CONSERVATION THROUGH CROPS RESEARCH

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In the future, water for irrigation in New Mexico and much of the southwestern United States will be more scarce and more expensive than it is at present. Economic pressure will force farmers to conserve water. Whether they conserve wisely depends, at least partially, on research now underway or being planned. Such research includes work in soils, crops, climatology, engineering, and economics. However, for this discussion, only crops research will be addressed.

In crops research one might divide the efforts into breeding and management; or into basic and applied; or into grains and forages. However, for the purposes of this presentation I am dividing crops research into research on conventional existing crops and research on new crops. I certainly won't cover all research in this area but will discuss several representative examples.

New Mexico State University has fairly large research programs on cotton and alfalfa with significant efforts on wheat and sorghum. The cotton breeding program was responsible for the release of one of the world's first hybrid cottons in 1979. While this research was not aimed primarily at saving water it certainly has that potential.

The first hybrid, NX-1, has outyielded the better conventional cultivars by about 15 percent over the last 5 years. The range has been from a 3 percent to a 36 percent yield advantage for the hybrid. It is important to note that the higher percentage comes from a year when yields were relatively low. It appears that the hybrid shows the most advantage over conventional cotton in years when there is stress. More testing is needed but apparently the hybrid is more stable across certain environments and can produce more fiber per unit of water used than can the conventional cottons, especially if water is limiting.
Unfortunately, NX-1 is not adapted to eastern New Mexico or west Texas. However, other hybrids are being developed which we hope will be. This

research is still progressing and, almost certainly, better hybrids will be released by New Mexico State University and by the 15 commercial companies which now are working on hybrid cotton.

Other types of research on cotton are being pursued by all the agricultural universities and research agencies in the cotton growing areas. Researchers with Texas A&M have a line with much better ability to produce on limited water than other cottons. Texas Tech researchers have been able to pinpoint some of the reasons for this increased efficiency using the electron microscope. The increased water efficiency appears to be caused by what amounts to a better plumbing system in the efficient line.

At New Mexico State University and in Texas, irrigation scheduling research has shown that cotton can be predisposed to a need for either more or less water by the amount and timing of irrigation during the early season. Cultivars respond differently to such treatments indicating breeding progress might be made for this characteristic.

Alfalfa is New Mexico's most important cash crop. However, it is also a large user of water with many farmers applying as much as 70 acre-inches of water per year. Observations and research indicate that despite this high use of water, alfalfa is a drought tolerant crop.

In the arid southwest, alfalfa was developed and is grown as a crop which does its best when water is not limiting. This does not mean that new cultivars cannot be developed which do well with something less than the optimum amount of water. Certainly using less water on alfalfa will result in lower yields. However, if 50 percent of the normal amount of water can produce 80 percent of the normal yield, a farmer may make more profit than would be made with normal amounts of water.

A New Mexico State University project now underway has shown that there is genetic variation in alfalfa for its ability to grow and produce when supplied with limited amounts of water. This variation exists between cultivars and also between plants within cultivars.

Furthermore, tests conducted in 1980-81 have shown that this characteristic can be passed on to the next generation. It therefore

appears that an alfalfa which will be a more efficient user of water than the alfalfa now being grown in New Mexico can be developed.

Other research now underway or being planned is designed to determine the effect of limited water on the root system, the quality of the forage, and the longevity of the stand of alfalfa. An attempt has begun to develop a cultivar having the ability to produce profitable yields with limited amounts of water.

Funds have been requested which, if granted, will allow research to be done on scheduling of irrigation water where the total amount is limited. We know much about how to apply 70 inches of water for maximum yields of alfalfa. We don't know how to schedule 36 inches of water for maximum yields especially considering the fact that alfalfa is a perennial and irrigation scheduling one year almost certainly affects yields the following years.

Sorghum has long been known as a drought tolerant crop and is grown on both irrigated and dryland in the arid southwest. It does respond to irrigation but has the ability to produce a crop even when water is severely limited.

Sorghum research is being conducted at most agricultural universities and research agencies in the southwest. Hybrids have been available for 25 years and hybrids usually have their greatest advantage over cultivars when there is stress on the plants. Therefore, much of the present work is aimed at developing better hybrids, particularly for moisture stress conditions.

Sorghum work at New Mexico State's Plains Branch at Clovis is aimed at higher yield and particularly at higher yield of protein. The researchers at Clovis also have found that the use of antitranspirants can increase sorghum and other crop yields particularly when water is limiting. Most of the water a crop uses is evaporated from the leaves. Antitranspirants reduce the amount of water evaporated and therefore increase water use efficiency.

Other research aimed at conserving underground water use on sorghum includes furrow diking and water harvesting. Furrow diking consists of constructing a small dike across the furrow every few feet so that

rainfall is held near where it falls rather than allowing it to move to the low spots in the field. Making such a dike requires almost no energy and can produce significant yield increases.

