Progressive Agriculture In Arizona

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Contents

On the cover

Rows of parabolic-tray collectors will feed 600-degree oil to the tall storage tank at the 150-kilowatt solar irrigation project near Coolidge. This and other projects aimed at cutting agricultural energy costs are described in our lead article.

Photo and art credits

David Bryant: p. 20; Linda Cassens: pp. 12, 13; Robert Dennis: p. 8; Robert Fowler: p. 6 left; Gordon Graham: cover, pp. 1, 2 bottom; Robert Halvorson: p. 10; Gary Nabhan: pp. 14 left, 15 left; Phil Ogden: p. 21; Judi Tobias: p. 9; Jim Van Dun: pp. 2 top, 3, 4 bottom, 5; Guy Webster: pp. 4 top, 6 right, 7, 14 right, 15 right, 16, 17, 18; Van Wilson: p. 19.

From the Dean

One of the roles of a land grant college of agriculture is to anticipate some of the state's future needs and help develop the ability to meet them. Especially in a technologically and economically complex area like agriculture, tomorrows become todays very quickly, and the ability to solve problems depends upon foresight. With this in mind, the College of Agriculture will host a symposium structured to provide an opportunity for a free interchange of ideas among our agricultural faculty, agricultural leaders and the public. The focus will be on the future trend of Arizona's agriculture. Dr. R. P. Upchurch, Head of the Department of Plant Sciences, will chair the conference in November in Phoenix.

How will Arizona's agriculture cope with the serious problems facing our state and nation, such as the decreasing supply of available water, increasing energy costs, and the demand for land for cities, factories and homes to take care or our increasing population? How will our crop and livestock systems change in the foreseeable future? Are there some new crops on the horizon that promise higher economic returns than those presently grown? Can we expect higher average yield of crops and greater productivity of livestock in the years ahead? These and other issues will be the focus of attention at the Phoenix Symposium.

This issue of *Progressive Agriculture in Arizona* is devoted mainly to a forward look in several areas critical to the future of Arizona's agriculture. We hope this brief look ahead will stimulate a desire to participate in the symposium.

To adapt to the sharp rise in irrigation costs that has occurred and is apt to continue, UA scientists are studying ways to use irrigation water more efficiently. Agricultural engineers are checking possibilities for cutting the energy costs of irrigation, tillage and heating. The energy article touches upon several ways to conserve energy.

Some of our plant scientists are finding ways to prepare the state's existing economic crops for the future. In the past half century, crop yields have increased markedly. Have yields per acre reached a plateau beyond which increases are not possible? The article on existing economic crops deals with this and other questions.

Other scientists are attempting to develop native Southwestern plants into potential economic crops. In this article the promise, problems and methods of such work are discussed.

New range management plans for public rangelands, as prescribed by new federal laws, will have a long-term impact on Arizona's cattle industry. The University is contributing a substantial effort to see that these plans are based on accurate local information and that permittees take an active role in the planning process.

The College of Agriculture's instructional program includes both on-campus classroom teaching and informal off-campus educational programs. Both approaches assist in the development of Arizona's most important resource for the future—our young people.

The Cooperative Extension Service, which stresses informal instruction outside of the classroom, gives special attention to youth development through the 4/H Program. Another Extension project, to help parents nurture the development of even younger Arizonans, is described in the report about the *Cradle Crier* newsletter.

We hope to see many of our readers at the Phoenix Symposium in November.

Darrel S. Metcalfe

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PROGRESSIVE AGRICULTURE IN ARIZONA

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Renewable energy sources will help put chlorophyll to work collecting sunshine

By Guy Webster

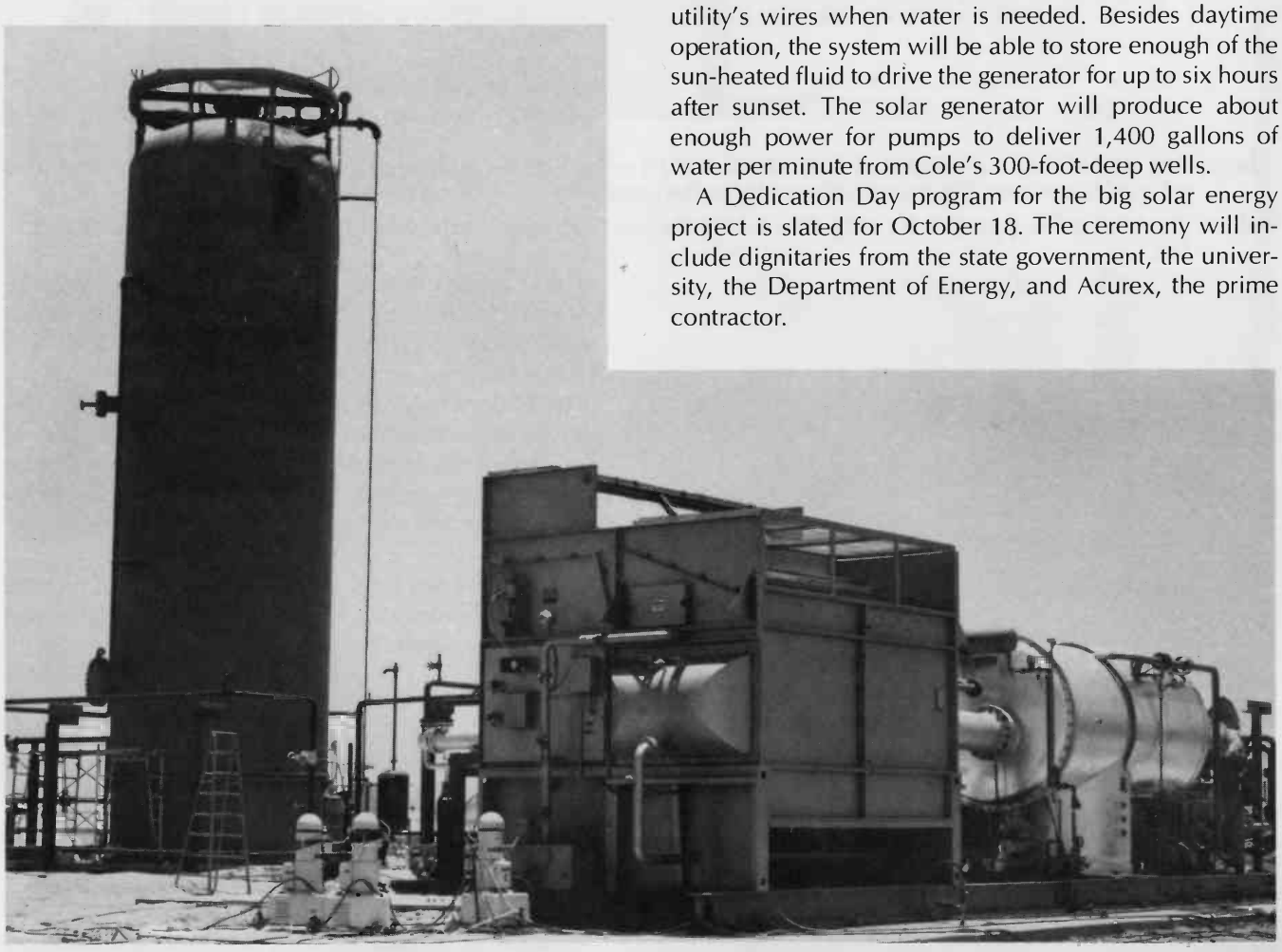
A field of green crops is a solar energy collector. Agriculture turns sunshine into energy-containing materials that people can use more directly, like food for themselves and their animals, or raw materials for clothing and industry.

But the pump must be primed. Energy must be expended to get that field of crops into condition for efficient sunlight-collecting and to harvest the yield. The mechanization of agriculture has meant that most of those energy requirements are now met by using petroleum or electricity instead of food-powered muscle.

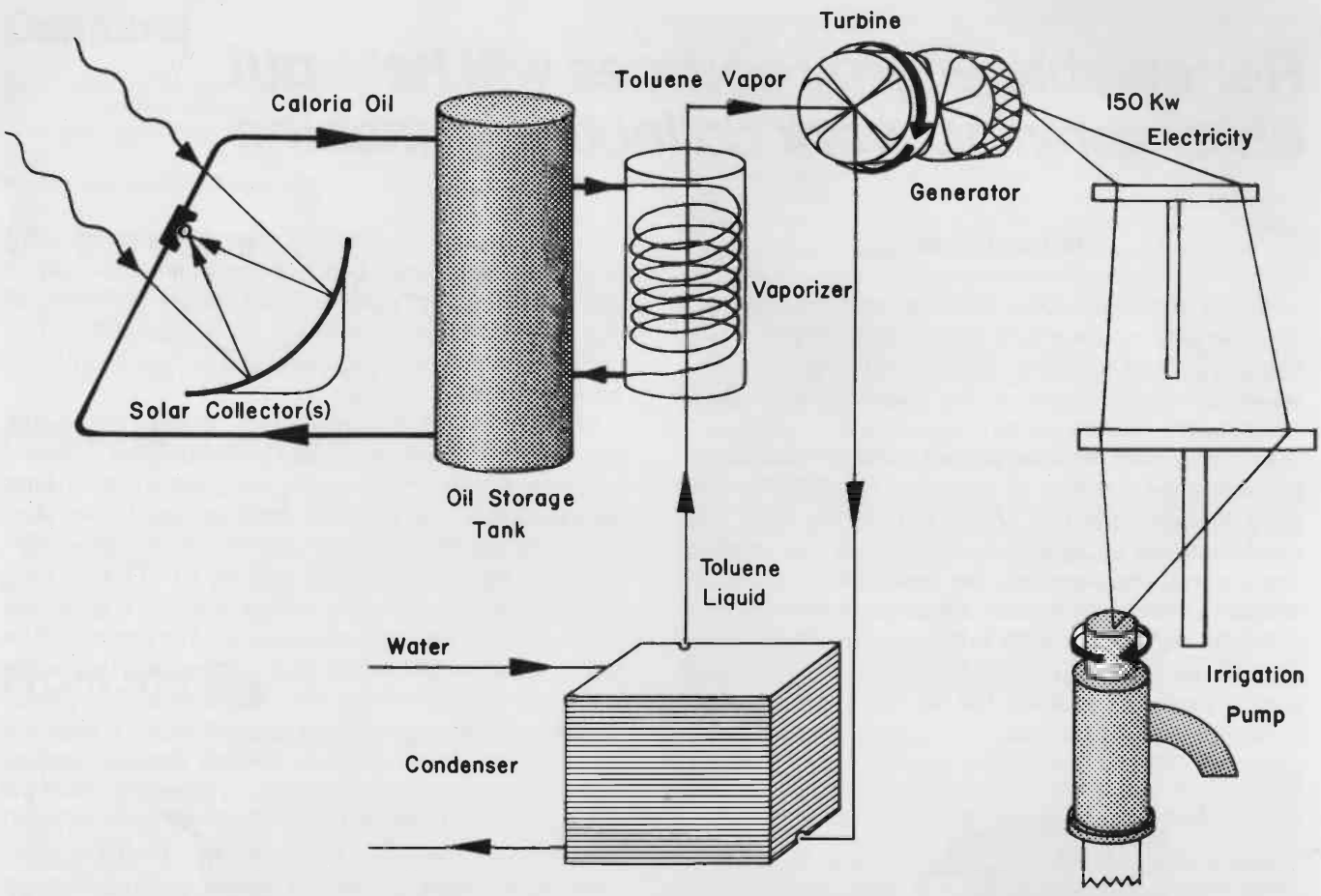
As the nation cuts back on petroleum consumption through the 1980s and '90s, allocation systems may well protect agriculture's share, but the higher costs are setting off reactions. Agricultural engineers and inventive farmers are checking scores of possibilities for cutting costs by using less "store-bought" energy. University of Arizona scientists are working on several projects to conserve energy in agriculture and to use alternative, renewable energy sources.

