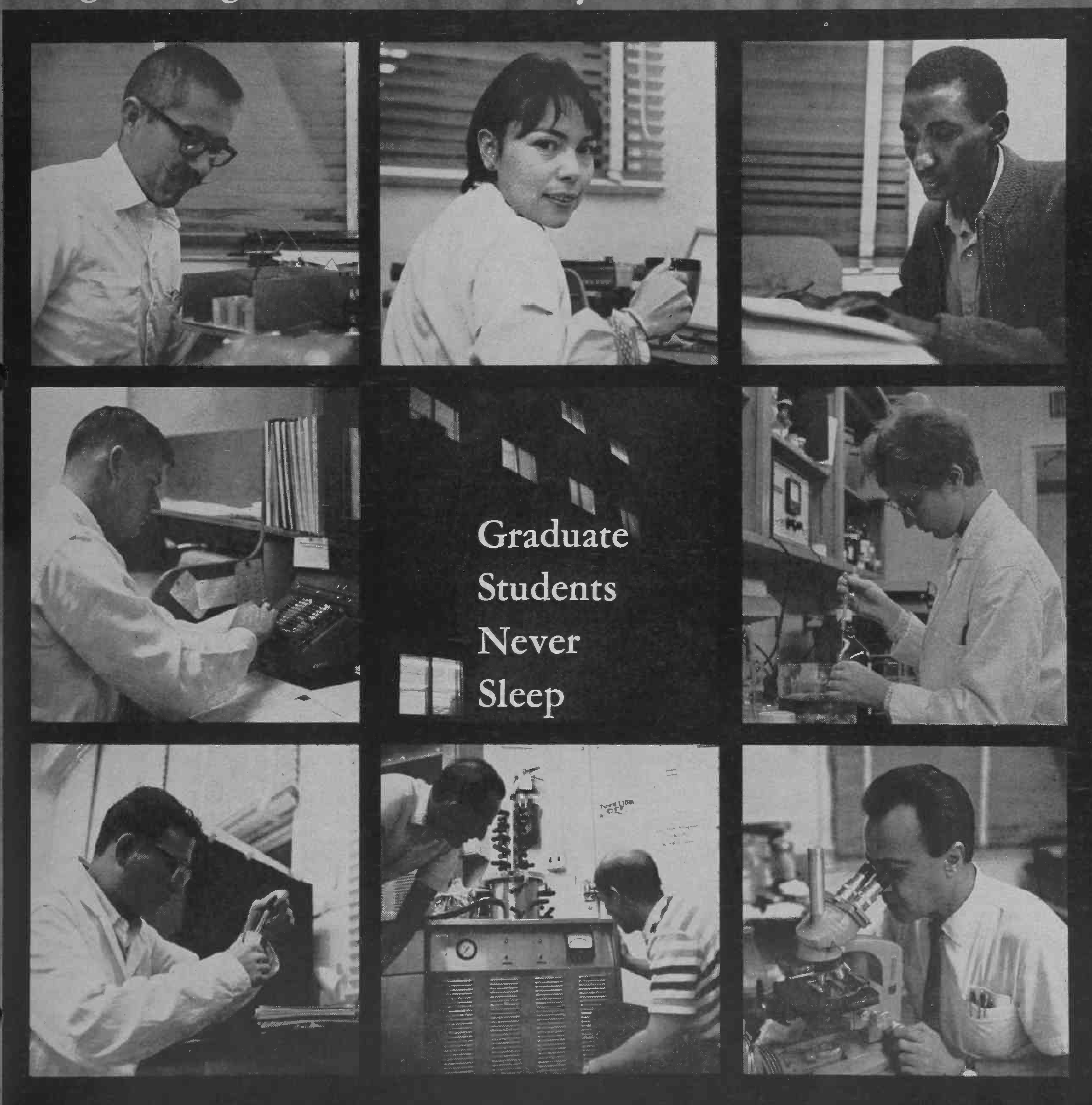
Progressive
Agriculture
in Arizona
Volume XXI, Number 2 March – April, 1969

College of Agriculture, University of Arizona, Tucson 85721



High School Grads Face 3 Big Decisions

You probably will make in the next few years some of your most important, far-reaching decisions.

The decisions you make will be with you for a long time to come. What are they?

- deciding which career to follow.
- taking a partner in marriage.
- rearing a family.

Your decisions in these matters, unlike most other decisions you'll make in your lifetime, will do more to determine the course of your life.

Most men and women choose their career, get married and start their families before they are thirty.

When you consider your career we hope you recognize the value of preparing for it by going to college.

When you decide to go to college and when you select your course of study, you have already made some major decisions relating to the choice of your career.

With a college education you have expanded your range of options:

- doors will be opened which would be otherwise closed . . .
- education will broaden your scope of interests . . . your awareness of a variety of opportunities that are available to you . . .
- simply earning a college degree will boost your lifetime earning potential by $175,000 more than you would have earned had you not gone to college . . .

While popular song writers and poets tell us young people can live on love and a handful of dreams, money never was, nor will be, unimportant.

In the running battle of income vs. outgo you will need to make many difficult choices between what you want to do and what you can afford to do.

So, why handicap yourself?

Instead give yourself that added boost in life by planning for a college education.

You'll not only increase your earning potential; you will live a fuller, happier life.

We stand ready at all times to help you. This is particularly true if your interests are with careers in agriculture and home economics.

If you write to us we can send literature to help you gain an insight into the many, many rewarding careers our students pursue upon graduation.

Our students are providing themselves with the added opportunities they gain by having an education.

Why don't you?

Harold E. Myers

Harold E. Myers, Dean
College of Agriculture &
School of Home Economics

In this Issue . . .

Progressive Agriculture in Arizona

March–April, 1969, Volume XXI, No. 2

Published Bi-Monthly by the College of Agriculture, including Agricultural Experiment Station, Cooperative Extension Service and Resident Instruction in the College of Agriculture and the School of Home Economics at the University of Arizona, Tucson, Arizona 85721. Harold E. Myers, Dean.

Entered as second class matter March 1, 1949 at the Post Office at Tucson, Arizona, under the Act of August 24, 1912. Second Class postage paid at Tucson, Arizona.

Articles and illustrations in this publication are provided by the faculty and staff of the College of Agriculture. Editorial use of information contained herein is encouraged. Photos or other Illustrations will be furnished on request.

Economics of Turfgrass in Arizona

*by William R. Kneebone & Jimmye S. Hillman**

Many large areas of agriculturally-related industries and endeavor have gone unnoticed by people who are concerned only with traditional concepts of plant and animal economics. One little noticed area of agriculturally related endeavor is that concerned with turfgrass. The establishment and maintenance of turfgrass in home lawns, parks, recreational areas, golf courses, school campuses, and industrial areas constitute a highly important agriculturally-oriented Arizona industry. This agri-industry affects every citizen of the state; and more people have contact with it than any other. Although the relationships of turfgrass to citizens are obvious, the magnitude of the industry in Arizona is not generally understood. This article presents available information relevant in evaluating the turfgrass industry in the state.

Home Lawns

In 1960 the Arizona population was 1,321,000 with 312,036 family units.[1] Population in 1967 was estimated at 1,668,000.[2] Assuming the same proportion of family units as in 1960 there were 394,000 family units in 1967. If 50% of these families had home lawns upon which they spent an average of $75 each year for water, fertilizer, mowing and pest control, their 1967 expenditures were $14.8 million.

Golf Courses and Parks

The most expensive turfgrass to maintain is that on golf courses. In 1967 there were 72 regulation golf courses in Arizona with a total of 999 holes.[3] Total maintenance cost per hole on golf courses in the far west averaged $4,653 according to the National Golf Foundation.[4] Assuming this figure as representative of expenses in Arizona annual maintenance expenditures on regulation courses in 1967 were $4.6 million.

In addition to the regulation golf courses there were in 1967, 19 par three courses in Arizona with a total of 234 holes. If we assume maintenance costs per hole on par three courses of only half those for regulation courses, or $2,326 per hole, total 1967 expenditures on Arizona par three golf courses were over $.5 million. Estimated total 1967 expenditures in Arizona for golf course turfgrass maintenance exceeded $5.1 million.

In 1965, Arizona had 249 muicipal and county parks covering a total of 132,898 acres and representing $6.6 million in operating costs.[5] Although portions of these parks were undeveloped, and other portions devoted to golf courses, a significant portion of most park acreages is general purpost turfgrass. If we assume that 25% of total park expenditure is devoted to maintenance of general purpose turfgrass we derive an estimate of $1.65 million which, with inflation to 1967 can be rounded off at $1.7 million.

School Campuses and Cemeteries

Large areas of turfgrass are maintained on school campuses, and cemeteries, while high school and college athletic fields represent a considerable turfgrass acreage which is relatively expensive to maintain. In addition, motels, airports, and industrial centers usually maintain some turfgrass as part of their landscaping. Nationally, it has been estimated that cemeteries and school campuses, including colleges and universities represent 9.7% of total turfgrass maintenance expenditure.[6] Combining maintenance cost estimates for home lawns at $14.8 million, golf courses at $5.1 million, and parks at $1.7 million we obtain a total of $21.6 million. If 9.7% of total expenditure on turfgrass estimated nationally for cemeteries and campuses holds for Arizona then $21.6 million is 90.3% of total expenditure, cemeteries and campuses would involve $2.3 million expenditure and Arizona's total would be $23.9 million. Since motel, industry, and other miscellaneous turfgrass areas are not included in this total it is certainly a conservative estimate.

Turfgrass Expenditures in Other States

Data from states which have made intensive surveys of turfgrass expenditures might help to evaluate their importance in Arizona. In 1964, a Texas study[7] estimated total annual turfgrass maintenance costs of more than $211 million in that state. This represents an annual per capita expenditure of $20.34. A detailed 1966 study in Pennsylvania[8] derived figures which indicated turfgrass maintenance and establishment costs at the rate of $161 million per year or a per capita expenditure of $13.90. A study in Ohio in 1967[9] based in part on the Pennsylvania results indicated a total expenditure of $181 million for a per capita figure of $16.16. A West Virginia estimate in 1968[10] indicates a total expenditure in that state of $64 million for turfgrass maintenance for a per capita figure of over $30.00.

If one assumes an Arizona per capita expenditure of $14.00 — a most reasonable figure in light of estimates from other states — he obtains an estimate of $23.4 million spent in Arizona in 1967 for turfgrass maintenance. This compares closely to the first approximation of $23.9 million — a per capita expenditure of $14.25.

(Turn to Page 6)

* *Professor, Department of Agronomy, and Professor and Head, Department of Agricultural Economics, respectively.*

1 *1960 Census Report.*

2 *Arizona Statistical Review. Valley National Bank. Sept. 1968.*

3 *National Golf Foundation Information Sheet ST2.*

4 *National Golf Foundation Information Sheet GC4.*

5 *1967 Statistical Abstract of the United States.*

6 *Nutter, Gene C. 1965. Turf-grass is a $4 billion dollar industry. Turfgrass Times 1(1).*

7 *Turfgrass maintenance cost in Texas. Texas Agr. Exp. Sta. Bull. B1027 November 1964.*

8 *1966 Turfgrass Survey. Pennsylvania Crop Reporting Service. Pennsylvania Department of Agriculture. Harrisburg, Pennsylvania.*

9 *Unpublished Special Problems Study in Agronomy. Ohio State University 1967. "Importance of Turfgrass in Ohio." Garry L. Seitz.*

10 *Henderlong, Paul R. 1968. The Turf Industry in West Virginia. West Va. Misc. Publ. 5.*

Picture at left shows a pink bollworm damaged boll, top, and a normal boll, bottom. In first picture toward the right a pink bollworm is revealed at work i[illegible] cutaway boll. The damage it leav[illegible] readily seen in the picture at far righ[illegible]

Evaluation of Insecticides for

*by T. F. Watson & D. G. Fullerton**

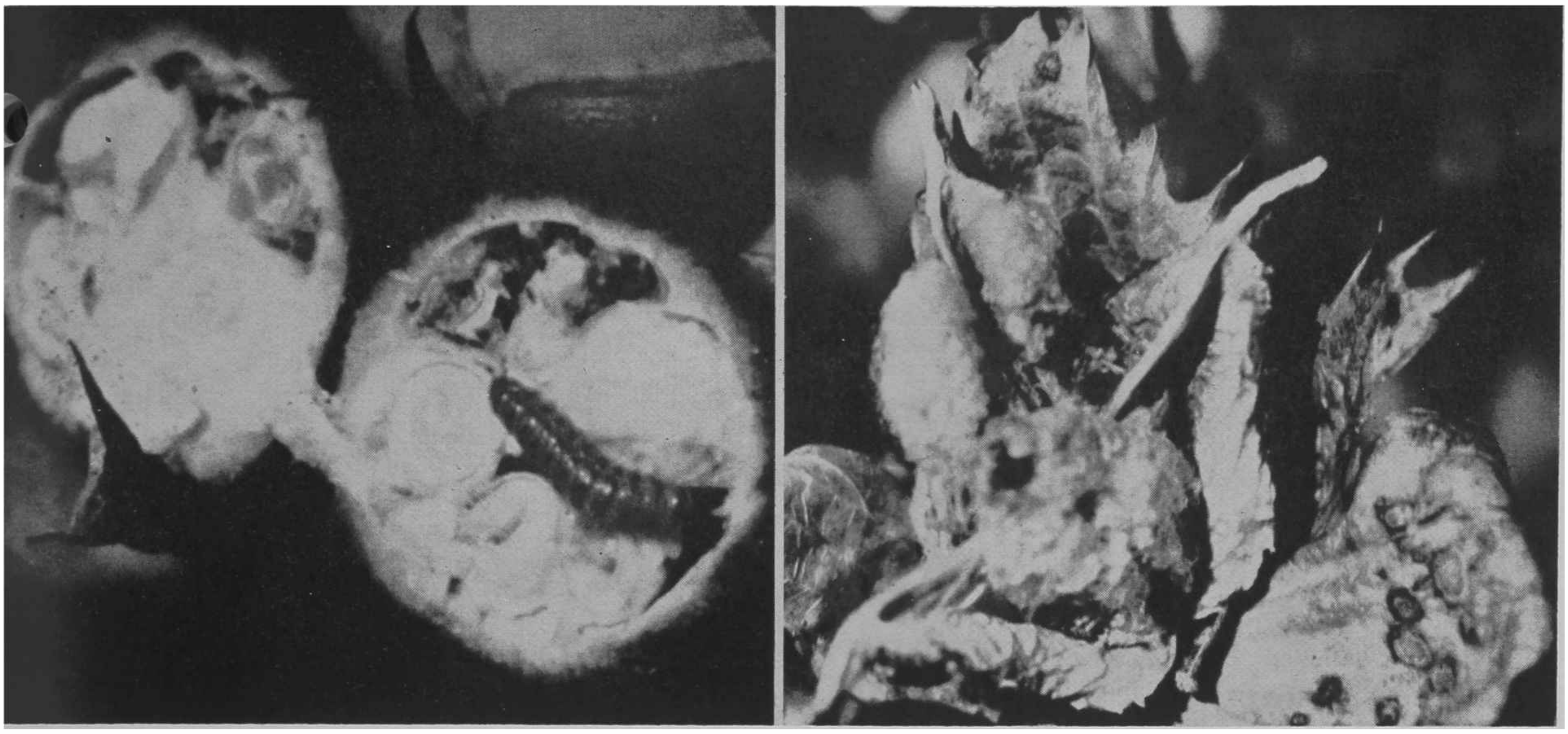
Insecticidal control of the pink bollworm, *Pectinophora gossypiella* (Saunders), is not only a costly venture but one in which satisfactory results are difficult to achieve. This method of controlling the pink bollworm, however, has become a necessity during recent years in many areas of Arizona because of high population levels. This situation may continue for the immediate future until research points the way to effective control through cultural and/or other practices.

