highlights

of agricultural research

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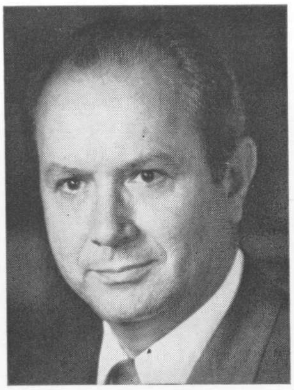
Agricultural Experiment Station
R. Dennis Rouse, Director

Auburn University
Auburn, Alabama

DIRECTOR'S COMMENTS

ON NOVEMBER 13, some 3,000 citizens of this State joined in partnership to recognize the importance of agriculture – the occasion being the 1975 Agricultural Appreciation Day. This not only served as an introduction to the traditional Farm-City program throughout the State, but this year it included a celebration of the 100th year of service by the Agricultural Experiment Stations of this Nation. The Farm-City theme for 1975 – A Declaration of Interdependence – is most descriptive of agriculture's role in the State and Nation and even the world. The day's program on November 13 provided an opportunity for those in attendance to gain a greater appreciation of the importance of this partnership in our lives that is unique to the United States of America. We also detected some spirit of the upcoming bicentennial of this Nation. It is certainly fitting that these three blend together, Farm-City program, the Centennial of publicly supported agricultural research, and the 200th Anniversary of the U.S. Constitution. This Nation's strength has been in agriculture, and both Congressman Bill Nichols and Governor George Wallace reminded us that even today **our power is in the productivity of our agriculture.** Although most people in the United States think of us as an industrial Nation, over 60% of the total assets of all U.S. corporations and farms in this Nation is in agribusiness. Alabama is not greatly different in this regard from the Nation.



R. DENNIS ROUSE

There were many highlights of the day: Tours and exhibits of agricultural research depicting a partnership between farmers and extension, agribusiness, and research; the delicious barbecue luncheon of Alabama poultry, beef, pork, and catfish; the many students who assisted. Also, entertainment by the Auburn University Singers, Auburn Knights, and the Auburn Band; words of encouragement and challenges by Auburn University President Harry M. Philpott, this author, CSRS Administrator Roy Lovvorn, Commissioner of Agriculture McMillan Lane, Farm Bureau President Jimmie Hays, and Governor Wallace. The movie that was premiered for Alabama, "Unfinished Miracles," should be seen, and I hope it will be, by every Alabamian; the 1975 Yearbook of Agriculture entitled "That We May Eat" tells the story of agricultural research in the state stations and I hope will be read by every person in Alabama. A copy of this book was handed to everyone leaving the arena, together with a southern grown apple and a bag of Alabama peanuts. I am confident everyone thought about and discussed Alabama agriculture on their way home.

My only regret is that every Alabamian was not privileged to participate in the Day. On behalf of agriculture, I wish to express publicly our most sincere thanks to all who made the day possible by their financial sponsorship or by their labor of love and dedication. And to those the producers of food and fiber and to their public servant partners in research and education who re-dedicated their lives not to memories of past accomplishments, but to future opportunities so that "those multitudes of the future may eat," we all express our appreciation.

Incentive is the driving force! Our free enterprise system allows incentive to be transformed to accomplishment. Scientists produce technology and farmers produce food, but in between, education and agribusiness are vital. All four components must have an incentive.

may we introduce . . .

Dr. Clarence E. Scarsbrook, professor in the Department of Agronomy and Soils, who is author of the article on page 3. In this story, Dr. Scarsbrook reports results of his investigations of leaching of applied nitrogen from farm soils, considering both efficiency of N use and possible ground water pollution from the fertilizer material. This is just one facet of his current research interests that center around how fertilizer and organic wastes applied to soils affect crop yields and environmental quality.

A native of Orrville, Scarsbrook did his undergraduate study at Auburn University and received his doctorate from North Carolina State University. He joined the Auburn School of Agriculture and Agricultural Experiment Station faculty in 1953 following service on the Louisiana State University faculty.

He holds membership in numerous professional and honor societies and has received national recognition for his teaching and research. He served as international president of Gamma Sigma Delta in 1968-70. A veteran of World War II, Dr. Scarsbrook retired from the U.S. Army Reserve in 1968 with the rank of lieutenant colonel.

HIGHLIGHTS of Agricultural Research

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ON THE COVER. Auburn University President Harry M. Philpott, left, and R. Dennis Rouse, right, present Agricultural Experiment Station Centennial Medallion to Governor George C. Wallace.

Leaching of N — Problem of Cropping Efficiency, Not of Pollution

C. E. SCARSBROOK, *Department of Argonomy and Soils*

LEACHING OF APPLIED NITROGEN is a problem that concerns both farmers and non-farmers. Farmers are concerned about N getting below the root zone so the high priced fertilizer material can't be used by crops. The non-farm worry is that nitrate may move into drinking water supplies.

Since efficient use of N is essential for top farm profits, the problem of N leaching is receiving emphasis in Auburn University Agricultural Experiment Station research. Experiments on coarse textured soils at the Foundation Seed Stocks Farm, Thorsby, and the Main Station, Auburn, are measuring the effects of plant population, rate of applied N, and water on nitrate movement through soil.

Rates of 150 and 300 lb. N per acre were applied to both cropped and bare soil. Corn was grown at drill spacings of 5 and 15 in. in 40-in. rows. The vertical distribution of nitrates in soil was measured several times during the year to a depth of 8 ft. Corn plants were analyzed for N uptake.

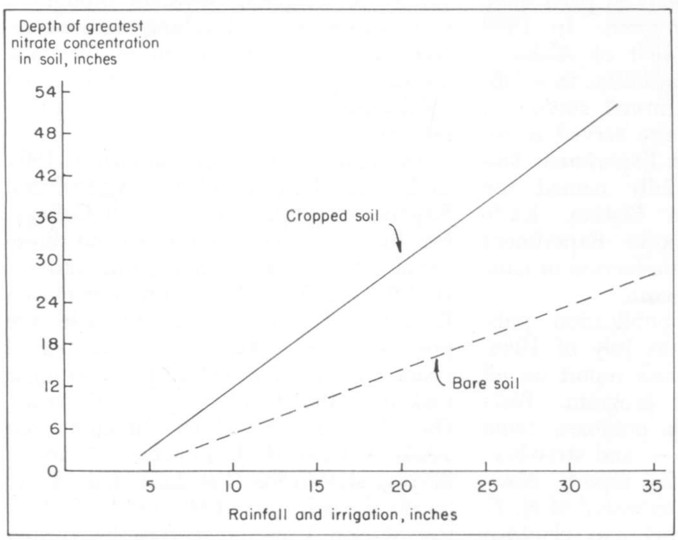
Preliminary results show that little or no N from the 150-lb. rate remained in the soil profile at harvest time. Corn took up most of the N from this rate – 95% in the thickly spaced corn and 80% in the widely spaced plantings. About 70% of the total uptake of N was in the grain.

Contrasting results were recorded with the 300-lb. N rate. A large portion of N was found in the soil after corn was harvested. Only 50-65% of applied N was recovered by the crop when 300 lb. was applied.

Uncropped soil retained large proportions of applied N from both application rates.

Water is the main transporter of nitrates in the soil, and depth of leaching is in proportion to amount of water from rainfall or irrigation, or both. The relationship between water received and depth of the main concentration of nitrates is shown by the graph.

Movement of nitrates is extremely variable, being affected not only by quantity of water but by such factors as rainfall intensity, soil slope, evaporation, gaseous losses, and moisture



Depth of nitrate concentration in soil was in direct relation to amount of water received.

Nitrate moved downward faster under corn than on uncropped soil.

conditions in soil when water is received. For example, at one sampling 32 in. of rainfall had not moved the main nitrate concentration below 6 in. in bare soil.

Downward movement of nitrate in soil was greater under corn than on bare ground, at each sampling. The greater penetration of nitrate under corn was probably affected by greater runoff from bare soil. The corn canopy reduced impact of raindrops, thus resulting in the soil surface being more conducive to water intake than on bare soil where rainfall impact tended to seal the surface. This factor, along with water being retained in corn rows, probably resulted in considerably less runoff in corn than on bare soil.

It is surprising that nitrate did not move downward more rapidly in the loamy sand or sandy loam test soils. One important reason is that texture of these soils varies with depth, causing soil pore spaces to vary in size at different depths. When water moving downward reaches a soil zone where pores become either smaller or larger, the flow of water is reduced. Thus, either a coarse, loose, open layer or a compacted, fine layer tends to reduce the rate of downward water flow within the profile. Once the plow layer is saturated with water, the downward movement of water and dissolved nitrate is greatly reduced.

To date there have been no definite conclusions coming from research on nitrate movement and loss. Tentative conclusions are as follows:

1. With an application rate of 150 lb. N per acre, little N is left in the soil profile after corn harvest. More nitrate is found in non-cropped bare soil that got no N than where 150 lb. N was applied and corn was grown.
2. Nitrates move downward more rapidly under corn than in bare soil.
3. With 300 lb. of N applied, there are large amounts of nitrate left in the soil at the end of the growing season. This is true whether corn is grown or the soil is left bare.
4. Much more N is removed from soil by corn spaced 5 in. in the drill than when 15-in. spacing is used (both in 40-in. rows).
5. With rates of N recommended for corn in Alabama, there is little or no danger of applied N affecting the nitrate content of streams and ground water.

FIG. Shown left is James Stanley Newman, the first director of the Auburn University Agricultural Experiment Station and on the right is Dr. R. Dennis Rouse, present director of the Auburn Station.