The most dramatic agricultural alternative energy project in the state is the largest solar-powered irrigation pumping system in the world, on Dalton Cole's farm near Coolidge. The privately designed and built system should be operating this fall after 15 months under construction. Heat from the sun, striking 2,140 square meters of parabolic collector surface will run a generator producing 150 kilowatts of electricity. The power will be fed into the local Electric District Number Two wires rather than directly to the irrigation pumps. The pumps can then draw an exchange amount of juice from the utility's wires when water is needed. Besides daytime operation, the system will be able to store enough of the sun-heated fluid to drive the generator for up to six hours after sunset. The solar generator will produce about enough power for pumps to deliver 1,400 gallons of water per minute from Cole's 300-foot-deep wells.

A Dedication Day program for the big solar energy project is slated for October 18. The ceremony will include dignitaries from the state government, the university, the Department of Energy, and Acurex, the prime contractor.

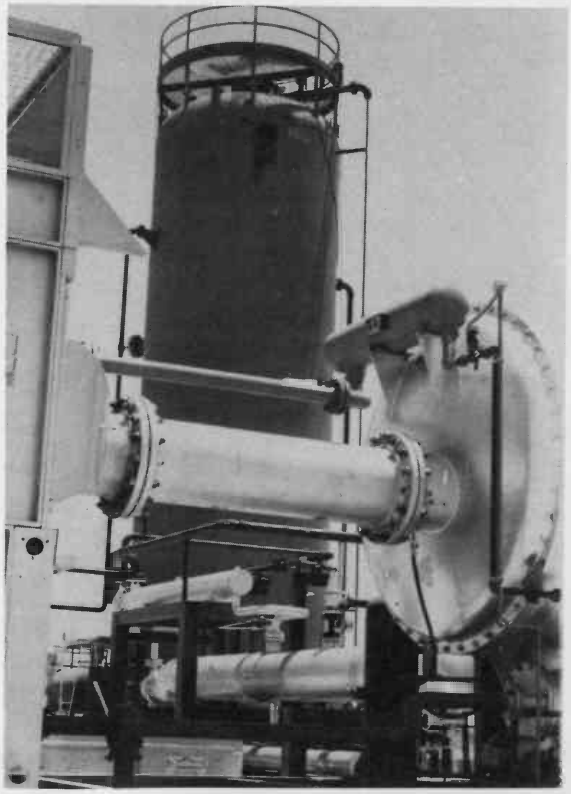


The heat storage tank of the Coolidge solar generator (left) will hold enough of the 600 degree Fahrenheit oil to run the electric generator for up to six hours after sundown.



Above: 150 KW SOLAR GENERATOR FOR IRRIGATION—The Caloria oil heated by the sun heats the toluene from a liquid to a vapor. The heated toluene turns the generator that powers the electric irrigation pump.

Below: The $5.5 million project for irrigation on the Dalton Cole farm is scheduled to begin full-scale operation this fall.



The U.S. Department of Energy is funding the project. A team of UA scientists headed by agricultural engineer Dr. Dennis Larson is studying the costs and performance of the system.

The $5.5 million cost of the Coolidge project includes research costs as well as pumping costs. But the cost of solar-powered pumping is still much higher than that for gas or electric pumping. The project will provide careful assessment of fuel savings and maintenance needs over the years.

Fortunately, this large solar generator should provide information for making future ones more cost-efficient. The Coolidge project is costing considerably less per kilowatt than the first major solar pumping system that was constructed. As power for irrigation, the project will be compared to earlier solar irrigation systems in Gila Bend and in Willard, New Mexico. In those two systems, the thermal engine directly drives water pumps, rather than generating electricity into a utility company's network.

Smaller scale

Even before large-scale solar irrigation economically merits common use, smaller solar pumps may find a role in some situations, says Larson. He is monitoring a 10

gallon-per-minute solar pump for use with the College of Agriculture's water-harvesting and grape-growing project at Page Ranch near Oracle.

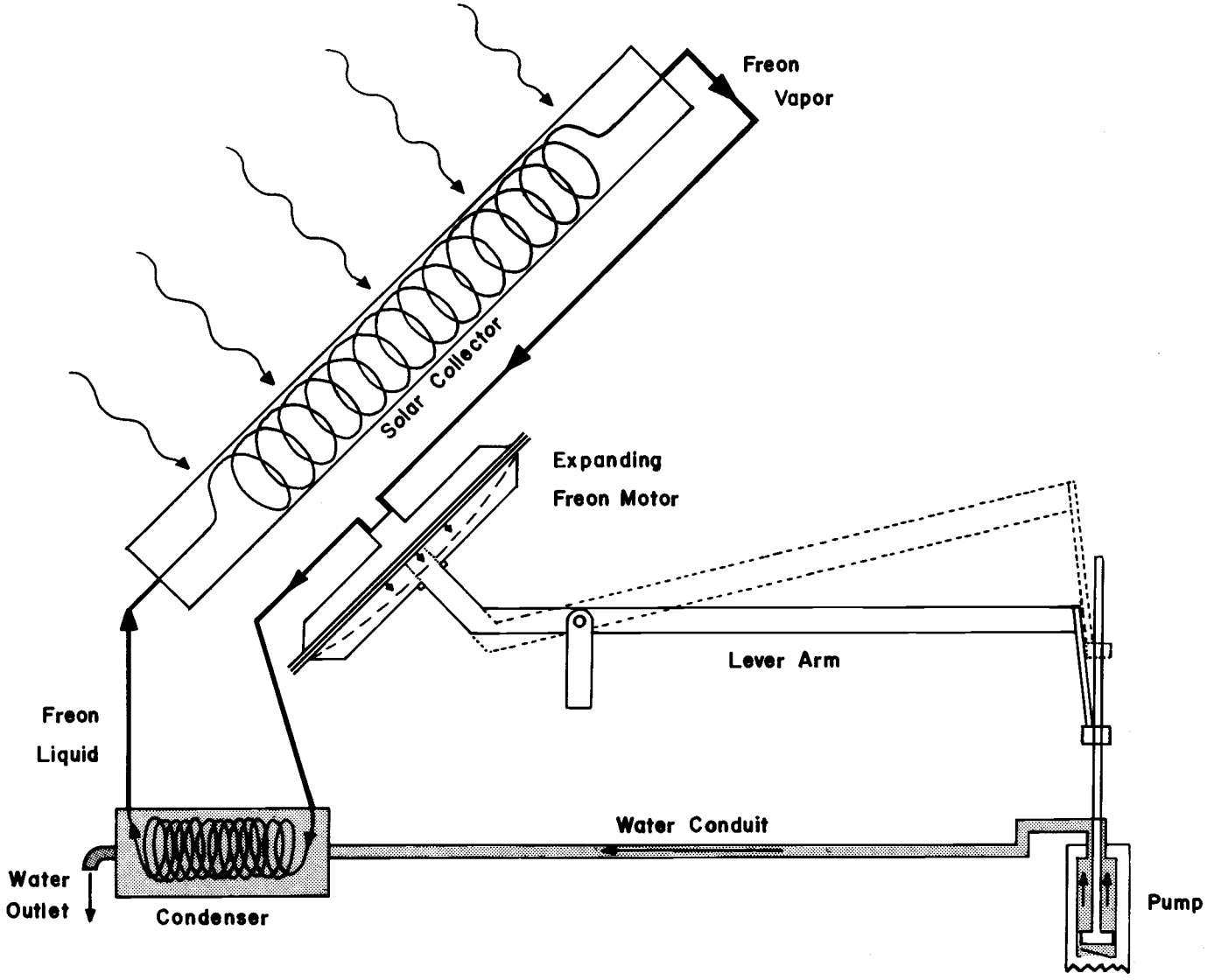
This pump uses no electricity. Solar heat expands freon from liquid to gas, which pushes the single cylinder, driving the pump. The circulating freon is then cooled by the freshly pumped water to condense before it is heated again. The Solar Pump Corporation of Las Vegas, Nevada designed and built the prototype. Larson and UA colleague Charles Sands set it in operation at the UA Campbell Avenue Farm in Tucson to check its performance and maintenance needs before moving it to Page Ranch. They have since suggested several refinements in the engine's design.

"We're working on the development of this device so that we'll have something to meet the specific needs at the Page site," said Larson this summer. "If we show that it works there, it will give people an extra choice for pumping water in relatively remote areas, far from a power line. A lot of livestock water tanks are in remote places, where the choices for pumping are small diesel, wind and solar. Some spots don't get enough wind, and if this solar plant works well, it could be operated with less attention than a diesel."

At Page Ranch, the pump is for watering plants, not livestock. The site is designed for collecting runoff water from between the widely spaced rows of grapes. The pump will move water from the downhill collection tank to an uphill storage tank so that it can be used to irrigate as needed.

Solar heating

The biggest increase in use of solar energy in the next couple of decades will probably be as heating for buildings and water. UA agricultural engineers Dr. Frank Wiersma and Dr. Dennis Larson have monitored a solar water-heater at the UA dairy farm since 1977. Two commercially manufactured solar collectors with 2.4



10 GALLON PER MINUTE SOLAR PUMP—The Freon heated by the sun expands to push the arm of the pump. Freshly pumped water then cools the Freon.

and 1.67 square meters of absorption area provide about 15 percent of the water-heating capacity needed for the milking parlor of the 130-cow dairy.

During the daytime, water circulates continuously through the collectors and a 480 liter (125 gallon), insulated storage tank. This preheated water is piped to the main, gas-fired water heater in controlled amounts. Another pipe to the main heater bypasses the solar heating system.

