WEEKLY REPORTS

Following are USWCL "ARS Weekly Activity Report" submissions for 2000. Each research scientist submits a minimum of one report per year. These reports are consolidated at ARS Area level and submitted to ARS headquarters for the information of agency and departmental management.

Scientist: Edward M. Barnes - Precision Farming using Remotely Sensed Information
New tools are being developed to assist agricultural producers evaluate their precision farming practices. ARS scientists at the U. S. Water Conservation Laboratory in Phoenix, Arizona, are refining methods to integrate remotely sensed information from aircraft or satellites with computer models that predict crop growth based on weather and soil conditions. This research is being conducted to help meet the information needs for precision farming. In precision farming, the rate of agricultural inputs is varied according to plant needs at a very fine scale (as small as 1- m x 1-m). Remotely sensed data are used to provide the crop model with information on plant conditions at fine spatial resolution and at select times during the season. The model is then used to test different management scenarios in specific areas of the field.

Scientist: Eduardo Bautista - Large Open-Channel Water Delivery Systems Computer Program
ARS scientists at the U.S. Water Conservation Laboratory, in cooperation with the Salt River Project, a water and power provider in the Phoenix metropolitan area, have been working on the development and testing of a computer program for scheduling the operation of large open-channel water deliver systems. Currently, canal operational schedules are developed manually based on canal operator experience. The expectation is that the computerized scheduling approach will not only reduce the effort required to produce the daily schedules but will also improve the accuracy and flexibility of water deliveries. The proposed approach can be applied to delivery systems with centralized supervisory control capabilities, where changes in water demands are known in advance. Adoption of this technology will require significant buy-in and support from the operators. Therefore, tests are currently being conducted to compare computer program generated schedules with those developed by operators. In a following phase, the computer generated schedules will be implemented manually by the operators. Eventually, the schedules will be fed as a series of commands to the canal's SCADA (Supervisory Control and Data Acquisition) system for automatic implementation.

Scientist: Herman Bouwer - Clogging Layers in the Design and Management of Surface Water Impoundments
Research at the U.S. Water Conservation Laboratory has shown that clogging layers in ponds or basins can be friend or foe to water conservation efforts. Infiltration rates from surface impoundments like storage ponds, wastewater lagoons, wetlands, groundwater recharge basins, and storm water retention basins, generally decline with time as sediment and other suspended solids accumulate on the bottom. These sediments, along with biological and chemical reactions, then form a slowly permeable "clogging" layer. The thickness of this layer may vary from an inch or less if the water is relatively clear and biological and chemical reactions are the main factors, to a foot or more

Environmental and Plant Dynamics

Scientists: Francis Nakayama & Terry Coffelt - Release of Guayule Latex
Under a Trust Agreement with Yulex Corporation, scientists at the USDA-ARS U. S. Water Conservation Laboratory, Phoenix, Arizona; and Western Regional Research Center, Albany, California; produced and released a large quantity of latex to Yulex. The latex will be used to produce guayule latex products for manufacturer testing and further develop guayule as a hypoallergenic source of latex for fabricating medical products. Techniques developed in producing the latex have been shared with Yulex for their use in developing a pilot processing facility.

Scientists: Terry Coffelt, R.W. Mozingo, & T.G. Isleib - Release of New Peanut Cultivar
Scientists at the USDA-ARS U.S. Water Conservation Laboratory, Phoenix, Arizona; Virginia Tech University; and North Carolina State University have cooperatively developed and released VA 98R, a new Virginia-type peanut cultivar. VA 98R has large pods and seeds acceptable for the export market, matures earlier than current widely used cultivars, maintains its higher yields during the harvest season, and has brighter pod color than other cultivars. Seed have been released to the Virginia Crop Improvement Association for seed increase and is expected to be available to growers this year.