STANDARD OF EXCELLENCE SET BY EARLY STATION DIRECTORS

ROY ROBERSON, *Department of Research Information*

In 1883, JAMES STANLEY NEWMAN, an innovative Virginia scholar, agriculturalist, and Civil War hero, came to Auburn University (then Alabama Agricultural and Mechanical College) as the first Director of the newly established Agricultural Experiment Station. Newman's logic, as printed in 1883, for the founding of a State agricultural experiment station system still holds true today. He said, "Farmers generally cannot afford either the time or money to conduct experiments with such accuracy and persistency necessary to render valuable results, hence, the need for a State system of research."

Newman was an author, teacher, and agriculturalist in his native Orange County, Virginia before the Civil War broke out. He grew up on a diversified farm, though his later farming endeavors in Georgia were concerned with fruit growing. Newman was interested in all types of agriculture, whether it was constructing ponds for food fish or growing new varieties of grass for farm animal grazing. He was always alert for any enterprise that would combine with the traditional cotton culture of the South. He personally conducted experiments on many varieties of apples, grapes, cherries, pears, peaches, figs, and raspberries to determine their comparative productiveness and adaptation to Alabama soils.

Newman assumed a position of leadership in Alabama agriculture after coming to Auburn. He served as president of the Alabama State Agricultural Society, which was reorganized in 1884. The first society had flourished before the Civil War. Newman was president of the Alabama State Alliance when he left Auburn in 1891 to become Director of the Experiment Station at Clemson.

In 1889, Newman started a series of cooperative fertilizer tests with some of the leading farmers in Alabama. Early cooperative experiments were conducted on farms in DeKalb and Wilcox counties. Later new varieties of seed were tested in different soil regions of the State, with the Experiment Station furnishing seeds and the farmers keeping records of the results. The present system of research, which is conducted at 10 outlying substations and 11 experimental fields located in different soil regions throughout the State, is an outgrowth of Newman's early experiments.

Results of experiments made on the Experiment Station farm at Auburn, which consisted of 226 acres of washed, red land that had been abandoned from profitable cultivation years before the Experiment Station began there in 1883, were of such value to farmers in the Auburn area that farmers in other soil-type regions were anxious to participate in an experimental program. In 1886 farmers in the Black Belt of Alabama persuaded the State legislature to establish a branch experiment station at Uniontown. Newman also served as director of the Black Belt Experiment Station, which was officially named the Canebrake Experiment Station. Early research at the Canebrake Experiment Station dealt with the production of oats, red clover, cotton, and corn.

The first research publication published at Auburn was in July of 1888, and it included Newman's report on all aspects of the research program. Tests on English peas, Irish potatoes, table corn, raspberries, cherries, and strawberries were discussed in his report. Newman's staff at that time consisted of N. T. Lupton, vice-president and chemist; P. H. Mell, botanist; and five assistants.

In addition to his research work, Newman was a professor of Agriculture. An outstanding scholar himself at the University of Virginia, Newman brought a new approach to teaching agriculture. Agricultural instruction under Newman became an applied science, as he used results from laboratory and field experiments in the classroom.

Director Newman left Auburn in 1891 to become Director of the Agricultural Experiment Station at Clemson College. For the next 7 years there was no director of the Experiment Station at Auburn. In 1898, P. H. Mell was promoted from Botanist to Director, and he held the position until 1902. After another 2 years without a director, J. F. Duggar took over the directorship for 17 years. Dan T. Gray served as Director from 1921-23, then M. J. Funchess started a 26-year stay in the Director's chair. E. V. Smith served from 1949 until 1972 as the Station Director, before he turned over the reins to R. Dennis Rouse, the present director.

ARE YOUR HOUSEPLANTS "BUGGED"?

MIKE WILLIAMS, *Department of Zoology-Entomology*

Scale insects, which suck cell juices from the foliage, twigs, and roots of houseplants, are usually small and inconspicuous. Nevertheless they are among the most troublesome pests of plants in the home. Plants may become infested and severely injured before the pest is known to be present. Because the foliage is not torn or eaten, the injury may not be detected until discoloration, wilting, or stunting occurs.

A sugar-like solution called "honeydew" is produced by many scale insects. Honeydew deposits support growth of sooty mold which ruins the appearance of the plant and covers the leaves with a black, soot-like fungus (Fig. 1) that inhibits the plant's food manufacturing functions, resulting in a weakened plant.

Researchers at Auburn University Agricultural Experiment Station have identified 155 species of scale insects presently known to occur in Alabama. While most of these are primarily found outdoors, many attack plants which are commonly grown in the home or greenhouse as ornamentals.

FIG. 1. Sooty mold growing on honeydew produced by cottony cushion scale on citrus.

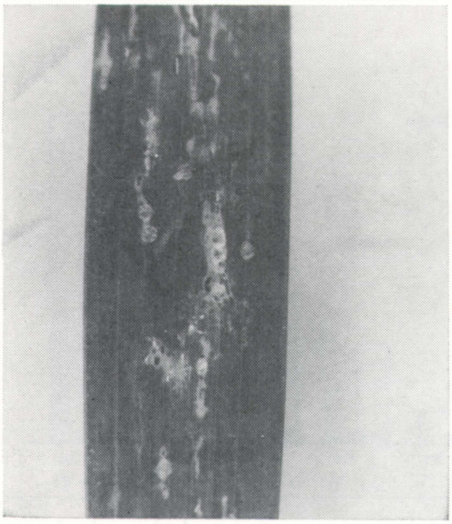


FIG. 2. Palm scale on ornamental palm frond.

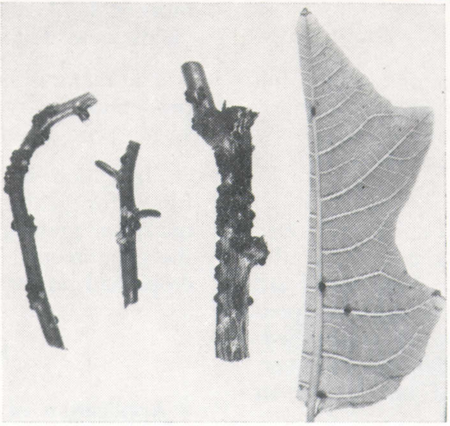


FIG. 3. Hemispherical scale on stems and leaf of poinsettia.

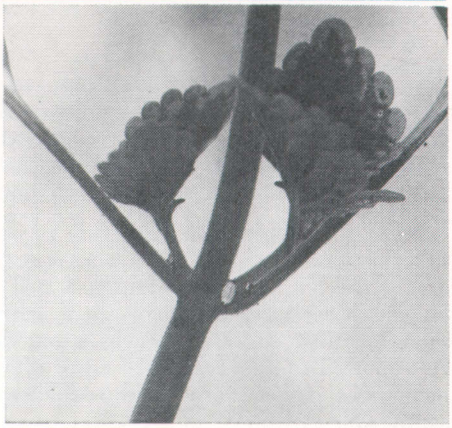


FIG. 4. Citrus mealybug feeding on coleus.

Most home and greenhouse plants are susceptible to infestation by scale insects. The home environment provides conditions which encourage large pest populations, therefore homeowners should carefully inspect plants to be sure that they are free of pests before bringing them into the home.

Scale insects may occur on any part of the plant including underground roots. Examine all parts of each plant, particularly the underside of leaves and opening buds. Many root infesting forms can be found feeding on rootlets between the root ball and the container in which the plant is growing.

Scale insects commonly found in the home can be divided into three groups: armored scales, soft scales, and mealybugs.

Adult armored scale females are about ⅛ in. long and are covered with a circular or oystershell-shaped, waxy cover (Fig. 2). They are not as common in the home as soft scales or mealybugs. The eggs of armored scales are protected by the scale cover.

Soft scale insect species most commonly found in Alabama homes are the hemispherical scale and the brown soft scale. Adult females of both species are about ¼ in. long. Hemispherical scale (Fig. 3) is highly convex and dark brown at maturity while the brown soft scale remains relatively flat and possesses an irregular black stripe down the back. Eggs or young of soft scales are protected by the body of the female until emergence.

Mealybugs (Fig. 4) grow to about 3/16 in. long and appear dusted with a powdery white wax. Mealybugs generally feed on leaves, where they usually hide along veins on the undersurface. One female may lay 600 eggs, which are usually protected by a cottony or waxy ovisac produced by the female. Some feed on roots of plants such as African violets. The citrus mealybug is the most common species found indoors in Alabama.

Quite often scale insects may be manually removed from the plant using a small pin or forceps. When large numbers occur, chemical control may be necessary to save the plant.

Very few pesticides are labeled for use in the home. Good control has been achieved by using aerosol preparations of pyrethrins, rotenone or SPB-1382. These compounds will be listed under ACTIVE INGREDIENTS on the pesticide label. Follow all directions and precautions. Spray every 10 days for three treatments or until scale are no longer present.

Irrigation, Nematicide Boost Fall Rye Production

C. S. HOVELAND, *Dept. of Agronomy and Soils*
R. RODRIGUEZ-KABANA, *Dept. of Botany and Microbiology*
J. G. STARLING and R. M. MIMS, *Wiregrass Substation*

MOISTURE SHORTAGES AND NEMATODES combine to limit fall production of winter annual forages in Alabama's Wiregrass. Although both problems usually are naturally overcome by December or January, the early season loss is enough to create interest in irrigation and nematicide application.