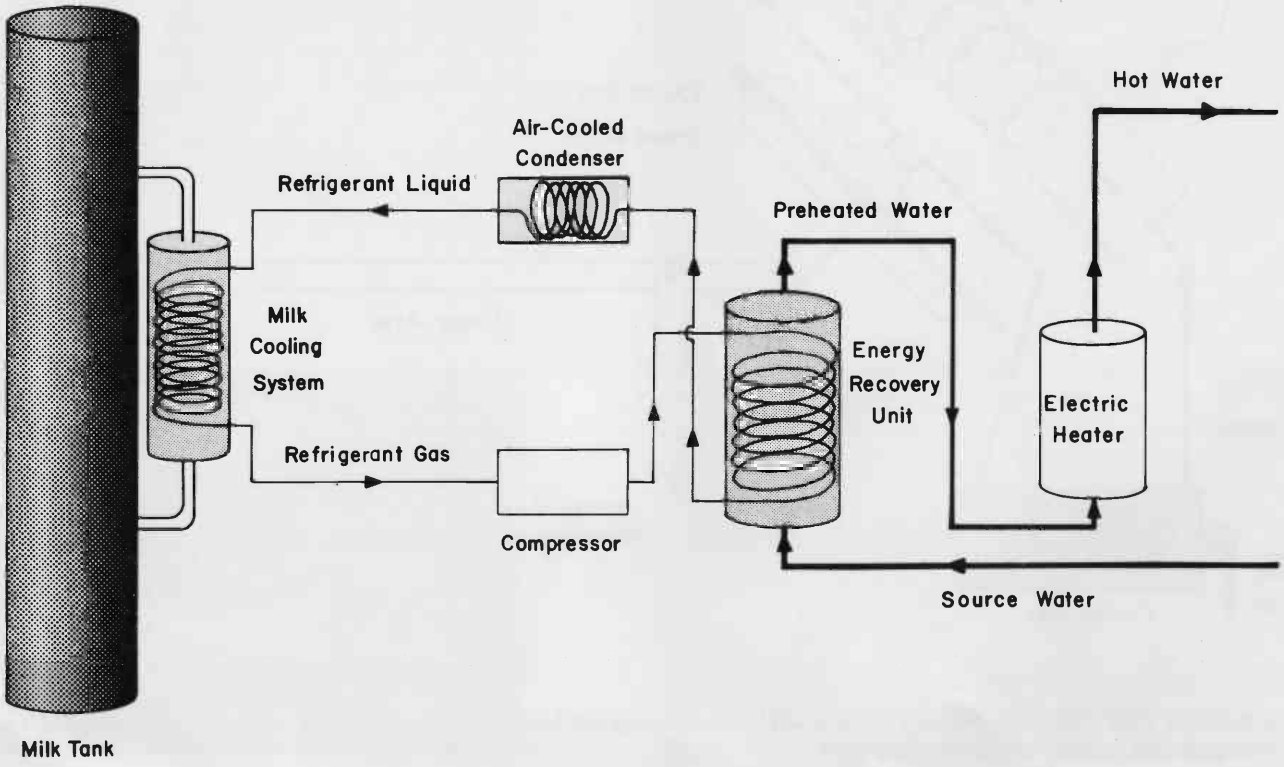
A fifth or less of the parlor's total hot water is channeled through the solar system. That way, the preheated water can be kept most of the day within 20 Centigrade degrees of the 70° C (158° F) needed for cleaning milking equipment. When a larger portion of the water is diverted through the solar heater, the water is preheated to a lower temperature.

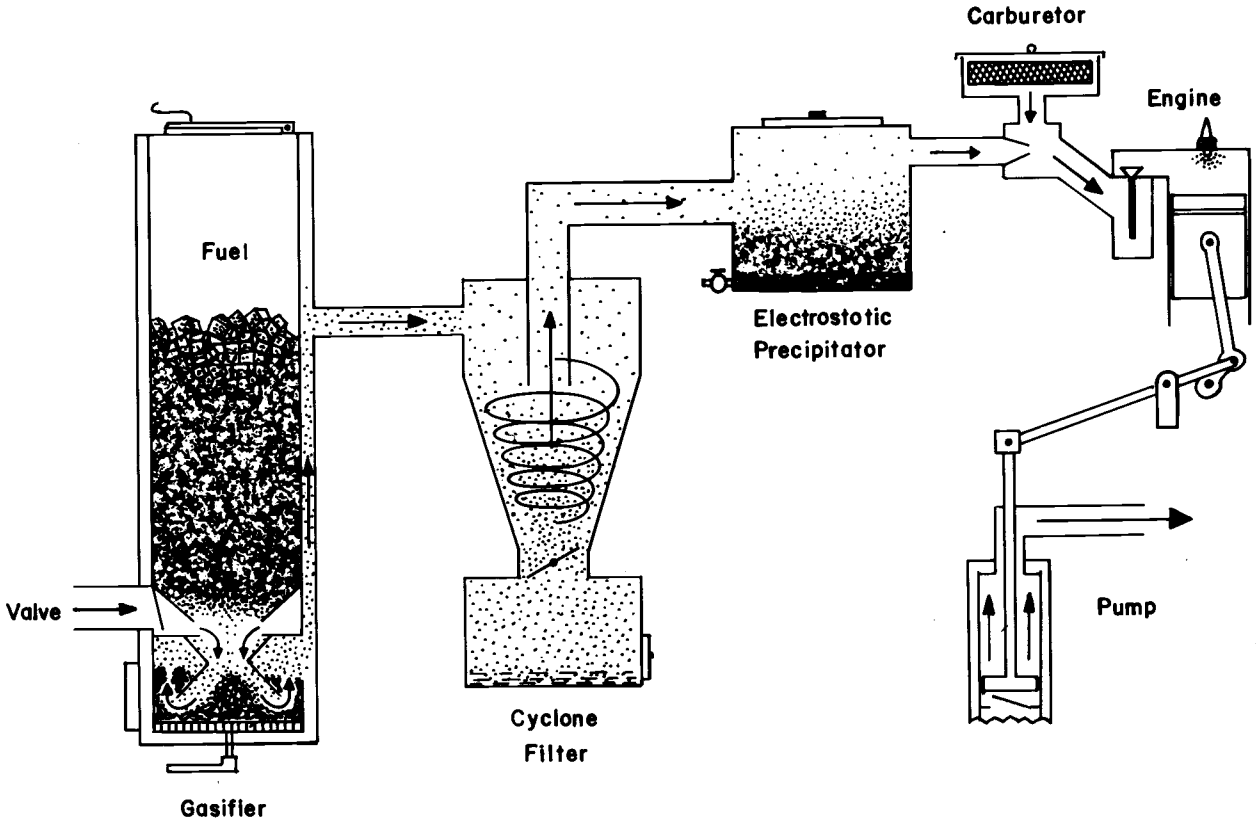
To plan for appropriately designed water-heating systems for dairies, Wiersma and his colleagues are compiling records of hot-water use from more than 100 dairies in 17 states. The dairies were selected with the help of Extension Service agents around the country, and include a range of sizes of operation in each region of the country.

Besides solar heat, a good source for heating water for dairies may be the waste heat produced from the cooling of the milk. The UA scientists are keeping performance records on a commercial heat-exchange system that has been installed on Baca Linda Dairy, a 600-cow-dairy near Litchfield Park. Intake water is heated by using it to

Above: Dr. Dennis Larson checks operation of the small-scale solar pump he is monitoring at the UA farm in Tucson.

Below: DAIRY HEAT-EXCHANGE SYSTEM — Refrigerant draws heat from the milk, is compressed, and transfers heat to water bound for the electric water heater. The water-cooled, then air-cooled refrigerant continues the cycle to cool the milk.





PRODUCER GASIFIER TO FUEL PUMP ENGINE—Straw or other fuel is partially oxidized in the gasifier. The valve lets in only enough air for combusion to continue, but not enough for complete oxidation. The reaction produces flammable hydrogen and carbon monixide gases, which are cleaned in the filter and precipitator, then burned in the internal-combustion engine that drives the pump.

cool and condense the refrigerant gas from the milk cooling system. The preheated water then flows on to the main heater, and the condensed refrigerant circulates to chill the milk. The heat for the water comes from the heat of the newly given milk.

Manure gas

Solar heating plays a minor role in another alternative energy project at the UA dairy farm. Agricultural engineer Dr. Douglas Williams built an anaerobic digester to convert some of the dairy's manure into flammable methane gas. Anaerobic means oxygen-free. The bacteria that turn the manure into methane don't like oxygen. They do like temperatures around 38° C (95° F), which is where the solar energy comes in. Williams' black-painted digester sits under a clear plastic covering in the winter to absorb heat from the sun.

The digester itself is simply three 55-gallon drums, without tops and bottoms, welded together into one long cylinder, with an inlet on one end and an outlet on the other. When filled with 150 gallons of fresh manure and water mixed in equal amounts, the sealed and virtually odorless tank puts out 20 cubic feet of methane gas daily. Williams puts five fresh gallons of the diluted dung into the digester every day, and takes out five gallons of used slurry, which is as good as new for fertilizer.

For now, he collects the methane in tractor-tire inner tubes and takes it home for fueling a gas stove. The output is enough for the cooking needs of a four-person family. Methane burns much like natural gas, but contains less energy per cubic foot.

Williams forsees digesters on a larger scale meeting many of the energy demands of dairy or feedlot operations. "They could generate electricity to run lights, motors, refrigeration units—even milking machines," he says. Another use may be in countries that have livestock but little cooking fuel.

Gasifier

Williams has another project in Tucson for turning other agricultural by-products into useful fuel. This one, a producer gasifier, turns straw into gases that will power an internal combustion engine hooked to an irrigation pump. The same setup could run the pump with corncobs, cotton gin trash, pecan shells or other crop residues.

The gasifier, like the anaerobic digester, depends on keeping out air when it's not wanted. The idea is to burn the straw or other fuel without allowing in enough air for complete oxidation. So instead of turning all of the organic matter into the usual oxidation products of carbon dioxide and water, the gasification produces useful amounts of flammable carbon monoxide and hydrogen gases (CO_2 and H_2O minus some O).

Dr. Douglas Williams savors a breakfast cooked with methane generated from manure in the anaerobic digester behind him.

This summer Williams was working on a couple of snags: getting the cubed straw to feed smoothly into the airtight combustion chamber and getting all of the tar and ash out of the produced gas before it gets to the pump engine. But he has no doubts about whether gasification works.

"This isn't a new technology, even though it hasn't been used much in the past 30 years," he said. "During World War II, Sweden rigged up thousands of tractors and trucks with gasifiers so that they could run on charcoal instead of gasoline. Almost 80 percent of their buses and about 34,000 cars during the war were using gasification." The units installed on cars looked like plain woodstoves sitting on the trunk with a pipe around to the engine.

"It ought to be even easier to hook up a gasifier to a stationary irrigation pump than it was to make mobile ones you could drive around with," said Williams.

Conserving energy

Abundant sunshine is Arizona agriculture's advantage. It gives the region an edge that has made up for the handicap of low rainfall. But because of that handicap, irrigation has been necessary for almost every commercial crop to take advantage of the solar energy. And though the state has built elaborate river-water irrigation systems, begun on the ruins of Indian canals, almost two-thirds of the irrigation water now used in Arizona is pumped from wells. Four out of five irrigated acres use at least some well water.

The energy expense of pumping is why most of the agricultural alternative-energy projects in the state use energy for pumping water. Larson and fellow UA engineer Dr. Del Fangmeier determined in 1977 that pumping can represent up to 80 percent of the total energy cost of producing irrigated cotton using well water.

Other UA projects are examining ways to cut energy consumption by reducing tillage steps and by irrigating only in every-other furrow or in other combinations. On the Marana Experiment Farm in both 1977 and 1978,

Dr. Williams (left) and student Ed Jorgensen discuss the routing of fuel gas into a pump engine. The hydrogen and carbon monoxide gas is produced by a gasifier and cleaned in the electrostatic precipitator at left.

cotton on plots with reduced tillage yielded as much lint as that grown with conventional tillage. The reduced-tillage treatment substituted chiseling for the plowing step of conventional tillage and eliminated one of two diskings and the mulching step. Engineers Larson, Walt Hinz and Fangmeier, and Pima County Extension Agent Jim Armstrong ran the tests and are repeating them in 1979.

