Progressive
Agriculture
in Arizona

Volume XXV, Number 6, November-December, 1973

College of Agriculture, University of Arizona, Tucson 85721

Our Cover . . .

This issue's cover is devoted to the article on Consumers and the Market: Fabric Scope for 1973-74. It is prepared by a senior student in Consumer Service in Food of the School of Home Economics. She and her co-author, Dr. Janet L. Vaughn, give us some insight into the fabric outlook this spring. Please turn to page 14 for this interesting article. *Editor*

In this Issue . . .

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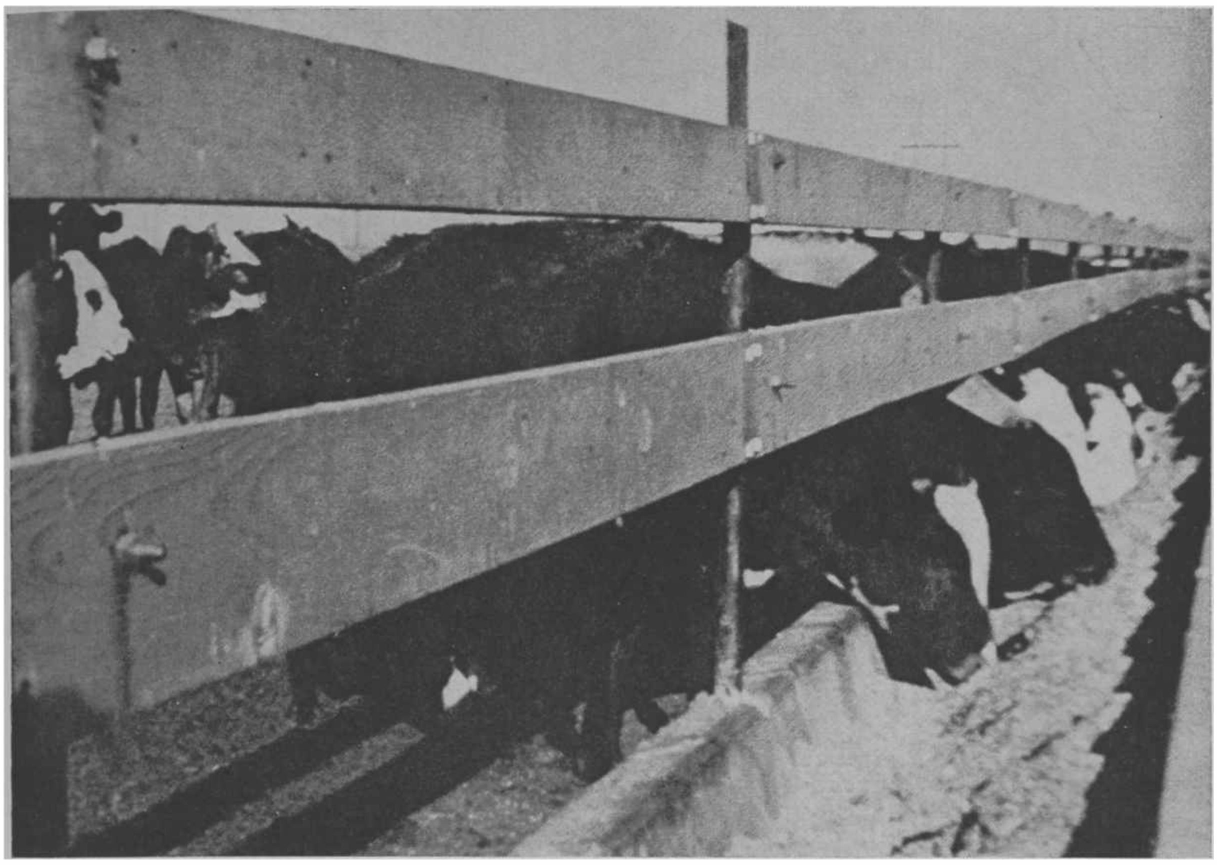

Figure 1. Cattle feeding during the last 12 years has more than doubled from 12.8 million head per year in the early 1960's to 26.7 million head in 1972.

Dynamic Aspects . . .

U. S. Beef Industry

*by Elmer L. Menzie & C. Curtis Cable, Jr.**

During the summer months of 1973, the U.S. consumer observed shortages of some favorite cuts of meat, and saw prices soar to the highest levels recorded. In an attempt to assure their family a supply of meat, many consumers bought home freezers, causing a temporary shortage of this household appliance. This, at least in part, reflected a growing assumption by many consumers that life without their customary meat supplies would be unbearable.

Consumer clamor over high meat prices resulted in government price ceilings in March. Controls were maintained on pork and poultry until July, and on beef until early September. Since prices paid by meat producers, especially for feed, were not controlled, costs rose and producers responded by cutting production and or limiting marketings. These actions helped to precipitate the relative shortage in meat counters in July and August.

The question often raised is, how did the U.S. get into the above situation, and what lies in store for the future. Few people realize the dynamic changes which have occurred, especially in the beef industry over the past 25 years. Beef and veal consumption per capita rose from 71.4 pounds per capita in 1950 to 118 pounds in 1972 (Figure 2). This increased demand plus population growth resulted in an increase in total consumption of beef and veal in the U.S. from 11 billion pounds in 1950 to 24.1 billion in 1972.

This strong growth in demand has been accompanied by increased demand for higher quality and more services. Consumers want a minimum of excess fat, a high degree of marbling or fat distribution and a high level of consistency in tenderness and flavor. In order to satisfy these demands producers have shifted to highly controlled and standardized feeding programs. Between 1961 and 1971, the percentage of beef produced and classified as U.S. Choice rose from 45 to 59. Retailers have shifted to prepackaged meat, with excess fat largely trimmed off.

While demand for both product and service has grown at a relatively fast rate, prices rose relatively slowly until 1971. The average retail carcass price for choice beef was 74.6 cents per pound in 1950 and had risen to 98.6 cents in 1970 (Figure 3). In 1972 the average price was 113.8 cents. By August 1973 it had risen to 144.2 cents. Much of the change up to 1970 was associated with rising costs of marketing and processing services.

While cattle numbers have continued to increase gradually, thus providing more beef, much of the growth in output since 1950 has come from changing management and production practices. Shifts have been made from grass fat animals to concentrated feeding in feedlots. Fed cattle marketings in 1960 were 12.8 million head, whereas by 1972 they were 26.7 million. Veal production in 1972 was less than one third of 1950. Calves formerly slaughtered at light weights for veal are now fed out.

Improved breeding and mangement has resulted in more calves and more meat per animal. The calf crop saved has increased by about 10 percent since 1950. Increased efficiency in feeding has reduced the amount of feed required per pound of gain and the time needed to obtain the gain. The use of standardized well balanced rations plus anti-biotic and hormone injections have improved the rates of gain and efficiency of gain. Improved carcass formation has provided more lean meat and of higher quality.

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* *Professor of Agricultural Economics and Marketing Specialist, Cooperative Extension Service, respectively.*

