

FIFTY-EIGHTH ANNUAL REPORT
FOR THE YEAR ENDING
JUNE 30, 1947



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UNIVERSITY OF ARIZONA, TUCSON

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‡In co-operation with United States Dept. of Agr., Bureau of Plant Industry.

January 1, 1948

PRESIDENT JAMES BYRON McCORMICK
UNIVERSITY OF ARIZONA

Dear Sir:

I have the pleasure of presenting herewith the Fifty-eighth Annual Report of the Arizona Agricultural Experiment Station for the fiscal year ending June 30, 1947. It contains reports of progress on active research projects, brief summaries of other station activities, and the summarized fiscal statement.

Respectfully submitted,

P. S. BURGESS, *Director*

Note: The illustration on the cover shows commercial lettuce harvesting in the Yuma Valley, Arizona, 1947.

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RESULTS OF THE YEAR'S RESEARCH

AGRICULTURAL CHEMISTRY AND SOILS

MINERAL COMPOSITION OF ARIZONA SOIL COLLOIDS

The study of methods for extracting colloid fractions from Arizona soils and for identifying the colloid minerals has been completed and was presented in the 57th Annual Report. For the year just completed these methods were applied to a group of 24 soils representing a cross section of the soils of the state. Only two minerals were identified in this group of soils, namely montmorillonite and hydromuscovite (illite). Montmorillonite has a high base exchange capacity and a high swelling capacity. This is much less true for illite. This would indicate that the percentage of the two minerals in the soil colloid, or the clay fraction, of Arizona soils may be related to the rate at which the soil takes water and responds to soil correctives when in poor condition.

Two soil types which are high in montmorillonite content were given special study, namely the Mingus clay from Camp Verde and the Joseph clay from St. Johns. Both were high in replaceable magnesium, namely 48 per cent of the total exchange capacity in the former and 25 per cent in the latter was replaceable magnesium. The Joseph colloid consisted of 60 per cent montmorillonite and 40 per cent illite, and the Mingus colloid 55 per cent montmorillonite and 45 per cent illite which together with the large percentage of clay in these soils explains the poor structural condition of these soils and the difficulty in getting them to take water.

CHLOROSIS

This problem continues as one of our major projects and most of the research is being confined to citrus studies. It continues to confirm our earlier observations that chlorosis in trees growing on calcareous soils is due to lack of iron utilization within the plant rather than a failure of the plant to take up ample micro-nutrient elements from the soil. The interference exercised by the calcareous substrate on utilization is almost entirely one of failure to utilize iron. Uptake and transport of manganese, zinc, and copper are not seriously affected by the calcareous substrate. The solution of the problem seems to be one devising a soil treatment which will increase the activity of iron within the plant and this can be accomplished to a limited extent by fertilization with sulphur-manure mixtures. However, the response will depend largely on the age of the tree and, in old trees which have been chlorotic over an extended period of time, recovery may require very heavy applications.

ORGANIC-NITROGEN FERTILIZER STUDIES

The investigation of nitrogenous materials in which the nitrogen is in organic form was continued with field plot studies on Laveen loam soil at the University Farm at Mesa, Arizona.

The fertilizers included in the field study were: Dicyanodiamid, guanylurea sulfate, guanidine nitrate, cyanamid, thiourea, N-20, N-40, and ammonium sulfate. The two fertilizer materials designated as N-20 and N-40 are condensation products of urea and dicyanodiamid prepared by the American Cyanamid and Chemical Company. The ammonium sulfate was included because its characteristic nitrification and plant utilization in Laveen loam is well known and it served as a standard with which to compare the actions of the other fertilizers.

The nitrification characteristics of all these materials have been studied and reported upon in the past. They have all been used also in a study involving the Neubauer technic of growing plants to determine the extent to which nitrification should be allowed to proceed before planting.

The yield results for the several fertilizers are given in Table 1.

TABLE 1.—INFLUENCE OF ORGANIC-NITROGEN FERTILIZERS ON BARLEY YIELDS

Treatment	Yield of barley in pounds per acre	Percentage increase due to treatment
Untreated	1,664	.....
Dicyanodiamid	1,715	3.06
Guanylurea sulfate	1,789	7.51
Guanidine nitrate	2,126	27.76
N-20	2,173	30.59
Ammonium sulfate	2,206	32.57
N-40	2,334	40.26
Cyanamid	2,417	45.25
Thiourea	2,700	62.26

All increases except with dicyanodiamid and guanylurea sulfate were statistically highly significant; increases with dicyanodiamid and guanylurea sulfate were not significant.

FERTILIZER EXPERIMENTS WITH FIELD CROPS

At the request of a number of farmers an additional man was assigned to the staff, during the year, to devote full time to field experiments. His major duties will be to conduct fertilizer experiments on field crops and to apply some of the laboratory discoveries to field conditions.

The first experiments were started in the spring of 1947, two on cotton and two on hegari. These four experiments are designed to study the effect of deep placement of fertilizer versus side dressing or surface applications. It has been the general experience among farmers in the state that summer crops do not respond to commercial fertilizer as do winter crops. Deep placement of fertilizer is being made on cotton and hegari on the theory that the feeder roots, on summer crops, retire from the

surface soil to deeper soil levels because of high surface soil temperatures and because of the drying and crusting of the surface soil.

ORCHARD CLAYPAN

During a routine inspection of the soil survey of the Stewart district in the Sulphur Springs Valley it was noted that an apple orchard growing on Tuck loam showed a great deal of die back and was in a serious state of decline. An investigation showed that the trees most seriously affected were growing in about 2 feet of soil lying on an impermeable hardpan. The orchard was intercropped with alfalfa.

It was recommended that the alfalfa be plowed under and the hardpan broken up with dynamite. This suggestion was followed out and after a year the trees are now thrifty and show no signs of decline.

FEEDS, FERTILIZERS, ECONOMIC POISONS, AGRICULTURAL MINERALS

Responsibility for the enforcement of four control laws relating to the manufacture and sale of feeding stuffs, commercial fertilizers, economic poisons, and agricultural minerals is placed in the Department of Agricultural Chemistry and Soils.

Feeds

During the year 1946 a total of 449 commercial feed samples, 35 samples of cottonseed meal, and 22 samples of mineral feeds taken from stocks on sale in the state were analyzed.

TABLE 2.—TONNAGES OF FEEDS SOLD IN THE STATE SINCE 1938, THE YEAR THE LAW WENT INTO EFFECT

Year	Commercial and mineral feeds	Cottonseed meal
1938	31,000	25,000
1939	34,000	35,000
1940	45,000	22,300
1941	48,400	19,100
1942	55,700	21,900
1943	82,500	17,400
1944	102,234	18,568
1945	82,046	16,699
1946	89,635	15,302

Economic poisons

This law went into effect in 1945 and the first annual report was published in July, 1946. It is designed to regulate the sale of insecticides, fungicides, and herbicides. The law requires only a registration fee and the office does not receive any data from which tonnage sales can be determined. During the year sixty-two companies registered products, of which six were in Arizona, twenty-six were in California, and thirty from other states. A total of 536 economic poisons was registered in the state for the year. A total of sixty-two samples was collected from stocks on sale and analyzed. A large part of the first year was necessarily devoted to developing methods of analyses for these materials.

Fertilizers

During the year 1946 a total of ninety-one samples of fertilizer taken from stocks on sale in the state were analyzed.

TABLE 3.—TONS OF COMMERCIAL FERTILIZERS SOLD IN THE STATE SINCE THE LAW WENT INTO EFFECT IN 1938

Year	Tons
1938	8,000
1939	8,500
1940	6,500
1941	9,500
1942	14,000
1943	15,500
1944	21,708
1945	29,450
1946	30,393

Agricultural minerals

Due to the fact that a considerable amount of low-grade gypsum and sulphur has been sold in the state and a number of new soil correctives have appeared recently on the market, an Agricultural Minerals Law was established by the State Legislature in 1947. This goes into effect on July 1, 1947. Briefly it requires that all agricultural minerals, not classed as commercial fertilizer, must be registered and sold on a guaranteed analysis.

AGRICULTURAL ECONOMICS

In agricultural economics, three lines of work were pursued. A study of the relative profitability of certain farm management practices in the production of alfalfa hay was conducted on about twenty farms in the Salt River Valley. The farmers co-operating carried on their operations in a normal way on usual-sized fields. During the year, the specific study had to do with the profitability of applying phosphate fertilizer. A detailed record of all the costs and factors involved in the production of alfalfa on these farms is being kept. The final determination will show under what sets of conditions it is profitable to apply phosphate fertilizer.

A second study, begun late in the year, involved the processes in the marketing of desert grapefruit. The University is co-operating with the desert grapefruit industry in an attempt to seek out those methods of crop disposal that will make possible the continuance of a substantial portion of desert grapefruit acreage on a profitable basis. The problems in this field are legion. Research is based on the assumption that there are opportunities for reducing costs and improving the efficiency of the marketing system, and it is toward these goals that the department's research program is directed.

The third line of work embraced a study of agricultural prices and the production and cost factors that determined them. A publication, *Arizona Agriculture, 1947*, was issued in February, 1947,

which presented results of this study. Also, a representative of the department submitted findings on prices of American-Egyptian cotton before a Tariff Commission hearing in Washington in February, 1947.

AGRICULTURAL ENGINEERING

GROUNDWATER STUDIES

Upper Santa Cruz Valley

Recharge from floods during the winter of 1946-47 and the summer of 1947 was insufficient to balance the pumping draft from the section of the valley between the International Boundary and Calabasas in 1947. Resulting water levels, particularly in the vicinity of the Nogales City pumping plant, in early November, 1947, were lower than in October, 1946. However, in previous years at this same time lower water levels had been recorded.

From Nogales to Tucson water levels in early November indicated a lowering of from 2 to 4 feet as the result of the previous season's pumping draft. Throughout this stretch the water levels were in general from .5 to 1.0 foot lower than any comparable set of measurements. In a few local areas of concentrated pumping draft, somewhat greater lowering than stated above was observed.

The Tucson area

Studies in the Tucson area were directed primarily toward the preparation of a water table contour map of the area. This necessitated the measuring of the water level in several hundred wells and the running of at least a couple of hundred miles of levels to the wells to determine their elevation. A tentative water table map has been prepared. The logs of numerous wells have been obtained and representative samples of the well waters collected from the area for chemical analysis. Much data remain to be analyzed and additional data obtained.