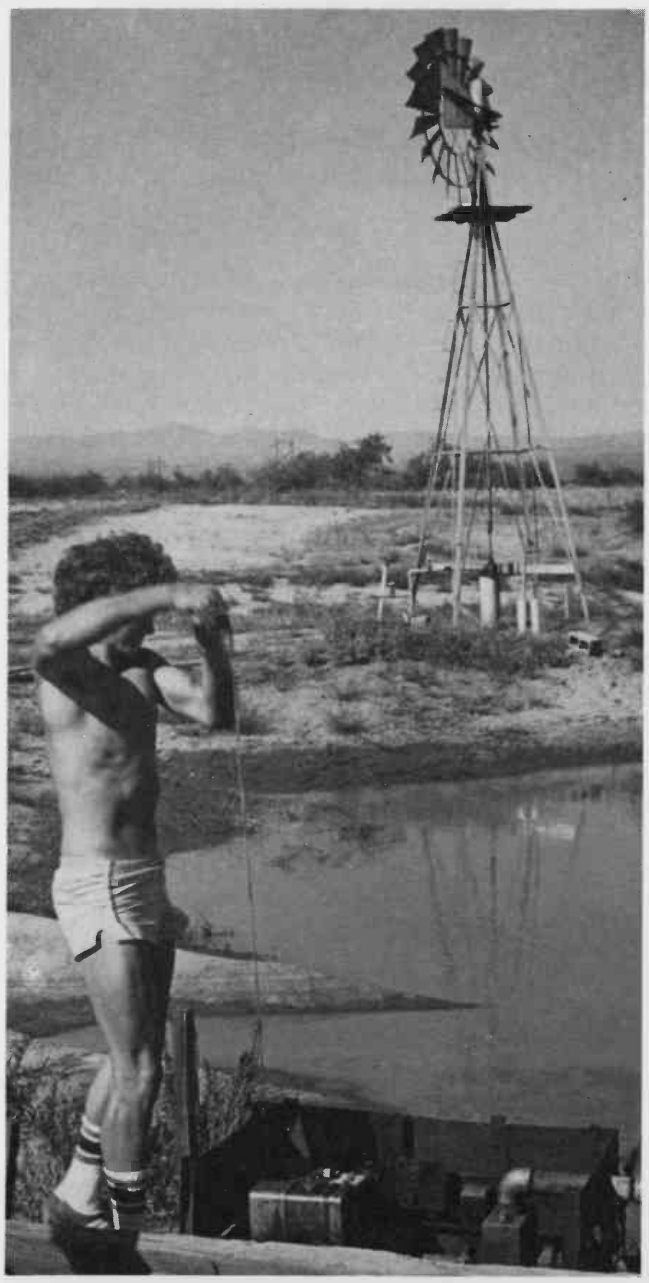
They are also comparing every-row irrigation to alternate-row irrigation, both with the reduced tillage treatment. Irrigating only in alternate rows used about one-third less water than every-row irrigation, but resulted in comparable lint yeilds: 5 percent lower in 1977, but 10 percent higher in 1978.

Studies of water-use requirements of several crops, by many scientists, are helping to reduce unnecessary irrigation.

Low-energy water

UA soil scientist Dr. Gordon Dutt is working with horticulturist Dr. Eugene Mielke on a system for harvesting rainfall to water plants where other sources for irrigation are unavailable or insufficient.

Their principal test site is at the Page Ranch west of Oracle. Ten acres of land there have been reshaped to drain onto long, four-foot wide waterways. Slightly sloped, 30-foot-wide catchment surfaces between the waterways were treated with salt to maximize runoff of water. Grapevines and fruit trees grow in the narrow waterways where the soil absorbs most of the runoff



UA worker John Chamberlain yanks cord to start the diesel pump at the Page Ranch near Oracle. Engineers plan to install a solar pump on the site to compare its performance to the diesel and wind pumps already there.

from the catchment surfaces. Water that's not absorbed flows into one of three storage ponds. From these, it can be pumped back onto the crops if needed.

Dutt reports that, though the area averages only 12 to 16 inches of rain a year, the grapes get almost all the water they need from the primary runoff. The added irrigation is usually about an inch and a half per year, about a tenth of what would be needed without the flow from the catchment surfaces.

"Having soil with a good water-holding capacity is an important part of this system," he explained recently. That allows the plants to get maximum use out of the sporadic rains.

On the other hand, the high absorption capacity of the local soil—a Whitehouse loam type—required that the catchment surfaces be treated to minimize infiltration and encourage runoff. The scientists rototilled the top couple inches of soil to break up soil structure, then mixed five tons of salt per acre into the top inch of the soil. After each of the next two rainstorms, they compacted the surface with a heavy roller. The four-foot wide rows for the plants were not salted and compacted, but the bottom and sides of the storage ponds were.

The salt separates into sodium and chlorine ions in the soil. The chlorine is leached further into the soil, but the sodium stays near the surface. It bonds with oppositely charged clay particles and causes them to stack more tightly together than they would otherwise. The clay makes such a tight, hard surface that water barely gets through: at the bottom of the storage pond, less than a tenth of an inch of water seeps in per day.

Since the water doesn't get into the catchment surfaces, the salt doesn't wash out. "There is no tendency for an increase of salt in the root zone of the grapes," said Dutt. The water in the storage pond is less salty than Tucson city water.

Fine wine

After a bout with Texas root rot, which is now under control with resistant root-stock and sulfur, the grapes are growing well. Grapes were chosen for the site because they require relatively little water, they have deep roots to make good use of stored soil moisture, and they have high economic value.

The researchers have begun a second site at Babocomari, south of Sonoita. There, the land was terraced, but not treated with salt. At Page Ranch, they will be comparing performances and costs of solar-powered, wind-powered, and gasoline-powered pumps for moving water between storage tanks. The fruit trees have become the basis for a study of solar food-drying. One hundred apricot trees of several varieties were planted at the site this year.

Some of the grapevines are yielding as much as vines in good California vinyards. Some varieties of wine made from Page Ranch grapes were judged by a taste panel to be as good as California's best. "Really, I think I can say, 'We're there. We've shown it will work,'" said Dutt.

The rows of grape vines and fruit trees at the Page Ranch are watered by the rainfall runoff from 30-foot wide, slightly sloped surfaces, plus drip irrigation pumped from lower catchment ponds.

Arizona field crops are looking fine in '79, but scientists prepare for the maybes of the '80s

Field crops in Arizona are in good shape. 1979 is expected to be an all-time record year for cotton production in the state. Wheat yields twice as much grain per acre as it did 20 years ago. Alfalfa yields almost 50 percent more forage per acre than it did 20 years ago, with less irrigation. The production of high-value, certified planting-seed crops, from cotton to wheat to peanuts, has tripled in 10 years.

The agronomists, geneticists, and other plant scientists who have helped farmers achieve these successes are proud of their results, and are continuing to work on plant improvements and increased efficiency of production. The task is two-fold: to find solutions to problems as they arise (or fly in), and to anticipate the problems of the future, either biological or economic, and prepare options for response.

King cotton

Cotton is growing on 665,000 Arizona acres this year, more than half of the irrigated land in the state and second-highest acreage ever. The value of the seed alone would make it one of the state's major crops, and the lint is worth up to 10 times as much as the seed. Favorable summer weather and low insect pressure are factors in the prediction for 1.2 million bales of the white stuff.

But a few years down the road, cotton may be running into trouble on several fronts. In calls for changes in Arizona agriculture, cotton is often the named or implied candidate for ex-champion status. It doesn't have to be that way, says UA Extension cotton specialist Dr. Brooks Taylor. If cotton has potential drawbacks, that's reason for research to attack the problems, not reason for throwing in the cotton towel.

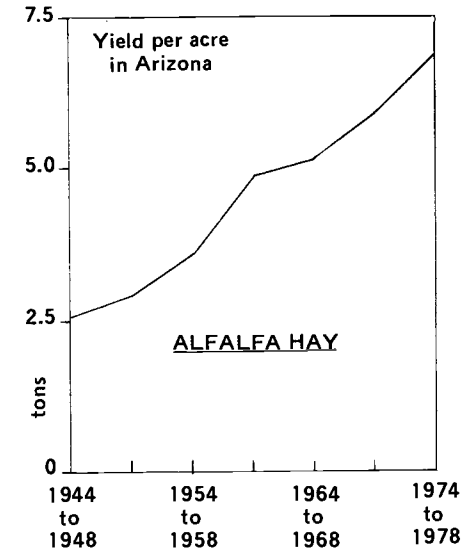
Specifically, Taylor explains, "Cotton is facing three main problem areas. One is to control insects that cause costly damage every season, but to do it with a minimum of objectionable insecticide-spraying. Another is aflatoxin. We've had people working on it for years, but it started to get a lot wider public attention last year. And the third big problem is water. There's a lot that can be done to improve the efficiency of water management on cotton."

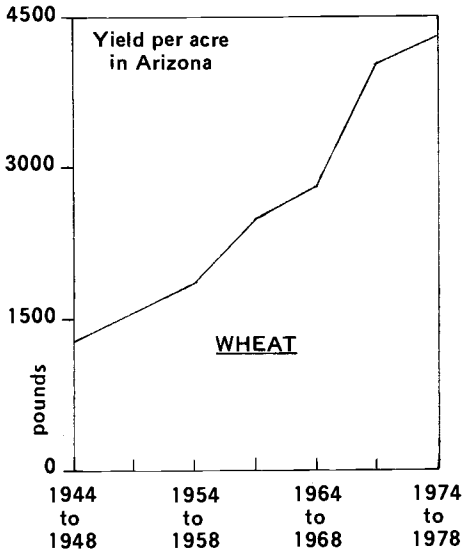
Ways to attack these problems are no mystery. Some of the work has been progressing for decades. Taylor discusses each in turn.

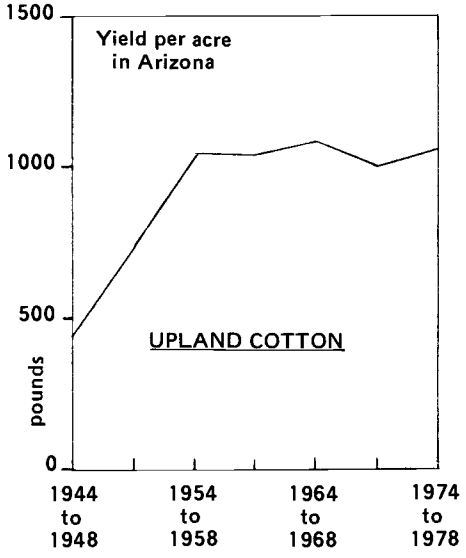
Shorter season

The key area for improvement on the insect front is in a shortened growing season. Pink bollworm and budworm do the most damage. Taylor says that the crux of getting rid of them is to terminate the crop earlier to

Graham County Extension Director Ron Cluff (right) and UA Field Testing Specialist Dave Parsons (left) prepare an on-farm alfalfa test demonstration for a field day. The top entry produced nearly 20 percent more forage than the lowest in this 1976–78 planting.







reduce the number of insects that reach the overwintering stage. "You terminate earlier by taking the water off earlier, but that is not enough," he adds.

"We have all sorts of research data to show that you can follow the entomologists' guidelines for a shorter season and get good results against the insects. It works very well on experimental farms, but many growers can't afford to do it. The yield you lose by stopping early often more than offsets your savings on pesticides."

A full production system that makes early termination economical is his prescription. Plant scientists at UA and elsewhere are working on it.

"When entomologists give us a September date for termination, instead of managing the field until then the same way as if we were terminating later, we need to go back to the front end of the season and develop a whole production system aimed at the shorter season. We haven't spent enough time doing that yet," says Taylor.

UA's 1979 Cotton Report includes examples of work to improve the growth and fruiting level of cotton at the beginning of the season. Extension agronomist Dr. Robert Briggs describes a plant growth regulator that increases first-harvest yields, "indicating that the use of this chemical would be beneficial for any short-season cotton management considerations." The chemical, PIX by BASF Wyandotte Corporation, applied at cotton's early bloom stage, produces a shorter, more compact plant that facilitates machine harvesting.