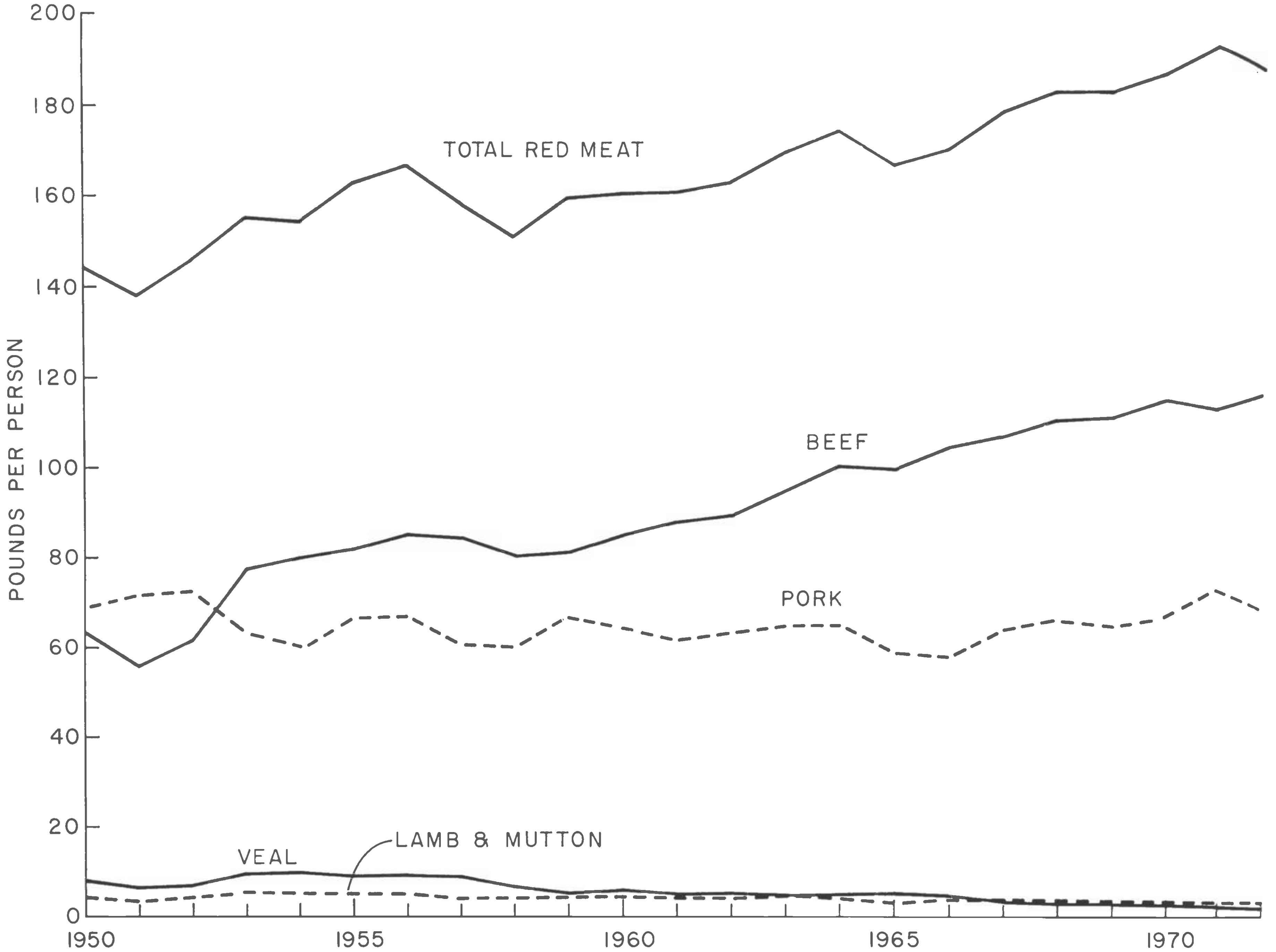


Figure 2. Per Capita Consumption of Red Meats, United States, 1950-72.

The change to concentrated feeding has caused other significant industry shifts. For climatic and other reasons, feeding has moved to the Western States. Arizona, New Mexico, Texas, Oklahoma, Nebraska, Kansas and Colorado increased marketings from feedlots from 5 million head in 1962 to nearly 15 million in 1972. Texas and Colorado have been major growth states.

As feeding has shifted so has marketing and slaughtering. Packing plants have moved to the major feeding centers and marketing has become a direct bargaining process between packers and their agents and feedlot operators. Major markets such as Chicago and Portland have ceased operation. Slaughter in Northern and Southern Plains and the Rocky Mountain States has more than doubled from 7.3 billion pounds in 1962 to 16 billion in 1972.

While feeding has increased, numbers of feedlots have declined and grown larger in size. In 1970 there were 176,817 feedlots whereas by 1972 they were down to 154,536. One third of the cattle were fed in 184 lots with over 16,000 head capacity. In Arizona there were 189 lots in 1961 and only 53 in 1972. Nine of those had a capacity exceeding 32,000 head. Over 80 percent of Arizona's 900,000 fat cattle were marketed from 21 lots. In Colorado a single firm has two lots with over 100,000 head capacity each. A new lot is being constructed with 150,000 head capacity.

These large feedlots require substantial capital and have forced changes in systems of finance. A new lot with 20,000 head capacity will have close to $1.5 million in plant and equipment. The average investment in feeders and feed will approximate $7 million. Most feedlot owners have shifted to custom feeding. Banks and other lending institutions put up 70 to 75 percent of the investment in animals and feed for individuals able to establish credit. Interested investors then put cattle on feed with the feedlot owner charging for the feeding service. This system has greatly diversified investments in feeding and permitted growth in firms and in the industry.

This growth and changes in the industry have not occurred without problems. The large lots result in odor, dust, waste discharge and other environmental issues. Some firms have been forced to relocate. Others may be forced to move or incur substantial costs if new more restrictive environmental guidelines on waste and effluent disposal are invoked. Research is being done on recycling and new product uses for wastes but to date no successful economic process has been developed.

There have been health issues as well. The recent ban on DBS has slowed production and reduced efficiency of gain. Possible limits on antibiotics could further reduce production rates and add to costs.

These limitations occurred at a time when meat supplies in total were relatively short. The effects of increasing the size of the basic U.S. beef herd during the last two or three years has not yet been felt in the market. Pork and poultry were in the low phase of their production cycle due to low prices in 1971 and 1972. The climate in many feeding areas in early 1973 was unfavorable and slowed livestock growth. Additionally, grain supplies were relatively short due to worldwide grain shortage in late 1972 and early 1973. All of these factors, combined with the growing demand in the U.S. and abroad for red meats, created the crises in U.S. meat markets in 1973.

This situation is showing signs of substantial improvement. World grain supplies are expected to be up significantly with the 1973 harvest. Some significant price drops have already occurred in crops like soybeans. Higher prices have stimulated poultry and pork producers to expand output, and the increased calf crop from the expansion in the beef herd in recent years is beginning to show up in the market. Expectations are that 1974 and 1975 meat supplies will be in better balance with demand. Prices to producers dropped significantly in October 1973 and are beginning to show up in some reductions at the meat counter.

Another factor will be in the production of meat analogs from protein substitutes such as soybean and cottonseed. Some use of these products has already been introduced. It is expected more will come as research and promotion efforts have been intensified as red meat prices have risen. Recent developments in research on cottonseed indicate a major breakthrough may have been made and that if problems are overcome, protein from this source can be obtained for substantially less than the cost of meat.

In order to remain competitive the livestock industry will have to continue to strive for greater efficiency to hold down costs. Additionally new less costly methods of handling and distribution such as centralized cutting and wrapping, quick freezing and other systems will have to be tried.