Need for supplemental moisture is well established, since fall months are usually dry in the Wiregrass and soils of the area have limited water storage capacity. Nematodes are known to seriously reduce yield of such row crops as peanuts, but their effect on forages is not definitely established. As reported in the Fall 1974 issue of *Highlights*, however, nematodes cause sharp yield reductions of tall fescue on sandy soil.

Research Shows Potential

Potential increases in production from irrigation and nematicide application are indicated by results of a 1972-74 Auburn University Agricultural Experiment Station project at the Wiregrass Substation, Headland. Autumn irrigation of 2.5 to 5.5 acre inches of water increased October-November rye forage yields 174% on the Dothan sandy loam test soil. Application of Furadan nematicide boosted autumn forage production 29%.

Wren's Abruzzi rye-Gulf ryegrass-Yuchi arrowleaf clover was the pasture mixture grown for the experiment. Planting was done September 20 each year on summer fallowed land. Some of the plots were treated with the nematicide Furadan 10G (carbofuran), 4 lb. per acre, before planting. Nitrogen applications of 50 lb. per acre were made at planting, in November, and again in late January.

Irrigation water was applied by sprinkler irrigation according to a water budget. Up to a total of 1 in. of water was applied in the plow layer. It was assumed that soil water storage was 1 in. and loss from soil and rye was 0.1 in. per day. Therefore, water was applied every 10 days unless rain fell. Forage was harvested by clipping every 3 to 6 weeks from autumn until spring.

Irrigation Effective

Rainfall was inadequate for satisfactory autumn forage growth in all 3 years. Moisture deficit was especially severe in 1973 when only 0.9 in. of rain fell in late September, 0.1 in. in October, and 1.6 in. during November 1-22.

Total irrigation water applied varied from 2.5 in. in 1972 to 5.5 in. in 1973, see table. October-November dry forage production averaged 1,260 lb. with irrigation, but only 460 lb. on unirrigated land. Irrigation increased forage yield the most in 1973, about 4½ times, and the least in 1974, when yields were doubled.

EFFECT OF IRRIGATION AND NEMATICIDE ON OCTOBER-NOVEMBER RYE FORAGE PRODUCTION, WIREGRASS SUBSTATION

Treatment	Dry forage yield per acre			
	1972-73	1973-74	1974-75	Average
	Lb.	*Lb.*	*Lb.*	*Lb.*
Not irrigated	580	250	540	460
Irrigated	1,470	1,380	940	1,260
Irrigation + nematicide	1,690	1,930	1,280	1,630
Water applied, inches	*2.5*	*5.5*	*4.5*	
Number of irrigations	*3*	*6*	*4*	

The major effect of autumn irrigation was to increase fall production of rye. However, it also improved stands and spring production of Yuchi arrowleaf clover, see graph.

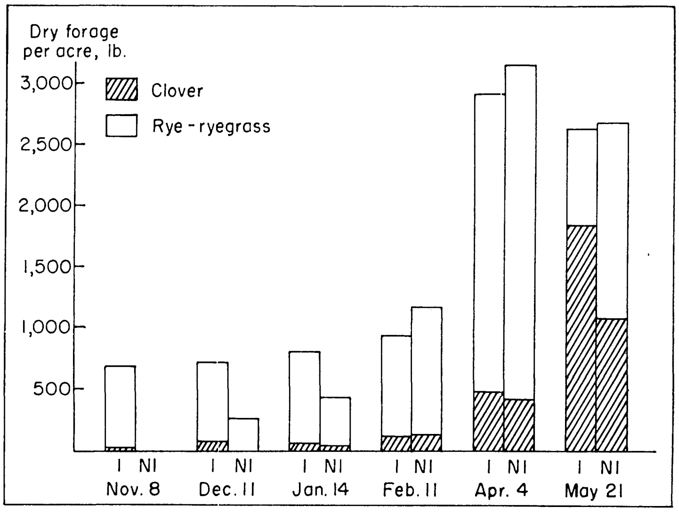
Irrigation improved the dependability of high quality forage for grazing in early autumn. Irrigated land had forage ready for grazing by mid- to late October in all 3 years of the experiment. Without irrigation, the 1972 and 1973 rye crops had no forage available for grazing before December.

Nematicide Use Less Certain

Application of Furadan nematicide at planting substantially increased autumn forage yields of irrigated rye, see table. The highest response was a 40% yield increase in fall 1973. The nematicide did not affect forage yield in winter and spring.

Nematode populations were relatively low in untreated soils of the experiment. Soil populations of meadow and stubby root nematodes were reduced, however.

Although advisability of using nematicides with winter grazing crops was not definitely established, results of the Wiregrass study suggest profitable use of irrigation where equipment is already available. Improved dependability of autumn rye forage production as shown in the test indicates potential for early fall grazing by timely irrigation.



Seasonal distribution of forage and amount of clover in forage of rye-ryegrass-Yuchi arrowleaf clover mixture under irrigation and non-irrigation, winter 1973-74.

Choosing Protein Supplement for Steer Finishing Rations

R. R. HARRIS and W. B. ANTHONY, *Department of Animal and Dairy Sciences*

J. E. BARRETT and N. R. McDANIEL, *Gulf Coast Substation*

LEAVING PROTEIN supplement out of beef finishing rations appears to be false economy. While per ton feed costs are lowered, steers gain slower and there is no reduction in cost per cwt. gain when non-supplemented feeds are used.

That was the general finding of a 3-year fattening test at the Gulf Coast Substation, Fairhope. Steers that had grazed rye-ryegrass-Yuchi arrowleaf clover for 167 days (Nov. 23-May 9) were divided into four groups for finishing on test rations containing different supplements or no supplement. Supplements compared were soybean meal (the most common one used in the area), a liquid protein supplement, and a corn-urea mix. The non-supplemented ration had the same feed ingredients, except no protein supplement was included, as shown in the table.

The liquid and corn-urea products are considered non-protein nitrogen (NPN) sources of protein. All mixtures were fortified with sulfur and potassium since it was thought that such addition would improve efficiency of utilization of rations containing the NPN materials.

Soybean meal was used at 10% of the mixture in Ration 1, which represented the standard finishing feed. The liquid concentrate (Rico-95), used at 4% of Ration 2, is a cane molasses base product with 95% protein equivalent that is sold as a nutrient balancer for feedlot rations. Ration 3 had 7% Golden Pro-60, which is a mixture of ground yellow corn and urea having 60% protein equivalent. This corn-urea mixture was heated and extruded through a special die during manufacturing. Ration 4 got no supplement.

STEER FINISHING RESULTS ON RATIONS WITH DIFFERENT PROTEIN SUPPLEMENTS, GULF COAST SUBSTATION, 1972-74

Item	3-year average result, by ration			
	Ration 1, soybean-meal	Ration 2, liquid supp.[1]	Ration 3, corn-urea[2]	Ration 4, no supp.
Ration components, pct.				
Ground shelled corn	72.5	78.5	75.5	82.5
Ground grass hay	15.0	15.0	15.0	15.0
Protein supplement	10.0	4.0	7.0	----
Salt	1.0	1.0	1.0	1.0
Dicalcium phosphate	1.0	1.0	1.0	1.0
Vitamin A	+	+	+	+
Dynamate[3]	0.5	0.5	0.5	0.5
Crude protein (actual)	13.1	12.1	13.2	8.8
TDN (calculated)	73.5	71.0	72.5	73.5
Ration cost/ton, $	95.80	84.07	87.40	83.67
Steer performance				
No. steers	30	30	30	30
Initial weight, lb.	781	778	778	777
Final weight, lb.	1,038	1,016	997	965
Gain, lb.	257	238	219	188
ADG, lb.	2.56	2.37	2.16	1.86
Total feed/steer, lb.	2,059	2,132	1,954	1,775
Daily feed/steer, lb.	20.4	21.1	19.4	17.6
Feed/cwt. gain, lb.	801	896	892	944
Feed cost/steer, $	98.63	89.54	85.39	74.20
Feed cost/cwt. gain, $	38.38	37.62	38.99	39.47
Carcass data				
Average grade[4]	11.3	10.8	10.7	10.4
Dressing pct.[5]	58.21	59.05	58.57	58.19
Marbling[6]	4.7	4.2	4.4	4.2
Yield grade[7]	3.1	3.0	2.8	2.9
Adj. backfat, in.	0.50	0.45	0.41	0.40
Ribeye area, sq. in.	10.92	10.74	11.02	10.27

[1] Manufactured by Pro Rico Industries, Inc., Mobile; marketed through Rico Liquids, Inc., Aliceville.
[2] Licensed by Triple "F," Inc., Des Moines, Iowa.
[3] Source of sulfur (K_2SO_4, $MgSO_4$) manufactured by International Chemical Corp., Libertyville, Illinois.
[4] 10 = average Good; 11 = high Good; 12 = low Choice.
[5] Warm carcass weight expressed as percent of final (unshrunk) feedlot weight.
[6] 4 = traces; 5 = small.
[7] Scores range from 1 to 5, with lowest being most desirable.

Protein contents of the supplemented rations were similar, but the non-supplemented mixture was considerably lower in crude protein, see table. All feeds were full-fed during test periods that averaged 101 days. Each steer received an ear implant of three 12-mg pellets of resorcylic acid lactone (RALGRO). Finished steers were sold for slaughter and carcass data given in the table were collected.

Rate of gain varied among groups, ranging from 2.56 lb. per day for steers consuming the ration containing soybean meal to 1.86 lb. for those fed non-supplemented feed. Those on mixtures containing the NPN sources of protein had intermediate rates of gain.