Cortaro-Marana district

Water levels in the Cortaro area, both on the valley slopes and in the valley trough continued to decline, reaching new low levels in all parts of the area. Pumping draft of between 25,000 and 26,000 acre-feet per year in 1945 and 1946 resulted in an average residual lowering of approximately 2 feet per year. Indications are that the pumping draft in 1947 will exceed 27,000 acre-feet and during this summer the water level at the continuous water level recorder on Well 16-C reached a new low of 112.5 feet. This is a lowering of 82.5 feet in the water table in this well since 1922.

Pumping draft in the Marana area in 1946 amounted to about 11,000 acre-feet, approximately 2,000 acre-feet less than in 1945. Only slight residual lowering of the water table occurred, as indicated by the water level measurements made in the spring of 1947.

The Eloy district

Water levels have been obtained in February of each year, following the winter months of little pumping draft, to determine the residual effects of the previous season's pumping. In 1947, at the time of measurement, it was found that about 40 per cent of the pumping plants were in operation. It is probable that this winter pumping for grain, vegetables, and the early preparation of cotton lands did not permit full recovery and equilibrium conditions of the water table to be established. The water levels in February, 1947, were found to average 9.7 feet lower than in 1946, indicating an accelerated rate of lowering as compared to that of previous years. A few scattered water levels taken in the fall of 1947 indicate the same accelerated rate of lowering.

Little Chino Valley

The dry winter of 1946-47 and the above normal temperatures in the early part of the spring led to scattered pumping in the artesian area prior to the regular measurement of water levels and artesian pressures in the valley. Drawdown effects were apparent and much of the value of the measurements for the determination of residual lowering from the previous year's draft on the ground-water basin was vitiated. East of the artesian area, along Granite Creek and extending into Lonesome Valley, a lowering of 1.6 feet was indicated between April, 1946, and April, 1947.

Shallow water table wells in the lower end of the artesian area show a direct response to irrigation, the water table rising in the summer and dropping during the winter months. In a few wells a continuous rising trend with higher water levels each summer indicates that trouble may be expected in a few local areas from a shallow water table or waterlogged condition in the future.

Two test wells were drilled in 1947 southwest of the presently known boundaries of the artesian aquifer. In both wells buried lava flows were encountered, but upon testing with a pump neither were found to develop sufficient water for irrigation purposes. It is now known that the extent of the artesian aquifer to the south, west and to the north is definitely limited. To the east along Granite Creek and in Lonesome Valley the logs of the few stock wells do not report any buried lava flows similar to those in which the artesian water is encountered in Little Chino Valley. Water levels in these wells are only slightly above the artesian pressure surface in the artesian area and no artesian pressure is indicated. Further information is required to determine whether the artesian aquifer extends into this area under normal water table conditions.

THE ANNUAL WATER SUPPLY FORECAST

Following the established custom the forecast of water supply expected to be available for irrigation was broadcast by radio over an Arizona network on April 1, and was publicized in Arizona

newspapers. At that date the usual precipitation season is at an end and the forecasts can be, and have been, quite accurate.

The winter precipitation had been among the lowest on record and there was no snow remaining at any of the high-elevation snow-course survey stations. The forecast stated that Navajo and Apache counties and Yuma Valley would have normal adequate water supplies. Elsewhere there would be shortage of varying degrees.

On the San Carlos project the gravity supply prior to the summer rainy season was estimated at only 15,000 acre-feet. Authorization had been received to pump 125,000 acre-feet. It was recommended that the planted area be cut to 35,000 acres, 27 per cent less than the cropped area in 1946, about one third of the total area.

For the Salt River Valley Water Users Association an allotment of pumped and stored water of 2 acre-feet per acre had been made and the natural-flow water would be very low. Farmers without natural-flow rights were advised to leave up to 35 per cent of the land fallow depending on the crops and other individual conditions. The quantity in storage at the beginning of the irrigation season was 382,000 acre-feet.

A paper on "Snow Surveys, Sublimation of Snow, and the Arizona Method of Forecasting Water Supplies for Irrigation Projects" was prepared and read at a conference of the Colorado River Water Forecast Committee on April 16, 1947.

THE TAMARISK TREE AND ITS WOOD

Preservative treatment of tamarisk fence posts.

The annual inspection of treated posts showed:

1. Of the 25 posts treated at Oakland in 1934, no additional failures.
2. Of the 139 posts placed in east fence line, George Kinne farm in 1935, no additional failures.
3. Of the posts treated and set in 1942: the 49 posts on Trowbridge-Page farm, no failures; the 50 posts on University farm: some posts are decayed on outside to depth of about $\frac{1}{8}$ inch. No failures.

In May, 1946, the co-operator on the Kinne farm treated 130 tamarisk posts using 5 gallons of pentachlorophenol diluted with 35 gallons of light fuel oil. The posts are set on a division fence $\frac{1}{4}$ mile north of the farm house.

Plantings of tamarisk trees for saw logs

The problem of what caused a pathologic or nutritional condition on most of the north planting and three fourths of the south planting late in 1943 has not been solved. The north planting recovered in 1946 and made excellent growth in 1947. None of the trees in the south planting have recovered. They have made almost no growth since 1943, but no one has died and the cambian layer appears normal.

In the spring of 1947 two drainage wells were drilled and operated and a drainage canal was extended, to counteract the rising water table along the base of the escarpment bordering the Yuma Valley. Test wells in the tamarisk plantings indicate a return of the water table to normal depth without injury to the trees. In the last annual report it was suggested that recovery of trees in the north planting might have been due to rise of the water table in 1946.

Row 2 of the north planting was topped in December. Considerable thinning has been done in both groves. The trees topped in March, 1946, have high new tops, but have not gained much in diameter as yet.

To prevent further damage to the tall, slender trees, the wind-break trees have been pruned in the belief that the upward deflection of wind and slight vacuum on the leeward side increased the damage.

Growing scarcity of sources of good hardwood, it is believed, will create a considerable field of usefulness for the hard tamarisk wood.

MISCELLANEOUS

Land clearing and leveling

During the past year some studies have been made of the methods used and the time requirements for the clearing and preliminary leveling of raw land for irrigation in the Upper Santa Cruz Valley. Due to the difficulty of estimating closely the cost of this type of work and because of its heavy equipment requirements, most of this work is done on an hourly contract basis. Usually a 70-drawbar-horsepower, or larger, crawler tractor, equipped with a bulldozer or carryall is used for this work. The approximate hourly rate for this type of equipment is \$10 per hour of actual operating time.

Time requirements for the removal of brush and small trees with a 70-drawbar-horsepower crawler tractor, equipped with a modified dozer are presented in the table following. The modification of the dozer consisted of a short, 36-inch blade attached to the dozer blade and extending about 14 inches below it.

TABLE 4.—TIME REQUIRED TO DOZE AN ACRE OF BRUSH AND TREES OF VARYING DENSITY AND SIZE

Growth classified as	Time required hrs. acre		Number of plants of various diameters at root crown			
			Less than 6 in.	6 to 9 in.	9 to 12 in.	Over 12 inches
Heavy	2.75	3.5	300-400	70-100	15-30	5-10
Medium	2.0	2.75	200-300	50-70	5-15	0-5
Light	1.5	2.0	100-200	20-50	0-5	0-3
Very light	.75	1.5	100-200	0-20	0	0

The clearing was done in a dry, silty, clay loam soil on which the vegetative cover consisted of approximately 80 per cent mesquite,

6 per cent catchlaw, 6 per cent buckthorn, and about 4 per cent miscellaneous growth.

Stacking of the brush with a dozer for burning required between 0.5 and 1.5 hours, which includes time for return to remove unburned stumps and large limbs.

Preliminary leveling was done with an 8-yard carryall and required from 1.5 to 2.5 hours per acre. This consisted of filling in small washes and low spots, holes left in the removal of large stumps, and the cutting off of the high spots, with no attempt to change the natural slope of the land.

This was followed by a once-over ripping with a 2-chisel ripper. With chisel penetration of between 14 and 18 inches, spaced $3\frac{1}{2}$ feet apart, the time requirement varied from 0.6 to 0.9 hour per acre. It was found that old abandoned cleared land required the higher time rate for ripping. No data were obtained on the time requirements of floating and leveling to definite uniform slopes.

Based upon the data given above the preliminary preparation of land for irrigation in this area may cost from \$35 to \$85 per acre, including the once over ripping expense.

Pumping Plant—University Farm, Casa Grande Highway

In 1926 a Pomona, double plunger, reciprocating pump was installed on the University Farm on the Casa Grande Highway. Repair parts were no longer available for this pump and in February, 1947, it was replaced by a new pumping plant. The new unit consists of a Peerless deep-well turbine pump, operating at 1760 r.p.m., and direct-connected to a $7\frac{1}{2}$ horsepower electric motor. The bowl assembly contains 11 stages of 6-inch bowls and is set at a depth of 70 feet with suction and column pipe of 4-inch diameter.

Upon test the pump delivered 118 gallons per minute against a total head 125 feet, when pumping into the elevated storage tank, with a pump efficiency of 65.5 per cent.

AGRONOMY

ALFALFA

Fertilizer project, Mesa Farm

Profitable increases in hay yields have been secured through a 2-year period from a single application of various phosphatic fertilizers to Hairy Peruvian alfalfa at planting time. P_2O_5 was applied in treble superphosphate and in liquid phosphoric acid at about equal rates. One series of plots received 10 tons manure in addition to 200 lb. treble superphosphate. Another got only the 10 tons of manure.

Based on 1947 yields from five cuttings, the plots which received 525 lb. per acre of liquid phosphoric acid were best, exceeding the checks by a total of 4,197 lb. of baled hay. All treated plots outyielded the untreated checks but not all treatments were statistically superior.

Although the August and October cuttings showed less advantage for the fertilizers, almost without exception, all fertilized plots outyielded the checks at each cutting.

Using a figure of \$25.00 a ton for hay, the increases for the fertilizers during two crop seasons ranged from a low of \$20.09 an acre for the 10 tons manure alone to \$70.64 for the 525 lb. liquid phosphoric acid. When the cost of the fertilizers was subtracted from the value of the 2-year hay increases, however, the 200 lb. treble super alone made the best return. Gross returns per dollar invested in fertilizers ranked as follows: 200 lb. treble superphosphate—\$7.83; 175 lb. liquid phosphoric acid—\$3.14; 600 lb. treble superphosphate—\$3.03; 525 lb. liquid phosphoric acid—\$2.24; 200 lb. treble superphosphate plus 10 T. manure \$1.28; and from the 10 T. manure alone—a loss of 19.6 cents. The manured plots have never recovered from a bad start caused by having to spread the manure after plowing the land.