Due to the urgent need for effective insecticides against the pink bollworm an experiment was conducted near Phoenix in 1967 to compare a number of insecticides in a replicated field experiment. The results obtai[illegible] from that test are reported in this article.

Twelve insecticides or insecticide combinations were compared with an untreated check. All treatments, including the check, were replicated four times in a randomized complete block design in a field of short-staple cotton. Plots were 8-rows wide and 1150 ft. long. Spray applications were made with a Hahn Hi-Boy or John Deere high-clearance sprayer on a five to six day schedule.

Treatments were evaluated by collecting boll samples at weekly intervals to determine the pink bollworm infestation levels and by harvesting plot yields at the end of the season. Fifty green bolls (approximately three weeks old) per plot or 200 per treatment comprised the weekly boll sample. Initially, only the average number of larvae per 100 bolls was recorded but later both the number of larvae per 100 bolls as well as the per cent bolls infested were recorded.

** Associate Professor and Research Associate, respectively, of the Department of Entomology. They were assisted in the research by graduate students: Jerry Phi[illegible] Robert Rush and Jeffrey Slosser.*



Pink Bollworm Control

Lygus populations were evaluated during early- and mid-season using the standard sweep-net method. The presence and abundance of bollworms, *Heliothis zea* (Boddie), was determined by examing 25 terminals per plot.

Results and Discussion

Insect pests other than the pink bollworm were considered to be of little or no consequence in this experiment. The bollworm was present at low levels throughout the test period but its influence on yields is considered unimportant since similar infestation levels existed in practically all insecticidal treatments; they were slightly greater however in the untreated check and may have possibly had some influence on the check yields.

Several of the insecticides and insecticide combinations effectively reduced the pink bollworm even though applications were initiated in a field already heavily infested. At this time there was an average of 62.7 larvae per 100 bolls inspected. This infestation, however, did not necessarily mean that yield losses had already occurred since research has shown that early large populations can be present without resulting in losses. Although all treatments resulted in lower infestations than those occurring in the untreated checks some were poor to intermediate in effectiveness. The infestation counts showing both the average number of larvae per 100 bolls and the per cent bolls infested are presented in Tables 1 and 2, respectively. These sampling data indicate that an initial high infestation can be reduced with the proper insecticide and proper application technique.

Yield data from the treatments in this experiment are shown in Table 3. In general, the relative effectiveness of the various insecticides as shown by infestation counts is reflected in the yields. Yields were more than twice that of the untreated check in six of the insecticidal treatments, with azinphosmethyl (Guthion) and azinphosmethyl plus toxaphene resulting in yields considerably in excess of the two-fold increase. There was, however, no apparent advantage of adding toxaphene to the azinphosmethyl. It should also be pointed out that in other tests, carbaryl (Sevin) at 2.0 lbs. per acre and azinphosmethyl at the rate of 0.5 lb. per acre gave results comparable to azinphosmethyl applied at the 1.0 lb. rate.

Rates at which some of the insecticides were applied probably influenced their position in the array as shown in Table 3. For example, treatments falling in the intermediate position, such as methyl parathion at 0.5 lb. per acre, probably would have shown better results at a higher dosage rate. This was also true of Azodrin and the combination of toxaphene-Azodrin.

The uniform pink bollworm infestation present in the field at the time the test was initiated may have caused some yield loss. Since it was uniform, however, yield differences at the end of the season should have been primarily the result of the insecticidal treatments in the experiment. Initial individual plot infestations provided a continuous source of reinfestation regardless of the effectiveness of the treatments in adjacent plots. Therefore, plot-size was considered adequate to accomplish the objective of this test and yield differences and infestation levels at the end of the season reflect valid comparisons of the treatments involved.

(Turn to Next Page)

Table 1. Effects of several insecticides and/or insecticide combinations in reducing pink bollworm infestations. Phoenix, 1967.

Treatment[1]	Rate lbs./A.	Pre-treat	Mean No. Larvae/100 bolls Collected on: August 1	8	17	25	30	Sept. 13	21
Check	—	95.5	95.0	77.0	102.5	103.5	212.5	249.0	307.0
Thuricide	2 qts.	68.0	68.5	61.5	62.5	92.0	132.5	147.5	130.5
Methyl Parathion	0.5	60.0	62.5	45.0	17.5	44.0	100.0	92.5	84.5
Toxaphene-Dylox	3-1.5	56.0	55.0	30.5	34.5	54.5	62.5	77.0	74.0
Toxaphene-Methyl Parathion	3-.63	48.0	47.5	40.0	26.5	22.5	70.5	44.0	50.0
CP 47114	1.0	84.0	84.5	41.0	17.0	31.5	55.5	39.5	48.0
Azodrin	0.63	54.5	60.0	34.5	16.5	22.0	47.5	41.0	32.0
Mobam	1.0	61.5	68.0	28.5	26.0	24.0	43.5	29.0	30.0
GC 6506	1.0	58.0	58.0	35.0	27.0	37.5	60.0	35.5	29.0
Toxaphene-Azodrin	3-.63	43.5	41.0	29.0	12.0	18.0	29.0	20.0	19.5
Toxaphene-DDT	4-2	45.5	48.5	29.5	17.0	20.0	28.5	15.5	18.5
Toxaphene-Azinphosmethyl (Guthion)	3-1	63.5	69.0	45.5	14.0	11.0	8.0	5.5	5.5
Azinphosmethyl (Guthion)	1.0	77.5	63.0	29.0	18.0	14.0	6.5	2.0	3.0

[1] *Insecticidal applications were made on the following dates*: 7/28, 8/2, 8/8-9, 8/15, 8/22, 8/28, 9/2, 9/6-7, *and* 9/12.

Table 2. Influence of insecticidal treatments on per cent bolls infested with pink bollworm larvae. Phoenix, 1967.

Treatment	Rate lbs./A.	Per Cent Infested Bolls Collected On: 8/17	8/25	8/30	9/13	9/21
Check	——	51.5	56.5	86.0	95.0	98.0
Thuricide	2 qt.	45.0	53.0	67.5	73.5	64.5
Methyl Parathion	0.5	13.5	33.0	59.0	54.5	47.5
Toxaphene-Dylox	3.0-1.5	22.0	29.0	41.0	41.0	36.5
Toxaphene-Methyl Parathion	3.0-.63	19.5	14.5	42.5	34.0	32.5
CP 47114	1.0	14.0	26.5	37.0	28.0	31.5
Azodrin	0.63	13.5	19.5	33.5	27.0	22.0
Mobam	1.0	19.5	20.5	29.0	23.5	21.5
GC 6505	1.0	18.0	29.5	39.5	27.0	18.5
Toxaphene-Azodrin	3.0-.63	10.0	18.0	21.5	18.5	12.5
Toxaphene-DDT	4-2	14.0	15.0	19.5	12.0	10.5
Toxaphene-Azinphosmethyl (Guthion)	3.0-1.0	8.5	10.0	7.5	5.5	4.5
Azinphosmethyl (Guthion)	1.0	16.0	12.0	5.5	1.5	3.0

Table 3. Comparison of yields from insecticidal treatments for pink bollworm control. Phoenix, 1967.

Treatment	Rate lb./A.	Mean Plot Yields	Stat. Sig.[1] 5%	1%
Check	——	201.0	a	a
Thuricide	2 qts.	285.0	b	b
Toxaphene-Dylox	3-1.5	355.0	c	c
Mobam	1.0	358.5	c	c
Methyl Parathion	0.5	378.5	cd	cd
CP 47114	1.0	395.0	cd	cd
Toxaphene-Methyl Parathion	3-.63	396.5	cd	cd
GC 6505	1.0	413.5	de	cde
Toxaphene-Azodrin	3-.63	418.0	de	cde
Azodrin	0.63	430.5	de	cde
Toxaphene-DDT	4-2	431.5	de	cde
Toxaphene-Azinphosmethyl (Guthion)	3-1	453.0	ef	de
Azinphosmethyl (Guthion)	1.0	485.5	f	e

[1] *Duncan's Multiple Range Test; treatment means followed by the same letter are not significantly different.*

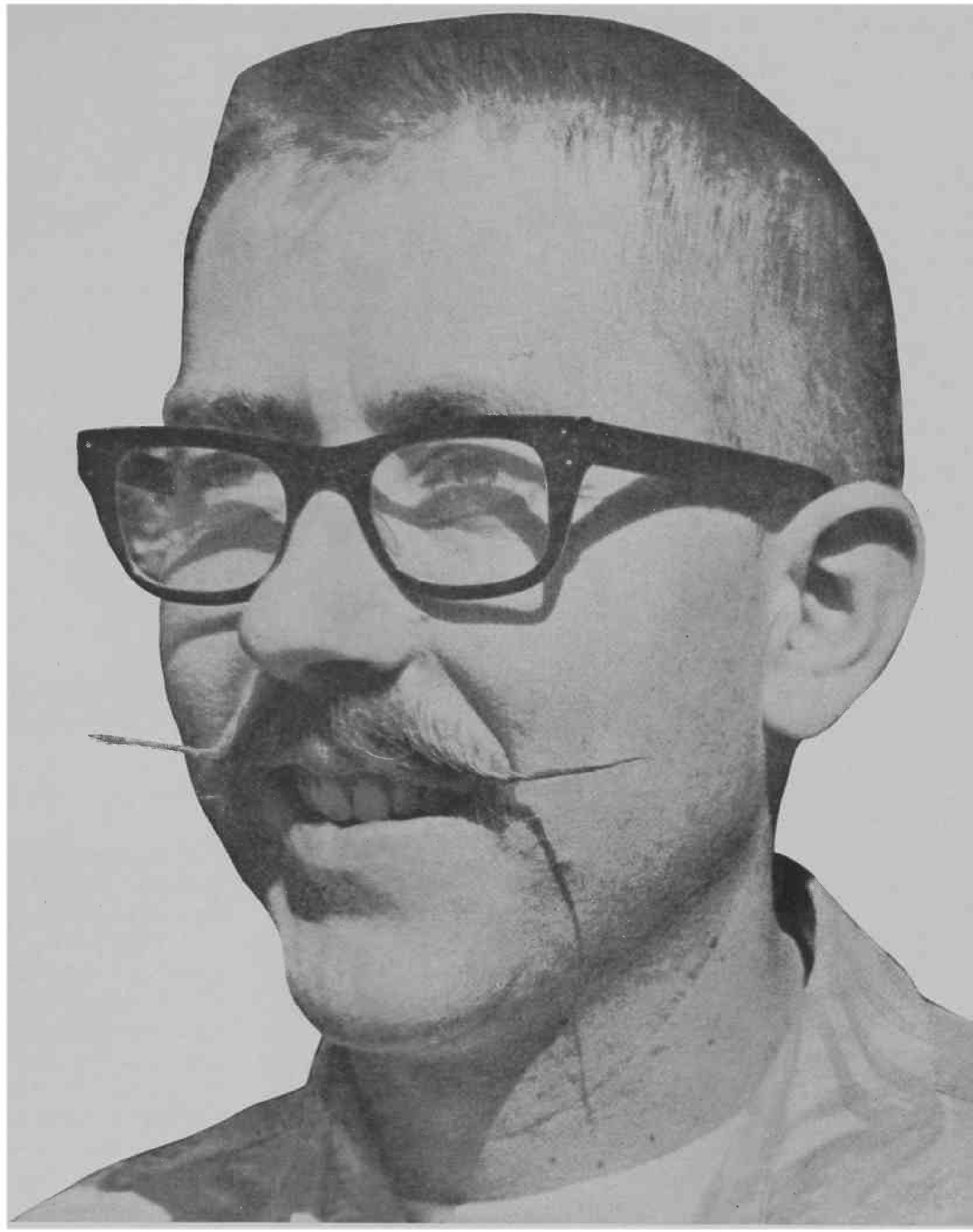
Turfgrass

(From Page 3)

Both the Pennsylvania and the Ohio survey added replacement value of lawn equipment to their maintenance totals to estimate the total magnitude of turfgrass expenditures in their states. In both cases the replacement estimates were nearly twice those for maintenance. If we assume that in Arizona replacement costs were only equal to those for maintenance we would derive estimated annual values of $46.8 million or $47.8 million for turfgrass as a segment of Arizona's total economy. Among the traditional agricultural sectors of the economy for which statistics are kept, these estimates exceed all but three — cotton, cattle, and vegetable crops.[11] Although turfgrass expenditures are primarily toward aesthetic and practical values rather than monetary returns they do represent a major part of the Arizona economy and turfgrass as a crop is one of the most important in the state.

