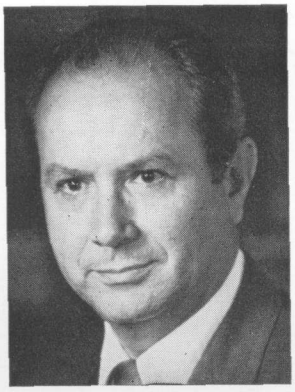
highlights

of agricultural research

Volume 23, No. 3
Fall 1976
Agricultural Experiment Station
Auburn University
R. Dennis Rouse, Director
Auburn, Alabama

DIRECTOR'S COMMENTS

THE MISSION of the Alabama Agricultural Experiment Station is to conduct applied and basic research. This research is directed toward the establishment and maintenance of permanent and effective agricultural and forest industries in Alabama; the development and improvement of the rural home and rural life; increasing the contribution of agriculture and forestry to improving the welfare of the people and the environment in which they live; and programs promoting world peace and human welfare.



R. DENNIS ROUSE

Legislation on both state and national levels specifies that research of the Agricultural Experiment Station shall be conducted under the direction of a designated director, and that he shall be responsible for seeing that results of such research are made available to people through publications and other appropriate means. To further the dissemination of published research, the U.S. Congress authorizes the director to transmit results of research in the mails of the United States under the federal penalty indicia.

Four times a year we use this publication, "Highlights of Agricultural Research," as one means to report research in progress by the Alabama Agricultural Experiment Station. One page summaries of 14 areas of research in progress or recently completed are put into each issue of "Highlights" and copies are mailed to approximately 10,000 selected Alabama individuals whose names have been placed on the mailing list either at their request or they have been designated by county Extension chairmen as leaders who should receive it. Although we would like for every person in Alabama to have this publication and to know of the research of this Station, we know that this is not possible. For this reason, it is important that agricultural leaders who do get this publication have an appreciation of the breadth of this extensive research program and that they inform others. We do ask that you review each issue with two objectives: (1) to look for reports of research of specific interest to you or to those with whom you have contact; (2) to gain a better appreciation of the breadth of the program of your Agricultural Experiment Station and what results of this research mean to the people of Alabama. This is not intended to be a substitute for more detailed research reports which are available on request nor for the other usual means of communication employed through the Cooperative Extension Service. It is simply one additional means of informing a few leaders in Alabama of the scope of this research program. It is important that the leadership in Alabama be aware of the research of the Alabama Agricultural Experiment Station.

In addition to "Highlights," this Station published and distributed to libraries and limited mailing list during the period July 1, 1975-June 30, 1976, a total of 54 Station publications. Also, our scientists had 271 scientific papers published in the various professional journals, and our Research Information staff released 112 articles and 233 pictures and cutlines to newspapers, magazines, radio and television stations, reporting newsworthy research developments. A list of all available Agricultural Experiment Station publications may be obtained upon request. If you have any suggestions concerning this or other publications of this Station, we would welcome your comments.

may we introduce . . .

Dr. Ronald L. Haaland, assistant professor in the Department of Agronomy and Soils, reports on one phase of his research on forage grasses at Auburn on page 3. A member of the research and teaching staff, he deals with various studies of breeding forage grasses for resistance to nematodes and disease.

A native of Havre, Montana, Haaland came to the Auburn faculty in 1974 from North American Plant Breeders in Brookston, Indiana. His prior work record includes experience as a graduate assistant at both Montana State University and New Mexico State University and as a lab and field technician at Montana State.

Haaland earned a B.S. degree in Agricultural Science and an M.S. in Agronomy from Montana State University. He completed his doctoral work in 1973 at New Mexico State Universtiy.

A member of the Crop Science Society of America and the American Society of Agronomy, Haaland is the author of numerous publications on fertility, breeding, and reproduction of various forage grasses.

HIGHLIGHTS of Agricultural Research

FALL 1976 VOL. 23, NO. 3

A quarterly report of research published by the Agricultural Experiment Station of Auburn University, Auburn, Alabama.

ON THE COVER. Intercrossing nematode resistant tall fescue in the greenhouse.

DEVELOPMENT OF NEMATODE RESISTANT FORAGES

R. L. HAALAND, G. R. SMITH, and C. S. HOVELAND
Department of Agronomy and Soils

R. RODRIGUEZ-KABANA
Department of Botany and Microbiology

NEMATODES can cause serious problems in cool-season forages, such as poor seedling establishment, growth, drought tolerance, and persistence (Fig. 1). These problems are particularly evident on sandy or silty soils. Work at the Auburn University Agricultural Experiment Station has shown that root pruning nematodes reduce forage yields of phalaris grass by 78% and tall fescue by 52%.

Presently, the expense of applying nematicides to hay or pasture land is prohibitive. A practical alternative, with long term effects, would be nematode resistant forage varieties. The Agronomy and Soils Department of Auburn is screening several forage species for nematode resistance.

Nematode infested soil was obtained from fields and placed in the greenhouse. Some of the same soil was treated for nematode control. Seeds of several forage species (the table) were planted in both soils. After 7-8 weeks of growth, seedlings were dug, plant heights measured, and their roots washed and examined for nematode damage. When compared to the seedlings grown in nematicide treated soil, susceptible seedlings had stunted top growth and stunted or damaged roots (the table and Fig. 2).

FIG. 1. Nematode infested plots of tall fescue, phalaris and orchardgrass at the Sand Mountain Substation. Plots treated with nematicide have a good stand.

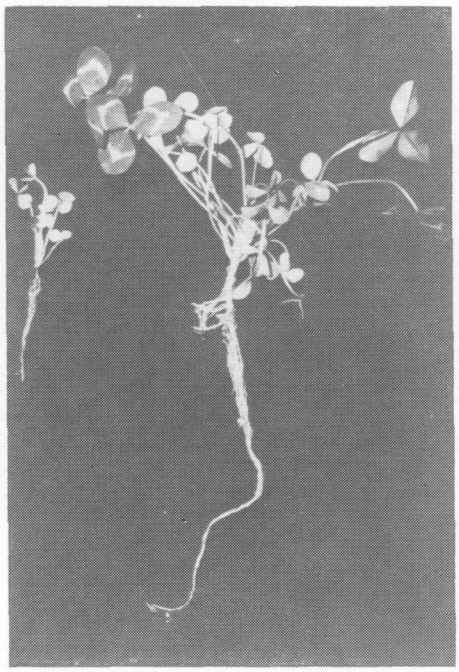


FIG. 2. Nematode damage to arrowleaf clover root (left) healthy root (right).

REACTION OF COOL-SEASON GRASSES AND LEGUMES TO NEMATODES

Species	Root score[1]		Plant height in millimeters	
	+Nem[2]	−Nem[3]	+Nem	−Nem
Tall fescue	7.4	2.8	61	135
Orchardgrass	8.0	4.0	33	65
Phalaris	8.0	4.7	53	122
Ryegrass	7.1	3.0	92	152
Wheat	5.5	2.8	110	181
Rye	7.3	3.5	117	174
Ladino clover	5.3	1.8	41	72
Red clover	6.0	3.3	53	78
Alfalfa	5.3	2.0	40	57
Crimson	5.0	3.0	46	67
Arrowleaf	4.1	3.0	54	67

[1] Root score: 9 = poorest root system, 1 = best root system.
[2] +Nem. = soil infested with nematodes, all plants showed nematode damage.
[3] −Nem. = soil without nematodes, no plants showed nematode damage.

All species evaluated, when grown in nematode infested soil, showed a reduction in plant height and an increase in root damage. Wheat showed the least root damage among the grasses, while arrowleaf clover had less root damage than other clovers. Phalaris grass was damaged more than other species as indicated by the root score and plant height reduction (the table). Annual species, such as rye, ryegrass, wheat, crimson clover, and arrowleaf clover, tended to be more tolerant of nematode damage than such perennials as tall fescue, orchardgrass, phalaris, ladino clover, red clover, and alfalfa.

In all species examined the number of resistant plants was very low, indicating that thousands of individual seedlings must be examined to find the more resistant plants. If plants that are resistant as seedlings maintain their resistance as they grow older, the resistant seedlings can be used as parental stocks for new varieties. About 10,000 seedlings each of tall fescue and phalaris have been screened for nematode resistance. Several selections of both forage species, with apparent nematode resistance, have been established in the field to intercross and will produce seed that should result in more nematode resistant seedlings.

Nematode resistant forages should increase yield, persistence, drought and heat tolerance, and perhaps extend the range of adaptation of some of these forages into regions where they previously could not be grown. These improvements would lead to an increased supply of winter forage for livestock.

Ammonia in Broiler House Air Increases Disease Problems

ROBERT N. BREWER, *Department of Poultry Science*
J. L. KOON, *Department of Agricultural Engineering*

THE RECENT FUEL SHORTAGE has caused poultry farmers to tighten poultry houses and, in many cases, to reduce the air exchange rate. These practices cause stale air to accumulate, which may be harmful to growing chickens.