Variety test, Gila Project Farm, Yuma

Eight varieties of alfalfa were planted in a well replicated test in the fall of 1943. For three years, due to inadequate harvest equipment, all varieties were harvested together and the yield data are not comparable.

In October, 1946, all varieties were cut together to give each the same start. Following that, each variety was cut throughout 1947 as nearly as possible when ready. Yields of hay were calculated from green samples taken at harvest time. For cuttings made through October the old variety, Hairy Peruvian, yielded best. The new variety, African, ranked second, with Arizona Chilean third.

On the three-year average basis Hairy Peruvian still leads all others. The Chilean selection 63-1 was second, followed by African and Indian.

Hairy Peruvian, Indian, and African all made more winter growth than did any of the others, including three Chilean types. The winter growers had to be harvested more times during the season. Winter growing types tend to provide more winter feed but for a hay producer that characteristic may mean only more cuttings but no more total hay.

COTTON

Fertilizer tests

Cotton fertilizer trials were conducted at all University Farms during the past year. Increased yields on poor land were obtained with a heavy rate of phosphate and nitrogen commercial fertilizer. On land that had been in alfalfa no increase in yields was obtained. Quality studies indicate that only small changes in boll size, fiber length, gin turnout, and strength were secured with the use of commercial fertilizer.

Quality studies

Work with improving the spinnability of Arizona cotton has been continued during the past year. Certain samples of Arizona cotton obtained and handled under special conditions have given a quality of yarn comparable to those produced in other areas

known to produce good fiber. The price differential for cotton in Arizona is still sixty points off of similar cotton produced elsewhere.

GUAR

Experience with guar, a relatively new summer-growing legume, has shown it to have promise in southern Arizona certainly below about 3,000 feet. The crop can be grown successfully for seed or green manure on a very low amount of water. Seed crops of more than 2,000 lb. per net acre were produced in 1947 at Tucson and Mesa Farms on no more than 2 acre-feet of water.

In general neither experimental nor commercial plantings have been really successful unless seeded into a pre-wet seedbed about three weeks to one month earlier than the normal planting date for hegari grown for grain.

Guar has been our best summer green manure crop tested at Mesa Farm as shown by succeeding barley crops.

SMALL GRAINS AND FLAX

Variety test, Mesa

Awned Onas, a soft white wheat variety, has outyielded Baart 38 by 12.5 per cent during the four years the two varieties have been compared. Although this variety is low in milling quality, its high yielding ability should make it valuable for feeding purposes.

Arivat Selection 18 barley has yielded 106.3 per cent of the Arivat parent during the four years it has been included in the tests at Mesa. This new variety is now being increased for early release. Several of the selections from a Vaughn X Scarab cross made several years ago by Dr. Bartel have outyielded both Vaughn and Arivat for grain during the last two years of testing. Some of these high yielding selections give promise of being superior to the Vaughn parent for pasturing.

Attempts to find an oat variety for southern Arizona superior to California Red in yielding ability have been unsuccessful.

Arivat barley nitrogen fertilizer test, Mesa

Tests this year indicate that there is no advantage in nitrogen fertilizer applications at heading. Those treatments with all the nitrogen added at heading outyielded the check by only 4.5 per cent, while those with the same amount added at planting showed an increase of 24 per cent over the check. Those treatments with half applied at planting and half at heading were intermediate in yield.

Flax

The results of a flax fertilizer test conducted at Mesa this year indicate that high rates of nitrogen fertilizer applications will be profitable. The highest yields were obtained with a total application of 100 pounds of nitrogen per acre. The increase over the check for this treatment was 60 per cent. This test also indicated that applications at flowering were less effective than applications

made prior to this time. The high yielding treatment had applications of 150 lb. of ammonium nitrate at planting and 250 lb. of 20 per cent liquid ammonium nitrate at the bud stage. Under the conditions of this experiment, phosphate applications resulted in no yield increases.

Punjab was the highest yielding variety in the flax variety test this year. Three Punjab selections which last year significantly outyielded Punjab were all below Punjab in yield this year.

SORGHUMS

Fertilizer test, Mesa

Results of fertilizing hegari grain sorghum in 1946 are shown in the following table:

TABLE 5.—HEGARI GRAIN SORGHUM YIELDS AS INFLUENCED BY VARIOUS FERTILIZER TREATMENTS, MESA EXPERIMENT FARM, 1946

Treatment*	Yield lb. per acre
400 lb. 16-20	5,287
150 lb. ammonium nitrate	4,928
Check	4,346
300 lb. liquid phosphoric acid	4,220
150 lb. liquid phosphoric acid	4,216
400 lb. treble superphosphate	4,128
200 lb. treble superphosphate	3,845

*All granulated fertilizers were broadcast over the plots and disked in at planting time. Liquid phosphoric acid was applied in the irrigation water.

Best yields were produced with the combination of nitrogen and phosphorus followed rather closely by the nitrogen alone. In no case did the phosphate alone increase the hegari yields.

After effect study, Mesa

In an effort to check the aftereffects of sorghums on wheat a study was started in 1946, at the Mesa Farm, using five varieties of sorghum. Included, as a check, was a fallow plot, on which no sorghum was grown.

The sorghums were harvested in the usual way for grain—the entire residue being turned under. On one half of the plots, an application of 50 pounds of nitrogen (250 pounds of 20 per cent liquid ammonium nitrate) was made just ahead of planting Baart 38 wheat to determine whether that would counteract the effect of the sorghums.

The fallow or check plots significantly outyielded all other plots, this being true in the fertilized half as well as in the untreated portion. There was also a significant difference between Martin and the other varieties in the depressing effect on wheat yields. Hegari decreased the wheat yield 42 per cent whereas Martin decreased it only 23 per cent.

The nitrogen fertilizer increased the over-all yield of wheat by 36 per cent.

The results raised several interesting questions and the experiment is being expanded to get more information on the subject (Table 6).

TABLE 6.—YIELDS OF BAART 38 WHEAT IN POUNDS PER ACRE FOLLOWING DIFFERENT SORGHUM VARIETIES AND WITH A NITROGEN TREATMENT ON HALF THE PLOTS, MESA EXPERIMENT FARM, 1947

Variety of sorghum	Subsequent treatment		Per cent increase due to N. application	Average of both treated and untreated	Per cent reduction as compared to no sorghum
	None	50 lb. N*			
None (check)	1,120	1,893	68.9	1,507	.....
Martin	886	1,446	64.3	1,166	22.7
Caprock	942	1,234	30.9	1,088	27.8
DD #38	898	1,233	37.3	1,066	29.3
E. Hegari	780	1,157	48.2	969	36.2
Hegari	626	1,136	81.0	881	41.6

*Nitrogen added as 250 lb., 20 per cent liquid ammonium nitrate.

Table 6 shows the highest wheat yields after the check or fallows plots with the shorter combine types being next and with the heavier forage types of sorghum reducing the yield of wheat most. The difference between the check and the various sorghums was statistically significant. The yield after Martin as compared with the other varieties shows considerable varietal difference in the effect on the succeeding crop. Noteworthy also was the increased yield, under all conditions in the test, from the nitrogen application preceding the wheat. Apparently that application overcame the effects of the sorghums to the extent that even with hegari, the nitrogen fertilized plots outyielded the fallow, unfertilized plots.

WEED CONTROL

2, 4-D for nut grass control

Tests this year at Tucson indicate that 2,4-D is effective in the control of nut grass. Although rather high concentrations (0.2 to 0.3 per cent) of this chemical are necessary in spray solutions and repeated applications essential for effective control, the low cost of this material makes it cheaper than other chemicals for nut-grass control. Two and three sprayings this year have resulted in stand reductions ranging from 85 to 95 per cent. It is hoped that eradication can be effected next year.

ANIMAL HUSBANDRY

PASTURE STUDIES

Since the fall of 1944, studies by the departments of Animal Husbandry and Agronomy were made of various irrigated pasture crops—alfalfa, small grains, sudan grass, and a grass-legume pas-

ture mixture consisting of perennial rye, meadow fescue, orchard grass, Dallis grass, and alfalfa. When these crops were pastured on a rotation basis, from sixty to seventy-five steer-days feed per acre were obtained during each pasturing.

Under favorable conditions average daily gains were 1 pound per head for weaner calves and around 1½ pounds for older cattle. Good big growthy steers on barley made over 2 pounds daily gain per head.

The interval of time from the pasturing of a crop until it was pastured again depended largely upon growing conditions—temperature, soil fertility, irrigation, and upon the system of grazing.

Where pasture crops were stocked so as to use the forage to about 70 per cent in from seven to ten days, the same acreage was ready for use at intervals of about thirty days during favorable growing weather and from forty-five to sixty days during cold weather, thus making it possible to obtain from six to ten pasturings from one acreage during a year. On the basis of these figures, an acre of irrigated land may be expected to carry from one to two mature animals per year and insure favorable gains.

RANGE SUPPLEMENTAL FEEDING

During the past few years there has been an increase in the practice of feeding a salt-cottonseed meal mix to cattle on southern Arizona ranges. The apparent purpose in mixing salt with cottonseed meal is to automatically limit the consumption of meal. Presumably, then, large amounts of cottonseed meal could be distributed on the range at one time and the amount eaten automatically limited by adjusting the amount of salt added.

There has been considerable speculation as to the amount of the different salt-meal mixes which cattle will eat under range conditions and the effect on the animal of ingesting a large amount of salt over an extended period of time. It has been reported by various ranchers that a range cow will eat from 2-3 lb. of a 30:70 salt-cottonseed meal mix per day. This would amount to ingesting from 0.6-1.0 lb. of salt.

An experiment was conducted to determine the amount of a 30:70 salt-cottonseed meal mix consumed and its effect on the rate of gain of young heifers. Two pastures of approximately two sections each were made available to the University on the Rain Valley Ranch near Sonoita, Arizona. No rain fell on this area from February, 1947, until after the experiment was concluded.

Eighty-four yearling heifers were used in the experiment. These were divided into two groups with the larger animals going into the group fed the salt-meal mix.

Approximately one half of the animals from each group had been fed a small amount of cottonseed cake for six weeks prior to the start of the experiment.

The experiment was initiated March 11, 1947, and terminated July 20, 1947—a period of 101 days.

The complete results are given in Table 7.

