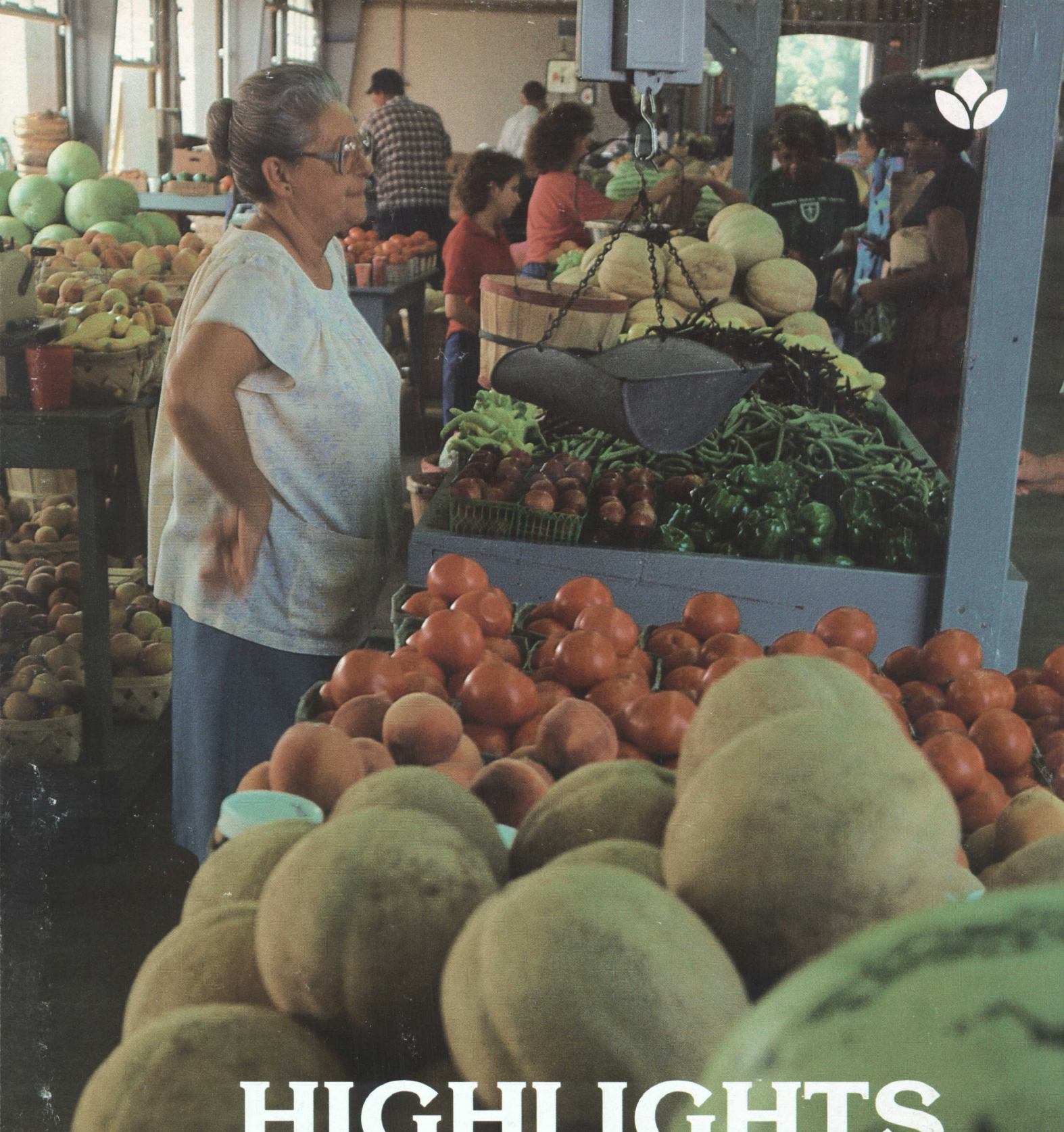


HIGHLIGHTS

of Agricultural Research

Vol. 33, No. 3
Alabama Agricultural Experiment Station
David H. Teem, Acting Director

Fall 1986
Auburn University
Auburn University, Alabama

NEW AND TIMELY PUBLICATIONS

Several new publications reporting results of latest Auburn agricultural research were issued by the Alabama Agricultural Experiment Station during the 1985-86 fiscal year. Copies of these new reports, listed below, are available upon request to Department of Research Information, 103 Comer Hall, Auburn University, Alabama 36849.

Bulletins

No. 570. Peach and Nectarine Varietal Performance in the Wiregrass Area of Alabama.
No. 571. Turfgrass-Sod Marketing in Alabama.
No. 572. Weed Survey of Permanent Pastures in Three Southern States.
No. 573. Thinning with the John Deere 743A.
No. 574. A Generalized Plotting Program to Produce Stand Maps.
No. 575. Response of Corn Hybrids to Aflatoxin Formation by *Aspergillus flavus*.
No. 576. An Interactive Simulation Program to Model Feller Bunchers.
No. 577. Forage Nutritive Quality of Weeds in Alabama.
No. 578. Legal Knowledge of Estate Planning Possessed by Alabama Farmers: Illustrated by Fact Situations and Legal Solutions.
No. 579. Sawmill Efficiency Improvement Analysis.

Circulars

No. 284. Centipedegrass Seed Production.
No. 285. Influence of Galecron and Pix on Cotton Yields.
No. 286. Root Growth of Loblolly Pine (*Pinus taeda* L.) Seedlings from Twenty Southern Nurseries.

Research Report Series

No. 4. Research Report 1986, Soybeans.

Progress Reports

No. 122. Tomato Variety Trials, 1986.

Annual Reports

1985 Annual Report of the Alabama Agricultural Experiment Station, Auburn University

Variety Reports

Performance of Corn Hybrids in Alabama, 1985
1985 Alabama Cotton Variety Report
Performance of Grain Sorghum Hybrids in Alabama, 1985
Performance of Soybean Varieties in Alabama, 1985
The 1986 Alabama Performance Comparison of Small Grain Varieties
Performance of Ryegrass Varieties in Alabama, 1985-86

Departmental Series

Agricultural Economics Series No. 38, "Data Collection in Subsistence Farming Systems—A Handbook."
Agricultural Economics and Rural Sociology Departmental Series No. 39, "The Financial Condition of Alabama Farmers, January 1986."
Agricultural Weather Series No. 25, "1985 Alabama Agricultural Experiment Station Weather Data."
Agronomy and Soils Department Series No. 106, "Procedures Used for Soil and Plant Analysis by the Auburn Univeristy Soil Testing Laboratory."
Forestry Departmental Series No. 12, "Growing the 'Best' Seedlings for Reforestation Success."
Research and Development Series No. 32, "Development of Aquaculture in the Philippines."

Southern Cooperative Series Bulletins

No. 311. Costs of Establishing and Operating Field Nurseries Differentiated by Size of Firm and Species of Plant in USDA Climatic Zones 7 and 8.
No. 317. Evaluation of Alternaria cassiae as a Mycoherbicide Sicklepod (*Cassia obtusifolia*) in Regional Field Tests.

ON THE COVER. Vegetable crop production requires good management and emphasis on marketing (see story page 10).

may we introduce

Dr. David Hill, Alumni Associate Professor of Agricultural Engineering. A native of Georgia, Hill came to Auburn in 1979 from the ag engineering staff at the University of Florida. He graduated magna cum laude with a B.S. degree in agricultural engineering from the University of Georgia, where he later earned his masters degree in the same subject area. Hill earned the Ph.D. from Clemson University and did additional graduate study at Cornell University. His area of specialty is pollution control and waste management.

Prior to his teaching and research experience at the University of Florida, Hill worked as design engineer for Lockwood-Greene Engineers Inc. in Spartanburg, South Carolina. Since coming to Auburn, Hill has been the driving force behind Auburn's internationally recognized animal waste utilization program.

Hill recently won the Director's Research Award for excellence in his research program in the Alabama Agricultural Experiment Station and the Farm and Industry Equipment Institute's Young Researcher of the Year Award. He is the senior author of an article on page 14 of this issue of *Highlights*, which describes some of his latest animal waste utilization work.

FALL 1986 Vol. 33, No. 3
A quarterly report of research published by the Alabama Agricultural Experiment Station, Auburn University.
DAVID H. TEEM ..... *Acting Director*
R.E. STEVENSON ..... *Editor*
ROY ROBERSON ..... *Associate Editor*
TERESA RODRIGUEZ ..... *Art Designer*

Editorial Committee: DAVID H. TEEM; W.D. DAVIES, *Professor of Fisheries and Allied Aquacultures;* J.E. DUNKELBERGER, *Professor of Agricultural Economics and Rural Sociology;* C.E. JOHNSON, *Professor of Agricultural Engineering;* G.J. KEEVER, *Assistant Professor of Horticulture;* R.E. KEITH, *Associate Professor of Home Economics Research;* A.J. LATHAM, *Associate Professor of Botany, Plant Pathology, and Microbiology;* CHRISTINE SUNDERMAN, *Assistant Professor of Zoology-Entomology;* J.W. ODOM, *Associate Professor of Agronomy and Soils;* T.J. PRINCE, *Associate Professor of Animal and Dairy Sciences;* J.A. RENDEN, *Associate Professor of Poultry Science;* and R.E. STEVENSON.

Proper Timing Is Necessary for Full Benefit of Irrigation by Soybeans

C.M. PETERSON, M.G. HUCK, and G. HOOGENBOOM

SOYBEAN PLANTS are sensitive to drought stress, especially between flowering and pod fill. Although Alabama usually gets enough total summer rain for adequate plant growth, uneven distribution of rains causes problems. This poor distribution causes available soil water in the rooting zone to be depleted at times during the growing season, causing stress on the crop.

Such tillage practices as subsoiling and chisel plowing may improve soybean performance on some soils by increasing rooting depth, thereby providing access to stored water reserves. Irrigation also can reduce drought stress because water can be applied to the crop as needed. However, results of an Auburn study indicate that timing of irrigation is critical in achieving maximum yields.