One problem with tighter houses and reduced air exchange is involved with ammonia that is released from manure into the house (a process called deamination). Prolonged exposure to low levels of ammonia and other contaminant gasses produces stress in young chickens, causing them to be more susceptible to disease exposure, especially diseases affecting the respiratory tract. Since tight houses and lowered ventilation contribute to damp, warm litter and speed up the release of ammonia and other gasses, chances for disease problems are intensified by such fuel saving practices.

Current research in the Auburn University Agricultural Experiment Station is seeking to determine effect of short term, high level exposure to ammonia gas on ability of young chicks to withstand exposure to disease organisms. Diseases involved are Marek's, infectious bronchitis, and Newcastle. Exposure rates are typical of those resulting when a poultry house is closed tightly for a short time.

In the first test, birds inoculated with whole blood contaminated with Marek's disease were exposed to ammonia. Anhydrous ammonia was introduced into the intake air of positive-pressure isolators where birds were housed, at levels giving 100 to 200 p.p.m. ammonia for a period of 24 hours. Following the 24-hour exposure, fresh air was used until experiments were terminated at 6 weeks.

About half of the Marek's inoculated birds had Marek's disease lesions by 6 weeks. However, this was true for both ammonia exposed birds and control birds not getting ammonia exposure, Table 1.

Examination of the respiratory system (nose, trachea, and lungs) revealed damage at all levels of ammonia to which birds were exposed. This damage consisted of inflamed eyes, nose, and trachea, immobilization of cilia in the trachea, and scattered calcified plaques in the walls of small tubules in the lungs.[1]

The nature of Marek's disease may be responsible for the lack of response occurring. Although Marek's can be spread by body chaff suspended in the air, irritation of the respiratory passages did not appear to enhance its entrance into the bird's body.

Chicks in the second series of experiments were administered infectious bronchitis-Newcastle disease vaccine orally at 10 days of age. They were then stressed with 25-50 p.p.m. of ammonia to 24 days. This stress period covers the normal reaction time for the virus vaccine.

Birds were weighed and compared at 6 weeks of age, Table 1. The combination of ammonia gas stress and vaccination (treatment 1) caused a marked decrease in feed conversion. Birds vaccinated but not exposed to ammonia (treatment 3) performed as well as the controls, whereas non-vaccinated, ammonia stressed birds (treatment 2) showed some effects of the stress and did not convert feed as well.

Damage to the respiratory tract would be expected to weaken the birds and create conditions favorable to attack by the common poultry diseases. Of more economic importance, perhaps, is the tendency of the ammonia stress to depress feed conversion. With the ever increasing cost of feed, a slight decrease in feed conversion can mean thousands of dollars loss to the poultry farmer.

Sound poultry management must include careful control of air exchange and proper litter management to control ammonia level. Mechanical ventilation may be necessary in some modern, insulated poultry houses.

[1] Histological examination by Dr. R. D. Powers, School of Veterinary Medicine.

TABLE 1. EFFECT OF AMMONIA STRESS ON MAREK'S DISEASE DEVELOPMENT IN BIRDS VACCINATED AND CONTACT EXPOSED

Treatment	Total no. of birds	Percent positive	Percent negative
Control			
Experiment 1	30	0	100
Experiment 2	30	3.3	96.7
Experiment 3	36	0	100
Total or average	96	1.0	99.0
Marek's inoculated			
Experiment 1	30	43.3	56.6
Experiment 2	30	50.0	50.0
Experiment 3	36	55.5	44.5
Total or average	96	50.0	50.0
Marek's inoculated + ammonia			
Experiment 1	30	53.3	46.7
Experiment 2	30	50.0	50.0
Experiment 3	36	61.1	38.9
Total or average	96	55.2	44.8
Contact exposed			
Experiment 1	30	46.6	53.3
Experiment 2	30	10.0	90.0
Experiment 3	36	38.9	61.1
Total or average	96	32.3	67.7
Contact exposed + ammonia			
Experiment 1	30	43.3	56.7
Experiment 2	30	33.3	66.7
Experiment 3	36	41.7	58.3
Total or average	96	39 6	60.4

TABLE 2. EFFECTS OF AMMONIA GAS AND INFECTIOUS BRONCHITIS-NEWCASTLE DISEASE VACCINATION ON WEIGHT GAIN AND FEED CONVERSION IN BROILERS

Treatment	Average weight at 6 weeks, grams	Feed conversion
1—Vaccination + ammonia		
Unit 1	883.6	
Unit 2	844.0	
Unit 3	815.5	
Unit 4	917.0	
Average	865.0	2.54
2—Ammonia gas only		
Unit 5	926.5	
Unit 6	903.0	
Unit 7	842.5	
Unit 8	831.0	
Average	875.6	2.29
3—Vaccination only		
Unit 9	696.8	
Unit 10	870.3	
Unit 11	788.1	
Unit 12	805.4	
Average	790.2	1.97
4—Control		
Unit 13	637.1	
Unit 14	632.2	
Unit 15	909.6	
Unit 16	973.4	
Average	788.1	2.02

SICKLEPOD: NEMESIS OF PEANUT FARMERS

GALE A. BUCHANAN, *Department of Agronomy and Soils*
ELLIS W. HAUSER, *Georgia Coastal Plains Experiment Station—USDA, ARS*

Sicklepod (sometimes called coffeeweed) is a competitive weed that is well adapted to soils of the Southeastern Coastal Plains. Selective removal of sicklepod from peanuts with herbicides is difficult.

Because of the difficulty of controlling sicklepod, it might be more logical to consider managing rather than controlling the weed in peanuts. Therefore, a better understanding is needed about how these plants affect each other, and that need was the basis for research now underway.

Competition experiments were conducted over a 3-year period by Auburn University Agricultural Experiment Station and the Georgia Experiment Station. Tests were located at the Wiregrass Substation, Headland, and the Georgia Branch Station at Plains, Georgia. Objectives were to determine (1) how different periods of weed-free maintenance or different periods of weed competition affected peanut yields; and (2) emergence dates of sicklepod plants that tower over peanuts at harvest time.

When sicklepod emerged with peanuts and were not controlled thereafter, peanut yields were reduced 43-70% below the weed-free yield. Surprisingly, peanut yields were not reduced if peanuts were kept free of sicklepod at least 4 to 6 weeks. This is well illustrated by the following data, which report yield from different periods of weed-free maintenance as a percentage of production on plots kept weed-free all season:

Weeks of weed-free maintenance	*3-year average yield, pct.*	
	Headland	*Plains*
0	40	46
2	63	76
4	87	96
6	98	91
8	99	93
10	99	96

Although sicklepod seedlings frequently emerged after the fourth week, few broke through the thick canopy of peanut foliage that later covered the ground.

In an evaluation of early season weed competition, peanut yields were not reduced if sicklepod were removed no later than 8 weeks after planting. But 10 to 14 weeks of competition significantly reduced weight of harvested in-shell peanuts.

Extent of the yield reduction is illustrated by data in the following table, which report yield with various weeks of weed competition as a percentage of production made on season long weed-free plots:

Weeks of weed competition	*3-year average yield, pct.*	
	Headland	*Plains*
2	96	95
4	94	99
6	93	89
8	88	86
10	87	68
14	54	40
18	42	42

Green weight of weeds was inversely related to yield of peanuts, which indicates how effectively sicklepod competes with the crop if not removed during the first 8-10 weeks.

These results emphasize the importance of controlling early flushes of sicklepod. Early season control is often difficult, but extra effort will be required to clean out the crop if weeds are allowed to grow early. And the early season efforts necessary for good control will pay off in higher yields and greater profits.

Findings of the study also explain the "late season" broadleaf weeds that seem to suddenly appear in peanuts. Actually these weeds don't come up in late season – they emerge within a few weeks after planting but are not noticed until they rise above the canopy of peanut leaves. Those that emerge in middles can be removed by cultivation. Sicklepod plants in the row may go unnoticed until they appear to "pop up" through the canopy, when actually they were well established early in the season. Observations about origin of late season weeds were confirmed by tagging individual weeds and following their development throughout the season.

Overlooking of sicklepod seedlings in early season became obvious in the research. Even with careful hand weeding of test plots it is extremely difficult to locate and remove all the weed seedlings.

Although most sicklepod plants emerged early, some germinated during mid-season but never grew large enough to break through the canopy of peanut foliage. They remained small and non-competitive until harvest. For the peanut foliage to suppress these late emerging weeds, however, conditions must be favorable for crop growth. Defoliation by insects, diseases, or foliar injury from herbicides decreases the competitiveness of the peanut plant and allows weeds to come through.

Economic Comparisons of Singled Cropped and Multiple Cropped Catfish Production Systems

K. W. CRAWFORD
Department of Agricultural Economics and Rural Sociology

SINCE BORROWED capital in farming has become increasingly important, farmers and lenders have begun looking beyond biological feasibility in the decision making process regarding involvement in innovative enterprises such as commercial catfish production. It is necessary for them to estimate costs and returns before production is initiated.

