THE Cross SECTION

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Volume 46—No. 8 THERE IS NO SUBSTITUTE FOR WATER August 2000

USDA researchers study plant protection mechanisms in effort to increase water use efficiency and crop yield

By Brandy Reed and Lyndy Stone

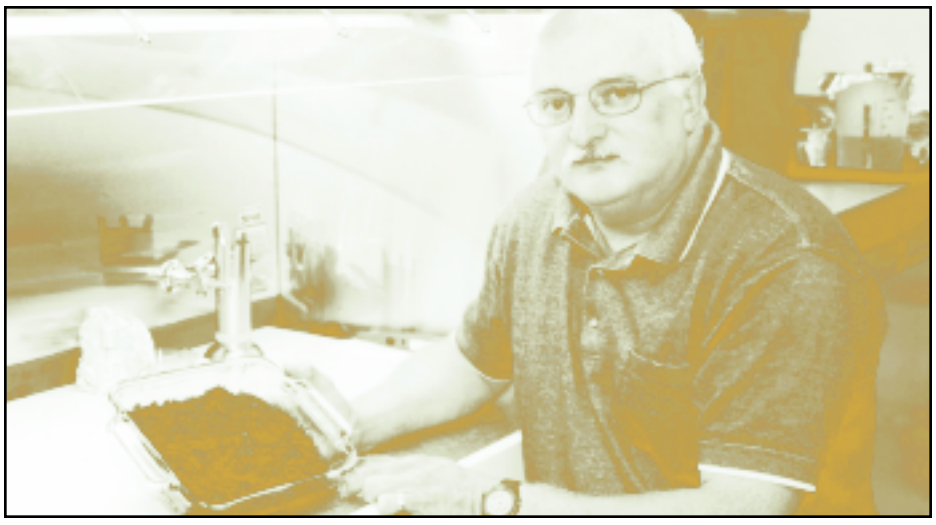
Travelers throughout the Southwest have often marveled at "resurrection plants" sold at roadside souvenir shops. These plants, yellowed and shriveled in their plastic bags, unfurl and turn green again when reintroduced to water. With that idea in mind, researchers at the USDA-ARS Plant Stress and Water Conservation Laboratory in Lubbock have identified plant protection mechanisms that could potentially help increase water-use efficiency and augment yields in all crops grown on the High Plains.

Doctors John Burke and Mel Oliver have been studying several plant species to help them understand what enables a plant to tolerate heat and recover quickly from desiccation in drought conditions. Due to the semi-arid climate and low average annual rainfall of 18 inches, supplemental irrigation is needed to maximize crop yield potential on the Texas High Plains. Their research could have extensive effects in helping crops within the region stay healthy between rainfall or irrigation applications and advance the plants' recovery and uptake of available water and nutrients.

Arabidopsis thaliana, a weed originating in Europe and Asia, is giving Dr. Burke's research team insight into the proteins plants use to establish protection from heat, or heat tolerance.

By using a simple chlorophyll-based bioassay, Dr. Burke said they can tell which parent plants have the high-temperature protection system and which do not. He exposes Arabidopsis seedlings to various heat intensities and bases their protection ability on how green they become following the exposure. Some seedlings are exposed exclusively to a high heat intensity for a set time, while others are exposed to gradual temperatures. The second method allows the seedlings more response time to trigger the protection system.

Following the exposure, the researchers observe the color of the seedlings' leaves. Yellow plants show vulnerability to stress, while dark green plants show heat tolerance. The seedlings remaining green during heat stress are discarded, since they contain natural components for heat protection. The surviving yellow seedlings, referred to as mutants, turn green in a few days and grow to be parent plants for additional testing, since a component of the plant's natural protection system is missing.



Drought Resistance Research

Dr. Mel Oliver displays a tray of *Tortula ruralis*, or star moss, grown at the USDA-ARS Plant Stress and Water Conservation Laboratory in Lubbock. Oliver, along with Dr. John Burke, is studying and identifying plant protection mechanisms that could potentially improve drought resistance in crops grown on the High Plains.Dr. Burke was unavailable to be photographed.

"We then use these sensitive plants to find out what component is missing and is therefore essential to high temperature protection," Burke said. "Once we know what is essential, we can then increase it, using molecular biological tools to increase tolerance."

Dr. Burke's team has extracted proteins from both tolerance levels of Arabidopsis seedlings and compared them. The differences show promise for identifying exactly which proteins or combinations of proteins are responsible for the high-temperature protection system, Dr. Burke said.