Results of the Auburn tests indicate that supplemental protein must be included in cattle finishing rations for gains to exceed 2 lb. per day. Further, level of protein was found to definitely affect feed intake. Steers on supplemented rations ate amounts equal to 2.2-2.3% of their body weight daily, whereas those on non-supplemented feed consumed only 2.0% of their weight. And feed conversion was directly related to rate of gain, as shown by data in the table.

Feed cost per lb. of gain averaged 38¢ to 40¢ during the 3-year test. Sale value of cattle averaged slightly above 46¢ per lb., liveweight basis.

Carcasses were Good (75%) or Choice (25%), with no significant differences among carcasses from steers finished on the different rations.

Two major findings summarize the feeding study:

(1) Protein supplement is necessary for feedlot rations to support good rate of gain.

(2) Non-protein nitrogen materials used as protein supplements supported efficient gains. The choice of a protein supplement is basically an economic decision.

Good land use ensures more efficient production.

LAND USE in ALABAMA

J. H. YEAGER, *Dept. of Ag. Econ. and Rural Sociology*

LAND, LABOR, CAPITAL, AND MANAGEMENT are the resources used in agricultural production. Land is a particularly important resource and in terms of physical land area and quality, there is a limited amount. It must be used wisely to meet present and future needs.

Alabama's population has grown from less than 1 million in 1870 to 3.4 million in 1970. With a fixed surface area for the State and growth in population, the land area per person has declined, see table.

Since 1950, there has been a substantial decline in land in farms. A part of the decline is accounted for by changes in definition of a farm used by the Bureau of the Census in the Census of Agriculture.

Harvested cropland provides the basis for a major part of our agricultural production. This classification of agricultural land has also declined as population growth occurred, going from 4 cropland harvested acres per person in 1900 to only 1 acre per person in 1970.

Such trends point up the significance of the increased efficiency in production that has taken place in American agriculture. However, in view of such trends, one is faced with the question: Will future increases in production efficiency be of a magnitude sufficient to permit further increases in population with a declining or even a fairly constant agricultural land base?

Alabama's surface area is 33,029,760 acres. Included in this area are inland bodies of water of 40 acres or more that amounted to about 577,000 acres in 1970. Thus the net land area of the State was approximately 32,453,000 acres.

Two broad categories of the net land area are agricultural and non-agricultural land. Agricultural land, which accounted for about 29,701,000 acres or 91.5% of the State's land area, included (1) cropland not pastured, (2) open pasture and other open land, and (3) farm forest and woodland. In 1970, the acreage devoted to each of these broad uses and proportion of total agricultural land were as follows:

	Thous. acres	*Pct.*
Cropland not pastured	3,690	12.4
Open pasture and other open land	4,645	15.6
Farm forest and woodland	21,366	72.0
Total	29,701	100.0

Forest and woodland account for almost 2 out of every 3 acres of land in the State.

Agricultural land as indicated includes much more than land in farms. A major part of the difference in total agricultural land and land in farms is accounted for in non-farm forest and woodland.

There is considerable variation in land use among Alabama counties. Types of soils and their productivity, topography, population pressures, degree of industrialization, and many other factors affect land use.

Although Baldwin is the largest Alabama county, the 1969 Census of Agriculture indicated that Dallas County had the most total land in farms while Madison had the greatest acreage of cropland. Total cropland as a percentage of total land in farms was 68% in Limestone, the highest of all counties, and lowest at 18% is Washington County.

In Clarke and Washington counties, slightly more than 65% of the farmland was in woods, according to the 1969 Census of Agriculture. County with the smallest portion of farmland in woods was Limestone with only 19%.

Only 2,752,000 acres, or 8.5% of the land area of the State, is classified as non-agricultural land. This category of land use includes urban and built-up areas, highways, railroads, airports, rural parks, wildlife areas, national defense sites, industrial areas, State-owned institutional land, small bodies of water, waste land, and land in miscellaneous uses. With further growth and development in the State, many of these uses of land will increase. Some types of developments will call for greatly increased demands for land. For example, nuclear plants can take about 5,000 acres for cooling lakes instead of about 40 acres required for ordinary power plants. Instead of a single subdivision, a new town may take land requiring up to 20,000 acres.

USDA estimates indicate that 2.7% of the total land mass in the United States is used for urban and industrial uses. By the year 2,000, it is estimated that 4% will be used for such purposes. Conversion of land from agricultural to non-agricultural uses is occurring daily. Competing demands for land are increasingly a matter of public concern.

POPULATION AND LAND, ALABAMA 1860-1970

Year	Total population[1]	Surface area[2] per person	Land in farms[3]		Cropland harvested[3]	
			Total	Per person	Total	Per person
	Thous.	*Acres*	*Mil. acres*	*Acres*	*Mil. acres*	*Acres*
1860	964	34	19.1	20		
1870	997	33	15.0	15		
1880	1,263	26	18.9	15		
1890	1,513	22	19.8	13		
1900	1,829	18	20.7	11	6.8	4
1910	2,138	15	20.7	10	7.0	3
1920	2,348	14	19.6	8	7.3	3
1930	2,646	12	17.6	7	7.1	3
1940	2,833	12	19.1	7	7.1	3
1950	3,062	11	20.9	7	5.7	2
1960	3,274	10	16.5	5	3.7	1
1970	3,440	10	13.7	4	2.7	1

[1] Census of population.
[2] Surface area of 33,029,760 acres for Alabama for the years indicated.
[3] Census of Agriculture. Some of change in acreages due to change in definition of a farm.

INTERMITTENT LIGHT

Speeds Broiler Growth and Improves Efficiency

G. R. McDANIEL and R. N. BREWER, *Department of Poultry Science*

MANAGING LIGHT is just as important for broiler production as for laying hens. However, the lighting program for broilers is quite different from that used for layers.

The purpose of controlled lighting with layers is to control the onset of egg production. In addition, light intensity and schedules are used to maintain a high rate of egg production over an extended period. Broiler producers, on the other hand, have historically used light to keep birds consuming feed on a 24-hour basis for maximum growth rate.

Open-sided broiler houses used in the Southeast make controlled lighting impossible during daylight hours. Such houses are being replaced, however, as increasing labor, energy, and feed costs are causing many growers to build environmentally controlled broiler houses. Usually these buildings are totally enclosed, allowing use of various controlled light programs.

Light Affects Growth

Effect of light on broiler growth rate was established in early research at Auburn University Agricultural Experiment Station. Broilers raised in the presence of continuous, low intensity light (approximately ½ ft. candle) grew at a faster rate than those raised on 12 hours of light and 12 hours of darkness daily. Most commercial broiler producers now use this system and prepare feed formulations for 24-hour feeding.

Low intensity of light tends to make broilers less active and offers some protection against pecking and scratching. Furthermore, low intensity lighting permits growing more birds per unit of house area.

Controlled Lighting Tried

The continuing search for better growth rate and feed conversion led to trying a more completely controlled lighting program. Such programs permitted using short feeding periods followed by dark as rest periods, which preliminary studies indicated to be most promising.

Studies involving approximately 100 broilers per unit were conducted in controlled environment chambers at the poultry research farm at Auburn. All management factors – temperature, air exchange, humidity, bird density, and feed – were kept constant. All birds were started on 24 hours light and kept on that schedule until 3 days of age. At that time they were placed on one of these light treatments:

(1) Continuous light at ½ ft. candle.

(2) Intermittent light – 15 minutes of light at 3 ft. candles followed by 45 minutes of darkness.

Intermittent Light Best

By 4 weeks of age the birds on intermittent light were heavier than those on continuous light. This improvement continued throughout the 8-week trial, Table 1. Feed conversion ratio also was better on intermittent light. Both males and females responded favorably to the cyclic light program. This response to intermittent light may be partially explained by (1) less activity of the chicks, thereby conserving energy, and (2) the once per hour stimulation of the flock to consume feed.

TABLE 1. CONTINUOUS VS. INTERMITTENT LIGHT ON GROWTH RATE OF BROILERS

Treatment and sex	4-week weight	Gain, 4-8 weeks	8-week weight
	Grams[1]	*Grams*	*Grams*
Continuous light			
Males	816	1,233	2,048
Females	700	902	1,602
Intermittent light			
Males	863	1,329	2,192
Females	726	983	1,710

[1] 454 grams = 1 lb.

Although this lighting program is best suited to environmentally controlled houses, it can be adapted for conventional open-type houses. During daylight hours the birds would be on continuous light, of course, but at night the lighting would be adjusted to 15 minutes on and 45 minutes off.

TABLE 2. EFFECT OF DEBEAKING ON GROWTH AND FEED CONVERSION OF BROILERS RAISED UNDER A PROPERLY MANAGED LIGHTING PROGRAM

Treatment[1]	Average results: Mortality	4-week weight	8-week weight	Feed conversion
	Pct.	*Grams*[2]	*Grams*	
Control	5.0	834	1,936	2.04
Debeaked	1.0	790	1,762	2.16

[1] 100 birds per chamber, two chambers per treatment.
[2] 454 grams = 1 lb.

More Birds Per House

In addition to the benefits of faster growth and better feed efficiency, controlled lighting allows more birds to be grown per house. This serves to reduce fixed costs. Greater broiler density is made possible primarily by reduced social stresses on the birds. As a result of controlled lighting, debeaking of day-old chicks is unnecessary, thus avoiding still another stress. Performance of non-debeaked birds is superior to debeaked birds, as shown by data in Table 2.

To compete in today's broiler business, producers must make use of as many technical advances as possible. The intermittent light schedule has been field tested on a large commercial operation and the results obtained agree with Auburn test results. Therefore, controlled lighting offers an opportunity to make production gains at low cost.