In a study by the Department of Agricultural Economics and Rural Sociology, budgets were calculated for two catfish cultures based on data from commercial producers in west-central Alabama. The general procedure for budgeting follows. First, costs for capital investments are determined for both non-depreciable and depreciable items. Subsequently, fixed expenses are calculated. These costs remain even if production stops. Included in these are land tax, depreciation, and opportunity costs on average capital investment or foregone interest payments had the money been deposited in savings. Average capital investment is commonly used when the budget is not for any specific year, that is, not for the start-up period or other years when actual interest and principal payments must be made to lending institutions.

Variable costs include outlays for fingerlings, feed, transportation, maintenance, aeration, seasonal labor, miscellaneous items, interest on operating capital, operator's labor, and control of diseases, parasites, weeds, and algae.

Total production is calculated based on biological growth rates. The price of liveweight fish in the examples is based on sales to a processor who provides custom harvest service. The sum of fixed and variable costs is deducted from total returns to yield net returns to land, management, and capital.

Next, rental value of land and a management charge, 7% of net returns in the example, are deducted. The residual is returns to capital investment above opportunity costs.

Finally, percentage return on average capital is computed by dividing returns to capital by average capital investment. This figure can be used to compare alternative investment opportunities.

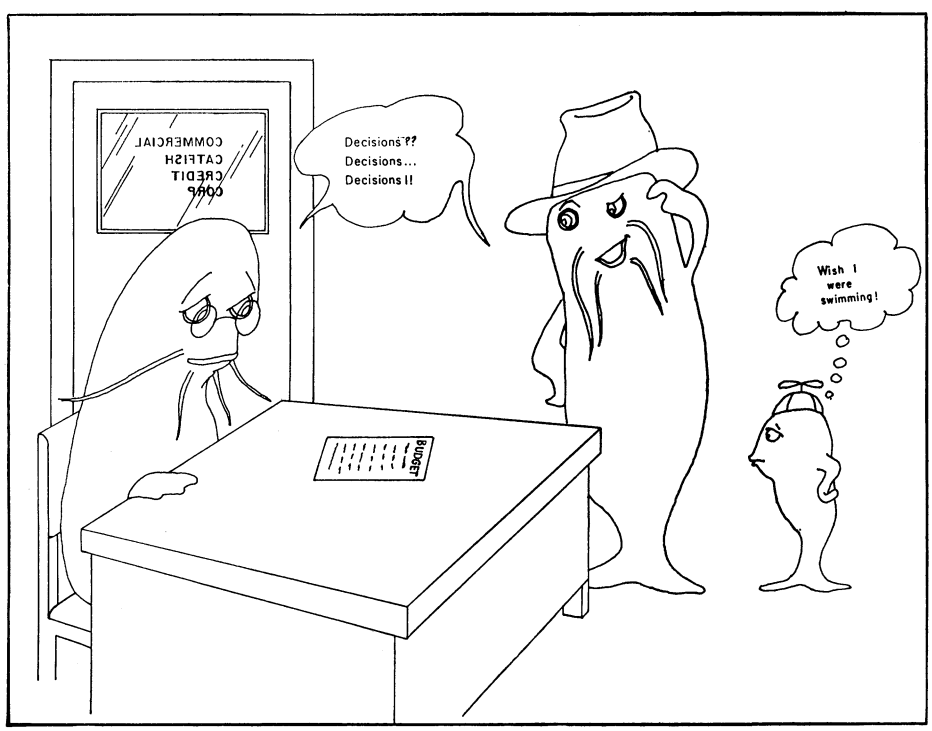
The most common method of commercial catfish farming in Alabama is single cropping. Fingerlings are usually stocked in the spring and reach harvestable size by fall. Using collected data, the first budget computed was for two 5-acre ponds. The average pond size for commercial producers in west-central Alabama was 5.6 acres in 1973-74.

If year-round rather than seasonal operation is practiced, returns can often be improved. Fixed costs can be reduced if distributed among more than one crop. A second budget, also for two 5-acre ponds, was computed for a year-round system of catfish production in ponds.

In this system, three crops of catfish would be harvested in 2 years. The only change in capital investments is a drilled well. The well is necessary for pond refilling after each harvest. The total increased capital cost is $6,000, which includes construction, pipe, and pump. Most variable cost items are simply three times the amount for the single cropped system.

Two catfish crops are overwintered. Thus, at harvest the size of these fish averages about 0.75 lb. However, harvesting is during the months when processors pay $0.50 per lb., liveweight. The other crop, averaging 1 lb. each, is sold for $0.45 per lb., as in the single cropped system.

Under the specified conditions, the costs of adding a drilled well to the capital investment items out-weighs the effect of spreading the fixed costs over more than a single crop. Possibly, the need for a well could be eliminated if harvest procedures circumventing pond draining could be used. Until then, single cropped commercial catfish should provide higher returns than a multiple cropped system for small ponds. For larger ponds, other budgets would be needed to estimate the economic feasibility.



BIENNIAL COSTS AND RETURNS FOR TEN ACRES OF CATFISH PRODUCTION IN WEST-CENTRAL ALABAMA, 1975

Item	Single cropped[1]	Double cropped[1]
	Dollars	*Dollars*
Costs		
Fixed	2,987.20	4,092.00
Variable	15,911.92	22,165.06
Total	18,899.12	26,257.06
Per acre	1,889.91	2,625.71
Per lb.	0.38	0.42
Returns		
Total	22,500.00	30,000.00
Net per acre[2]	360.08	374.29
Net per lb.[2]	0.07	0.06
Annual on average capital investment	11.20%	7.92%

[1] Involves a 2-year time period.
[2] To land, management, and capital.

TWO HUNDRED YEARS OF AGRICULTURE

J. H. YEAGER
Department of Agricultural Economics and Rural Sociology

THE $40,000 TRACTOR with air-conditioned cab and tape deck, furnished with short wave radio to contact wife at home was made possible by the progress of agriculture in the past 200 years.

Would anyone like to go back to following a mule? Guiding the Gee Whiz, Joe Harrow, or Oliver GX turning plow would be tough work. And working all year, having to pull fodder to make feed for the mules would cramp a modern farmer's style considerably.

A farm wife can forget to bring in wood and still have a hot meal ready when her husband comes home. She can grow marigolds in her No. 3 washtubs instead of drawing them full of water for washing. A young bride marrying a "farmboy" may be carried over the threshold to an air conditioner, washer, dryer, carpeted house, tiled bath, inter-com, stereo, vacuum cleaner, electric stove, mixer, blender, and other wizards of gadgetry at which her great-grandmother would faint.

The wonders of science and technology have released workers from the farm, freeing many to produce nonfarm goods and services. In 1970, only 5% of Alabama's population lived on the farm in contrast with the 89% of 1870.

Yet we are still the best fed nation in terms of quality and quantity of food supplied at a relatively low percentage of disposable income. There is no working 3 hours for a loaf of bread. Truly, we are in the "Fantastic Age" of agriculture.

Space does not permit a listing of all the milestones of agriculture, but these are outstanding:

1873 Eli Whitney invented cotton gin
1833 McCormick reaper patented
1849 Mixed fertilizers first manufactured commercially
1862 Morrill Land-Grant College Act
1892 Successful gasoline tractor built
1916 Federal Farm Loan Act
1926 Hybrid corn seed commercially available
1935 Rural Electric Administration
The list could go on and on.

Since Alabama became a state 157 years ago, its major crops have drastically changed. Records a century old reveal the diversity of Alabama's crops. Almost 223,000 lb. of rice were grown in 1870. Tobacco, hops, and buckwheat were also grown, plus corn, cotton, potatoes, and small grains. Sugarcane – more than 6,600 acres of it – was reported in 1880, and the production of 795,199 gal. of molasses.

TABLE 1. PRODUCTION OF MAJOR AGRICULTURAL PRODUCTS, ALABAMA 1870

Item	Unit	Amount
Barley	Bu.	5,174
Buckwheat	Bu.	144
Indian corn	Bu.	16,977,948
Oats	Bu.	770,866
Rye	Bu.	18,977
Wheat	Bu.	1,055,068
I. potatoes	Bu.	162,512
Cotton	Bales	429,482
Hay	Tons	10,613
Hops	Lb.	32
Rice	Lb.	222,945[1]
Tobacco	Lb.	152,742
S. potatoes	Bu.	1,871,360

[1] Over 2 million pounds produced in 1850.

Mules, asses, and oxen were typical farm workstock of yesteryear, as well as horses. Milk cows numbered 170,640 in 1870 compared with 91,000 head today. Sheep, mules, and oxen have virtually disappeared from modern farms, but swine numbers have increased from 719,757 head in 1870 to 820,000 in 1975.

Butter production on the farm has disappeared, but chickens, once scarce, have skyrocketed with the development of Alabama's giant poultry industry after the 1950's.