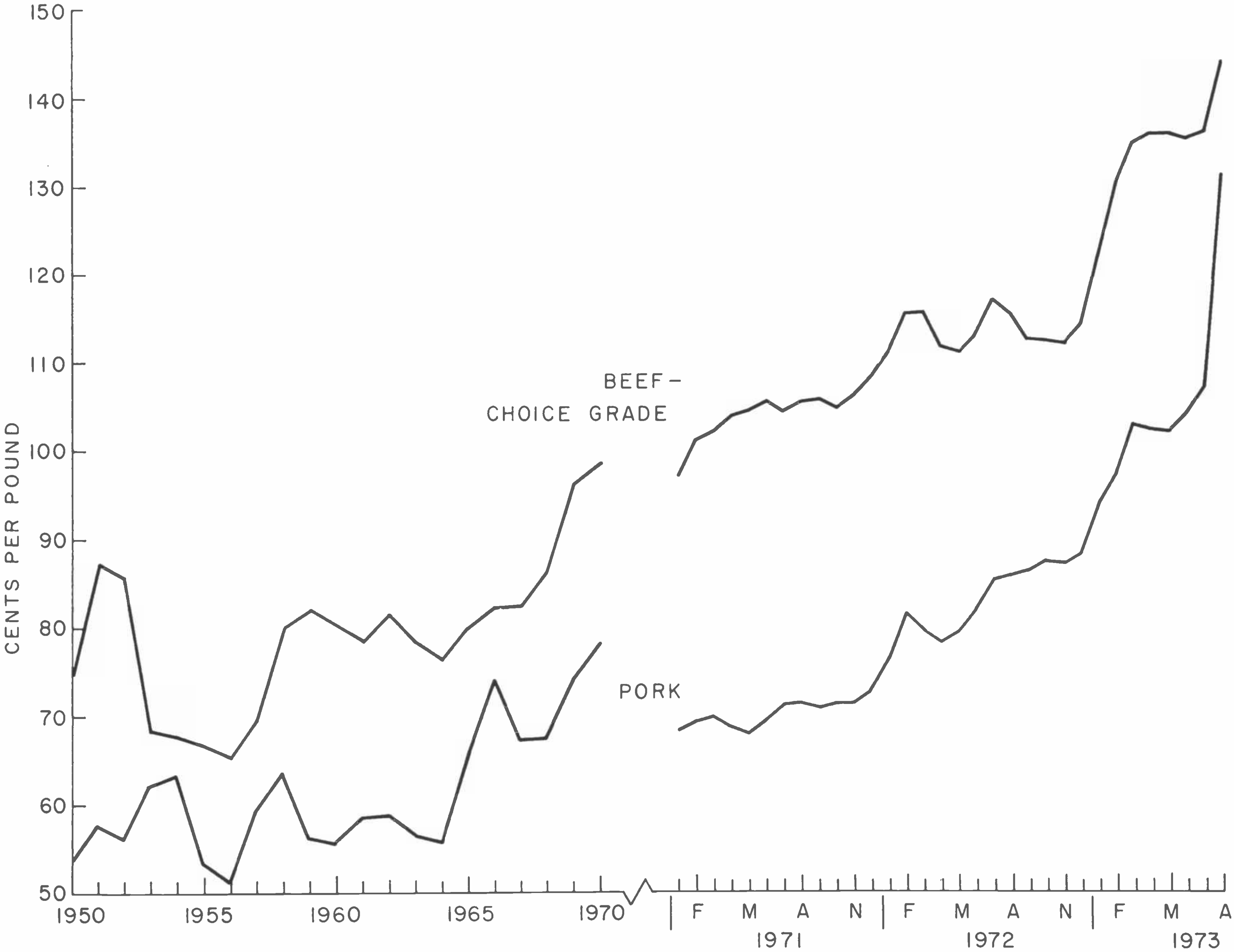


Figure 3. Average Retail Price per Pound for Beef and Pork, United States, Annually 1950-1970, Monthly 1971-1973.

Christmas Tree Marketing in Tucson . . .

Inferences for the Arizona Market

*by Philip N. Knorr & Francis H. McVay**

For many years and at considerable shipping expense, most Christmas trees have been imported into Arizona. Interest in raising Christmas trees has been increasing. A few unsuccessful attempts to establish conifer plantations in Arizona have been made from time to time. Arizona was one of the last states to create a state forestry department and only since 1970 have funds been obtained from the federal government, through the Clark-McNary Act of 1924 (Sec. 4), to provide forest tree planting stock at cost to its citizens. During the fall and winter of 1971-72, publicity about the availability of this planting stock renewed interest in the possibility of raising Christmas trees in Arizona.

Potential Arizona growers of Christmas tree plantations need to realize that this is a high risk venture. Before undertaking the establishment of such coniferous plantations, some knowledge of markets and marketing would be of value. To provide this information, a cross-section descriptive study of the Tucson Christmas tree market was made in the 1971 season. Tucson is widely used by national companies to test-market new products because of its size, wide diversification of people and its isolation from other market areas.

A complete census of Tucson Christmas tree lots was made. Eighty-five separate tree lots were found in the city between December 5th and 10th. Realizing the short time span that the lots would be available for a visit and knowing the operators would be busy during the selling season, only a few minutes were allocated for an initial interview with each manager. Information collected during this first contact included pricing methods and price information, tree source, wholesaler, geographic origin of the tree, species offered for sale, the approximate number of trees bought or that would be bought and where the manager could be located later to answer a post-season questionnaire. A second interview, requiring about thirty minutes, partly structured and partly open-ended, was completed two months after Christmas with the 74 (of the 85) operators who could be located. Supplementary information as well as data for cross-checking or adjusting any extrapolations was obtained from Christmas tree wholesalers and U. S. Forest Service sources.

Table 1. Means of transportation for Christmas trees of differing origin shipped into Tucson in 1971.

Origin of	*Approx. Distance in miles*	*Truck*	*R. R.*	*Piggy-back*	*Unknown*	*Total*
		Means of transportation percent				
Michigan and Wisconsin	1900	12.4	16.6	4.4	—	33.4
Oregon and Washington	1500	12.4	9.6	0.0	—	22.0
Montana	1200	19.3	0.0	0.0	—	19.3
Texas and Colorado	900	0.5	0.0	0.0	—	0.5
Arizona	150	1.5	0.0	0.0	—	1.5
Unknown	—	—	—	—	23.3	23.3
Total		46.1	26.2	4.4	23.3	100.0

The eighty-five separate tree lot locations in Tucson were operated by 26 organizations or owners, which in turn could be placed in one of three categories: chain stores (53 lots), non-profit organizations such as church groups, U. of A. Forestry Club, etc. (27 lots) and individual operators (5 lots).

The inventory of all trees on all lots indicated that of the 49,000 trees shipped to the 85 Tucson retail lots, only 5½ percent were not sold. If one assumes that only customers within the city limits purchased at the 85 lots, the ratio of trees to people is one tree per 5.95 individuals. If, more likely, virtually all of the population in the greater Tucson area bought trees at the 85 lots, the ratio drops to one tree per 7.76 people.

Of the 49,000 trees offered for sale, almost 17,000 came from Michigan and Wisconsin and over 20,000 came from Washington, Oregon, and Montana (for percentages see Table 1). Origin of most of the remaining trees was unknown but, judging by species, appearance and known wholesaler, they probably came from the same areas as the 37,000 with identified sources. Special care was taken in the study to count those grown in Arizona;

Professor of Forestry and Graduate Student, respectively, Watershed Management Department, U of A.

of the total, only 731 (or 1½ percent) were local trees. Almost half of the trees were brought to Tucson by truck, one-fourth by rail and one-fourth by unidentified means. One shipment, obviously a trial run to test an innovation in Christmas tree shipping, came piggy-back (loaded truck trailer shipped by rail) from Michigan.

Eighty-five percent of the 49,000 trees brought into Tucson were Scotch pine and Douglas-fir. The remaining 15 percent covered more than a dozen other species (Table 2). Quality as judged by color, needle length, density, shape and height was most important to purchasers. Trees that did not sell were those of poor quality (mostly small unsheared Douglas-fir) except for some Austrian pine. These specimens were too tall for most homes, 12 to 15 feet, and there were evidently too many of these expensive trees for the limited market such as bank lobbies, etc. Douglas-fir, sheared a year or so prior to cutting, to aesthetically fill out and shape the form, was the only offering to completely sell out before Christmas. All the Scotch pine had been sheared but varied more in quality and were generally more expensive than other species.

Prices in 1971 in Tucson for Christmas trees ranged from 50 cents per foot for small Douglas-fir up to $3.00 per foot for the best specimens of Colorado blue spruce and sheared Scotch pine. Most families purchasing

Figure 1. The President and Vice President of the student Forestry Club present a Christmas tree to University of Arizona President John P. Schaefer. This tree is a typical plantation raised and sheared Scotch pine, the preferred species for Tucsonans in 1971. It was shipped from Michigan.

a tree paid between $5.00 and $10.00 for it. Retail mark-up over wholesale cost averaged close to 100 percent. Shipping costs averaged about one-fourth of the wholesale cost of the trees. Only 7 Christmas tree lots offered information about profit and indicated that net income averaged 26 percent of sales. Of the 74 Christmas tree retailers polled after the season, 19 said they were discontinuing the business while 14 said they planned to expand.

While the study was limited to the Tucson Christmas tree market in 1971, the authors thought it would be of value to extrapolate the Tucson data to estimate the 1971 Arizona Christmas tree market. If large corporations often use Tucson as a gauge for national markets, certainly Tucson is an even better indicator for Arizona markets. As in any extrapolation, proper caveats should be observed. Of the 49,000 Christmas trees brought into Tucson, 46,500 were sold. If the high and low ratios of tree to persons (1:5.95 and 1:7.76) are used to extrapolate for estimates of the number of Christmas trees sold in Arizona, the range is from 310,000 to 240,000. The latter estimate is judged to be closer to the actual number of trees retailed in the state in 1971. With a mean price for a Christmas tree ranging from $5.00 to $10.00, an estimate of the money Arizona consumers paid for Christmas trees in 1971 lies between $1,200,000 and $3,100,000.

It is ironic that, to the best of the authors' knowledge, not one Arizona cypress was offered for sale, yet this is one of the favorites in the southeastern United States where many acres are grown in plantations for the southern market. Species that consumers will purchase and that can be grown commercially in the state will be of concern to Arizonans who would like to raise this crop. The Agricultural Experiment Station is carrying on a modest amount of research concerning the growing and marketing of Christmas trees.

Table 2. Species of Christmas tree shipped to Tucson for retailing in 1971 by number and by percent.