TRITICALE as a GRAZING CROP for YEARLING BEEF STEERS

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C. S. HOVELAND, *Department of Agronomy and Soils*
J. K. BOSECK and W. B. WEBSTER, *Tennessee Valley Substation*

TRITICALE is a cross between wheat (Triticum) and rye (Secale).

Although this cereal grain was produced in Germany about 1888, it remained somewhat a biological curiosity until about 1930 when European scientists stepped up research in an attempt to develop triticale into a commercial crop. The first research on triticale in North America began in 1954 when an intensive research program was initiated at the University of Manitoba in Canada.

Several commercial seed companies began marketing triticale in 1969 in the United States and considerable publicity has recently been given the crop. Much of the recent research was directed toward yield and nutritive value of triticale grain as a potential food source. Research reported here concerns use of triticale as a grazing crop for beef steers.

Paddock at left is triticale, ryegrass, and Yuchi clover; paddock at right is wheat, ryegrass, and Yuchi clover.

Experimental Procedure

A test comparing wheat and triticale as grazing crops for cattle was begun in 1971 at the Tennessee Valley Substation, Belle Mina. Wheat and triticale were each grown in combination with ryegrass and arrowleaf clover. Only cool-season annual grazing crops were grown on the test area so that land could be plowed in June or July and fallowed during summer. Fallowing helped ensure good stands for early grazing by conserving moisture and controlling weeds. Usually the crop was planted during the last week of August or first week in September.

Varieties of wheat and ryegrass recommended for northern Alabama were planted annually with Yuchi arrowleaf clover in each of two, 2-acre areas. Comparison pastures included the same forage combination except that triticale was substituted for wheat. Fasgro-131 variety of triticale was planted each year during this 4-year study. Also, Fasgro 204 and 385 varieties were planted 2 years each.

A complete fertilizer was broadcast before planting, providing at least 40 lb. each of N, P, and K per acre. Two additional nitrogen applications of 40 to 50 lb. each were made in January and March. Wheat or triticale was seeded at a rate of 1.5 bu. per acre. Ryegrass was included at a rate of 15 lb. and clover at 10 lb. per acre.

Stocker steers, weighing about 450 lb. initially, grazed the test pastures from October until May except when lack of forage or weather conditions were such that they were removed. When off grazing, cattle were fed corn silage and supplement while confined to pens in a pole-type barn. The stocking rate of about two animals per acre was constant within a grazing season.

Results

Growth of triticale during early autumn was somewhat slower than that of wheat. All three varieties were damaged by cold weather to a greater extent than wheat. Fasgro 204 was completely killed both years in which it was planted and stands of the other two varieties were 40 to 80% killed by cold. Had there not been ryegrass and clover planted with the triticale, no late winter and spring grazing would have been available.

The triticale-ryegrass-clover sward produced the same number of days of grazing as did the wheat combination, even though the starting date was about 5 days later, see table. Carrying capacity of the swards was not critically evaluated because the stocking rate was constant at 2 steers per acre. However, the stocking rate used was near optimum for conditions of this test.

Daily gain of steers was higher on wheat-ryegrass-clover than on the triticale-ryegrass-clover, 1.38 vs. 1.10 lb. Gain per acre from grazing also favored the wheat-ryegrass-clover sward by about 60 lb. (423 vs. 366).

These calves averaged eating about 100 lb. of CSM, 130 lb. of corn, and 2,150 lb. of corn silage per steer for the 6-week "wintering" period while off grazing. Daily feed was 1.5 lb. CSM, 2.0 lb. of corn, and about 33 lb. of corn silage.

Conclusions

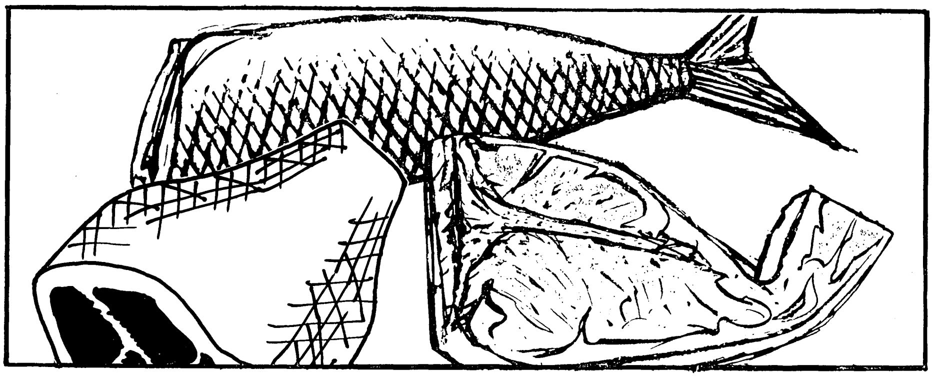
Results indicate that the triticale varieties used in this study offered no advantage over wheat when included with ryegrass and clover in a sward grazed by yearling beef steers. Rate of gain and total gain per acre favored the wheat combination during this 4-year test. Until more cold-tolerant triticale varieties are available, wheat is preferred as a dependable winter annual grazing crop in the Tennessee Valley.

WHEAT AND TRITICALE IN COMBINATION WITH RYEGRASS-CLOVER AS GRAZING FOR YEARLING BEEF STEERS, TENNESSEE VALLEY SUBSTATION, 1971-74[1]

	Wheat-ryegrass-clover	Triticale-ryegrass-clover
Grazing season:		
began	Oct. 17	Oct. 22
ended	June 4	June 9
Days grazed	170	170
Days off grazing	60	60
Stocking rate, animals/acre	2.0	2.0
ADG of steers, lb.		
on grazing	1.38	1.10
off grazing	2.00	2.07
Grazing gain/acre, lb.	423	366
Feed/steer while off grazing in drylot, lb.		
CSM	99	98
Corn	132	130
Corn silage	2,218	2,062
Daily feed/steer while off grazing in drylot, lb.		
CSM	1.5	1.5
Corn	2.0	2.0
Corn silage	33.6	32.6

[1] Most values reported are 4-year averages; however, flood damaged the pastures during March 1973 causing data for the 1972-73 grazing season to be incomplete.

Beef, pork, and fish are important sources of the world's protein supply.



A COST COMPARISON of SELECTED AGRICULTURAL PROTEIN SOURCES

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Department of Agricultural Economics and Rural Sociology

AMERICAN AGRICULTURE has been both praised and castigated during the last few years. The praise came from the ability of the U.S. farmer to quickly respond to changing market conditions. The castigation resulted from the failure of the U.S. to supply additional amounts of agricultural products to lesser developed nations.

Whether either or both approbations are warranted depends upon the interpretation of the role of the individual farmer within the American system of agriculture. Analysis of production decisions faced by the American farmer reveals part of the difficulty.

Consideration of differing types of production is difficult since production units vary. Using 1974 input and market prices, the comparative costs and returns for selected products were computed. An 80-sow hog unit was highly profitable with net return of 25% on cash costs. With all variable costs considered, a 30-head cow-calf operation had negative net returns. Two of the primary export crops, soybeans and wheat, had relatively low cash costs, with soybeans showing especially high returns in terms of cash costs. Peanuts, which are grown under acreage allotment, also had a favorable ratio. If capital investment, operating costs, and returns are motivating forces for producers, a shift of production into soybeans would be expected and in fact has occurred. Farmers thus perceive profit opportunities and make corresponding production adjustments by the results obtained through the market system.

In a global view, planners are concerned about protein deficiencies among people of developing nations. Rather than considering the net production of edible product, their concerns are with the quantity of available protein. Meat and fish products are generally considered to contain a higher level of protein than crops. On a dry weight basis this assumption is true; however, only a limited quantity of dried meat is marketed. In the form normally purchased by consumers, both peanuts and soybeans contain a higher level of protein than do meat animals or fish, though the quality of animal and vegetable protein is not comparable. When considering the cost per pound of protein, soybeans, wheat, and peanuts can be produced at a much lower cost than hogs, cattle, or catfish. The combination of a high level of protein and little change in form from production to consumption makes soybeans an especially favorable production item.

TABLE 1. NET RETURNS AND OPERATING COSTS OF SELECTED AGRICULTURAL PRODUCTS, ALABAMA, 1974

Product	Unit	Net ret.	Cash cost	Ret. of cash cost
		Dol.	*Dol.*	*Pct.*
Hogs	80 sow	20,517	80,490	25
Cow-calf	30 head	—53	5,047	..
Catfish	1 acre	344	781	44
Peanuts	1 acre	212	200	106
Soybeans	1 acre	123	69	178
Wheat	1 acre	44	74	59

TABLE 2. PROTEIN PRODUCTION AND OPERATING COST PER POUND OF PROTEIN FOR SELECTED AGRICULTURAL PRODUCTS, ALABAMA, 1974

Product	Net. prod.[1]	Prot.	Prot. prod.	Cash cost per lb. prot.
	Lb.	*Pct.*	*Lb.*	*Dol.*
Hogs	183,000	11	19,581	4.11
Cow-calf	10,410	16	1,634	3.09
Catfish	1,500	18	264	2.96
Peanuts	1,320	26	342	0.58
Soybeans	1,800	34	614	0.11
Wheat	1,800	13	238	0.31

[1] Production of product available at retail level.