Dramatic changes have occurred in the number, average size, and investment in farm real estate over the years. There were 55,000 farms in Alabama in 1860. The number increased to an all time high of 273,000 farms in 1935, and then declined to about 70,000.

Average size of Alabama farms in 1860 was 346 acres, which decreased to 68 acres per farm in 1930 and has increased since then to about 188 acres as reported in the 1969 Census of Agriculture. Today, tenant farming is a small 10% compared to 65% in 1930.

The amount of farmland in Alabama has declined since the 1950's. So has cropland harvested, but the value of farm real estate has gone from an average of $4 per acre in 1870 to $383 per acre in 1975. At this value, the total value of Alabama farm real estate is more than $5 billion. In 1870, it was only $68 million. It goes without saying, of course, that the value of today's dollar is less.

Farm product sales have risen since 1880 when their value was $56.9 million. In 1974 their value was $1,190 million.

The only thing certain in the future of agriculture is that 200 years have brought change and the next 200 will bring more.

TABLE 2. LIVESTOCK AND PRODUCTION ON FARMS, ALABAMA 1870

Kind	Number
Horses	80,770
Mules and asses	76,675
Working oxen	59,176
Milk cows	170,640
Other cattle	257,347
Sheep	241,934
Swine	719,757
Wool prod.	381,253 lb.
Butter prod.	3,213,753 lb.
Cheese prod.	2,732 lb.

These steers were on the pasture management system that included 5 to 6 hours of grazing on cereal grain-clover pasture and feeding of hay on adjoining grasslot when not grazing.

Hay Feeding Questionable on Cool-Season Pastures

R. R. HARRIS, *Dept. of Animal and Dairy Sciences*
C. S. HOVELAND, *Dept. of Agronomy and Soils*
J. K. BOSECK and W. B. WEBSTER, *Tennessee Valley Substation*

CEREAL GRAIN-CLOVER PASTURES provide the basis for an excellent method of growing stocker beef calves in Alabama. But don't count on every-day grazing all winter, especially in northern Alabama. Good management usually requires removal of calves from the cool-season pastures for up to 60 days during winter in that area.

The possibility of increasing the productivity and profitability of these cool-season annual pastures by regular hay feeding was investigated in an experiment at the Tennessee Valley Substation, Belle Mina. Specifically, the study was to determine whether daily hay feeding throughout the season (either on test pasture or on an adjacent sod area) would reduce the time cattle were off pasture during winter or improve animal gain.

Test Procedure

Six 2-acre paddocks of wheat-ryegrass-arrowleaf clover were established annually during 1971-75. These pastures were grazed whenever forage supply and weather conditions permitted during the October-June period.

Yearling beef steers averaging about 475 lb. each were divided into three groups to compare three management systems on grazing. Two pastures were grazed in each of the management systems:

Group 1 – Steers had continuous access to test swards and were fed a daily allowance of hay (3.3 lb. per steer).

Group 2 – Steers were grazed 5 to 6 hours daily and then removed to an adjacent summer grass sod where they were fed hay (2.8 lb. per day) and kept overnight.

Group 3 – Steers grazed when forage was available, but without hay being fed, and were removed to barn when forage was insufficient during January and February.

Because of weather conditions, steers in groups 1 and 2 also had to be removed from test pastures during mid-winter. All were fed in the barn during the time off grazing. Groups 1 and 2 got hay and cottonseed meal as their wintering ration, while Group 3 steers were fed corn silage supplemented with rolled corn and cottonseed meal.

As an average, grazing began October 17 and lasted until June 2. Wheat and ryegrass provided most of the forage since clover stands were generally only fair to poor.

Pastures were stocked with 2 to 3 steers per acre, but weather conditions prevented maintaining this rate. The most accurate measure of pasture carrying capacity was animal grazing days per acre, and this measure was used in evaluating systems.

Hay Boosted Carrying Capacity

Feeding hay increased the carrying capacity of the test pastures, as shown by data in the table. However, the extra gain per acre because of the higher stocking rate was less than expected. Carrying capacity was increased 29-62% by hay feeding, but per acre gain was increased only 10-15%.

Rate of gain per steer was considerably less on these pastures than usually obtained under similar conditions. Typical gains in the past have been about 1.6 lb. daily, whereas these amounted to 1.0 to 1.4 lb.

Hay feeding also reduced the number of days that steers had to spend off the pastures. However, as indicated earlier, this did not result in the predicted animal gain per acre of land. In the case of limited grazing (Group 2), extra labor was necessary for managing the cattle.

Hay consumption totaled about 1,000 lb. per steer for the winter period. This includes that fed as a wintering ration plus that fed on pasture.

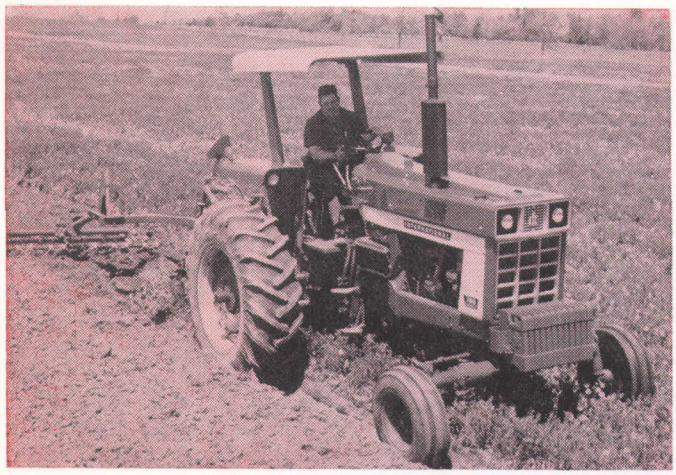
Steer Performance Disappointing

Individual steer performance was disappointing in this test. Although feeding limited amounts of hay to steers on the wheat-ryegrass-arrowleaf clover pasture increased carrying capacity up to 60%, it boosted per acre gain only 10-15%. Thus, poor steer performance must be weighed against increased carrying capacity in determining value of the practice. In the case of limited grazing, extra labor for management also must be taken into account.

ANIMAL PERFORMANCE ON WHEAT-RYEGRASS-CLOVER PASTURE UNDER MANAGED GRAZING AND WITH HAY FEEDING

Performance measure	Performance by groups		
	Group 1—continuous grazing, hay on pasture	Group 2—grazing 6 hr. daily, hay on adjacent grass sod	Group 3—no feed on pasture, off grazing in winter
Grazing days/acre	411	517	319
Grazing gain/acre, lb.	467[1]	485[1]	423
ADG on grazing, lb.	1.13[1]	.94[1]	1.44
Days grazed	183	189	170
Days off grazing	45	39	58
Total feed/steer			
Coastal hay, lb.[2]	1,090	944	----
Cottonseed meal, lb.[3]	67	58	99
High moisture corn, lb.[4]	----	----	132
Corn silage, lb.[5]	----	----	2,218
Steers/treatment, No.	44	46	24

[1] Includes gain made from hay fed during grazing period.
[2] Fed at rate of 13 lb. per steer daily when off grazing.
[3] Fed at rate of 1.5 lb. per steer daily when off grazing.
[4] Fed at rate of 2 lb. per steer daily with silage as wintering ration.
[5] Full-fed, 34 lb. per day, during winter period.



Tractor overturn protection will save lives and reduce injuries during tractor upsets.

SAFER OPERATION OF A FARM TRACTOR

ELMO RENOLL, *Department of Agricultural Engineering*

THE MODERN FARM TRACTOR is greatly improved over older models and is safer than in years past. But it continues to be involved in farm accidents because it still requires a human operator.

Tractors and farm machines account for more than 50% of all farm accidents. The farm tractor and fatal accidents are closely associated, with tractors involved in two out of every five fatal farm accidents.

Several things can be done to help reduce tractor accidents and the resulting fatal injuries. One way to reduce these accidents is to give each tractor operator safety training. Hopefully this will enable him to operate the tractor in a safe manner and help him recognize potentially dangerous situations. If the following suggestions are adhered to by the tractor operator, many serious and costly tractor accidents can be avoided.

Be on the alert for ditches, banks, and holes to avoid upsets.

Operate at a safe speed when turning, crossing slopes, or during adverse field conditions.

Do not operate a tractor on extremely sloping land.

Don't allow children on or near the tractor.

Attach pull loads only to the drawbar and add front weights to the tractor.

Start heavy loads smoothly and slowly to avoid backward turnovers.

Keep PTO shield in place.

When operating a tractor equipped with a front-end loader, keep the load low and speed slow. Add weight to the rear for balance.

Remember tricycle tractors are less stable than wide-wheel front-end ones.

Another way to help reduce deaths from tractor accidents is to provide upset protection for the operator.

Tractor accidents are usually classified by type of accident or by tractor use at the time of the accident. As indicated in the table at right, the most common type of tractor accident involves an upset.

These upsets include turning over backwards and to the side. Turning the tractor over sideways many times is associated with ditches, roadbanks, and excessive field speeds. Turning over backwards frequently results from improper drawbar hitching or excessive drawbar loads. A protective cab or frame and safety belts will lower the death rate from tractor upsets and reduce the number of injuries.