Scientist: David Dierig - Release of Two New *Lesquerella fendleri* Germplasm Lines
Scientists at the USDA-ARS U. S. Water Conservation Laboratory, Phoenix, Arizona; and the USDA-ARS George E. Brown Salinity Laboratory in Riverside, California; have developed and released a new line of *Lesquerella fendleri*, a potential new industrial oilseed crop, that will allow it to be grown on soils with saline irrigation problems. Lesquerella has been identified as potentially able to clean up contaminated soils by accumulating selenium, a harmful trace element found in soils, in its leaves and stems. The oil from lesquerella is used for industrial purposes, and the selenium bioaccumulation would not be transferred to the food chain. This new salt tolerant line allows lesquerella to be grown on more marginal soils where drainage effluents are reused, and it also provides germplasm with high genetic diversity for future improvements. Scientists at the U. S. Water Conservation Laboratory have also developed and released a new line of *Lesquerella fendleri* with improved oil content and seed yield compared to previously released germplasm lines that will significantly advance its commercialization. The new line provides a higher margin of profit for producers of the oil needed for many uses. Seed from these new lines are available upon request. Development of lesquerella into a viable commercial crop will provide an alternative crop for U.S. farmers and an alternative domestic source of hydroxy fatty acids, presently filled by imported castor.

if the water contains a lot of sediment (clay, silt, fine sand). Clogging layers are desirable where the main function of the impoundment is storage of water, or where the impoundment contains sewage effluent or other wastewater that should not contaminate underlying groundwater. Clogging layers are undesirable where the main function of the impoundment is infiltration for recharge of underlying groundwater or disposal of rainfall runoff. For both types of systems, there can be repeated or periodic inflow events with muddy water. The coarser soil particles will then settle out first, followed by finer particles until the sediment layer is topped with a thin layer of the finest clay or soil particles. This process repeats itself with subsequent inflow events, resulting in a layered sediment accumulation or soil "lining" with each layer also being individually graded from relatively coarse at the bottom to fine at the top. Column studies in the laboratory with silica sand as bottom showed that such layered linings gave greater reductions in infiltration rates than a compacted lining placed on the sand in a dry column using the same amount of soil. Thus, for engineered earth linings, it is more effective to apply the soil as slurries and in split applications to a water filled pond, than placing it on the bottom of a dry pond and compacting it. Also, for wetlands, this indicates that periodic inflows of muddy water can cause large decreases in infiltration rates so that plastic or other linings may not be necessary. The same can be true for storage basins. For recharge basins, it indicates the importance of avoiding sediment in the inflow water as much as possible. Pre-sedimentation or otherwise desilting of the water may then be desirable before it enters the recharge basins. Also, where sediment still accumulates on the bottom of the recharge basin, regular drying and removal of the clogging layer are necessary to maintain high infiltration rates. The clogging layer thus plays a major role in the design and management of surface water impoundments, regardless of whether infiltration into the bottom needs to minimized or maximized.

Scientist: Thomas R. Clarke - Cooperative U.S. - Canadian Experiment Gets Underway
Remote sensing has shown potential as a crop management tool, both as an input to crop management models and as a direct measurement of crop status. ARS scientists at the U.S. Water Conservation Laboratory (USWCL) in Phoenix, Arizona, and the South Central Agricultural Research Laboratory (SCARL) in Lane, Oklahoma, have joined Canadian counterparts at the Horticultural Research and Development Center in Saint-Jean-sur-Richelieu, Quebec, to develop this potential. USWCL remote sensing experts will take measurements on a broccoli crop grown at The University of Arizona's Maricopa Agricultural Center, and vegetable quality experts at SCARL will evaluate harvested broccoli. Their findings will be compared to remote sensing measurements to see if quality can be predicted from the plants' spectral signature. Canadian crop modelers will use remotely-sensed and physical parameters collected in the field to test a vegetable crop management model, developed for northern latitudes, for its applicability to other climates.

Scientist: Albert J. Clemmens - Desert Research Leads to Irrigation of Crawfish in Louisiana
For decades, ARS research scientists at the U.S. Water Conservation Laboratory in Phoenix, Arizona, have been developing methods to improve surface irrigation systems. Prior ARS research that led to application in Louisiana includes laser-controlled land grading, pioneered by ARS scientists in the mid-1970s; level-basin irrigation systems, used as a standard for high irrigation efficiency in Arizona; and drain-back level basins, which allow lighter water applications and cost less to develop than conventional level basins. The use of these drain-back systems is growing in Arizona, with about

10,000 acres developed over the last four years. The distinguishing feature of drain-back level basins is their ability to drain excess water off the field. Farmers in Louisiana recognized the potential in this concept and, with the help of ARS Scientists and NRCS field-office personnel, developed a new level-basin system with surface drainage. Key features of a surface-drained level-basin system are precision land grading; level slope; and internal drainage ditches, constructed on a grid, that allow water from high rainfall events such as hurricanes to run off quickly. Farmers have found that in addition to achieving excellent drainage, they are able to irrigate more efficiently. Thus far, about 10,000 acres have been developed for rice, corn, wheat, soybeans, duck habitat, and crawfish!