As shown in the table there is no appreciable difference between the rate of gain of the controls and those fed the mix. The consumption of the mix was much lower than that anticipated. This apparently resulted from the large amount of dry feed on the ranges. This is substantiated also by the very high daily rate of gain of both groups. Actually the cottonseed meal consumed each day, approximately one-half pound, could not be expected to influence the rate of gain appreciably, hence the lack of difference in rate of gain of the two groups.

TABLE 7.—RAIN VALLEY, 30:70 SALT-COTTONSEED MEAL
EXPERIMENT
(Length of Experiment—101 days)

	Controls	Expt. group
No. of animals	42	42
Average initial wt./animal	297.3 lb.	381.6 lb.
Average final wt./animal	421.4 lb.	508.8 lb.
Average gain/animal	124.1 lb.	127.2 lb.
Average gain/animal/day	1.23 lb.	1.26 lb.
Lb. of rock salt consumed/animal/day	0.053	.....
Lb. of mix eaten/animal/day	.....	0.707
Average final blood carotne (gamma per cc)	1.79	1.83
Average initial Ca content, mg/100 ml. plasma		
A. Those receiving cottonseed previously	10.65	11.36
B. Those not receiving cottonseed previously	11.16	10.56
Average initial P content, mg/100 ml. plasma		
A. Those receiving cottonseed previously	4.48	3.96
B. Those not receiving cottonseed previously	4.92	4.60
Average final P content, mg./100 ml. plasma		

BLOOD P LEVELS OF CATTLE FROM SULPHUR SPRINGS VALLEY

During the early spring of 1947, Charles Grantham, of Rain Valley Ranch near Sonoita, Arizona, purchased several head of young Hereford breeding stock from Sulphur Springs Valley.

Group 1 is composed of heifers approximately one year old. Since weaning, these animals had been on Sulphur Springs Valley range. The feed of these animals had been supplemented with cottonseed meal for approximately six months previously.

Group 2 was composed of heifers approximately two years old. Several had been bred. This group had subsisted entirely on range feed.

The normal blood phosphorus level of cattle of all ages varies between 4.5-6.0 milligrams of phosphorus per 100 milliliters of plasma. The results in the table below show that group No. 2 was below this average value and substantially lower than the group fed cottonseed.

TABLE 8.—INORGANIC P. PER MG/100 ML. PLASMA

Group 1	Group 2
7.5	2.4
5.3	4.7
6.3	4.8
4.3	4.9
5.4	4.5
5.9	4.8
7.2	2.6
4.6	3.0
	4.6
5.81 Av.	3.96 Av.

ANIMAL PATHOLOGY

PASTURE DISEASE LOSSES

Extensive studies have been continued on this problem. In a severe outbreak in Yuma Valley there was a 20 per cent loss in a herd of 3,500 feeder cattle on alfalfa and Bermuda pastures. The symptoms and lesions found in these cattle were similar to those reported in previous years. Hemoglobinuria was constant in most cases.

During the investigation made on the cause of the hemoglobinuria occurring in cattle of the Yuma, Coolidge, and Salt River valleys blood from sick animals as well as minced tissue (liver, kidney) from autopsied animals was injected intravenously and intraperitoneally into normal animals. In no case was it possible to transmit the pathological condition.

Aseptically removed blood and liver and kidney tissue from the same animals were cultured in various bacteriological media. In general these cultures remained sterile. However, from the liver and kidney of two animals an anaerobic bacterium was isolated which produces a very potent hemolysin. There were no outstanding lesions in either of these animals which would indicate a possible focal point for growth of the bacterium. A few preliminary experiments have also indicated that the bacterium has a low pathogenicity for rabbits and guinea pigs. Its relationship, particularly the hemolysin, to hemoglobinuria of cattle is now being further investigated.

Stained kidney tissue sections of one animal which had died with a severe case of hemoglobinuria showed the presence of numerous Leptospiral-like bodies in the congested tubules. The presence of these bodies as well as some of the pathological changes in the diseased animals suggested that at least part of the condition may have been the result of a *Leptospira* infection. Consequently several strains of *Leptospira* have been obtained from veterinary research centers and their possible relationship to the hemoglobinuria condition of cattle in Arizona is now under investigation.

This condition may be different from cases occurring in the Salt River Valley since no correction was gotten by the changing of

feed. In the Salt River Valley this year we were able to stop losses by changing the cattle to dry feed.

POISON PLANTS

It was discovered last year that Whitethorn (*Accacia Constricta*) contains a cyanogenic substance during dry seasons of the year and that during these periods of low feed supply on the ranges this plant may be eaten in sufficient quantities to cause death from cyanide poisoning. At that time an investigation was initiated to determine the conditions in the rumen which influenced the release of cyanide.

It has been found that from 200-300 grams of dried Whitethorn leaves containing from 125 to 175 milligrams of HCN per 100 grams of plant material will cause the death of a 75-pound goat in five to ten minutes when the plant material is placed directly into the rumen with a stomach tube. The cyanide exists in the plant in combination with organic substances, probably sugars. This cyanide is hydrolyzed from the complex by the enzyme emulsin, which occurs in Whitethorn in appreciable quantities. As soon as the cyanogenic substances are eaten and mixed with moisture, emulsin starts the hydrolysis and liberation of free cyanide.

An investigation is being made of factors which influence the rate of cyanide release by emulsin. This is to include the influence of various salts such as nitrates and chlorides and the influence of moisture content of the rumen.

The occurrence of the fungus *Claviceps paspali* in Dallis grass (*paspalum dilatatum*) was shown to be the cause of poisoning in cattle grazing these pastures. The symptoms included in-coordination, muscular tremors, labored breathing and paralysis.

DIAGNOSTIC LABORATORY

Positive diagnostic analyses included 4,700 tube agglutination tests for pullorum in turkeys. The percentage of reactors was .1 per cent. Specimens from 1,400 poultry, cattle, sheep and hogs were studied and diagnoses given.

BOTANY AND RANGE ECOLOGY

BURROWEED INVESTIGATIONS

The effectiveness of 2,4-D and other herbicides on burroweed (*Haplopappus tenuisectus*) when applied to small control plots has been reported previously. During the summer of 1947 application of these results to larger areas was attempted. None of the formulations or methods of application which were successful on the smaller trial plots proved applicable on the larger areas. The results with dusts were very indecisive and the aqueous solutions show that per cent of kill is directly related to the concentration of the herbicide. The Dow Chemical Company supplied material and arranged for equipment to test three different methods of application to large areas. All three methods of application gave some promise but these results were complicated by the severe drought conditions that were prevalent during this

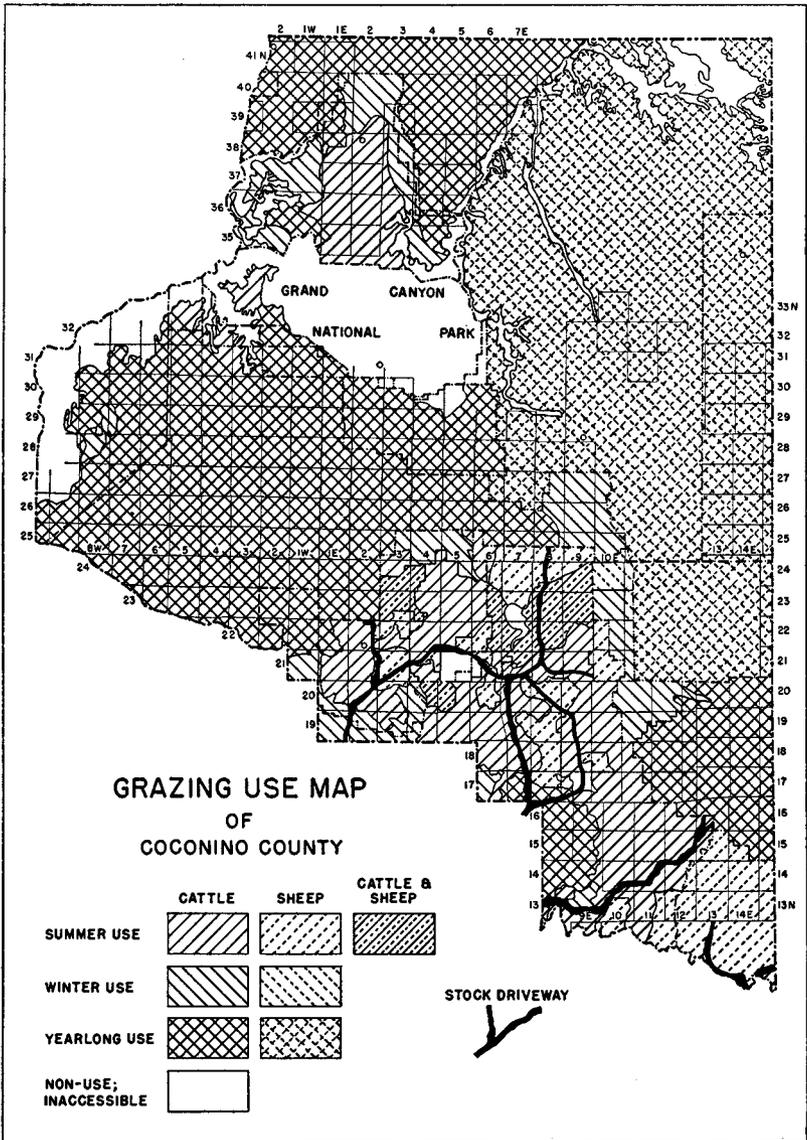


Figure 1.—Grazing Use Map of Coconino County

summer. The tests proved that burroweed plants require more drastic treatment than other field weeds if control is to be effective.

ARIZONA RANGE RESOURCES AND THEIR UTILIZATION

Work on the range resources of Coconino County is nearing completion. Figure 1 shows the Grazing Use Map of this county.

Large areas are used on a year-long basis for cattle and sheep. The Navajo Reservation in the eastern half of the county accounts for most of the sheep grazing. The summer ranges are scattered areas of higher altitude. Classifications of the various range types are being prepared.

GRASSES ADAPTED TO ARTIFICIAL RESEEDING IN DESERT GRASSLAND

Adaptation trials of sixty native and introduced grasses were conducted at the Santa Rita Experimental Range on a deteriorated grassland in co-operation with the Southwestern Forest and Range Experiment Station and the Nursery Division of the Soil Conservation Service. Introduced species found to be adapted after two-year trials in row plantings include *Eragrostis chloromelas*, *E. echinoclroides*, *E. lehmanniana*, *E. lehmanniana* var. *ampla* and *Pennisetum ciliare*. Additional exotic species which showed promise in contour furrow plantings are *Andropogon ischaemum* and *Eragrostis superba*. Native species adapted to the site were tanglehead (*Heteropogon contortus*), Arizona cottongrass, (*Trichachne californica*), and plains lovegrass (*Setaria macrostachya*).