The importance of the frame or cab in reducing deaths from tractor upsets is evident from several recent research studies. One such study was conducted for 6 years. A stunning 40% of these tractor upsets resulted in death. In addition, 53% produced serious injury. All of the injuries and deaths were on "open" tractors, with no cabs or frames.

In this same study about 5% of the accidents involved tractors equipped with overturn protection. Although they made up only a small part of the study, these accidents produced no fatalities, and no injuries in half of them.

Not all tractor and machinery accidents occur on the farm. Off farm accidents are increasing. About one-third of the tractor accidents take place on highways and rural roads.

Farm tractors and machines traveling on highways present unusual safety problems. These slow moving machines are a hazard to faster traffic and are in effect a standing invitation for a rear end collision. Various safety devices have been designed for use on the rear of these tractors and machines to warn the motorist that a slow moving vehicle (SMV) is ahead.

One such safety device is a unique reflective triangle 14 in. high. This SMV emblem is recommended by the National Safety Council. Every tractor and farm machine which is operated on the road, even for very short periods of time, should display this SMV emblem on the rear.

Research studies have shown that when the SMV emblem was required by law in one state the number of highway rear end collisions between fast moving vehicles and slow moving tractors was reduced 20% in the first year.

Safe operation of the farm tractor should be a way of life dedicated to reducing tractor accidents.

Use of tractor at time of accident	
Tillage, planting, harvesting	29%
Tractor en route to a site	15%
Materials handling	15%
Towing vehicle or implement	11%
Passenger riding	6%
Clearing land	4%
Stationary power	4%
Others	16%
Types of tractor accidents	
Tractor upset	58%
Fall from tractor	13%
Crushed	9%
Run over	8%
Motor-vehicle collision	6%
Power takeoff	3%
Others	3%

REDUCING USES OF ENERGY IN AQUACULTURE

E. W. McCOY, J. L. BOUTWELL, C. M. JOLLY
Department of Agricultural Economics and Rural Sociology

AMERICAN AGRICULTURE has become highly dependent upon fossil fuels. Production processes utilizing large amounts of fossil fuel have been acceptable because this type energy source was relatively abundant. Many types of production initially were efficient users of renewable energy sources, but production per unit was low.

With increased population and income, however, more intensive production methods were developed. Although energy efficiency was reduced, economic efficiency was increased. The economic returns, based on the consumer's willingness to purchase the outputs, more than compensated for the added input costs. Thus, existing production systems have resulted from least cost attempts to satisfy market demand.

Due to increased cost and long run scarcity, it may be appropriate to examine the efficiency of fossil fuels in agricultural production. One efficiency measure is the ratio of food produced (food energy) to the energy used in production (cultural energy). While both measures can be converted to calorie units, the fossil fuel energy is not directly consumable as food by humans. Two types of aquacultural production can be used to illustrate how cultural energy input requirements may be reduced without decreasing the level of food energy produced.

Fish, as with terrestrial animals, encompass numerous species with diverse feeding habits. Many that normally feed upon natural foods will accept formulated feed. An aquacultural production system can be a feedlot or a pasture.

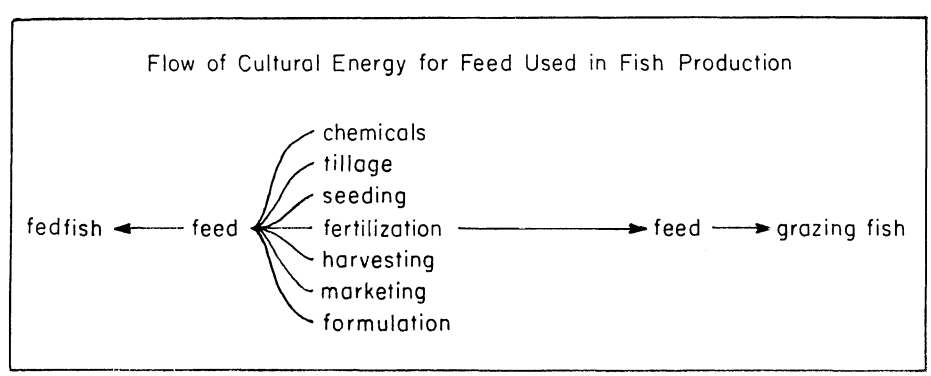
Trout, salmon, and catfish, for example, are produced under intensive feedlot-type conditions. Although the feed ingredients are grown with a net energy gain most of the energy gain is lost when the ingredients are formulated into feed and consumed by fed fish. A portion of the loss is due to cultural energy requirements of the feed mill, but the major loss comes from the intermediate consumer — the fed fish. Fed fish convert no more than 15% of the feed energy into edible food energy. In addition to feed, fed fish production also requires other energy inputs. While the energy efficiency ratio is higher for fed fish than for most terrestrial animals, the overall result is a net energy loss in production.

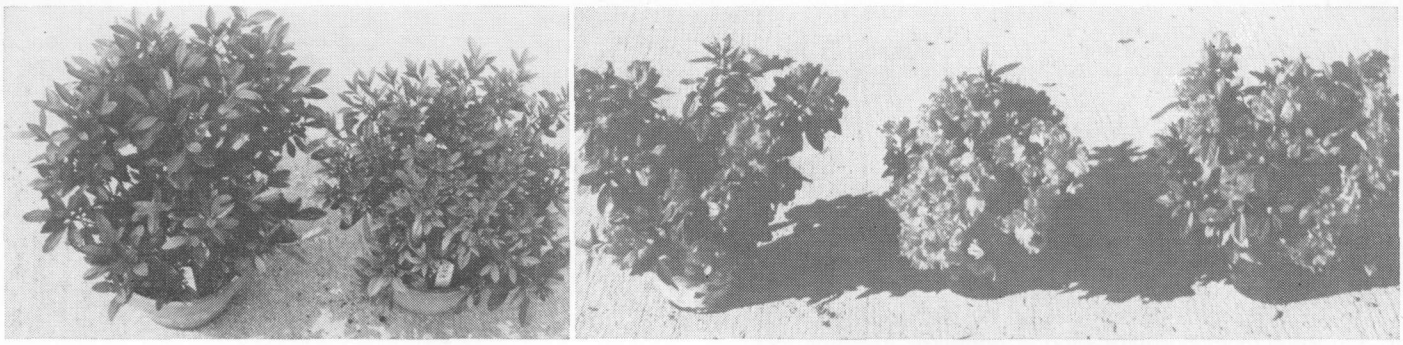
Alternative types of fish production exist however. Just as grass fattening of cattle has become increasingly feasible, so has production of "grazing" types of fish. In the aquatic pasture, fish feed upon water vegetation much as cattle or sheep graze on grass.

An aquacultural enterprise utilizing grazing type fish can be combined with livestock feedlots to increase the energy efficiency ratio for the overall operation. The feedlot waste materials would represent the feed input for the aquacultural enterprise. Two crops could be grown from the feed fed to livestock. Cultural energy requirements in production of the fish would be relatively low. The major energy inputs would involve collection and transportation of waste materials to the pond. With a properly engineered system, much of the movement could be done by gravity. Food energy output from this type of fish production would be comparable to the amount produced per unit in intensive fish cultures.

If feed for grazing fish is produced using inorganic fertilizers, the net energy ratio still exceeds the ratio for fed fish culture. In fed fish culture, fertilizer is applied to crop land to produce feed grains. After the grain is harvested and processed, it is fed to the fish. For grazing fish, the feed produced is directly consumed as illustrated in the figure. No cultivating, harvesting, marketing, or processing energy for the feed input is required.

When consumers go to the marketplace, few directly consider the energy content of foods they buy or the energy that was expended in producing that food. As long as the price is acceptable, they purchase products that fit established taste and preference patterns. Although several energy efficient fish production systems are now available, consumer demand for the output is low. With increasing scarcity and high costs for fossil fuels these or similar systems will become more competitive. Consumers may find "Florida Perch" at $0.69 per pound a very acceptable alternative to trout filets at $2.69 per pound.





LEFT: Increased branching of azaleas resulting from Atrinal (5,000 p.p.m.) is obvious on plant at right, as compared with untreated control at left. RIGHT: Sheared Red Ruffles azalea treated with 4,000 p.p.m. Atrinal (center) shows normal blooming. Check is at left and Offshoot-O treated plant (4,000 p.p.m.) is at right.

New Chemical Pinching Agent Shows Promise for Controlling Growth of Woody Ornamentals

KENNETH C. SANDERSON and WILLIS C. MARTIN, JR., *Department of Horticulture*

CHEMICAL PINCHING agents for woody ornamental plants are used by many individuals and groups. Growers, arborists, highway maintenance workers, and landscape contractors use these chemicals to control growth and help maintain a desired plant shape.