Water harvesting in one form consists of creating an impermeable soil surface on half the area such that all rainfall must move to the untreated area thus doubling the effective rainfall on that area. The treatment being used at Clovis is common table salt. It reacts with the clay making the surface impermeable but does no permanent damage to the soil.

Perhaps the most intensely researched crop in the world has been wheat. New findings continue to create new avenues for improvement, however, and yields continue to increase. Emphasis has been more on increasing yields under either full irrigation or dryland conditions and this research has been successful. Better lodging resistance, disease and insect resistance, and better response to fertilizer have all increased water use efficiency in wheat.

Research now underway in New Mexico and probably at other locations is aimed at evaluating available cultivars for their yield potential when they are grown under limited irrigation. Further work is needed on how to best use irrigation water when only a fraction of what is needed is available.

Other conventional crops are being studied and certainly there will be progress in developing cultivars and management systems which require less water.

Relatively new and exciting areas of research are being conducted at several locations in the southwest. Those areas of research are the introduction of new crop species to the southwest from other parts of the world, and the domestication of wild species. Several research projects are now underway. With better funding, research in these areas would be increased because they show promise of being very productive. Funding is difficult to obtain because there is no clientele group to lobby at the state or national level.

At New Mexico State one project is aimed at domesticating guayule. Guayule is a perennial shrub native to Texas and Mexico which has natural

rubber in its cells. This type of rubber is in demand for radial and large heavy duty tires. The United States gets natural rubber now from Hevea rubber trees which grow in Malaysia and Indonesia, areas of the world which could quickly be cut off from the United States.

Guayule research results from Texas, New Mexico, Arizona, and California have all been promising although several years of work are needed before commercialization can proceed. A viable guayule rubber industry would be of strategic importance and would allow farmers to grow an alternate crop requiring less water. However, funding for new crops research has been very limited and, in the case of guayule, some research and seed increase plots now in the field may have to be abandoned.

Another crop being studied at New Mexico State is crambe. Crambe is closely related to the mustards and was introduced from the Mediterranean region. It produces a seed high in oil which contains high levels of erucic acid. Erucic acid oil is in demand by industry because it remains stable at very high temperatures. It can be used as a lubricant in rolled steel mills, in jet engines, and has many other industrial uses. It can also be made into a nylon which, for many uses, is superior to nylon made from petroleum. Crambe is a short season crop which therefore uses less water than many crops. It would fit well into a double-crop system.

In Texas and Arizona a crop called guar is being grown and research on how to increase yields has been initiated. Guar seed contains a gum needed by the food and petroleum industry. It is used to keep drilling mud particles in suspension and for wells drilled deeper than 15,000 feet it is almost irreplaceable. Guar does well on relatively poor soil, requires less water than many crops, and since it is a legume it requires no nitrogen fertilizer. It shows great promise as a crop which can be greatly improved by breeding and by management research. The acreage is almost certain to increase over the next few years.

Other crops being studied are buffalogourd, a protein and energy source; jojoba, an oil source which would help replace sperm whale oil; mustards and rape, edible oil and fuel sources; millet, a feed grain; and kochia, a forage crop.

New Mexico State has a kochia project at Clovis which is attempting to convert kochia from a weed to a desirable forage crop. Kochia is a very efficient user of water and produces high yields. It has some undesirable traits, however, which need to be eliminated or reduced.

Russian thistle is a similar plant which has been studied in the past. It, too, is water efficient but needs even more improvement than does kochia. There are other candidate crops that might fill a need and at the same time use less water than currently grown crops. The sunflower and Jerusalem artichoke are possibilities.

Another promising genus is Cuphea. It contains more than 300 species, all of which grow wild. Two are native to the southwestern United States. The others grow in Central or South America. All contain lauric acid oil having 8 or 10 carbon atoms per molecule. All of our supply of this type oil comes from palm trees and must be imported. Cuphea oil would be used in making soap, detergents, cosmetics, jet engine lubricants, etc. It is in demand and it does appear that Cuphea would require less water than most presently grown crops. There is no research on Cuphea in the southwest at present although funds for research are being requested.

Another genus which produces a needed oil is Lesquerella or bladderpod. It is found throughout the southwest. It produces an 18-20 carbon chain molecule which is needed by industry. Among other things, it is used as a grease thickener. Lesquerella needs much breeding improvement but limited research indicates it is a good candidate for domestication. It requires relatively small amounts of water. Again, there is no research at present in the southwest because of lack of funding.

Many other species of crops and native plants exist which might be a good source of a product in demand and which are low water users. Much research is needed to find and develop these species into crops adapted to the arid southwest.