Species	*Number purchased*	*Percent of total purchased*
Scotch pine	22,294	45.2
Douglas-fir (unsheared)	19,602	39.8
Douglas-fir (sheared)	1,855	3.8
Austrian pine	2,539	5.1
Colorado blue Spruce	1,467	3.0
12 other species	1,542	3.1
Total	49,299	100.0

In photo this page the three admire a sheaf of one of the stiff-trawed, high-yielding wheats which have had such an impact on Arizona agriculture. From left are: Charles R. Farr, Maricopa Extension Agent, J. H. Sossaman and his son, James J., both of Higley. It was on the Sossaman Farm that some of the earliest on-farm tests were conducted. In other parts of the state other University personnel (page 9) were also introducing the new feed grain crop. The U of A team include from left: Top row — R. G. Sackett, Assistant Agronomist, Agricultural Experiment Station and Executive Secretary, Arizona Crop Improvement Association; R. K. Thompson, Research Associate in Agronomy & Plant Genetics, Mesa Farm; Donald R. Howell, Yuma Extension Agent; — Middle row — James F. Armstrong, Pima Extension Agent; James W. Little, Pinal Extension Agent; John L. Sears, Graham Extension Agent in Charge; — Bottom row — E. B. Jackson, Professor of Agronomy & Plant Genetics, Yuma Farm; Carmy G. Page, Cochise Extension Agent in Charge; and C. L. Isaacson, Apache Extension Agent in Charge.

Impact of Introducing Stiff-Strawed, High-Yielding Wheats to Arizona Agriculture

*by Robert E. Dennis & Arden D. Day**

Arizona produced an average of 27,000 acres per year of wheat, 1964-66, with an average yield of only 2660 pounds per acre. Beginning about 1966, stiff-strawed, high yielding wheats from Centro Internacional De Mejoramiento De Maiz Y Trigo (CIMMYT) were introduced into our state with an on-farm test at the Jim Sossaman farm near Higley. Changes the introduction of new wheats brought to our agriculture are shown in Table 1.

Wheat acreage has now increased eight-fold. Yield is up 60 percent to 4,200 pounds per acre. The Arizona wheat crop in 1973 approached one-half million tons with a gross value of $45,000,000.

The stiff-strawed Mexican wheat seed for the International Spring Wheat Nursery at the Sossaman Farm was provided by Nobel Prize winner Norman Borlaug of CIMMYT in 1965.

* *Extension Agronomist, Cooperative Extension Service; and Agronomist, Arizona Agricultural Experiment Station, University of Arizona, Tucson, Arizona 85721.*

Charles Farr, Maricopa County Agricultural Agent, made arrangements for and helped establish this on-farm test. He and David Ammon, Extension Agronomy Assistant, harvested the matured crop from this now historic on-farm test.

"We were glad to let Chuck put the test on our farm," said J. H. Sossaman. "We weren't growing much wheat at that time because barley was higher yielding. In addition, our barley always lodged and often lay in the furrows at harvest time."

James J., his son, said, "The wheats in the test stood up well and produced yields considerably higher than those obtained from the old variety, Ramona 50. It's gratifying to see the way these new wheats have helped farmers — and have provided grain for Arizona's growing livestock industry."

The results of the 1966 Sossaman on-farm test are reported in Table 2.

Many of the high yielding entries in the Sossaman test provided by Dr. Borlaug were then experimental lines. The names appearing in the table are those assigned later by Centro Internacional De Mejoramiento De Maiz Y Trigo. After yield results for the 1966 Sossaman test were obtained, it was crystal clear that the named variety then available, Sonora 64, should be carefully observed throughout lower elevation irrigated areas of Arizona.

Gene Lorance, agronomist with the Western Cotton Products Division of Anderson-Clayton, volunteered to ob-

Table 1. Acreage, yield and total production of wheat for grain in Arizona, 1964 to 1973.

Year	Acres Harvested (thousands)	Yield (Lbs./acre)	Production (Thousands of tons)
1964	33	2,880	47.5
1965	26	2,700	35.1
1966	23	2,400	27.6
1967	50	2,940	73.5
1968	52	3,120	81.1
1969	73	3,720	135.8
1970	150	4,140	310.5
1971	173	4,080	352.9
1972	170	4,080	346.8
1973	214	4,200	449.4


R. G. Sackett

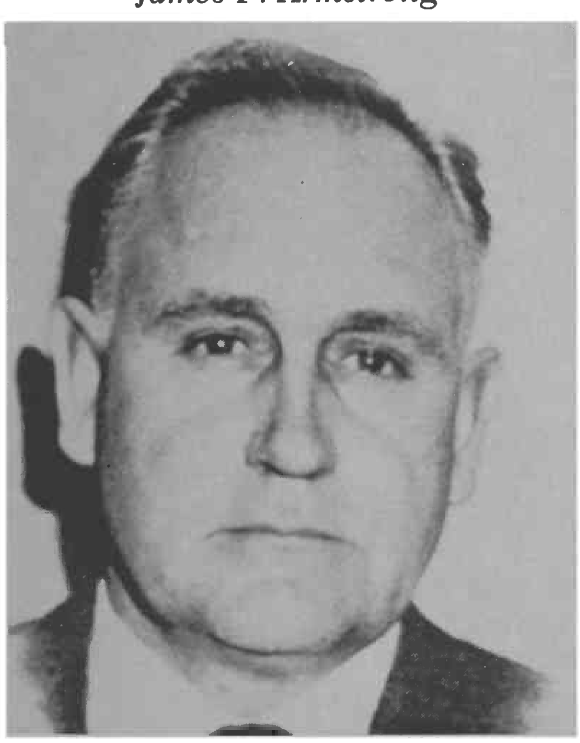

R. K. Thompson


Donald R. Howell

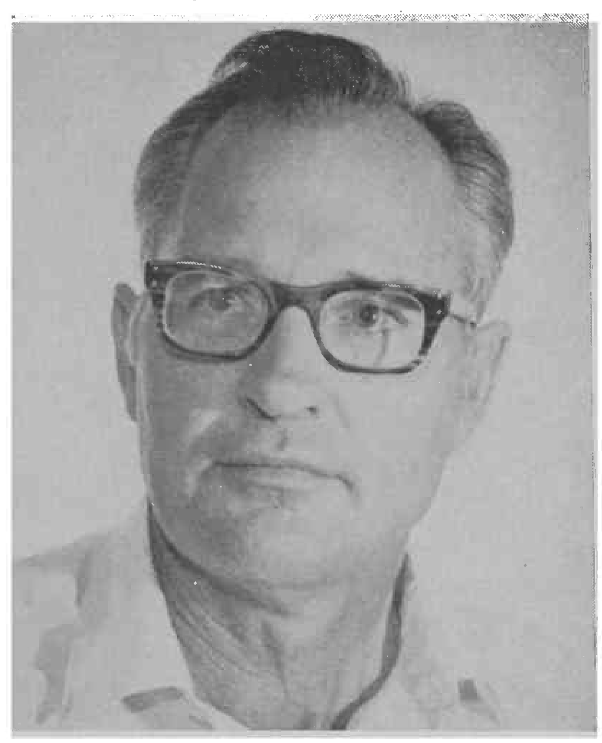

James F. Armstrong


James W. Little


John L. Sears


E. B. Jackson


Carmy G. Page


C. L. Isaacson

tain 300 pounds of Sonora 64 seed from Anderson-Clayton seed sources in Mexico. This planting seed was distributed to Don Howell, Yuma Agricultural Agent; Jim Little, Pinal Agricultural Agent; and Charles Farr. Each established on-farm tests so that growers in their respective counties could see the high yielding potential of the new Sonora 64.

Tests were located at William G. Brandon's farm, Queen Creek, the Floyd Spar farm at Roll, and the Parke Gilbert farm near Casa Grande. Yield results from these tests again revealed superiority of the short, stiff-strawed Sonora 64. In fact, the results were so good we could hardly believe it possible.

Arizona is fortunate to have excellent plant breeders in the Agricultural Experiment Station who have contributed greatly to this program. Also, small amounts of seed which originally came into this country under the most exacting conditions need to be reputably expanded so that enough seed is available to all growers at a price they can afford to pay. For this we depend on our Arizona Crop Improvement Association as well as the cooperative members of the commercial seed dealers in our state.

On-farm tests concerning cultural practices have gone hand in hand with variety evaluation. Extension Agent Howell has completed three years of date-of-planting tests. Extension Agent Jim Little of Pinal, who speaks Spanish, has developed and maintained close working relationships with Research and Extension workers in Mexico. He has tested dozens of lines and varieties in Pinal County. Farr has continued with carefully planned Extension programs so as to help farmers obtain all possible benefits from the introduction of the new varieties.