LONGEVITY OF PERENNIAL RANGE GRASSES

An analysis of longevity of four important range grasses was made from quadrat studies over a sixteen-year period at Desert Grassland Station on the Santa Rita Experimental Range. Data have been secured for these species under three grazing treatments as to mean age attained by individual plants. Under grazing by cattle and rodents Rothrock grama lived an average age of 1.5 years although one plant survived for ten years. Some plants of Black grama and Arizona cottongrass lived throughout the sixteen-year period but the average age was 3.7 and 3.0 respectively. Poverty three-awn had a mean age of 2.5 with an extreme of eleven years. The short life expectancy of all the species indicates the desirability of adequate seedling establishment by conservative grazing use.

FLORA OF ARIZONA

The various members of the department continued co-operation with Dr. T. H. Kearney revising his *Flowering Plants and Ferns of Arizona*. A check-list of the ferns of Arizona giving the ranges of these plants was published during the year. About 50,000 sheets in the Herbarium have been given accession numbers and about twice that number remain to be accessioned. Lack of space for expansion has held up work on all but the most important groups of plants. The grass section has been completely revised and is in excellent condition for use in working on a grass manual for the state.

DAIRY HUSBANDRY

PERMANENT PASTURE

Of the nine different grasses included in the 1943 and 1944 plantings only one, Dallis grass, has survived. These plantings

TABLE 9.—AVERAGE COMPOSITION OF ALFALFA HAY FROM THE UNIVERSITY CAMPBELL AVENUE FARM AND SEVEN FARMS IN GRAHAM COUNTY

No. Samples	Cutting	Moisture (per cent)	Crude Fat (per cent)	Crude Fiber (per cent)	Protein (per cent)	Nitrogen-free Extract (per cent)	Ash (per cent)	Ca. (per cent)	P.
UNIVERSITY FARM									
2	1st	6.11	2.04	24.98	18.07	39.06	9.73	1.894	0.241
2	2nd	5.02	1.99	30.60	16.96	35.29	10.12	1.688	0.284
2	3rd	8.50	2.20	24.55	15.25	39.23	10.26	1.569	0.280
2	4th	7.27	2.16	29.51	19.65	31.02	10.38	1.515	0.311
1	5th	7.96	1.44	30.34	16.56	33.35	10.35	1.630	0.269
1	6th	6.22	7.29	24.15	18.78	33.18	10.38	1.536	0.328
GRAHAM COUNTY									
9	1st	7.96	2.34	25.67	17.99	34.81	10.34	1.639	0.248
8	2nd	9.40	2.44	26.10	18.97	32.26	10.74	1.649	0.276
7	3rd	5.18	2.22	29.14	17.52	36.38	9.54	1.359	0.248
6	4th	5.30	2.22	28.88	17.18	37.58	8.85	1.121	0.261
5	5th	5.54	2.38	21.62	18.69	41.43	9.73	1.244	0.268

include Perennial rye grass, Meadow fescue, Smooth brome, Orchard grass, Dallis grass, Rhodes grass, Alfalfa, Bur clover, and Yellow sweet clover. The clovers produced well the first spring and then practically disappeared.

Alfalfa and Dallis grass are the only ones to produce any appreciable amount of feed after the first year. Dallis grass is the only one which could compete with Bermuda grass for any length of time.

MINERALS

The milking herd has access to three mineral mixtures as follows: 1. Equal parts of calcium carbonate and salt. 2. Equal parts of steamed bonemeal and salt. 3. Equal parts of calcium carbonate, salt and steamed bonemeal. Block salt is also available adlibitum.

This study has been conducted for a period of 294 days representing a total of 10,421 cow-days. The consumption of the different mixtures was 60, 66, and 68 pounds respectively for Nos. 1, 2, and 3. The average daily mineral consumption per cow was 2.62, 2.88, and 2.97 grams respectively for the three mixtures, or a total daily mineral consumption per cow of 8.46 grams in addition to the block salt consumed.

ENTOMOLOGY AND ECONOMIC ZOOLOGY

RANGE RODENT INVESTIGATIONS

The project on rodents of the grazing ranges, which has been carried on for several years, much of the time in co-operation with the Fish and Wildlife Service, was closed with the end of this fiscal year. This work resulted in the publication of several bulletins and articles, and brought out some new ideas concerning the relations of rodents to grazing ranges.

A rodent which feeds on cactus and mesquite, for both of which plants themselves controls are being sought, can hardly be considered detrimental to the range. The rodent (white-throated wood rat) itself is as much a result of overgrazing as are the mesquite and cacti. Jack rabbits and kangaroo rats are likewise "animal weeds."

The most notable addition to the vertebrate collections is a pair of wood ducks, a very rare species in Arizona, for which we are indebted to the Arizona Game and Fish Commission. These are the first wood duck specimens in hand to be recorded and preserved in this state.

ENTOMOLOGICAL INVESTIGATIONS

Active research on Arizona scale insects has been discontinued, but the extensive collections already on hand and mounted for preservation and study enable the department to identify specimens sent in by other agencies.

Work is well under way on an improved vegetable insect pest project, the preliminary work on which appeared as a bulletin

dated at the very close of the previous fiscal year, but which was not available in the mails until autumn.

With the recently increasing importance of virus diseases of plants, many affecting vegetables, attention is being given to those insect groups to which belong so many of the vectors of virus diseases, especially the aphids and leafhoppers. Fortunately, considerable collections and experience with aphids have already accrued to the department.

HORTICULTURE

VEGETABLE CROP INVESTIGATIONS

Tomato plant production

Tomato plants, for shipment to Indiana, were successfully grown in the open at Mesa and at Yuma. These tests were part of a co-operative project between Purdue University and several southern and southwestern states. It required about eight weeks to produce a good tomato plant for shipment from the early March plantings, but only six to seven weeks to produce a good plant from the plantings made the middle or latter part of March.

Shipments of plants to Indiana were made on May 6, 15, and 26, and each lot was set out within forty-eight hours after arrival. The yields of marketable U.S. No. 1 and U.S. No. 2 canning tomato grades reported* for the three dates of shipment were as follows: first shipment, 14.25 tons per acre; second shipment, 11.27 tons per acre; and third shipment, 9.95 tons per acre.

The low yield from the third shipment was attributed to curly top infection which occurred before the plants were shipped. Since the 1947 season was one of the worst on record as far as curly top incidence is concerned, the results of the test are very promising.

Lettuce breeding and selection

The program of developing improved lines of Imperial 44, 152, 615, and Great Lakes, was continued this past year with special emphasis on the selection of lines of Imperial 44 for resistance to premature bolting and for more uniformity within the various lines. Seed from over 700 individual plants were saved for progeny tests during the fall and spring seasons, 1947-48. The most uniform and best lines from these tests will be used as foundation stocks for the improved strains of lettuce. In addition to the regular program of improving the standard varieties, a number of hybrids and new strains are under observation to see if new and better varieties can be produced for local conditions.

Cantaloupe breeding and selection

Arizona 45, which is a selection for uniformity and productivity from mildew resistant 45, continued to show considerable promise as a commercial variety. In a varietal test which included twenty-five varieties and strains of commercial cantaloupes, Arizona

*Report by Dr. John Hartman, Purdue University Experiment Station, Lafayette, Indiana.

45 outyielded the two commercial lines of 45 in the test. Growers who have had this cantaloupe in their fields are much interested in it. In addition to the variety test a large number of hybrids with mixed parentage were selfed and selections made for improved quality. A number of the lines gave readings of 13 per cent or more of total solids with a Zeiss hand refractometer.

Sweet corn variety trials

Three separate sweet corn variety trials were conducted during 1947; one on the Yuma-Mesa at Yuma, planted February 14, and two on the Mesa Experiment Farm at Mesa, one planted on March 6 and 7 and one planted August 5. These tests indicate that sweet corn probably can be grown successfully on a commercial scale if the right variety and good cultural methods are used. Some fifty-seven varieties and strains were used in the different tests with most of them being included in all three tests. In general, varieties that were good in one test were good in the other tests indicating that seasonal variations are not particularly important in the production of sweet corn in Arizona. Yields of 1,600-to 2,000-dozen ears per acre were common with the better varieties. There was some worm damage, particularly in the fall planting at Mesa, and for this reason all the large ears were not marketable, but with a good corn-ear-worm control program combined with the planting of resistant varieties it is felt that sweet corn production can be a profitable commercial venture.

The best varieties from these tests, considering ear size, worm resistance, quality and production, are Ioana, Aristogold Bantam, Aristogold Bantam Evergreen, Erie, Golden Grain, Improved Golden Cross Bantam, Golden Hybrid, Bantam Hybrid 57, and Golden Glory. Soobred, Tendermost, Tendergold, and Seneca Hybrid are also worthy of further trials.

CITRUS INVESTIGATIONS

Oil spray program for controlling weeds

This program in Washington Naval and Valencia blocks has been in operation on the Salt River Valley Citrus Research Farm since the summer of 1944. The seasonal quantities of Diesel oil used are indicated in the following table:

GALLONS OF DIESEL OIL USED PER ACRE				
	1944	1945	1946	1947
Spring	.....	267	142	65
Summer	110	220	116	100
Fall	110	0	11	0
Total	220	487	269	165

In comparison with other cultural treatments the orange fruit yields and quality were very favorable on the oil spray block. During the past two winters much less freezing of Valencia fruit occurred in the oil spray blocks than in other blocks.

During the summer of 1947 mixtures of Diesel oil and water with thorough agitation proved more effective than straight oil. Half water and half oil is satisfactory especially when used with an emulsifying agent such as Tricon X-100. Although the Dow General mixture (70 gallons of water, 30 gallons of Diesel oil, and 1 quart of Dow General) has proven effective as a weed killer, it is not known whether the ingredient di-nitro might be toxic to citrus trees after repeated applications. Used as a weed killer in the orchard 2, 4-D has proven toxic to citrus trees. Shell 20 has been used effectively on Bermuda grass and Johnson grass in the citrus orchard.

In the summer of 1945, oil-spray control of weeds was begun on a block of grapefruit trees. Results to date show that large, rough-skinned grapefruit result at spring harvest under this system of cultural management.

Weeds should not be allowed to grow over 4 inches in height at the time various oil spray applications are made. It is important to apply an oil spray four or five days before an irrigation to obtain complete weed killing. Weed killing efficiency is increased if the oil is applied during the hot part of the day.