"Every organism can induce a protection system (against heat)," Dr. Burke said. "It is called the heat-shock response."

His research seeks to isolate the "mutant" plants that are injured or lacking the protection ability and assess them to understand the key components of the natural high-temperature protection system and what makes it work, he said.

"The same genes that protect Arabidopsis are in our crops, but we do not know to what extent," he continued. "By using the Arabidopsis mutants to show which proteins are essential for high temperature protection, we have a measuring stick for examining crop plants to see if sensitive lines have reduced levels of the essential proteins.

His team hopes to learn what is hindering the crop plants in switching on their own natural protection systems.

"We can either add genes or possibly take something away that is blocking the message (to the protective proteins) or holding the plants back," Dr. Burke said.

Burke pointed out that producers often have difficulty getting their irrigation applications across their fields in an optimum time for their crops. Arabidopsis could be the link to helping reduce the damage of High Plains crops between rainfall or irrigation, so when the water finally gets to the plants, they can use it.

Arabidopsis thaliana is ideal for research because it has the least amount of DNA in higher plants, Burke said. It also has a short life cycle, 60 days from seed to seed, so the research team can get five to six replications within each year.

The Plant Genome Project is also mapping Arabidopsis. Genetic researchers for the Monsanto Corporation have already mapped out the weed's genes, and Burke expects public researchers to have the task completed sometime in 2001.

They can also move genes into the plant to transform it with ease, and its genes will translate well into High Plains field crops, Burke said.

Tortula ruralis, or star moss, also shows a mechanism that could enable High Plains field crops to survive between rainfall or irrigation applications.

Star moss can continue to survive at 200 times the water deficit of other crops, such as cotton and soybeans. In comparison, desert cactus species permanently wilt or die at less than three times the water deficit of other crops.

Dr. Oliver's interest in desiccation tolerance was piqued years ago as he worked on his masters and doctoral degrees. He was amazed at how some mosses and lichens survive long stretches of time without water. His entire professional career has been devoted to finding how these plants succeed in such harsh environments and how they can help improve other species.

"Ninety percent of crop species originated from the tropics," Oliver says. "It never made sense to me why plant breeders would take a crop plant variety that is rarely droughted and use it to look for genes that increase drought tolerance."

Oliver believes the answer may be found in a naturally-evolving drought tolerant plant. One such plant, Tortula, is unique because it adapts its cells to survive without water. More complex desert plants have structural or storage adaptations to hold water. Tortula, which Oliver collects in the Rocky Mountains, protects its cellular contents

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Future crop varieties could contain genes from desiccation-tolerant plants

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during drying by forming a viscous fluid that turns into a sort of "biological glass" during long drought periods. In addition, when the moss is re-hydrated, it initiates a repair process within minutes that allows the plant to recover quickly from any damage caused by drought.

The goal of Oliver's research is to isolate the genes in star moss that allow the plant to survive under drought conditions and quickly return to normal when re-hydrated. He then plans to introduce these genes into crop plants so that they can experience the same traits, continue to produce during dry spells, and recover faster when rains return. The research could also allow for future crop production in semi-arid or unproductive arid lands.

Oliver's team is using DNA microchip technology to decide if genes common to all plants and plant tissues are dessication tolerant. Since thousands of genes interact to perform a specific plant function, Oliver makes a copy of the plant's DNA, referred to as cDNA, to sample the genes that trigger the desired function. Twenty-thousand cDNAs are put onto a slide and probes are used to find out which genes are responsible for the plant's actions.

Now, Oliver has isolated at least 18 genes involved in dessication tolerance. He and his helpers have transferred two of these genes into tobacco plants. Although they are still evaluating the results, Oliver says one gene looks very promising.

Recently, Oliver has expanded his dessication research to include other plants. These include Sporobolus, an African grass, and Romondo, an Australian dicot. Both act "dormant" under drought and revive when hydrated. These plants differ in the way they achieve dessication tolerance, so they are useful for isolating other genes that may increase drought tolerance in other plants.

While Oliver's research speedily progresses as new technology emerges, he is unsure of when drought-tolerant crop varieties will be available for retail on the High Plains.

"It will take at least five years of field testing before it can come out on the market," Oliver said. "You never know. It could be 20 years, or 10 years, or quicker than that."