Since the Sossaman test, new strains and varieties have been evaluated each year. Now there are several varieties superior to Sonora 64 in productivity.

The Mexican wheats are also grown in Pima County, but adaptive research by Jim Armstrong, Pima County Agritultural Agent, has shown that spring barley often has an edge on the spring wheats there, when both are grown as winter-annuals. This is reasonable since wheats from Mexico were developed for warm climates. Jim has given principal emphasis to water use and other cost of production studies for barley and wheat.

Table 2. Wheat Variety Test — Sossaman Farm, 1966.

Country of Origin	*Variety or Experimental Entry*	*Yield (% of Ramona)*
Mexico	**Bajio 66**	**176 a**
Mexico	**Sonora 64**	**173 a**
Mexico	**Jaral 66**	**162 a**
Australia	**Mendos**	**130 b**
Mexico	**Roque 66**	**130 b**
Mexico	**Penjano 62**	**130 b**
U. S. (Arizona)	**Arizona 5525-4 (Maricopa)**	**121 bc**
Mexico	**Pitic 62**	**121 bc**
Pakistan	**C-271**	**121 bc**
Mexico	**Nainari 60**	**116 bc**
U. S. (Arizona)	**Onas 53**	**114 bc**
Mexico	**Sonora 64-Knott A, 18892-2M-3Y-5M-26**	**114 bc**
Mexico	**8156 (White Grain)**	**113 bc**
Argentina	**Klein Pendidor**	**112 bc**
Pakistan	**Pakistan (Lyall Apur) 5747**	**107 bcd**
Mexico	**Lerma Rojo**	**103 bcd**
U. S. (Arizona)	**Ramona 50**	**100 bcd**
Columbia	**Crespo**	**98 cde**
U.A.R.	**Giza 144**	**93 de**
Australia	**Gabo**	**92 de**
Argentina	**Klein Petiso-Rafaelo**	**83 def**
Brazil	**Carazinho**	**74 ef**
U.S.A.	**Crim**	**71 ef**
Columbia	**Bonza 55**	**70 ef**
U.S.A.	**Chris**	**55 f**
Mexico	**TZP-AN64, 19025-10CM-101Y-100C-2Y**	**50 fg**
U.S.A.	**Justin**	**19 g**
Canada	**Selkirk**	**19 g**

Yields followed by the same letter are not significantly different at .05 level by Student Newman Keul's test.

The new wheat varieties have been evaluated at the higher elevations in the second phase of the spring wheat introduction effort. On-farm tests have demonstrated that these varieties are stiff-strawed. Wheats may be planted in March and harvested in June with economic yields at elevations above 3000 feet. Use of wheats in this way is catching on and acreage of spring planted wheat at higher elevations will probably increase. These on-farm tests have been led by Carmy Page, Cochise County Agricultural Agent; John Sears, Graham County Agricultural Agent; Leonard Isaacson, Apache County Agricultural Agent; and Amos Underwood, formerly Navajo County Extension Agent, now deceased.

It is of interest that Orville Vogel's work in Washington paralleled that of Dr. Borlaug. The two breeders worked hand in hand in development of better wheat varieties with Vogel giving his attention to winter-wheats. Because of this, Arizona's principal winter-wheat variety is now the high-yielding Nugaines. With the winter and spring wheats at the higher elevation, on-farm tests have been conducted at the Phelps Dodge Experimental Area managed by Charles Davis and located near Hereford; Charles Kimzey farm, Cochise County; Augusta Flake farm, Snowflake; Wayne Peterson farm near Willcox; Carl Bowman farm, Safford; Verle Palmer farm, Eden; and the Patterson farm managed by Jim Hauser at St. Johns. Each of these farmers have given of their time and resources to make these tests possible. The program would never have moved forward without their help.

The progress for wheat is significant, but it is only the beginning. One-third of Arizona's farmers obtain yields at least 1000 lbs. per acre above the state average yield. Yields of more than 5 tons per acre have been reported.

What will the average yield of wheat be in 1980? No one can really be sure. But we can be sure that University Extension Agents and Researchers will continue to work with farmers and all segments of Agri-business to, as 4-H-ers say, "Make the Best Better."

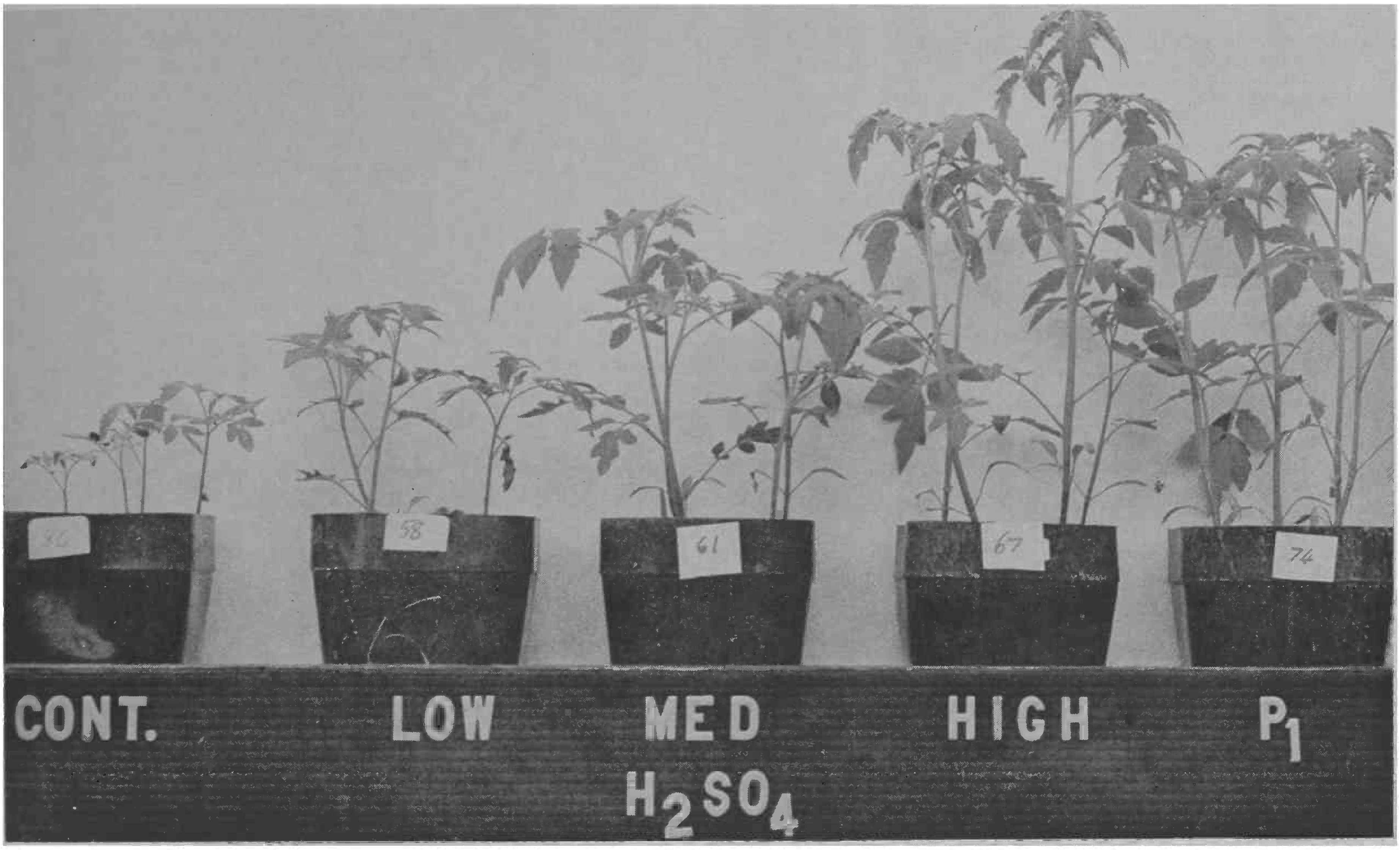


Figure 1. Effect of spot treatment with sulfuric acid on growth of tomatoes grown on the Comoro soil. (Low = 300 Med. = 600; High = 1200 P_1 = 300 lbs./acre.)