Starch storage in the grapefruit tree in relation to seasonal temperature and nitrogen nutrition

During the months of July and August, when the highest average temperatures prevail, starch reserves in all parts of the tree, except large branches and trunk, are practically exhausted. After September 15, when average temperatures drop to 80 degrees F. and below, starch storage proceeds rather rapidly. At 55-60 degrees F. and below, starch is rapidly converted to sugar. There is evidence to indicate that during the coldest months, December and January, the maturing fruit place a considerable drain on the stored starch. After the first or second week in January, when average temperatures begin to rise, starch accumulates rapidly and steadily to a maximum at about the middle of March. All through the season, particularly in February and March just prior to bloom, starch concentrations in the shoots are higher in the trees which are in a higher state of nitrogen nutrition, as indicated by leaf analysis for nitrogen. This relation appears to be the same throughout the tree including the roots. The larger fleshy roots are the most efficient storage organs. It is apparent that a high state of nitrogen nutrition results in a more complete utilization of stored root starch by the actively growing parts of the tree.

Nitrogen control induces early grapefruit maturity on Yuma Mesa

Grapefruit trees on the Yuma Mesa Citrus Research Farm continued to show earlier maturity when nitrogen is controlled by proper timing of application coupled with growing of summer cover crops for the removal of excess nitrogen. The nitrogen-control program can be handled easily on young trees but practical features of the program in mature orchards still need to be worked out.

Irrigation of citrus

The University Citrus Research Orchard located at Tempe was operated on an allotment of 3 acre-feet of irrigation water during the year of 1947. The grove had eight irrigations at approximately thirty-day intervals during the summer. The grove is irrigated by means of open ditches and the magnitude of the ditch loss is not known. Practically all of the allotted water had been applied by the middle of October. During the months of November and December the citrus trees were showing serious water deficits. Water shortage on the citrus farm has become so serious that many of the cover crop tests have had to be discontinued.

Many of the citrus groves in the Salt River Valley are now operating on an allotment of 2 acre-feet of water. *What is the most efficient irrigation schedule for an allotment of 2 acre-feet of water for citrus?* This is a very pertinent and timely question. On the basis of experimental evidence acquired on the University Citrus Farm at Tempe, the following irrigation schedule seems advisable where the soil is similar to that existing on this farm, and is to be tested through several seasons.

1. January: Wet soil down to 6 feet requiring approx. 9 inches of water.
2. March 15: Apply approximately 3 inches of water.
3. June 15: Apply 4 inches of water to alternate borders (a's).
4. Aug. 1: Apply 4 inches of water to alternate borders (b's).
5. Aug. 20: Apply 4 inches of water to alternate borders (a's).
6. Sept. 20: Apply 4 inches of water to alternate borders (b's).
7. Nov. 1: Apply 4 inches of water to all borders to irrigate in fertilizer.

NUTRITION

NUTRITIONAL STATUS CO-OPERATIVE PROJECT

A co-operative project to study the nutritional status of population groups has been started by the Experiment Stations of western states. Studies will be started in Oregon and then extended to other western states.

PHYSIOLOGICAL AVAILABILITY OF FOOD FACTORS

In previous work it was found that carotene in cantaloupe was a highly available source of vitamin A. Further studies reveal that mixing an oil solution of carotene with corn starch makes the carotene more available as a source of vitamin A. Carotene in cantaloupe is dispersed in a highly digestible food. This is probably the reason for the high availability of carotene in cantaloupe.

AMINO ACID CONTENTS OF FRUITS AND VEGETABLES

The importance of amino acids in nutrition has been emphasized during the last few years. Much work has been done on meats and cereals but little on fruits and vegetables. A satisfactory

method was developed for the hydrolysis of vegetable products for the determination of tryptophan. Broccoli, cauliflower, and alfalfa were comparatively high in tryptophan while sweet corn and carrots were low. Tryptophan, besides being a constituent of proteins is important for the prevention of pellagra.

PLANT BREEDING

ALFALFA BREEDING

The requirements of an alfalfa variety for the irrigated valleys of southern Arizona are:

- 1st—High yield of hay.
- 2nd—High quality of hay which means fine stems and a high percentage of leaves.
- 3rd—High seed yielding ability.
- 4th—Nondormant, southern type which permits winter growth for grazing.
- 5th—Greater longevity of stand.

Any alfalfa breeding program to be of benefit to the growers should have as many of these five objectives as possible. The first consideration in any improvement by breeding is the foundation varieties from which selections are made. One of the important findings in connection with commercial varieties of alfalfa is that they are highly variable with regard to all the important characters. It has been found possible to select out as many types from an *adapted* commercial field as from a cross between widely different sorts. Accordingly, selection has been confined to the three leading Arizona varieties; namely, (1) Chilean, (2) Indian, and (3) African. From 500 to 1,000 individual plant selections are made in successive years from these fields and planted in short rows on the Yuma Experiment Farm. *It is in these progeny rows that the superior types begin to appear* and from which selections are made for testing. The seed of the best selection is increased for planting by a co-operator active in the Arizona Crop Improvement Association. As an indication of the value of this type of breeding it may be stated that the seed of selection 21-5 is selling at 36½ cents per pound as compared to 25 cents per pound for the original Chilean from which it was selected. Furthermore, the acreage of 21-5 for the purpose of producing certified seed has been increased from 750 acres to 1,000 acres for the 1948 seed crop. With an average of 300 pounds of seed per acre, this 1,000 acres will produce 300,000 pounds of certified 21-5 seed in 1948, or enough to plant 15,000 acres.

Since this method of selective breeding has produced strain 25-5 from the Chilean or common type of alfalfa, this same method is being used to improve both the Indian and African varieties. Approximately 1,000 individual plants have been selected from each of the Indian and African varieties, and the seed from each plant has been planted in a short row on the Yuma Experiment Farm. The seed from eighty-five of the highest seeders have been planted in triplicate and their seed setting will be further

tested in 1948 from which an improved type of each variety both as to seed setting and hay quality will be established.

UPLAND COTTON BREEDING

Progeny rows of five new strains were grown on the Mesa Experiment Farm in 1947. Two of these strains are crosses between Santan Acala and New Mexico 1517. Two strains are back crosses of Santan on Santan X N. M. 1517. The fifth strain is a cross between Santan and Stoneville 2B. All have fiber slightly longer than Santan, and much stronger. They have consistently produced better yields at the Mesa Farm.

Each progeny row was replicated four times in an effort to further increase the yield. This work will be continued with at least four of the strains, and further crosses will be made as each possesses some good quality not found in the others.

At the present time spinning tests have been made on only two of these new strains—the straight crosses between Santan and 1517. In each case the yarn was much stronger and slightly better in grade than that obtained from Santan. The better yarn grade was due to a slightly lower nep count.

These five new strains, together with four from Sacaton and one from California, were grown on the Mesa Farm in 1947 with Santan and P18-C (Shafter Acala) as checks. Each of the twelve varieties was replicated twelve times in a latin square. The same varieties were grown at Sacaton and near Casa Grande. These three field tests were conducted in co-operation with the U.S. Field Station at Sacaton.

Samples of nine of the new strains as well as Santan have been sent to Texas A & M College where spinning tests will be made. When the results of these tests have been received, and the yield tests have all been harvested, a decision will be made as to which of the new strains will be increased for distribution to growers. Any new strain introduced will yield more than either Santan or P18-C, and will give a much stronger yarn. There is a good chance that the yarn grade will be better also.

Three or four of the most promising of these strains have already been increased in a preliminary way, and if one of these is selected, probably as much as 50 acres can be grown in 1948.

LONG STAPLE COTTON BREEDING

Three hundred twenty-eight progenies of multiple crosses of SxP Tanguis, Eea Island and Upland were planted in 50-foot progenies. The objectives in these crosses are strong fiber, larger bolls, smaller size of plant, and increased earliness. These were grown in comparison with SxP, the standard variety, and twenty-six of these progenies are distinctly superior to SxP in earliness, productiveness, and plant type. Through a program of selfing, these progenies are rapidly acquiring the uniformity necessary for a commercial variety. Considerable progress has been made in establishing strains with larger bolls than the SxP. This character in combination with a productive type with reduced size of plant

will greatly increase the efficiency of the mechanical cotton picker in harvesting.

WHEAT BREEDING

Head selections numbering 4,867 were made from the following wheat crosses: There were 3,064 selections from the Baart 38-Timopheevi crosses. These were taken from first, second, and third back crosses, Baart 38 being the recurring parent. The object in these back crosses is to build up the Baart 38 genotype with respect to Agronomic characters in combination with rust resistance of the Timopheevi.

The 1,283 selections from a cross of Baart 38 on a strong strawed sort were made for the purpose of increasing the strength of straw of the Baart 38.

The remainder of the selections were from a cross of durum wheat on Baart 38 for the purpose of testing the possibility of using durum wheat in crosses to increase the rust resistance of the bread wheats.

Each of the 4,867 head selections was threshed separately and planted in a head row. A study will be made of these head rows in the spring of 1948 when selections will be made for the purpose of establishing the best strains.

PLANT PATHOLOGY

ALFALFA BACTERIAL WILT

Previous to 1945 some eighty-five varieties of alfalfas were tested at the Arizona Agricultural Experiment Station for their resistance to the alfalfa wilt bacterium, *Corynebacterium insidiosum* (McCul.) Jensen. Of these a single setting from a plant of F. C. 19316, inoculated with the wilt bacterium in 1942, showed promise of disease-resistance. This plant continues to survive. Under the conditions in which it has grown, seed has not been produced in any appreciable quantities. Artificial tripping of the flowers has not been effective in increasing seed production. The original seed from which this plant was grown originated in Turkistan.

All of the presently grown southern Arizona alfalfas, such as Hairy Peruvian, African, Indian, and Chilean are susceptible to *C. insidiosum*. Two reportedly resistant varieties, Ranger and Buffalo, are unprofitable for hay in southern Arizona due to their slow recovery after cutting.

In addition to F.C.19316, some recently acquired varieties of alfalfa are being studied as to their wilt-resistance. Some of them are listed on page 33.

The first seven varieties mentioned appear to be well adapted to the central and southern parts of this state and may prove useful in the wilt-resistance program. In addition, seeds from plants (escapes from disease) from already established fields of alfalfa in the Litchfield Park, Glendale, and Tubac districts, are being utilized as sources of plants for future inoculations with the wilt bacterium. Most of these collections represent the Hairy Peruvian alfalfa.

Name or number of variety	Source of seed	Remarks
IAL ("Temecine")*	Tunisia, North Africa	Seed is introduced by Dr. L. C. Curtis in 1944
Pansaleo	Ambato, Ecuador	
Morada	Ambato, Ecuador	
Unnamed	Guaranda, Ecuador	
P.E.I. 150, 418 "Demnat"	University of Morocco	
P.E.I. 150, 419	Kasha Tadla, Morocco	
P.E.I. 150, 420 "Tunesia"	Morocco	
Fifteen hybrid and polycrosses† developed at the Uniform Alfalfa Nurseries		
56-C2 x C10	57-C24	537-C2
56-C3 x C21	57-C41	567-C2 x C21
56-C10 x C17	57-C45	A204 Nebr.
56-C17 x C19	57-C46	
56-C21 x C17	57-C48	
57-C22	57-C56	

*Appears to be unusually susceptible to the rust fungus, *Uromyces striatus* Schroet.

†They have not thrived too well so far, under southern Arizona environment.

LETTUCE WATERY BROWN ROT

With the co-operation of the American Cyanamid Corporation, soil applications of "Aero" calcium cyanamid have been continued in an effort to reduce losses in both fall and spring lettuce plantings due to the watery brown rot fungus, *Sclerotinia sclerotiorum* (Lib.) Mass. In outdoor plots, cumulative applications of the chemical over a period of years apparently do not increase its effectiveness in reducing the amount of disease. Applications of granular calcium cyanamid at the rate of 900 lb. per acre in soil that had been inoculated with the sclerotia of the fungus for periods of two years (Border 2) and three years (Border 3) resulted in the following percentages of diseased plants over a period of two years.

Border No.	Treatment	Percentages of diseased no. 615 lettuce plants	
		1946*	1947
2	Check	83.1	91.5
	Treated	55.1	68.8
3	Check	75.2	84.9
	Treated	45.2	67.4

*Several applications in previous years had already been made in the soil of both borders, so that these figures prevailed after several applications of calcium cyanamid. It should be noted that repeated additions of sclerotia to the soil made infestation with the fungus heavier than would normally occur in nature.

CHILI PEPPER DISEASES

Co-operative studies on the control of root diseases of chili peppers were initiated in 1947. Approximately 6 acres of a field selected for its exceptionally heavy infestation with the chili-wilt *Fusarium* was divided into thirty-three plots, and ten different treatments with soil disinfectants, soil amendments, fertilizers, and rotation crops were begun. Although there was an apparent benefit from some of the treatments, the results in 1947 were not considered significant because of the low incidence of wilt in the check plots and the unsatisfactory cultural conditions.

CITRUS ROOT DISEASES

This project was primarily initiated to study dry root rot of citrus but, as suspected from the start, the root troubles are due to a variety of causes. Typical dry root rot infections have responded favorably to applications of manure, sulphur, and ammonium sulphate in basins around the affected trees. Dry root rot has not been as abundant as formerly during the past five years, but a number of other maladies in which the above-ground symptoms are similar to those of dry root rot have been particularly prevalent in 1946 and 1947.

The citrus nematode (*Tylenchulus semi-penetrans*), found in a few citrus orchards a quarter-century ago, in the Salt River Valley, is now abundant in a number of declining groves and evidently a factor of economic importance.

Injury to the feeding roots, caused by the accumulation of alkali salts in the root zone during the drought of 1946-47, is probably responsible for the poor condition of a considerable number of citrus groves.

COTTON DISEASES ON NEW LAND

Over 1,500 acres were planted in cotton in the Sulphur Springs Valley in 1947, practically all on land never before cropped to cotton. Many of the fields showed *Verticillium* wilt, evidently introduced in the seed. Some fields showed slight to severe damage from the indigenous Texas root rot fungus. No Southwestern Cotton Rust was observed. That only three plants in a single field were found infected with the angular leafspot bacterium may be attributed to the fact that all seed (the carrier of the bacterium) brought into the district had been acid-delinted.

In connection with the possible seed-transport of the *Verticillium*-wilt fungus, studies carried on during the last season have supplied an abundance of material for study. Inoculations of stems, bolls and pedicels of cotton with pure cultures of *Verticillium albo-atrum* have invariably resulted in "takes" as was expected. A wealth of preserved material is available for the tracing of the fungus into the boll and seed if, as believed, such entry occurs.

FLAX DISEASES

Many specimens of diseased flax have been cultured and studied in order to provide a sound basis for the control of prevalent dis-

eases. In addition to the cultural studies, field plots have been planted under different treatments for the control of soil-borne pathogens.

PHYMATOTRICHUM (TEXAS OR COTTON) ROOT ROT

Rotation experiments: A series of rotation experiments designed to explore the possibilities of profitable use of root-rot infested land was initiated in 1944. Five rotations based on cotton as the cash crop, and three based on flax are under way at the Mesa farm. Three rotations including alfalfa, and four including horticultural crops have been tried at Tucson. With only four years' results available several interesting facts have become evident:

(1) The difference in yield of cotton between the untreated control plots and treated plots has become progressively larger in the second, third, and fourth year of the experiments.

(2) There has thus far been no marked decrease in the amount of root-rot infection in treated plots planted to cotton every year or on alternate years, but more of the plants die later in the season after they have matured all or most of their bolls.

(3) The increase in seed cotton harvested per acre on treated plots averaged:

Treatment	1946	1947	1947 (lb.)
Manure furrowed in	78%	185%	965 lb.
Manure, sulphur and coml. nitrogen furrowed	105%	239%	1251 lb.
Following sour clover	89%		
Following hubam clover		216%	1130 lb.
Following guar and sulphur	140%	291%	1523 lb.
Following guar, sulphur and hubam clover		327%	1708 lb.

(4) In 1946, flax following a green manure crop of guar produced 25.4 per cent more seed than flax following sesbania. In 1947, the yields were not significantly different. Flax following a seed crop of early maturing guar yields from 25 to 40 per cent less than following a green manure crop of guar which supplies a much greater amount of organic matter to the soil.

(5) As an early cotton especially adapted to root-rot-infested land because it matures over two-thirds of its bolls by the first picking, "Paula C" is outstanding. In 1947, Paula C. picked an average of 1,345 and 1,385 lb. per acre against 880 and 917 lb. for Acala. Paula was introduced into Arizona in 1946 by this department.

POULTRY HUSBANDRY BREEDING INHERITANCE STUDIES

Developing a high producing strain of White Leghorns

Foundation matings.—During the current year a foundation of three dams with an average egg production of 247 eggs was mated to a male, the dam of which had laid 271 eggs the first year and 208 eggs the second year. Twenty-six progeny from this mating are now in the process of establishing their first year's record.

In the foundation mating of 1945-46, the females averaged 233 eggs, and the male came from a dam with 249 and 131 eggs for two consecutive years. From this mating five progeny averaged 254 eggs. These were from two families one of which averaged 279 eggs and the other 229 eggs.

One family greatly exceeded the production of the foundation while the other was slightly under. A third family had a mortality of 100 per cent. This indicates trends on a family basis all stemming from the same foundation.

Family matings.—A family mating of nine females averaging 241 eggs were mated to a male from a dam laying 271 and 208 eggs for two consecutive years. The eighteen progeny from this mating are now establishing their egg record for the first year.

The family mating of 1945-46 in which twelve females with a group average of 228 eggs were mated to a male the dam of which had laid 242 and 221 eggs for two consecutive years produced twenty-one progeny, the average egg production of which was 174 eggs.

From the foundation mating with an egg average of 241, the progeny averaged 254 eggs. From the family mating with an egg average of 256, the progeny averaged 175 eggs. In this year the foundation mating proved far superior to the family mating.

Prolonged economic production

A female foundation of ten birds with an average egg production of 253 eggs the first year and 233 eggs the second year were mated to a male from a dam laying 252 eggs the first year, 225 eggs the second year, and 187 eggs the third year.

From this mating twenty-three progeny were obtained which are now establishing their first year egg records.

A female family mating of seven birds with an average record the first year of 260 eggs and a second year of 238 eggs were mated to a male from a dam with 252 eggs the first year, 225 eggs the second year, and 187 eggs the third year. From this mating twenty-three progeny were obtained which are now establishing their first year's record.

The progeny from the 1945-46 foundation mating, thirteen in number, averaged 193 eggs. This mating was composed of nine females with an average egg production of 247 eggs the first year and 183 the second year. The male involved came from a dam laying 241 eggs the first year and 174 eggs the second year. The progeny are being carried over this current year to establish their second year records.

The progeny from the 1945-46 family mating, seven in number, averaged 188 eggs. The mating consisted of thirteen females with an average egg production the first year of 216 eggs and the second year 130 eggs. The male involved came from a dam laying 241 eggs the first year and 174 eggs the second year.

The progeny are being carried over this current year to establish their second year records.

In this case the results from the family mating were just about equal to the foundation mating.

Establishing a strain for large eggs

In the spring of 1947 the foundation mating of two individuals with an average egg size of 25 ounces to the dozen was mated to a male from a dam with an egg size of 27 ounces to the dozen. From this mating only the progeny of C79 survived. These progeny, four in number, are now in the process of establishing their first year's egg weight.

In the family mating a group of ten females with an average egg size per dozen eggs of 26.3 ounces was mated to a male from a dam with an egg size of 27 ounces to the dozen. From this mating forty progeny were obtained. These are now in the process of establishing the weights on their first year's eggs.

From a foundation mating in 1945-46 in which the average egg weight of eggs from the females was 27 ounces to the dozen and the male's dam with eggs averaging 27.4 ounces to the dozen, eight progeny were obtained. The average weight of eggs from the progeny of 23.2 ounces to the dozen cannot be compared to the foundation until the second year's weight is obtained, as the averages in the foundation were based on second year's egg size.

From a family mating in 1945-46 consisting of ten females with an egg size of 26.9 ounces to the dozen, and mated to a male from a dam with an egg size of 26.6 ounces to the dozen, fifteen progeny were obtained. These progeny had an average egg size of 23.5 ounces to the dozen. Although the egg size of the progeny has consistently been less than that of the mating the difference this year is greater than in years past.

Pendulous crop as an inherited factor

This abnormality has been established as an inherited factor in turkeys. Chickens frequently exhibit this condition and in some instances it is most severe.

Barred Plymouth Rocks with decided pendulous crops were mated to a male showing a similar enlarged crop.

Four females were mated but only one survived and hatched chicks with which to continue this work. Males used for subsequent matings were also from this dam.

Birds were examined each three months and the degree of crop enlargement recorded. In no case was a severe pendulous crop encountered. Ten birds were checked, with five having normal and five very slightly enlarged crops. It was noted that the greatest deviation from normal occurred during the hot dry period of the year. This is to be expected since more water is consumed, thereby aggravating any tendency toward a pendulous crop condition.

The results are in general agreement with those recorded in previous work.

APPENDIX**ANALYTICAL SERVICE**

Table 10 gives a tabulation of the chemical analyses made in the Department of Agricultural Chemistry and Soils during the

year for citizens of the state mostly from the farms and ranches. The analyses made in the Tucson and Phoenix laboratories are given separately.

TABLE 10.—COMPILATION OF ANALYSES MADE IN THE DEPARTMENT OF AGRICULTURAL CHEMISTRY AND SOILS

Samples	Phoenix	Tucson
Waters	1,027	477
Soils	1,082	658
Manures	22	3
Feeds	49	
Gypsum	6	39
Plant materials	84	93
Minerals		12
Miscellaneous	10	10
Total	2,280	1,292

TWENTY-FIFTH ARIZONA EGG LAYING TEST

The termination of the twenty-fifth Arizona Egg Laying Test which ended September 22, 1947, after a period of 357 days, finds the White Leghorn pen of thirteen birds owned by the Foreman Poultry Farm of Lowell, Michigan, in first place. This pen laid 3,451 eggs with a point value of 3,357. In second place was another pen of White Leghorns owned by the Rusk Poultry Farm of Windsor, Missouri. This entry has 3,312 eggs and 3,338 points to its credit, only 19 points less than the first place pen. Another White Leghorn entry owned by J. T. Milligan of Paso Robles, California, is in third place with 3,342 eggs and 3,298 points.

The high individual for the 357-day period is a White Leghorn hen owned by the Siek Poultry Farm of Benson, Arizona. This bird laid 309 eggs with a point value of 324, which is equivalent to a percentage production of 86.6.

The percentage production of the entire test of 59 per cent represents an average egg production of 211 eggs for the 257-day period and exceeds last year's production by 2.9 per cent.

Within the number of birds to complete the test, 9 or 1.8 per cent laid 300 eggs or more in the 357-day period; 50 or 9.9 per cent laid from 275 to 299 eggs; 114 or 22.6 per cent laid from 250 to 274 eggs; 117 or 23.2 per cent laid from 225 to 249 eggs; 92 or 18.2 per cent laid from 200 to 224 eggs; 52 or 10.3 per cent laid from 175 to 199 eggs; 38 or 7.5 per cent laid from 150 to 174 eggs; 18 or 3.6 per cent laid from 125 to 149 eggs; and 14 or 2.8 per cent laid less than 125 eggs.

One hundred and seventy-three or 34 per cent of the birds to finish the test laid 250 eggs or more. Three hundred and eighty-two or 76 per cent laid 200 eggs or more.

The average egg size of 23.8 ounces to the dozen is just under the average of 24 ounces for large eggs.

The mortality of 13.4 per cent is the lowest in the last sixteen years.

SOIL SURVEY (CO-OPERATIVE WITH THE U.S.D.A.)

The work of surveying the agricultural lands in Yavapai County was resumed after a five-year interruption due to the war. This work will be completed and the report written during the early winter of 1947-48. When the Yavapai area is completed the Sulfur Spring area which was originally surveyed in 1938-40 will be revised and prepared for publication. The soil survey report of the Duncan area was approved for early publication.

As a departure from regular practice the University published as Technical Bulletin 113, the soil survey report of the Queen Creek area, Arizona. The field work in this area was conducted by members of the Soil Conservation Service. Since the Soil Conservation Service no longer concerns itself with making block surveys or basic surveys, there has been no co-operation along that line during the past year.

Work has continued on the analysis of soil survey samples during the past year and this type of work will be expanded to form a part of a Purnell project on the physical and chemical properties of the more important soil types in the state. Greenhouse investigations which will form part of the work under this project were not carried out this year because of a lack of proper greenhouse facilities.

SUMMARY OF STATION PUBLICATIONS

TECHNICAL BULLETINS

No. 112.—*Soil Properties Contributing to Citrus Chlorosis as Revealed by Seedling Tests*, by W. T. McGeorge, 36 pages. In the study of chlorosis one important phase of the problem is the availability of iron, manganese, copper, and zinc in the soil. The investigations reported in this bulletin present a seedling method, using rye and barley seedlings, for measuring the availability of these elements in Arizona soils. It was found to be especially useful when the roots and tops are analyzed separately as the root: top ratio shows the transport of these elements within the plant itself. It is shown by seedling tests that the major cause of chlorosis on plants growing in alkaline calcareous soils is not due to unavailability in the soil but to the failure of the plants to utilize these elements after they have been taken up by the roots.

No. 113.—*Physical Land Conditions on the Queen Creek Soil Conservation District Arizona*, by E. C. Nielson, W. G. Harper, and H. V. Smith, 49 pages. This bulletin presents a survey of the Queen Creek district with the Soil Conservation Service, the Bureau of Plant Industry, U.S. Department of Agriculture, and the Arizona Agricultural Experiment Station co-operating. It presents data on the geology and climate of the district, maps showing distribution of the land classes, identification and distribution of the several soil series located in the district, and other data of interest to land owners in the district.

GENERAL BULLETINS

No. 204.—*Vegetable and Herb Seed Production in Arizona*, by A. E. Griffiths, Winston W. Jones, and A. H. Finch.

No. 205.—*Conserving and Developing Arizona's Agricultural Wealth*, prepared by Agricultural Postwar Planning Committee of the Arizona State Resources and Planning Board; compiled by George W. Barr.

No. 206.—*Arizona Agriculture, 1947*, by George W. Barr.

No. 207.—*Beekeeping Near Cotton Fields Dusted with DDT*, by S. E. McGregor and C. T. Vorhies.

MIMEOGRAPHED REPORTS

No. 82.—*Certified Seed Potatoes in Arizona—Requirements and Procedure*, by R. B. Streets.

ANNUAL REPORT

Fifty-seventh Annual Report for fiscal year ending June 30, 1946.

OTHER PUBLICATIONS

Bartel, Arthur T., *Some Physiological Characteristics of Four Varieties of Spring Wheat Presumably Differing in Drought Resistance*. Jour. of Agr. Res., Vol. 74, No. 3, pages 97-112, Washington, D.C., February 1, 1947.

Bolomey, R. A. and Kemmerer, A. R., *The Determination of Ascorbic Acid; A Simplification of the Roe Method*. J. Biol. Chem. 165, 377, 1946.

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Harland, F. G. and R. N. Davis, *Babcock vs. Mojonnier Test for Homogenized and Unhomogenized Milk*. Jour. Dairy Sci. 29:845-48, 1946.

Haskell, Horace S. and Reynolds, Hudson G., *Growth, Developmental Food Requirements, and Breeding Activity of the California Jack Rabbit*. Jour. of Mammalogy, Vol. 28, No. 2, pp. 129-36. May, 1947.

Kemmerer, A. R. and Shapiro, F., *Three Sources of Amino Acids for the Niacin Assay*. Anal. Chem., 19, 308, 1947.

Kemmerer, A. R., Bolomey, R. A., Vavich, M. G., and Davis, R. N., *Effect of Thyroprotein Upon Vitamin Content of Milk*. Proc. Soc. Exp. Biol. Med., 63, 309, 1946.

McGeorge, W. T., *Fertilizer for Semi-Arid Soils. Citrus Leaves* 26; 11, Dec. 1946.

McGeorge, W. T., *Modified Neubauer Method for Soil Cultures*. Soil Science 62; 61, July 1946.

McGeorge, W. T., *Corrective Measures for the Salinity Problem in Southwestern Soils*. Better Crops with Plant Food 31; 19, June 1947.

Phillips, Walter S., *A Check-list of the Ferns of Arizona*. American Fern Journal. Vol. 36, No. 4, pp. 97-108. Oct.-Dec. 1946; Vol. 37, No. 1, pp. 13-20. Jan.-March 1947; Vol. 37, No. 2, pp. 39-51. Apr.-June 1947.

Smith, G. E. P., *Snow Surveys, Sublimation of Snow, and Forecasting Water Supplies for Irrigation Projects*. April 16, 1947. A paper read before the conference of the Colorado River Water Shed Forecast Committee. (Mimeographed copies available.)

Ninth Annual Report of the Arizona Fertilizer Control Office, 16 pages. This bulletin is a report of the inspection and analyses of commercial fertilizers sold in the state during 1946.

Ninth Annual Report of the Arizona Feed Control Office, 57 pages. This bulletin is a report of the inspection and analyses of mixed feeds, mineral feeds, and cottonseed meal sold in the state during 1946.

First Annual Report on Economic Poisons, 24 pages. This bulletin is a report on inspection and analyses of economic poisons sold in the state during the fiscal year 1945-46.

TABLE 12.—FINANCIAL STATEMENT, 1946-47, UNIVERSITY OF ARIZONA, AGRICULTURAL EXPERIMENT STATION

	RECEIPTS				Total
	Hatch	Adams	Purnell	Bankhead-Jones		Non-Federal Funds
Received from the Treasurer					
of the U. S.	\$15,000.00	\$15,000.00	\$60,000.00	\$14,392.26	\$104,392.26
State appropriations .....	.....	.....	.....	.....	108,640.59
Main stations .....	.....	.....	.....	.....	.....
Substations .....	.....	.....	.....	.....	97,833.42
Special endowments .....	.....	.....	.....	.....	11,849.57
Sales and balances forward .....	.....	.....	.....	.....	29,592.56
Total receipts	\$15,000.00	\$15,000.00	\$60,000.00	\$14,392.26	\$352,308.40
	DISBURSEMENTS				
Personal services	14,170.92	12,346.24	46,106.80	11,281.30	247,864.30
Travel	630.33	1,505.70	2,281.23	1,471.42	13,201.15
Transportation of things	4.21	42.41	342.37	156.82	1,066.34
Communication service	68.15	35.44	87.13	146.27	1,679.81
Rents and utility services .....	.....	.....	.....	.....	4,882.24
Printing and binding	22.58	.....	63.44	1.25	5,643.17
Other contractual services	9.08	100.55	143.22	107.03	6,852.42
Supplies and materials	94.73	740.11	7,565.20	906.73	18,111.56
Equipment .....	.....	229.55	3,410.61	321.44	21,927.73
Total disbursements	\$15,000.00	\$15,000.00	\$60,000.00	\$14,392.26	\$352,308.40