduate and undergraduate courses dealing with water supply and wastewater treatment and to initiate related research. This individual will also teach undergraduate courses in hydrology and hydraulics.

Qualifications include a Ph.D. in civil, chemical or environmental engineering.

Interested applicants should contact P. W. Purdom, Director, Environmental Studies Institute, Drexel University, Philadelphia, Pennsylvania 19104. Telephone: (215) 895-2265.

RESEARCH FACULTY POSITION

In January, 1979, a research faculty position will be available at the Water Resources Research Center at the University of Guam. It will be at the assistant professor level (\$14,660 - \$19,860 per academic year) in the area of hydrology with an emphasis on mathematical (computer) modelling of groundwater flow.

A knowledge of physical modelling procedures is desirable. The applicant should hold a Ph.D. degree. This is basically a full-time research position, but the applicant may be required to teach one course per semester in engineering, math, or science.

Interested applicants should send a copy of their latest resumé to: Stephen J. Winter, Water Resources Research Center, P. O. Box EK, University of Guam, Agana, Guam 96910.

RESEARCH REVIEW

PROJECT TITLE: Physiological Aspects of Plant Water Use Efficiency

PRINCIPAL INVESTIGATORS: Charles Y. Sullivan and Jerry D. Eastin
Agronomy Department

The objectives of the project are to define some of the physiological characteristics of plants which will maximize water use efficiency, particularly with limited water availability, and to develop techniques of selecting plant types with desirable responses for use in breeding for improved yield potential and increased water use efficiency.

Some crops use water more efficiently than others, but much is unknown about the physiology of the plants in regulating the efficient use of water or of their responses to limited water availability. Grain sorghum is a fairly efficient dryland crop in Nebraska and has been used primarily in this study.

A leaf disc method was utilized to test 120 sorghum hybrids for tolerance to desiccation and high temperatures in the field. Of these hybrids 13 were found to have injury ratings of less than 40%, 69 were between 40 and 60%, and 38 were over 70% injured by an imposed stress. A procedure has also been developed for screening of seedlings for drought resistance. Drought stress is controlled by additions of an osmotic agent, polyethylene glycol, to nutrient solutions in which the plants are grown. Plants are grown in an environmental chamber and drought stress imposed at 7 to 10 days of age. One hundred eleven entries from a sorghum population (NP9BR) were screened for stress tolerance by this technique. Sorghum hybrid RS 671 was used as a check. Of the sorghums tested, 25 had higher drought resistance than the check hybrid and 65 ranked poorer. These results with both seedlings and field grown older plants indicate that progress can be made in selecting for increased stress tolerance with contemplated improved water use efficiency.

In more detailed studies, plants have been grown hydroponically in plastic tubes in a greenhouse where control of the root environment, visual examinations, and measurements of the roots and water use are possible. By this system, water stress can be controlled by addition of an osmotic to the nutrient solutions at different stages of development. A stress of -6.5 bars applied during panicle development reduced leaf water potentials by an average 2 bars and reduced root length, root weight, plant height and total shoot weight. It also reduced photosynthesis by about 22% and reduced grain yield by about 45%. A stress of -7.5 bars during bloom reduced leaf water potentials by an average 3.5 bars. There were no significant reductions in photosynthetic rates, and yields were not reduced by the greater stress applied at this stage.

Stomatal closure is a primary means of the plant for reducing water loss, and reduced photosynthetic rates are usually coupled with increased stomatal resistance. Stomatal resistance increased considerably during stress at the panicle development stage, but the stomata were relatively insensitive during the bloom stage. During each stress period leaf osmotic concentrations increased which resulted in maintenance of positive turgor during the stress. This ability of the plants to maintain cellular turgor during stress is believed to be an important contributing factor in enabling plants to function during periods of water stress. The plants also showed a conditioned response to water stress in photosynthesis. Rates 2 or 3 days following stress were often higher than those immediately following exposure to the stress.

Water use efficiency in terms of grain produced per unit of water used may be improved by a mild stress. A stress of -4.0 bars for about 12 days during panicle development resulted in 991 kg grain produced per k-liter water used, compared to 888 kg grain produced by unstressed controls for the same water use.

This was not a large yield advantage, but it does point to the potential for increased water use efficiency from stress conditioning. Plants were grown to maturity in the nutrient solutions with an equivalent of 13 to 14 acre-inches of total water use, with a yield equivalent to 57 to 59 bu. per acre at 14% moisture calculated at the population density at which the plants were grown (44,000 plants/acre).

Much of the research and data processing on the project has been performed by Graduate Research Assistant Jerry M. Bennett.

NEWSLETTER ITEMS SOLICITED

The Water Current Newsletter will publish, without charge, announcements, programs for up-coming conferences, employment opportunities or other newsworthy items on hydrology, water resources or related topics. We will be happy to help advertise any water-related job openings in this newsletter. Please send any job openings you would like to have published to the editor, and we will see that they are advertised.

Postal regulations require that we update our mailing list annually. If you no longer wish to receive the Water Current and would like to have your name deleted, please complete the following, clip on dotted line, and return to the Center at this address: Nebraska Water Resources Center, 310 Ag. Hall, University of Nebraska, Lincoln, Nebraska 68583.

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