[11] *1968 Arizona Agriculture. Arizona Cooperative Extension Service and Agricultural Experiment Station Bul. A-54.*

I'll Farm Where Salome Danced



*by Wilson E. Nolan**

I have had a life-long ambition to be a farmer. And, now as I am about to earn my master's degree in agronomy I will be a partner in a cotton farm at Salome, Arizona.

When I started out I wasn't too sure of myself. My grades in Palos Verdes High School at Palos Verdes, California, were less than noteworthy. In fact, I was required to take a makeup senior English class after leaving high school.

I had no idea that I could compete in a college and therefore really wasn't giving it much consideration. So, I took on various jobs for a year and a half until I decided what I wanted to do.

My burning desire was to be a farmer. But, really didn't feel this would ever materialize.

Finally, I decided more education wouldn't hurt; might even help.

At first I enrolled at Palo Verde Community College in Blyth. As I did so I had all sorts of misgivings — could I measure up? I didn't know.

Once enrolled however I exerted a great deal of effort toward passing every class and much to my astonishment I did quite well. After three semesters I had accumulated 58 units and began thinking about going to a university.

I had become aware of the University of Arizona from my exposures to the Yuma County Agents — Stan Heathman and Jim Hazlitt — who provided service and advice to the Hunter-Matthews farm on which I worked summers.

And, once I decided to go on to a university the U of A seemed to be the logical choice.

I went to Tucson to inspect the campus and to inquire about admission possibilities. While there I took several tests and visited with several of the agriculture faculty. Also, I spent some time with the director of resident instruction, Dr. D. S. Metcalfe and his secretary, Mrs. Margaret Bonnin.

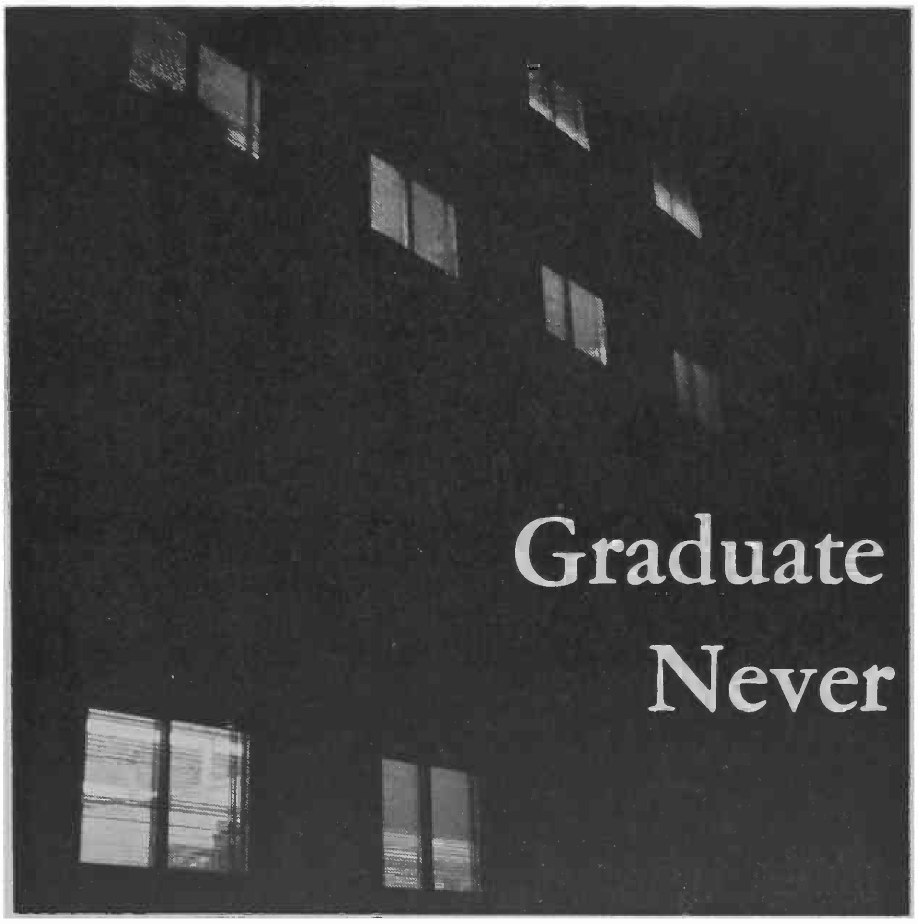
These people impressed me. They immediately impart to you that the Ag College wants you, will work with you and will help you.

It's quite a feeling, believe me.

(Turn to Page 24)

** One of two sons of Mr. and Mrs. A. D. Nolan, Hermosa Beach, Calif., he earned a B.S. in Agronomy last year and is completing M.S. this spring. His brother is a naval architecture student at University of Michigan.*

Editor's note: Wilson has been a 1 student at the U of A and has received the following recognitions — in 1965-66, Merit Award in Mathematics and Science, California Junior College Man of Year, President of Alpha Gamma Sigma, Manager of Soccer Team; in 1967, National Science Foundation scholarship, Ralston-Purina Scholarship, Junior Scholarship Award, member of Alpha Zeta and Phi Kappa Phi; in 1968, U of A Scholarship Honors, The American Society of Agronomy Student Award, Silbowl for Scholastic Honors, member of Gamma Sigma Delta and is a candidate for a Rhodes Scholarship.



Graduate Students Never Sleep

*by D. S. Metcalfe**

Tests he runs sometimes keep him in the lab the entire night. That's Michael L'Annunziata, above, from Springfield, Massachusetts, a Ph.D. candidate in agricultural chemistry and soils. Below from left are: John Drake from Rexburg, Idaho, just beginning his Ph.D. program in entomology; John R. Potter of Tucson setting up the spectrophotometer while working for a Ph.D. in botany; and completely absorbed in preparing his Ph.D. thesis is Fatoholah Boldaji from southern Iran which he says is similar to Arizona. After 5½ years he's homesick and eager to return home next month.

Graduate students face the realization that while there is so little time in which to acquire an education, there is so very much to learn.

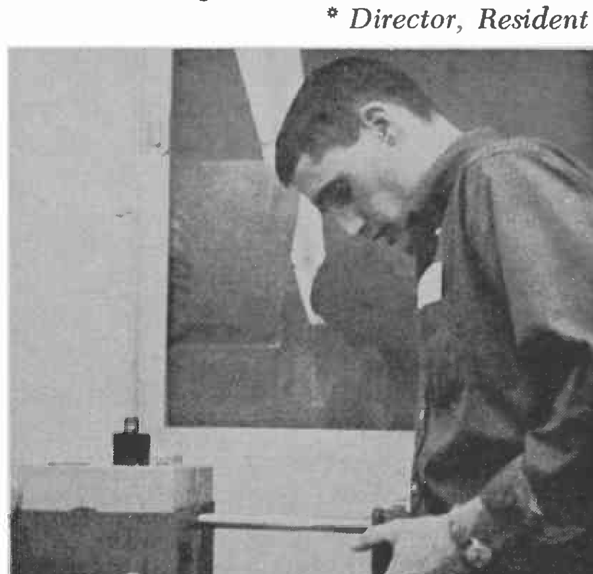
That's why you find graduate students more intensely seeking knowledge in their race with precious time.

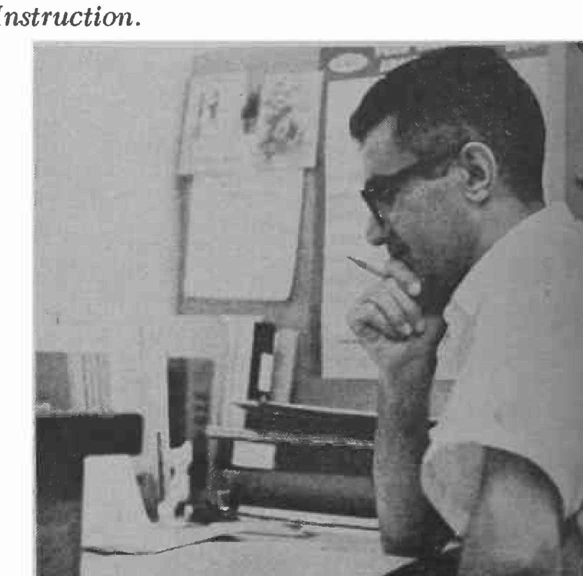
Graduate student determination to gain a formal education and the way in which he is devoted toward this goal fits the description of a scholar recently given them by Harold E. Myers, Dean of the College of Agriculture:

"The successful scholar must possess a high level of mental capacity, but in addition he must have a *desire* for an education, plus a willingness to devote the necessary *energy* required in seeking his goal."

This explains why we find graduate students quietly at work in the laboratory, huddled over an area for study — a portion of a laboratory counter, a table in the corner of the lab, a professor's desk, the top of a sophisticated laboratory equipment. It shows that he has acquired the ability for deep concentration. And, the place where he

* *Director, Resident Instruction.*





does it is of secondary importance.

We find they work far into the night. Every night for long hours.

And, yet, while it seems to be a grueling pace, sooner or later, he expresses genuine concern over the lack of time to acquire all of the knowledge he, or she, wants, or needs.

The hunger for knowledge, the willingness to devote more than the average required time to obtain it, the constant search, the endless study and comparing of notes and ideas with fellow students and faculty holds a certain fascination for them.

It is evident they have been caught up in the spirit of the search . . . for knowledge . . . the hunger for it . . . the enlightenment and joy which comes with obtaining it.

This characterizes the graduate student at the University of Arizona College of Agriculture.

And, it demonstrates why Graduate Students Never Sleep.

Our cover pinups of graduate students diagrammed at right are: top row, left, Wilson Nolan from Salome who earned his B.S. last June and will earn M.S. next June will go into partnership farming at Salome upon graduation. He's developing an electronic seed sorter for use in plant breeding. Middle, Maria Otero from Esperanza, Son., Mexico, will do research for a large poultry operation at Hermosillo after completing her studies next summer; right, David Mbuvi from Kenya, East Africa, is working on his Master's degree in range management; middle row, left, Scott Beasley from Lufkin, Texas, is working for a Ph.D. with an eye towards teaching and research in a university; right, Alison Hyde from Oak Park, Illinois, is working for an M.S. degree in botany; bottom row, left, Michael Vodkin from Dorchester, Massachusetts, also wishes to do research and teaching when he earns his Ph.D.; middle, Charlton Wenger, left, from Goshen, Indiana, and Kenneth Ellis from Tucson unite to make a freeze-dry mechanism operate properly in a plant pathology laboratory; right, F. Demirkan, a FAO Fellow from Izmir, Turkey, is working with R. T. Ramage who developed hybrid barley. Demirkan is Chief of the Cytology Laboratory at the FAO Crop Research Center at Izmir. He's here for 12 months.

Above is Marvin Miller from Fontanelle, Iowa, who is finishing his requirements for a Ph.D. in alfalfa breeding. In a corner basement room of the Agriculture building, below, is a room for study and work. Since the cribbage board and cards were dusty study was uppermost in their minds as they sat from left to right around the table: Keith Henderson, a Ph.D. candidate in agronomy from Yuma, Colorado; Richard Bray is enrolled in an M.S. degree program in plant breeding from Big Stone City, South Dakota; Hassan Khalifa is working on a Ph.D. in plant breeding with particular emphasis on cotton and is from Singa, Sudan; and Darrell Cole of Providence, Kentucky, who is concentrating on water utilization in alfalfa physiology.

Opportunities Ahead

Population growth by 1975 will generate $200 million increase in Arizona's farm economy from just beef, milk and eggs. More from other farm products.

*by Roy M. Kottman**

I am always exhilarated by the excitement which accompanies an Honors Convocation. It gives me a special thrill to address this student body and this faculty because we are here to pay homage not only to intelligence and to leadership, but to that priceless ingredient which can best be described as *hard work!* There is no question but what those of you being honored here today have been blessed with high mental capacity. I am equally sure, however, that no one among us, student or faculty, believes that you who are being honored have achieved the recognition being paid you here this morning without having expended a generous measure of just plain effort. C. C. Cameron has expressed it ably in a little poem which goes like this:

GENIUS, that power which dazzles mortal eyes,
Is oft but perseverance in disguise.
Continuous effort of itself implies,
In spite of countless falls, the power to rise.
'Twixt failure and success the print's so fine,
Men sometimes know not when they touch the line;
Just when the pearl is waiting one more plunge,
How many a struggler has thrown up the sponge.
As the tide goes clear out it comes clear in;
In business 'tis at turns, the wisest win;
And, oh, how true when shades of doubt dismay,
"Tis often darkest just before the day."
A little more persistence, courage, vim,
Success will dawn o'er failures cloudy rim.
Then take this honey for the bitterest cup;
THERE IS NO FAILURE, SAVE IN GIVING UP.
No real fall, so long as one still tries.
For seeming set-backs makes the strong man wise.
THERE'S NO DEFEAT, in truth, SAVE FROM WITHIN:
Unless you're beaten THERE, you're bound to win.

We are honoring winners here this morning! All of us — whether our grade point is good or not so good — are pleased and proud to be present on this occasion.

May I congratulate all of you on your association either as faculty or students with the College of Agriculture and the School of Home Economics. Agriculture and Home Economics are vital to life and living. It is for these reasons that you, as students, have sensed among the members of your faculty in Agriculture and Home Economics, a spirit of service, an attitude of optimism, and a sense of dedication not often found in other schools or colleges on the university campus.

The strength of our nation, or of any nation for that matter, will be no greater than the quality of its homes, the productivity of its agriculture, and the concern of its people for its natural resources.

If the world in which we live is to survive the challenges of burgeoning population, conflicting ideologies, and limited arable land, those of us in Agriculture, Home Economics and Natural Resources must play an increasingly pre-eminent role, not only on the campuses of our Land-Grant universities, but in our farm organizations, our business associations, in our churches and schools, and in legislative halls, both state and federal. It will be up to us as men and women educated in agriculture and home economics, to play an increasingly pre-eminent role in a world-wide attack on the problems associated with hunger and malnutrition, unchecked population growth, deterioration of the family, and pollution of our land, air and water. Among the weapons of choice for this battle, which is worldwide in its implications, are research and education in agriculture, home economics and natural resources. Make no mistake about it, a growing realization of the importance of education in agriculture, home economics and natural resources constitutes the main reason for increasing enrollments in Agriculture and Home Economics at colleges and universities all across our nation. As we recognize, on this occasion, those students who have achieved above and beyond expectations, we must all resolve to rededicate ourselves to what should be an obvious truth, namely, that the seeking of truth and the dissemination of it, which in other words means research and education in agriculture and home economics, are among mankind's highest callings.