The relatively high protein cost position for hogs, cattle, and fish is partially due to the change in form from production to consumption. The catfish, for example, have been deheaded, skinned, and gutted and the fish in the market contain only 60% of the weight sold by the farmer. In addition both catfish and hogs consume a high energy ration. The amount of protein in the animal flesh represents conversion of the protein contained in the feed. In some instances the ingredients in the feed could be used for direct human consumption. Circumventing certain changes in form, the product would be sold in the market at a lower cost, i.e., a comparable amount of protein for a reduced price.

Cattle and some species of fish have the ability to convert plant materials into flesh containing high levels of protein. In these instances the animal is not competing with humans for the same food supplies. Given these considerations, why do farmers produce hogs, catfish, and fed beef?

Neither the American consumer nor consumers in developing nations purchase protein; they purchase food. Tastes, preferences, and many other intangible factors help determine the market price for a product. Catfish and trout, which both consume high energy diets, command a market price substantially above buffalo fish, bream, or carp which feed low on the food chain. The farmer is guided by the amount of profit expected at a given market price. So, even with high production cost, catfish and trout have returns substantially above other alternative types of fish production.

Total operating cost is a valid comparison for determining production alternatives only when farmers are not free to make their own market decisions. So long as producers have choices, a more valid measurement is net returns or profit. However, when decision time arrives for an individual farmer, other criteria, such as type of land available and his own preferences toward what type of farming he enjoys, may have more bearing than either total costs or net returns.

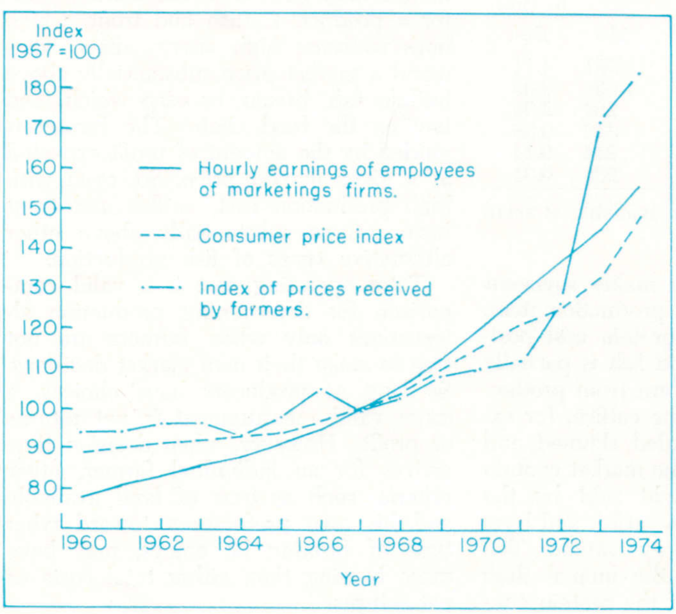
Relative Changes in Prices Received by Farmers and Hourly Earnings of Employees of Food Marketing Firms

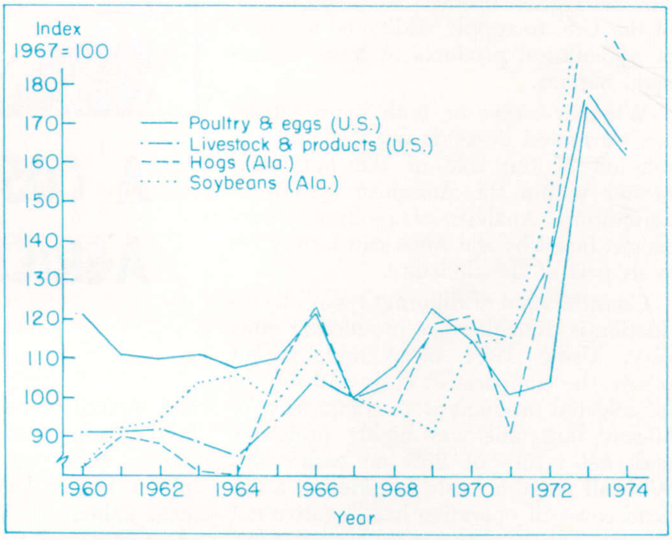
MORRIS WHITE, *Department of Agricultural Economics and Rural Sociology*

EVENTS THAT OCCURRED in the early 1970's affected producers, handlers, processors, and consumers of farm foods in ways that will be remembered for many years. Producers operated with less government regulations and received less government payments than at any time since the 1930's. The price-stabilizing effects of high Commodity Credit Corporation loans and of large volumes of major commodities in storage were missing. Although there was a slight upward trend in the Index of Prices Received for all agricultural commodities (1967 = 100), there were no wide year-to-year fluctuations between 1960 and 1971, Figure 1. The index was 18% higher in 1971 than in 1960, but during the next 3 years there was a rise of 72%.

Bolstered by federal minimum wage regulations and labor union contracts, hourly earnings of employees of marketing firms increased every year and at a fairly uniform rate. Between 1960 and 1971 hourly rates increased 51%, but the rise was only 27% in the next 3 years. With respect to 1967 levels, employees' hourly earnings were low in relation to the Consumer Price Index (CPI) through 1967, while commodity prices were above the CPI. After 1967, hourly earnings rose more than the CPI but prices received by farmers increased less than the CPI until 1972. Wages (above minimum wage level) paid to employees of marketing firms are, in the long run, most affected by the supply of the demand for services of employees. Changes in consumer demands for more services come about gradually over a period of years, and as a result abrupt ups and downs in employees' hourly earnings generally do not occur.

Use of average data for the U.S. smoothes over numerous small and individual fluctuations. The number and magnitude of fluctuations in commodity prices are greater than in hourly earnings of marketing firm employees. Use of a price



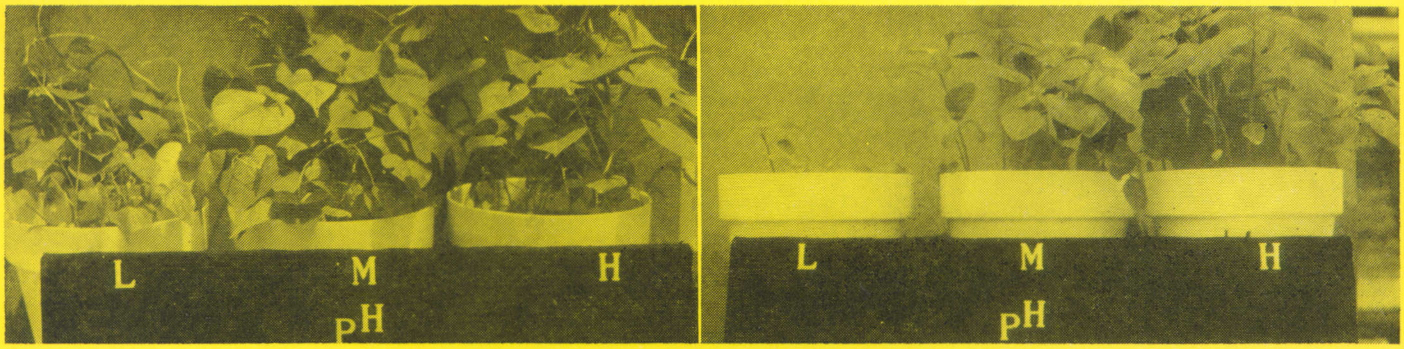


index representing prices received by producers in a particular state, or prices received by producers of an individual commodity reveal more clearly the number and magnitude of price changes that individual producers encounter, Figure 2. The index of prices received by farmers for all commodities in the U.S. (1967 = 100) reached a peak of 184 in 1974, while the index of prices received by soybean growers in Alabama (1967 = 100) reached a peak of 282. The change for some individual growers exceeded the 282 level. The degree of sharp decreases in prices is similarly not reflected in composite or national price indexes.

Various levels or rates of hourly wages exist for marketing firm employees. However, the basic rate paid to employees performing a specific job are fairly uniform throughout broad geographical areas. The greatest majority of wage earners expect to be employed on a 40-hour per week basis. Where overtime is a probability the amount is not highly variable and rate of pay is specified. Employees are paid on a weekly, bi-weekly, or monthly basis. These conditions make possible a fairly steady income flow for employees performing comparable jobs.

Income flows to producers of agricultural products are both variable and unpredictable. Fluctuations in farm commodity prices are difficult to forecast. Total production and variations in quality are major factors in determining income, and both are beyond the control of agricultural producers.

Price indexes measure changes in prices only, and hourly wage indexes measure only changes in hourly rates of pay. Neither of the indexes reflect costs incurred, and price indexes do not include volume or quality data. Therefore, neither index should be interpreted as being representative of relative gross or net incomes. What is illustrated is the variability in price per unit of product that agricultural producers encounter, compared to the relatively stable hourly earnings of those who add services to the product in the marketing channel.



Growth of morningglory (left) and redroot pigweed on Hartsells sandy loam soil at low (5.1), medium (5.4), and high (6.3) pH.

Soil pH Affects Weed Growth, Too

G. A. BUCHANAN, C. S. HOVELAND, and M. C. HARRIS
Department of Agronomy and Soils

LITTLE ATTENTION has been given to how soil pH affects weed growth. Yet this can be an important factor in severity of weed competition in crops. The relative response of weed and crop species to soil pH has an important effect on the initial competitive relationship of the crop with the weed population. Soil pH also is a major factor in determining where weeds will occur and in regulating weed populations.

The influence of soil pH on weed growth was investigated in greenhouse studies at Auburn University Agricultural Experiment Station. Hartsells fine sandy loam and Lucedale sandy loam soils from long time fertility studies were used, adjusted so that all required mineral elements were at an optimum level. Six cool season and 10 warm season weed species were grown in pots of the two soils. Plant herbage was harvested and weighed to obtain comparative dry matter yields on low pH and optimum pH soils.