UPDATE: Meet your High Plains Water District administrative Staff

EDITOR'S NOTE – Since January 1, 2000, the High Plains Underground Water Conservation District has hired several new employees to fill positions of staff members who have either retired, moved from the area, or found new employment. Beginning with this issue of the *Cross Section*, we provide an update of your Water District staff by profiling employees in the Administrative Division. Profiles of employees in the Technical Division and the Conservation, Water Use, and Compliance Division will be printed in the September and October issues, respectively – **CEM**.

The nine employees who make up the Water District's administrative division serve the public in many ways; whether it is issuing water well permits, typing reports, accounting for revenue and expenses, overseeing the operation of programs and activities, or informing the public about ways that they can conserve water.

A. Wayne Wyatt, General Manager

Although he jokingly characterizes himself as "just the guy in the head shed," High Plains Water District manager A. Wayne Wyatt has influenced water policy issues in the High Plains region and across the state.

A native of Girard in Kent County, Wayne began his career with the Water District as a field representative in 1957. He resigned in 1967 to become manager of the newly-created South Plains Underground Water Conservation District No. 4 at Brownfield. A year later, he became a member of the Texas Water Development Board staff in Austin, where he served as chief of the TWDB water level section, chief of the ground water quality monitoring section, chief of the ground water data branch, assistant director of the ground water division, and director of the water importation division. He assumed his duties as High Plains Water District General Manager on February 1, 1978.

Besides overseeing the Water District's many programs and activities, he is currently chairman of the Llano Estacado Regional Water Planning Group. The regional water planning group is charged with developing a 50-year water plan for a 21-county area in the southern high plains of Texas. He also keeps a close watch on legislative issues that could affect ground water use within the region.

During the more than 40 years that he has worked in the area of ground water, many peer groups and professional organizations have honored Wayne. Some of these include the Region One Texas Soil and Water Conservation District's "Professional Man of the Year," the Gerald W. Thomas Award for Outstanding Agriculturist, the Bureau of Reclamation's Citizen Award, the Professional Agriculture Workers Award, and the Texas Agricultural Irrigation Association's Industry Achievement Award.

He served on several advisory boards at Texas Tech University and Texas A&M University. He served two terms as president of the National and State Ground Water Officials Association.

Wayne has authored or co-authored more than 100 technical and semi-technical reports dealing with water conservation and Texas ground water resources.

On the weekends, Wayne and his wife, Linda, can usually be found at their ranch in Crosby County, where he tends to his "critters," mends fences, and handles other ranch-related chores.

Comer Tuck, Assistant Manager

While he is one of our newest employees, Assistant Manager Comer A. Tuck Jr. brought 31 years of water-related experience at the Texas Water Development Board in Austin to the Water District when he joined our staff on June 5.

Comer was raised on a dairy farm in Clay County, Texas, graduated from Bellevue High School, and attended Tarleton State University. He later attended Texas Tech University, where he received his Bachelor of Science degree in Agricultural Engineering in 1969.

While at the TWDB, Comer was involved in a wide range of water management activities. These include supervisor of TWDB agricultural loan and grant programs, contract manager for brush management/watershed yield studies, team leader for TWDB certification of ground water district management plans, and team leader for six of the 16 regional water planning groups created under Senate Bill 1 in 1997.

As the District's assistant manager, Comer is overseeing the administration of the Llano Estacado Regional Water Planning Group and overseeing partial administration of the District's precipitation enhancement program. In addition, he checks applications for agricultural water conservation equipment loans before review by the County Committee.

"The High Plains Water District has had a great working relationship with Comer during his career at the TWDB," said Wyatt. "His water planning expertise will be invaluable as we near the final deadline for completing and submitting the Llano Estacado Regional Water Plan to the TWDB for approval," he said.

Comer and his wife, Zelika, have two grown children.

Becca Williams, Director of Administration

As the Director of Administration, Becca Williams oversees much of the day-to-day operation of the Water District. Becca joined the Water District staff in December 1983 as permit chief.

Becca was born in Lubbock, attended Monterey High School, and graduated from Texas Tech with a Bachelor of Arts degree in English, a minor in Spanish, and a teaching certificate.

She reviews daily revenue receipts and accounts payable, reviews monthly reports to the Board of Directors, and edits and proofreads news releases, PSAs, and *Cross Section* text.

She also oversees the water well permit process and manages the annual budget preparation, the annual tax rate calculation, and the agricultural water conservation equipment loan program.

During the legislative session, Becca keeps a close watch on all ground water legislation. She secures copies of bills pertaining to the District's areas of interest, reads and studies them, and watches for hearings on the proposed legislation, which may require testimony from District staff. The District staff sometimes offers suggestions on how a bill can be changed or amended to accomplish the objectives intended by the author, while eliminating the District's concerns.