We here in America have done, are doing, and I am confident are determined to continue doing in the future, more about education for more of our people than any other nation on the face of the earth.

Whatever our critics may say, and whatever you may hear among the prophets of "gloom and doom" on this campus or in any other walk of life, the fact of the matter is pretty much as Eric Hoffer has stated: "America is the only new thing in history."

There are a great many unique elements in what might be called the equation of our national purpose; elements which make America new and different from all other nations of the world. I'd like to touch briefly on just two of those elements in the equation of our national purpose — education in agriculture and education in home economics. Before making detailed reference to agriculture and home economics, however, I should like to make it clear that despite the voices of detractors to the contrary, I happen to believe that we here in the United States are doing a pretty good job of providing educational opportunities for our people. I substantiate that contention by the fact that at the present time, 43 per cent of our young men and women are going on to college. That figure is climbing each year. In this country, it is fast becoming possible for a young person to set his or her sights on a college educati[on] and have reasonable assurance of achievi[ng] that education. No other nation and no other era in history comes even close to the kind of opportunity which is available to young people here in the United States. Only five per cent of England's young people ever get to college. In Germany, the figure is eight per cent; France affords only 16 per cent of its young people an opportunity to go to college. In Russia, 24 per cent go, but here in our country 43 per cent of our youth now avail themselves of the opportunity of higher education. Not a perfect record to be sure, not ideal; but where in all the world can you come even close to it? Nowhere! No other nation begins to approach the United States in the proportion of 17-year olds in school — 70 per cent!

Here is another statistic which I think speaks loud and clear for the progress we have made in providing opportunity for education in our country. *More than half* of the young people entering our United States colleges and universities during the current academic year are the sons and daughters of parents who never had an opportunity to go to college. I am sure that it is a matter of pride to you, just as it is to me, that we here in the United States have 36.2 million students in grade school, 13.6 million in high school and 6.2 million in colleges and universities. More than 56 million of our 200 million citizens are enrolled in formal education. No other nation on the face of the earth can claim an anywhere nearly comparable record f[or] affording its citizens educational opportu[nity]

* *Dean, College of Agriculture and Home Economics, The Ohio State University, Columbus, Ohio. He gave this talk to faculty and students at the Student Honors Convocation at the College of Agriculture, University of Arizona, Tucson. Jan. 9.*

ties. As students in agriculture and home economics, I know that you share my appreciation for our great country. One of the reasons I am so proud to be associated with students in agriculture and home economics is because you, who are students in agriculture and home economics, are seekers of truth, you are not satisfied with rumor and hearsay, your courses and your teachers have led you to seek facts, you are concerned about integrity, morality and human decency. I salute you for it. I pray God that your attitudes and your leadership will provide a leavening influence on our university campuses all across this great nation to the end that truth and mutual respect among students, among faculty, and between students and faculty, may prevail, as it has historically prevailed on our American campuses.

When I think about the freedom of opportunity for education which we enjoy in these United States I cannot help but hearken back to my experiences in India just one year ago today. On that occasion I was sitting in the office of the Minister of Education in one of the Indian states which I shall not mention because I do not wish to embarrass anyone. The Minister of Education, himself a highly competent individual, was very proudly telling us that in his State, education is required for all children through the sixth grade. As we continued our discussion, I noted a chart on the wall which piqued my curiosity. When I asked the Education Minister about the chart, he indicated that he had hoped I would not see that particular chart because it indicated that 69.2 per cent of the youngsters entering first grade in that State were so mentally retarded that they were denied admission to the second grade. As I made this statement I thought immediately of the increasing number of nutrition studies which indicate clearly that permanent brain damage can and does occur as a result of malnutrition during the first few years of a child's life. I thought also of the billions of gallons of irrigation water which are wasted as the snow-melt of the Himalayan Mountains rushes wildly to the sea, often flooding everything in its path. I thought of the millions of acres of potentially fertile land in that northwest Indian state, acres which await only life-giving irrigation waters to produce a miracle of abundance for the starving and undernourished millions in that particular region of India. I have many times since thought of those millions of first grade drop-outs and vowed to myself that someday, hopefully within my lifetime, the influence of faculty and students working under The Ohio State University contract in that Indian State will help to make possible such an abundance of food products that this scourge of malnutrition-induced first grade drop-outs will be vanquished for all time in the future. I am sure that your University of Arizona contract personnel in northeast Brazil have seen similar ravages of malnutrition and have likewise resolved to correct those conditions. The achievement of better opportunities in life for young Brazilians and young Indians may not be accomplished during my lifetime. It will almost certainly require the talents and the dedication of young men and women like yourselves. I happen to be one who believes that the grim race between starvation and agricultural production can be resolved in favor of adequate diets for all mankind, but such resolution will almost certainly require a valiant effort on the part of each one of you and of your counterparts enrolled in agriculture and home economics throughout the world. Even here in the United States the challenge of maintaining our present abundance of foodstuffs makes the study of agriculture and home economics assume dimensions of importance which were unrealized only a few short years ago.

As you know, our population in the United States passed the 200 million mark in November 1967. It is expected to be 250 million by 1980. As we sit here this morning there are 6,800 more mouths to feed in the United States than there were yesterday morning at this time. Every 13 seconds, we have an additional mouth to feed here in our nation. Those statistics are exciting to anyone interested in providing the food and fiber for this burgeoning population but it is the rate of increase which is of greatest interest to you whose careers lie ahead of you. Significant as these figures are, they pale by comparison with worldwide predictions. World population is over three billion at the present time. It will exceed six billion by the year 2000! This tremendous world population growth is both awesome and exciting. To those of us in agriculture and home economics, it means an era of unprecedented opportunity. What these statistics really say to each one of us is that present world population growth is equal to the establishment of a new country the size of the United States every three years. And, as graduates in agriculture and home economics, you will be helping to feed all of those people. Think of it! Here in the United States our total outlay for food was close to $100 billion last year. Think of the worldwide market for food and fiber that is coming on-stream, over and above present markets, each three years. You young men and women could not have chosen a more exciting, a more challenging, or a more humanitarian career than you have chosen by your enrollment in agriculture and home economics.

It is precisely because of the unprecedented challenges of worldwide population growth with its gargantuous demand for food and fiber, that you and I must be continually concerned about recruiting high-ability students for the study of agriculture and home economics — about recruiting increased numbers of young men and women with talents similar to those we are recognizing in this Honors Convocation. Food is vital! Human beings cannot exist without food. I cannot emphasize too strongly that unless we are successful, on a worldwide basis, in our efforts to attract to agriculture, home economics and the underlying sciences and engineering, a greater share than we have been attracting of the best young minds in this nation and throughout the world, mankind on our planet will almost certainly be faced with staggering problems of malnutrition and hunger. This is, of course, what the Paddock Brothers predicted in their book[1] entitled "Famine, 1975! America's Decision: Who Will Survive?" published two years ago. I, for one, do not subscribe wholly to the gloom and doom predicted in William and Paul Paddock's book. Rather, I am inclined to concur with the point of view expressed by Secretary of Agriculture Orville L. Freeman in his new book[2] called "World Without Hunger." I believe as does Secretary Freeman that there is hope for adequate nutrition on a worldwide basis because I have seen, I have experienced, and I have thrilled to the application of research results as they have been put to use in practical everyday situations. I am confident that given reasonably enlightened political leadership in the underdeveloped countries of the world, a leadership which provides adequate incentives for the agricultural sector, and a leadership which generously supports research and education in agriculture and home economics, plus a leadership which fosters and promotes population control, we can, and we will be able to make available an abundance of food and fiber for all of the people who will populate our planet in the foreseeable future. We have already demonstrated that we can do this! We have produced food in America in such abundance, and at such a low cost, and with such low input of labor that our greatest nutritional problem is obesity and whether you want to believe it or not there are a lot of problems more traumatic than that one.

If you don't think so, just contrast our situation with that in the developing countries of the world where 35 per cent of all children die before they reach the age of six. Much of this high death rate is occasioned by malnutrition if not outright starvation. And as in the Indian State about which I spoke earlier, of those who do survive, two-thirds of the children in the developing countries suffer from malnutrition. Many of them are physically or mentally handicapped throughout life because of inadequate food during their early years.

I am confident that world peace can be achieved in our time if among the other wise and necessary actions which our country must take, we will but lead the way for all nations to find ways of following those paths of research and education which we here in the United States have been privileged to follow. Peace without abundant food seems to me to be but an idle dream! As I try to look into the future to see the kind of world in which you who are students today will be living and working 10, 20, or 30 years from now, I see no alternative but for you to plan on being diligent students all of your lives. A major part of your future endeavors will involve the very difficult tasks of studying and of thinking! You will be successful in proportion to your willingness and your determination to face up to the task of thinking, studying, and managing rather than in proportion to the amount of physical labor which you may do. I do not mean to imply that you will not have to bestir yourself physically if you go into production agriculture or even if you engage in that greatest home economics employment of all — homemaking! You know as well as I do that successful people do not shy away from physical effort. What I am trying to say to you is that each one of us who has been privileged to receive a

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[1] *Paddock, William and Paul, "Famine, 1975! America's Decision: Who Will Survive?" Little, Brown and Company, Boston, Mass. 1967.*

[2] *Freeman, Orville L. "World Without Hunger" F. A. Praeger, New York, 1968.*

college education must plan for and devote a considerable amount of our time to the task of updating ourselves through both formal and informal educational endeavors so that we can, indeed, provide enlightened leadership for the exciting but always demanding roles that we must play if we are to make a significant contribution toward achieving that brotherhood of man which all of us long for, but which I am convinced will not be achieved in a world suffering from malnutrition.

You know, I sometimes think that having agriculture and home economics administered in the same college is one of the best dividends which we receive from the legislation which established our Land-Grant institutions in this nation. In any event, my observations back at Ohio State would seem to indicate that there are more advantages than disadvantages in this type of arrangement. In this connection, I am reminded of the story of two high school teachers who were enrolled in summer school at Ohio State. It seems that they were exchanging views during a coffee break when one of the young ladies said to the other, "I get fed up having you constantly complain about the small number of young men enrolled in our classes. After all, the good Lord has created on this earth almost the same number of men as of women. I don't see how you can improve on that arrangement."

Whereupon the second girl said, "I don't want to improve on it, I just want to get in on it."

It seems to me that one of the very best ways for a young woman to get in on making her life meaningful in a world that is often characterized as being a man's world, is for her to enroll in home economics. I say this because present evidence points toward the fact that a young woman graduating from high school in 1969 will, in all probability, be employed outside the home for at least 25 years during some time in the remainder of her life. Twenty-five years is a long time. It would probably seem an eternity if one were to be employed for 25 years on a dull, routine, uninspiring job of lesser challenge than one's mental capacity logically should confront.

Far too many young women still think, and say, that education is really not very important because they are going to be, as they put it, just a wife and mother. Anyone making that observation obviously has not thought very carefully about her own home and her own mother. If there is any task in the world of greater importance than being a wife and mother, I haven't yet heard of it! Each wife and mother has more influence on the education of her children, on the nutrition of her children, on the mental health of her children, and on the citizenship development in her children than any teacher in the classroom will ever have. I have always contended that a mother can do a better job of educating her own children if she, herself, is well educated. It should be self-evident, also, that a wife's education is a major determinant in whether her husband's career will be successful or unsuccessful. It has frequently been said that the hand which rocks the cradle rules the world. I, for one, hope that more and more of the minds which direct that cradle-rocking will be highly educated minds.

One of my greatest concerns over the past 20 years has been a concern for attracting greater numbers of highly capable high school graduates into careers in agriculture and home economics. I would feel that my efforts had been far more successful if we had 5,000 undergraduate students in agriculture rather than the 2,300 that we have at Ohio State, and if we had 3,000 undergraduates in home economics rather than the 1,000 that we have.

As you are so well aware, the demand for graduates in agriculture and home economics has seriously outrun the ability of our colleges to provide them. It appears to me to be crystal clear that a great many of the really significant issues and concerns of our world in future years can be more successfully dealt with if we will resolve to work together — students and faculty — to recruit a much greater number of highly-talented young men and women for the study of agriculture and home economics.

I realize that many students in this audience are non-resident students. I hope that you who are non-residents will bear with me as I make reference to Arizona. It just seems to me that this state is an unusually bright and shining example of what our free enterprise system, inspired and assisted by the research and educational impact of our Land-Grant institutions can accomplish. Agriculture is by far the largest industry in Arizona just as agriculture is the largest industry in my own state of Ohio, and is by far the largest industry in the United States and, for that matter, throughout the world.

In preparing my remarks for this occasion, I took the opportunity to review what has been happening to agriculture in Arizona over the past 10 years. I can tell you that I was both astonished and tremendously impressed. You will note that I used the word astonished rather than the word surprised. Whenever I use either of those words I am reminded of the story about the meticulous grammarian whose wife came home unexpectedly from her bridge club only to find her husband kissing the cook, whereupon she reportedly blurted out, "Why Henry, I'm surprised!" At this juncture in the story, Henry is supposed to have turned to his dear wife and said, "Mabel, will you never learn to use the King's English, it was I who was surprised, you were astonished!"

Be that as it may, I was astonished that the value of Arizona's seven[3] leading sources of cash farm receipts has increased almost unbelievably over the past 10 years. The value of cattle and calves sold in Arizona more than doubled during that period. The value of your state's forage crops increased by 83 per cent during this same 10-year period. Income from vegetable crops in Arizona has increased by nearly 40 per cent while the value of dairy products increased by more than 30 per cent. I wish I had these achievements to talk about back in Ohio. Your production of citrus fruits and grapes has increased by a whopping 300 per cent during the last decade. I am of the opinion that these growth figures for agriculture in your state will have a highly significant impact on Arizona's future economic growth and development.