Use of Sulfuric Acid on Phorphorus Deficient Arizona Soils

*by John Ryan and J. L. Stroehlein**

The amount of native or naturally occurring soil phosphorus (P) and residual fertilizer in calcareous Arizona soils is adequate for many agricultural crops even though P which is chemically available to the plant is only a fraction of the total amount of the element in the soil. While some Arizona soils are known to be deficient in available P, it is likely that in marginally deficient soils, P will become more deficient under more intensive cropping systems, particularly for short season crops. In the study reported herein it was found that sulfuric acid applied at low rates was effective in increasing both vegetative yield and P uptake of tomato plants grown on a calcareous soil low in available P in the greenhouse.

In acid and neutral soils P is mainly associated with iron and aluminum compounds while in calcareous soils of high pH, calcium is the principal element involved. The rate at which calcium phosphate compounds release P to growing plants depends on the chemical nature of these compounds as well as the texture and surface area of the soil. Available data suggest the P occurs in calcareous soils in Arizona principally as hydroxyapatite which is relatively insoluble but potentially available. (See Arizona Agricultural Experiment Station Bulletin A-42).

* *Post-Doctoral Research Associate and Associate Professor, respectively, in the Department of Soils, Water and Engineering. This work was supported by a grant from the Arizona Mining Association.*

A relatively minor portion has been shown to occur as stable and insoluble compounds such as carbonatoapatite and fluroapatite. Calcium phosphate compounds become more soluble by reducing the pH of the soil. The form of phosphate ion most readily taken up by plants occurs in the slightly acid to neutral range. The type of crop as well as environmental factors such as temperature are important. Cool season crops such as small grains and lettuce are more likely to respond than most warm season crops. Alfalfa is probably the warm season crop which responds best to P applications.

Several acid producing materials such as elemental sulfur, sulfuric acid, calcium and ammonium in polysulfides, and sulfates of iron and aluminum have been used in the past on calcareous soils. Responses in terms of increased micronutrient availability and improved water penetration have been frequently observed. Most studies involved the use of elemental sulfur which gradually oxidizes in the soil to form sulfuric acid. Its mode of

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action is thus different from that of sulfuric acid which reacts immediately with the soil. Whether a response to P occurs or not depends upon the relative amounts of calcium and P dissolved by the acid treatment as large amounts of soluble calcium tend to depress phosphate solubility. In most studies of soil acidification the effect on P in relation to plant growth has received only incidental consideration. Consequently, soils selected were not primarily deficient in P which would tend to invalidate conclusions in this regard.

Sulfuric acid has been used as band treatment in soils and in irrigation water under field conditions. However, no direct comparison between various methods of application have been made at equivalent rates of acid. In this greenhouse experiment four methods were compared: 1) applying acid in the irrigation water, 2) uniformly mixing the acid with the soil, 3) acid application as a layer and 4) as a spot treatment. Treatments were compared at a rate equivalent to 1200 lbs/acre. In the case of the spot treatment rates of 300 and 600 lbs/acre were also used. A higher level of acid, equivalent to 1% of the soil weight, was used as a layer or band treatment. As a comparision two rates of P were included, 300 and 600 lbs/acre. While no direct comparison can be made between field and greenhouse studies there rates were such as to alleviate any P deficiency.

Sulfuric acid was added in sufficient water to bring the soil to field capacity and poured on the surface of the potted soil in the case of treatment 1. Two hundred gram lots of soil were treated with acid and water, dried and mixed with the remaining 1800 g for treatment 2 and as a 2 cm layer in the pot at a depth of 6 cm for treatment 4. For the spot treatment appropriate amounts of acid were injected into the center of the pot at a depth of 10 cm using a pipette and rubber bulb. Untreated control pots were also included and all treatments were replicated five times. Adequate and equal amounts of N were supplied as NH_4NO_3 in solution.

The soils used in the study were a Comoro sandy loam which was P deficient and a Lateen sandy loam which had previously shown a response to added P when greenhouse tomatoes were grown under cooler temperatures during late winter. Both soils had a pH of 8.2. The $CaCO_3$ equivalents were 6.0% and 12.5% and the P available contents as extracted by CO_2 and water were 1.7 and 6.9 ppm, respectively.

The randomized pots were seeded with tomatoes (*Lycopersicum esculentum*) at a depth of 1 cm in March. After establishment, the seedlings were thinned to four plants per pot. The plants were harvested after nine weeks, dried, weighed, and analyzed for total P. The cropped soil was subsequently sampled from the zones of acid treatment. The pH was determined using a 1:2.5 soil water ratio and soluble P in the extract was determined.

Marked differences were observed in behavior between the two soils. On the Lateen soil, deficiency symptoms were apparent in the early stages of growth in March but disappeared with the onset of higher temperatures. The irrigation treatment and high level of acid applied as a layer produced slightly higher yields than the controls, but they were not significant. A comparison of the various treatments is shown in Figure 4. Yields from the Lateen soil were greater than from the Comoro soil. The absence of any significant response indicates that from the Lateen soil contained an adequate level of available P under the conditions of this study. This is further evidenced by the higher levels of P in the plant tissue from the Lateen soil as well as by the amounts of available P as shown by the soil tests.

Significant responses occurred in growth and P uptake on the P deficient Comoro soil. Figure 2 shows the effect on plant growth from the four methods of application. The patterns of P uptake were similar to those of dry matter yield and are depicted in Figure 3. The low uptake of the acid treated pots relative to the applied P may be partly due to positional unavailability in the early stages of growth. As the plant roots permeate the soil, the P solubilized in the acid treated zones would be available for uptake. The acid applied at 1200 lbs./acre both as a band and a spot treatment produced yields almost as high as the P fertilizer at 300 lbs./acre. High yields were also shown where the acid was applied to the soil surface in the irrigation water. Mixing of the acid with the bulk of the soil was the least effective of the four methods. The slope of the response curve for the spot treatment suggests that maximum growth could be obtained by increasing the rate of acid (Fig. 1). When the acid was applied at 1% of the soil weight as a band treatment, a depression in yield resulted. This was probably due to growth inhibition as a result of soil acidity as the pH of the layer was 3.9 No such effect was observed with the Lateen soil which had a pH of 6.5 after cropping, reflecting the higher lime content of this soil. Plants growing on the untreated Comoro soil showed symptoms of P deficiency which also occurred with the low rate of acid as a spot treatment and when the acid was thoroughly mixed with the soil. In the former case it is prob-

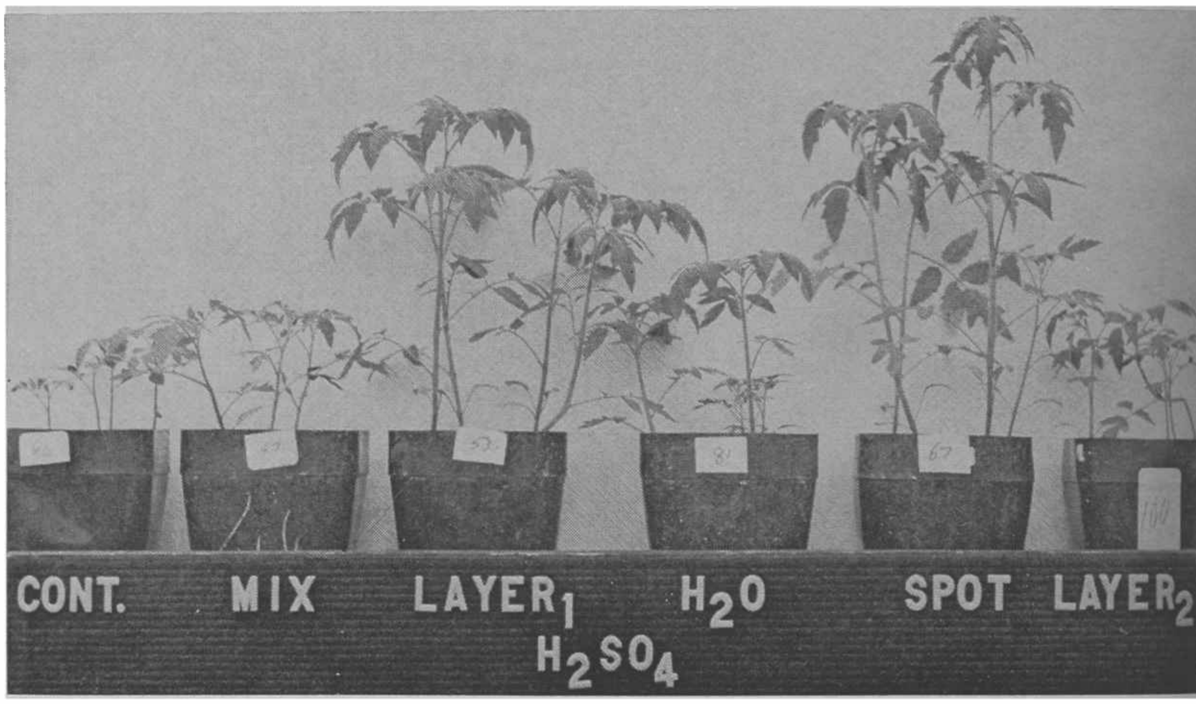

Figure 2. Comparison of sulfuric acid application methods on growth of tomatoes on calcareous Comoro soil. (H_2SO_4 at 1200 lbs/acre applied as spot treatment, mixed with soil, as a 2 cm.-layer, in water on pot surface and as a layer at 1% of the soil weight.)