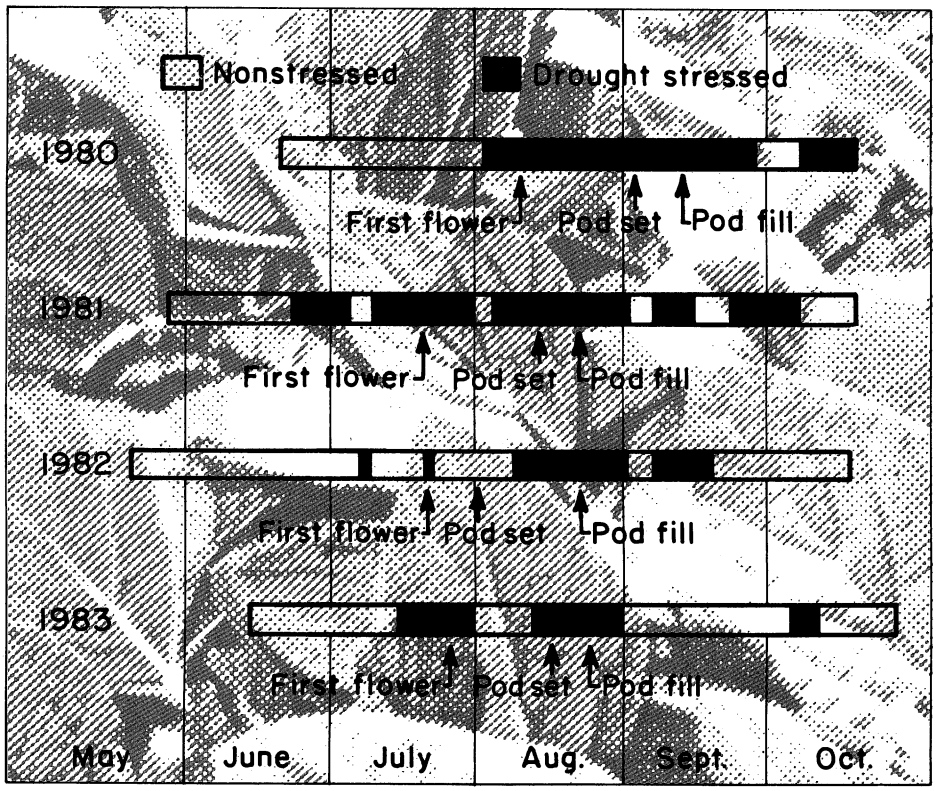
The 4-year Alabama Agricultural Experiment Station-USDA-ARS study measured the effects of drought stress and irrigation on growth of Braxton soybean plants. Plants were grown in the Auburn rhizotron (an underground root observation laboratory) in soil compartments containing loamy sandy topsoil packed to a uniform density. Each 2 x 3 x 6 ft. compartment had glass viewing windows on one side that permitted observation of root growth.

Some of the soil compartments were irrigated daily, while others were not irrigated and received only rainfall. As indicated by the graph, rainfall was insufficient for optimum plant growth during most growing seasons and resulted in periods of drought stress for nonirrigated plants. The driest of the 4 years was 1980, while 1982 and 1983 were both wet. The periods of prolonged drought stress during flowering, pod set, and pod fill in 1980 and 1981 accounted for a marked reduction in seed yield without irrigation.

EFFECT OF IRRIGATION ON ROOT LENGTH AND SEED YIELD OF SOYBEANS IN RHIZOTRON BINS, 1980-83

Irrigation treatment	Root length/sq. ft. of glass wall				Seed production/bin			
	1980	1981	1982	1983	1980	1981	1982	1983
	Ft.	*Ft.*	*Ft.*	*Ft.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Irrigated	—	15.4	9.2	14.5	1.27	1.48	1.46	1.15
Nonirrigated	—	34.2	10.5	16.9	.63	.95	.95	1.16

Timing of drought-stress periods over four growing seasons is illustrated. Bars indicate time from planting until harvest each year, with shaded portions indicating periods of drought stress for nonirrigated treatment. Supplemental water was added to the irrigated treatment during these periods.



Drought stress throughout pod fill in 1982 contributed to the differences in yields of the two treatments reported in the table. Two drought periods occurred in 1983, but a wet period in early August and rains throughout September prevented significant drought stress during most of flowering and also during mid- to late pod fill. Thus, seed yields in 1983 for both irrigated and nonirrigated treatments were similar.

Measurements of root growth during the last 3 years of the study, given in the table, indicated sizeable differences in root systems of plants from the two treatments. Irrigated plants generally had fewer, more evenly distributed roots than nonirrigated plants, mostly in the top 3 ft. of soil. Total root length of nonirrigated plants was much greater in 1981 when soil water was depleted relatively early in the growing season. In 1982, heavy rains during July maintained a high soil water content throughout the vegetative growth period, and root growth of both treatments was similar. In 1983, ample moisture was present until midway through vegetative growth. However, a drought during the last 2 weeks of July contributed to increased root growth in the nonirrigated treatment.

This study demonstrates the importance of drought stress on soybean growth and suggests that timing of irrigation may be a critical factor in maximizing soybean yield. Results also emphasize the importance of continuing irrigation once it is begun, particularly during dry growing seasons. Otherwise, plants which are irrigated during vegetative growth may not form sufficient roots to support moisture requirements during later dry cycles. Reduced pod set and seed fill would then result. Conversely, plants exposed to drought stress during early vegetative growth develop larger and usually deeper root systems. These root systems could enhance total water uptake and, therefore, potentially contribute to improved yields, especially if irrigation is initiated later in the growing season.

Peterson is Professor of Botany, Plant Pathology, and Microbiology, Huck is former Adjunct Associate Professor and Hoogenboom is former Graduate Research Assistant of Agronomy and Soils.

Grapple Skidder Productivity Measured in Auburn Research

R.A. TUFTS

USE OF RUBBER-TIRED grapple skidders is becoming the most common method of transporting wood from stump to roadside in timber harvesting operations. These machines also perform rough delimbing by backing the load through a delimbing gate.

As with any new procedure, it is important to know the productivity of grapple skidders and to understand the variables that affect this productivity. Such information was developed in Alabama Agricultural Experiment Station research. The variables load size and skidding distance were found to have important effects on productivity of grapple skidders. An equation developed in the analysis (presented in box below) proved to be a good estimator of time per cycle of operation.

The study considered six different brands of machines and eight different operators. The machines ranged in size from 96 to 185 horsepower. Independent variables considered are listed in the table, along with the range and average of values considered.

INDEPENDENT VARIABLES WITH AVERAGES AND RANGES CONSIDERED IN THE ANALYSIS

Variable	Av.	Min.	Max.
Skid distance, ft.	656	184	2,488
Load weight, lb.	3,217	518	8,289
Machine horsepower	131	96	185
Machine weight, 1,000 lb.	23.08	18.68	29.00
Ratio, machine weight:hp	0.18	0.15	0.19
No. of bunches/cycle	1.15	1	4
No. of trees/cycle	7.33	1	22
Basal area/cycle, sq. ft.	2.69	0.4	6.9

Skidding distance was found to affect time per cycle (travel empty to woods, pick up load, and return load to roadside) more than any other variable, figure 1. No interaction was found between distance and load. Both have a linear effect on time per cycle (output directly proportional to input). For every 100 ft. of skid distance, cycle time increases 0.277 minute, and for every additional 100 lb. of load, cycle time increases only 0.020 minute.

Load size affected production more than any other variable studied, figure 2. At any skid distance, production of the machine can be increased by increasing the load size. Therefore, the standard practice of moving deck locations to minimize skidding distance is not the most important step to take. Increasing load size would be more profitable.

The average load size for the largest machine was only 2,740 lb., whereas for the smallest machine, average load size was 3,431 lb.

Another indication of inefficient use of large skidders showed up in the ratio of machine weight divided by horsepower. This measure was negatively correlated with time per cycle. This means that the larger machines were not only transporting comparatively smaller loads but were also traveling slower.

Tufts is Assistant Professor of Forestry.

EQUATION

Time/cycle = 7.237 - 0.009081 * Dist + 0.001497 * Load R^2 = .81
- 30.7905 * Ratio + 0.05557 * Dist * Ratio
- 0.006355 * Load * Ratio + 0.001624 * Dist * Nbnch
- 0.000133 * Load * Nbnch

where: Dist = skidding distance in feet
Load = load weight in pounds
Ratio = machine weight (1,000's of pounds) divided by horsepower
Nbnch = number of bunches per cycle

Productivity of skidder = time/turn divided into 60 minutes per hour X load size

FIG. 1. Skidding distance affected time per cycle more than any other variable.

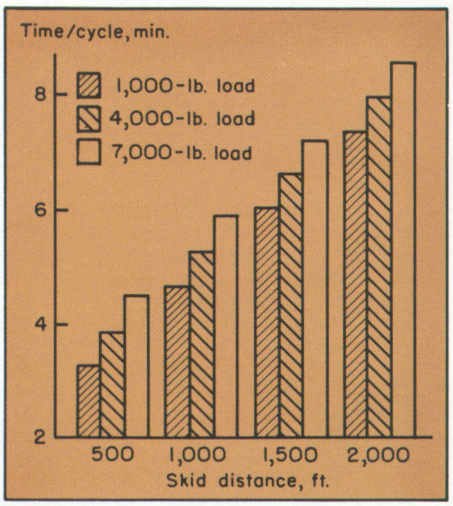
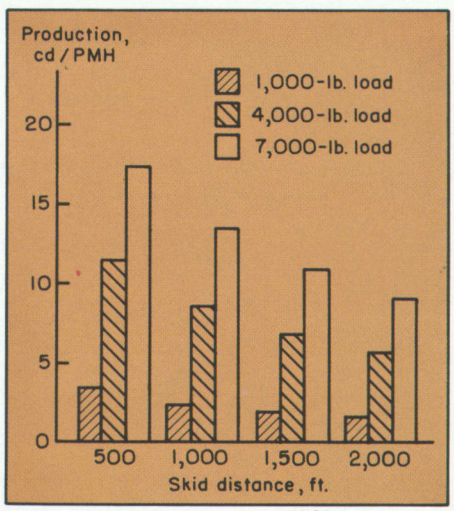


FIG. 2. Load size affected production more than any other variable studied.



Use of rotational grazing system reduces cost of feeding gestating sows

T.J. PRINCE, A.L. STEPHENSON, and J.T. EASON

PASTURES FOR SOWS could very well make a come-back as hog farmers look for ways to cut production costs. Pastures successfully replaced up to two-thirds of the feed required for sows in an Alabama Agricultural Experiment Station test at the Sand Mountain Substation, Crossville.

On a dollar basis, the savings by grazing sows amounted to as much as $40 per sow per year over drylot feeding. Since pasture cost was only $18 per sow per year, the bottom-line saving is worth considering.

Using pastures for swine breeding herds is nothing new, of course, but there is a need for research information based on genetically superior swine and intensive pasture management systems in use today. Therefore, the Sand Mountain Substation study was begun to accurately determine the ability of sows to utilize forages and to determine supplemental energy and protein needed by sows grazing intensively managed pastures.

The 3-year study evaluated use of a rotational grazing system for gestating sows. The 64 test gilts (Landrace X Yorkshire X Duroc crosses) were divided into four groups. The control group was housed in drylot and fed 4 lb. per day of a corn-soybean meal gestation diet that supplied 100% of the daily nutritional requirements as outlined by the National Research Council. The other groups, all of which received equal amounts of vitamins and minerals as the controls, were allowed to graze in the rotational pasture system and fed one of the following amounts of feed:

1. 67% of the energy and protein fed to the drylot (control) sows
2. 33% of the energy and protein fed to control sows
3. no supplemental feed

Savings possible of $40 per sow per year by grazing.

The rotational forage system consisted of a perennial pasture of orchardgrass and crimson clover and summer and winter annuals. The summer annual pasture was Tifleaf millet and the winter annual was rye, ryegrass, and clover. The sows were stocked at the rate of 12 per acre and rotated between the perennial and annual pastures depending on season and the amount of grazing available.