What I have just said about Arizona's dynamic agriculture represents the situation as of 1968. Those statistics are past history. What you and I must always be concerned about is what we are going to do about the future. The late C. F. Kettering, long-time Vice President for Research of the General Motors Corporation, and for many years a member of the Board of Trustees of The Ohio State University, had a favorite expression whenever he was confronted by imposing statistics of past accomplishments. "Boss" Kettering used to say that he was much more interested in the future than he was in the past because, as he put it, "It is in the future that I expect to live the rest of my life."

As we look to the future of agriculture in Arizona, there is remarkable potential for growth and development. Your present population of an estimated 1.7 million will likely reach at least 2.2 million by 1975. Those of you who are students will be just nicely started on your careers at that time. It is not too early, however, for you to be thinking about what this population growth will mean in terms of new markets for agricultural products or in terms of the 150,000 new families that will be involved, each with need for information on foods and nutrition, textiles and clothing, household equipment, and child development and family living. Consider with me for just a few moments, the future demands in Arizona for just four commodities — beef, dairy products, vegetables and eggs.

Considering Arizona's beef cattle industry and using the 1968 national per capita consumption figure of 107 pounds of beef, I have made some estimates of the new wealth which can be generated by Arizona's beef industry of the future.

A per capita consumption of 107 pounds of beef means that the 500,000 additional people who will be living in your state by 1975 will provide a new market for 50 million pounds of beef. That represents close to 90 million pounds of live weight which in turn is the equivalent of 90,000 1,000-pound beef steers. The production of this beef would result in $24 million of additional cash receipts from the sale of beef cattle each year. In terms of Arizona's economy it would mean an additional $75 to $100 million changing hands on the main streets of Arizona's cities and towns. If this number of steers were to be produced by beef cow herds in this state, it would require more than 1,000 additional 100-cow beef herds. If you were to divide this projected new beef business among the 14 counties in your state, you would quickly find that future opportunities in production agriculture are not without challenge and excitement.

If we take a similar look at Arizona's rapidly growing dairy industry — an industry which has grown by 30 per cent in the last 10 years, we find that the people who will be living in Arizona by 1975 will provide a new market for 285 million pounds of milk each year It will require 19,000 additional dairy cows, each producing 15,000 pounds of milk annually to produce this added amount of milk. In terms of 100-cow dairy herds, capturing the market for this much new milk production would require 190 such herds. This amount of new production at $6 per hundredweight would generate $17 million in cash farm receipts. Therefore, if Arizona's dairy industry were to meet the challenge of producing the dai

[3] *Cotton, cattle and calves, vegetable crops, products, feed grains, hay, citrus and grapes.*

products for just the new people who will be living in the state by 1975, the total economy would be benefited to the extent of between $50 and $85 million annually.

In talking about these additional increments of production for either beef or dairy products in Arizona by 1975, I am not talking about Arizona out-competing other areas of the country which now ship dairy products into the state. I am merely talking about meeting the challenge of competition for the new market which does not exist today but which I have estimated will exist in Arizona by 1975 because of a rapid population increase from 1.7 million at present to an estimated 2.2 million by 1975.

In considering another very important aspect of Arizona's agriculture, I was again rather astonished to note that Arizona ranks Number 4[4] in the United States in the production of fresh-market vegetables and melons. Your vegetable and melon industry generates nearly $90 million in cash receipts annually. This represents an increase of nearly 40 per cent since 1959. In fact, vegetables and melons are challenging cotton as the leading field crop of this state. Here again, it seems to me, that Arizona's agriculture has a tremendous opportunity if it is to meet the demands of the additional people who will be living here by 1975.

If we consider the U.S. per capita consumption of 97 pounds of fresh vegetables, this means that Arizona will need to produce nearly 50 million additional pounds of vegetables such as lettuce, carrots, broccoli, cabbage and other crops just to meet the needs of the additional people who will be living here by 1975. Of equal significance are the growing population centers to the west and north of your state as well as many other metropolitan areas throughout the United States which are present or potential market areas for Arizona produce. All of the additional people who will be living in these population centers by 1975 are going to have to be fed, and, as I tell Ohio producers, we might as well have this out-of-state money coming into our state as to have it go elsewhere. Arizona's vegetable and melon industry has long been aggressively sensitive to the demand beyond the borders of this state as evidenced by shipments to other states totaling nearly 50,000 carlots of vegetables and melons each year.

Another commodity that offers tremendous opportunity in terms of Arizona's increasing population is egg production. I do not anticipate that per capita consumption will go above 280 eggs per person. At this level, however, if Arizona's poultry producers were to compete successfully for the new market right here in their own state, they would need to produce nearly 12 million additional dozens of eggs by 1975. This would require 57,000 additional layers and provide $3.6 million of new wealth each year at current prices. Here again, in terms of the overall economic activity which would be catalyzed by this amount of agricultural production, we are talking about $10 million to $20 million additional dollars changing hands on Main Street in the state of Arizona. Arizona currently has approximately 1.2 million laying hens on its farms. In the last 10 years poultry numbers increased by 50 per cent. Last year nearly 250 million eggs were produced in this state, and 364 million eggs were consumed in this state. This means that currently more than 100 million eggs or nearly 10 million dozen eggs must be shipped in to the state of Arizona just to meet the needs of your present population.

The impact of agricultural production on the general economy goes far beyond what most of us realize. I think I can illustrate this by referring to an exhibit which we used at the Tri-State All-Electric Farm Show which is held each year at Dayton, Ohio. For the 1965 exhibit, our Poultry Science staff decided that they would show just what it means to a community to have a poultry industry in that community. They performed all of the calculations involved in the contribution to the economy of having just one laying hen in the laying flock. It required a large blackboard for them to do all of the calculations but it proved very dramatic to those who saw that the annual amount of off-farm business catalyzed by having one laying hen in a community, under Ohio conditions and using Ohio costs, amounted to $9.57 per hen per year. It is this contribution of agricultural production to the overall economy of an area that is so important! I think we haven't communicated this message as effectively as we should in terms of obtaining support from our legislators, or from the business community, or from the general public. The fact that $3 to $5 of off-farm economic activity is generated for each dollar of new wealth that is produced in agriculture really gets the attention of businessmen on Main Street when they finally listen long enough to understand what we are saying

I think there is little question but what it is within the realm of good reason to anticipate that the overall economy of the state of Arizona can be increased by a total of a quarter of a billion dollars by 1975 through agricultural development if you young men and women who will be leaders in Arizona's agriculture by the mid-1970's, will do what it takes by way of continued study, a genuine zeal for further developing confidence in yourselves, and by way of making sure that you continue to support your already excellent College of Agriculture, your distinguished Experiment Station, and your highly respected Extension Service. These goals that I have been talking about can be reached by 1975 if all of the present and potential leadership in the state of Arizona will work together to accomplish this job.

The further building of Arizona's agricultural economy will not happen automatically, however. Neither will the desired improvement in quality of living for Arizona's families happen automatically. Both will require scholarly excellence, political statesmanship and dedicated leadership on the part of those of you who have elected to cast your future lot with agriculture or home economics in Arizona.

In making reference to the future potential for beef cattle, dairy cattle, eggs and vegetables, I do not mean to imply that all of the other livestock enterprises and crops now being produced in Arizona are of any less importance than the four commodities about which I have spoken. The people of Arizona may choose to put their efforts on entirely different livestock enterprises or to emphasize crop production rather than livestock production. What I have attempted to do by reference to these four commodities is to dramatize the tremendous opportunities for students enrolled in agriculture. Never before in the history of our nation have graduates from our colleges of agriculture had comparable opportunities to effect economic development through their chosen field of endeavor, whether here at home or in under-developed nations all around the globe. Never before have we had the prospect of such rapid population growth as we have at the present time and for those of us in agriculture and home economics, more people means increased challenge and expanded opportunity.

I am confident that you share my indignation when you hear people, who are almost totally ignorant of research and education programs in either agriculture or home economics, make inquiry as to whether there is really going to be a need for agriculture and home economics in research and educational institutions of the future. The facts of the matter are, of course, that there will be colleges of agriculture and schools of home economics just as long as people indulge in that "quaint old habit" of eating, and the equally "quaint old habit" of getting married and rearing families. It will only be when people cease to eat, and when the concept of marriage and the rearing of families becomes obsolete, that education and research in agriculture and home economics will cease. That situation, my friends, will come to pass only if our civilization succeeds in destroying itself.

It is my nature to be optimistic. Personally, I am going to live each day as if my life would never end, and as if my contribution (meager thought it may be) were the most significant one of all in saving our world from oblivion. I like the way that S. W. Foss expresses the need for determination in our lives in his little poem entitled, "Which Way?"

With all our wise reflections,
Life has but two directions;
A way for those who fight to win,
A way for those who shun.
And YOU can have the choosing
Of the winning, or the losing,
It's up to you, my brother,
You can either fight or run.

The world is full of trouble,
And YOUR cares are sure to double,
And YOUR weary feet may falter
Ere the setting of the sun;
But the prizes are before you,
And the hand of God is o'er you.
It's up to you, my brother,
You can either fight, or run.

From what I see in your faces and from what I have experienced in the patient and gracious attention you have shown me here this morning, and from what I know of the fine educational institution in which you are enrolled, I am confident that the opportunities and the success which await each of you, either here in Arizona or elsewhere around this huge and exciting world of ours, will be little short of phenomenal. I congratulate each of you who are being honored at this Convocation this morning. I salute each and every one of you in this audience for your dedication to and your devoted efforts on behalf of agriculture and home economics as they continue to influence for good for all of the people, and all of the countries, all around our world!

[4] *Arizona Agricultural Statistics, 1968, Bulletin S-3, Arizona Crop and Livestock Reporting Service, Phoenix, Arizona, March, 1968.*

Photo at right, from left are Mrs. and Mr. Willis (Bill) Combs, and Bill's mother, Mrs. Lyla Combs, all of Queen Creek, and who donated the 7 acres of wooded meadow land near Williams for the Pinal 4-H Camp. They are talking to Keith Jones, Pinal County 4-H Agent, who is seated in the car.

After the Dust Settled . . .

They had a 4-H Camp

It all started when Mrs. Lyla Combs of Queen Creek offered 7 acres of land to Pinal County 4-H Board of Directors as a campsite for 4-H boys and girls.

Her proposal reacted upon board members, adult leaders and boosters of 4-H as if the idea had all the unexplainable power of an unusually strong dust devil.

It stirred things up in Pinal county. Sucking people, equipment, money, labor and ideas upward into the whirlwind.

And when things settled down, Pinal county 4-H boys and girls had their own summer camp.

It's on a site with a mountain meadow, rimmed with tall ponderosa pine occasionally sprinkled with a mighty oak.

It's near Williams.

And, for Mrs. Combs it was a dream come true.

You see, she had always wanted to use the land for children. At first she thought of the joys and benefits her grandchildren would realize from such a wonderful location.

But, now her grandchildren are no longer little. And, the boys and girls of Pinal county's 4-H clubs are.

So, with the encouragement of her own grown children, Mr. and Mrs. Willis (Bill) Combs, she offered the land.

The camp is located six miles East of Williams. Its' on an East slope giving a wonderful view of the San Francisco Peaks near Flagstaff.

The meadow is large enough to support a ball diamond, and in the thick stands of ponderosa there is room for archery, hikes and other recreation facilities.

The whirlwind offer set the nine member 4-H Board of Directors going.

They all caught the infectious spirit of their goal — a camp. Just as they did several years ago in building and providing a fairgrounds for the county's youth.

When a freight train jammed cars into the Picacho overpass, South of Coolidge, one of the cars was an 8,000 gallon capacity, double walled tank car used to haul vinegar. Its inner lining was stainless steel and just ideal as a water tank for their camp. Allison Steel Company of Phoenix found a way to donate this tank to 4-H.

The tank weighed 16 tons. And, to move it from Picacho to the Williams area they needed help. A trucking company took on the responsibility of getting it installed at the campsite. And, because of the double wall it tends to be insulated from temperature changes.

Certified safe water is obtained in Williams and the 8,000 gallons serves a full camp complement for a week.

Restroom and shower facilities are modern and were their most expensive installations.

Each building consists of double cabins connected by a covered breezeway. They were obtained at auction in Pinal county, dismantled, hauled to the campside on a borrowed truck which broke down South of Flagstaff.

With this plight they were helped by Bill Milliner of Flagstaff and Scottsdale who managed to get the trailer to within 25 feet of where the cabins were to be erected.

They went to Bogle Farms near Maricopa for a donation of steel, double deck bunk beds to fill the cabins.

Interested people in the county got together and made enough mattresses to fill each bed with a "thick, comfortable mattress." These were made from purchased ticking and donated cotton at a cost of only $3 each.

The Rowe Brothers helped the Board of Directors plan, gave advice on construction of the campsite and provided loading and hauling equipment.

They were given wire for installation of electricity which the Arizona Public Service Company installed through the help of Millard Meccia of Williams.

The camp is wired in such a way as to blend with the surroundings without calling attention to itself.

As Roy Swisher of Coolidge says, "we begged, borrowed and borrowed without the intention of returning almost all of the fixtures in the buildings."

There is no mess hall as yet but each cabin has a small table and they all cook as a unit on grills made by vocational agriculture students from materials furnished by the area farmers.

In the event of rain each group move their cook units under the breezeway.

Roy Swisher is an accountant from Coolidge. He and Keith Jones, Pinal County 4-H Agent with the U of A's Cooperative Extension Service say that the people in the county have been wonderful in the help they've given through donations of cash and materials, as well as labor and equipment.

The 4-H clubs pitched in as well. Stanfield 4-H Club made miniature cotton bales which were sold at the fair permitting them to contribute $150 to the camp kitty.

The Apache Junction Prospectors' 4-H Club donated $100 they had raised while the Thunderbird 4-H Club from Queen Creek put in $35.

Roy and Keith tell that the camp now represents an investment of $15,000. Half of this sum is covered by a public service loan from the Valley National Bank in Casa Grande.

They are emphatic about their next objective of paying off the indebtedness after which they have their sights trained on the addition of the other needed facilities.

They need a combination recreation-mess hall with a kitchen estimated to cost about $20,000. They need another building for toilet facilities for about $5,000, and two more housing units with double cabins for $3,000.

Presently they have in storage between Coolidge and Casa Grande a walk-in refrigerator. It's being kept there until they find a way to haul it to the camp.