Scientist: Terry Coffelt - Hypoallergenic Guayule Latex

An estimated 20 million Americans are now allergic to Hevea latex products. Guayule is a source of hypoallergenic natural rubber latex suitable for making medical products. Research by ARS and FDA has shown guayule latex to be an effective barrier against disease-causing viruses and bacteria. ARS scientists at the U. S. Water Conservation Laboratory in Phoenix, Arizona, and Western Regional Research Center in Albany, California, in cooperation with Yulex Corporation through a trust agreement are developing methods and techniques to harvest and extract latex from guayule. These tools can be used in constructing a prototype commercial-size extraction plant. Latex from the project will be used for formulation testing in making latex films. Knowledge obtained from this cooperative project will facilitate the commercialization of guayule.

Scientist: David Dierig - The Potential of Lesquerella

Scientists at the U. S. Water Conservation Laboratory in Phoenix, Arizona, and the U. S. Salinity Laboratory in Riverside have developed a new line of *Lesquerella fendleri*, a potential new industrial oilseed crop, that will allow it to be grown on soils with saline irrigation problems. Lesquerella has been identified as potentially able to accumulate selenium, a harmful trace element, from contaminated soils in its leaves and stems. The oil from lesquerella is used for industrial purposes, and the selenium bioaccumulation would not be transferred to the food chain. This new salt tolerant line allows lesquerella to be grown on more marginal soils where drainage effluents are reused and it also provides germplasm with high genetic diversity for future improvements. Development of lesquerella into a viable commercial crop will provide an alternative crop for U. S. farmers and an alternative domestic source of hydroxy fatty acids, presently filled by imported castor.

Scientist: Douglas J. Hunsaker - NRI Grant Awarded for Nitrogen Fertigation Guidelines

In July 2000, Soil Scientist Floyd Adamsen and Agricultural Engineer Douglas Hunsaker at the USDA-ARS, U.S. Water Conservation Laboratory, Phoenix, Arizona, were awarded a 3-year, $192,000, grant under the USDA-National Research Initiative-Competitive Grants Program to develop management guidelines for fertigation in surface irrigation systems. Proper fertigation practices can save labor, energy, and farm machinery costs. Improper practices can cause nitrate contamination of groundwater and surface water. These funds will be used to determine appropriate timing and duration of nitrogen injection during irrigation events for various surface irrigation systems.

Scientist: Sherwood B. Idso - Atmospheric CO_2 Enrichment Yields More Oranges with Higher Vitamin C Concentrations

The World Health Organization recently reported that more than half the world's population is malnourished. To help alleviate this problem, agricultural research strives to determine how to boost crop productivity and improve nutrient content. In a long-term experiment, now in its 13th year, scientists at the U. S. Water Conservation Laboratory, Phoenix, Arizona, have evaluated the effects of a 75% increase in the air's carbon dioxide (CO_2) concentration on these two aspects of fruit production in sour orange trees. In years of normal productivity, the 75% increase in atmospheric CO_2 produced a 75% increase in the number of fruit harvested from the trees; and the vitamin C concentration of the juice was 5% greater than the juice of the fruit produced on the trees exposed to normal air. In anomalous years, when elevated CO_2 boosts fruit production by 200% or more, the CO_2-induced increase in orange juice vitamin C concentration can be as high as 15%. It was thus concluded that this dual benefit of the ongoing rise in the air's CO_2 content should be a great boon to humanity as both population and atmospheric CO_2 levels continue to rise.

Scientist: Francis S. Nakayama - Guayule Latex

An adequate supply of guayule latex has been unavailable for industry to fabricate and test hypoallergenic latex products which are sorely needed by the U.S. medical profession. Therefore, ARS researchers at the U.S. Water Conservation Laboratory, Phoenix, Arizona, and the Western Regional Research Center, Albany, California, through a Trust Agreement with Yulex Corporation, have developed a simple process to produce sufficient quantities of latex for expanded research. The technique is expected to provide guidelines for commercial production of latex. Latex was also provided to Yulex to enable them to produce reliable medical products. This work significantly advances the cultivation and commercialization of the water-conserving, arid-adapted guayule plant.