On day 110 of gestation, sows from all treatments were moved to an environmentally controlled farrowing house where they were full-fed a 15% protein lactation diet for the 30-day lactation. After weaning, sows were returned to their respective treatments and bred for the next litter. Sows remained on the study for 5 parities unless they were removed for failure to conceive or for soundness problems.

COMPARATIVE PERFORMANCE OF GESTATING SOWS IN DRYLOT AND ON ROTATIONAL GRAZING, SAND MOUNTAIN SUBSTATION

Item	Result, by feeding system			
	Drylot 100% feed	Pasture + feed		
		67% of drylot	33% of drylot	No feed
Litter size at birth	10.2	10.2	10.1	10.6
Litter birth wt., lb.	31.7	33.7	31.0	31.0
Litter size at 21 days	8.1	8.0	7.9	7.6
Litter wt. at 21 days, lb.	86.5	86.5	84.5	73.5
Gestation gain, lb.	75.2	81.4	72.8	55.4
Lactation gain, lb.	−29.3	−25.1	−13.6	4.4
Lactation feed, lb./day	16.9	16.7	18.5	18.7
Days to estrus	6.3	5.9	6.6	6.6

As shown by data in the table, litter size at birth and litter birth weight were not affected by the grazing system or the level of supplemental energy and protein fed. However, number of pigs alive at 21 days of age and litter weight at 21 days tended to drop with lower levels of supplementation, especially in the zero supplemental feed group.

As an average, the grazed sows showed gestation gains similar to drylot sows. Again, sows getting only pasture (no supplemental feeding) had lower gestation gains. The majority of this decrease was in the first parity when the no-supplement pasture group gained only 31 lb., as compared with 84, 78, and 60 lb. for the drylot and 67% and 33% supplementation groups, respectively. This indicates that an adequate period is necessary for first-litter gilts to be able to efficiently utilize forages so supplemental nutrition can be reduced. In parities 2 to 5, sows in pasture groups gained as much or more than those housed in drylot and fed 100% of their nutrient requirements.

Lactation weight loss was less for sows that were grazed than those that were fed in drylot. This was true despite the fact that all were farrowed in the same house and were full-fed the same lactation diet. Lactation weight loss decreased as the level of supplemental feeding in gestation decreased. Although this decreased weight loss may be partially explained by lower gestation weight gain, it may also indicate a more efficient utilization of the lactation feed consumed.

The results of this study show that gestating sows rotationally grazed on high quality pastures can be fed as little as one-third of recommended energy and protein levels without reducing reproductive performance. The cost of establishing and maintaining pastures was $18 per sow per year. At the 33% feeding level, a savings of 2 lb. of corn and 0.35 lb. of soybean meal per day for 275 grazing days per year represented a savings of $40.42 per sow in feed costs. Therefore, rotational grazing systems represent an economically feasible alternative for swine producers.

Prince is Associate Professor of Animal and Dairy Sciences and Stephenson is Herdsman and Eason is Superintendent of the Sand Mountain Substation.

FARMERS PAY HIGH INTEREST RATES, TOO

W.E. HARDY, JR.,
and S. OLOWOLAYEMO

COMPLAINTS ABOUT farmers and agribusinesses having access to better credit terms and lower interest rates than other sectors of the economy are heard regularly. But just how much truth is there in such charges? Not much, according to findings from an Alabama Agricultural Experiment Station study.

The opinions about farm credit stem from the existence of such organizations as the Farm Credit System and Farmer's Home Administration, which were established to handle specific credit needs of farmers, agribusinesses, and rural residents. While the organizations offer obvious benefits to agriculture, general economic factors tend to diminish any advantage that farmers might have.

The agricultural industry, particularly at the farm level, is characterized by highly variable product prices. These prices typically follow seasonal and cyclical patterns with their level generally set by supply. When prices are relatively high, production of that commodity is expanded. This increased supply causes the price to decline, which leads to reduced quantities produced. This reduced supply then causes a trend back to higher prices.

During inflationary periods, interest rates and product prices, except for agricultural products, generally rise. Prices received by farmers are influenced little by inflationary pressures, while prices paid for production inputs are subject to inflationary movements. For example, from 1961 to 1985 the index of prices paid by farmers increased 269%, while the index of prices received rose only 143%. The consumer price index, which gives an indication of the movement of overall prices paid by consumers, grew 258%.

Actual (nominal) interest rates paid by agriculture and all other segments of the economy rise with the level of inflation. This direct relationship occurs because, with inflation, a dollar will purchase more today than it will at some time in the future. Interest compensates the lender for this decrease in purchasing power. If actual interest rates paid are adjusted to remove the inflationary effects, real interest rates are obtained.

In the research done to determine if farmers have an interest advantage, nominal or actual interest rates paid for agricultural loans were adjusted by various price indexes to remove any inflationary effects and give the appropriate real rates. Two sets of adjusted agricultural interest rates were derived, one based on the agricultural prices paid index (PPI) and the other calculated with the agricultural prices received index (PRI). Real interest rates paid by those in other sectors of the economy were obtained by deflating actual interest rates with the consumer price index (CPI).

Comparisons were made for short-term non-real estate borrowing and for long-term real estate loans. Rates for Production Credit Association loans represented short-term agricultural loans, while commercial bank rates on short-term loans were utilized to represent other sectors of the economy. Federal Land Bank rates represented the charge for long-term agricultural loans. These rates were compared with home mortgage rates, which represent interest paid by others.

When nominal rates were compared for 1961 to 1985, the average rate paid by farmers on short-term PCA loans was higher than the rate paid by those in other sectors even without correcting for inflationary effects. This has fluctuated in more recent years. From 1978 to 1982, for example, average annual interest on PCA loans was less than at commercial banks. For 1983 to 1985, however, the average PCA rates were higher than bank rates.

Agricultural borrowers appear to be in a relatively better position with nominal long-term rates. Average annual rates were lower for FLB than home mortgage loans in all but 6 years, with nearly a half-percent advantage in the average rate for the 25-year period.

When nominal rates were adjusted to account for inflation, the resultant real interest rates more clearly reflected the actual interest burden. For example, PCA rates adjusted for PPI and PRI were higher than average real bank rates for the 1961-85 study period. From 1973 to 1982, however, the average real rates paid on PCA loans were generally lower.

Long-term agricultural rates were found to be somewhat lower when CPI adjusted mortgage rates were compared to real FLB rates obtained by using the PPI and PRI. Real FLB rates adjusted by the PRI were higher than real mortgage rates during 1982-85, reflecting the increased pressure that farmers are feeling.

Results of this analysis can be summarized by the general statement that, for the past 25 years, farmers have paid (1) somewhat higher rates in the short-term market, and (2) lower rates in the long-term market than those in other sectors of the economy. In recent years, however, long-term rates for agriculture have also tended to be higher when adjusted by the index of prices received.

Hardy is Professor and Olowolayemo is a former Graduate Student Aid in Agricultural Economics and Rural Sociology.

AVERAGE ANNUAL INTEREST RATES FOR LOANS FROM PRODUCTION CREDIT ASSOCIATIONS AND FEDERAL LAND BANK, SHORT-TERM COMMERCIAL BANK LOANS, AND MORTGAGE LOANS, UNITED STATES, SELECTED YEARS, 1961-85

Year	Nominal interest rates				CPI[1] adjusted real interest rates		PPI[2] adjusted real interest rates		PRI[3] adjusted real interest rates	
	PCA	Bank	FLB	Mortgage	Bank	Mortgage	PCA	FLB	PCA	FLB
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
1961	6.61	4.97	5.64	5.98	5.52	6.64	7.51	6.41	6.89	5.98
1964	6.47	4.99	5.60	5.78	5.37	6.22	7.03	6.09	6.81	5.89
1967	7.29	6.00	6.02	6.33	6.00	6.33	7.29	6.02	7.29	6.02
1970	8.98	8.48	8.68	8.27	7.31	7.13	8.02	7.75	8.16	7.89
1973	8.09	8.30	7.48	7.78	6.24	5.85	5.62	5.19	4.52	4.18
1976	8.24	7.52	8.66	8.76	4.40	5.12	4.29	4.51	4.43	4.66
1979	10.71	13.18	9.20	10.48	6.07	4.83	4.28	3.68	4.46	3.83
1982	14.34	14.69	12.27	14.47	5.08	5.01	4.50	3.85	5.93	5.07
1985	12.30	9.74	12.25	12.12	3.02	3.76	3.78	3.77	5.28	5.26
Average ..	9.03	8.84	8.28	8.73	5.53	5.62	5.68	5.21	5.83	5.35

[1]Consumer price index.
[2]Agricultural prices paid index.
[3]Agricultural prices received index.

Dietary Protein Level Affects Semen Production and Carcass Quality of Broiler Breeder Males

J.L. WILSON, G.R. McDANIEL, C.D. SUTTON, and J.A. RENDEN

THE MALE was the forgotten element in managing broiler breeders for many years, especially in ration development. Most nutrition research centered on correct feeding of females. Males simply ate the same diet. But that is changing now, with use of new management systems in which males and females are grown separately and then fed separately in cages after maturity. Already there is research evidence that males need different feed than females.

Previous Alabama Agricultural Experiment Station research indicated that feeding males 12-14% dietary protein on a restricted basis was just as good as feeding 16-18% protein diets. There was no difference in age at sexual maturity or in semen production because of lower protein feeding. In fact, greater numbers of males produced semen throughout the life of the flock with 12% protein than with 14%, 16%, or 18% protein feed.

The newest Experiment Station study was done to not only document how low protein diets maximize reproduction in male broiler breeders, but also to identify how these results came about. Specific objectives were to (1) monitor the number of males producing semen, (2) measure the quantity of semen produced, (3) measure percent carcass fat and protein in males producing semen and those not producing semen, and (4) determine testes weight.

At 6 weeks of age, 246 broiler breeder males were randomly assigned to either a 9%, 12%, or 15% protein diet. The 15% protein diet was similar to commercial breeder diets and was designated as the control. The diets were formulated with the limiting amino acids as a similar percentage of the total protein for all treatment groups. Each group received the same amount of feed per day.

Semen was collected and evaluated during four periods (25 through 30, 36 through 37, 42 through 43, and 48 through 49 weeks of age). Ten birds (five males producing semen, five males not producing semen) from each treatment group were randomly selected for carcass composition analyses at 22 and 28 weeks of age. Remaining males were analyzed at 50 weeks of age.

Feeding 9 or 12% protein reduced body weight slightly (greatest difference was 0.79 lb.), but had no effect on testes weight. Males not producing semen had smaller testes than males producing semen. Semen volume, concentration, and number of spermatozoa per ejaculate were not affected by dietary treatment.

Sexual maturity was not delayed by feeding 9 or 12% dietary protein. A larger percentage of males fed the 9% diet produced semen from 29 to 50 weeks of age than either the 12 or 15% groups, figure 1. As a group, the males fed the 9% protein diet produced dramatically greater numbers of spermatozoa per day than males in the other treatment groups at each test period.