Also in the 1979 Cotton Report, Dr. Jack Mauney and Dr. Thomas Henneberry of the UA/USDA Cotton Research Center in Phoenix describe a study of causes for square shedding. Squares are the unopened cotton flowers, so keeping them on the plant is important for obtaining a good short-season yield. Through June and early July of the 1978 study, most shedding of squares was attributable to plant-bug feeding (especially Lygus bugs). From mid-July through August, worm damage and physiological causes became the most important factors.

Hybrid cotton

Other work includes looking for ways to improve germination at low temperatures for earlier planting, variety tests using a short season, and a study of effects of early chemical crop-termination on insect populations.

Taylor underlines the need for developing new varieties of cotton suited to a short season and for assuring the quality of planting seed. But developing a new commercial variety of cotton usually takes 10 years or more. UA cotton breeder Dr. Lee Stith is progressing in the development of high-yielding hybrid cotton, expected to be commercially available by the mid-1980s. The biggest remaining hitch is to increase fertility.

Aflatoxin research is making headway, too. But the work should be intensified to lick the problem of the fungus-producing poison found in some cottonseed, says Taylor, noting, "Four years ago the cotton growers came to the University and said, 'Aflatoxin is our number one problem.'"

Since then, UA plant pathologist Dr. Thomas Russell has measured aflatoxin levels in more than 10,000 samples from fields and gins. He has identified many factors that make contamination more likely, including elevation, insect damage and moisture level. Work by Maricopa County Extension dairy agent Otis Lough and others has yielded a technique for decontaminating cottonseed to be fed to cattle.

Taylor expects more progress could be made by developing an easier test for aflatoxin levels. Laboratory analysis now costs $10 per sample. The goal of identifying what management techniques to use for minimizing the contamination will require analysis of thousands more samples. Russell's evidence so far points to the merits of short-season production with careful water management in July and August to avoid rank growth.

Water management

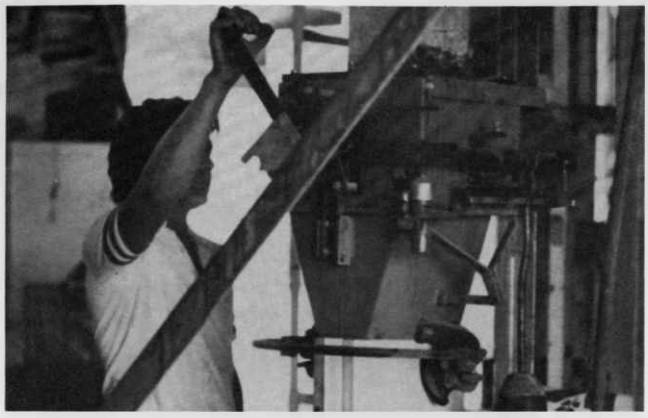
"The water problem is obvious, but it's incredible how little we know about managing it most effectively," says Taylor. "We don't even have adequate methods to measure how much water is applied, or for knowing when to irrigate. The sophisticated probes for measuring soil moisture are still not affordable for common use by growers."

Many advances have been made in irrigation efficiency, such as laser-beam land-leveling to smooth out dips and rises that waste water. But other factors often work against the advances. Taylor's example: the concrete irrigation ditches that separate many cottonfields are too far apart and take up too much space for maximum irrigation efficiency on laser-leveled land.

"We need to know not only the optimum level of water, but what changes in irrigation schedules make the best yields on less than the optimum amount. If a grower is going to cut back from five irrigations to four irrigations, he needs to know which one of the five to cut out, and how to space the remaining four," explains the Extension specialist.

"We need more of an interdisciplinary approach to identify what other management practices can mitigate a cutback in water: What changes can be made in planting date, row-spacing, fertilizing, insect control, weed control or other management practices to make the most of less water? We don't even know what kind of returns we can expect from cotton compared to other crops with the same amount of water."

Determining the problems that may grow, and the gaps in our knowledge of how to deal with them, locates areas for applied research by agricultural scientists. Taylor acknowledges that established crops like cotton get more commercial research than crops in the experimental stages. But he points to the innovative ability of public teamwork research: "It took a university-type research system to develop something like the wick applicator." The new rope-wick herbicide applicator which is sweeping the state in popularity this year is a simple, inexpensive device that uses less herbicide for better results than other applicators.



One of Arizona's many seed crops is bermuda grass seed. Here, a worker at Valley Seed Company in Phoenix fills bags of recleaned bermuda seed, grown in the Wellton/Mohawk area.

"Also," says Taylor, "growers look to the University as a respected, impartial evaluator of commercial research."

Alfalfa yields climb

Production of alfalfa, Arizona's most important forage crop, has climbed almost 50 percent per acre in the past two decades. The state's growers have achieved this dramatic improvement while actually decreasing the amount of irrigation on the crop, and while yield averages nationally have held steady.

Yield in Arizona has gone from 4.5 tons per acre in 1959 to 6.5 tons in 1978 and estimated for 1979, reports UA Extension agronomist Dr. Robert Dennis. The figures exclude about one ton per acre grazed by sheep and cattle each year. Thus, Arizona has the highest average alfalfa yields in the world.

"The yield increases have resulted from the use of new, higher-yielding, pest-tolerant varieties and improved cutting management and other production practices," says Dennis. Good potential exits for continuing to increase the yield. Work on variety improvements and production efficiency continues. On-farm test plots coordinated by Extension agents help demonstrate to growers the means for improving yields.

"Many Arizona farmers have average alfalfa yields of more than 10 tons per acre. Test plots routinely yield 12 to 14 tons, thus the technology is present for a doubling of alfalfa yields," says Dennis.

Acreage of alfalfa planted in the state has stayed within 10 percent of last year's 206 acres for each of the past 20 years. Four-fifths of those acres were in Maricopa, Pinal or Yuma counties in 1978.

Breeding emphasis

Breeding to improve and maintain insect tolerance has been a major emphasis of alfalfa work by Dr. Melvin Schonhorst, Dr. Mervin Nielson and Rex Thompson at the University experimental farms ever since the spotted alfalfa aphid nearly eliminated alfalfa as a forage crop in the Southwest in the mid-1950's. Breeding for resistance

to alfalfa aphids is a continuing effort because new strains of the spotted aphid evolve frequently and a new species, the blue alfalfa aphid, hit the state in 1975.

UA alfalfa-breeding research has also paid off in varieties that are resistant to stem nematodes and Phythophtera root-rot fungus. The breeders have developed systems for rapid identification of resistant plants. Much of their work, though, lies in combining the resistance traits with the superior forage-production qualities necessary for commercial usefulness.

Nielson predicts, "Alfalfas of the future will have resistance to a multitude of pests and will give the farmers high yields of good quality forage at lower costs."

Schonhorst and physiologist Dr. Albert Dobrenz are working on improvements in heat and salt tolerance. Other current studies are selecting for greater nitrogen fixation and better ability to exploit the state's abundant sunshine.

Water-use studies of alfalfa have identified the stage of most rapid growth as the period that alfalfa uses water most efficiently. Varieties with the highest forage production were also found to be the most efficient in water use. Other studies compare water-use efficiency in different harvesting schedules.

Besides breeding programs and improvements in management efficiency, another factor that could affect the future of Arizona's alfalfa is research in other states into possible uses of alfalfa in human diets. Dennis reports, "Extracts from alfalfa juices are high in protein and may become an important source of human food. The low humidity of Arizona favors the production of alfalfa that is nearly free of leaf diseases. This factor could help Arizona become an important source of alfalfa extracts for human food."

12-fold wheat growth

Wheat production in Arizona increased every year from 1968 to 1976, growing from 81,000 tons to 970,000 tons in those eight years before dropping back to about 300,000 annually in 1977 and 1978. Introduction of high-yield, stiff-straw, semi-dwarf varieties during the late 1960s accounts for most of the increased yield potential. Strong international wheat prices in the mid-1970s, and UA Extension Service test plots that showed farmers the performance of the new wheats in many areas, were factors in the realization of that potential.

Shortly before introduction of the new varieties, pioneered by Drs. Norman Borlaug of Mexico and Orville Vogel of Washington state, Arizona wheat yields were averaging about 2,500 pounds per acre. About 25,000 acres were harvested annually. By the state's record year in 1976, wheat was harvested on 431,000 acres, almost a third of Arizona's irrigated land, and yield averaged 4,500 pounds per acre.

The new wheats were introduced to Arizona farmers in a 1966 test demonstration arranged by Maricopa County Extension Agent Chuck Farr on Jim Sossaman's farm near Higley. Other demonstration tests soon followed in Yuma and Pinal counties, coordinated by Extension agents Don Howell and Jim Little, then in other counties.

The correlation of wheat acreage to price shows up in the drop from the 431,000 acres in 1976, when the price averaged $130 per ton, to 140,000 acres the next year, with price averaging $89 per ton.

Rex Thompson, agronomist at UA's Mesa Experiment Farm and Arizona's wheat project leader, points out that the market price can affect yield-per-acre as well as the number of acres planted: "With these semi-dwarf wheats, you can push them a little harder (by applying more nitrogen) and get more out of them... The growers tend to get good yields when the price is up."

Dennis predicts that wheat acreage will climb again with the fall 1979 plantings in response to strengthened wheat prices.

Meanwhile, UA scientists are working on water and nitrogen consumption studies to make wheat-growing in the state more efficient. Progress in breeding work aimed at developing varieties that produce lots of grain with little water has been hampered by two wet winter growing seasons in a row, Thompson reports.

He notes that growing in winter makes wheat a more efficient water-user, since evaporation losses are less than for a crop that would require the same amount of water in the summer. "Wheat does have potential for growing in places that have little water for irrigation," he says.

Barley's decline

Before 1960, Arizona farmers were planting 5 or 10 times as many acres of barley as wheat. But the balance shifted after the switch to higher-yield wheat varieties in the 1960s. Barley acres dropped from 176,000 in 1968 to 35,000 in 1978. The per-acre yield of barley in the state has not kept pace with the wheat-yield increases, though it is still nearly double the national average for barley.

Agronomist Dennis holds out one possibility for a change in barley's decline here: "Research workers in Montana have developed waxy varieties of barley. This may permit the manufacture of syrup from barley and may help to shift the spotlight from wheat to barley." The waxy barley can be made into maltose syrup at a lower temperature, and lower cost, than can normal barley. Ice cream and candy manufacturers are interested in using the maltose in place of sucrose (cane or beet) syrup.

Like barley, grain sorghum is on an extended decline in Arizona in terms of acres harvested. It has lost considerable ground to corn in Cochise County, formerly the state's leading sorghum county.

Seed crops

Seed crops have a bright future in Arizona because they take advantage of the state's unusually dry climate. The number of acres in certified seed production tripled from 16,000 in 1969 to 48,000 in 1977, according to UA's Robert Sackett, executive secretary of the Arizona

Crop Improvement Association (ACIA)—the official seed-certification agency in the state.

To be certified, seed must meet inspection standards while still in the field, then laboratory physical standards and genetic purity standards. Strict limits are set on foreign matter, including weeds. Germination standards are 80 percent or higher, depending on the crop.

Seeds of 40 varieties of 11 crops were certified in 1978 by ACIA. Cottonseed for planting, which became part of the certification program in the last five years, grew on 34,578 acres out of the 47,873 that were certified in 1978. Seven varieties of cotton were grown for certified seed.