Warm Season Weeds

Redroot pigweed and Florida beggarweed were particularly sensitive to low soil pH. These summer weeds made only slight growth at pH levels of 5.2 or less, as shown by data in the table. Florida beggarweed grew less at pH 5.4 than at pH 5.7 or above, on both soils.

Large crabgrass and showy crotalaria were the least sensitive species studied, showing no growth reduction at pH as low as 4.7. Coffee senna growth was reduced less than 25% at this low pH. Sicklepod, crowfootgrass, prickly sida, jimsonweed, and tall morningglory were intermediate in sensitivity to acidity.

Growth of corn, soybeans, and cotton was reduced only at the lowest pH (4.7) on the Lucedale soil. On the Hartsells soil, however, only cotton showed growth reduction at the lowest pH. Growth of sorghum-sudangrass was sharply reduced at low soil pH on both soils, while pearlmillet was quite tolerant of soil acidity.

Cool Season Weeds

Among winter weeds listed in the table, annual bluegrass, Carolina geranium, and buckhorn plantain were the most tolerant species to low soil pH on Hartsells fine sandy loam soil. Chickweed was the least tolerant among the weed groups to low soil pH on this soil, and common dandelion and wild mustard were intermediate in response.

On Lucedale sandy loam, dry herbage yields of annual bluegrass, Carolina geranium, dandelion, and buckhorn plantain were similar at pH levels of 5.2 and 5.7, but much less at pH 4.7. Chickweed and wild mustard suffered yield reductions when soil pH was 5.2.

Rye was more tolerant to low pH on the Lucedale soil than any other cool season crop or weed species in the study.

The results reported show soil pH to be an important factor in growth of weeds, just as it is for crop plants. Thus, soil acidity can be a significant factor in determining early competitive relationships between crops and weeds. Furthermore, it can exert influence on ecological shifts in weed populations. A better understanding of weed response to soil pH could provide valuable information for use in planning long range weed management programs.

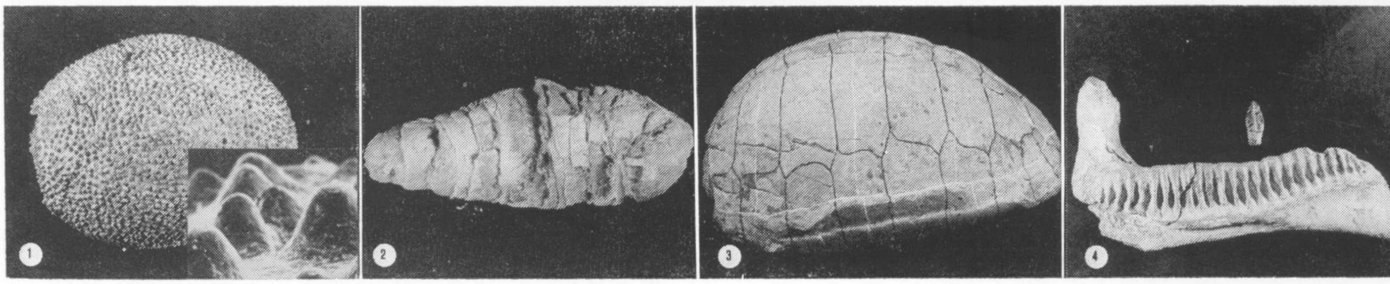
RESPONSE OF WEED AND CROP SPECIES TO SOIL PH

Weed or crop species	Growth compared to that at optimum pH[1]: Lucedale sandy loam, pH 4.7	Lucedale sandy loam, pH 5.2	Hartsells fine sandy loam, pH 5.1	Hartsells fine sandy loam, pH 5.4
	Pct.	*Pct.*	*Pct.*	*Pct.*
Warm season species				
Florida beggarweed	10	40	20	55
Crowfootgrass	44	60	61	79
Redroot pigweed	8	70	8	82
Prickly sida	35	35	40	95
Jimsonweed	40	58	70	80
Tall morningglory	38	60	70	100
Coffee senna	78	80	90	96
Sicklepod	60	59	78	90
Large crabgrass	81	80	88	99
Showy crotalaria	79	79	80	80
Soybean	60	88	81	100
Cotton	37	88	66	100
Corn	60	97	85	100
Pearlmillet	60	68	84	100
Sorghum-sudangrass	10	54	37	95
Cool season species				
Wild mustard	10	80	21	40
Annual bluegrass	33	100	70	82
Chickweed	20	80	5	58
Buckhorn plantain	10	88	70	88
Common dandelion	8	82	18	32
Carolina geranium	35	90	75	90
Rye	88	98	71	78
Wheat	68	100	68	70
Crimson clover	31	73	41	52
Arrowleaf clover	20	100	32	34

[1] Optimum pH—5.7 for Lucedale and 6.3 for Hartsells.

A COLLECTION of VERTEBRATE FOSSILS

JAMES L. DOBIE, *Department of Zoology-Entomology*



(1) A fossil egg and scanning electron microscope close-up of the egg's surface, Dallas County, Alabama. Upper Cretaceous Deposit—65 million years old. (2) A coprolite, Dallas County, Alabama. Upper Cretaceous Deposit—65 million years old. (3) Side view of the shell of a turtle, *Agomphus alabamensis*, Lowndes County, Alabama. Paleocene Deposit—63 million years old. (4) Lower, jaw bones of a duckbilled hadrosaurine dinosaur, Montgomery County, Alabama. Upper Cretaceous Deposit—65 million years old. Upper, tooth of a duckbilled dinosaur, Hale County, Alabama. Upper Cretaceous Deposit—65 million years old.

DURING THE 35-MILLION YEAR SPAN of the Upper Cretaceous geological period, an area of Alabama known as the Black Belt was covered by a warm and shallow sea. Some of its inhabitants, turtles, crocodilians, mosasaurine lizards, sharks, rays and bony fishes, adapted as the environment changed; others did not and their numbers declined.

Dinosaurs and Birds

Dinosaurs and birds, not adapted for life in the sea, lived on land or in or along fresh water lakes and streams. They also did not adapt, and they along with some of their vertebrate kin slowly dwindled in number to extinction. That area where dinosaurs roamed and turtles swam, now transformed by the inroads of civilization, is a Black Belt graveyard of fossil turtles, dinosaurs, lizards, and fish. . . .

Vertebrate fossils include more than old bones and teeth. Eggs (Figure 1), preserved footprints, coprolites (mineralized feces, Figure 2), imprints of scales, feathers, and skin . . . also are considered fossil materials. Paleontology is the study of such fossils.

Museum of Paleontology

The Auburn University Museum of Paleontology (AUMP), a collection of vertebrate fossils, was started in 1967 and is housed on the main campus. Most of the four thousand catalogued specimens were collected in various counties of the Black Belt in Alabama, although some specimens from other states are included. One of the fossil turtles donated to the museum served as a doorstop (Figure 3); another was used as a mantelpiece decoration in a school house in Lowndes County, Alabama.

The studies which are of interest to vertebrate paleontologists are extremely varied but most paleontologists are motivated by the common desire to reveal the evolutionary history of vertebrate life. That which is done in collecting, describing, determining the ecological setting occupied by the fossil species, indicating the time when the species lived and whether it became extinct, and perhaps why, all basically proceed under the central theme of revealing the history of vertebrate life.

Published Research

Published and current research are on a new species of snapping turtle from Florida, a new family of lizards (specimen found near Wetumpka in Elmore County, Alabama), the first occurrence of a fossil egg from the Southeastern United States and the anatomy of its shell (Figure 1), a new genus and species of crocodilian from Dallas County, Alabama, a taxonomic revision of a turtle group that formerly lived from New Mexico to Georgia (Figure 3), a new marine snake and fish from Mississippi, and studies on the dinosaur fauna of Alabama (Figure 4).

Persons interested in having specimens identified, making donations, or those having information concerning the location of specimens are invited to contact the author.

STRUCTURE of an INSECT VIRUS

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Department of Zoology-Entomology

INSECTS, like most other organisms, are susceptible to diseases caused by viruses. Such viruses are of interest for many reasons, but chiefly because of their potential for use in controlling insect pests. The effectiveness of viruses for control of several insects has been adequately demonstrated by numerous laboratory and field experiments, and extensive testing has shown that they are harmless to non-target organisms. However, more information on efficacy and safety will be required before these pathogens can be registered for use as insect controls.

Many different types of viruses infect insects. They differ in size, shape, and chemical composition, as well as in symptoms and pathologies they cause in their host insects. The nuclear polyhedrosis viruses (NPV) are one type of insect virus that is being studied at Auburn University Agricultural Experiment Station. Characteristically, virus particles (virions) of the NPV are enclosed within polyhedral protein crystals or inclusion bodies (PIB), Fig. 1. The virions are rod-shaped, contain DNA, and multiply in the host nucleus.

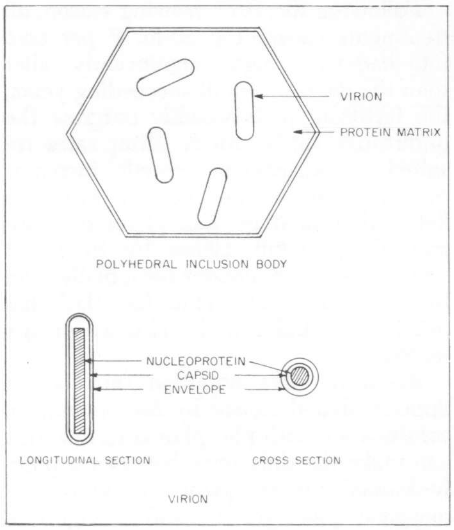

FIG. 1. Diagram of a polyhedral inclusion body and detailed structure of an individual virion.

