Water Currents

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Dear Reader:

Texans face seemingly endless water resources problems. Seldom is there a year without a drought, a flood, or both somewhere in the state. Few Texas areas can boast of sufficient water supply or adequate water quality to meet future demands of cities, industries, and agriculture.

Research to help Texans solve their present and future water resources problems is a top priority of the Texas Agricultural Experiment Station (TAES). This agency, of which the Texas Water Resources Institute is a part, is the agricultural research arm of the Texas A&M University System.

Ongoing water research projects conducted by TAES scientists address a wide range of water resources problems in Texas. Studies, for example, include irrigation efficiency, groundwater modeling, plant breeding for drought tolerance, and water quality protection.

Obvious benefits of water resources research to all Texans may be seen in the price and availability of produce on the grocery shelf and of clothes made of natural fibers.

Irrigation methods developed by TAES researchers greatly improve the uncertainty of agricultural production. As water supplies diminish and as water pumping and distribution costs increase, however, today's irrigator must ask the same questions of agricultural researchers that dryland farmers have asked throughout TAES history: (1) What production methods make the best use of rainfall? and (2) What crops are most likely to produce with limited water?

Water Currents, a brand new publication from the Texas Water Resources Institute, will report current and completed TAES research so that Texans may make more informed decisions regarding water resources issues. Topics planned for future issues are as varied as Texas rainfall and as vital as the state's dependence upon water.

J. R. Runkles, Director,
Texas Water Resources Institute

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Editor: Lou Ellen Ruesink

Designer: Karen Glenn

Cover photographer: Griff Smith

For further information on research presented in this issue, contact **Water Currents,** Texas Water Resources Institute, College Station, TX 77843; send subscription requests and mailing changes to the same address.

Preparing for Drought

TAES agricultural economists analyzed the dire economic circumstances of ranchers during the infamous drought of the 1950s and concluded that_other than a lucrative oil lease or outside employment_a rancher had no better alternative to survive drought than good ranch management.

"The time to prepare for drought is during periods of normal or above normal rainfall," they advised in TAES Bulletin 801. "To be prepared for drought one must keep in mind each year that drought conditions may prevail during the year just ahead."

TAES research through the years has continued to emphasize the importance of good ranch management and the necessity of preparing for drought. Since 60 percent of all land surface in Texas is rangeland_naturally vegetated lands used primarily for livestock and wildlife grazing _ proper management for drought concerns not only the livestock industry, but affects the economy of the entire state.

Continuing research programs at the TAES research centers near Sonora and San Angelo on grazing management and on brush and weed control help Texas ranchers make the tough decisions necessary to maintain ranges better able to withstand drought years. This type of information is constantly updated by new TAES research findings.

Scientists associated with the Sonora research station have tested different systems of grazing management on the 3,400-acre station since 1948. They have found that systems designed to give pastures periodic rest from grazing are not only beneficial for improving the composition and quality of range vegetation, but also can support as many or more livestock on the same number of acres as the more common range management methods of grazing cattle continuously on a pasture.

Leo B. Merrill, professor in charge of the station at Sonora, has for the past 37 years studied various grazing systems. He has concluded that pastures need periods of systematic rest from grazing to maintain plant vigor and to allow seed production and seedling growth.

His test pastures at the station have shown better plant growth and seedling establishment when allowed a period of rest from moderate grazing than pastures which are lightly stocked, but continuously grazed. Rest- rotation grazing, according to Merrill's research, permits higher livestock production and means steady range improvement.

One of the major advantages of rest-rotation grazing systems seen on the test pastures at Sonora is the increased water use efficiency of the pastures. Pastures grazed under a rotation system, according to several TAES projects, use rainfall more effectively and lose less soil and nutrients to rainfall runoff.

Another research effort which will help ranges and livestock withstand extremely low rainfall years is D. N. Ueckert's study of ways to control undesirable brush and weeds including poisonous plants. Ueckert, a range scientist at the San Angelo TAES research center, explains that even in good rainfall years, livestock losses caused by toxic plants cost producers and consumers millions of dollars. Most poisonous plants become much more of a problem for livestock producers during a drought when desirable forage is scarce.