Scientist: Paul J. Pinter, Jr. - Remote Sensing Studies in Free-Air CO_2 Enrichment (FACE) Experiments

A powerful approach for monitoring the effects of global change on vegetation in the future has been developed and tested by scientists at the USDA-ARS, U. S. Water Conservation Laboratory in Phoenix, Arizona. They have observed that the accuracy of satellite estimates of agricultural plant productivity are unlikely to be affected by rising levels of atmospheric carbon dioxide. This work is part of the Free-Air CO_2 Enrichment (FACE) research at Maricopa, Arizona, in which plants growing in open-fields are exposed to levels of CO_2 expected to occur by the middle of the 21st century. Since the FACE technique exposes plants to natural levels of light, water, and nutrients without the complications and measurement problems caused by artificial chambers, it is an ideal approach for use in remote sensing validation studies. The research was conducted using ground-based sensors similar to those on satellite systems. FACE results are applicable to large-scale production agriculture and thus far, the experiments at Maricopa have included wheat, sorghum, and cotton, important worldwide food and fiber crops.

Scientist: John Replogle - Investigation of Flume Calibration Variances

Engineers at the U.S. Water Conservation Laboratory, ARS, Phoenix, Arizona, are addressing reports of a few flumes that have been constructed for measuring water, which, when field calibrated, appear

to deviate from expected behavior. While hundreds of thousands of flumes are in use worldwide, such calibration problems have only been experienced with a few. These flumes include a large Parshall flume that deviates from published calibrations by over 20%, and some trapezoidal broad-crested weirs with unusually high overfalls that appear to over-discharge about 6 % at maximum flows. Laboratory studies on models of Parshall flumes fail to reproduce these differences. Thus, the original published calibration may need review. Currently, a trapezoidal broad-crested weir is under study to investigate problems associated with the high overfalls and provide guidance for correcting them. Assuring accurate flow measurements is important to ongoing water conservation efforts.

Scientist: Theodor Strelkoff - Surface Irrigation Software Development

The surface-irrigation software development group at the USDA-ARS, U.S. Water Conservation Laboratory in Phoenix, Arizona, together with the ARS Northwest Irrigation and Soils Research Laboratory, Kimberly, Idaho, received a three-year NRI grant from CSREES to incorporate a phosphorus transport and fate component into the existing surface-irrigation simulation program, SRFR. Phosphorus, an essential plant nutrient applied to many crops can be discharged into receiving streams with the irrigation-water runoff, encouraging algal growth and eutrophication of receiving water bodies. Simulation will allow users to test a variety of "what-if" scenarios aimed at reducing phosphorus discharges while maintaining uniform and efficient irrigation. Potential users include NRCS field offices, consultants, extension personnel, and universities.

Sccientist: Gerard W. Wall - Global Change Impact on Wheat Production

Atmospheric carbon dioxide (CO_2) concentration is rising, and little is known about the effects of elevated CO_2 on future world sorghum production. Sorghum grain production is 6th in acreage in the U.S., 2nd in Africa, and 4th in the developing countries as a whole. Because of concerns about food security, sorghum has been identified as high priority for global change research. Scientists from the USDA-ARS, U.S. Water Conservation Laboratory, Phoenix, Arizona, and from The University of Arizona, Tucson, Arizona, as well as others, investigated the relationship between atmospheric CO_2 and growth by exposing a sorghum crop in an open field to about 50% more CO_2 than is present in the earth's atmosphere today. The sorghum was grown with both ample and reduced water supplies. Results indicated that when water was in ample supply, elevated CO_2 had a nominal effect on sorghum growth and yield. In contrast, limited water had a substantial (15%) stimulating effect on the elevated CO_2 yield. Consequently, on a relative basis, the beneficial effect of a rise in atmospheric CO_2 concentration on productivity will be greater for water-stressed than well-watered sorghum. More efficient use of water by sorghum plants in a future high CO_2-world will be beneficial to both producers and consumers, particularly during a drought year.