Carcass comparison of males at 22, 28, and 50 weeks showed that carcass protein content was not affected by dietary protein level or reproductive state. Level of dietary protein did affect percent carcass fat. As noted in figure 2, the higher the protein content of feed the lower was carcass fat content. Males not producing semen had a tendency to have less carcass fat than males producing semen. The findings of increased carcass fat and greater number of males reproductively active in the 9% dietary protein group support the theory described in mammals that a minimum percentage of body fat is critical in the initiation of puberty and the continuance of reproductive function.

Results from the study clearly demonstrate the suitability of a 9% protein feed for broiler breeder males after 6 weeks of age. The low protein feed had no adverse effects on age at sexual maturity, quantity of semen produced, or longevity of semen production. A greater percentage of males fed the 9% protein diet produced semen from 29 to 50 weeks of age, which resulted in a larger number of spermatozoa produced per day than by males fed 12% and 15% protein diets. Since protein is an expensive ingredient in poultry rations, these findings point to the opportunity for feed cost savings without any loss of productivity in broiler breeder flocks.

Wilson is a Graduate Research Assistant and McDaniel is Professor of Poultry Science, Sutton is a former Poultry Extension Specialist, and Renden is Associate Professor of Poultry Science.

FIG. 1. Sexual maturity was not delayed by low protein diets.

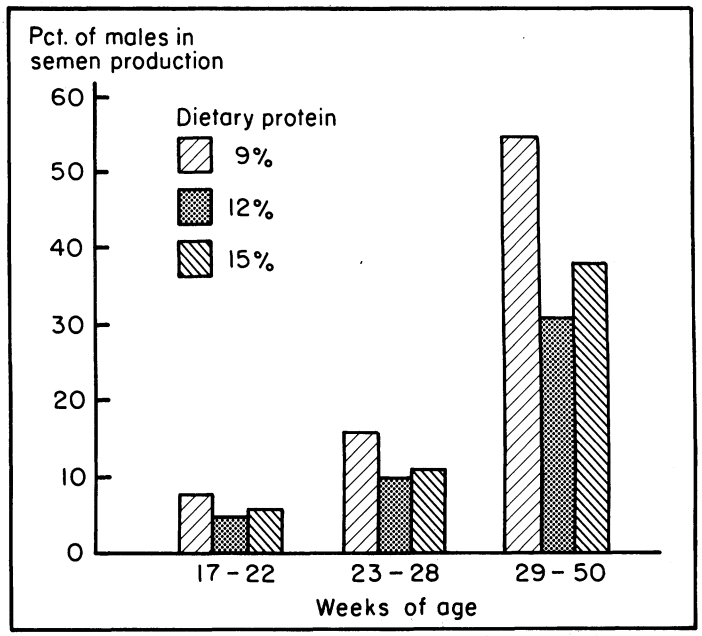
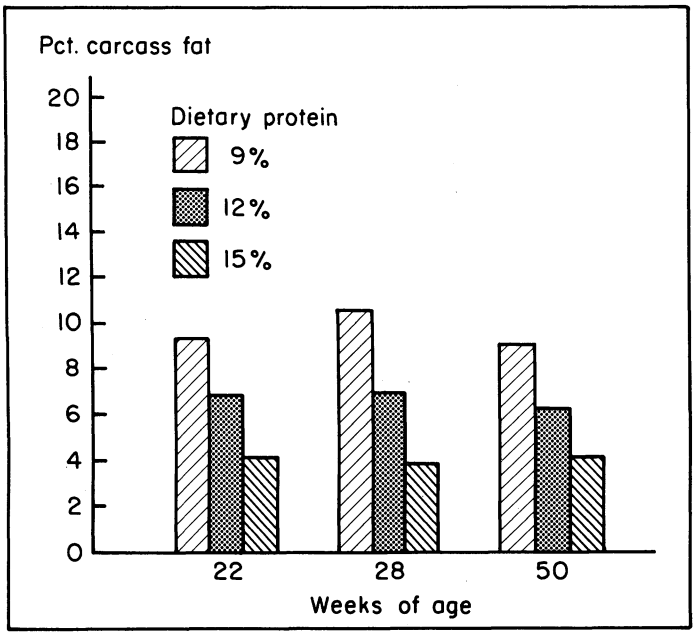


FIG. 2. Level of dietary protein did not affect percent carcass fat.



Virus Gene Transfer Offers Hope for Genetic Pest Control

D.M. BISARO, W.E. GARDINER, G. SUNTER, and I.D. CHANG

SUCCESSFUL TRANSFER of virus genes to plants in research at the Alabama Agricultural Experiment Station is an indication of the vast potential use of genetic engineering to produce plants which carry traits beneficial to agriculture. Tobacco plants, for example, have already been genetically engineered with resistance to herbicides, certain insects, and viruses. Most researchers are optimistic that, with the aid of plant breeders, more crop plants can be developed with resistance to most pests and tolerant of a wide range of growing conditions.

Tomato golden mosaic virus, which belongs to the geminivirus group, was used in the Auburn tests. Members of this group infect a wide range of plants and cause diseases such as tomato golden mosaic, bean golden mosaic, cassava latent, beet curly top, maize streak, and wheat dwarf.

Genetic information is carried by genes, which are stored in coded form in DNA molecules. The genetic information of tomato golden mosaic virus is divided between two nearly identical sized DNA molecules (called component A and component B). Both DNA components (similar to small chromosomes) are required for infection, since each contains genes which are necessary for different parts of the viruses' life cycle. In susceptible plant cells, the viral genes are expressed using the machinery of the host cell itself. The viral genes instruct the host cell to make copies of the virus.

Research on the function and expression of geminivirus genes (there are only six or so) employed a recently developed technique which allows genetic material to be introduced into the chromosomes of plant cells that can be regenerated into whole plants. Plants altered in this way are said to be transformed. Using a specially constructed vector (carrier) DNA designed by the Monsanto Company, the separately cloned DNA components of tomato golden mosaic virus were introduced into petunia cells. Transformed plants carrying either the A or B component of the virus as a new genetic trait were regenerated, and these plants were normal in appearance. However, biochemical analysis indicated that viral DNA was released from the plant chromosome and replicated in the cells of A-containing plants, but not in B-plants. This indicates that the A-component supplies the information necessary to replicate itself and the B-component, and that B provides some function(s) required for symptom development.

Transformed plants flowered normally and were used in various crosses. Seedlings from crosses of A and B parents displayed a remarkable phenotype. One-fourth of the progeny of such crosses showed symptoms of virus infection— the proportion expected to receive an A-component from one parent and a B-component from the other parent. Biochemical analysis of symptomatic progeny confirmed that both A and B DNAs were present and replicated in these plants. Other possible combinations of crosses (AXA, BXB) failed to produce progeny plants showing symptoms of the virus.

Successful transfer of virus genes to this plant indicates potential uses for genetic engineering in plant improvement.

These results convincingly demonstrate that functional tomato golden mosaic virus genes can be genetically delivered into plants using transformation technology, providing a new method for the study of plant virus functions. Using this technique, natural or modified viral DNAs can be placed in every cell of a plant, regardless of whether they can produce active virus particles capable of spreading to other cells by the normal infection process. DNA molecules have been constructed which carry mutations at specific sites within viral genes. Introduction of these into plants should allow the function of each individual gene to be determined.

Much has already been learned about geminivirus replication using gene transfer technology. As the ongoing studies provide detailed understanding of viral gene function, it is hoped that the findings will suggest means for controlling these important pathogens.

Bisaro is Assistant Professor, Gardiner and Sunter are Post-doctoral Fellows, and Chang is a Research Associate of Botany, Plant Pathology, and Microbiology.

Rooting cuttings in market-size containers shows promise for ornamental production

G.J. KEEVER and G.S. COBB

Cuttings were propagated in cell pacs (left), 3-in. pots (center), and 1-gal. pots (right).

PRODUCTION of container-grown ornamentals is a labor-intensive, costly procedure. Typically, plants are propagated in beds, flats, or small containers and transplanted once or twice into larger containers before being marketed. This transplanting increases labor and equipment costs and may slow plant growth.

Another option, and one that may offer cost savings, is propagating in a market-size container in which the plant remains until sold. This method eliminates transplanting expense, of course, but it requires more growing area during the early part of the production cycle. Using more than one cutting per container may reduce production time, but this increases material and labor costs.

A comparison of the two production methods in Alabama Agricultural Experiment Station research shows both advantages and disadvantages for propagating in larger containers. Although cuttings were slower to root in large containers, growth was greatest after 12 months.

Crepe myrtle (Basham's Party Pink variety) and azaleas (George Tabor and Hino-crimson) were used in the comparison of seven propagation and transplanting techniques listed in the table.

Cuttings were taken in spring 1984 and treated with IBA (a rooting hormone). Cell pacs (72-cell units) and 3-in. pots were placed in a shaded greenhouse, while 1-gal. containers were placed outdoors under shade cloth (47% light exclusion). In both cases, irrigation frequency was adjusted to maintain a film of water on the foliage to facilitate rooting.

Liquid fertilizer was applied weekly, beginning shortly after root initiation. Fertilizer applied was 100 p.p.m. N from 20-20-20.

Liners in cell pacs and 3-in. pots were transplanted when roots had developed sufficiently to maintain the growth medium intact upon removal from the container. After being transplanted into 1-gal. containers and placed outdoors under 47% shade, plants were topdressed monthly with 1 teaspoon of 12-4-6 per container. Rooting was evaluated when cuttings were removed from intermittent irrigation (June-July 1984). Top growth and root growth were measured in May 1985.

Rooting success showed no differences among the plant species. However, time required for rooting varied among propagation media and container types. Cuttings of all species took 2-3½ weeks longer to root in 1-gal. containers than in cell pacs or 3-in. containers. This was probably the result of environmental differences between the greenhouse and shade house.

Growth per container (top dry weight) varied somewhat among species, but was generally greatest when two cuttings were propagated in 1-gal. containers (treatment 7). Least growth resulted when cuttings were propagated in cell pacs and subsequently transplanted to 3-in. and then 1-gal. containers (treatment 1).

Top growth of crepe myrtle was only slightly greater when cuttings were rooted in cell pacs and transplanted directly into 1-gal. containers (treatment 2) compared to transplanting twice (treatment 1). Transplanting two cell pacs into a 1-gal. container (treatment 3) resulted in similar total top growth as when one or two cuttings were rooted in 3-in. containers and later transplanted into 1-gal. containers (treatment 4 and 5).

Growth did not differ when one or two cuttings were propagated in either 3-in. or 1-gal. containers, suggesting that propagation of multiple cuttings per container may not be beneficial with rapidly growing species, such as crepe myrtle. This could change if shorter production cycles or larger containers are used.

Response of George Tabor and Hino-crimson azaleas to transplanting sequence was similar to that of crepe myrtle. However, both cultivars produced more top growth per container when two cell pacs were transplanted into a 1-gal. container (treatment 3) or two cuttings were rooted in each 3-in. and 1-gal. container (treatments 5 and 7). This suggests that the production cycle for slower growing species may be shortened by placing multiple cuttings or liners in marketable containers.