Two types of chemicals are available: destructive and inhibitive. Both types overcome apical dominance, stimulate growth of lateral shoots, and reduce plant height. Unfortunately, plant damage is common.

Available pinching chemicals have been tested for effectiveness and safety of use since 1968 by Auburn University Agricultural Experiment Station. A material sold under the name Offshoot-O® (a combination of methyloctonate and deconate) has been the most effective one, especially on azaleas. It kills the top while causing little or no damage to the rest of the plant.

Growth inhibitors have proved effective for pinching certain plants, but plant distortion, flower abortion or disruption, and retarded growth have been undesirable side effects. Materials tried were Ethrel (an ethylene compound), Maintain CF-125® (chloroflurenol methyl esters), and NIA 10637 (ethyl-hydrogen propylphosphonate).

Beginning in 1975, a new chemical sold under the trademark name Atrinal (common name, dikegulac) has been evaluated. Chemically, it is sodium 2,3:4, 6 di-o-iospropyl-idene-2-keto-L-gulonate.

The new agent, applied as a foliar spray, turned the immature top leaves of azaleas yellow for 7 to 14 days, but without affecting mature foliage. Terminal bud growth was inhibited and, simultaneously, axillary buds began to grow.

The first experiment in the greenhouse was done in January on small, young plants of the Kingfisher variety of evergreen azalea. Atrinal induced lateral shoot development as follows:

Treatment	*Shoots/plant, number*
None	41.8
Sheared	65.4
1,000 p.p.m. Atrinal	42.0
2,000 p.p.m. Atrinal	48.4
3,000 p.p.m. Atrinal	50.4
4,000 p.p.m. Atrinal	51.8

Plants of the Red Ruffles and Red Gish azalea varieties were sprayed with Atrinal in July in a second experiment. All plants were approximately 10 × 10 in. in size and were sheared 1 week before spraying. A 42,000 p.p.m. Offshoot-O spray was also included.

Sprays of 4,000 or 5,000 p.p.m. Atrinal produced more shoots than Offshoot-O treated plants, as shown here:

Treatment after shearing	*Shoots/plant*	
	Red Gish	*Red Ruffles*
Check	125.1	65.3
3,000 p.p.m. Atrinal	180.0	97.2
4,000 p.p.m. Atrinal	202.6	117.1
5,000 p.p.m. Atrinal	199.0	117.1
42,000 p.p.m. Offshoot-O	155.9	82.0

As was true in the first experiment, Atrinal treated azaleas flowered normally.

Sprays of Atrinal were tested on small plants of cleyera, *Ternstroemia gymnanthera* in June. Plants sprayed with 3,000 to 4,000 p.p.m. Atrinal had more shoots than sheared plants, as shown by the following data:

Treatment	*Shoots/plant, number*
Sheared	11.6
2,000 p.p.m. Atrinal	10.3
3,000 p.p.m. Atrinal	20.1
4,000 p.p.m. Atrinal	22.3
5,000 p.p.m. Atrinal	11.8

Preliminary testing of Atrinal has also been done with other plants (Ilex cornuta 'Dwarf Burford,' *Pieris phillyraefolia*, and *Rhododendron prunifolia*). Although shoot data are not yet available, Atrinal appeared to be an effective pinching agent on *Rhododendron prunifolia*. *Ilex cornuta* 'Dwarf Burford' plants have not exhibited the typical, temporary yellowing of immature foliage associated with Atrinal treatment.

There is still much to be learned about this new chemical pinching agent. Research reported shows that Atrinal is a safe and effective pinching agent. Results indicate that it can be used alone or in combination with shearing to increase shoot numbers in woody ornamentals, such as azaleas.

THE FLORIDA LARGEMOUTH bass is distinguishable from the northern largemouth in coloration and larger maximum size. The lateral dark stripe is usually broader and darker near the tail for the Florida subspecies; also anteriorly the stripe is more interrupted for the Florida bass forming a series of more or less distinct blotches (Fig. 1).

The large size attained by the peninsular Florida bass has generally been attributed to the longer growing season. Within its range Florida bass commonly attain weights of 14-16 lb. and occasionally will exceed 20 lb., while the northern subspecies seldom exceeds 12 lb. Intergrades are recognizable throughout northern Florida, southern Alabama, central Georgia and parts of South Carolina.

FLORIDA LARGEMOUTH BASS IN ALABAMA WATERS

W. D. DAVIES, *Department of Fisheries and Allied Aquacultures*

FIG. 1. Note the broader and more interrupted lateral band of the Florida subspecies (top) compared to the northern subspecies (bottom).

Differences between the two subspecies may also involve differences in feeding habits which would be reflected in catchability. When the two subspecies are stocked together, as they have been in California, significantly fewer Florida bass have been caught by fishermen.

Preliminary pond studies at the Auburn University Agricultural Experiment Station were designed to test growth and catchability differences between the subspecies.

Nine 1/10-acre ponds were used to evaluate reported differences in growth between the subspecies. Each pond was stocked with a reproducing population of forage species, plus 12 fingerling bass.

From periodic seining and draining records, it was evident that the northern subspecies grew faster than the Florida (Fig. 2). Since the environments were similar, the differences in growth rate were attributed to genetic factors. The first year's growth, therefore, is not the factor which contributes to the larger size of the Florida largemouth. The larger size attained by the Florida bass is probably caused by a faster rate of growth after sexual maturity or by greater longevity.

Four ¼-acre ponds were used to compare catchability between the subspecies. Ponds in series were systematically fished by a team of fishermen with different artificial lures

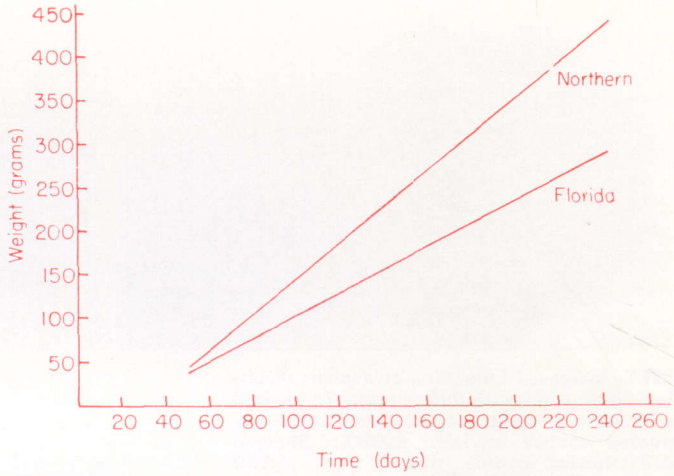


FIG. 2. Comparison of growth between Florida and northern largemouth bass.

and a variety of live bait over a period of several months.

An analysis of the catch indicated that Florida bass were more difficult to catch in a pond environment than the northern subspecies (Fig. 3). Since excessive harvest of bass is the primary reason for farm pond fish populations not producing good fishing, stocking Florida bass may be an important management tool in public waters. Also the reduced catchability may be an important factor in the longevity of Florida bass.

In recent years Florida bass have been introduced into Alabama's public and private waters for a variety of reasons. The 20 lb. 14 oz. largemouth bass caught in California was an introduced Florida bass; numerous popular articles are predicting that a new world record bass could be caught anytime. The fact that such a fish was taken in California apparently has resulted from a combination of excellent forage, heavy fishing pressure, favorable climate, and reduced catchability. Many sportsmen groups stock Florida bass into their favorite fishing waters in the hope of producing trophy sized bass. Also the State of Alabama has stocked Florida bass into some public fishing lakes mainly because fingerling bass from Florida can be obtained 1-2 months earlier than the northern subspecies.

The potential results from stocking Florida bass in Alabama waters appear to be: A decreased catch rate for largemouth bass, an increase in population density of largemouth bass due to the decreased catch rate, and better utilization and control of forage species as a result of the increased density.

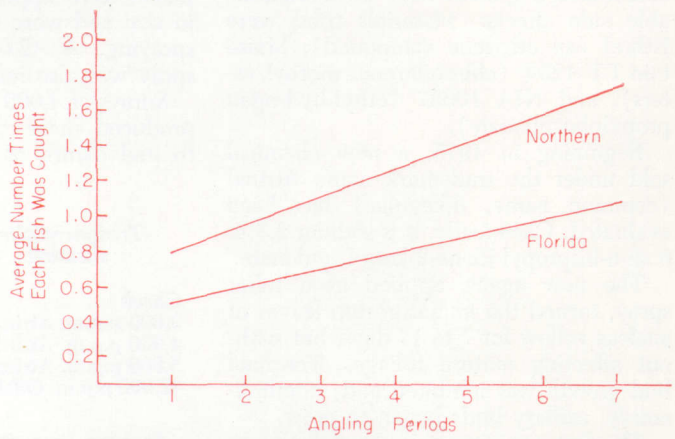


FIG. 3. Comparison of catchability between northern and Florida largemouth bass.