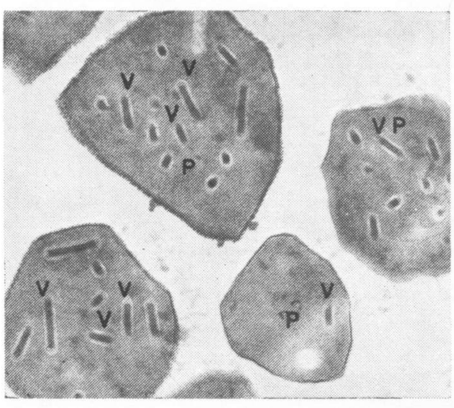

FIG. 2. Electron micrograph of polyhedral inclusion bodies in cross section showing protein matrix (P) and embedded virions (V); magnified approx. 5,000X.

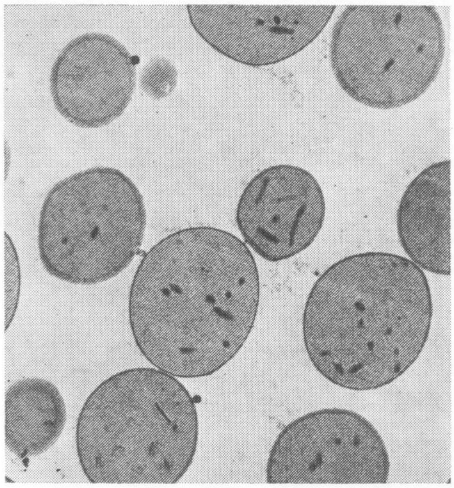

FIG. 3. Electron micrograph of polyhedral inclusion bodies in cross section after treatment with alkali; magnified approx. 3,500X.

NPV that infect pest insects of the looper complex, e.g., cabbage looper, *Trichoplusia ni;* soybean looper, *Pseudoplusia includens;* alfalfa looper, *Autographa californica,* have been under investigation at Auburn for several years. Although many different aspects of these viruses have been studied, recent emphasis has been on determining their morphological, biochemical, and serological relationships. The purpose of this report is to illustrate some of the morphological features of this group of viruses.

The viruses were mass-produced in the laboratory by infecting large numbers of looper larvae or caterpillars. Virus-containing PIB were harvested from dead caterpillars and purified by using a series of different types of high-speed centrifugations. Purified PIB were either sectioned for electron microscopy or treated with dilute alkali to release the virions prior to examination with the electron microscope.

Figures 2-5 are electron micrographs of preparations of NPV that infect loopers. A cross section of a PIB with enclosed virions is shown in Figure 2. A typical PIB of this type has 20 faces or sides, and is about 3-5 micrometers in diameter (micrometer = approximately 1/25,000 inch). Virions measure 20-50 × 200-400 nanometer (nanometer = 1/1,000 micrometer). When PIB are treated with alkali, the protein matrix is disrupted and the PIB become swollen and lose their angular shape, Figure 3. Eventually, PIB disintegrate and virions are released, Figure 4. Presumably, similar events occur in the gut of a caterpillar during the infection process.

Several envelopes that were shed from the virions are also apparent in Figure 4. A virion without an envelope is known as a nucleocapsid, and several of these can be seen in Figure 4. With some NPV, more than one virion are enclosed within a common envelope, Figure 5.

Knowledge of viral morphology is important to a better understanding of these pathogens and the role or function of their components in the infection process. Such knowledge is also essential to determining identity and relatedness to other viruses; this must be established before the control potential of the insect viruses can be realized, both in effectiveness and safety.

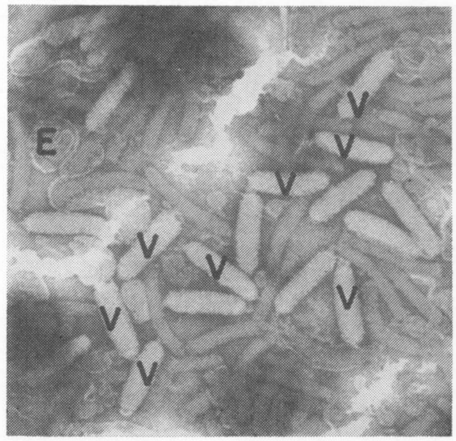

FIG. 4. Electron micrograph showing free virions (V) and envelopes (E); magnified approx. 25,000X.

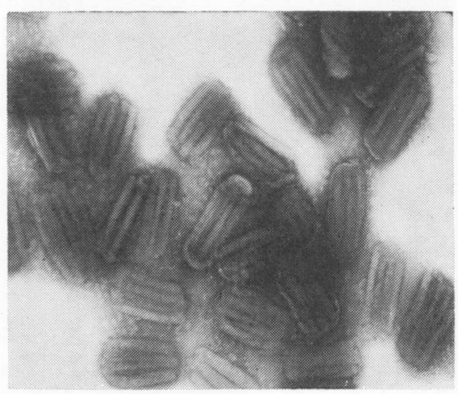

FIG. 5. Electron micrograph of virions within a common envelope; magnified approx. 22,000X.

Phosphorus Fertilization Aids Stand Establishment on Poorly-Drained Coastal Plains Soils

DAVE HYINK and MASON CARTER, *Formerly, Forestry Department*

PROVIDED DRAINAGE and fertilization, extensive areas of problem forest soils might support more productive tree growth. The Coastal Plains flatwoods areas contain zones of low-lying, poorly drained soils that are inadequately aerated, acidic, and low in available phosphorous. These sites, characterized by vegetation such as grasses, sedges, gallberry, waxmyrtle, baldcypress, and pitcher plants, can support excellent pine growth if drainage and fertilizer are provided.

In 1970, the Auburn University Agricultural Experiment Station installed an experiment on the Rains soil series in Baldwin County, Alabama. Rains soil possesses essentially all of the previously mentioned characteristics. The purpose of the experiment was to measure the response of slash and loblolly pine seedlings to nitrogen (N) and phosphorous (P) fertilization and drainage.

The site chosen was partially drained by means of fire-plow ditches at 50-ft. intervals. The area was hand planted to loblolly and slash pine in the winter of 1970-71 at a spacing 6 × 8 ft. (Fig. 1).

Fertilizer treatments applied at planting time were: (1) Control, (2) 50 lb. P per acre, (3) 100 lb. P per acre, (4) 50 lb. P plus 50 lb. N per acre, and (5) 100 lb. P per acre at planting time, plus 50 lb. N per acre applied at age 2. The fertilizer was applied by hand-broadcasting. The source of P alone was triple-super-phosphate (TSP or CSP); the source of P+N was diammonium phosphate; and the source of N alone was ammonium nitrate.

Yearly measurements have been completed through four growing seasons. No significant effects of treatment on survival were present 4 years after planting. Species differences in survival percentage remained essentially the same as those witnessed 1 year following planting; 68% for slash and 86% for loblolly. It should be mentioned that the loblolly pine seedlings were larger and appeared to be in better condition than the slash pine seedlings when they were planted.

Following the 1971 growing season, all treatments except the 50-lb. P per acre rate had tree heights significantly taller than the control. In all succeeding years, the fertilized plots steadily outgrew the unfertilized plots. All fertilizer rates resulted in significant growth increases over the control, but no one rate was better than another. Except for the control plots, height means by treatment were consistently greater for loblolly than for slash (Fig. 2). Thus far, slash has outgrown loblolly in the absence of any fertilizer.

Based on data observed thus far, it appears that drainage by fire-plowing in combination with phosphorus fertilization can make the difference between a poorly-drained pitcher plant site with submarginal pine growth and a vigorous, well stocked pine stand.

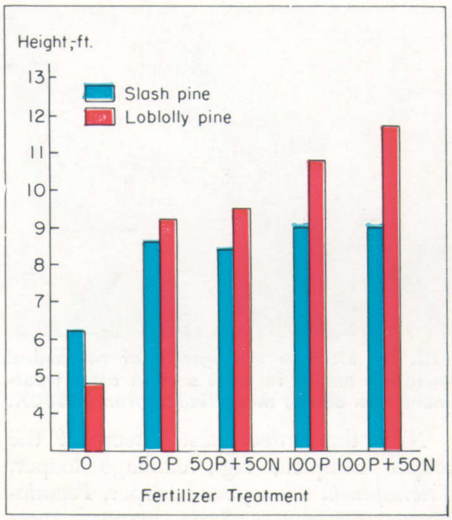

FIG. 2. Height growth of slash and loblolly pines after different rates of fertilization.

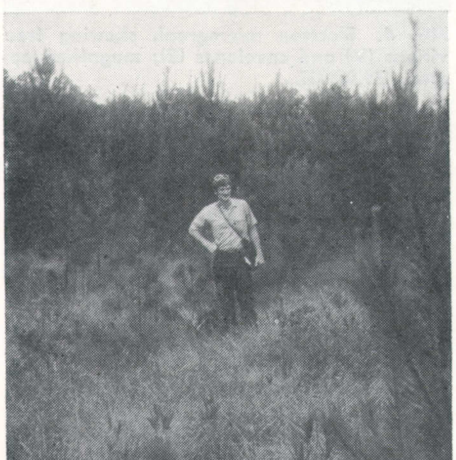

FIG. 1. A control plot surrounded by fertilized plots during the 5th growing season in 1975.

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