Relative root density of the three species correlated closely with the top dry weight data. Root density was always least when plants were transplanted twice and greatest when two cuttings were directly propagated in 1-gal. containers, except with George Tabor azalea.

Although cuttings of the three species rooted quicker in smaller containers in the greenhouse, rooting percentages did not differ between the greenhouse and outdoors. Furthermore, top and root growth were greater after 12 months when plants were propagated directly in marketable containers. The stress experienced by transplanted liners, particularly those in cell pacs transplanted once or twice, appeared to reduce growth through the remainder of the production cycle.

Propagating multiple cuttings per container or transplanting multiple rooted cuttings to each container appears to have merit with slow to moderate growing species. However, material costs and production scheduling must be carefully evaluated for optimal efficiency.

Keever is Assistant Professor of Horticulture and Cobb is former Superintendent of Ornamental Horticulture Substation.

Treatment number	*Propagated in*	*Transplanted*		*Plants per pot*	*Propagation medium*
		1st time	*2nd time*		
1	cell pac	3-in. pot	1-gal. pot	1	peat-perlite-vermiculite (equal volume)
2	cell pac	1-gal. pot	—	1	
3	cell pac	1-gal. pot	—	2	
4	3-in. pot	1-gal. pot	—	1	amended pine bark
5	3-in. pot	1-gal. pot	—	2	
6	1-gal. pot	no transplanting		1	
7	1-gal. pot	no transplanting		2	

Risks in Vegetable Crop Production

M.E. ZWINGLI and J.L. ADRIAN

DEPRESSED PROFITABILITY of traditional farm enterprises such as corn, cotton, and soybeans has led many growers to seek alternative crops. Vegetable crops, because of their profit potential, is an alternative considered by many growers.

Vegetable crop production has been characterized as having a high degree of risk associated with both price and yield related income variability along with risks related to institutional barriers. While an enterprise may seem quite profitable one year, variability in these factors can cause large losses when evaluated over several years. Thus, it is important to evaluate the impact of variability in the components of receipts (price, and yield) when considering vegetable crops as an alternative. To illustrate these potential risks, a recent Alabama Agricultural Experiment Station study analyzed data for six crops (broccoli, cabbage, sweet corn, cucumbers, bell peppers, and turnip greens). Data in the table represent prices received between 1979 and 1983 in the Atlanta wholesale market with consideration given to transportation costs.

Because fresh vegetable production is an intensive enterprise requiring a high degree of management skill, many first time producers are faced with reduced yield levels. In order to measure this production risk or the effect of yield decreases on income, average per acre net income was calculated at both a 100% (average yield level for a good producer) and 70% of the average yield. Using the percentage decrease in per acre net income resulting from a 30% decrease in yield as a measure of production risk, broccoli showed the least risk, with sweet corn having the greatest risk, see table. With a 107% decrease in net income, sweet corn, on average, showed much potential for negative income at the 70% yield level.

As yields decreased for each crop, the income variability associated with production risk rose sharply. This stresses the need for producers to follow recommended production practices, use appropriate varieties, and irrigate. Weather related risks, such as frost damage to early spring and late fall crops, also must be considered.

While both overall and within season price variability are important measures of risk, producers are ultimately concerned with the effects of price variability on net income. To measure this effect, weekly price quotations were used to calculate per acre net income with income risk measured by the degree of variability in per acre net income as price varied (criterion 5). Varying degrees of income risks were shown by the six crops, with broccoli showing the lowest risk and sweet corn the greatest. Cucumbers, cabbage, and sweet corn all had risk measures (critertion 5) larger than 100, indicating the greater potential for losses during some years.

Until Alabama gains a reputation for quality and sufficient quantity to interest wholesale buyers, producers will have to accept the risk of negative income.

To analyze price related income risk, the six selected crops were evaluated with respect to their overall price variability, within season price variability, and overall variability in per acre net income. As shown by criterion 3 in the table, cabbage had the highest degree of price variability, followed by cucumbers. At 45.83%, cabbage producers could expect to get a price within approximately 46% of the average price 68% of the time. The remaining four crops (turnip greens, broccoli, bell peppers, and sweet corn) had roughly equal risk associated with price related income variability.

Next, within season price variation (between weeks) was measured (criterion 4). Turnip greens and broccoli had the least risk while cucumbers showed the greatest risk. At 30.17%, producers of cucumbers could expect prices to vary by as much as 30% of the average price from week to week during the relevant harvest season 68% of the time.

Overall, broccoli and turnip greens showed the least amount of production and price risks of the six crops evaluated, and sweet corn had the greatest risk. While these measures should be used to evaluate the relative potential of alternative vegetable crops, other factors must also be considered. These include availability of resources such as land, harvest and packing labor, capital to purchase specialized packing and harvest equipment, water necessary for irrigation, and one's ability to successfully produce a given crop. Producers must also recognize the difficulty of market entrance.

Traditionally, Alabama producers have generally been residual suppliers and, as such, are contacted by wholesale brokers only during times of supply shortages. Thus, producers attempting to access national wholesale markets during times of adequate or surplus conditions can expect few opportunities and, even then, potentially highly depressed prices. As producers in Alabama gain a reputation for quality and sufficient quantity neccessary to interest wholesale buyers, these market barriers may be reduced. Until that time, emerging producers should be willing and able to accept the risk of negative income during some years. Because vegetable crops are high cost enterprises, losses during some years can be quite substantial.

The Auburn study indicates vegetable crops are high risk enterprises requiring far greater management skill and greater emphasis on marketing activities than traditional crops. Because of these factors, potential producers should not view vegetable production as necessarily being the answer to their income problems. Careful consideration must be made concerning the aforementioned factors if one is to be successful with these enterprises.

FEASIBILITY RANKING OF SELECTED NORTH ALABAMA-PRODUCED FRESH VEGETABLE CROPS AT THE ATLANTA WHOLESALE MARKET BY ALTERNATIVE EVALUATION CRITERIA, 1979-83

Evaluation criteria, crop, and measure	Ranking					
	1	2	3	4	5	6
Average per acre net income						
Crop	broccoli	bell pepper	turnip greens	cabbage	cucumbers	sweet corn
Measure, $/acre	1,561	851	790	693	502	194
Sensitivity of av./acre net income to a 30% decrease in yield						
Crop	broccoli	turnip greens	cabbage	cucumbers	bell pepper	sweet corn
Measure, pct.	38.25	41.80	53.13	58.18	59.66	107.47
Overall variability (between weeks and years) in weekly average prices						
Crop	turnip greens	broccoli	bell pepper	sweet corn	cucumbers	cabbage
Measure, pct.	19.64	20.73	20.77	21.66	27.49	45.83
Within season variability (between weeks) in weekly average prices						
Crop	turnip greens	broccoli	bell pepper	cabbage	sweet corn	cucumbers
Measure, pct.	7.46	9.54	15.68	17.45	19.20	30.17
Overall variability (between weeks and years) in weekly av./acre net income						
Crop	broccoli	turnip greens	bell pepper	cucumbers	cabbage	sweet corn
Measure, pct.	36.23	45.34	69.45	103.80	125.26	152.84

Zwingli is a Research Associate and Adrian is Professor of Agricultural Economics and Rural Sociology.

Cash flow statement valuable tool for farm financial management

S.C. BELL and K. BECKHAM

HIGH INTEREST rates and other capital costs make production efficiency a major farm need. Efficient use of capital is especially important because of the large amounts of capital being borrowed. Using financial management to minimize interest expense could make a big difference in profitability of many farm operations.

Financial management includes decision making concerning investment, tax liabilities, and financing of current operations, all of which involve forward planning. Perhaps the most useful financial management tool available is the cash flow statement—a periodic summary of farm receipts and expenses.

An important use for a cash flow statement is evaluating the potential for adding a new enterprise. This use was the emphasis of an Alabama Agricultural Experiment Station study, which considered adding a 120-sow operation (a one-man operation) to an existing farm.

A detailed enterprise budget was prepared to establish cost and receipt data to serve as the basis for the cash flow statement presented below. Assumptions included (1) feed would be purchased, (2) operating capital would be borrowed, (3) 12% interest would be paid, charged on the unpaid balance at the end of each month, (4) expenses would include $1,200 per month for family and nonfarm business expenses and $3,000 per year for Social Security, and (5) sows would be bred so 20 would farrow every 6 weeks (eight farrowings and eight marketings per year).

The first year, expenses built up to $39,102 in June, before there were any sales. With a minimum of $1,000 maintained in the checking account, capital has to be borrowed each month that expenses exceed sales. At the end of the first year there is $38,384 in accumulated borrowings. This includes $12,750 of interest on a $127,500 loan made for hog facilities and breeding stock. There is no payment made on principal the first year.

In the second year, the highest accumulated borrowings are in January, $29,050. The accumulated borrowings reach zero in November but increase to $20,400 in December because of interest payment of $12,750 and no sales that month.

The cash flow statement indicates no payment on principal until the third year, with only $1,737 paid that year. Interest at 10% on the capital facilities loan was added each year to the outstanding debt. Beginning the fourth year the operating expenses were paid from hog sales and no additional operating capital was to be borrowed. A payment of $21,168 was to be made on the principal loan in the fourth year.

Since the operating expenses were paid for out of sales in the fourth year, this would hold true for subsequent years. Therefore, all funds above current expenses in succeeding years were applied to the loan for facilities and breeding hogs, with the following payment schedule: fifth year, principal $22,284 and interest $10,460; sixth year, principal $24,513 and interest $8,231; seventh year, principal $26,964 and interest $5,780; and eighth year, principal $29,661 and interest $3,083.

There was only $1,178 remaining debt at the end of the eighth year. This was paid in the ninth year along with $117 interest. Therefore, the original loan of $127,500 was paid out by the beginning of the ninth year and the hog enterprise is able to finance itself.

Two important uses of the cash flow statement are evident in results of the study.

(1) It indicates to the lender who made the $127,500 loan that even though the hog enterprise budget shows a net return of $35,615.92 annually, there can be no payment on principal until the third year.

(2) It leads to saving on interest. By using an agreement whereby borrowed funds are received as needed and interest on the unpaid balance is paid on a monthly basis, total interest paid on the operating loan is $4,654. If all operating capital required for the year were borrowed at the beginning of the year and interest paid for the year, total interest payment would be $16,122. Thus, use of the cash flow statement creates a savings of $11,468.

Bell is Professor and Beckham is a Graduate Student of Agricultural Economics and Rural Sociology.