Rod Goff of Stanfield and president of the current Board of Directors will solve this problem with the help of the other board members. They are: Mrs. Mike Bidegain of Kearney and vice president; Mrs. Max Taylor of Coolidge and secretary; Jim Harvey of Valley Farms and treasurer; Mrs. Willis Combs of Queen Creek; Joe Cooper of Florence; Bud Jackson of Casa Grande; Mrs. Richard Roorda of Apache Junction; and Oliver Anderson of Maricopa.

Swisher, though he has served out the allowable terms on the board, acts unofficially as their accountant.

This live wire supporter of 4-H says, "the boys and girls get more out of summer camp than any other thing I know of.

"Some of them have never been away from their parents for an overnight stay. Some could not afford camping expense, or would never get to a camp any other way.

"After a week at camp," his eyes flashing with joy, "these kids are just different people."

"They make better 4-H'ers for the rest of the year!" he exclaimed.

In bottom left photo, from left, are Jones and Roy Swisher, Coolidge Accountant, who contributed so much energy, time and ingenuity in getting the camp built and supplied with facilities. In bottom right photo Joe Cooper and his wife, Ann, also were key people in the development of the Pinal County 4-H Camp.

He has been a 4-H camp counselor for many years. As a volunteer he has seen the changes in the personalities of the 4-H boys and girls.

He and his family traveled the 225 miles to camp each week for 13 trips while building it.

And with his hands used to a pencil and calculator, they gained new experience digging ditches for water and sewage lines. He served as carpenter, painter, electrician and plumber. He enjoyed every blistering minute of it, too.

But, he wasn't alone.

Many others from Pinal county also worked on the camp. And, while there isn't room to list all who helped, the Joe Cooper family should be included.

Joe and his wife, Ann, and their children Cort, 16, Brent, 14, and Pam, 11, loaded their family pickup week after week to put in long weekends of work on the camp construction, pitching in with shovel, hammer, saw and pliers.

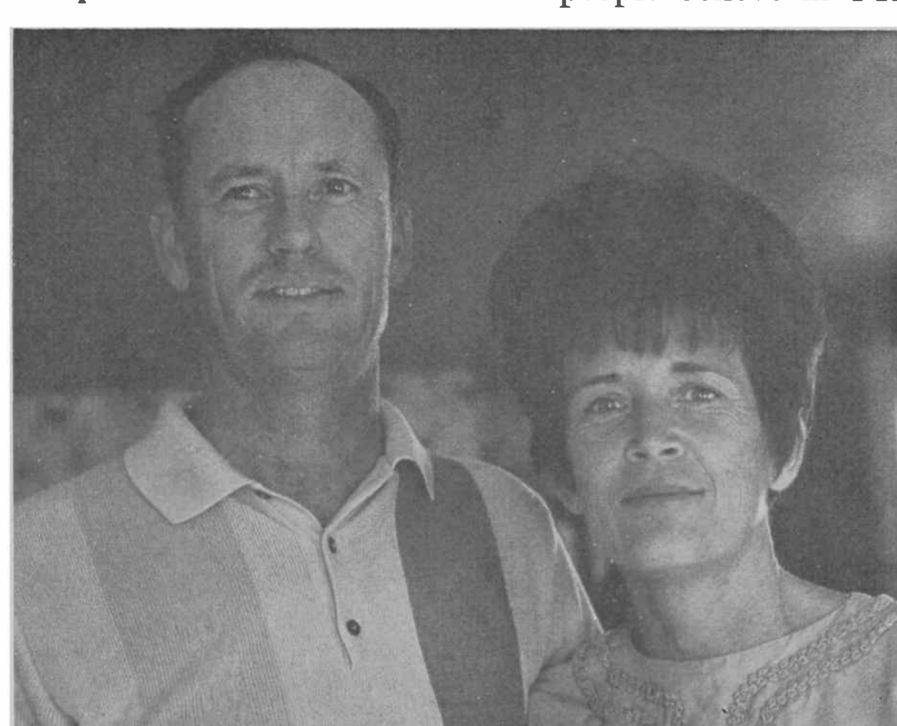
Cooper who also has been active in 4-H activity pointed out that they'd had trouble booking their own 4-H camping programs in other people's camps. Competition for such time is heavy.

He said, "you need to get out and sleep with these boys and girls to get to know them."

This experience he felt adds to closer working relationship during the balance of the 4-H year. "It's great!" he said.

And, while he said it his wife, Ann, sat near him beaming her agreement.

All of these people believe in 4-H.



Several Tests to Predict the Performance of Cottonseed Evaluated

*by Robert E. Dennis, L. L. Comer and C. N. Hodges**

Planting cottonseed in a greenhouse or placing seed in a constant temperature germinator may provide data to more accurately predict the field performance of cottonseed planted under adverse conditions. Many factors such as hardness of seed coat, depth of planting, texture and compaction of soil, residual heribicide, improper placement of fertilizer and insects and diseases affect seedling emergence. However, in properly aerated soil having adequate but not excessive moisture it is principally temperature that determines how soon germination and seedling emergence can occur.

Soil temperature conditions are often unfavorable when cottonseed is planted in the early spring. When this happens only the most vigorous seeds produce strong, healthy seedlings. Growers need information on each seed lot that will more accurately predict performance under adverse conditions.

The objective of this study was to compare the performance of cottonseed planted under adverse soil conditions with predicted performance based on the results of several tests. Acid-delinted, fungicide-treated seed of 24 representative varieties, provided by the Arizona Cotton Planting Seed Distributors and commercial concerns for 1967 Arizona on-farm variety tests, were used.

Data concerning field performance under adverse conditions were obtained by planting seed two inches deep in soil at the University of Arizona Casa Grande Overpass Experimental Farm at Tucson on March 15 and 16, 1967. A specially designed planting device was used to make 100 holes each 0.5 inch in diameter and two inches deep. A seed was placed in each hole and covered with moist soil. The planting pattern was a randomized block with six replications.

The soil temperature, Figure 1, and moisture content at the seed planting depth were recorded daily. Seedlings were counted as emerged when both cotyledonary leaves were above the soil surface and the hypocotyl straightened. Counts were made through May 20.

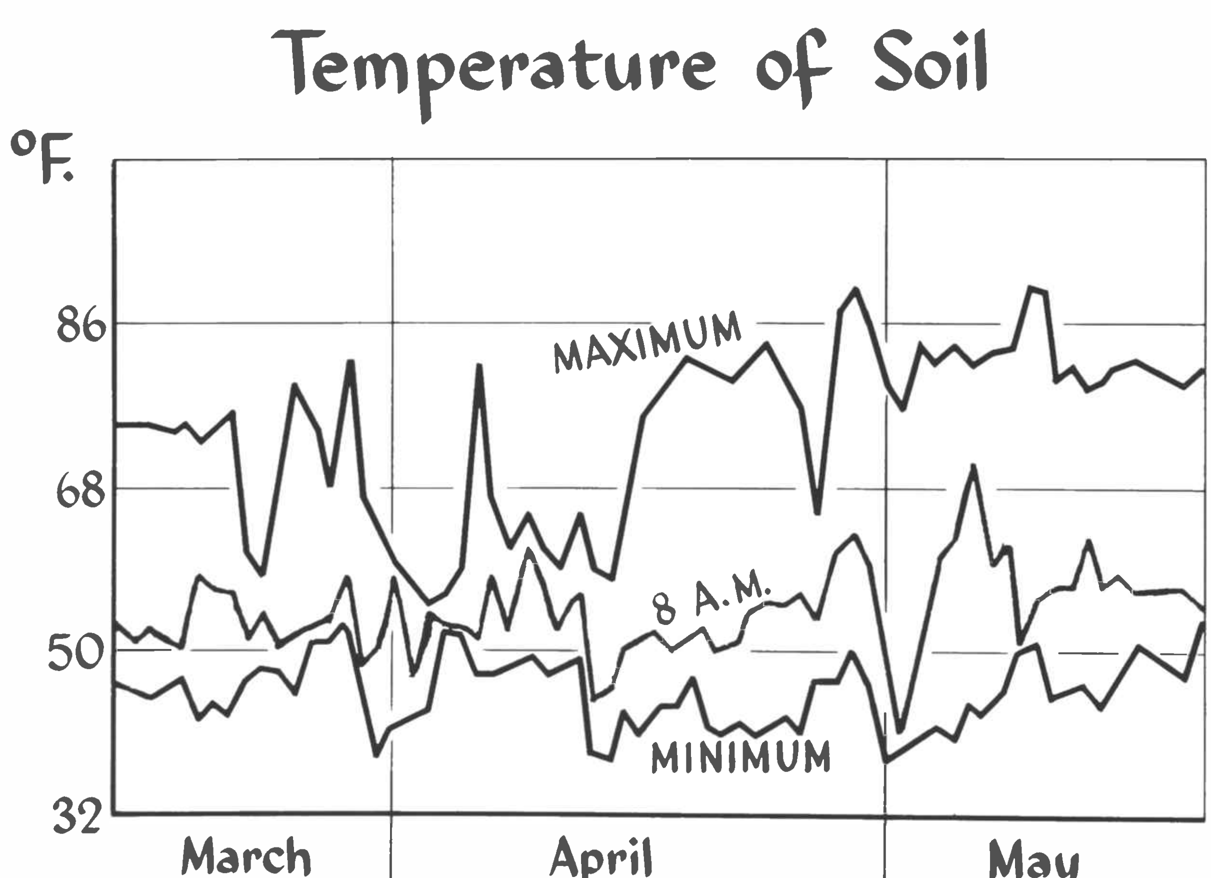


Figure 1. Graph showing daily maximum-minimum and 8 a.m. temperatures of soil at 2 inches in depth at the field testing plot, Tucson, 1967.

Several Tests to Predict Emergence Evaluated

Carbon dioxide concentrations of 300, 1200 and 2400 ppm were maintained in three different adjacent greenhouses. Air in the greenhouses was cooled by continuously moving it through water at 77° F. Surface soil from the area used for the field experiment was placed in benches in each greenhouse. Four replicates of

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** Extension Agronomist, former graduate student, Department of Agronomy; and Supervisor, Environmental Research Laboratory, University of Arizona. This article is a portion of a thesis by L. L. Comer (now Research and Development Agronomist with Monsanto Chemical Co.) submitted in partial fulfillment of M.S. degree requirements in Agronomy. Data for the official laboratory germination test were supplied to the University by Harley Reeder, registered certified seed analyst, Agricultural Seed Laboratory, Phoenix.*

Figure 2. Larry Comer, above, is observing cotton seedlings in the greenhouse in which the level of CO_2 in the atmosphere was maintained at 1,200 p.p.m. He did the work as part of his master's degree program.

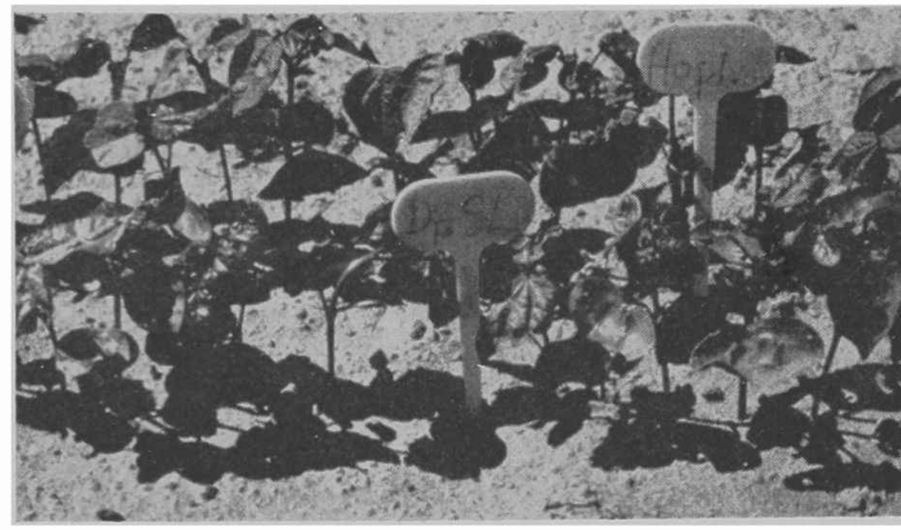


Figure 3. Cotton seedlings of Deltapine smoothleaf and Hopicala planted in border rows of field experiment. Note excellent stand obtained even though planting was made March 15 in relatively cool soil.

seed of each of the 24 entries were planted two inches deep in soil in each greenhouse. Seedling counts, using the same criteria as in the field experiment, were made 15 days after the initiation of the test.

Three germinators, each with a different constant temperature were used in another phase of the experiment. Temperatures were maintained inside the different germinators at 60, 65 or 70° F. Four replicates of 50 seeds each were placed in sterilized glass petri dishes on nontoxic filter paper. Petri dishes containing the seeds were placed in the germinators and radicles (young roots) were evaluated at 7 and again at 12 days. In these tests a seed was considered germinated when it had produced a radicle 0.5 cm long.

The standard tetrazolium quick test, with and without a Vitascope, was also used as a means of predicting seedling emergence in the field. For this test seeds were first placed in distilled water and then in a one per cent solution of tetrazolium chloride after the seed coat and membrane had been removed.

Results

The fluctuation of soil temperature that occurred in the field is shown in Figure 1. Soil moisture was at about 10 per cent when the experiment was initiated. Moisture content of the soil dropped slightly at different times, but in each instance rain, snow or application of irrigation water caused it to return to near 10 per cent. The temperature in the greenhouse ranged from 75.2 to 82° F during the course of the experiment.

The correlation coefficient for seedling emergence in the 1200 ppm CO_2 chamber and that obtained in the field was 0.72. The correlation coefficient for results obtained in the standard laboratory test and the field was only 0.41. Seed are held at 86° F for 8 hours and then at 68° for 16 hours for 12 days in the standard germination test for cotton.

It was of interest that the average dry weight of seedlings 15 days after planting was 2.64 g. for the 300 (normal atmospheric level), 4.20 g. for the 1200 and 3.45 g. for the 2400 ppm CO_2 chamber.