Ranges in poor condition or during dry years are more likely to have undesirable or poisonous brush and weeds than ranges in good condition. These plants not only cause livestock losses, but also compete with useful plants for available soil moisture as well. Control methods for undesirable plants under study by TAES researchers include mechanical, chemical, biological, and burning. Many of these control methods used singly or in some systematic combination have proven effective and economical in TAES research, while others need more study.

Ueckert has tested different methods of brush and weed control to reduce livestock losses to poisonous plants and prickly pear. He is especially involved in the study of chemical control of bitterweed, the most common poisonous plant problem on the Edwards Plateau; rayless goldenrod along the Pecos River; and locoweed in the Davis Mountains. His ongoing research not only looks at the most effective and economical herbicides and methods of application, but also tries to determine the best time of year and stage of growth to apply herbicides.

Results from the Sonora and San Angelo studies of grazing systems and undesirable plant control are already helping Texas ranchers prepare for and produce during dry years. Other current TAES research projects specifically related to drought include: (1) effects of drought on the nutritional quality of forage, (2) methods of reestablishing rangeland after a drought, (3) techniques of evaluating range conditions, and (4) selection of plants according to their drought tolerance..

C. A. Bonnen and J. M. Ward. 1955. Some economic effects of drought on ranch resources. TAES Bulletin 801.

Drought Down on the Farm

Time was when a farmer could do little more in a dry year than curse the cloudless sky. TAES research can now help him prepare for dry seasons with information on how to (1) choose crops bred for their ability to withstand drought; (2) manage his land SO that the soil holds rainfall as effectively as possible; and (3) apply irrigation water, if he is lucky enough to have even a limited supply, at exactly the time it will do the most good.

TAES scientist, C.J.. Gerard, conducts water management studies on various field crops on the Rolling Plains. He advises farmers that it is critically important in wet years or dry to choose crops and to manage soils and water in order to make the most efficient USC of their limited water supply. His research has shown that plant variety, soil properties, and water management play vital roles in using rainfall and supplemental irrigation to the best advantage.

Crop production in the Rolling Plains, according to Gerard who is professor of soil physics at the TAES research c- enter at Vernon, depends upon the effective use of rainfall. Irrigated cropland will probably always be a small percentage of acres compared to dryland or rangeland production in the Rolling Plains area. Gerard, however, includes both irrigation and dryland production in his water management studies.

He works primarily to determine the response of different crops to rainfall and to develop ways to mate the best use of every drop of available moisture. Most of Gerard's work has been on water management in cotton production, but he also has research experience with nearly all of the c-rope grown on the Rolling Plains.

A plant's ability to extend roots into previously unoccupied soil, according to Gerard, is the most important feature for water USt' efficiency. 1 his continuous invasion of new soil mass enables plants to grow for clays or weeks without rain or irrigation Another drought stress feature Gerard found in some varieties of cotton is a plant's ability to go into a dormant stage to wait for rainfall before beginning to fruit.

Water use by plants, according to the soil physicist, depends upon climatic-conditions, soil moisture availability, and plant growth stage. High temperatures, high light intensities, low humidity and high wind speeds all mean high water USC by elands. In contrast, low temperatures, low light in intensities, high humidity, and low wind speeds create an environment of low evaporative demands or water needs.

While a farmer has little or no control over climatic- conditions, he can influence the soil moisture availability by how he prepares his fields and how well he maintains his soil. The shape and width of rows, the method and timing of plowing, and the preparation of a field to hold rainfall art some of the ways a farmer can make a difference in how efficiently a crop uses available rainfall.

Compaction plays a significant role on productivity of many soils in the Rolling Plains. Hardpan soils or compacted layers of soil cause root distortion and prevent plants from using water as efficiently as they might otherwise. Deep plowing such as chiseling reduces the effects of compaction and increases the available soil water reservoir and crop yields. Chiseling breaks up the layers of soil beneath the earth's surface and can, according to> (Gerard, increase cotton and sorghum yields by as much as 14 percent.

A farmer can also apply irrigation water at the time a crop tan USt' it most effectively. (Generally water use by crops, according to> Gerard,, reaches a maximum during the reproductive stage of plant growth when vegetative growth and leaf area are high. Watt r

USt by plants is low during early vegetative growth period, but increases as the plants grow.. At maturity, when vegetation dies,, the water use by plants decreases and eventually becomes only evaporation from the soil.