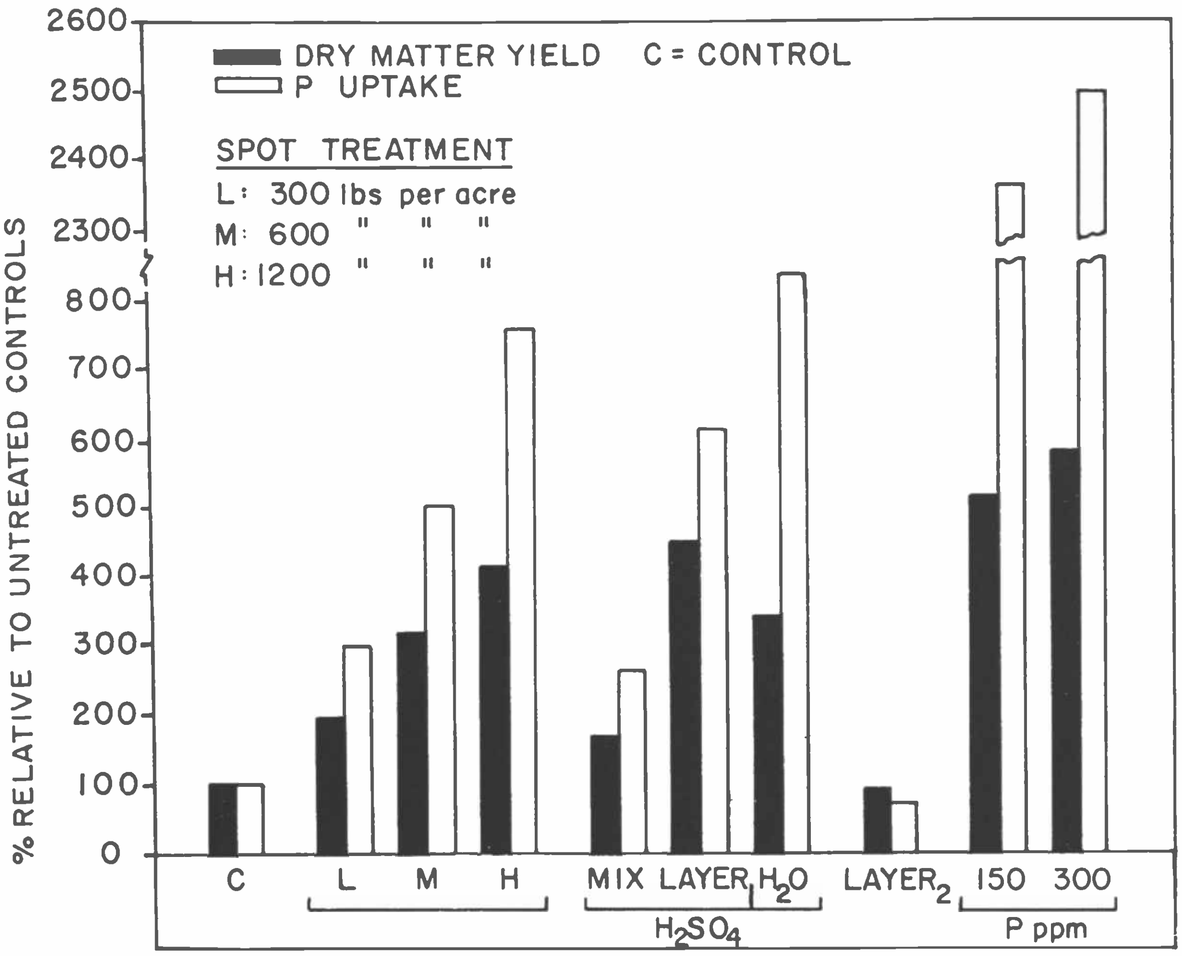

Figure 3. Effect of sulfuric acid application on relative dry matter yield and P uptake of tomatoes grown on Comoro soil.

able that sufficient P was not released while in the latter it is likely that the initially dissolved P was reprecipitated when mixed with the untreated soil, since insufficient acid was applied to change the pH of the entire soil volume.

Measurements of soil pH and water soluble P served to explain the results observed. Only a small fraction of the soil was influenced by the spot treatment. The pH of the treated zone in the Comoro soil decreased from 8.2 to 6.4 while the water soluble P increased from 1 to 8 ppm. The effect of the acid was limited to the treated zone. The increased supply of P from the zone was effective in promoting plant growth. The treatment effect was less pronounced in the Lateen soil with pH decreasing from 8.2 to 7.0 and P increasing from 0.7 to 1.8 ppm. In neither soil had the mixing of acid with the bulk soil any effect on P solubility. The acid treatment in the irrigation water reduced the pH of the surface centimeter of the Comoro soil to 7.8 and increased P solubility to 3.8 ppm accounting for the improved growth and uptake of P. With layer treatment at the high rate of acid there was no increase in soluble P. This may be due to fixation of the initially dissolved P by iron and aluminum which were dissolved by the acid treatment.

The results indicated the potential use of sulfuric acid for increasing P availability and hence plant growth on P deficient soils. The rates of application were such to suggest that sulfuric acid might be economically used on a field scale. While banding was shown to be the most effective method, this situation may not be easily simulated in the field. Injecting behind a plow moldboard is a possibility. This may also help to destroy existing plow soles. However, no information is available as to the possible effect of such a practice. Injection of acid into the soil has been practiced in the field, followed by tillage which results in complete incorporation into the soil, possibly decreasing the effectiveness of the application. In contrast, the effectiveness of elemental sulfur would be enhanced by soil incorporation. Cultivation would influence the residual or long term effect of the acid treatment which can only be reliably measured in the field. The advantages of using sulfuric acid for improving P availability are further enhanced when trace element deficiencies occur in these soils. The latter effect has been shown in the March-April issue of this journal. With increasing costs and a projected decrease in the supply of P fertilizers, sulfuric acid may prove to be an economic and effective substitute.

As yet, no economic analysis has been made of sulfuric acid in Arizona agriculture. While the agronomic advantages are obvious at this stage we can only speculate as to the dollar returns to the farmer from using sulfuric acid. It is important to realize that like most farm chemicals, sulfuric acid requires careful handling. It should only be used as an amendment for specific purposes based on soil and water analysis and professional advice.