Feral and Free-Ranging Dogs Threat to Alabama Livestock

LESLIE E. BROWN, CARL A. CUDE, and M. KEITH CAUSEY
Department of Zoology-Entomology

RESEARCH ABOUT feral (wild) dogs and the problems they create on Alabama livestock farms has been conducted since 1968 at Auburn University Agricultural Experiment Station. This ongoing project encompasses the behavior, general ecology, and life history of feral dogs, as well as their interactions with wildlife species, domestic livestock, and free-ranging or domestic dogs.

To assist in assessing the impact of feral and free-ranging dogs on livestock, a questionnaire was compiled and mailed during August 1974 to Alabama Beef Cattle Improvement Association members with operations in 59 counties. A letter written by Dr. Richard E. Deese, Extension Animal Husbandman, was enclosed to encourage questionnaire recipients to respond.

Responses Indicate Problems

Of the 188 questionnaires mailed, 59 were returned from livestock operations in 41 counties. Forty-four of these respondents, who raised livestock in 35 counties, reported problems with dogs either harassing or killing their livestock within the 3-year period prior to August 1974. During this same period, neighboring livestock owners in all but 2 of these 35 counties had also experienced dog problems, which implies that a widespread problem exists within Alabama. Free-ranging dogs seem to have caused a larger number of complaints (17) than did feral dogs (11). Free-ranging dogs were also cited for livestock deaths by 13 owners, while only 5 owners attributed animal deaths to feral dogs.

Livestock losses attributed to dogs during the 3-year period prior to August 1974 totaled 142 animals and more than $21,000, but were incurred by only 29 (49%) of the respondents. Calves accounted for 66% of the animals lost and 69% of the estimated monetary loss.

Conducting frequent (at least monthly) inventories had little deterrent effect on dog depredation, since 73% of the owners who reported harassment or loss of livestock inventoried their herds frequently. Neither did the disposal of dead livestock by burial or incineration, rather than by decomposition in the pasture, discourage dog depredation. Of the respondents experiencing problems with dogs, 68% properly disposed of their dead livestock. The protection of cows during calving seemed to have essentially no effect on livestock losses attributable to dogs. Among the owners losing stock, 14 used protective measures for cows during calving and approximately the same number (12) did not.

Various Control Methods Used

Some form of dog control was practiced by 37 (84%) of the 44 owners experiencing dog harassment of livestock, and by 8 of 15 respondents who did not have problems with dogs. The method used by most (36) of the livestock owners was shooting, which was considered moderately effective by the majority of users. Poisoning, the next most widely utilized method, was also regarded as giving moderately effective control. Two owners attempted to divert dogs from their property with fencing, but judged its effectiveness to be poor.

The most effective methods of controlling dogs were telling the owner of the offending dogs (used by only one livestock owner) and trapping, used by two of the responding owners. Because of their concern for the security of their herds, 30 of the owners experiencing dog problems and 11 owners not experiencing problems indicated a desire for more conscientious enforcement of dog control laws, whether existing or subsequently enacted.

Outside of municipal boundaries, dog control is limited by the lack of resources in most counties, even though the Code of Alabama (Title 3, Section 13) permits counties to hire humane officers. Even in counties capable of employing humane officers, they are hindered in performing their duties by an area of jurisdiction too large for one person and by the lack of updated statewide animal control laws. Humane officers are presently supported only by Sections 1, 4, 5, and 13 of Title 3 of the Code of Alabama in providing assistance to those with dog complaints. These sections, respectively, hold the owner of a stock killing dog liable for twice the value of the livestock; levy a penalty of from $5 to $50 on owners of sheep killing dogs permitted to run at large; impose a fine of from $2 to $50 on owners who permit any of their dogs to run at large, if approved by the county commissioners of that county; and delegate to the county humane officer the same authority as that of a deputy sheriff. The humane officer also benefits from Title 22, which requires an annual rabies immunization and tag for all dogs, imposes a penalty of from $5 to $100 on an owner refusing to have his dog vaccinated, and provides for the disposition of untagged dogs.

Legislation Needed

Additional legislation could strengthen the position of animal control personnel and attack the dog overpopulation problem. It would be desirable to enact laws requiring differential license fees favorable to sterilized male and female dogs, penalties for the release of unwanted animals, and perhaps partial State support for county animal shelters and rendering services. However, until the public and governmental officials are made aware of the magnitude of existing animal problems, this type of legislation and its enforcement remain at a low priority level. To help effect legislative change and other improvements in rural dog control, livestock owners should utilize the services of their county humane officers, inform their county commissioners of existing problems and suggest possible solutions, and encourage local judges to enforce existing legislation.

If livestock owners have no choice but to conduct their own animal control programs, the most effective, selective, and humane control methods are (1) informing neighbors of their dogs' misdeeds, (2) trapping, and (3) shooting. Making dog owners aware of their dogs' unwanted presence on your property should be your first priority. If owners do not heed your warning, it may be possible to prosecute under one of the above mentioned sections of Title 3 of the Code of Alabama. Trapping can be productive if one uses a combination of live traps and No. 2, steel jaw or leghold traps, which have had the jaws padded with automobile heater hose. Careful selection of bait and location of traps is necessary to make the trap site attractive primarily to dogs. In addition, shooting can be a highly selective control method if a high powered rifle with scope is used.

Changes in Agricultural Lending in Selected Alabama Commercial Banks

ROBERT J. BRADDOCK and SIDNEY C. BELL
Department of Agricultural Economics and Rural Sociology

ALABAMA FARMERS have demanded more agricultural credit during the last decade. This means that lending agencies must play a larger role in order to meet the farmers' needs.

The need for more credit stems from increasing production costs, rising farm real estate values, and a greater demand for food and fiber in domestic and foreign markets. Added to this is inflationary pressure exerted by the entire economy. As these increase, so will the farmer's need for more capital, which is vital for production.

Most agricultural credit is currently supplied by commercial banks, Federal Land Bank Associations, Production Credit Associations, Farmers Home Administration, insurance companies, and merchant dealers. The first three supply the greatest proportion of credit.

Farm loans by Alabama commercial banks are very important to the farm borrower. However, most of Alabama's commercial banks put little emphasis on the agricultural loan area. The farm borrower's concern is whether the decline in commercial bank loans will continue.

In 1965 Alabama farmers borrowed $253.4 million from these three major agricultural credit agencies. In 1975 farmers borrowed $677 million from them, a 167% increase.

Commercial banks have been leaders in agricultural credit. In the past, Alabama farmers have depended heavily on them for operating and intermediate credit, and for farm real estate loans to a lesser degree.

In 1965 Alabama commercial banks lent $137.3 million to farmers. This had increased 138% by 1975, to $326.8 million. Yet these banks were not maintaining a constant proportion of the farm credit market. Whereas they supplied 54% of the agricultural loan volume in 1965, they supplied only 48% in 1974.

The Alabama banking industry has grown substantially in the last few years, especially in assets, deposits, and loans. A survey was taken in 1968 and again in 1975 of 12 commercial banks in commercial agricultural areas of the State. The object was to determine changes in financial measures and agricultural lending of these banks. The table below shows these changes for a 7-year period.

Average total assets increased from $40.3 to $86.6 million or about 115% during the period. Average total deposits of these banks increased from $35.5 to $72.8 million, a 105% increase. Total loan volume increased, too, from $21.6 million in 1968 to $46.3 million in 1974, a 114% increase.

Agricultural loans make up a vital part of each agriculturally oriented bank's portfolio. During the 7-year period, average agricultural loan volume increased 70%. Farm real estate loans increased 50%, while non real estate loans to farms increased 76%. This rise in credit resulted from higher farm real estate value, and the increased expense of production.

To see the extent of a commercial bank's involvement in agricultural credit, it is best to compare agricultural with total loan volume. This ratio shows how much of the total loan volume is composed of agricultural loans.

In 1968, the sampled banks averaged 23% of their total loan volume for farm loans. This dropped by 1975 to only 17%. In terms of total volume of loans for these 12 banks, agricultural loans made up 26% *less* of the total loan volume in 1975 than in 1968.

Bankers said the main reason for this decline was alternative investments. Increased competition from other lenders, lack of trained personnel to adequately handle agricultural loans, and state usury laws were cited as reasons for the decline in agricultural loans.

It appears that the decline will continue. Agricultural loans will be less important to agriculturally oriented banks in the future according to 1975 data from such banks. Bankers said they would put greatest emphasis on consumer installment loans in the future. Next in importance will be commercial industrial loans, agricultural loans, and residential mortgage loans, they said.

If Alabama's most agriculturally oriented banks are going to place less emphasis on agricultural loans, then the rest of Alabama's banks will probably put even less emphasis on such loans in the future.