Eighteen million pounds of certified cotton seeds were shipped out of Arizona last year to help meet the demand for high quality seeds from farmers in other parts of the country. The potential is good for continued increases in this market.

Besides cotton, certified crops and numbers of varieties represented by ACIA are: wheat, 12 varieties; barley, 5; soybeans, 1; alfalfa, 3; bermudagrass, 1; okra, 5; safflower, 2; peanuts, 1; and millet, 3.

"Climate is the key factor in why Arizona can produce high quality planting seeds," said Sackett. "We can harvest without rain. Moisture could lower the quality of the seed by starting it germinating or rotting." He expects the certified seed program to continue growing in the state because it makes use of Arizona's special weather resources to produce a high-value product.

Developing new crops is old idea in Arizona

By Gary Nabhan
Research Technologist
UA Plant Sciences Department

In 1895, chemist Robert H. Forbes wrote a prophetic statement of purpose in an Arizona Agricultural Experiment Station bulletin.

"An important part of agricultural experiment station work, especially in a new and developing country, consists in the study of native forms of animal and vegetable life with a view to their improvement into profitable crops and industries... It is believed that some of the unique forms of vegetable life found in the arid Southwest would repay investigation and cultivation. The trees and plants of this region, being indigenous, are well-adjusted to our peculiarities of soil and climate, and in certain instances it is to them rather than to the staples of other regions, that we must look for profit."

Forbes was not only remarkable in envisioning the potential value of native desert plants; he was also a capable promoter of such research. Serving as Dean of the School of Agriculture at the University of Arizona, and later as a representative in the state legislature, he never lost sight of the underestimated value of our indigenous resources.

Beginning with Forbes' pioneering work, the Arizona Agricultural Experiment Station has always been involved with native crops which can withstand extreme heat and produce economic harvests on minimal doses of water. Forbes, his colleagues and followers have evaluated native beans, mesquite, canaigre, guayule, jojoba, plus gourds and other oilseeds for their economic products.

Although these plants are little known outside arid zones, they have the potential for reshaping desert agriculture worldwide. Arizona's Sonora Desert is being recognized for its vast reservoir of potential crops. Nearly 400 wild species have been utilized as food by the desert Indians, and at least 500 species were historically processed for medicine, fiber, and other uses.

Altering the environment

The reason for considering the cultivation of native plants for desert agriculture is that fitting a crop to the harsh environment costs less than modifying the environment to suit the crop.

The dropping levels of ground water and the rising cost of pumping it have made this increasingly evident. For in Arizona, irrigation not only functions in providing plant roots with needed moisture, it is also used to cool down the field environment and to flush out salts which chronically accumulate in desert soils. Farmers have therefore been paying to make the entire crop environment more moderate in order to grow selections derived directly from temperate climates. These prices are now

UA plant breeder Dr. David Rubis (left) and Ed Houser of the Firestone Tire and Rubber Company check flats of guayule seedlings at the UA Campbell Avenue Farm greenhouse.

prohibitive in certain parts of the Southwest, so that we are again "looking for profit" in our indigenous plants that do not require so much environmental modification.

Fortunately, these experimental crops need not compete directly with conventional crops. They will not necessarily usurp good farmland from our current major crops, since there is enough abandoned land in marginal agricultural areas with which to experiment. Additionally, some of the native plants render products which are so unique that they will not even be marketed on the same terms as our customary crops.

For example, the current demand for a heat-stable lubricant like jojoba's liquid wax far exceeds the supply. Buffalo gourds yield a root starch with unusual physical properties of interest to several industries. Guayule and other hydrocarbon-rich plants are renewable sources of raw materials that we now extract primarily from foreign sources.

Guayule shrubs are native to the semi-arid regions of southwestern Texas and north-central Mexico. Cultivated guayule can yield 1,200 to 1,500 pounds per acre of rubber with chemical and physical properties virtually identical to that from rubber trees. Dr. Rubis and other guayule researchers are working on shortening the plant's 4- to 5-year maturation period.

Selection is key

Yet most cultivated crop plants were developed over centuries, even millenia.

Is it possible to suddenly bring a wild plant into cultivation, and expect immediate profits?

The answers are no, and yes. Without selecting superior genetic lines of a wild species, and improving its response to cultivation, the answer is no. Such a non-scientific approach is bound to fail. On the other hand, if research efforts are geared to speeding up the plant domestication process which has guided the evolution of all crops, the answer is yes.

Imagine the chances for success which will be missed if we do not screen the variable wild populations for their most valuable individual plants. At the 1978 Jojoba Conference at Riverside, California, veteran desert botonist Howard Scott Gentry of Phoenix waxed eloquent on the range of potential present within jojoba:

"Her fruits are small, round or long; some are large but never large enough; some are one-seeded, two-seeded, or three-seeded; some grow singly, twinned or clustered; some dehisce easily or not at all. Her seeds vary from pea-size (2,000 per pound) to peanut-size (400 per pound). The oil content varies from 37 percent to 54 percent. Some seeds grow into plants without hesitation, but others start and die from frost or other unknown causes."

Unless the range of plants yielding similar products is evaluated thoroughly, an industry may be too quickly founded on the wrong choice.

During World War II, a shortage of cordage fiber stimulated the government to evaluate several Southwestern plants for the tensile strength of their leaf fiber. Since yuccas had previously been imported and utilized by Germany, much time and energy was invested in experiments with soaptree yucca. At the same time, the fibers of beargrass and century plants got only cursory attention.

Although the wartime yucca fiber industry soon atrophied, broom manufacturers took note of the possibility of using beargrass as cheap fiber. Today, along the U.S.-Mexico border, a multimillion dollar industry is based on this renewable resource, even though it was largely overlooked during the war. The soaring prices of broomcorn sorghum have made beargrass an important native plant industry in the Southwest. As times change, so do the values of various resources.

Genetic improvement

After identifying the wild plant species or varities with the most valuable products and traits, it is necessary to investigate their potential for genetic improvement. The University's buffalo gourd team led by Dr. W. P. Bemis is evaluating the inheritance of oil and protein quality in this promising oilseed crop. The nutritional quality of certain hybrids will probably surpass the highest quality known from any wild populations.

Buffalo gourd grows wild in much of the arid Southwest. Seeds from the baseball-size gourds contain high-quality food oil and protein. The large, fleshy roots yield starch that has properties some food processors want. The perennial plant grows and fruits in hot areas with average rainfall of 10 to 12 inches. The UA Buffalo Gourd Research Team headed by breeder Dr. William Bemis and food scentists Drs. James Berry and Charles Weber plans to assemble data for a growers-users conference next winter.

Dr. LeMoyne Hogan, leader of the UA College of Agriculture's research on jojoba, examines boxes of cuttings with various soil and fertilizer preparations. The unsaturated liquid wax from jojoba seeds is similar enough to the oil of the endangered sperm whale that it can be used as a replacement for the whale oil for the complete range of uses of sperm whale oil, from fine lubrication to foam control in penicillin production. The wax may have other uses, too, and the seeds are edible. The perennial, evergreen shrub grows on well-drained, coarse soils with 5 to 18 inches of rain a year. Substantial investments in commercial jojoba plantations have already been made, though the plants require 3 to 7 years to produce commercial crops.

A variety of breeding strategies must be considered, too. With guayule, plant breeders are able to develop hybrids that combine several favorable characteristics such as high rubber content and good cold tolerance. Yet after hybridization, it may be best to induce "apomicts" from a select hybrid. Apomicts are forms that produce seeds that are genetically identical to the parent. This strategy allows replication of the favorable characters of the hybrid, generation after generation. On the other hand, if there is any latent genetic vulnerability in the selected hybrid, such as susceptibility to disease, it could quickly threaten an entire field of genetically identical plants. Thus the tradeoffs of one breeding strategy versus another must be weighed.

Finally, after improved selections or hybrids are produced, field trials must follow. If a plant is not well-adapted to a particular environment and dies before flowering, the hypothetical value of its seeds is irrelevant.

Chemists had chosen *Euphorbia lathyrus* as a quality hydrocarbon-producing plant to experiment with in the Tucson area. Unfortunately, in the summer of 1979, these plants succumbed to disease when brought into field cultivation. Often, diseases unknown to plants in the wild affect them dramatically when they are densely planted and flood irrigated. Promoters of new crops are quickly learning not to count their chickens before they are hatched out into commercial scale plantings.

Fascinating challenge

Although these setbacks sound discouraging, they are to most scientists a fascinating challenge. Already, plant pathologists and agronomists have joined breeders to find ways to avoid, evade or solve such problems.

The real test for the new desert crops lies in their water use efficiency. Will Arizona farmers be able to produce an economic yield of these plants while irrigating less frequently or not at all?

Surprisingly, the native desert plants now under study do not necessarily produce more dry matter per unit of applied water than conventional crops in the same amount of time. Sorghum, for instance, can amass

A wild tepary bean vine twines into a mesquite bush. Tepary is native to the Sonoran Desert. Indians of the area have used it as both a wild and cultivated source of food. Tepary reaches maturity with as little as 8 to 10 inches of water. Yields of 20 bushels of beans per acre have been obtained with three irrigations and no fertilizer in a region with only 4 inches of annual rainfall. The dry beans are used as pinto beans are, and are similarly rich in protein.

more overall weight on less water over a growing season than most desert shrubs, trees and annual vines.

Recent investigations by USDA's Jack Mauney and ASU's Stan Szarek indicate that native desert plants are often conservative in their growth: when the plants suddenly get an abundance of water, they do not use it as efficiently as they do the meager moisture they are used to.

Does this mean that we would gain little water conservation by cultivating plants that have evolved in the desert? On the contrary, we have much to gain. Even though native tepary beans may amass the same overall weight per plant as great northern beans given the same amount of water monthly, they may mature in only two-thirds the time. By having a short growth cycle, they can save considerable water by quickly producing beans before drought sets in. In addition, teparies and other desert plants apparently put a higher proportion of their overall weight and energy into seeds (beans). Thus, tepary and great northern plants may weigh the same, but the tepary will likely have more beans. Finally, teparies continue to set pods during summer heat too extreme for great northern plants to produce in.

Desert opportunities

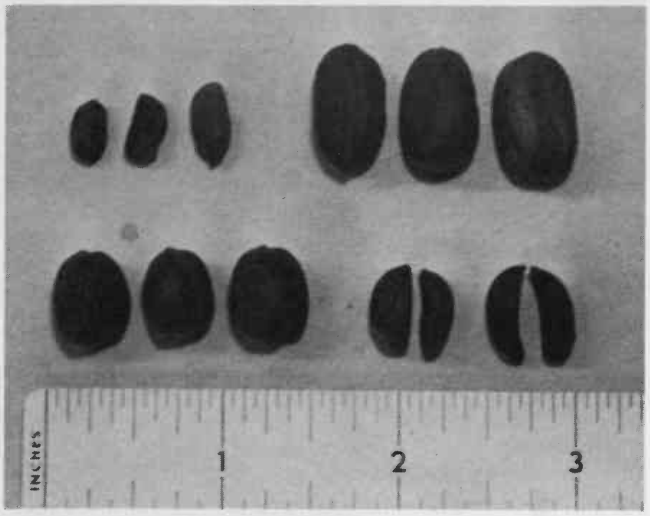
Certain desert plants such as the wild gourds use considerable amounts of water when irrigated regularly, but can survive long droughts without irrigation that would kill other non-adapted perennial plants. The root of the finger-leafed gourd is known to have survived a year and a half with no measurable precipitation in Baja, California.