BUDGET SUMMARY (FIRST YEAR)

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
Total receipts							20,430	20,515		20,430	20,515	
Year's obligations												
Operating expenses	1,846	2,634	3,815	5,785	8,542	8,542	9,520	9,522	8,542	9,520	9,522	9,342
Capital expenditures								375			375	
Family and nonfarm business	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Debt payment on previous year's obligations, interest												12,750
Total this year's obligations	3,046	3,834	5,015	6,985	9,742	9,742	10,720	11,097	9,742	10,720	11,097	26,292
Cash deficit or surplus	−3,046	−3,834	−5,015	−6,985	−9,742	−9,742	9,710	9,418	−9,742	9,710	9,418	−26,292
Balance beginning of period	1,000	1,004	1,020	1,005	1,020	1,028	1,036	1,000	1,000	1,008	1,000	1,000
Total available dollars	−2,046	−2,830	−3,995	−5,980	−8,722	−8,714	10,746	10,418	−8,742	10,718	−10,418	−25,292
Borrowing necessary to maintain $1,000 minimum balance	3,050	3,850	5,000	7,000	9,750	9,750	0	0	9,750	0	0	26,300
Debt payment this year's borrowings												
Principal							9,355	9,121		9,412	9,206	
Interest							391	297		306	212	
Balance end of period	1,004	1,020	1,005	1,020	1,028	1,036	1,000	1,000	1,008	1,000	1,000	1,008
Accumulated borrowings this year	3,050	6,931	12,000	19,120	29,061	39,102	29,747	20,626	30,582	21,170	11,964	38,384
Interest on accumulated borrowings	31	69	120	191	291	391	297	206	306	212	120	384
ACCUMULATED BORROWINGS AND INTEREST												
Second year												
Accumulated borrowings this year	29,050	19,923	29,872	20,453	11,240	21,102	11,595	2,293	12,066	2,469	0	20,400
Interest on accumulated borrowings	291	199	299	205	112	211	116	23	121	25	0	204
Third year												
Accumulated borrowings this year	10,862	1,553	9,766	154	0	500	0	0	0	0	0	0
Interest on accumulated borrowings	109	16	98	2	0	5	0	0	0	0	0	0

Cultural Practices vs. B-Nine for Bedding Plant Height Control

C.H. GILLIAM, J.L. TURNER, S.M. HARDY, K.S. RYMAL, and R.L. SHUMACK

EARLY IN 1983 the EPA issued an intent to withdraw the daminozide-containing growth regulants Kylar®, Alar®, and B-Nine® from the market because of suspected residue problems in apples (Alar) and peanuts (Kylar). The EPA has subsequently withdrawn the intent and each of the growth regulants is still on the market and sold with a full federal label. However, the potential loss of B-Nine to control height on selected vegetable and ornamental transplants led to a study by the Alabama Agricultural Experiment Station to evaluate alternative cultural practices to control vegetative growth of tomato transplants during bedding plant production.

In March 1985, Monte Carlo VFN variety tomatoes were seeded and subsequently transplanted into flats on March 27. A peat/perlite medium was used in a 1:1 ratio by volume amended on a cubic yard basis with 2 lb. gypsum, 6 lb. dolomitic limestone, 1½ lb. MicroMax, and 2 lb. superphosphate 0-20-0. Plants were grown in a double layer greenhouse and fertilized weekly with 150 p.p.m. N from a soluble fertilizer. Two weeks later five treatments were initiated: (1) B-Nine, one application (April 11); (2) B-Nine, three applications (April 11, 16, 21); (3) control treatment watered as needed (X); (4) plants watered about ½X; and (5) plants watered ¼X. The treatments with reduced water were included to determine if height suppression could be achieved by watering practices.

On April 26, caliper and dry weights were determined at the end of the bedding plant production phase of the test. At the same time, four replications of five plants from each treatment were field planted in rows 5 ft. apart with plants 15 in. apart in the row. Field fertilization consisted of 1,000 lb. per acre of 5-10-15 preplant incorporated (PPI), 200 lb. per acre triple superphosphate PPI, and 500 lb. per acre of 13-13-13 sidedressed after the first fruit was golf ball size.

The spray program in the field consisted of Parathion® + Bravo® applied at planting, Pydrin® + Bravo weekly until first fruit set, and Pydrin + Lannate® + Bravo weekly during harvest. Weed control consisted of 0.75 lb. per acre Treflan® (PPI), 0.5 lb. per acre Paraquat® in row middles, and hoeing as needed. Tomatoes were harvested and graded on five dates. At the 5th harvest date subsamples were tested to determine if (daminozide) residues from B-Nine use were detectable in the fruit.

Results of this test showed that only B-Nine suppressed tomato height during bedding plant production, table 1. Neither tomato caliper (thickness of the tomato stem just above soil level) nor dry weight was affected by any treatments. These data confirmed that removal of this material would eliminate a good height suppression material. Also, these results showed that withholding water had no effect on suppressing height during the bedding plant production phase.

The Auburn study showed that cultural factors during bedding plant production had little effect on tomato yield, table 2. Fruit size was similar among treatments, but B-Nine applied three times delayed ripening. After the first three harvest dates, only 12% of the total marketable yield had been harvested from plants receiving three B-Nine applications, as compared to 28-36% from the control plants and those undergoing moisture stress.

Residue samples collected from the 5th harvest date did not have detectable daminozide levels in any of the samples. Because plants treated three times with B-Nine had delayed harvest, it was impossible to test for residue levels at an earlier harvest.

In summary, results showed that only B-Nine effectively controlled tomato height in bedding plant production. B-Nine applied three times delayed earliness of ripening, an important factor for growers who produce tomatoes for the early market. Neither B-Nine nor water stress during bedding plant production affected tomato yield in the field. Finally, there were no detectable daminozide levels in tomatoes sampled on the 5th harvest date, indicating that use of B-Nine in tomato bedding plant production should pose no danger to human health.

Gilliam is Associate Professor, Turner is a Research Associate, Hardy is an undergraduate student, and Rymal is Professor of Horticulture, and Shumack is an Extension Horticulturist.

TABLE 1. EFFECTS OF CULTURAL FACTORS ON GROWTH OF MONTE CARLO VFN TOMATO SEEDLINGS[1]

Treatment	Height	Caliper
	In.	*In.*
B-Nine (April 11)	6.0	1.7
B-Nine (April 11, 16, 21)	4.8	1.7
Control (X)	8.0	1.7
Watered ½X	7.5	1.5
Watered ¼X	8.0	1.6

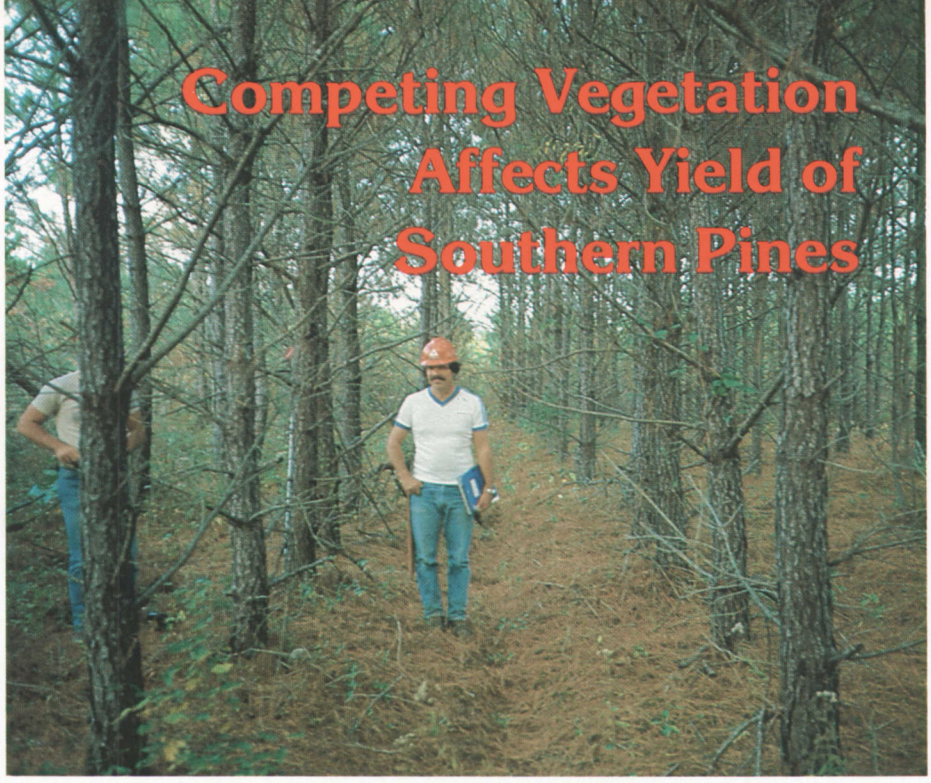
[1]Data collected 4 weeks after transplanting.

TABLE 2. INFLUENCE OF CULTURAL FACTORS DURING BEDDING PLANT PRODUCTION ON TOMATO YIELD

Treatment	Marketable yield/acre[1]				Percent marketable yield, by harvest no.				
	Total cwt.	5 x 6	6 x 6	6 x 7	1	2	3	4	5
B-Nine (April 11)	444	330	87	28	4	11	7	26	52
B-Nine (April 11-16-21)	482	380	70	32	0	4	8	18	70
Control (X)	441	330	87	24	11	13	12	23	41
Watered ½X	504	409	69	26	7	16	5	13	59
Watered ¼X	436	337	57	42	11	11	11	17	50

[1]Size yields reported here are in accordance with the size standards established by the USDA for the Los Angeles type lug arrangements. 5 x 6 arrangement: minimum diameter 2 11/16 in., maximum diameter 3 3/16 in.; 6 x 6 arrangement: minimum diameter 2 5/16 in., maximum diameter 2 14/16 in.; 6 x 7 arrangement: minimum diameter 2 4/16 in., maximum diameter 2 10/16 in.

Competing Vegetation Affects Yield of Southern Pines



G.R. GLOVER and J.L. CREIGHTON

ONE OF THE MAJOR problems in growing southern pines is competition from hardwood and herbaceous vegetation for moisture, nutrients, and light. As in agricultural crops, competing vegetation can reduce survival, growth, and yield of desired pines. Use of chemical herbicides to control unwanted vegetation has been common in forestry for three decades, but information documenting its long-term effect on yield is scarce.

Though long-term studies are currently underway at Auburn, results are several years away. To provide interim information on pine yield response to vegetation control, a project was initiated by the Alabama Agricultural Experiment Station to locate and measure southern pine stands where a direct comparison of chemical vegetation control to other control methods or to no control existed. Forty comparisons were measured across the Southeast, of which 22 involved hardwood control and 18 involved early control of herbaceous vegetation.

Inconsistent treatment effects were found in operational comparisons treated with the herbicide 2,4,5-T. In some cases untreated plots had more pine volume than treated plots, due to poor initial plot layout and erratic effects of 2,4,5-T. More consistent effects and yield trends were noted in research and operational comparisons treated with currently registered forestry herbicides. Looking beyond treatment means and examining the relationship between pine yield and amount of hardwood in the stand resulted in stable relationships across most comparisons, operational or research.

Regardless of treatment, location, or age of trees, as the amount of hardwood increased (poorer hardwood control) pine yield decreased drastically, figure 1. This same trend was evident in almost all comparisons regardless of age, type of herbicide, or location of the comparison.