Lack of water during tile reproductive stages of plant growth according to Gerard's research, can cause substantial yield reductions . Applying supplemental irrigations just prior to, during, or just after the reproductive stages, Gerard found, is an efficient way of using water for increased yields.

By applying Gerard's research findings on plant and soil characteristics, farmers on the Rolling Plains and in many other arc as of Texas c an prepare for and produce during the next drought.

Reducing Risks

Texas producers should seriously consider insuring their crops against low yields due to drought or other disasters, according to TAES agricultural economist James Richardson.

This year crop insurance becomes a much more critical issue since a new All-Risk Crop Insurance Program replaces federal disaster relief previously available to crop producers.. All-risk crop insurance is a federally-subsidized government program, but it is sold by private insurance agents, farm c credit associations,, farm <>organizations, and hanks.

Not only must a farmer decide whether to purchase ail-risk crop insurance before a specific crop deadline, he must also choose from nine different options based on yield and price coverage. Yield coverage means insuring against a yield 50, 65, or 75 percent below the average yield based on the past ten years of county production records. Price coverage determines the payment received for yield below insured levels. Price levels of low, medium, or high change from commodity to commodity and from year to year, but generally a farmer must choose to insure his crop for approximately 60, 70, or 90 percent of the projected market price..

Richardson, stationed on the Texas A&M University campus in College Station surveyed crop producers in Lynn County Texas to come up with two "typical" 1982 Southern Plains farms.

Based on information from the survey, Richardson modeled two farms, 793 acres and 1,457 acres with cotton and grain sorghum as the major crops. One-third of all cropland on each farm was irrigated, and 60 percent of all cropland was leased from nearby landowners. Production costs, labor requirements, and projected yields for the two farms in 1981 were also gleaned from the survey.

Plugging this information into a computer model which he designed, Richardson compared the net worth of the two typical farms after ten years of (1) no crop insurance, (2) commercial crop insurance - available only for hail or fire, or (3) each of the nine options offered by the federal All-Risk Crop Insurance Program.

The computer model, called the Farm Level Income and Policy Simulation Model (FLIPSIM II), randomly selected prices and yields for the ten years, 1982-1991. It also included such things as loan payments, family living expenses for the "typical" farm family of four, machinery replacement and depreciation, and taxes. The model increased costs of production ten percent per year and crop prices by seven percent per year.

The results of the computer analysis suggest, according to Richardson, that High Plains cotton and sorghum farmers should come out ahead in 1991 if they annually purchase all-risk crop insurance guaranteeing the highest level of price coverage and one of the two highest levels of yield guarantees. A farm with maximum coverage each year for the next ten years, Richardson says, would on the average have a net value of almost twice that of a farm with no crop insurance coverage during the same time span.

For those producers still leery of computer-generated advice, Richardson can show with pencil and paper that on a typical farm in Lynn County the insurance claims collected over a ten-year period would average $1.50 for every $1.00 of insurance coverage purchased.

Richardson is careful to warn that the results of his research can only be applied to similar farms in similar areas. He does hope, however, that his model will he used to evaluate crop insurance options in other parts of Texas and with other types of farming operations.

Ripples & Waves

So that future droughts do not have to mean disaster for Texas producers, studies related to drought such as the following examples will continue to be a research priority for the Texas Agricultural Experiment Station.

Fifty years of research at the Blackland Research Center near Temple helps farmers to conserve soil moisture and reduce wind erosion - one of the most serious consequences of drought.

Meteorologists at Temple integrate weather forecasts and agricultural management to help crop farmers determine (1) the best dates for planting, (2) the most appropriate fertilizer rates, (3) the best crop species and cropping systems as well as (4) the most efficient irrigation rates and scheduling.

Remote sensing experts use photographs taken from airplanes and satellites to inventory range conditions and to evaluate range management techniques.

A water stress index developed by agricultural engineer Ed Hiler determines the most efficient irrigation scheduling based on critical growth stages and crop yield susceptibility.

Soil cracking, as pictured on the cover, is one of the soil physical processes studied by agricultural engineer John Nieber. His research looks at soil physical properties and soil physical processes and their influence on soil moisture availability to plants.

Sorghum growers can prepare for drought a little more confidently since crop scientist George McBee found that the amount of sugar in a plant determines its ability to tolerate drought conditions.