Many desert plants are in a sense opportunistic. They tolerate extremes, but when water is ample they utilize it liberally.

Thus the possibilities of crop failures due to drought are more remote with native desert plants. Few, however, can outproduce conventional crops when water is not a limiting factor.

But water *is* the limiting factor in the desert, and it is affecting economic activities in arid lands, too. Therefore, Arizona scientists are working to make desert crops economically advantageous to farmers, not simply environmentally suitable and technologically possible.

With luck, hard work and patience, we may soon see the day when some of Forbes' favorite indigenous plants have been transformed into profitable crops and industries.



Jojoba beans vary in size and shape. Plant scientists are working on selection of the most productive varieties.

Newsletter helps new parents help children

Denise Hunt of Globe watches daughter Andrea, 2, learn about toes. Hunt says the Cradle Crier newsletter "has enhanced my motherhood experience."

"Hello parents. Your baby is one month old!" So begins the first issue of the **Cradle Crier.**

This newsletter continues, "Your baby is unique—not like any other newborn. However, all babies develop certain skills in about the same order. Your child's skills may appear more quickly or more gradually than those of other babies. If your recognize these abilities as they appear, you will be able to help your child learn as much as possible."

Since **Cradle Crier** was started by UA Extension Specialist Dr. Shirley O'Brien in January 1977, it has offered new parents information and hints about raising children. Those who decide to accept the offer can get on their county Extension office's **Cradle Crier** list. They get a month-by-month account of the developmental stages their baby is going through at about that time, with specific suggestions for helping the child's (and the parents') learning and happiness.

For example, the fourth issue, which arrives when the baby is four months old, suggests objects to include in a "variety show for baby" hanging over the crib. The next month's issue suggests that as the baby's ability to tell people apart improves, he or she is less likely to be frightened by "strangers" if they approach one at a time to become "friends." Each issue describes aspects of small and large muscle development, mouth and eye coordination, social development, emotional development and language development.

Denise Hunt of Globe, when her daughter Andrea was 27 months old this summer, said, "This newsletter has enhanced my motherhood experience. In the beginning it was a lifesaver. It has helped me feel more secure about what I do with Andrea, and that makes our relationship more pleasant."

She uses many of the games, toys and songs suggested in the newsletter. "It's always describing things that you can make," she said. "One that Andrea liked a lot was just rolling a little ball through one of the long rolls that gift wrap comes on—in one end and out the other. It was educational, but didn't cost anything."

Reinforcement

Besides the new ideas she has gotten from **Cradle Crier,** Hunt likes the newsletter's treatment of information she's gotten elsewhere, too: "It's not that it is full of revelations, though it does have many things I didn't know. But it pulls things together in a very handy way. It reinforces a lot of my own ideas about how to raise kids, like that each baby develops at its own rate, and you can be aware of your child's individuality and love her for it."

She has been getting O'Brien's newsletters since Andrea's birth. **Cradle Crier** is the name of the first 12 monthly installments. They are followed by a year of the quarterly **Crib Courier,** then the quarterly **Toddler Tattler** for two-year-olds. O'Brien plans to continue the series through age five.

Hunt learned about **Cradle Crier** through her Lamaze birth-training classes. The instructor passed out cards describing **Cradle Crier.** Class members who wanted to get it regularly sent in their cards to Gila County Extension Home Economist Betty Jean Faris.

Each county Extension office chooses its own ways to distribute and use the **Cradle Crier.** In many of the less populous counties, Extension home economists get names and addresses of newborns from hospital pediatric nurses or newspaper lists. Others have hospital volunteers insert the first issue into the new mother's "going home" bag.

Many new mothers learn about the **Cradle Crier** from friends or relatives who have found it useful. Julie Bosen of Springerville, mother of infant triplets and a two-year-old, submitted a good friend's name to the mailing list. "I sent her name in since, when we talk about her

children, I'm always telling her what I just read in the **Cradle Crier** anyway," said Bosen.

In Yuma County, bilingual radio station KAWC broadcasts readings from the Spanish version of **Cradle Crier** and tells listeners how to get free copies. Translator Ramon Paz prepared the Spanish editions last year, following requests heard by several Extension home economists. The translation was tested with a sample group of young Spanish-speaking parents in Nogales before gaining wider circulation. It is titled **El Niño en la Cuna.**

Yuma County Extension Home Economist Vicky Steinfelt said recently that the Spanish translation has let usage of the newsletter grow dramatically in her area. "It was a real need," she said. "People would ask for information about young children. Now we can say, 'Yes, we have that in Spanish.'"

Outreach projects of the Public Health Department have introduced the newsletter to many families. Home-visiting Extension aides have brought it to others.

Extension aides

Yuma and other Arizona cities have Cooperative Extension Service programs employing paraprofessional aides to teach nutrition and home management skills. The aides work with individual families at home and with small neighborhood groups. Aides visiting families with babies or toddlers often bring the appropriate issue of the newsletter.

Connie Brice and other aides in the Expanded Food and Nutrition Program (EFNEP) for the Maricopa County Extension office go over the newsletters point by point with about 300 client families. "They get more use out of it if we read it over with them and discuss it," says Brice.

Lucinda Chavez and her family, until moving from Mesa to Tucson recently, were one of Brice's client families getting O'Brien's newsletter. Chavez and her husband have three children: five-year-old Heather, three-year-old Christopher and one-year-old Cassandra.

Chavez said that she uses some **Cradle Crier** ideas for fun ways she can help her younger children learn, "like the suggestion in the early months to put pictures around the crib and let the baby feel different textures. We've tried out a lot of things from it with Christopher."

Maricopa County EFNEP coordinator Carolyn Smith pointed out ways the newsletter suits the purposes of the nutrition-education program. "They are both really concerned with the well-being of the children. Discussing **Cradle Crier** can help people realize what is normal for a young child. That makes it easier to recognize if there's something that's not normal. It may be related to a nutritional problem or it may not be, but at least we can find out if it's something that needs attention."

Starting out

When O'Brien began the job of Extension human development specialist in 1976, she talked with Extension home economists in each county about how she could be helpful. "Mary Kay Simmons in Willcox suggested a newsletter for new parents. It made sense because parents of young children often don't have time for

Maricopa County Extension Aide Connie Brice (left) visits with one of the families in the Expanded Food and Nutrition Program: Lucinda Chavez and her three children, Christopher, 3, Heather, 5, and Cassandra, 1.

Cassandra and Christopher Chavez get some surprises out of sister Heather's experiments with soap bubbles.

educational meetings or seeking out information that might be helpful."

The plan for a newsletter about young children had an extra appeal for O'Brien, based on her own childhood. Her late father ran a weekly newspaper in eastern Oregon. By the time Shirley was four, she began helping, first by counting batches of papers as they rolled off the press, then with a progression of other chores.

The trick with a newsletter is to make one that people will pick up and look at as soon as it comes in the mail. O'Brien's idea was to time the newsletter directly to the age of the reader's own child. "Most people like to compare their child to whatever the average level of development is for that age, so in each issue I highlight the stages of development around that particular age," she said.

Using the theme of developmental stages, O'Brien discusses in the newsletter many potential trouble spots for children and parents, and also many chances for enrichment and learning. Advice about crying, discipline, sibling rivalry, fear and toilet training comes along with suggestions for developing the child's self-esteem, curiosity and abilities to communicate, explore, share, care and learn.

She writes about a nuturing environment of caressing, love, repetition and order that allows the child to gain a feeling of trust and security.

"In every issue, at least once I stress the fact that every child is unique and has its own timetable of development," she said. "Generally, children will do things when they're ready and you can't push or speed them up much without stress. The 'teachable moment' concept that I used is based on being able to recognize when the child is ready to learn something new and to help the child's own efforts."

20 States

The newsletter itself employs the teachable moment idea by offering information and suggestions about child-raising right at the time the parents wants most to learn.

Cradle Crier has been well received by public service agencies as well as by parents. The State Department of Health reprints it for use in its clinics for women, infants and children. Agencies in more than 20 other states and several Army bases have also picked up the newsletter in some form. Since it's not copyrighted, O'Brien has no record of how many copies have been distributed. Just through UA Extension, more than 40,000 copies of the first issue have been printed and given out.

Like other two-year-olds, **Cradle Crier** is still developing. While O'Brien worked on the third quarter of the **Toddler Tattler,** Extension health specialist Kay Blundell recently completed a series of one-sheet **Cradle Crier** supplements about health. They include topics like caring for sick babies, preventive dentistry, immunizations and accident prevention.

During the International Year of the Child, O'Brien is glad to see more and better information about young children available to parents.

She tells parents, "You are the first, the most important and the best teachers your child ever can have. Encouraging your child's natural curiosity is a big job, but a rewarding one. It's something you do *with* your child, not *to* your child."

Wider inputs urged in new range plans

William Riggs, Jr., like most Arizona ranchers, holds grazing permits for public land to supplement his private ranch land.

Riggs, his wife and two sons manage about 400 mother cows near Willcox.

"In the eyes of some of these college guys, this may be strictly a go-broke operation, but we like the life, so we're going to hang on as long as we can," he said recently.

His ranch is mostly private land, but includes permit land administered by the U.S. Forest Service, the U.S. Bureau of Land Management (BLM), and the State of Arizona. Many ranches throughout Arizona and the West lean the other way, with more public land than private. Ninety-three percent of the range cattle in Arizona graze on public land at some time.

The permit-holding ranchers and the federal land agencies are in the midst of an extensive review of grazing permits. The University of Arizona's Range Management Program is helping ranchers, and others, prepare for new grazing plans tailored to local conditions.

The Federal Land Policy and Management Act of 1976 calls for a reexamination of every alloted permit for livestock grazing on federal land. Each allotment must have an allotment management plan (AMP). Though some of the requirements depend on whether the land is administered by the Forest Service or by the BLM, all AMPs must prescribe the extent and nature of livestock operations to be conducted, and must detail the range improvements to be undertaken and maintained. The plans must fit into the multiple-use, sustained-yield goals for public land.

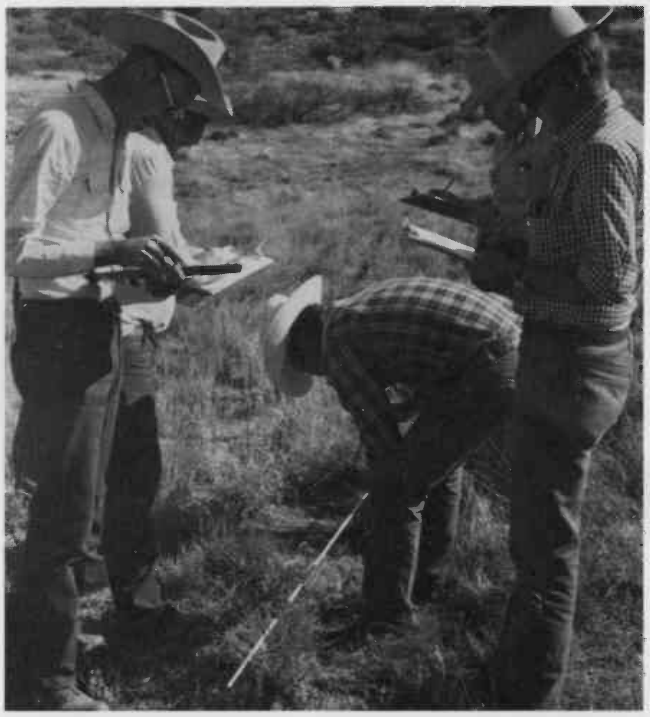
By regulations, the permittee must be consulted in the preparation of the AMP.