In her spare time, Becca is in charge of volunteers who staff "Second Helpings," a program of First United Methodist Church which provides hot meals to Lubbock's hungry people. She received the 1999 "Extra Mile Award" from the

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CARMON McCAIN, Editor
INFORMATION/EDUCATION DIRECTOR

Administrative staff assists with the Water District's daily operation

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Community Relations Commission in recognition of her service through the "Second Helpings" program.

Becca has two grown sons and a grandson.

Kathryn C de Baca, Executive Secretary

Handling the manager's daily correspondence, making travel arrangements for staff members, taking the minutes of monthly board meetings, typing letters and reports, and making physical arrangements for District-sponsored meetings, workshops, and seminars are just a few of Executive Secretary Kathryn C de Baca's many responsibilities.

Kathryn joined the Water District staff in April 1992 and is one of the several key staff members who help with the day-to-day operation of the Water District. Besides her normal duties, Kathryn also types reports and correspondence to members of the Llano Estacado Regional Water Planning Group.

Kathryn was born in Pampa and was raised on a farm north of Petersburg. She attended Petersburg High School and graduated from Watson's Business College in Plainview.

After graduation, Kathryn worked 21 years for Southwestern Public Service in Plainview and Lubbock. After her children were in school, she worked for a Lubbock attorney for 13 years before joining the Water District staff.

Her husband, Jerry, is employed with Texas Tech University.

Kathryn and Jerry enjoy spending time with their three children and four grandchildren. They attend all sporting events of their two older grandchildren, who live in Lubbock. They also enjoy attending Texas Tech Lady Raider basketball games.

Kathryn and Jerry love to travel. Their daughter and her husband, an F-15 fighter pilot, have been stationed at several Air Force bases around the country during the past three years. This gave Kathryn and Jerry the opportunity to visit Alaska last year. "We are looking forward to many other opportunities to travel in the future," she said.

Sarah White, Secretary/Receptionist

Sarah White is the first person people see when they enter the District headquarters in Lubbock. She joined the Water District staff as secretary/receptionist on March 1, following the resignation of Georgia Moss.

Besides her secretary/receptionist duties, Sarah also issues water well permits for Crosby, Lubbock, and Lynn Counties and processes water well permit applications and well logs for the entire 15-county Water District service area.

Sarah, a native of Lorenzo, Texas, brings a wealth of experience to the Water District staff.

"I am very pleased to be working for the Water District," she said. "I wanted a position in a small office with a positive team environment. We spend a lot of time at work, and I wanted it to be a positive experience."

Director of Administration Becca Williams characterizes Sarah as a very intelligent and energetic worker. "Her attitude and organizational skills are tremendous assets to our office, and I am glad she has joined our team."

Sarah was recently married to John White. Sarah and John have six children and seven grandchildren. She enjoys variety in life and says that if she had her way, she would live in blue jeans.

Carmon McCain, Information/Education Director

Carmon McCain's interest in the news media can be traced back to 1964 when a photograph of him reading a newspaper was printed in the *Midland Reporter-Telegram*. Since then, he has pursued a professional career in journalism/public relations that resulted in his current position as the District's Information/Education Director.

He was born in Midland, Texas, and attended public schools there. After graduation from Midland High School, he attended Midland College and later Texas Tech, where he received a Bachelor of Arts degree in journalism with a public relations emphasis in 1985.

Carmon joined the High Plains Water District staff in April 1987, after seven years with the *Lubbock Avalanche-Journal*.

As Information/Education Director, he strives to promote water conservation awareness and water education to producers and homeowners throughout the District's 15-county service area.

He is the editor of *The Cross Section*. In addition, he writes news releases that keep the 32 newspapers, 40 radio stations and nine television stations within the District informed about our on-going programs and activities. In addition, he provides on-air voice talent for the 60-second radio and 30-second TV public service announcements produced by the District.

Carmon makes several public presentations to civic and professional organizations each year for the District. He also maintains the web sites he designed for the Water District (www.hpwd.com) and the Llano Estacado Regional Water Planning Group (www.llanoplan.org).

He is a member of the American Water Works Association (AWWA), a member of the Texas Section AWWA (TX-AWWA) Water Conservation and Reuse Division, and recipient of seven TX-AWWA Watermark awards for efforts to raise public awareness about water issues in Texas.

Carmon served as Governor of Lions Clubs District 2-T2 in 1995-1996 and is currently an account executive for the 2000 United Way of Lubbock campaign.

His wife, Karen, is office manager for Sonja O. Lee, DVM. They have one daughter.

Lyndy Stone, Information/Education Assistant

Informing the public about the importance of water and water conservation can be a big job. This challenge is welcomed by Lyndy Stone, the District's new Information/ Education Assistant. She joined the Water District staff on May 26, following the resignation of Brandy Reed.

Lyndy was raised in Lamesa and was Salutatorian of her 132-member high school class. She graduated from Texas Tech in May with a Bachelor of Science degree in agricultural communications.

She previously worked as a reporting student for the *Lamesa Press-Reporter* and as a communications intern for Plains Cotton Cooperative Association. During her time at Tech, she was active in the Mortar Board chapter, the Agri-Techsans, the Collegiate Future Farmers of America chapter, and Agricultural Communicators of Tomorrow.

Some of Lyndy's responsibilities include writing articles for the *Cross Section*, maintaining the newsletter mailing list that includes more than 6,900 local, state, national, and international subscribers, helping in the preparation and mailing of news releases to media organizations within the Water District and Texas, preparation of displays for regional fairs and professional meetings, and implementing the District's *Learning To Be Water Wise* water education program in area public schools.

"Lyndy is an outstanding member of the District's Information/Education team. Besides her normal duties, she is busy revising the Water District's supplemental textbook, *An Introduction To Water And Water Conservation With Emphasis On The High Plains of Texas*." Once completed, the textbook will be available for viewing on the High Plains Water District web site," said Information/Education Director Carmon McCain.

Her husband, Jerry Don, is employed with D&D Cable Services, Inc.

Pat Kunkel, Bookkeeper/Cost Accountant

Since February 1989, Bookkeeper Pat Kunkel has kept a close accounting of every penny of the District's revenue and expenses.

Pat does an outstanding job of the cost accounting for each of the District's programs–plus special projects such as the precipitation enhancement program and the Llano Estacado Regional Water Planning Group.

One staff member commented about Pat's bookkeeping efficiency: "You could accidentally drop a dime from your pocket, and Pat would have an accounting of it before you could pick it up off the floor."

Her bookkeeping duties include the payroll, general ledger, preparing financial statements, accounts payable and receivable, and preparing records for the annual audit. In addition, she conducts biannual audits of the financial records for each county water well permitting office.

Pat was raised on a farm southeast of Ropesville, graduated from Ropesville High School, and later moved to Lubbock.

An avid fan of all sports, Pat really enjoys watching the Texas Tech Lady Raiders play basketball.

She and her husband, Ben, have two children and three granddaughters.

Mary Martin, Administrative Assistant

Our newest employee is Administrative Assistant Mary Martin, who joined the Water District staff on July 17.

As an administrative assistant, Mary's job responsibilities include keeping records and files up to date. She also has the responsibility of keeping the District's research library organized. As part of her duties, Mary helps with the processing of agricultural loan papers and water well permits. She also helps with various office mailings.

She and her husband, Bob, live 10 miles west of Spur on their family farm, where they raise cattle and registered quarter horses.

When she is not spending time with their horses, Mary loves to read, sew, and work on needlework projects.

Mary and Bob have three children and eight grandchildren.

"The staff is what makes the High Plains Water District function," said A. Wayne Wyatt, manager. "Each person uses his or her individual talents to help area residents conserve, preserve, protect, and recharge the ground water stored in the Ogallala Aquifer within the District."

Next: The District's Technical Division

Former Water District Director Weldon Newsom of Dalhart dies

Weldon Newsom of Dalhart, former director and secretary-treasurer of the High Plains Underground Water Conservation District No. 1 Board of Directors died June 28 in Amarillo. He was 76.

Newsom was born December 14, 1923 in Ranger and moved with his parents to Whitharral in 1924. He graduated from Whitharral High School and attended Texas Tech University before entering the U.S. Armed Forces in 1943. He married Lillie Horton in Whitharral on January 24, 1946.

He was elected to the Water District Board of Directors in January 1964 to represent District Directors' Precinct Two, consisting of the portions of Cochran, Hockley, and Lamb Counties within the District. He had previously. served as a member of the Water District's Cochran County Committee from 1961 to 1963.

Newsom completed three two-year terms as a member of the Board and served as Secretary-Treasurer from 1965 to 1969. During this time, he served with fellow Directors Russell Bean of Lubbock, John Gammon of Friona, Ross Goodwin of Muleshoe, Earl Holt of Hereford, Andrew Kershen of Hereford, Chester Mitchell of Lockney, and John Pitman of Hereford. Newsom did not seek re-election to the Board of Directors in January 1970.

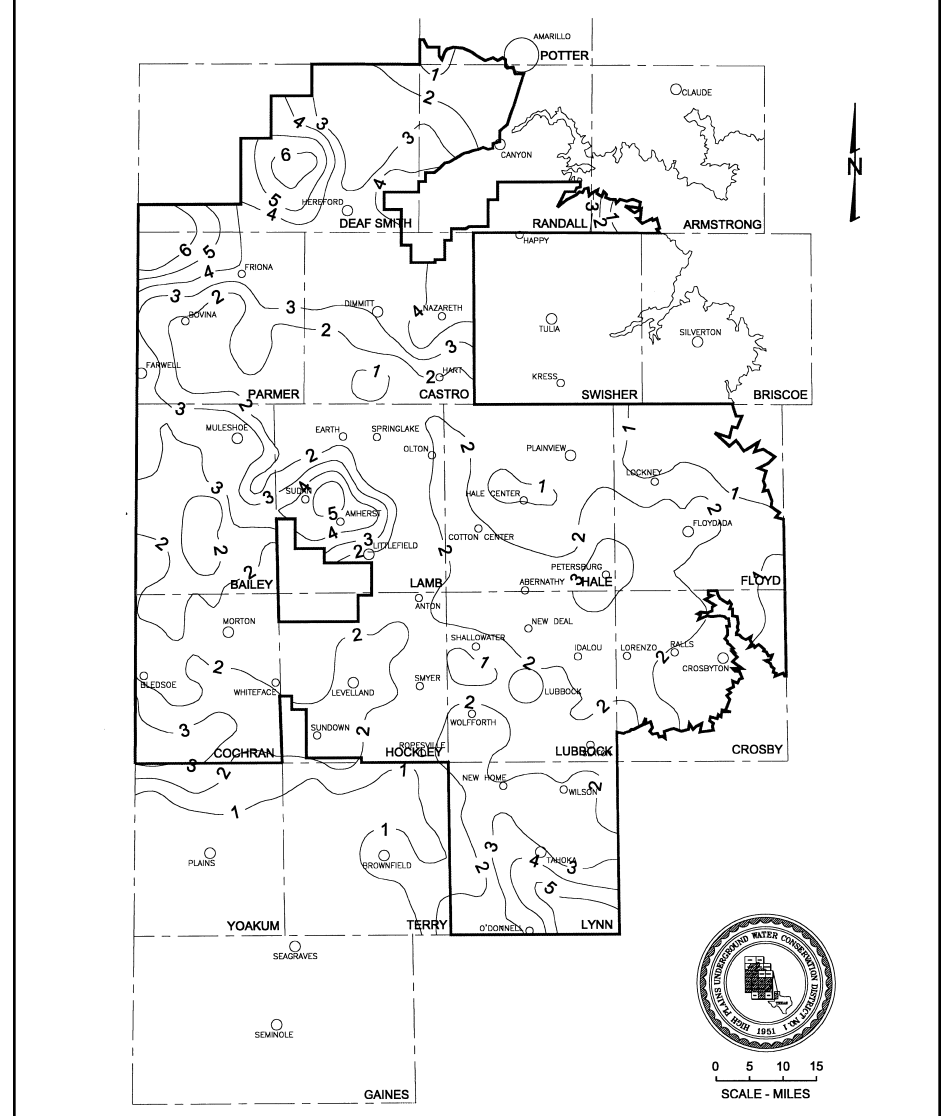
He moved from Morton to Dalhart in 1970 and farmed in the Hartley and Clayton, New Mexico areas.

WELDON NEWSOM
1964 FILE PHOTO

"I had limited interaction with the Board of Directors at that time, since I was serving as a field representative for the District in the early 1960s," recalls Manager A. Wayne Wyatt. "However, I remember Weldon as being a very good businessman, who was interested in the future of the water resources of the Texas High Plains. Preventing contamination of the ground water supplies was of special concern to him."

Survivors include his wife; two sons; a sister; and four grandchildren.

July 2000 precipitation



July 2000 Rainfall

Rain gauge readings showed from one to six inches of precipitation within the High Plains Water District from June 27 to July 26, 2000. Most of the District received from one to three inches of rainfall with the exception of portions of Deaf Smith and Parmer County, which received six inches of rainfall.

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