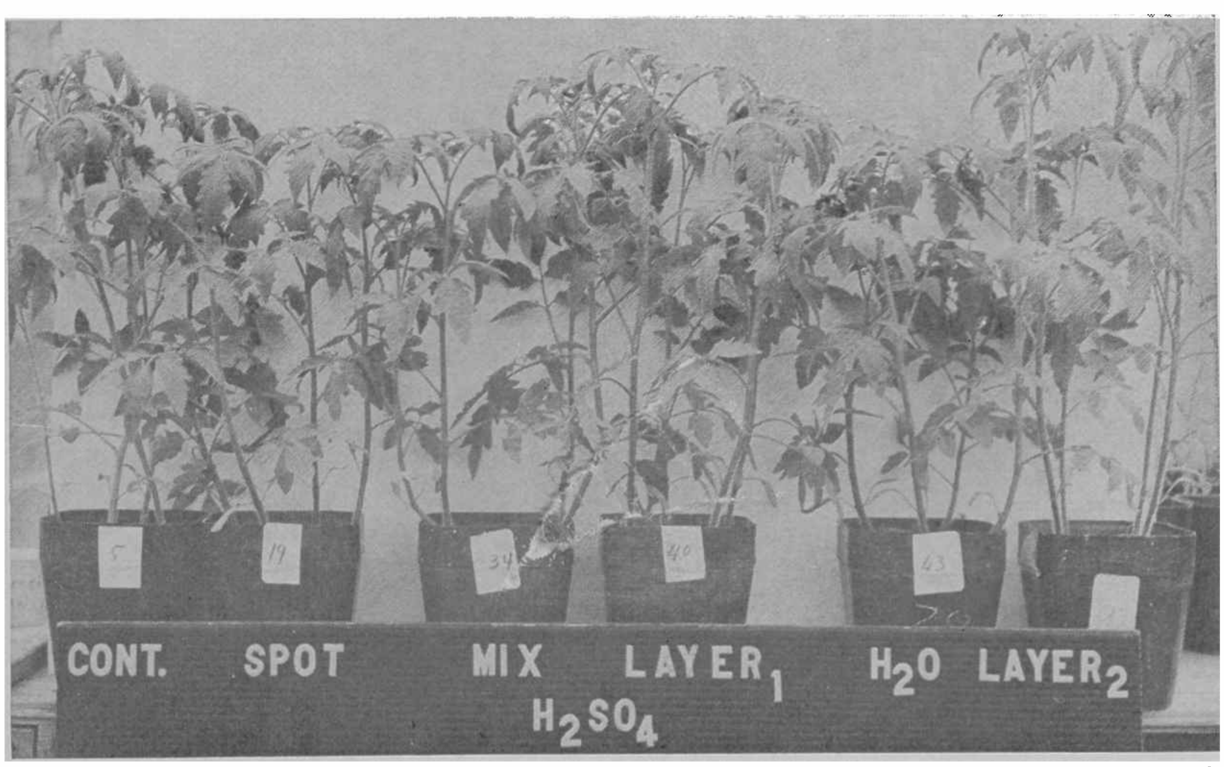

Figure 4. Comparison of sulfuric acid application methods on growth of tomatoes on calcareous Lateen soil. (H_2SO_4 at 1200 lbs/acre applied as a spot treatment, mixed with the soil, as a 2 cm-layer, in water on pot surface and as a layer at 1% of the soil weight.)

Fabric Scope for 1973-1974

*by Barbara Cook & Janet L. Vaughn**

A period of revaluation seems to be surfacing in the United States today. From the nostalgia of "American Graffiti" to the back-to-the 50's look in fashion, the search is on for a more simple, less cluttered life-style.

Shortages of both natural resources and agricultural products have caused unprecedented rises in the cost of living for most Americans. While food prices continue to rise and dominate the media, the fabric industry predicts shortages of wool, cotton, and polyester.

The August 1973 issue of *Fabric-news* reports a beginning polyester shortage which "will remain for at least another 12 to 18 months." Such a shortage is caused by the worsening petroleum shortage since polyester and some other manmade fibers are made from petroleum byproducts.

While the industry indicates a shortage, local retail outlets claim polyester continues to dominate the scene for fall and holiday wear. In a recent interview, Shirlee Anderson, Divisional Merchandise Manager of Levy's department store in Tucson, said there is an abundance of polyester garments for fall. "Polyester is blended with other fibers — such as nylon — for consumer interest and appeal." She doesn't believe that such fiber blending is caused by the shortage of the polyester fiber.

However, wool is another story. The increase in land value has made raising sheep unprofitable because of their need for vast grazing acreage. Consequently, most wool is imported and only small amounts are available. Thus, the higher prices for this fiber.

"Wool is being blended to keep the price down," Anderson said, "but the prices of coats and items made from wool have increased substantially since 1972. Wool yarn is disappearing from the local retail outlets because of the spiralling costs and consumer refusal to pay such increasing costs.

Cotton shortages were evident as early as March 1973 when price increases on towels and sheets were made, according to James Davis, the Merchandise Manager of Steinfeld's department store. Davis said, "About three weeks ago (late August), we were asked to order towels and sheets for stock through December 15. If we ran out of sheets tomorrow, we couldn't obtain any more."

Davis wasn't sure a cotton shortage had caused the sharp decrease in supply. In the manufacture of towels and sheets, it's easy to produce "irregulars" which raises the cost of quality merchandise. "While some lines are still available, the prices are out of sight," said Davis.

Children's clothing and infant's sleepwear have taken a sharp rise in prices because of increased labor costs and the federal regulations for flame retarding infant's wear. The flame retardant coating is applied to the fabric itself. The result is "rather stiff and uncomfortable" according to Davis. "The process required extensive chemical testing, and now infant's wear is priced very high because of such testing costs."

Another problem accompanies the flame retarding of infant's wear. The flame retardant is removed if the garment is washed in a nonphosphate detergent according to Mary Jean Wylie, Associate Professor of Home Economics of the University of Arizona. Most companies fail to indicate this removal of the retardant by washing on the care label of the garment. So the consumer pays for a nonphosphate detergent — in the interest of ecology — and pays extra for the flame retardant — through no choice as a consumer buyer. And, after the first washing, the protection that the government initially intended is lost down the drain!

Children's clothing prices will continue to be high according to Davis. He gave reasons for such trends as the labor involved in making a child's garment is about the same as for an adult's, and the difference in the amount of fabric required is insignificant when compared to the labor costs.

American consumers demand another convenience: durable press finish. Polyester and similar knits are increasing in demand because of the no-iron characteristics. "Women today demand a no-iron finish, and price doesn't matter that much," says Anderson.

Cotton may be treated with a durable press finish but such garments soon need some ironing after just a few launderings. But the homemaker just doesn't have the time for such "touching up"! According to Wylie, cotton fibers lose as much as 50 percent of their strength when such a durable press finish is applied. Consequently, blended fabrics and knits are much more in demand — especially for women's wear.

The ladies and juniors departments of Levy's show few woven fabrics but feature knits almost exclusively says Anderson. *American Fabrics and Fashions* reports in the fall issue that "Knits will pass wovens in apparel poundage this year for the first time in U. S. textile history."

While cotton knits are expected to be in demand even more in the Spring of 1974, both Davis and Anderson believe that prices will be even higher.

Because of anticipated fiber shortages and higher prices for ready-to-wear, home sewing is gaining as a household production activity. Many are more willing to buy fabric and

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spend time making adult and children's clothing as an alternative to the high costs associated with ready-to-wear.

In a recent *Barron's* article, Singer predicted the total number of home sewers would increase 25 to 30 percent by 1977 — a most intersting prediction considering the number of women expected to also be gainfully employed outside the home.

Many appliance manufacturers and food companies emphasize quick preparation and time conserving qualities — for which the homemaker pays dearly. Yet, the number of persons who opt to make the household's clothing is increasing at an accelerating rate. The sheer, economic facts may be spurring them on to spending time rather than money.

Another strategy which consumers can use to conserve on clothing costs is to pay particular attention to the care labels which are attached to ready-to-wear g a r m e n t s. Anderson and Davis both described typical consumer complaints as: poorly constructed or manufactured garments. In fact, when such complaints were investigated *the consumer* was at fault. That is, garments were not laundered or ironed properly.

According to federal regulations, labels indicating the fiber content by percent and care of the garment must accompany each item which is for sale. "Manufacturers are very conscientious about content and care labeling," Davis said, "but if we get a shipment without labels, we have labels printed and charge such costs to the manufacturer. It's our only protection against consumer abuse of the garment." Labels also must state the manufacturer's name or number, and the generic name of the fiber.

Appropriate care of the item is the key to its life expectancy or use. As consumers our responsibility is to read the label and follow the instructions. With the multiplicity of available items, retail sales personnel cannot be *reasonably* expected to know *all* the answers regarding care and use.

Although many fall fashions are polyester knits and blends, cotton is still strong on the Southwestern scene for the "natural" feel and look. While

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Figure 1. One of the department store buyers, Carol Weber, left, of Steinfelds in Tucson, is being queried by author Barbara Cook, right, about the trends of women's ready-to-wear for spring and summer.

Figure 2. Barbara Cook, senior in Home Economics, left, is shown some of recent style arrivals in the store as acquired by Shirlee Anderson, Buyer for Levy's in Tucson. Ms. Anderson says that women customers demand a no-iron finish for convenience without too much concern for cost. Their time is important.

many women prefer the easy care of manmade fibers and cotton blends, many men prefer cotton shirts because of the comfort and absorbancy factors.

Comfort is the quality considered most important by 85 percent of Americans regarding clothing. Maybe it's time we modify some of our fast-moving, easy care ideas and consider the merit of more permanent items. Selecting the appropriate fabric initially and caring for it properly are priority actions in order to maximize consumer satisfaction.

PROGRESSIVE AGRICULTURE IN ARIZONA

to

Official Publication of the College of Agriculture and School of Home Economics University of Arizona GERALD R. STAIRS, Dean