Checkerboard ranches

Through workshops and individual consultation, UA range management specialists are helping permittees and other people make the most of their chance for AMP input.

Riggs said of ranchers, "Just dealing with government agencies is our biggest problem... So many of these ranches are like checkerboards, with a little Forest Service land, some private, a piece of the State and a little BLM. To get a good management plan, you've got to have the cooperation of all the agencies.

"If I talk to one guy over under this tree, then have to go cross the canyon to talk to another, then go somewhere under another tree to talk to another, I spend all my time running around. But if I get them all together under one tree, we can put together a management plan that really works."



Practicing the line transect method of measuring range cover at a UA workshop are, from left, Globe area cattlemen Ray Hick, Lon Winters and Steve Bixby, Jr., UA Range Specialist Dave Bryant, and rancher Jim Tidwell. They are noting whether designated points along the tape line hit plant cover, rocks or bare soil.

Riggs participated in a UA range management workshop in Safford in 1978. He said the meeting helped ranchers keep abreast of the range analysis systems used by the various agencies.

The Safford event was one of 30 workshops and field tours about range management coordinated by UA Range Specialist Dr. Dave Bryant between September 1977 and March 1979. More than 2,500 people participated in at least one.

"Seventeen of the workshops dealt specifically with range analysis and evaluation techniques, and were aimed at rancher permittees on Forest Service and BLM lands," said Bryant. "The primary purpose of this concentrated workshop effort is to establish a line of communication between ranchers and regulatory agencies where conflicts and potential problems exist."

Phase One

Riggs was one of 250 ranchers at the ranch school co-sponsored by the University and the Arizona Cattle Growers' Association (ACGA) in March 1978. That school at the Pima County Fairgrounds kicked off Phase One of the UA workshop series. Like the later programs in the series, the ranch school program included federal agency personnel. Riggs praised the two-day school for the information presented about livestock nutrition, development of water supply and management ideas. But he said that equally useful was the chance to meet informally with other ranchers, the college specialists, and the men from the federal agencies.

Elgin area rancher Fred Baker, chairman of ACGA's Research and Education Committee, said, "One of the most valuable aspects of the school for ranchers was the opportunity to get out and actually make the plant identifications and measurements that are used for determining range condition and trend. They'll know what the agency people who are responsible for making these estimates are actually talking about." Estimates of range condition and trend, and of forage production and utilization, are required in allotment management plans.

Mohave County rancher Jack Wilson participated in the Kingman edition of the workshop series. "These programs are valuable because they bring them to your own area," he said recently. He suggested, though, that some of the information could be better adapted to local climate.

Phase Two of the workshop series began with a two-day session titled "Your AMP! What Can You Do?" at Punkin Center in Gila County last March. At that workshop and elsewhere, Bryant and his fellow UA range specialists Phil Ogden, Lamar Smith and Ed LeViness have emphasized that cattlemen can benefit from careful preparation of input for the management plans.

Bryant estimates that preparation of the new AMPs in the state will be completed in five to eight years. Several of the plans already written have lowered the number of cattle allowed to use the land, compared to the previous grazing permits. On the current market, each cow-calf pair of a ranch's capacity translates to about $1,500 in the ranch's value. Most ranches with federal permits are operating under temporary plans until AMPs are finished.

"It is imperative that rancher permittees fully understand the implications of allotment management planning and their role in it," said Bryant.

The Phase Two workshops advise permittees to keep good records of range utilization, precipitation, plant condition and composition, calf production, wildlife populations and other factors in range condition. Also discussed are the use of old photographs to document long-term trends, regular readings of condition-and-trend transects, and advance preparation of written ideas for managing the land.

Gila County

Although designed for permittees, these UA Extension Service workshops are free and open to anyone. In midsummer, Bryant was planning for autumn editions in Kingman, Flagstaff, Prescott, Safford and the Rio Rico area.

Cattleman Dwight Cooper of Roosevelt said in May, "I'd have to give the Extension guys an A-plus on that Punkin Center session." He appreciated the lessons about management systems and utilization records, and the fact that the workshop "gets everybody together where they can discuss some of the issues involved without having it tied to your individual problems."

Another Gila County rancher, Lee Jones of Payson, attended the Punkin Center workshop and one of the

UA Livestock Specialist Ed LeViness explains techniques for range evaluation to Paiute ranchers at a workshop in the Arizona Strip north of the Grand Canyon.

Phase One series. "One of the main benefits of the workshop was the face-to-face communication among the university people, the Forest Service people and the permittees," he said. "We've had a lot of disagreements with the Forest Service, and it's far better to talk about these things before anything has been done than to go back and try to fix things up afterwards."

Disagreements between permittees and federal agencies in Gila County are not new. But, as Gila County Extension Agent Van Wilson wrote last year, "Recent allotment management planning efforts have rekindled many of the old fires of dissension and emphasized the need for better communication and, thus, cooperation among permittees and federal land management personnel."

Fifty-six percent of the county is in the Tonto National Forest. The 84 Tonto permittees who operate within the county run about 22,000 adult cattle, producing about 13,200 calves a year. Says Wilson: "Gila County ranches would not exist if it were not for the public land being grazed by livestock."

The UA range workshops have pleased participating agency personnel as well as ranchers. David Dockray, Forest Service range conservationist for the Payson Ranger District, helped put on the workshop in Payson. About 25 people attended that one.

"The workshop promoted a better working relationship between us and the permittees," said Dockray. "I think it helped them understand some of the problems we have and it outlined our working procedures."

The workshop included information about identifying range plants and assessing range condition and trend. "We felt this was worthwhile for the permittees and for anyone else interested who was present," said Dockray.

Other help

Globe area rancher Jimmie Griffin said the procedural information in the workshops is helpful, "because many of the ranchers haven't had enough training in the technical production and utilization studies. If a range con-

servationist runs a production and utilization study, the rancher without training has no idea whether he's getting a fair shake or not."

Besides the workshops, UA range scientists have given individual help to cattlemen preparing management plans.

Griffin is one who has welcomed such help. He ranches on the Tonto National Forest along U.S. Highway 60 north of Globe. Two years ago, he heard of Forest Service plans to cut his allowed number of cattle from 800 to 330. So Griffin sought university help through County Agent Wilson.

"Dr. Ogden and Dr. Bryant came out to the ranch and studied the thing. They didn't shrink from any work," Griffin recounted this summer. "Dr. Ogden sat through practically all of my sessions with the Forest Service to keep things on an even keel."

Griffin's new managment plan allows 430 head of cattle, to be increased to 540 as range conditions improve. He compares that to the 330-head plan he had heard about. "The university's help meant an extra 100 head to me. That means the difference in whether I can stay in business or not."

New UA Committee

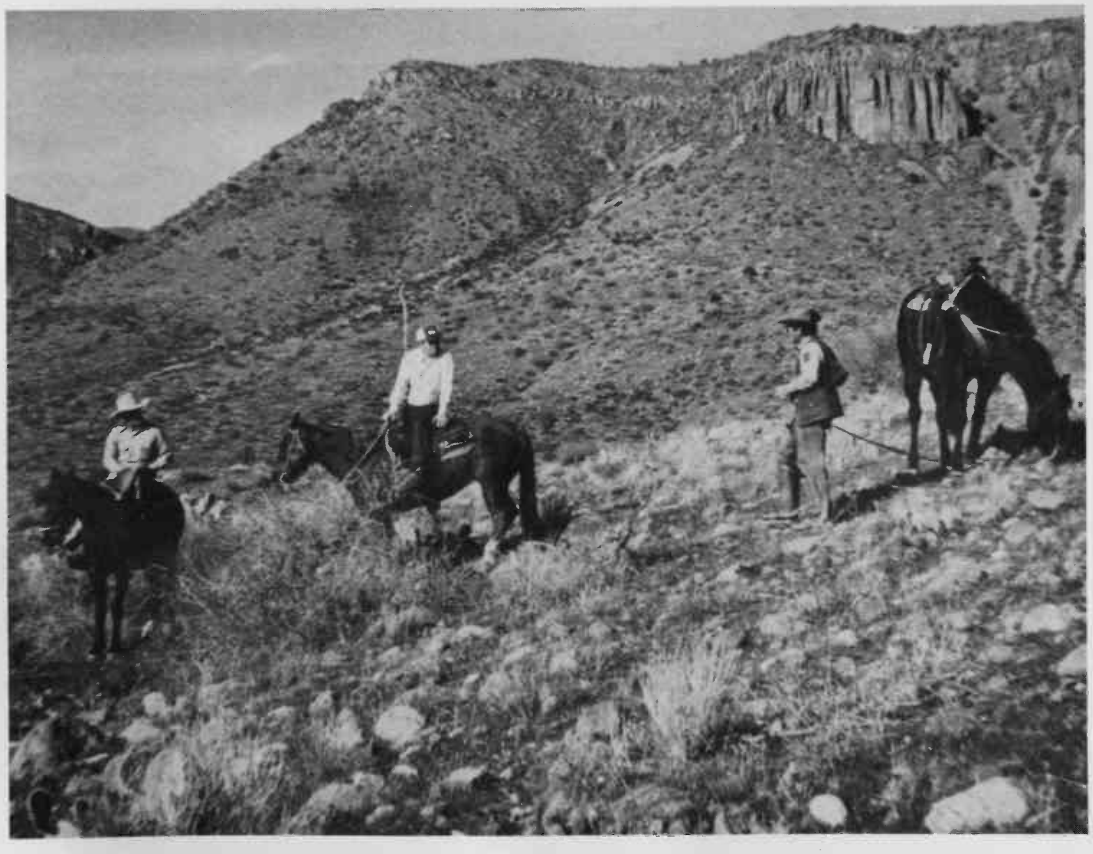
To make its help more accessible to ranchers and other interested Arizonans, the College of Agriculture in May set up a UA Public Rangeland Coordinating Committee. The committee's nine-member resource group will continue to offer workshops and individual consultation to improve input for allotment management planning.

"It's to everyone's advantage to have the most accurate and complete information possible about local conditions when planning for the use of public land," said Bryant, who chairs the committee.

To strengthen the resource group's efficiency, the new committee also includes a liaison group of one Cooperative Extension Service agent in each county. They will keep track of where help is needed.

The nine UA specialists in the resource group are Bryant, Ogden and Smith in range management; Al Lane and Ed LeViness in livestock; John Stair in wildlife; Charles Robertson and Tom Stubblefield in agricultural economics; and Brian Spears in range entomology.

The liaison group, whom anyone seeking assistance should contact, is Charles Isaacson in Apache County, Larry Sullivan in Cochise, Terence Wheeler in Coconino, Van Wilson in Gila, Ron Cluff in Graham, Ira Higginbotham in Greenlee, Herold Loughead in Maricopa, Robin Grumbles in Mohave, Robert Racicot in Navajo, Garrett Blackwell in Pima, Phillip Lewis in Pinal, Richard Harris in Santa Cruz, Carlton Camp in Yavapai and Tom Piper in Yuma.



Permittee John Schminke, UA Range Specialist Dave Bryant and Forest Service Range Conservationist Jerry Poe ride together to examine conditions on Schminke's permit area near Roosevelt.

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