The correlation coefficient for results obtained in the field and those obtained in the 70° F constant germinator was 0.64, Table 1. This was a relatively simple and inexpensive test. The correlation coefficient for results obtained from the tetrazolium quick test and those obtained in the field was 0.72. The tetrazolium test is useful but the analyst using it must have had considerable training and experience in order to properly interpret results obtained.

Data reported in Table 2 summarizes results of some of the tests conducted in this study. Results of several of the predictive tests provided more reliable information concerning performance of cottonseed in the field than the laboratory test presently used. Data obtained from this preliminary research indicate that additional studies might provide a relatively simple test to more accurately predict field performance of cottonseed when planted in the field under adverse temperature conditions.

Table 1. Percent of seeds that produced a radicle 0.5 cm or longer after 12 days in constant temperature germinators.[1]

	Germinator Temperature - °F		
Variety	*60*	*65*	*70*
1517D	**17.0**	**87.0**	**91.0**
Hopicala	**21.0**	**90.5**	**93.0**
Stoneville 213	**21.6**	**72.0**	**89.5**
Deltapine 16	**48.6**	**86.5**	**93.5**
Pima S-4	**90.6**	**87.0**	**90.5**
Mean (24 varieties)	**34.7**	**72.9**	**88.5**
Correlation coefficient[2]	**0.26**	**0.59**	**0.64**

[1] *Varieties presently most important in Arizona are included in this table.*

his test and results under field conditions.

Table 2. Field seedling emergence rank compared with rank as predicted using several different tests.[1]

Variety	*Field*	*Official Test*	*CO_2 1200 ppm*	*70 F Germinator*	*Tetrazolium*
1517D	**1**	**5**	**5.0**	**16.5**	**2.5**
Hopicala	**2.5**	**1**	**5.0**	**12.0**	**2.5**
Stoneville 213	**8.0**	**20**	**10.5**	**20.0**	**18.0**
Deltapine 16	**12.0**	**11**	**8.0**	**8.0**	**10.0**
Pima S-4	**17.0**	**3**	**15.0**	**18.5**	**2.5**
Correlation coefficient (24 varieties)		**0.41**	**0.72**	**0.64**	**0.72**

[1] *Varieties presently most important in Arizona are included in this table. Performance was the same when rank is indicated to be the same.*

Remove the competition and blue panicgrass, in photo at left, responds on a Papago Reservation flood plain. In the same picture the stand of mesquite and annual grasses are shown which provide poor and undependable forage. Total annual cost per acre is $2.99 when amortized at 8 per cent for 50 years.

In photo at right is another fence line contrast which shows the dense stand of blue panicgrass developed after root plowing and seeding. After treatment a dependable, good quality forage supply is obtained providing 1.4 animal unit months per acre. Before treatment the same area yielded 0.66 animal unit months per acre — a 23 fold increase.

Papago Floodwater Pastures

Show Promise

*by J. R. Simpson, R. A. Young, P. R. Ogden & C. W. Whitfield**

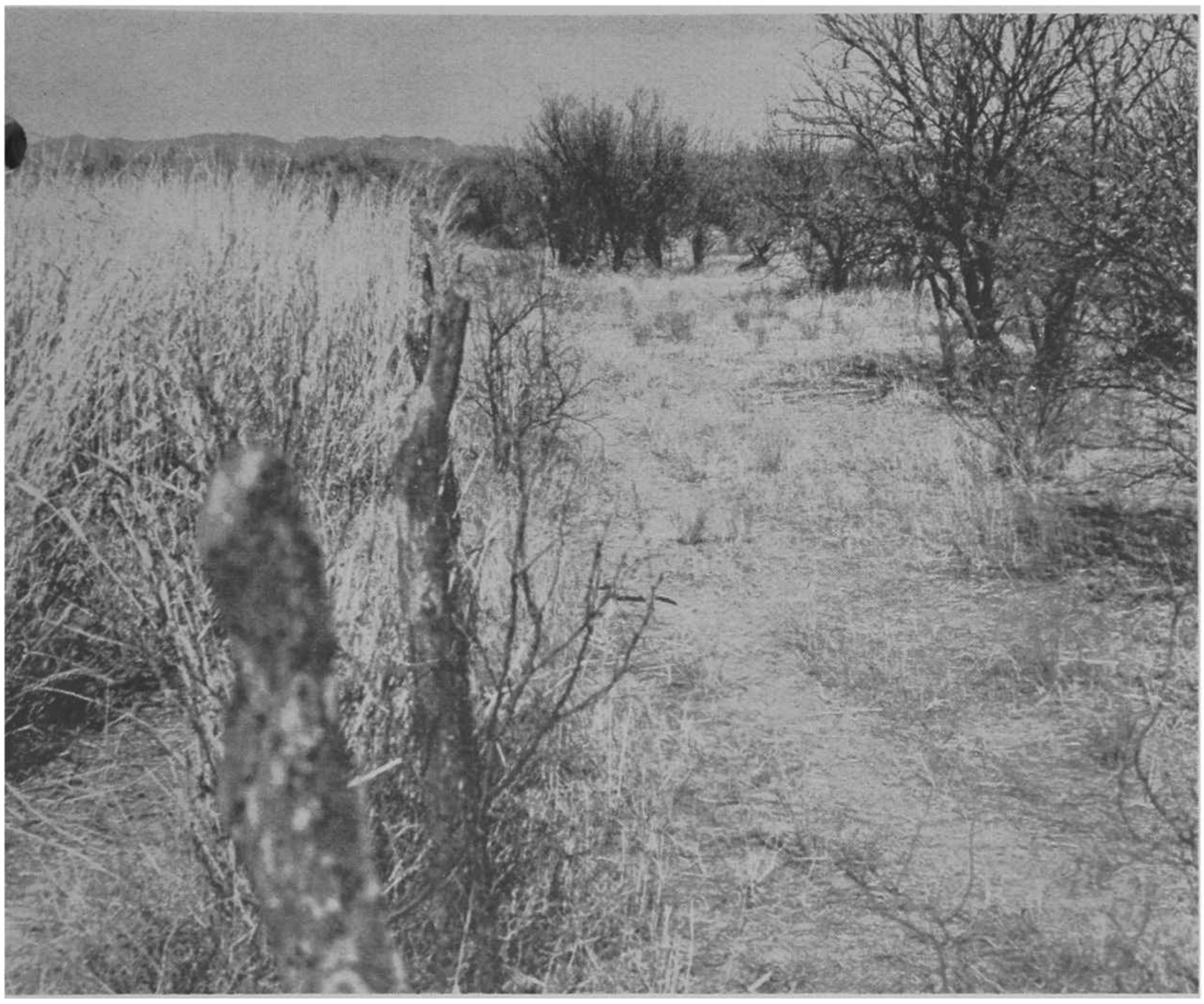
Intense summer rainstorms associated with warm, moist, unstable air flowing North and West from the Gulf of Mexico cause brief periods of rapid runoff in many areas of the southwestern U. S. The use of flood runoff from such storms to irrigate supplementary perennial grass pastures was tested by the Bureau of Indian Affairs on the Papago Indian Reservation in Southern Arizona. The results of these pilot studies were sufficiently encouraging to warrant an economic analysis of the possibility of extending the development to approximately 25,000 acres of alluvial soils on low level lands elsewhere on the reservation (Simpson, 1968). The findings should be of interest in other areas where similar conditions prevail.

** Simpson is former graduate Research Assistant and now with New Mexico State University; Young is Associate Agricultural Economist; Ogden is Associate Professor of Range Management; and Whitfield is Land Operations Officer, B.I.A., Papago Reservation Sells.*

Background

The 2.8 million acre Papago Reservation is in South central Arizona, its eastern border lying about 26 miles West of Tucson. The reservation consists of arid valleys lying between 1,400 and 2,600 feet above sea level, broken by occasional mountain ranges with peaks reaching above 7,000 feet elevation. The high temperature and low rainfall are typical of the Sonoran Desert. The sparse annual precipitation is distributed mainly in two periods — the intense, localized summer rains in July, August and September; and lighter, more generalized winter rains originating in the Pacific. Summer rains are unpredictable, and extreme drouth conditions are experienced in about one year of every four. This, together with years of over-grazing, have led to conditions where annual plants provide most of the forage on the reservation grazing lands. Supplementary forage, in order to provide feed during dry seasons, would be very desirable on the reservation.

Additional pasture development would be carried out in the same manner as was done on the 5,000 acres completed in the past six years. Bulldozers topple the trees and in the same operation, dislodge roots with a "root knife," literally plowing the land. The trees are small enough to be left to rot, and no further land preparation is required. The area is then fenced, and corrals, water spreading dikes, and "charcos" (earthen watering ponds) are built. The pastures are seeded by aircraft just prior to the summer rains. Grazing is deferred for one year to allow the stand to develop.



Because of the vast area of the reservation, some basis for preliminary screening of potential sites for development was needed. The U. S. Air Force provided aerial photographs, which were helpful in this regard. On-the-spot inspections were made of locations selected on the aerial photos and twenty three sites comprising 22,700 acres were chosen as suitable for detailed analysis. Considerable variation was observed in size, estimated productivity and development costs among the sites. Each site was evaluated individually, but for the sake of brevity, we report the average costs and returns for all sites here.

Yield Estimates

Blue panicgrass and Lehman lovegrass are the most successful of the perennial grasses tested, the former judged to be best adapted to "well-flooded" areas (about 90 per cent of the area studied), and the latter best in the areas of lighter inundation. Blue panicgrass on well-flooded areas is estimated to produce about 1,040 pounds of usable forage, oven dry weight basis (ODW), per acre per year. Lehman lovegrass on the less watered locations is estimated to produce 180 pounds of usable forage per acre per year. On the assumption that 20 pounds of ODW forage equals one animal unit day, average yield is estimated at about 42 animal unit days (or 1.4 animal unit months) per acre per year for the entire development. It is assumed that the pastures can supply feed for four months of each year.

Cost Estimates

Costs per acre are given in the accompanying table for the intial investment and for annual operation and maintenance expenses. The initial expenses are converted into annual equivalent costs, using the appropriate annuity tables, on the basis of an eight per cent interest rate and a life of fifty years. The resulting costs per animal month (AUM) is $2.14, a relatively favorable figure. (Other investigations have estimated the market value of an animal unit month of forage on western ranges at around $3.00) (Gardner, 1962; Jeffries, 1964). Reducing the amortization period from 50 to 25 years, other factors unchanged, leads to a cost of $2.37 per AUM. Reducing the interest rate from eight per cent to six per cent results in costs of $1.77 per AUM at 50 years and $2.07 per AUM at 25 years.

Conclusion

Other investigators have found that clearing and reseeding rangelands characterized by dense woody cover is often a questionable proposition. The present study suggests that under conditions where local runoff can be inexpensively utilized to boost forage yields, such investments can be relatively attractive.

Summary of Cost Computations**

		$ per acre	
A.	**Initial Investment in Pasture**		
	Clearing	**14.30**	
	Seed (includes application)	**3.40**	
	Fencing	**4.00**	
	Dikes	**.80**	
	Watering ponds	**4.90**	
	Corrals	**.50**	
	Total	**$27.90**	
	Annual equivalent cost of investment (Amortized at 8% for 50 years)		**$2.28 per acre per year**
B.	**Annual operating and maintenance costs per acre**		
	Fences and corrals (3% of original investment)	**.14**	
	Watering ponds	**.07**	
	Eradicating woody invaders (aerial spray at 5 year intervals)	**.50**	
	Subtotal—Operating costs	**$0.71**	
C.	**Total annual cost per acre**		**$2.99**
D.	**Cost per Animal Unit Month*** **		**$2.14**

** *1967 prices.*
*** *1.4 AUM per acre per year.*

HONEY BEE NUTRITION

*by L. N. Standifer**

A general knowledge of honey bee nutrition helps in understanding how the bee grows and how the colony develops and maintains itself.

The anatomical and vital physiological systems usually associated with living animals are present in the honey bee. Food enters the alimentary canal (see diagram) of the adult bee by way of the mouth and the long tubelike esophagus, which extends through the thorax and into the abodmen, where it enlarges to form the honey stomach. Nectar is transported in the honey stomach from the flower to the hive. Immediately behind the honey stomach is the proventricular valve. It retains the nectar load in the honey stomach, lets food pass into the midgut, but prevents food from returning. The midgut or ventriculus is a relatively large segment of the alimentary canal, lined on the inside with peritrophic membrane. Beyond the midgut are the short, small intestine, the large intestine or rectum, and finally the anus.

The adult honey bee has six sets of paired glands located in the head and thorax. The labial glands are generally believed to be associated with the alimentary canal. They deliver their secretions at the base of the labrum. Their function is dependent on the age of the bee and on the work in which it is engaged.