At three of the oldest successful herbaceous vegetation control studies in the South, herbaceous vegetation was controlled by hand hoeing and herbicides, figures 2 and 3. Comparable vegetation control and growth results can be obtained by using currently registered herbicides. Volume for the plots with vegetation control was approximately double that for untreated plots at age 10. Furthermore, the vegetation control plots on the low site produced volume at the same rate as the no control (operational) plots on the high site. Longer term data are needed to fully evaluate herbaceous vegetation control effects, but indications are that rotation ages can be decreased by at least 2-3 years and a more uniform stand of trees can be obtained.

Data from the Auburn study clearly indicate that increases in competition from hardwoods and herbaceous vegetation decrease pine yield. The logical assumption is that it is competition from the vegetation which is the cause of this yield reduction. Herbicides can be a useful tool for controlling unwanted vegetation, but before these chemicals are applied each stand should be evaluated as to the need for vegetation control and the availability of suitable and effective herbicide treatments.

A more complete description of methods and results is given in an article by Glover and Dale F. Dickens, "Impact of Competing Vegetation on Yield of the Southern Pines," published in 1985 as Georgia Forest Research Paper No. 59. Copies are available from Georgia Forestry Commission, Forest Research, P.O. Box 819, Macon, Georgia 31298-4599.

Glover is Assistant Professor and Creighton is a Research Specialist of Forestry.

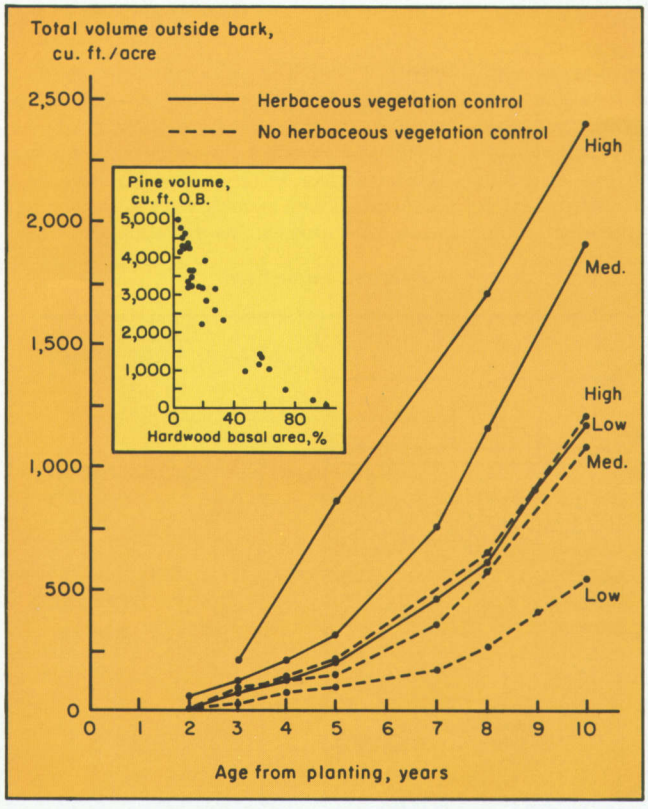


FIG. 1. (Above) Loblolly pine stand at age 10 on high site index land which received herbaceous vegetation control following planting.

FIG. 2. Total pine cubic-foot volume per acre by pine age for three herbaceous vegetation control studies (age 10). Site index (SI) at a base age of 25 years for loblolly pines equals 75-80 ft. on a high site, 60-65 ft. on a medium site, and 45-50 ft. on a poor site.

FIG. 3. (Inset) Total pine cubic-foot volume per acre by percent hardwood basal area for Fayette, Alabama, site preparation study (age 24).

UTILIZING ANIMAL WASTE FOR ENERGY AND LIVESTOCK FEED

D.T. HILL, T.J. PRINCE, and J.P. BOLTE

ALTHOUGH UTILIZATION of animal waste as a resource in the United States went virtually unnoticed until the mid-1970's, the Alabama Agricultural Experiment Station has had a strong agricultural and animal waste management research program since the late 1960's. This program is directed at developing methods to utilize animal wastes for refeeding and energy production, and it recognizes the importance of animal agriculture to the economy of Alabama and the special problems encountered in confined production of poultry and swine.

Research conducted since 1980 has centered primarily on development of a practical utilization system for production facilities commonly encountered in Alabama and the Southeast. For swine facilities, this involves using liquid transport flushing systems. These waste streams are very dilute (over 98% water) and present special problems when reuse is the goal. Energy production and refeeding require much more concentrated material. Early on, the need for reconcentrating the waste was recognized. Work was conducted using a vibrating screen to separate the dilute waste stream into its solid and liquid components. The major conclusion from this work was that the solid portion could be refed to the sow herd at a major economic advantage compared to using a fraction of it in on-site energy production.

In 1983, it was recognized that the solid portion could not be used both as an energy source and in refeeding. The economics simply demanded the use of the solids in refeeding. This left only the extremely dilute liquid fraction (typically less than 1% solids) as the source for on-site energy development. Since 1984, research on a novel and promising methane production system using the dilute liquid fraction of the waste has been in progress.

During the last 3 years, three studies have been conducted to determine the nutritional value of screened swine waste solids for swine. Gestating sows were chosen as the experimental animals because the waste solids are high in fiber and not nutritionally suited for growing pigs. Balance trials were conducted to determine the digestion and utilization of the energy and protein in waste solids as compared to typical corn-soybean meal diets. It was determined that the metabolizable energy content of waste solids was about 60% of the level of energy in corn.

A second trial determined that the protein present in waste solids was not digestible by sows. Maximum consumption of waste solids was 13 lb. per day (at 30% dry matter content). Thus, waste solids can be used in typical sow diets to replace about 60% of the grain. However, protein, vitamins, and minerals must be added at normal levels.

In the third study, sows fed waste solids for two gestations at levels up to 50% of the energy requirement achieved normal reproductive performance. Waste solids can be used to substitute for the more expensive energy sources in sow diets and result in considerable feed savings.

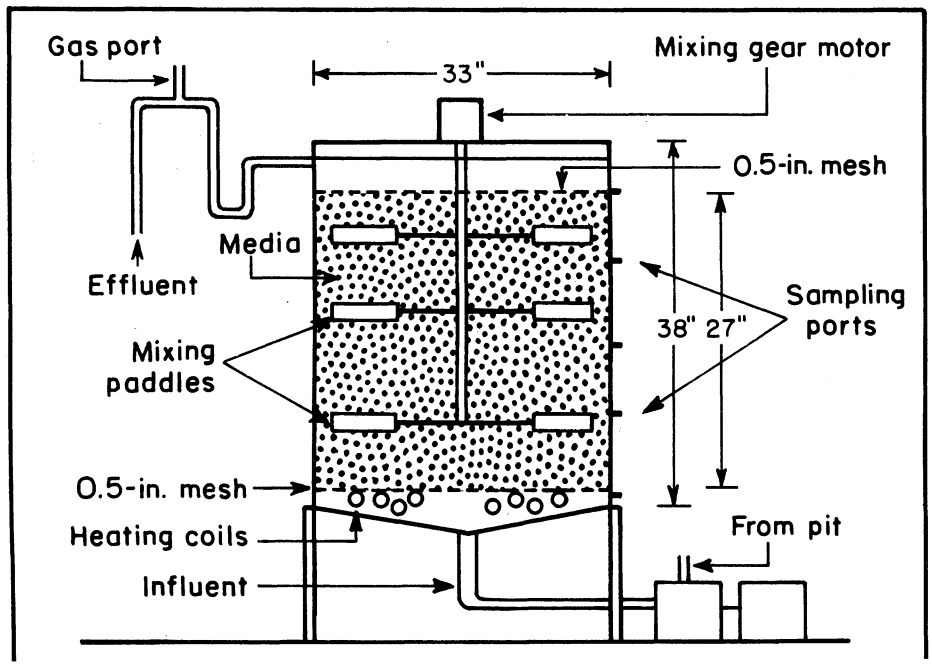
Anaerobic digestion, the conversion of organic waste materials to methane gas by anaerobic bacteria in a closed fermentation vessel, has proven to be an effective method of recovering high quality energy from swine waste. Additionally, the digestion process removes approximately 50% of the solid material from the waste, greatly reducing further treatment requirements before disposal. For effective fermentation in conventional anaerobic digesters, a fairly concentrated waste (5-15% total solids) is required. In refeeding systems that employ a screening process, coarse solids are removed from the waste, leaving a very dilute liquid fraction. This liquid portion is rich in dissolved nutrients and fine solids and contains approximately 60% of the "potential" methane originally present in the whole waste.

In order to effectively utilize this waste for methane production, research is being conducted on an innovative fermenter design termed the "suspended particle-attached growth (SPAG)" reactor, see figure. In these fermenters, the anaerobic bacteria are fixed inside the fermentation vessel by attachment to an inert support matrix. This provides high bacterial populations inside the reactor resulting in several benefits: (1) effective conversion to methane of the very dilute wastes found in flushing or refeeding systems, (2) operation of fermenters at substantially higher flow-through rates, resulting in smaller and more economical conversion systems, and (3) much more stable reactors, capable of rapidly adapting to changes in feeding rate or scheduling and less susceptible to operational failure.

Using these SPAG fermenters, dilute waste of approximately 1.5% solids content has been used to produce methane at rates of about 5.5 cu. ft. per pound solids added or 2.8 volumes of methane per volume of fermenter per day. Thus, SPAG fermenters are well suited to integration with refeeding systems and allow the producer to utilize every portion of the swine waste for recovery of an economically useful resource. Further research on this promising fermentation technology is being conducted to determine optimal support media material and operating conditions.

The animal waste management and utilization research program at the Alabama Agricultural Experiment Station is geared to producing results which will keep animal agriculture in the state competitive now and in the future. The new SPAG reactors, though still in the developmental stage, have the potential to provide on-site energy production while allowing simultaneous use of the solids for refeeding. This research, combined with results from refeeding and anaerobic digester studies, has placed Auburn and the Alabama Agricultural Experiment Station among the top animal waste utilization facilities in the country.

SPAG, a new technology in anaerobic fermenters.



Hill is Alumni Professor of Agricultural Engineering, Prince is Associate Professor of Animal and Dairy Sciences, and Bolte is a Research Associate of Agricultural Engineering.

Use of Encapsulated Food Acids in Cured, Restructured, Hot-Processed Pork

D.L. HUFFMAN, J.C. CORDRAY, and W.R. JONES

MANY MEAT PRODUCTS, such as summer sausage, have a distinctive flavor that is associated with product pH. The traditional method of producing such products is to rely on naturally occurring microorganisms, or the use of starter cultures to initiate the bacterial fermentation and lower the pH. These procedures take from 8 to 20 hours (depending on the product), during which time the microorganisms consume carbohydrates and form lactic acid which in turn lowers meat pH. Once the meat has reached the desired pH, it is heat-treated to inactivate the lactic acid-producing bacteria and stop the pH decline.

In response to interest in using encapsulated food acids to produce low pH products, a recent Alabama Agricultural Experiment Station study investigated the effect of encapsulated glucono-delta lactone and encapsulated lactic acid on cured, restructured pork. Use of encapsulated food acids would provide an opportunity for development of unique flavors in existing and new processed meat products.

Sows of the type used in the manufacture of whole hog sausage were slaughtered, and carcasses were boned leaving the lean/fat mass from each side intact. The lean/fat mass was tenderized twice on a blade tenderizer then separated into a lean component (consisting of chunks of very lean tissue) and a trimming component (containing fat, connective tissue, and some lean meat). The two components were placed in a blender in a 50:50 ratio along with 0.25% curing salt (6.25% sodium nitrite), 3% salt, 2% sucrose, 1.5% liquid smoke, 1.5% water, and 0.05% sodium erythorbate and blended for 12 minutes. The master batch was divided into four equal batches, and additional ingredients were added to create the four treatments: (1) control (C), 3% water; (2) sodium acid pyrophosphate (SAP), 3% water, and 0.5% SAP; (3) lactic acid (LA), 3% water, 0.5% SAP and 1% encapsulated LA; and (4) glucono-delta-lactone (GDL), 3% water, 0.5% SAP, and 1% encapsulated GDL.

Following addition of the extra ingredients to each batch, each treatment was blended for an additional 2 minutes, stuffed, heat processed to 152-156°F (about 5 hours), showered to 90°F, and held at 37°F until evaluated.

EFFECT OF ENCAPSULATED FOOD ACIDS ON CURED, HOT-PROCESSED, RESTRUCTURED PORK

Item	Treatments			
	C	SAP	LA	GDL
pH after mixing	5.99	5.53	5.53	5.59
pH after cooking ...	6.17	5.85	5.33	5.21
pH after chilling ...	6.30	5.94	5.46	5.41
Pigment conversion	58.6	70.1	71.7	75.7
Flavor[1]	5.1	5.6	5.4	5.7

[1]1 = Extremely bland, 8 = extremely intense.

There were no differences of practical importance among treatments for percent fat or protein and only the SAP treatment was lower than the control treatment for moisture content. This moisture difference was likely related to pH alteration. Panelists detected no differences in cohesiveness, juiciness, or connective tissue among the treatments. The SAP and GDL treatments had significantly more intense flavor than the control treatment. These flavor differences appear to be directly related to differences in pH. Objective analysis detected no differences in shear value or tensile strength among the treatments, indicating that textural properties and binding strength were not affected by the addition of food acids.

In the curing reaction, the more total meat pigment that can be converted to cured meat pigment, the more intense and desirable the color will be of the final product. Speed of the curing reaction is very important in products such as those produced in this study because little time, usually about 60 to 90 minutes, is allowed in the manufacturing process for the reaction to take place. The trend observed in this study was for the SAP, LA, and GDL treatments to have more cured meat pigment in the final product than the control. No difference in percent pigment conversion was observed among the SAP, LA, and GDL treatments.

The pH data for each treatment after mixing, after cooking, and after chilling are shown in the table. After mixing, the pH of the control treatment was different than the SAP, LA, and GDL treatments. This difference was due to the addition of sodium acid pyrophosphate during the mixing cycle. Little, if any, of this pH drop at this time was due to the encapsulated food acids because the temperature of the meat was not high enough to melt the capsule. The only food acid released prior to cooking was the result of damage to the capsule by mixing, but this was minimal.

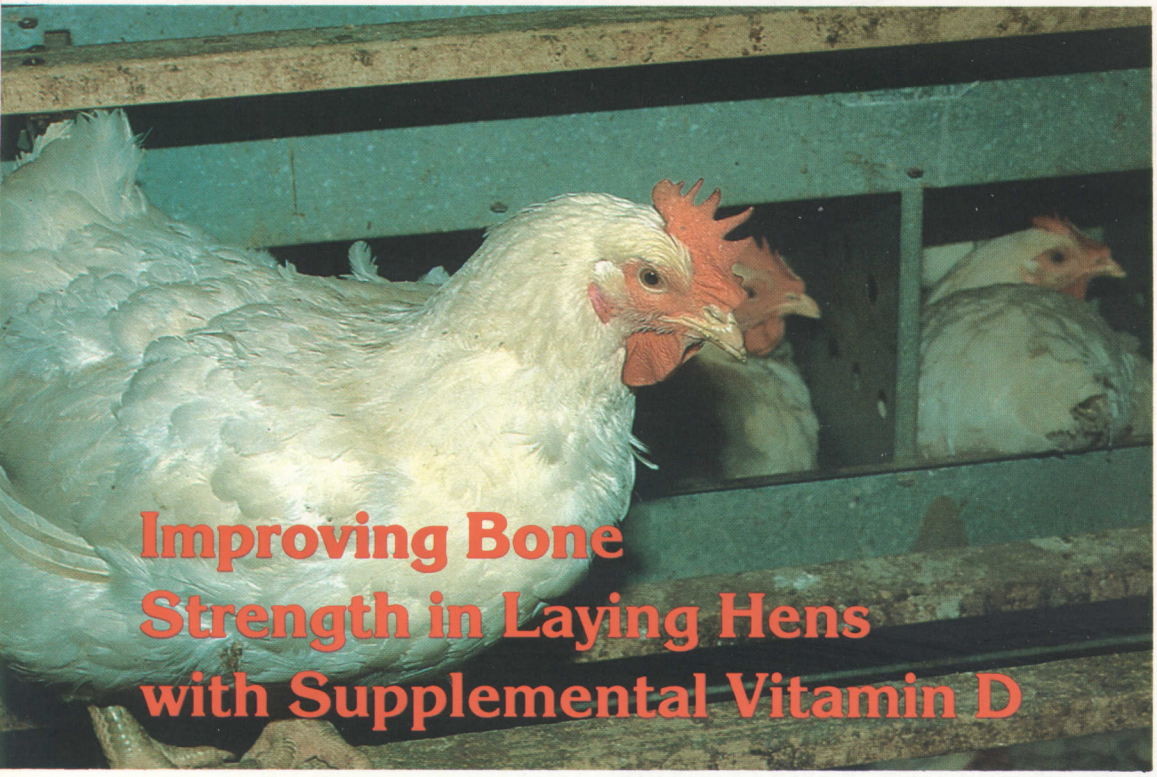
After cooking, the control treatment had a higher pH than the SAP treatment, which had a higher pH than the LA and GDL treatments. Differences in pH observed at this time among the SAP, LA, and GDL treatments were due to the release of the encapsulated acids during the cooking cycle.

During chilling, pH values increased slightly due to the natural buffering capabilities of the meat. The final pH, taken after the product had chilled, ranked in the same order as those taken after cooking.

Yield data indicate that products lost an average of 1.9% during chilling. In terms of both cooked and chilled yield, the control treatment had a slightly higher yield than the other three treatments. There was a trend for the lower pH products to have slightly less water holding capacity than the control treatment.

The results of this study indicate that encapsulated food acids may have merit when used with hot processed meat to produce low pH products. Using these acids may make it possible to develop unique flavors in processed pork products while significantly improving the value of hot-processed sow meat.

Huffman is Professor of Animal and Dairy Sciences; Cordray is Director of Research and Development, A.C. Legg Packing Co.; and Jones is Extension Specialist and Associate Professor of Animal and Dairy Sciences.



Improving Bone Strength in Laying Hens with Supplemental Vitamin D

R. GOODSON-WILLIAMS and D.A. ROLAND

BONE FRAGILITY in old hens is a major problem for the poultry industry. During processing of these hens, bone shattering is a primary economic concern. Weak bones may also be reflected in reduced shell quality and lowered production levels near the end of the laying cycle.

In the past, researchers have tried such things as increasing levels of calcium, sodium, and phosphorous and adding fluoride to the diets of these chickens. Each treatment has shown some success, but most have unwanted side effects like reduced feed consumption and shell quality. Now a project at the Alabama Agricultural Experiment Station is experimenting with the use of vitamin D3 (cholecalciferol) to improve bone strength.

Vitamin D is vitally important to egg production, egg shell formation, and bone mineralization. It is essential for regulation of calcium absorption from the intestine and deposition and removal of calcium from medullary bone. The National Research Council recommends 227 ICU per pound of vitamin D for laying hens.

Three experiments were done at Auburn to evaluate the effect on bone strength of increasing the level of vitamin D in layer diets. Two experiments (1 and 2) were conducted on old hens (over 65 weeks of age) and the third experiment on young birds (26 weeks of age). Experiments 1 and 2 were conducted for 10 weeks, while the young hens in experiment 3 remained on treatments for 9 months. Levels of vitamin D ranged from 0 to 40,000 ICU per pound in experiments 1 and 3 and from 0 to 80,000 in experiment 2. Each experiment included the recommended 227 ICU per pound. Egg production, egg specific gravity (a measure of shell quality), egg weight, and feed consumption were measured weekly. At the end of the test, tibia samples were removed from 20 birds per treatment. In experiment 2, after 5 weeks on treatment another sampling of tibia from 20 birds was taken. Bone variables measured included weight, ash, calcium, and breaking strength.

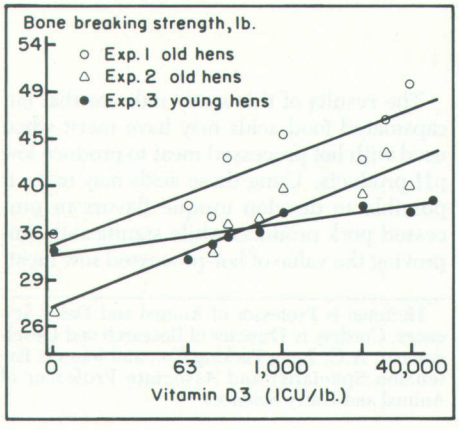
In each experiment bone weight, bone ash, bone calcium, and bone breaking point increased as the level of vitamin D in the diet increased. The figure shows this linear relationship for bone strength in each experiment. The slope of the line for old hens was the same in both experiments.

All parameters measured showed improvement with increased vitamin D. Even at the highest levels of vitamin D fed, there was no plateau, indicating that maximum bone deposition had not been reached. Therefore, improvement in bone strength can be achieved by increasing the supplemental level of vitamin D. However, caution is necessary with higher levels because egg production and egg specific gravity were adversely affected in two of the tests at levels over 10,000 ICU per pound.

The addition of vitamin D brought about improved bone strength in young and old hens. At the latter part of the laying cycle, a vitamin D level of up to 10,000 ICU per pound fed for only 10 weeks resulted in increased bone strength without significantly reducing egg production and shell quality.

Goodson-Williams is a Graduate Research Assistant and Roland is Professor of Poultry Science.

Influence of supplemental vitamin D3 on bone breaking strength of laying hens.



ALABAMA AGRICULTURAL EXPERIMENT STATION, AUBURN UNIVERSITY
AUBURN UNIVERSITY, ALABAMA 36849

David H. Teem, Acting Director
PUBLICATION—Highlights of Agricultural Research 9/86 11M
Penalty for private use, $300

**BULK RATE
POSTAGE & FEES PAID
USDA
PERMIT No. G269**