CHANGES IN FINANCIAL MEASURES OF SELECTED ALABAMA COMMERCIAL BANKS, 1968-75

Item	Average value		Change from 1968-1975
	1968	1975	
	Mil. dol.	*Mil. dol.*	*Percent*
Total assets	40.3	86.6	115
Total deposits	35.5	72.8	105
Total loans	21.6	46.3	114
Total farm loans	2.3	3.9	70
Real estate	.6	.9	50
Non real estate	1.7	3.0	76

USING PATHOGENS to CONTROL LOOPERS

J. R. McVAY and R. T. GUDAUSKAS, *Department of Botany and Microbiology*
J. D. HARPER and C. A. KOUSKOLEKAS, *Department of Zoology-Entomology*

INSECTS are susceptible to many diseases caused by microorganisms such as fungi, bacteria, and viruses. The possibility of using such disease agents or pathogens to control insect pests has long been recognized, and research with this form of biological control has been conducted for several years by many institutions and agencies, including Auburn University Agricultural Experiment Station. Controversy over chemical insecticides and the stringent controls on their production and use have focused greater attention on pathogens as possible substitutes and as a means of reducing use of chemicals.

Two pathogens that have been studied extensively at Auburn and elsewhere are the nuclear polyhedrosis viruses (NPV) and the bacterium *Bacillus thuringiensis* (BT), both of which infect various caterpillars including cabbage loopers. Many of the biological, chemical, and physical properties of these pathogens have been determined in the laboratory, and their efficacy as control agents has been established by field tests. As an example of the latter, some data from experiments on the North Alabama Horticulture Substation are summarized in Table 1. Control of cabbage loopers and imported cabbage worms with BT was equal to that with the chemical insecticide. Although somewhat less effective, the NPV also reduced damage caused by loopers.

Results from this and similar studies prompted investigation into the possibility of combining BT and NPV to control loopers. Conceivably, such a combination could be advantageous when more than one type of caterpillar occurred on the same crop simultaneously. Also, the two pathogens possibly might interact in a synergistic manner, thereby giving a much higher level of control but with less pathogen than if each were used separately. However, the pathogens possibly might interfere with the action of each other making a combination less effective in control than either pathogen alone. Answers to these and related questions were sought in laboratory experiments using combinations of NPV and BT on cabbage looper larvae.

Laboratory-reared larvae were fed on a standard artificial diet-medium into which desired concentrations of the pathogens had been incorporated. The dosage levels of the pathogens were in the range expected to kill 10 to 40% of the larvae treated. Such dosage levels are lower than those used in most field and laboratory studies, but were chosen in hopes of finding pathogen interactions that might be masked or overridden at higher dosage levels.

Combinations of the two pathogens resulted in higher larval mortality than did either pathogen alone, Table 2. However, the increase was relatively small and did not indicate any synergistic interaction of the pathogens.

A second study was conducted to determine if treatment with a low dose of one pathogen followed later by a comparatively low dose of another would alter the level of mortality expected from either pathogen alone. Larvae were first fed for varying periods of time on diets containing a dose of NPV expected to kill ultimately about 10% of the larvae. The largae were then transferred to diet containing BT at a level previously shown to kill about 20% of the larvae. Control larvae were fed for the same periods on clean or non-virus-containing diets before transfer to diet containing BT.

Mortalities among larvae fed on NPV diet prior to feeding on BT diet were consistently higher than those among larvae fed for the same time on clean diet before feeding on BT diet, Table 3. Analysis of the data showed that all of the increases were within the range expected as additive effects and did not indicate any synergistic interaction between the pathogens.

Results of these experiments showed that NPV and BT in combination produced greater mortality of cabbage loopers than either pathogen alone. The level of increased mortality appeared to be due to the effect of one pathogen added to that of another, and was not sufficiently great to indicate synergism from the combination. However, there did not appear to be any interference between actions of the pathogens at the dosage levels tested. Possibly, some interference might occur with combinations at higher dosages. Based on the level of increased mortality seen in these tests, simultaneous application of NPV and BT would not seem practical for control of cabbage loopers. However, the results did indicate that control with BT might be enhanced if loopers were already infected with NPV. This is significant because natural infection by NPV invariably occurs in populations of cabbage looper in the field.

TABLE 1. CONTROL OF LOOPERS AND IMPORTED CABBAGEWORMS ON CABBAGE AND COLLARDS, CULLMAN, 1971-1975

Treatment	Rate/A.	Damage rating[1]
BT	0.5	2.7
BT	1.0	2.3
Chlordimeform	1.0	2.8
BT + chlordimeform	0.5 + 0.5	2.1
NPV	50 L.E.[2]	3.4
NPV	100 L.E.	5.0
Untreated	----	6.7

[1] 1-10 scale, where 1 = no damage, 5 = 5-10% leaf loss, 10 = total leaf loss (a rating of 5 is considered the limit of marketability).
[2] L.E. = larval equivalent, or amount of virus from no. of larvae indicated.

TABLE 2. MORTALITY OF CABBAGE LOOPERS FED ON DIET CONTAINING BT, NPV, OR BOTH

Treatment	Mortality[1]
	Pct.
Low BT	22
Low NPV	22
Low BT + low NPV	33
High BT	29
High NPV	39
High BT + high NPV	43

[1] Among 50 larvae; larvae were allowed to feed on the indicated diet until they died or pupated.

TABLE 3. MORTALITY OF CABBAGE LOOPERS FED ON DIET CONTAINING BT FOLLOWING PRIOR FEEDING ON DIET CONTAINING NPV

Prior treatment[1]	Mortality[2]
	Pct.
Clean diet for 24 hr.	44
NPV diet for 24 hr.	49
Clean diet for 48 hr.	27
NPV diet for 48 hr.	37
Clean diet for 72 hr.	26
NPV diet for 72 hr.	35
Clean diet for 96 hr.	15
NPV diet for 96 hr.	27

[1] Larvae were fed on clean diet or on diet containing NPV for the time indicated then transferred to diet containing BT and allowed to feed until they died or pupated.
[2] Among 150-200 larvae.

Stand Conversion From Low Quality Pine In North Alabama Using Bromacil and Direct Seeding

GLENN GLOVER and DEAN GJERSTAD, *Forestry Department*

Dry ridge-top sites stocked with low-grade hardwoods constitute a significant portion of the forested area in northern Alabama. When fully stocked with hardwoods these sites produce no more than 100 board feet per acre per year but are capable of producing 300 to 500 board feet per acre per year if fully stocked with pine. However, most forest ownerships in north Alabama are less than 50 acres, making conversion to pine by heavy mechanical or tree-injection methods uneconomical.

Test Method

A less expensive method of simultaneously applying a pelleted herbicide and pine seed using light equipment was tested by Tennessee Valley Authority and Auburn University Agricultural Experiment Station researchers using the pelleted herbicide bromacil (as Hyvar XP-10% active ingredient). Bromacil was applied at 0, 1.0, 1.5, and 2.0 lb./A. of active ingredient (a.i.) on a 4 ft. × 4 ft. grid.

Herbicide application and seeding were carried out as one operation using a 12 h.p. tractor with a scalper on the front and an H-C furrow seeder on the rear. An agricultural chemical applicator was mounted on the rear and modified to drop the required amount of herbicide in spots 2 feet either side of the seeded furrow. Stratified loblolly pine seed coated with bird repellent were distributed at the rate of 0.7 lb./A. with furrows spaced 8 ft. apart.

Test Sites

Two areas in Colbert County, one a loam soil (Area I), the other a sandy clay loam (Area II), were chosen for the study. Oaks dominated the overstory of both areas with small hickories abundant in Area I, but nearly absent in Area II. The majority of overstory trees were 4 to 12 in. diameter breast high. None of the overstory was removed before treatment.

Stocking and Size of Loblolly Pine Seedlings Four Years After Direct Seeding and Application of Bromacil

Bromacil treatment	Average number of seedlings/acre		Average seedling height	
	Area I	Area II	Area I	Area II
Lb./A. a.i.	*No.*	*No.*	*In.*	*In.*
0	590	1,588	9.3	15.4
1.0	1,497	2,360	27.6	17.6
1.5	953	817	33.0	16.7
2.0	454	1,316	20.6	34.2

Test Results

Four years after seeding, treatments appeared to be effective in Area I but not in Area II. The table shows number of pine stems per acre and average height of the three tallest trees on each of six rows per plot.

An acceptable minimum stocking of 400-500 trees per acre was accomplished with all treatments. Except for the 2.0 lb. rate, treatment did not affect tree height in Area II. In Area I though, all herbicide treatments resulted in a substantial increase in tree height. The difference in response between Areas I and II may be due to higher organic matter and clay content of Area II's soil, which bind and inactivate the herbicide.

Test results indicate promise for the use of pelleted herbicides for stand conversion, but further work is needed. Modified methods such as removal of merchantable overstory to reduce competition and offset costs of herbicide and seeding operations should be considered.

AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY
AUBURN, ALABAMA 36830

R. Dennis Rouse, Director

PUBLICATION—Highlights of Agricultural Research 9/76 10M
Penalty for Private Use, $300

POSTAGE PAID
U.S. DEPARTMENT OF AGRICULTURE

AGR 101
BULK RATE

U.S.MAIL

STATE AGRICULTURAL EXPERIMENT STATIONS
Serving 1875 Mankind 1975