The hypopharyngeal or brood food glands produce

* *Apiculturist, Entomology Research Division, Agricultural Research Service, Bee Laboratory, Tucson, in Cooperation with the University of Arizona Agricultural Experiment Station.*

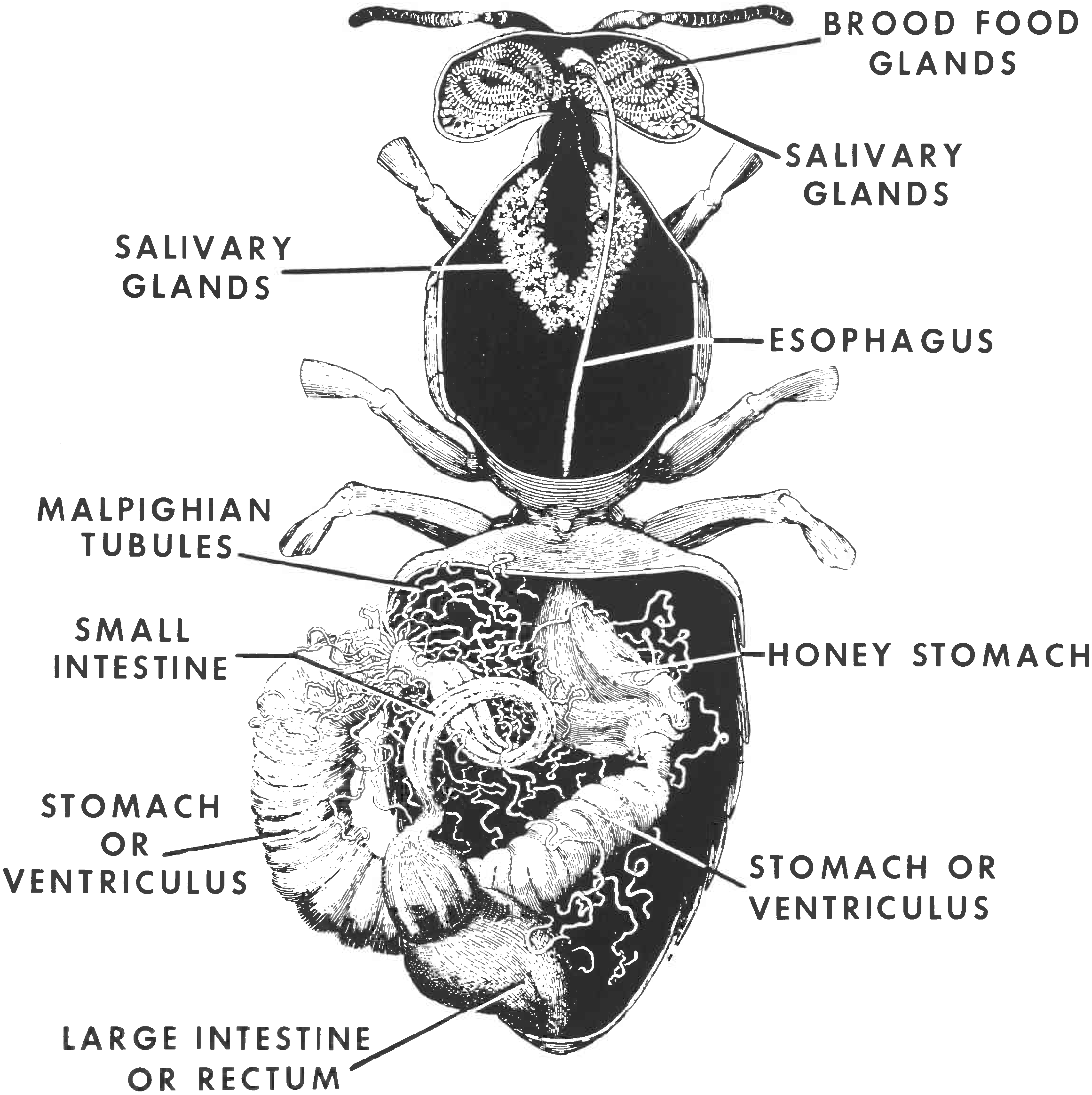


Figure 1. The alimentary canal of adult worker honey bee

the food called royal jelly. Most of the larval food comes from these glands. They also supply food for the adult queen and possibly adult drones. They are fully developed only in the worker bee. Royal jelly is milky in appearance, slightly acid, and rich in digestive enzymes, proteins, carbohydrates, fats, and vitamins.

The mandibular glands are saclike, single structures located immediately above the mandibles. They are extremely large in the queen, smaller in the worker, and vestigial in the drone. They do not vary in size with age or occupation. However, if the newly emerged bee does not consume adequate protein during the first few days of adult life, these glands do not develop fully.

The secretions from these glands in queens contain a compound called queen substance, which is essential for social unity of the colony. This substance is not in the glandular secretions of worker bees. Workers probably use the secretion from their glands to prepare and manipulate wax for building comb. It may also be used to soften the pupal cocoons of bees and is found in royal jelly.

The primary function of the postcerebral glands, located in the back of the head, is to provide the enzymes necessary for the digestion of foodstuff consumed by the bee.

The thoracic or salivary glands in the anterior part of the thorax secrete a corbohydrate-splitting enzyme, invertase, in large amounts.

The function of the postgenal glands in the lower inner wall of the head and the sublingual glands at the base of the bee tongue is unknown.

Two pairs of rectal glands or pellets on the sides of the rectum are associated with fat absorption.

Beeswax is secreted by specialized cells called wax glands on the underside of the abdomen of the worker bee. Generally wax glands become fully developed about the 15th day of adult life. Secreted beeswax appears as thin, delicate scales or flakes. It is a byproduct of metabolism and directly follows the digestion of large quantities of nectar or other sugars. The bees use wax to form the cells of the comb in which food is stored and brood is reared.

When wax is needed for comb building, the 16-to 24-day-old bees fill their honey stomachs, then hang together in vertical sheets or festoons. The wax scales are secreted, then removed with the hindlegs, and passed forward to the mouth, where they are worked by the mandibles and subsequently applied to the edge of the comb. The wax glands shrink and become nonfunctional between the 20th and 25th day of adult life, or about the time worker bees become field-foraging bees.

DIGESTION

The movement of pollen through the alimentary canal of the adult bee reveals something of the digestive process. Ten minutes after the material is fed to the bee, the pollen grains are clustered at the proventriculus. Thirty minutes after feeding they are within the peritrophic membrane in the forepart of the ventriculus. Ninety minutes after feeding, the peritrophic membrane-enwrapped pollen mass enters the anterior or small intestine. At the end of two hours the pollen is within the small intestine or just entering the large intestine or rectum. The peritrophic membrane that encircles the pollen grains in the midgut persists in the rectum for a considerable time before all is voided in the feces.

The fatty acids in pollen are made water soluble by neutralization with alkalies in the alimentary canal secretion. The proteins are broken down into peptides, and these are further hydrolyzed into amino acids.

The lipids of bee food occur chiefly in pollen. The lipid-splitting enzyme lipase is abundant in the midgut of the adult worker and drone. Its value in digesting the lipids is unknown. In higher animals lipids are digested by lipase or esterase into free fatty acids and glycerol.

NUTRITIONAL REQUIREMENTS

Honey bees and other insects have no unusual nutritional requirements. They require carbohydrates, proteins, fats, minerals, vitamins, and water for growth, development, maintenance and reproduction. Nectar and honeydew are the chief sources of supply for carbohydrates in the diet of bees, and pollen furnishes all the other indispensable constituents.

Adult bees can live on corbohydrates glucose, fructose, sucrose, trehalose, maltose and melezitose. They cannot utilize the carbohydrates galactose, mannose, lactose, raffinose, dextrin, insulin, rhamnose, xylose, or arabinose. Beekeepers often feed suscrose if a shortage of nectar or honey exists. Bees also utilize fruit juices and certain occasional plant juices. A small amount of carbohydrates is also obtained from pollen. The adult bee can survive on corbohydrates; however, proteins, fats, minerals, and vitamins are necessary in rearing the immature stages.

Proteins of a precise quality and definite amino acid composition are required for optimum growth and development of the brood food-producing hypopharyngeal glands and no doubt others. When nursing duties are finished (between 10th and 14th day of adult life) and field duties are undertaken, the requirements for protein decrease, and the chief dietary constituent becomes the carbohydrates obtained from nectars and honey.

Fats, like carbohydrates, are also used as sources of energy. Bees probably require and utilize some of the fats in pollen they consume. However, chemical analyses of feces show that large amounts of fats in the pollen consumed by bees pass through the digestive tract and are not utilized.

Water is necessary in the diet for diluting concentrated honey. It is also used in air-conditioning the cluster. Normally bees do not store water as they do nectar and pollen. It is collected only when needed.

The nutritional value of the enzymes, coenzymes, and pigments found in pollen is largely unknown.

SOURCES AND CHEMICAL COMPOSITION OF FOODS

NECTAR When nectar is collected, it may contain from 5 to 75 percent soluble solids (sugars), most of which is in the 25 to 40 percent range; the remainder is water. The primary sugars are sucrose, glucose, and fructose. As the nectar is manipulated and finally stored as honey, much of the sucrose is inverted to glucose and fructose, usually in about equal amounts.

HONEYDEW Various species of insects secrete a material called honeydew, which bees collect and store in the comb. Honeydew has a high percentage of dextrins and melezitose. It is generally considered a poor source of carbohydrates for bees.

PLANT JUICES Bees often collect juices from overripe fruit and various plant exudates that are rich in sucrose or related sugars. They usually do this only when nectar is not available.

POLLEN Pollen furnishes all the other indispensable constituents of the diet, except water, that are required for vital activity, including rearing young bees. Not all pollens are alike nutritionally, and bees grow and develop better on some than on others.

In nature bees generally utilize a mixture of pollens in their diet. This is eaten by adult bees and is fed to worker and drone larvae after they are 3 days old. Co

Table 1. Amino acid content of average pollen and sweet corn pollen, expressed as per cent of crude protein

Component	Average pollen percent	Sweet corn pollen percent
Arginine	5.3	4.7
Histidine	2.5	1.5
Isoleucine	5.1	4.7
Leucine	7.1	5.6
Lysine	6.4	5.7
Methionine	1.9	1.7
Phenylalanine	4.1	3.5
Threonine	4.1	4.6
Tryptophane	1.4	1.6
Valine	5.8	6.0

Other constituents of pollen include:

Constituent	Amount Per cent
Fats	1.3 -19.7
Mineral (ash):	
Calcium	1.00-15.00
Chlorine	0.60- 0.90
Copper	0.05- 0.08
Iron	0.01-12.00
Magnesium	1.00-12.00
Phosphorus	0.60-21.60
Potassium	20.00-45.00
Silicon	2.00-10.40
Sulfur	0.80- 1.60

	Micrograms per gram identified
Vitamins:	
Ascorbic acid	131.00-721.00
Biotin	.19- .73
D	.20- .60
E	.00- .32
Folic acid	3.40- 6.80
Inositol	.30- 31.30
Nicotinic acid	37.40-107.70
Pantothenic acid	3.80- 28.70
Pyridoxine	2.80- 9.70
Riboflavin	4.70- 17.10
Thiamine	1.10- 11.60

sumption and digestion of pollen by adult bees are essential, since they can only produce brood food from pollen that they have eaten. This brood food, or royal jelly, is fed to all larvae the first 3 days of life and to the queen bee throughout her larval and adult life. Royal jelly has the following approximate chemical composition (in percent): water 66, dry matter 34; of the latter, carbohydrate 13, protein 12, fat 5, ash 1, and undetermined matter including vitamins, enzymes, and coenzymes 3.

Bee-collected pollens are comparatively rich in the carbohydrates. Reducing sugars range from 15 to 43 percent, with an average of about 29 percent. The glucose, fructose, sucrose, raffinose, and stachyose content is not significant, although the bees apparently utilize those that are available. Corn pollen, for example, has a high starch content. The pollen shell is not utilized by bees, but is eliminated with the feces after the internal matter has been removed by digestive processes.

The protein value of pollen varies from 10 to 36 percent. The amino acid content of average pollen and sweet corn pollen with a crude protein of 26.3 and 26.9 per cent, respectively, is shown in Table 1.

All the amino acids in Table 1, except threonine, are essential for normal growth of the young adult bee. With the exception of histidine and perhaps arginine, they cannot be synthesized by bees and must be obtained from the pollens consumed.

Bees also occasionally collect spores and store them as pollen. Although spores can be utilized as a proteinaceous food, they do not stimulate brood rearing and are generally considered a poor substitute for pollen.

ARTIFICIAL DIETS

The beekeeper can supplement the diet of nectar or honey with sucrose. This is usually mixed with about an equal amount of water and fed as sirup.

There is no substitute for pollen. Various materials, including brewer's yeast, soybean flour, dry skim milk, and egg albumin, mixed with honey or sugar water, have been fed to bees, but the colony stimulation is minor compared to that derived from fresh pollen. The addition of dried pollen trapped from colonies earlier increases the stimulation slightly.

The two most commonly used artificial diets are the pollen supplement diet and the pollen substitute diet. Their composition is as follows:

Materials	Percent
Pollen supplement:	
Sugar-water (2 parts sugar to 1 part water by weight)	67
Pollen-soy mix (1 part fresh dry pollen to 3 parts soybean flour by weight)	33
Pollen substitute (dry mix):	
Soybean flour	20
Casein	30
Brewer's yeast	20
Dry skim milk	20
Dried egg yolk	10

Few problems facing the apiculture industry today require immediate research attention as much as the development of an artificial or chemically defined diet for honey bees as a substitute food for pollen. Work on nutrition and physiology of the honey bee may soon lead to an artificial diet for bees.

Principals in the 1969 College of Agriculture Student Honors Convocation are from left: Dr. Darrel S. Metcalfe, director of resident instruction for UA's agricultural college; Dr. Roy M. Kottman, dean of College of Agriculture and Home Economics, Ohio State University, Columbus, Ohio, who delivered the featured talk starting on page 10; and Dr. Harold E. Myers, dean of College of Agriculture at the U of A.

I'll Farm . . .

(From Page 7)

They introduced me to my friendly advisor Dr. W. R. Kneebone, professor in agronomy. He spent considerable time helping me select and plan my courses.

My first semester in Tucson was a period of adjustment. I had only one friend who left after two weeks for the Air Force. And, I had doubts of being able to compete in a large university. For this reason I felt my only chance was to give it (study) all I had. And, I did.

At the end of the semester I was again amazed when I passed with flying colors. With more confidence I began taking more courses each semester and started to feel at home around the campus.

During my first summer I was lucky in receiving a National Science Foundation undergraduate research fellowship in soils. With this I had my first taste of research and liked it and therefore decided to make it my second choice goal. Farming was still uppermost in my mind.

As I was about to graduate and even though I had a good job offer I was convinced that I should go on to earn a master's degree. Now that I have a bachelor's degree it seems still somewhat unreal. And, I realize that college graduates are human too — we still put our pants on one leg at a time.

My graduate advisor is Dr. R. T. Ramage, the man who developed the first hybrid barley, Hembar. I worked with him on this program and found the work fascinating.

But that nagging desire to be out there farming was still with me and I had to do something about it. So, I pushed my studies in order to speed up the program.

Now, soon, I shall graduate with a M. S. degree — my work permit.

I am sure that my education will help me on my new job. After all education is to me a form of insurance which provides more flexibility.

For you see the things I have learned will help me on my new job. I'll be in farming partnership with Ben Matthews. He is one of the fellows I worked for at Salome.

It will be my job to farm 250 acres of cotton and I have just barely enough time to finish up here and start planting this year's crop.

PROGRESSIVE AGRICULTURE IN ARIZONA

Official Publication of the College of Agriculture and School of Home Economics The University of Arizona

Harold E. Myers Dean

to: