ANNUAL PROGRESS REPORT

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION PROJECTS

1. PROJECT: (Fund, number, and title): S46-A: 17 AND S10 - THE DEVELOPMENT OF BEEF CATTLE ESPECIALLY ADAPTED TO THE COASTAL PLAIN REGION OF NORTH CAROLINA

2. DEPARTMENTS AND COOPERATING AGENCIES: Bureau of Animal Industry

3. PERSONNEL: H. A. Stewart and E. U. Dillard

4. NATURE OF RESEARCH AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked):

Brahman-Hereford and Africander Hereford-Angus breeding groups were continued as previously. The Brahman crossbred bull used in 1952 failed to settle any cows and thus the calves produced by Brahman crossbred females were sired by bulls of other breeding. Six of thirteen Africander cows calved and six Brahman-Hereford F_1 calves were produced by grade Hereford cows. A different polled Brahman-Hereford bull was used in 1953 and another (1952 calf) has been selected for use in 1954. Two Africander-Angus-Hereford bulls are on "rate of gain" test at Raleigh. The mean 182 day weight of the various groups of calves were as follows: Africander crosses 372 pounds, Brahman F_1 334 pounds and Grade Hereford 291 pounds. As yearlings the mean weight of the Brahman crossbreds was 32 pounds more than that of the Grade Herefords.

The Romo Sinuano-Hereford group is being reproduced at Raleigh and one heifer and two bull calves were produced in 1953. One bull had imperfect genital development and was slaughtered. The other is on "rate of gain" test. The first F_2 females are to calve in 1954.

5. APPLICATION OF FINDINGS (expressed in terms of measurable public benefits if and when justified):

Lack of sufficient numbers to allow for selection within breeding groups makes it impossible at present to assess the value of these crossbred groups for replacing other breeds.

6. WORK PLANNED FOR NEXT YEAR:

At the Frying Pan Experimental Range the production of Brahman-Hereford, Africander Hereford-Angus and grade Hereford cattle will be continued. Romo Sinuano-Herefords will be produced at Raleigh.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

"Research work with Crossbred Brahman cattle at the North Carolina Experiment Station." The American Brahman 4(10): 7-10. 1953.

8. Prepared by _____ Approved _____ (Director).

Date _____ _____

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION
1953 ANNUAL PROGRESS REPORT, NON-FEDERAL PROJECTS
(Four copies to be sent to Director's Office)

1. PROJECT: (Fund, number, and title): State 46-Ai17 The Development of Beef Cattle Especially adapted to the Coastal Plains Region of North Carolina and Similar Areas.

2. Departments and Cooperating Agencies: Animal Industry

3. Personnel: H. A. Stewart, E. U. Dillard, E. H. Hostetler

4. NATURE OF RESEARCH AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked): Grade Hereford, Brahman x Hereford crossbred, Africander Angus Hereford F_2, and Brahman x Hereford F_2 calves were produced on the Coastal Plains Forest range. Grade Hereford cows producing either grade Hereford or Brahman x Hereford crossbred calves have not produced as many, or weaned as heavy, calves as either the Brahman x Hereford or Africander x Hereford crossbred cows.

1952 Calving Performance by Breeding of Calves

	Breeding of calves Produced			
	Grade Hereford	Brahman x Hereford F_1	Brahman x Hereford F_2	Africander Angus Hereford F_2
No. of cows bred	25	16	21	13
No. of cows calving	12	8	14	8
No. of live calves	12	7	13	7
% Calf crop 1952	48	44	62	64
% Calf crop 1951	55		50	82
Av. birth weight	67.5	70.5	60.2	58.5
Av. weight at 6 mos.				
1952 calves	226	294	325	321
1951 calves	222	286	323	300

Three of the Romo-Sinuano x Hereford crossbred females produce F_2 calves in the spring of 1952, at Raleigh. One calved to a Hereford bull in August. One was a 3 year old, the others 2 years. All calves are heifers. The 182 day weights of these calves are 421, 382, 385 and 391 pounds.

These cattle are the most docile cattle on the farm. They do not become excited when cornered. They lack in thickness and compactness.

5. APPLICATION OF FINDINGS (expressed in terms of measurable public benefits if and when justified): The calf raising performance of Brahman x Hereford crossbred females under adverse conditions merits recommendation under certain conditions of management.

6. WORK PLANNED FOR NEXT YEAR: Inter se matings will be continued within each of the three groups: Brahman-Hereford; Africander-Hereford-Angus; and, Romo-Sinuano-Hereford. Selections within these groups will be based on reproductive performance, rate of gain and carcass quality.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:
A summary on Crossbreeding with Brahman cattle is being prepared by Dr. E. J. Warwick, S-10 Regional Coordinator, from data pooled from several Southern states.
A report on North Carolina work is anticipated this year.

"Beef Cattle Breeding Research in North Carolina"
N. C. Expt. Station Quarterly
Research and Farming

8. Prepared by H. A. Stewart Approved _____
(Director)

Date Feb 27, 1953 Date _____

ANNUAL REPORT, COOPERATIVE REGIONAL PROJECTS

Provided for Under Sections 9b3, 10b, and 11,
Research and Marketing Act
February 1, 1953

1. PROJECT:

S-10 -- The Improvement of Beef Cattle for the Southern Region Through Breeding Methods.

2. COOPERATING AGENCIES AND PRINCIPAL LEADERS:

The following agencies and state experiment stations are cooperating in this project with the personnel listed comprising the Technical Committee:

Bureau of Animal Industry, USDA	R. T. Clark, E. J. Warwick
Alabama	Keith E. Gregory
Arkansas	Warren Gifford
Florida	Marvin Koger
Georgia	B. L. Southwell, Walter Neville
Louisiana	Richard A. Damon, Jr.
Maryland	J. E. Foster
Mississippi	T. B. Patterson
North Carolina	H. A. Stewart
South Carolina	E. G. Godbey
Tennessee	C. S. Hobbs
Texas	B. L. Warwick
Virginia	C. M. Kincaid

Administrative Advisor - R. E. Patterson, Texas

3. NATURE OF WORK, AND PRINCIPAL RESULTS OF THE YEAR:

The work at the various cooperating stations has in general progressed according to plan. Project revisions or additions have been made or are under consideration at the Georgia, Florida, and Louisiana state stations and at the Jeanerette, Louisiana and Brooksville, Florida federal stations. There are now eleven state experiment stations and three Bureau of Animal Industry field stations (each of these operated cooperatively with the state experiment station in which located) actively working on the project. As of July 1, 1952 there was a total of 3,296 breeding females two years old or over being used in the project. During the 1951-52 feeding season, 526 bulls, 285 steers, and 464 heifers, were performance tested under feedlot conditions. About one-fourth of these were fed individually with the remainder being fed in groups

Additions to facilities during the year include the purchase by the Arkansas station of 3100 acres of land primarily for use on this project. Construction of necessary buildings and corrals for handling the cattle on this tract is now nearing completion. The Alabama station has continued to develop land, and land is being cleared for additional pastures at the Louisiana station at Baton Rouge. Several of the stations are now stocked to approximately the capacity of existing facilities, while others could use additional cattle. During the year 80 head of purebred Brahman, Hereford, and Aberdeen-Angus females were purchased to replace grade animals in the

Louisiana project, and 80 head of purebred females were purchased by the Tennessee station. Other purchases included 17 head of Shorthorn females by the Alabama station, 10 head of Polled Hereford females by the Georgia station, and 24 head of Hereford heifers by the Brooksville, Florida station. About 40 purebred females were transferred from the Virginia College of Agriculture to the Front Royal, Virginia station, and the Arkansas station received 5 outstanding Hereford females and a bull as a gift. Santa Gertrudis females have been secured on loan by the Texas station and the Brooksville, Florida station.

A problem not considered important at the time this project was started is that of dwarfism. Animals obtained for use in this project at several stations have produced dwarf calves, and it is not clear as yet how much this occurrence may interfere with contemplated research and whether side projects may have to be started to study dwarfism itself.

As has been pointed out in previous reports, this project has purposely been kept broad since it is felt that the greatest present need is for a knowledge of basic factors involved in beef cattle breeding. The work includes four general phases with most cattle involved contributing to more than one phase. The following summarization gives the situation and progress by phases:

A. Development of Measurement Methods and Selection Criteria.

Rather detailed production records are being kept at all stations including birth weights, weaning weights, and type and condition scores at weaning on all calves dropped. Some animals are being slaughtered at weaning while others are performance tested in the feedlot. Growth records are kept of all replacement animals and some test animals on pasture. A sufficient volume of information has now accumulated to permit worthwhile analyses of data to determine the influence of certain biological and environmental factors on performance under Southern conditions and to determine the interrelationships of the various characters of productive importance. Preliminary analyses of Georgia, Tennessee, and Arkansas data indicate that bull calves and steer calves tend to be heavier at weaning time than heifers but that the amount of the difference varies from herd to herd and from time to time with some evidence that breeds may differ in the degree of sexual dimorphism. In all data thus far studied, the weaning weights of cows increase with age until maturity is reached at about six to eight years. The magnitude of these changes also seems to vary from herd to herd. Preliminary analysis of data indicates that the repeatability of weaning weights of calves from the same cow is usually in the range of .4 to .5, thus being high enough to permit fairly early culling of cows.

The Arkansas, Virginia, and Tennessee stations have been making detailed body measurements at various ages and these are now being analyzed to study their relationship to type scores and their interrelationships at different ages.

Considerable study has been made of the environmental factors affecting feedlot gains of animals on test. Within the limits of the animals included in the tests, age, initial weights and type scores, and age of dam have had little influence on subsequent feed-lot gains. Sex differences in feed-lot gains have been pronounced with bulls outgaining steers and steers in turn outgaining heifers.

Further analysis of data from individually self-fed bull and steer calves at the Virginia station indicates that feed consumption is closely related to body size while rate of gain is almost independent of size. Thus, differences in rate of gain were highly related to efficiency of gain.

The carcasses of animals slaughtered are being evaluated as well as facilities permit. At some stations this is limited to securing carcass grades and weights in commercial packing plants. The Texas station has been securing detailed carcass information on a sample of each steer-progeny group including grades, weights, weights of the various wholesale cuts, and proportion of bone, lean, and fat in each cut as determined by mechanical separation. This information is being used to evaluate breeding groups.

Work at the Tennessee station on the relationship between level of nutrition and type score has been continued and indicates that animals in better condition tend to receive the higher scores. Analysis of Arkansas data indicated that age had an important bearing on apparent type.

The Maryland station continued studies of early weaning of calves and has shown it is possible to raise beef calves with good growth rates when weaned as early as 90 days of age. This work will be carried on to determine if it is possible to evaluate growth rates at earlier ages than have heretofore seemed feasible.

In a search for new techniques which might be useful in predicting future performance, the Texas station has studied various blood constituents in relation to gaining ability. Serum protein bound iodine seems to be more closely related to ability to gain than any substance studied thus far. Results to date indicate that animals with an optimum blood serum level of this material gain more rapidly than those which are either high or low.

B. Assessment of the Productive Value of Cattle from Various Sources and of Different Breeds or Types.

As data accumulates great variability between individuals within breeds continues to be observed. Figures from the stations where two or more of the British breeds of cattle have been compared make it doubtful that there are consistent over-all breed differences in ability to raise heavy calves or to make rapid or economic gains in the feedlot.

Breeders speak of various "strains" of beef cattle and at the time this project was started, it was hoped that sampling of the various British breeds might lead to the identification of strains and/or herds in which the animals were uniformly highly productive. In practice, few genetically distinct strains are found and individual variation often overshadows strain differences even if they exist. Sampling of these breeds should continue, however.

The North Carolina, South Carolina, Florida, Georgia, Louisiana and Texas stations are carrying on studies involving the crossing of the Brahman breed with British types. Brahman bulls bred to British type cows have produced calves averaging approximately 30 pounds heavier at weaning

than those from purebred or grade British types, and calves out of Brahman crossbred cows showed considerable advantage in weaning weight over those of British type cows at the Georgia station. Although not enough data is available to be at all conclusive, the calves produced at the South Carolina station by crossing two British breeds have continued to compare favorably with the Brahman crossbreds.

The Romo Sinuano crossbred females produced at the North Carolina station by shipping in semen from Colombia, South America have been bred and will calve for the first or second time during 1953. To date they have been growthy cattle and their maternal abilities will be studied with interest.

C. Comparisons of Different Breeding Systems.

Aside from the crossbreeding studies referred to above, little data is available as yet due to the slow reproductive rates of cattle.

At the Front Royal, Virginia station two lines of Shorthorn cattle are being compared with similar outbred groups, and a line of Herefords and one of Angus are being set up for similar comparisons. At the Tennessee station 4 inbred lines are being formed so that they and their crosses may be compared with conventionally bred animals. The South Carolina study referred to above provides some information on crossbreeding between the British breeds of cattle, and the Louisiana project will provide data on the pre- and post-weaning performance of purebred and crossbred British types as well as animals produced by crossing with the Brahman breed.

In other herds the principal genetic tool being used to date is mass selection for performance based on records taken. Inbreeding and cross-breeding studies are contemplated at several stations as numbers permit and as animals are developed whose quality would indicate that they would be desirable foundation material.

D. Estimating the Heritability of Characters of Productive Importance in Beef Cattle.

Tests conducted at three locations in Texas and on a smaller scale at the Alabama and Virginia stations with bulls assembled from different herds either by purchase or loan arrangement continue to show rather large differences between individuals and between sire progeny groups, thus suggesting a high heritability for rate of gain. Studies at the Virginia station in which high and low gaining bulls have been bred to randomly selected groups of cows with the resulting steer progenies fed out, have for the past three years tended to indicate only a moderate heritability for this character with the data for the three years averaging between 25 and 30 percent. The Virginia work is being continued, and progenies of high, medium, and low gaining bulls are being fed during the current year at the Texas station so more data will be available on this point.

Within the next few years much better heritability studies than now possible will be made as data accumulates.

4. APPLICATION OF RESULTS AND BENEFITS REALIZED:

As pointed out in previous reports, when work is being done with a species which reproduces as slowly as beef cattle, it is questionable how rapidly research results can or should be applied to the industry in general.

Purebred and commercial cattlemen have shown a great deal of interest in this project as indicated by their attendance at field days devoted entirely to the presentation of results from various state projects, by correspondence, and by personal conversation. During the year an article on the Regional Project was prepared at the request of the editor of the Southern Livestock Journal and appeared in that publication. Numerous other magazine and newspaper stories have appeared in print at the various state stations. In Virginia representatives of one of the state breed associations approached experiment station personnel for assistance in setting up a performance testing program with their members.

These miscellaneous items of information indicate that the industry is willing and anxious to apply research findings as soon as they are available.

5. WORK PLANNED FOR NEXT YEAR:

In general, it is planned to continue the program essentially as now carried on. During the next year the Arkansas station plans to reactivate their studies of milk production which were interrupted by having to change locations during the past year. The program of the Jeanerette, Louisiana station is being revised and the Georgia station is contemplating a study in which groups of Polled Hereford cattle will be selected solely for a single character to see if there is indirect selection for others.

No stations in the region have as yet set up special projects to study dwarfism, but this may be necessary if it continues to increase in frequency.

6. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING YEAR:

Arkansas — Brown, C. J. Going Ahead at University of Arkansas. Hereford Jour. July 1952, p. 272.

Gifford, Warren, et al. Record of Performance Tests for Beef Cattle in Breeding Herds. I. Milk Production. II. Milk Production and Subsequent Growth in Calves. Ark. Agr. Exp. Sta. Bul. 531. (in press)

Georgia — Southwell, B. L., and E. J. Warwick. Factors Influencing Weaning Weights and Subsequent Feed Lot Gains of Polled Hereford Calves. Proc. Assn. South. Agr. Workers 49: 56, 1952. (abstract)

Maryland — Buric, J., W. W. Green, and J. E. Foster. Early Weaning of Beef Calves for Earlier Evaluation of Rate and Economy of Gain. Jour. An. Sci. 11(4): 737-738, 1952. (abstract)

North Carolina — Stewart, H. A. Breeding Productive Beef Cattle. North Carolina Agr. Exp. Sta. Rpt. No. 15, 1952.

Texas — Kunkel, H. O., R. W. Colby, and C. M. Lyman. A Study of the Protein-Bound Iodine in the Prediction of Rate of Gain in Immature Beef Cattle. Jour. An. Sci. 11(4): 742, 1952. (abstract)

Kunkel, H. O., R. W. Colby, and C. M. Lyman. The Relation of Serum Protein-Bound Iodine Levels to Rates of Gain in Beef Cattle. Jour. An. Sci. (has been accepted for publication and is in press.)

Burns, K. H., R. W. Colby, P. Gougler, and H. O. Kunkel. Notes on the Correlation Between Serum Protein-Bound Iodine Levels and Metabolic Rates in Immature Beef Cattle. Am. Jour. Physiol. (has been accepted for publication and is in press.)

Virginia — Kincaid, C. M. Repeatability of Feeder and Slaughter Grades of Beef Cattle. Proc. Assn. South. Agr. Workers 49:57, 1952. (abstract)

Kincaid, C. M., R. C. Carter, J. S. Copenhaver. Heritability of Rate of Gain from Progeny Tests with Beef Cattle. Jour. An. Sci. 11(4): 741, 1952. (abstract)

APPROVED:

Chairman, Technical Committee

Regional Administrative Advisor

July 21, 1952
Stillwater, Okla.

North Carolina

Report by H. A. Stewart

Objectives for the year:

To compare groups of cattle from different topcrosses on grade Hereford cows and F_2 generations from them for their adaptability under Coastal Plains conditions.

To establish breeding groups of cattle from topcrosses to grade Hereford and Angus cows.

To obtain information on the feedlot performance of purebred Hereford, Angus and Shorthorn bulls and heifers and on prospective Brahman-Hereford F_2 and Africander-Hereford F_2 herd bulls.

To further assess the Romo Sinuano breeding introduced in 1948 and 1949.

To continue the study of total performance of the progeny of bulls used in the same herd the same year.

Progress made

Calving performance at Frying Pan Range

Breed of dam	1952 % calvrs dropped	1952 % survival	1951 % survival	Weaned Wt. 1951 calved
Grade Hereford	48.8	46.3	55	260
Fricander-Hereford F_1	61.5	53.8	82	308
Brahman-Hereford F_1	66.7	61.9	50	325
All cows	56.0	52.0		

One polled Brahman-Hereford F_2 and 2 Africander Hereford F_2 bulls were fed with the purebred bulls at Raleigh. Performance of these bulls was below that of bulls of the same breeding fed in previous years due to treatment previous to feeding period.

Herds or breeding groups maintained from crosses

Brahman Hereford 28 F_1 & F_2 females 1 F_2 & 1 F_3 polled bulls

Africander-Hereford-Angus 13 F_1 & F_2 females 1 F_2 bull
1 Africander-Angus polled bull

Romo Sinuano-Hereford 5 F_1 females 3 bulls

Fifteen bulls and 13 heifers were fed 168 and 233 days respectively for information on postweaning rate of gain. A comparison of the progeny of

2 Hereford bulls showed an average difference of 22 pounds per bull calf and 18 pounds per heifer during the feeding periods.

Three of the Romo Sinuano x Hereford crossbred females calved in the spring of 1952. One was a 3 year old the others 2 years. All had heifer calves. The weights on the 2 calves that have reached 6 months old are 435 and 385 pounds. The 3 year old cow weighs 1380 and the 2 year olds average about 1000 pounds. The 2 year old bulls weigh from 1100 to over 1400 pounds. These cattle are the most docile cattle to handle that we have seen. They do not become excited when cornered. Unbroken calves can be haltered and measured with no jumping and kicking.

Evidence as indicated by the mean performance of bull progenies as well as a rather complete analysis of some data show differences between bulls used randomly on cows in the same herd the same year. This evidence points toward possible bull differences in progeny gains during the suckling period as well as during the post weaning feeding period. These sire effects are continued into the offspring of this generation where calf weaned weights appear to reflect the sire differences between progeny groups of cows.

In an attempt to determine a more effective program of selection in large animals an analysis was made on a group of sheep data. This analysis included estimates of heritability as well as genetic correlations between the economic traits considered. From the findings of this study, as well as findings from similar studies in swine and in corn, it is apparent that negative genetic relationships are to be expected in beef cattle breeding.

Estimates of the Genetic Correlations for Five Traits in Sheep

	120-day Weight	Type of Birth	Fleece Weight	Mature Weight
Birth Weight	1.363 545 *	.191 100 *	.183 100 *	1.028 100 *
120-day Weight		-.476 100 *	-.360 100 *	.504 100 *
Type of Birth			-.304 197 *	-.875 197 *
Fleece Weight				-.360 197 *

* Indicates the minimum degrees of freedom for any component used in the calculation of the correlation.

Data that will fit into studies such as this is very difficult to find and expensive to gather. All contributions to total performance must be measured. Cow performance data must be readily associated with the heifer, steer or bull performance of her progeny. Assessment should be made of the adequacy records now collected. This points up the necessity of an adequate and complete record keeping system that will endure through the years if such studies are to be made on data now being collected.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION
1952 ANNUAL PROGRESS REPORT, NON-FEDERAL PROJECTS
(Four copies to be sent to Director's Office)

1. PROJECT: (Fund number, and title): S46 ai 17 Rl S-10
The Development of Beef Cattle Especially Adapted to the Coastal Plain Region of North Carolina.

2. Departments and Cooperating Agencies

3. Personnel: H.A. Stewart, E.U. Dillard, E.H. Hostetler

4. NATURE OF RESEARCH AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked): Brahman-Hereford crossbred calves were produced in 1951 and the same matings were continued in 1952. Seven Brahman-Hereford F_2 calves were dropped during 1951, and 21 F_2 cows of this breeding are now in this breeding group. One polled F_1 bull was used to sire the 1951 calf crop and another was used this year. A few polled F_2 calves have been dropped. An attempt is being made to fix this trait in the breeding group. Selections are being made to eliminate animals difficult to handle under our system of management.

The grade Hereford group is being maintained at the Forest as a check on the performance of the other breeding groups. Cows from this group are being mated to produce both grade Hereford and Brahman-Hereford calves. As the other breeding groups become established the practice of producing crossbred calves will be discontinued.

Six Romo-Sinuano-Hereford F_1 heifers are now at Raleigh. Three of these have dropped F_2 heifer calves in 1952. Two of these calved at two years old. The 10 Romo-Sinuano-Hereford bulls on the bull feeding trial averaged 1.87 pounds per day while the 8 purebred Hereford bulls with them averaged 1.88 pounds. One of the crossbred bulls of this group made 2.5 pounds per day for a period of 196 days.

Body temperature, pulse rate, and respiration comparisons are being made between Romo-Sinuano-Hereford crossbred bulls and purebred Herefords under conditions of controlled temperature and humidity. Under periods of stress it appears that the crossbred group adjust more rapidly and remain more at ease.

5. APPLICATION OF FINDINGS (expressed in terms of measurable public benefits if and when justified): Crossbred cattle containing Brahman breeding are consistently heavier at weaning and at comparable age intervals than grade Herefords. The alertness and nervous temperament of these cattle are economically sound reasons for not encouraging their use by beef producers generally in this area.

6. WORK PLANNED FOR NEXT YEAR: Continuation of breeding groups. Appraisal of heat tolerance of various crossbred combinations.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:
None

8. Prepared by H. A. Stewart Approved _____
(Director)

Date 3/24/52 Date _____

S46 ai 17 RM S-10
The Development of Beef Cattle Especially Adapted to the Coastal Plain Region of North Carolina.

The respiration rate of the Herefords appears to be higher than that of the crossbreds. Skin temperature of the crossbreds appear to be higher than those of the Herefords. Work of this nature will continue. Later an attempt will be made to relate these findings with performance in the field.

The following table shows the performance of the various breeding groups at Frying Pan Range on September 24, 1951.

Breeding group	Percentage Calf Crop	Weights of Cows No. calf	With Calf	2-Yr. old Heifers	1951 Calves
Brahman-H $F_1 \times F_2$	50	990 lbs.	915 lbs.	753 lbs.	325 lbs.
Africander-H $F_1 \times F_2$	82	995 lbs.	873 lbs.	725 lbs.	308 lbs.
Grade Hereford	55	900 lbs.	837 lbs.	728 lbs.	260 lbs.

FINAL REPORT, COMPLETED OR REVISED PROJECTS

~~North Carolina~~ Agricultural Experiment Station

1. Project title, number, and fund: **Utilization of Reeds in Forest Grazing, P14-ai3 (Purnell) Master Project**

2. Departments and cooperating agencies: **Animal Industry, N C. Dept. of Agr., Bureau of Animal Industry, U.S.D.A. and U. S. Forest Service.**

3. Major personnel: **J. E. Foster, H. H. Biswell, W. O. Shepherd, E. U. Dillard, Earl H. Hostetler and J. L. Rea, Jr.**

4. Date begun: **1942** Date ~~revised~~/completed: / **1951** If discontinued without completion state reasons: **(continued but much work now being conducted will be continued under projects of a more specific character.**

5. Estimated total cost by funds (salaries and maintenance): **$125,000.00**

6. The problem (briefly restate its nature, importance, and economic significance):

The problem involved is one of determining to what extent switch cane (Arundinaria tecta), and to a certain degree other native forages, may be used in the production of cattle in the Coastal Plain area of North Carolia.

The region in which this work is being conducted corresponds roughly to the Tidewater section of the Coastal Plain. In this area forest range provides about 25-30 percent of the total feed for beef cattle. Most cattle producers make some use of forest range at some time during the year.

There are possibilities for expansion of beef cattle production in the Coastal Plain area. If a satisfactory program integrating cattle production and forest production can be worked out the economic position of the area would be greatly improved. Interest in making use of the vast forage resources of the Coastal Plain is being manifested by numerous individuals and by pulp and paper (companies with large land holdings.

7. Major results and conclusions:

Most important findings to date include the following:

(1) Total digestible nutrients in cane forage during the early summer months have been found to be quite comparable to those in other green forages commonly used by cattle.
(2) Quality of forage seems to vary with quality of site upon which it is grown.
(3) Cane is particularly subject to damage from overuse during the summer.
(4) Winter grazing seems to have very little effect upon cane stand or vigor.
(5) The subsequent stand and vigor of the cane may be seriously affected before changes in body weight are noticeable in cattle grazing the cane.
(6) Creep feeding on high quality cane range is of doubtful value, however, its possibilities on poor quality range have not been studied.
(7) Some type of concentrate supplement is required for beef cattle grazing winter range. Protein supplement seems advantageous though the amount and kind of supplement deserves further study.
(8) Mineral deficiencies probably exist on some of the poorer sites, but further study is needed on this question.
(9) Cane furnished adequate forage for breeding cows from about May 1 to January 1 without additional supplements other than minerals.
(10) Growth of forage occurs during a relatively short period in the spring and early summer - very little regrowth occurs when foliage is removed after active growth stage.

(over)

* Two copies to be sent to the Office of Experiment Stations.

8. Practical applications and public benefits achieved or in prospect:

First of all, the investigations to date have served to focus attention upon this vast forage resource which has been utilized only to a very limited degree. Results of studies thus far have provided some information about the quality of forage, the susceptibility of the cane to damage by over-use at certain times of the year, and high variability of carrying capacity by site. Cattlemen and timbermen throughout the area have shown an increased interest in cattle production as a result of published information. More attention is being given to the quality of the cattle grown in the area. As more answers are found to the many problems yet present the economy of the whole area will be bettered by the extension of cattle production to larger holdings.

Publications:

Biswell, H. H., and J. E. Foster

1942. Forest Grazing and Beef Cattle Production in the Coastal Plain of North Carolina. N. C. Agr. Exp. Sta. Bul.334

Biswell, H. H., J. E. Foster and B. L. Southwell

1944. Grazing in Cutover Pine Forests of the Southeast. Jour.of Forestry.Vol.42, No.3.

Biswell, H. H., Collins, R. E., Foster, J. E., and Boggess, T. S. Jr.

1945. Native Forage Plants. N. C. Agr. Exp. Sta. Bul. No. 353.

Biswell, H. H., and Foster, J. E.

1946. Stock-Poisoning Plants of North Carolina(Revised). N.C.Agr.Exp.Sta. Bul. No.342.

Biswell, H. H., and Foster, J. E.

1947. Is Rotational Grazing on Native Range Practical? N.C.Agr.Exp.Sta. Bul. No. 360.

Blackman, B. B.

1945. Digestibility of Reeds by Beef Cattle. N. C. State College. Thesis for Master's degree (Unpublished).

Campbell, R. S. and H. H. Biswell

1945. Better Management on Southern Coastal Forest Ranges. Forest Service U.S.D.A. A15-17.

Foster, J. E.

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Foster, J. E., Biswell, H. H., and Hostetler, E. H.

1945. Comparison of Different Amounts of Protein Supplements for Wintering Beef Cows on Forest Range in the Southeastern Coastal Plain. Jour. of Animal Sci., 4: 194

Foster, J. E., Biswell, H. H., and Hostetler, E. H.

1946. Grazing and Creep Feeding Calves on Native Range. N. C. Agr. Exp. Sta., Bul. No. 355

Lindahl, Ivan, Davis, R. E., and Shepherd, W. O.

1949. The Application of the Total Available Carbohydrate Method to the Study of Carbohydrate Reserves of Switch Cane (Arundinaria Tecta) Plan Physiology, 24 (2): 285-294.

Director

OES-Form-17 (Rev.)
(January 10, 1951)

North Carolina Agricultural Experiment Station

FINAL REPORT, FEDERAL-GRANT PROJECTS
(Send 3 copies to Office of Experiment Stations at time of closing)

/ P14-A13 (Purnell) Utilization of Reeds in Forest Grazing.

1. PROJECT (Fund, number and title): Subproject 8. The Development of Beef Cattle Especially Adapted to the Coastal Plain Region of North Carolina.

2. STATION DEPARTMENTS AND COOPERATING AGENCIES (e. g., USDA, TVA, etc.): N. C. Agric. Expt. Sta., N. C. Dept. of Agric., U.S.D.A., B.A.I., and B.P.I.S.A.E., U. S. Forest Service.

3. MAJOR PERSONNEL: H. A. Stewart, E. U. Dillard and E. H. Hostetler.

4. DATE BEGUN: 1944 DATE COMPLETED: 1951
(If discontinued without completion state reasons):
This project being continued as S46-A117 P.M. S-10

5. ESTIMATED TOTAL COST BY FUNDS (Federal-grant and others):
$12,000.00

6. THE PROBLEM (Briefly restate its nature, importance, and economic significance):
It is known that the common British breeds of cattle do not perform as satisfactorily as Brahmans or some other breeds in tropical or sub-tropical climates. Crosses of common beef breeds with either the Brahman or the Africander perform better in such climates than do British breeds.

Reed grazing in Eastern North Carolina is potentially important for beef production. It is desirable, therefore, to know what kind of cattle will be most productive in the area and in particular whether cattle carrying Brahman, Africander or other breeding will enjoy the same advantage demonstrated in slightly more extreme(tropical) climates. If they are better by even a portion of the amount by which they excel the British breeds in some portions of the United States, their use in the area would be of tremendous economic importance.

7. ABSTRACT MAJOR RESULTS AND CONCLUSIONS:
Several years will be required to complete this work. Results to date do not justify conclusions.

(Over)

8. PUBLIC BENEFITS (Present or potential, realized by public, stated in dollars, bushels or other values):

None to date

9. CITATION OF PUBLICATIONS (Issued and/or in manuscript form):

Stewart, H. A. and E. U. Dillard. 1950 - Summary of the Performance of Africander-Hereford, Brahman-Hereford and Grade Hereford Groups at the North Carolina Experiment Station. Progress Report 4, An. Husb. Series 1.

10. Prepared by _____ Approved _____ (Director).

(Sign original only)

Date April 5, 1951 Date _____

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION
1951 ANNUAL PROGRESS REPORT, NON-FEDERAL PROJECTS
(Four copies to be sent to Director's office)

1. PROJECT: (Fund, number, and title): S46-A117 R.M. S-10 Development of Beef Cattle Especially Adapted to the Coastal Plain Region of North Carolina and Similar Areas.

2. DEPARTMENTS AND COOPERATING AGENCIES: N. C. Agr. Expt. Sta., Dept. Animal Industry, U.S.D.A., B.A.I.

3. PERSONNEL: H. A. Stewart, E. U. Dillard and E. H. Hostetler.

4. NATURE OF RESEARCH AND PRINCIPAL RESULTS OF THE YEAR (Confidential Information should be so marked):

Production of grade Hereford and Brahman-Hereford F_1 calves continued. Inter se matings were made within Brahman-Hereford and Africander-Hereford crossbred groups, using yearling bulls. Five Brahman-Hereford F_2 and no Africander-Hereford F_2 calves were produced. The 39 grade Hereford cows bred artificially with Romo-Sinuano semen produced 19 calves of which 10 bulls and 5 heifers survied. A red Africander-Angus line bull from the Jeanerette Louisiana station was obtained for use in 1951. All prospecive bull calves were winter fed for information on rate of gain.

The fourth trial comparing grade Herefords, Brahman-Herefords and Africander-Herefords was completed. The Brahman-Hereford group again gained most efficiently and had a higher dressing percentage than the others. For the first time grade Hereford calves outgained the Brahman-Hereford group. Average carcass grades were Medium Good, High Commercial and Medium Commercial for the grade Hereford, Brahman-Hereford and Africander-Hereford respectively.

5. APPLICATION OF FINDINGS (expressed in terms of measurable public benefits if and when justified):

Present findings do not justify recommendations.

6. WORK PLANNED FOR NEXT YEAR:

Continuation of grade Hereford, Brahman-Hereford, Africander-Hereford groups. Production of Romo-Sinuano-Hereford F_2 calves.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

Progress Report 4 - Animal Husbandry Series 1. Summary of the Performance of Africander-Hereford, Brahman-Hereford and Grade Hereford Groups at the North Carolina Experiment Station.
H. A. Stewart and E. U. Dillard

8. Prepared by H. A. Stewart Approved R W Cummings (Director)

Date 4/9/51 Date 5/1/51

6 October 1949

MEMORANDUM TO PROFESSOR HOSTETLER:

Reference is made to Mr. E. C. Elting's letter of September 23, 1949.

The "First Supplement to the Project Analysis and Working Plans for Studies in the Coastal Plain of North Carolina, Second Revision, March 1945" prepared in October 1947 gives the status of all work under these projects at that time. Since then subprojects 1, 2 and 4 have been completed and the data is in process of being analyzed.

Subproject No. 3, "Logging Effects and Degree of Grazing". The results of this subproject have been summarized and progress is being made for publication of these results.

Subprojects Nos. 7, 9 and 10. Field work has been completed on these subprojects. Chemical analysis of material gathered in these studies is being conducted by the Bureau of Animal Industry, Washington.

Subproject No. 6, "Wintering Calves on Reeds". This subproject has been temporarily discontinued pending development of Frying Pan Experimental Range in Tyrrell County. This project has not been known as "Subproject No. 2" insofar as I am able to determine.

Subproject No. 8, "Development of Beef Cattle Especially Adapted to the Coastal Plain Region of North Carolina" is active at the present time with work being conducted at the Frying Pan Experimental Range in Tyrrell County. This project is also known as S46-a117 and is one of the projects through which this station is contributing to the Regional Beef Cattle project.

In addition, Subprojects 11 and 12 are now active with work being conducted at the Tidewater Experiment Station, Plymouth, N. C., and at the Frying Pan Experimental Range.

We are enclosing a copy of the supplement to Project Analysis and Working Plans.

E. U. Dillard

E. U. Dillard

Enclosure-

Summary of Beef Cattle Breeding Work Accomplished from

June 30, 1949 to January 1, 1950

Project S46-Ai17 Development of Beef Cattle Especially Adapted to the Coastal Plains Region of North Carolina and Similar Areas.

1. Continuation of production of Brahman Hereford F_1 calves
   1 PB Brahman bull 17 grade Hereford cows $\begin{matrix}6\,♂\\5\,♀\end{matrix}$ calves dropped 1949

2. Continuation of inter se matings of -
   a. Brahman x Hereford group
      1 F_1 bull 11 F_1 cows
      4 female 3 male calves dropped
   b. Africander x Hereford group
      1 F_1 bull 10 F_1 cows 4 ♀ 5 ♂ calves dropped

3. Feed lot testing of F_1 and F_2 bull calves
   3 F_2 Africander
   3 F_2 Brahman

4. Summary of data gathered to date on performance between breeding groups -
   Hereford x Hereford
   Brahman x Hereford
   Africander x Hereford
   in feed lot and reproductive performance.

Sub-Project. Introduction of new germplasm

1 Expect 10 - 12 calves from grade Hereford cows bred artificially to Romo Sinuano bulls

2 Romo Sinuano x Hereford heifer dropped June 5, growing well. Weaned at 405 lbs. at 6 months.

Project S74-Ai28. The Improvement of Beef Cattle Through Breeding Methods.

1. Six purebred Hereford bull calves measured, graded and started on feed trial for rate of gain and feed efficiency data.

2. Summary of data gathered on comparison of progeny of 2 Hereford bulls used on same farm for 8 years.

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 1950
(Three copies to be given to the OES examiner)

1. PROJECT: (Fund, number, and title): PURNELL A.H. P14-S, UTILIZATION OF RANGE IN FOREST GRAZING---S, DEVELOPMENT OF BEEF CATTLE ESPECIALLY ADAPTED TO THE COASTAL PLAIN AREA OF NORTH CAROLINA. (Reg. No. S-10)

2. DEPARTMENTS AND COOPERATING AGENCIES: Animal Industry

3. PERSONNEL: H. A. Stewart, E.S.Dillard and E.H.Hostetler

4. NATURE OF WORK AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked): Seventeen grade Hereford cows bred to a Brahman bull produced 6 bull and 5 heifer calves. Inter se matings were continued with the Brahmanx Hereford and AfricanderxHereford groups. The former, composed of 1 F_1 bull and 11 F_1 cows, produced 3 male and 4 female calves. The latter composed of 1 F_1 bull and 10 F_1 cows, produced 5 male and 4 female calves. The Brahma x Hereford crossbred calves will be added to the inter se breeding group. A study of the performance of 137 calves sired by Brahman, Africander and Hereford bulls was made. The calves were dropped and carried to weaning on the Hofmann Forest area from 1945 to 1947. The BrahmanxHereford crossbred ca calves were, on the average, 29 pounds heavier than the Africander x Hereford crossbreds, and 37 pounds heavier than the grade Hereford calves at weaning time. Although no consistent differences between these groups of calves could be shown in survival from birth to weaning time, all of Brahman x Hereford crossbreds did survive to weaning. This is 7 per cent higher survival than either of the other groups. Calving the previous year did not affect the weaned weight of the calf. A 100 pound increase in cow weight resulted in an average increase of 14 pounds in the weaned weight of the calf.

Fifty-three grade cows were moved to Raleigh for insemination with Romo-Sinuano se from Colombia. Thirty-nine cows were inseminated one or more times. 1950 calf crop from this group was estimated at 16. One heifer calf was dropped on June 5 to such service from 1948 shipments. 2 F_1 Brahman x Hereford and 1 F_2 Africander x Hereford bull calves were fed to obtain information on their feed lot performance. Steers of these two groups, as well as a group of grade Herefords from the same group of cows were fed out at

~~5.~~ BENEFITS realized by farmers or the public through application of findings, (Raleigh stated in dollars, bushels, or other values, where possible:

5. BENEFITS

No recommendations should be made from these findings.

6. WORK PLANNED FOR NEXT YEAR: The production of F_1 progeny from the Brahman x Hereford group will be continued. The inter-se breeding groups will be continued using bulls from the 1949 calf crop on which rate of gain date has been obtained. Semen may be imported for back crossing Romo Sinuano heifers to that breed.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

Master's Thesis Thomas J. Marlowe.
Title - A Comparison Between Africander-Brahman and Hereford Bulls on Grade Hereford Cows.

8. APPROVED: H. A. Stewart
Project Leader.

Director.

THE ROLE OF FOREST GRAZING IN BEEF CATTLE PRODUCTION IN THE SOUTHEASTERN UNITED STATES

FIRST SUPPLEMENT TO THE
PROJECT ANALYSIS AND WORKING PLANS
FOR STUDIES IN THE COASTAL PLAIN OF NORTH CAROLINA,
SECOND REVISION, MARCH 1945

WORKING PLANS FOR 1948 STUDIES

Prepared by

W. O. Shepherd and E. U. Dillard

October, 1947

A cooperative project
of
The Agricultural Experiment Station
of the
North Carolina State College of Agriculture and Engineering
with
The North Carolina Department of Agriculture
and
The Forest Service and Bureaus of Animal Industry and Plant Industry,
Soils, and Agricultural Engineering, of the United States
Department of Agriculture

THE ROLE OF FOREST GRAZING IN BEEF CATTLE PRODUCTION IN SOUTHEASTERN UNITED STATES

WORKING PLANS FOR NEW STUDIES DURING 1948 IN THE COASTAL PLAIN OF NORTH CAROLINA

(This is a supplement to the revised Working Plans of March 1945.)

Seven major problems of forest range grazing are listed in the approved problem analysis and working plans of June 1942, and the revision of March 1945 (page 10). Since the research program could not cover all of these at one time, the aim in the early stages of the project has been to "first tackle those phases which it is thought will yield the greatest and quickest returns to the farmer". The studies thus far have dealt largely with the cattle management phases of "finding the most practical systems for utilizing the reed (switch cane) forage type by beef cattle". Although certain phases of this problem will be continued, studies have progressed to the stage where considerable effort can be shifted to other important problems. The study plans included in this supplement involve two major problems included in the original problem analysis which are now considered to be of primary importance, fire protection and forage management.

PRESENT STATUS OF STUDIES OUTLINED IN THE REVISED WORKING PLANS OF MARCH 1945

The grazing program which has been carried on in the vicinity of the old Blackland Branch Station at Wenona will be transferred to the Tidewater Experiment Station, near Plymouth. The desirability of such a move became apparent (and was anticipated in the 1945 working plans) when the Blackland Station was sold and replaced by the Tidewater Station in 1944. The studies now in progress will be closed out according to schedule at the end of the 1947 grazing season.

At Hofmann Forest the need for additional research facilities and a revision of the studies has become increasingly evident in recent years. Inadequate roads, trails and fences has made cattle management difficult and has resulted in exorbitant losses of experimental cattle. A lack of suitable winter pastures tends to limit the application of results of wintering studies. An initial lack of uniformity among the "logged pastures", in both forage stand and logging treatment, has been aggravated by repeated wild fires and overgrazing to the extent that these pastures are of limited value to the study for which they were designed. However, observations in these pastures have emphaized the importance of fire as a problem and also as a valuable tool in grazing and timber management. To attack some of the most important forest grazing problems on a sound basis at Hofmann Forest will require a new set of

experimental pastures. Whether it will be most feasible to locate these pastures at Hofmann Forest or at some more accessible area, is now under consideration. When a decision is reached the project analysis and working plans will be revised to incorporate results obtained to date and new studies to be undertaken.

The subprojects outlined in the 1945 study plans are listed below and the present status of each is indicated. All studies which are being completed or closed out will be analyzed as soon as possible and reports prepared for publication.

Subproject No. 1, "Effects of Heavy Grazing and Moderate Grazing on Reeds and on Cattle Gains at Wenona". This study culminates at the close of the 1947 grazing season in November.

Subproject No. 2, "Use of Reeds in Finishing Yearling Steers". This study, conducted at Wenona and Tidewater Station, will be completed at the close of the third finishing trial in the spring of 1948.

Subproject No. 3, "Logging Effects and Degree of Grazing". This study at Hofmann Forest, scheduled to run "at least 10 years", was closed out in 1946 after four grazing seasons when it became apparent that little additional information would be obtained by continuing it further. The pastures lacked uniformity both as to forage and logging intensity, and the data are not conclusive regarding the effects of logging or degree of grazing on cattle gains. Two wild fires in 1945 further accentuated differences among pastures and disrupted the original design. These pastures now are useful only for studies requiring no pasture comparisons.

The study has shown that grazing has significantly increased the establishment, mortality and growth of pine seedlings. Some pertinent information has also been obtained regarding the effect of fire on pond pine regeneration. A report on these phases is being prepared for publication.

Subproject No. 4, "Mineral Requirements on Forest Range". This study, which has been conducted at Hofmann Forest under the supervision of the Animal Nutrition Section, Department of Animal Industry, N. C. State College, is being closed out with the calving data to be obtained in the spring of 1948. The study failed to demonstrate a cobalt deficiency in the forage, perhaps due to the fact that all cattle received supplements of bonemeal and cottonseed meal which contained traces of cobalt. The study was redesigned in the fall of 1946 but it is being discontinued until better facilities for a well controlled experiment are available.

Subproject No. 5, "Different Planes of Nutrition for Wintering Breeding Cows on Forest Range". The sixth trial comparing three levels of protein supplements (two, four, and six pounds per head daily) from January until April, was completed in 1947, when this study was closed out. Results of the first two trials, and an earlier one comparing two and four pounds of supplement, were published in 1945. The range pastures on which these trials were conducted were quite heterogeneous and somewhat deficient in desirable winter forage. Further wintering studies are needed with variations of the supplemental feeding program and on ranges more suitable for winter use.

Subproject No. 6, "Wintering Calves on Reeds". This was set up as a three year study at Wenona. Fires in 1941 and 1943 interrupted the experiment, but two trials were conducted during the winters of 1942-43 and 1944-45. This study will be continued at Tidewater Station, or elsewhere, when facilities are available.

Subproject No. 7, "Relative Grazing Values and Nutritive Properties of Forage". The forage sampling and chemical analyses for this study have been completed. The data are being summarized by N. R. Ellis, of the Bureau of Animal Industry, U. S. Dept. of Agriculture. Observational data concerning palatability, season of use, relative importance, etc., have been collected in all of the grazing studies and will be continued in future studies.

Subproject No. 8, "Development of Beef Cattle Especially Adapted to the Coastal Plain Region of North Carolina". This long-term project, begun in 1944, is being continued. In 1947 two-year-old heifers obtained by crossing grade Hereford cows with Brahman and Africander bulls were bred to young bulls of the same ancestry for the first time in this study.

Effect of Degree and Season of Defoliation on the Productivity and Vigor of Switch Cane.

(Subproject No. 9)

Purpose:

An exploratory investigation of the response of switch cane to definite degrees of defoliation at different seasons. The results obtained here will be of greatest value as background information for developing improved management methods and grazing studies involving switch cane.

Importance of Study:

The vague terms, "heavy", "moderate", and "light" have commonly been employed to indicate intensity of utilization. To be meaningful, these terms must be defined according to some tangible criteria such as per cent defoliation or utilization at particular seasons. The degree of defoliation that switch cane will endure at various seasons, and still maintain its vigor and productivity, has not been determined. Such information is needed for intelligent management of this most important native forage species of North Carolina's Coastal Plain region.

Switch cane forage fits well in a grazing program during one or more of the following periods:

(1) During the spring and early summer before lespedeza and other late pastures are producing well.

(2) During the entire summer to supplement, or replace, farm pastures.

(3) During the fall or winter after permanent pastures have become dormant.

These periods are included in the present investigations of arbitrary "light" and "heavy" rates of utilization, and also "total" defoliation, employing hand harvesting.

Status:

The study was begun informally in 1946 and is now in the second season. Observations thus far indicate: (a) that the bulk of the annual forage growth on ungrazed cane occurs in May and June; (b) regrowth of foliage is slight and new leaves are small following defoliation in July or later, and does not begin for at least one month after defoliation: (c) growth is apparently dormant by November; (d) light utilization, as practiced here, stimulates very little regrowth; (e) more than one year is necessary to evaluate the effects of the treatments being used, since the early foliage growth appeared to be normal on all plots the second season.

Methods and Procedure:

Hand plucking on small plots is employed to simulate grazing effects of the following seasons and intensities of utilization:

Continuous early (May through July), both light and heavy.

Continuous summerlong (May through November), light and heavy

Winter (Nov. - Dec.), light and heavy.

Total utilization (one time per annum) in May, July, and Sept.

(In addition to these nine conditions, check plots with no utilization are included for comparison.)

The degree of defoliation arbitrarily selected for "heavy" utilization is 40 percent of the available foliage each month for both the "early" and "summerlong" periods, and a single 100 percent defoliation in winter. The corresponding "light" utilization rate is 15 percent each month for "summerlong", 20 percent for "early", and 50 percent in winter. A constant percentage was adopted as the basis of degree of utilization because no reliable information was available to indicate the amount of initial growth to expect, and considerable regrowth was anticipated. A single defoliation in early winter is expected to provide an adequate, though rigorous, test of winter utilization because growth is dormant at that time and some of the older leaves are shedding.

Location:

The study is being conducted in a uniform stand of ungrazed switch cane just west of the "logged pastures" at Hofmann Forest. The area had been completely burned over by a severe wild fire of early April 1945. New growth of the cane was vigorous and uniform, over-topping all brush sprouts.

Number and size of plots:

Plots representing each of the nine utilization treatments, and also an untreated check plot, are replicated three times, making a total of 30 plots. Each replication is grouped in a block of plots separated from the other blocks by a distance of 70 to 80 yards. Each plot is 3.3 x 6.6 feet (1/2000-acre).

Establishment of plots:

In each block area 10 plots were selected for uniformity; then treatments were assigned at random. The plot corners were marked by wood stakes about two feet long, and wire was strung between the stakes to clearly delineate the boundaries.

Brush sprouts were cut off near the ground and removed from the plots. This procedure will be repeated at least once each year in order to minimize possible effects of brush competition.

Harvesting procedure:

The specified percentage of foliage is plucked by hand from each individual cane stalk. So far as possible, the cluster of three to six leaves of an individual branch are plucked together, that is, utilization is by branch clusters. To obtain greatest accuracy, individual leaves were the unit of utilization at the beginning of the study. It became apparent that plucking one or two leaves from a cluster did not simulate grazing conditions as closely as did plucking a cluster at a time. Therefore the procedure was changed the second season.

Harvested forage is bagged separately for each plot and both green and oven-dry weights are obtained. Any rhizomes connecting plants inside the plots with plants outside, are cut each spring by spading and/or chopping to a depth of 10 inches along a line completely surrounding the plots and one foot outside the boundary. This one-foot "buffer" strip receives the same treatment as the plot. (During the first season, while the advisability of severing connective rhizomes in this manner was being investigated, a three-foot buffer strip around each plot was included in the utilization treatments and rhizomes were not cut.)

Harvesting begins when the cane has put out two full leaves (usually early in May) and continues at four-week intervals thereafter until the winter harvesting in November or December.

Records:

In addition to forage yields, the following information is recorded each time a plot is harvested:

Estimated foliage density (in percent of ground cover)

Average number and size of leaves per stalk (estimated from sample counts and measurements)

Average number of leaves harvested per stalk (estimated)

Observations on amount of regrowth, condition of forage, etc.

The number and size of live stalks, dead stalks, and new basal shoots will be recorded at the end of each season. Average cane height and estimated foliage density were recorded for all plots at the beginning of the study.

Duration:

The study should be continued at least through the third season (1948).

Statistical analysis:

For forage yields, and other comparisons of the nine utilization treatments, the following analysis will apply (for one year);

Source	d.f.
Blocks	2
Treatments	8
Error	16
Total	26

For comparisons including the check plots, the degrees of freedom would be increased to 9 for treatments and to 18 for error.

To increase precision, the forage yields may be adjusted for initial plot density, cane height, or number of stalks per plot by covariance analysis.

Supplemental Information:

For additional evaluation of the cumulative, or residual, effect of these treatments it may be feasible to determine the levels of food reserves of the cane at the close of the study (see subproject 10), or to harvest the total forage produced the following season.

Organic Food Reserves of Switch Cane in Relation to Season and Stage of Growth

(Subproject Number 10)

Purpose:

To determine the seasonal fluctuations of the food reserves of switch cane, in relation to recognizable growth stages, as a basis for better understanding the proper management of this forage species.

Importance and scope of study:

The depletion of stored foods during the early rapid growth stage, and the replenishment of food reserves during subsequent stages of growth, are well known phenomena of seasonal development in perennial plants. Various studies with perennial forage species have shown that harvesting the foliage when the food reserves are at a low level tends to reduce the vigor and productivity of the forage stands. For sustained forage production, the plants must be allowed to build up their food reserves between harvestings.

Switch cane appears to possess the facilities for rather remarkable food storage capacity in its stout rhizomes and perennial stems, but this species is very sensitive to misuse and is easily weakened or killed by heavy continuous grazing. Simple microchemical tests show that the rhizomes contain abundant starch and recognizable amounts of sugar. Undoubtedly the accumulations of these and other plant foods fluctuate considerably during the year, and probably in relation to recognizable stages of seasonal growth. If the periods of depletion and low levels of food reserves, and also the periods of replenishment and high reserves, could be established, it would contribute materially to a better understanding of proper management of the switch cane forage type. Such is the primary objective of the present study.

Information will also be obtained pertaining to the principal storage products, the relative importance of aerial stems as storage organs, the gross chemical composition of the leaves and other plant parts at different seasons, and relationships among several chemical components. Such information will provide a basis for simplifying further studies involving food reserves, and will also add something to the present meager knowledge of switch cane physiology.

This physiological approach may prove to have rather wide application in switch cane management research. Since a depletion of the cane's food reserves probably precedes the apparent reduction in vigor and forage productivity resulting from misuse, it seems quite logical to expect that a measurement of the food reserves might be helpful for an early evaluation of management studies and for detecting deterioration of cane vigor before the forage stand is seriously damaged. This application will be tested in the future if the results of the present study indicate that it would be feasible.

Status:

This investigation was begun informally in 1946. Samples of stems and rhizomes have been collected at monthly intervals since July 1946 except for the months of January, February, and March in 1947. Preliminary chemical analyses have been made and the preservation methods and analytical procedures to be followed have been adopted. It has been found that oven-drying (at 70°C) and alcohol preservation of the plant material give comparable results, and that the dried samples are more easily processed in the laboratory.

Methods and Procedure:

Plant material:

Rhizomes and stems are collected at monthly intervals throughout the year. Leaves are also sampled except in late winter when insignificant amounts remain on the plants in the open site where the collections are being made.

Sampling area:

In order to minimize possible effects to site variation, all samples are collected in a restricted area at Hofmann Forest, and from cane of uniform height. This particular area was burned in 1945 and now has a uniform stand of cane 3-1/2 to 4-1/2 feet tall, a limited amount of brush, and very few trees. It is recognized that the specific results obtained will apply only to this area. Other conditions will need to be investigated in order to make general conclusions for the region.

Collection and preparation of samples:

Pieces of sod of convenient size (one to two square feet) are cut out, with the aerial portions intact, and washed free of soil. Roots are removed and surface water allowed to evaporate from the rhizomes. Then; approximately 200 gram samples (green weight) of the leaves, stems, and rhizomes (including the underground portions of the stems) are collected in paper bags, the stems and rhizomes being cut into segments less than an inch long to facilitate drying. Whenever possible, sampling is done about the same time of day (early afternoon) every month.

As soon as they can be transported to Raleigh the samples are dried to constant weight in a forced-draft oven at 65° to 70°C. They are then shipped to the chemical laboratory for analysis.

During 1946 the freshly cut material was placed in glass jars and sufficient 95 percent alcohol was added in the field to provide at least an 80 percent solution after dilution by the water in the plant tissue. The drying method was substituted in 1947 after tests showed that the two methods gave comparable results.

Chemical analysis:

The samples are being analyzed at Beltsville, Maryland, and at Tifton, Georgia under the direction of N. R. Ellis, Principal Chemist in Charge, Animal Nutrition Investigations, Bureau of Animal Industry, U.S.D.A. Determinations are being made for "total available carbohydrates", total sugars, starch, ether extract, crude protein, cellulose, lignin, crude fiber and ash. After relationships among these constituents are established for switch cane, most of the determinations can probably be omitted with impunity in further studies. It is anticipated that the "total available carbohydrate" determination will be most useful.

Records:

The samples are weighed when they are bagged and again when removed from the drying oven.

On each sample date, the following items are noted and recorded:

Stage of growth and condition of foliage

Time (hour) of sampling and drying

Soil moisture conditions and height of water table

Any unusual observations or circumstances

Duration:

The study will be carried through two full years at which time it will be decided from an inspection of the data whether or not more samples are necessary.

Statistical Analysis:

Considering the type of data involved and the experimental design used, it is believed that a statistical treatment would be of limited value in the interpretation of this study. However, the following analysis might be applied to test variation between months and between years, for any one of the chemical constituents.

Source	d.f.
Months	11
Years	1
Months x years (error)	11
Total	23

Forage Species and Construction Methods Useful for Establishing Pasture Firebreaks in the Pond Pine Forest Type.

(Subproject Number 11)

Purpose:

This is an exploratory study to investigate (a) techniques for the construction and establishment of pasture firebreaks and (b) forage species adapted to Coastal Plain forest sites and suitable for use on firebreaks.

Importance:

Wild fire is the major hazard of the forest industry in much of the Coastal Plain of North Carolina. At the time of the 1937 forest survey, almost 100 percent of the pond pine-hardwood type showed evidence of burning, and on 1/4 to 1/3 of its area fire had been severe enough to kill saw-timber trees (Forest Survey Release No. 4 and No. 5, 1940). Although the damage was less severe in other types, from 71 percent (in the northern division) to 82 percent (southern division) of all forest land in the Coastal Plain gave evidence of having been burned over. In this area fire conditions have improved but little in recent years and many areas continue to burn over every two to five years. Fire control is difficult because of the expense and limited accessibility of forest tracts with few fire barriers. The prolific understory of herbs and brush which characterizes the Coastal Plain forests produces intense fires which are difficult and dangerous to combat. Wet conditions which ordinarily prevail over much of the year add to the difficulty and expense of maintaining an adequate system of firebreaks in preparation for the occasional dry periods of high fire hazard.

There are good indications that grazing might be applied to the fire problem to good advantage. Definite benefits of grazing were demonstrated on three recent occasions at Hofmann Forest when wild fires died out or were brought under control upon entering the experimental range pastures. Observations at the Wenona experimental area and elsewhere indicate that fire hazards are materially reduced by grazing. If it were applied specifically for maximum fire protection, the efficiency of grazing as a fire control tool could undoubtedly be greatly increased. One of the most promising applications appears to be in the cheap maintenance of wide fire lanes or "pasture firebreaks" established at strategic locations so as to prevent fire from entering the forest or to break up large tracts and thus confine accidental burns to relatively small areas. This method involves the establishment of a "sod" of pasture plants which will prevent the invasion of inflammable native vegetation onto the lane, and which in itself will be a fire barrier by virtue of being green or closely grazed during the fire season. By themselves, such lanes could not be expected to stop intense fires in a strong wind, but under the dry conditions of bad fire seasons they would serve as emergency access roads and provide relatively safe avenues of attack for fire fighters and equipment.

Scope of study:

As a prerequisite to investigating this means of fire control, information is needed on practical procedures for constructing the fire lanes and preparing the seed bed, and on forage species which are suitable for this purpose and adapted to conditions encountered in forests of the lower Coastal Plain. It is with these preliminary phases that the present study is primarily concerned. The first phase will investigate implements and methods for fire lane construction. Then promising pasture species and mixtures will be tested on the fire lanes. The main criteria in evaluating a species or mixture will be its utility in the maintenance of an effective firebreak under forest grazing conditions. Good forage productivity, particularly from early fall until late spring, is also desirable. If results and observations here indicate that this application of grazing is practicable, the method will be developed further in later studies.

Status:

This is a new subproject.

Methods and Procedure:

Construction of fire lanes and preparation for seeding:

A. Brush cutter only -- no ditches at sides of fire lane.

B. Brush cutter as in "A" but ditched at both edges by use of a fire plow or angle-dozer.

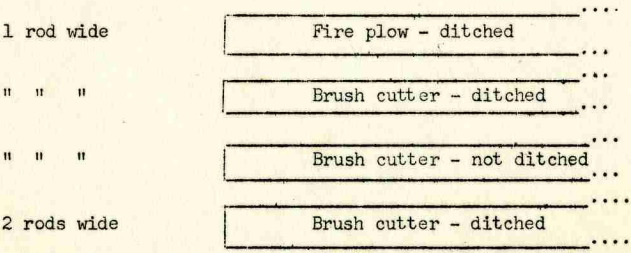
C. Fire plow for working up the fire lane, and angle-dozer or road grader for leveling; with ditches left at both edges.

A bush-and-bog harrow, or other farm implement will be used to supplement these methods if necessary to prepare a suitable seed bed.

Number and width of lanes: (All lanes will be 1/4 mile long.)

Three lanes 1 rod wide: each constructed by a different method. One lane 2 rods wide constructed by method B.

Diagram of lanes



All lanes approximately 75 rods long.

Location of lanes:

The lanes will be oriented north-south in Block I of the Tidewater Experiment Station. They will be spaced at least 200 feet apart. After the sites for the lanes have been selected, the location of the specified types of lanes will be randomly assigned.

Site preparation:

Old trees and reproduction too large to be cut up by the brush cutter or fire plow will be removed in advance by the most feasible method at hand.

Species and mixtures:

The following species will be tested in pure stands and in all possible simple mixtures combining one grass with one legume:

Grasses

Italian ryegrass (Lolium multiflorum)
Tall meadow fescue (Festuca elatior arundinacea), Ky. 31 or Alta strains.
Redtop (Agrostis alba)
Dallisgrass (Paspalum dilatatum)

Legumes

Subclover (Trifolium subterraneum), Mt. Barker or Tallarook strains
Ladino clover (Trifolium repens)
Wetland deervetch ("big trefoil") (Lotus uliginosus)
Kobe lespedeza (Lespedeza striata)

These species represent winter annuals and cool weather perennials of both grasses and legumes, a summer perennial grass, and a summer annual legume. Also grasses and legumes having rather low fertility requirements and tolerant of wet conditions are included. They were selected by the Department of Agronomy, N. C. State College as representing the kinds of forage species offering most promise for firebreak pasture mixtures in the Tidewater section of the N. C. Coastal Plain. No information is now available concerning their value for this particular use.

Rate of seeding and time of planting:

The following rates of seeding are expected to give satisfactory forage stands:

Species	Lbs. of seed per acre	
	In pure stands	In mixtures
Italian ryegrass	50	35
Tall meadow fescue	20	12
Redtop	15	10
Dallisgrass	25	15
Subclover	20	15
Ladino clover	4	3
Wetland deervetch	6	4
Kobe lespedeza	40	20

All plots will be sown as early in September as moisture conditions permit. Since lespedeza and Dallisgrass are not well adapted to fall sowing, these species will be resown in the spring.

Soil treatments:

All lanes will be limed uniformly at the rate of 3 tons per acre. The lime will be applied during the last phase of seedbed preparation.

Fertilizers will be applied so as to provide 60 pounds per acre of P_2O_5 and K_2O for plots containing legumes, and 60 pounds of nitrogen per acre for plots with grass only.

All lanes will be uniformly fertilized with 2-12-12 at the rate of 300 lbs. per acre except the 8 check plots which are not seeded. These receive no fertilizer.

The plots containing legumes will receive an additional 200 lbs. per acre of 2-12-12 fertilizer. The plots without legumes (except the eight check plots) will receive additional nitrogen fertilizer equivalent to 54 lbs. of nitrogen per acre. "Cal-Nitro" (20%N) would be preferable if it is available. Nitrate of soda (16% N) will be satisfactory. The additional 54 lbs. of nitrogen per acre will require 340 pounds of soda, or 270 pounds of "Cal-Nitro" per acre.

These rates of liming and fertilizing have been suggested by the Department of Agronomy as about the minimum which will probably be satisfactory for obtaining a good stand of all the species being tried. Although there is a need for information concerning the response of those species to different levels of lime and fertilizer, particularly under the conditions being investigated here, this phase has been omitted to simplify the experimental design.

Number and size of plots, and experimental design:

Plots will be the width of the lanes and 24 feet long, allowing 50 plots per lane.

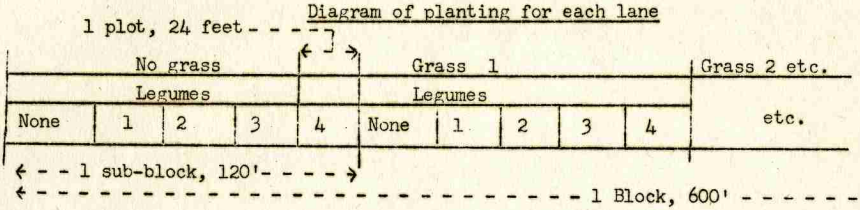
There will be two blocks (replications) per lane, with 25 plots per block.

Blocks will be divided into sub-blocks of 5 plots; 4 plots seeded to one each of the legumes and the other with no legume.

Each of the four grasses will be seeded over an entire sub-block; the other sub-block will have no grass (only legumes and a check plot not seeded).

Species will be assigned to plots and sub-blocks at random.

Diagram of planting for each lane



Management of fire lanes:

The lanes will be open to grazing at all times except for the first month or two of the initial growing season. Brush or other invading species will be removed the second or third year if necessary to maintain the usefulness of the lane as a firebreak. For this purpose a brush cutter, bush-and-bog harrow, or other suitable equipment will be used.

If additional fertilization appears to be needed during the second or third season, the design can readily be modified to incorporate this treatment on half plots.

Records:

Records will be kept of the cost of establishing a suitable seedbed on each lane; equipment and man hours required for each phase of construction, the number of trips over the same area required for each type of equipment, etc. Also observations concerning the apparent adaptability of each kind of equipment for the site conditions encountered will be recorded.

Forage stand will be estimated in early summer and early winter and rated 1 to 10, 1 being excellent.

Density of ground cover will be estimated (in tenths) for forage species and weeds in late fall or early winter.

Apparent inflammability of ground cover will be rated during the usual fire season of late winter and early spring; rate 1 to 10, 1 being minimum inflammability (excellent protection). It may be feasible to augment this rating by firing one edge of each lane with a torch during dry weather and recording the distance and rate of fire penetration into each plot.

Observations of relative palatability, seasonal growth, and general performance of individual species and mixtures will be made and recorded periodically.

Forage yield will not be attempted the first year. This measurement will be included later if it seems to be desirable and if facilities and available labor permit.

Statistical analysis:

The following analysis will be applied to forage stand an inflammability data (analysis shown for one year):

Source	d.f.	
Lanes (L)	3	
Blocks (B)	1	
B x L (error a)	3	(applies to B)
Grasses (G)	4	
G x L	12	
G x B	4	
G x B x L (error b)	12	(applies to G, GxL, & GxB)
Legumes (Lg)	4	
Lg x L	12	
Lg x B	4	
Lg x B x L (error c)	12	(applies to Lg, Lg x L, & Lg x B)
Lg x G	16	
Lg x G x L	48	
Lg x G x B	16	
Lg x G x B x L (error d)	48	(applies to Lg x G, Lg x G x L, Lg x G x B, Gx B x L, and Lg x B x L.
Total	199	

This analysis can be refined further to test the performance of individual species or mixtures.

Note: There is no error term for testing the significance of differences between lanes. If appreciable differences occur, field observations will probably account for them. A future replication of this study, here or elsewhere, will provide an estimate of error for testing lane differences.

Dr. H. L. Lucas of the Institute of Statistics, N. C. State College, has approved the design of study and has suggested the analysis presented here.

Duration:

At least three years.

Materials needed:

Machinery and equipment:

A heavy fire plow, an "angle-dozer" or heavy road grader, a rotary brush cutter, a bush-and-bog harrow, and a track-type tractor.

Land area to be seeded:

Three lanes 1 rod wide, and one 2 rods wide, at least 75 rods long; approximately 1/2 acre in each narrow lane and one acre in the wide lane, a total of about 2-1/2 acres.

Lime and fertilizer:

Lime - 7-1/2 tons

2-12-12 fertilizer- 1150 pounds

Sodium nitrate 170 pounds or "Cal-Nitro" 135 pounds

Seed:

Sufficient seed of each species to plant .1 acre in pure stands and .4 acre in mixtures at the rates specified.

Grazing Capacity of Switch Cane by Seasons in Relation to Density and Height of Cane and Tree Cover, and Response of Switch Cane to Utilization at Different Seasons.

(Subproject Number 12)

Purpose:

The purpose of this study is to obtain information vital to the development of a range appraisal method and useful for developing management systems for the switch cane forage type. The specific aims are to determine (1) forage productivity (in cow days of grazing) and forage quality (as indicated by chemical analysis) at five different seasons in relation to density and height of cane; (2) response of switch cane to heavy utilization at these five seasons as reflected in cane vigor and forage production during successive years; (3) the effect that tree cover may have on (1) and (2).

Importance and Scope of Study:

Efficient management of native range involves, first, the determination of the amount of available forage, or grazing capacity, and second, the application of grazing systems which will most nearly produce the results desired. Usually the objective is maximum beef production and a sustained forage yield. In some instances, however, it may be preferable to partially destroy the forage resource, and perhaps sacrifice something in cattle gains, in order to obtain other benefits such as fire control, increased pine reproduction, hardwood control, etc.

To date, no evaluation factors have been devised for determining grazing capacity of switch cane range with any precision. From long experience, the capacity of the highly productive experimental ranges at Wenona have been quite accurately determined. At Hofmann Forest, however, the capacity of the experimental ranges was over-estimated at the beginning of the study and the stand of switch cane was severely damaged before the situation was corrected. Hence, there is no standard of correct utilization for medium and small cane such as occur at Hofmann Forest and generally throughout the pond pine forest type.

One orthodox method is to determine grazing capacity from a range survey, or inventory of kinds and amounts of grazable forage. The "amounts" are sometimes estimated in units of weight, but usually they are expressed in terms of "density", or ground cover, which has been found to be a usuable and rapid method of forage appraisal on native ranges. Certain "productivity" factors are then applied in order to convert the density data to grazing capacity. These productivity factors are intended to express the relative amounts of usable forage represented by a unit of density of the various forage species. For example: If the productivity factors, or ratings, of species A and species B were 40 and 80, respectively, then a unit of density (a square foot, acre, etc.) of species A would represent one-half as much usable forage as would a unit of species B. Such factors or ratings may vary with seasons. Some species, for instance, are not usable in winter and others are grazed only during the spring. For switch cane, at least, the ratings may require adjustment for the size of the plants. Forage quality and also productivity per unit of density appear to be correlated with cane height which in turn, probably reflects site quality.

A first step in developing factors for the calculation of grazing capacity of switch cane ranges from forage surveys is to determine the gross forage production in terms of cow days or months of grazing per unit of foliage density. This should be determined by seasons corresponding to growth habits and forage characteristics of the species. The relation of height of cane to productivity should be established also. The relationship of density to forage yield (by weight) can be determined by clipping or plucking the forage from plots on which density estimates have been made. This determination offers another approach to the grazing capacity problem and also provides a check on the accuracy of the "density estimation" technique as applied to range appraisal. After factors expressing the relationship of foliage density and cane height to forage yield and grazing capacity are determined, they can be adjusted for correct utilization, or "proper use", when the latter is determined from further studies.

Heavy utilization for a short period, amounting to almost complete defoliation during a restricted season, should reveal the season or seasons when switch cane is vulnerable or resistant to grazing. The problem will then be to determine the degree of utilization this species will tolerate during the periods when it is sensitive to over-use. In previous studies this species has been grazed during either the entire summer or winter seasons. Winter grazing has not reduced the vigor and productivity of the cane stand appreciably. Continuous heavy summer grazing has seriously damaged this species in two or three years. Since the summer grazing season has extended from May until Septemer or December, it has not been possible to determine whether or not switch cane is particularly susceptible to grazing damage during certain portions of that period. Limited facilities preclude the investigation of different degrees of utilization in this study at the present time.

A good opportunity to investigate the effect of tree cover on grazing capacity and tolerance of utilization is offered at the Tidewater Station where cane stands occur both in forested sites and in open sites without trees.

Status:

This is a new subproject.

Methods and Procedure:

Treatment:

Practically complete utilization of switch cane foliage during each of the following periods:

1. May - June (active growth stage)

2. July - August (late growth and early full leaf stage)

3. Sept. - Oct. (mature leaf stage)

4. Nov. - Dec. - Jan. (early winter)

5. Feb. - Mar. - Apr. (late winter - before spring growth)

Conditions:

Trees vs. no trees: The study will be conducted both on a site having a fairly dense stand of young pond pine trees (20 to 30 feet tall) and on an open site with no pine-overstory.

Cane height and density: The range pastures will be so located that the average density and average height of switch cane will vary considerably between pastures but will be as uniform as practicable within individual pastures.

Size and number of experimental ranges

2 reps. (10 pastures) under trees

2 reps. (10 pastures) in the open (no trees)

Pastures (paddocks) will be approximately one acre in size; those having least forage will be slightly larger and those having most forage will be slightly smaller in order to keep the grazing periods reasonably comparable.

Location of paddocks and treatment assignment:

The pastures will be located in Blocks J and K of the Tidewater Experiment Station. Within each of the two conditions, trees vs. no trees, the treatments and replications will be assigned at random, disregarding cane density and height which will be evaluated by the application of covariance analysis.

Small plots:

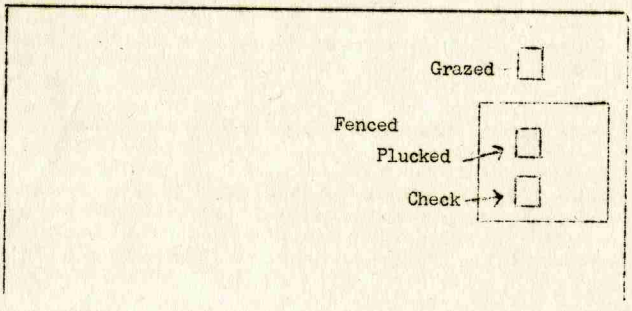
Small plots, initially comparable as to density and size of switch cane enclosed, will be staked out in triplicates within each paddock on an area having forage and tree conditions representative of the paddock. Two of these plots will be protected from grazing by a fenced enclosure; the third will be open to grazing. One of the fenced plots will be plucked by hand, at the time the cattle are removed, to simulate the degree of utilization of the grazed plot (and the paddock).

These small plots are not intended to sample the paddocks (which will be carefully surveyed by other methods), but are being used to evaluate some of the results through precise measurements which would not be feasible on the entire paddock. Specifically, the small plots will provide an estimate of: (a) yearly variations in forage growth (fenced plots), (b) cumulative effects of the grazing treatments (fenced plots vs. grazed plots), (c) trampling and breaking effects on cane involved in grazing as against merely utilization effects (grazed vs. plucked plots), (d) forage yield, (by weight) from year to year under the five "treatments" as related to density and height of cane (plucked plots), and (e) the accuracy of the density estimate method as a means of estimating grazing capacity. For this last purpose (e) the plucked plots in the paddock enclosures will be supplemented by plucking 10 additional plots of ungrazed cane of various heights to better determine the regression of density and height on forage yields.

Figure 1. Diagram illustrating the design and showing a random assignment of grazing periods and replications. The shape of individual pasture will not necessarily be regular, but will be adjusted to fit the areas of uniform forage and tree conditions.

Trees		No trees	
May-June	July-Aug.	Nov.-Dec. Jan.	July-Aug.
Sept.Oct.	Feb.-Mar.-Apr.	May-June	Feb.-Mar. Apr.
July-Aug.	Nov.Dec.-Jan.	Sept.-Oct.	Feb.-Mar. Apr.
May-June	Sept.-Oct.	Nov.-Dec. Jan.	Sept.-Oct.
Feb.-Mar. Apr.	Nov.-Dec.-Jan.	May-June	July-Aug.

Figure 2. Diagram of small plots in a single pasture. These plots, in triplicate, will be located in an area selected as representative of the forage conditions in the pasture.



The size of the small plots will be 3.1 x 3.1 feet. This size permits convenient access to the entire plot from the edges and also simplifies conversion of forage yields per plot to pounds per acre (grams per lot x 10= pounds per acre).

Number of cattle and method of grazing:

Stocking will be at the rate of two cows per pasture. A total of eight cows will be required since only one pasture of each replication will be grazed concurrently. A check group of about 4 cows (grazed on switch cane range) should be provided for comparing gains and for replacements. Mature cows, comparable in condition and without calves at their side, will be used if possible. Pairing will be at random unless there is considerable variation in size, in which case light cows will be paired with heavy cows. The pairings will be maintained, and cows will continue on the same tree conditions (trees vs. no trees), for a complete grazing cycle (one year). Within the tree conditions, assignment to replications will be at random.

The cattle will be turned into appropriate pasture early enough in the designated grazing period to insure that the cane foliage will be fully utilized before the end of the period. If it appears that two cows will not fully utilize a particular pasture in the specified time, an extra cow from the check group can be added. When the pastures have been utilized to the point where the cows fail to obtain a "fill", the cattle will be removed and held on auxiliary switch cane range until time to begin the next grazing period. Grazing will begin in May after the cane has put out two or three full leaves. It is anticipated that any one of the pastures will support the two cows for two to six weeks. The grazing will be done near the middle of each of the five grazing periods. During the winter the cows will be fed one or two pounds of protein supplement (cottonseed or soybean meal) because switch cane forage is deficient in protein at this season.

Records and Measurements:

Range pastures:

Forage surveys will be made of each pasture at beginning of study to determine botanical composition of vegetative cover and especially the density and height of switch cane. For this purpose, each pasture will be sub-divided into 10 to 20 portions, and a forage writeup made for each separate portion. These will be combined to obtain the average for a pasture. Grazing dates will be recorded for each pasture.

Degree of utilization will be estimated for each pasture when the cows are removed.

Photo stations will be established in one replication of pastures (10 total). These will be photographed before and after grazing each year.

Plots:

On each plot the following records will be made at the beginning of the study, and each year thereafter (during the full leaf stage of growth):

Foliage density

Number and size of cane stalks

Number and size of new basal shoots

Average number of branches per stalk and leaves per branch

Average size of leaves

In addition, forage yield (converted to dry weight) will be recorded for the plots harvested by hand during each grazing period.

Amount of regrowth after utilization will be noted periodically and at the end of the growing season.

Supplementary data:

Samples of cane rhizomes and stalks will be collected from each paddock for carbohydrate analyses at the close of the study and possibly at the end of each season.

A sample of cane forage for feed analyses will be collected from each pasture while the pasture is being grazed.

The cattle will be weighed as they are turned in and taken out of the pasture. A check group of about four cows, grazed on abundant cane forage, will be weighed at the same time.

Initiation and Duration:

The study will be started in May 1948 and will continue for at least three full seasons.

Statistical analysis:

For grazing capacity of the pastures in cow days per acre, the analysis for one year will be:

Source	d.f.
Trees vs. no trees (T)	1
Reps. within T (error a)	2
Seasons of utilization (S)	4
S x T	4
S x Reps. within T (error b)	8
Total	19

The regression of grazing capacity on Height and Density of cane will be determined; also, the partial regression on "forage other than cane" will be included if this proves to be important, leaving five degrees of freedom for the final error term.

The effect on grazing capacity of utilization at different seasons will be reflected by the analysis given above during successive years. The small plot data will give supplemental information on items affecting grazing capacity. Such items as number and size of new shoots, and number and size of leaves reflect the vigor of the switch cane as affected by season of utilization. These items, or others measured on the small plots, can be analyzed independently (for example, forage yield on plucked plots) or as paired comparisons (grazed vs. check plots, grazed vs. plucked plots, etc.).

Two examples of the small plot analyses (for one year) follow:

A. Forage yield from plucked plots:

Source	d.f.
Trees vs. no trees	1
Season of grazing	4
Trees x Season	4
Reps. within Trees x Season (error)	10
Total	19

Regression of yield on Density and Height will reduce the degree of freedom for error to 8.

B. Difference in number of new shoots on grazed plots vs. check plots:

Trees vs. no trees (T)	1
Season of Grazing (S)	4
T x S	4
Reps. within T x S	10
Grazed vs. check (G)	1
G x T	1
G x S	4
G x T x S	4
G x Reps. within T x S	10
Total	39

The regression or other factors, such as number and size of stalks, foliage density, etc., which may affect the number of new shoots, can be investigated by utilizing 1 d.f. for each factor.

Note: Dr. H. L. Lucas of the Institute of Statistics, N. C. State College, has approved the design of this study from the statistical point of view and has suggested the statistical analyses presented here.

Equipment and Material Required:

Fencing:

Approximately two miles of fence line; 24 rolls of barbed wire (for three strands); and almost 700 posts (at 15' intervals). The post requirement can be reduced by at least one-fourth by attaching wire to standing trees.

Other Equipment:

Watering facilities will be needed for eight cows in four groups; including four watering tubs and four hand pumps or six shallow open wells.

A.H. 30.7(33.31-134.10)

MEMORANDUM OF UNDERSTANDING
Between
THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION
THE NORTH CAROLINA DEPARTMENT OF AGRICULTURE
and
THE BUREAUS OF ANIMAL and PLANT INDUSTRY and the FOREST SERVICE
of the
UNITED STATES DEPARTMENT OF AGRICULTURE

Supplementing the Memorandum of Understanding (Approved August 29, 1940, by the Office of Experiment Stations) between the North Carolina and Georgia Agricultural Experiment Stations, the North Carolina Department of Agriculture, and the Georgia Coastal Plain Experiment Station, and the Forest Service and the Bureaus of Animal and Plant Industry, United States Department of Agriculture, for studies of the relation of forest grazing to beef cattle production in the southeastern United States.

1. Name of Project: The role of forest grazing in beef cattle production in the southeastern United States.

2. Object: To determine the possibilities and practices to follow in utilizing southeastern forest land areas in systems of beef cattle production as a source of supplemental forest and farm income. Studies involved in the attainment of this objective include:

   A. Range forage.

      1. Makeup of vegetation on important grazed forest land types.
      2. Growth characteristics and growth requirements of important grazed plants.
      3. Utilization and palatability of important plants.
      4. Nutritional values of important plants.

   B. Forest range management.

      1. Management practices, including their effect on range forage, trees, and animals, such as:

a. Intensity and season of grazing.
b. Rotational and other systems of grazing.
c. Forest burning.

2. Grazing capacity as related to other factors of management and forage growth.

C. Beef cattle production.

1. Production of feeder cattle.
   a. Controlled versus year-long breeding season for breeding herd.
   b. Correcting nutritional deficiencies.
   c. Wintering on range with and without supplementary feeds, versus wintering on farm pastures or harvested feeds in dry lot for breeding herd and feeder stock.
   d. Other seasonal grazing and feeding problems.
   e. Creep-fed versus non-creep-fed calves.
2. Production of slaughter cattle.
   a. Methods of creep-feeding calves.
   b. Methods of finishing yearlings and two-year-old feeders through various types of supplementary feeding on the forest range versus use of harvested feeds in the dry lot and in conjunction with cultivated pastures.

D. Values from various range and livestock practices on forest and related farm lands in relation to range forage and feed costs and to cattle and timber production.

3. Cooperating Organizations: The North Carolina Agricultural Experiment Station through its Departments of Animal Husbandry, Agronomy, and Forestry; the North Carolina Department of Agriculture through its Divisions of Branch Stations; and the United States Department of Agriculture through its Bureaus of Animal and Plant Industry and Forest Service. As progress of the work under this project warrants, arrangements may be made by mutual agreement for desirable participation of other agencies.

4. Location of Work: In laboratories and other buildings and on land made available by the North Carolina Agricultural Experiment Station and the North Carolina Department of Agriculture primarily at or near Wenona, but also at or near Raleigh, and Pollocksville, N. C., and in laboratory buildings and lands of the United States Department of Agriculture.

5. **Date Effective:** This project shall become effective on the date of the final signature required for its execution.

6. **Organization:** The leaders of the research covered by this cooperative project shall be the Director of the North Carolina Agricultural Experiment Station, the Commissioner of the North Carolina Department of Agriculture, and the Chiefs of the Forest Service and the Bureaus of Animal and Plant Industry, United States Department of Agriculture. Each of these leaders may assign specialists of their respective forces to the work on this project, who will be responsible for the preparation of current work plans and who will supervise and conduct the investigations.

7. **Method of Procedure:** During the early stages of the project, exploratory or pilot studies will be undertaken to determine: (1) The make-up, growth requirements, and forage value of the vegetation on important forest land types; (2) the results from present use, seasonally and in varying degrees, of such lands in beef cattle production; (3) the influence of burning; (4) nutritional deficiencies; and (5) other related problems in the normal growth, development, and reproduction of cattle, and their sale value when grazing forest lands as a part of the systems of beef cattle production in the Southeast. These exploratory studies will aim to indicate those features of basic knowledge on which more information is urgently needed, and to define the more important phases of the problem that will require intensive study.

The intensive studies which will be undertaken as rapidly as exploratory studies justify, will attack the problems in a joint and unified program of work, on such phase or phases as are mutually agreed can best be handled with available funds and facilities. Detailed plans of work for these intensive studies, with appropriate outlining of financial obligations, will be prepared and revised as necessary annually by the responsible representatives of the several agencies.

The Bureaus of Animal and Plant Industry and the Forest Service will assume leadership for the U. S. Department of Agriculture, in regional coordination of the subject matter involved in this project in their respective research fields of animal and forage crop production, and forest and range land use.

It is understood that while all parties are interested in fundamental research, the United States Department of Agriculture is primarily concerned with results having regional application, and the North Carolina Agricultural Experiment Station and the North Carolina Department of Agriculture with results having local application.

8. Interest of Members of Congress: No member or delegate to Congress shall be admitted to any share or part of this agreement, or to any benefit to arise therefrom, in accordance with U. S. Code, Title 41, Section 22.

9. Agreement:

(a) The North Carolina Agricultural Experiment Station and the North Carolina Department of Agriculture agree:

1. To assign to these investigations such members of their staffs as may be mutually agreed upon as necessary to assist in planning, supervising, and conducting the research outlined herein.
2. To furnish such land, equipment, materials, cattle, forage, laboratory and office facilities, and other services, as mutually agreed upon.

(b) The Bureau of Animal Industry, United States Department of Agriculture, agrees:

1. To provide such technical service and labor as may be mutually agreed upon in the research outlined herein.
2. To provide necessary travel and subsistence for its employees.
3. To provide supervision in connection with the development of the research program.
4. To provide as mutually agreed upon such feed, materials, and miscellaneous equipment as will be used exclusively for the work outlined in this project.

(c) The Forest Service agrees:

1. To provide such technical service and labor as may be mutually agreed upon in the research outlined herein.
2. To provide necessary travel and subsistence for its own employees.

3. To furnish supervision in Washington, D. C., and in the field through its Appalachian Forest and Range Experiment Station, in connection with the research program.
4. To provide miscellaneous expenses as mutually agreed upon, such as feed, labor, equipment, materials, and incidentals not provided by the other cooperators.

(d) The Bureau of Plant Industry agrees to furnish such technical service, advice, and consultation as may be mutually agreed upon in the research outlined herein.

(e) In the interest of efficient conduct of the project, the Bureaus of Animal and Plant Industry and the Forest Service agree to arrange when mutually acceptable, for the interchange of travel, facilities, and responsibilities hereunder.

10. Limitations of Expenditures by the Government: The expenditures of the United States Government will not exceed $12,500 each for the Forest Service and the Bureau of Animal Industry for the fiscal year ending June 30, 1941. The amount thereafter will be determined by appropriations by Congress. No additional funds over those now being spent by the Bureau of Plant Industry in the area are anticipated.

11. Limitations of Expenditures by N. C. Agr. Expt. Station and N. C. Dept. of Agr.: The annual cost to the North Carolina Agricultural Experiment Station and to the North Carolina Department of Agriculture will be determined by the land, facilities, and personnel furnished in these investigations. It is estimated that these services will be at least equal in value to those furnished by the United States Department of Agriculture.

12. Disposition of Products, Fees, etc., Arising out of the Work: All equipment, materials, and facilities procured in connection with this project will remain the property of the agency procuring the same and be subject to disposition by such agency. In most cases the products from this project will be disposed of by the party owning them, but in the event that property belonging to one of the parties is to be disposed of by any of the other cooperating agencies, said party will make such disposition strictly in accordance with authorized instruction from the party that owns said property. Such authority for disposition of property owned by either of the cooperating State agencies will

be granted only by the leader concerned, or his duly authorized representative, and likewise authority for disposition of property owned by the Forest Service and the Bureau of Animal or Plant Industry will be granted only by the Chief of the Service or Bureau concerned or his duly authorized representative.

13. Provision for Termination: This Memorandum of Understanding will remain in force until June 30, 1960, unless terminated earlier by mutual agreement. Any agency to this agreement may terminate its participation by written notice to each of the other cooperating agencies not less than 90 days prior to the end of any fiscal year. Such termination on the part of a cooperator will not nullify this agreement in respect to the remaining agencies.

SIGNATURES: IN WITNESS WHEREOF, the parties to this Memorandum of Understanding have executed this instrument on the date set opposite their signatures.

Oct 17, 1940 — Date
Ralph W. Salter
Director, North Carolina Agricultural Experiment Station

Oct-18-40 — Date
W. Kerr Scott
Commissioner, North Carolina Department of Agriculture

October 22, 1940 — Date
C. I. Forsling
Acting Chief, Forest Service

Date
R. W. Miller
Acting Chief, Bureau of Animal Industry

Oct. 23-1940 — Date
E. C. Auchter
Chief, Bureau of Plant Industry

APPROVED:

OCT 24 1940 — Date
James Jardine
Chief, Office of Experiment Stations

RWS
AMM

A.H. 30.6(33.30-110.15(134.9)

MEMORANDUM OF UNDERSTANDING
of
THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION
THE NORTH CAROLINA DEPARTMENT OF AGRICULTURE
THE GEORGIA EXPERIMENT STATION
THE GEORGIA COASTAL PLAIN EXPERIMENT STATION
and
THE FOREST SERVICE, THE BUREAUS OF ANIMAL AND PLANT INDUSTRY
UNITED STATES DEPARTMENT OF AGRICULTURE

---

1. **Object:** To study the utilization by cattle of forage on forest or cutover forest land in the southeastern United States in relation to production of beef and timber.

2. **Name of Project:** Studies of the relation of forest grazing to beef cattle production in the southeastern United States.

3. **Cooperating Organizations:** The North Carolina Agricultural Experiment Station, North Carolina Department of Agriculture, Georgia Experiment Station, Georgia Coastal Plain Experiment Station, the Forest Service and the Bureaus of Animal and Plant Industry of the U. S. Department of Agriculture.

4. **Location:** In the southeastern States of the United States. Work is to be conducted largely on the Coastal Plain areas in North Carolina and Georgia.

5. **Date Effective:** This memorandum of understanding shall become effective July 1, 1940.

6. **Organization:** Leaders of the research shall be the Director of the North Carolina Agricultural Experiment Station, Commissioner of the North Carolina Department of Agriculture, Directors of the Georgia Experiment Station and the Georgia Coastal Plain Experiment Station, and the Chiefs of the Forest Service, Bureaus of Animal and Plant Industry. Each of these leaders may assign specialists of their respective force to this work.

7. **Method of Procedure:** Detailed procedures for conducting investigations covered by this document shall be worked out and agreed upon by the project leaders concerned. Modifications that may be necessary from time to time may be made in the form of letters, subject to the approval of the leaders named above.

8. Anticipated Duration of Project: Approximately 20 years.

9. Legal Authority for the Work: Appropriations for salaries and expenses of the U. S. Department of Agriculture and Acts governing the activities of the North Carolina Agricultural Experiment Station and the North Carolina Department of Agriculture; the Georgia Experiment Station and the Georgia Coastal Plain Experiment Station.

10. Government Liability for Damages: Responsibility of the Federal Government for damages will be governed by the usual rules of law.

11. Interest of Members of Congress: No member or delegate to Congress shall be admitted to any share of this memorandum of understanding or to any benefit to arise therefrom, in accordance with U. S. Code, Title 41, Section 22.

12. Agreement:

(a) The North Carolina Agricultural Experiment Station or the North Carolina Department of Agriculture agrees separately or together to furnish such land, equipment, cattle, forage, laboratory facilities, technical assistance and supervision as may be available for the investigations conducted in North Carolina.

(b) The Georgia Coastal Plain Experiment Station or the Georgia Experiment Station agrees separately or together to furnish such land, equipment, cattle, forage, laboratory facilities, technical assistance and supervision as may be available for the investigations conducted in Georgia.

(c) The Forest Service agrees to provide in connection with its responsibilities: (1) Technical services and supervision in Washington, D. C. and in the field; (2) labor; (3) as mutually agreed upon miscellaneous expenses as needed, such as feed, equipment and incidentals not provided by the other cooperators; (4) travel and subsistance for its own technical workers and for cooperators in the cooperating States in connection with these investigations; (5) transportation facilities for use in connection with the work.

(d) The Bureau of Animal Industry agrees to provide in connection with its responsibilities: (1) technical service and supervision in Washington, D. C., and in the field; (2) labor; (3) as mutually agreed upon miscellaneous expenses as needed, such as feed, equipment and incidentals not provided by the other cooperators; (4) travel and subsistence for its technical workers and for cooperators in the cooperating States in connection with these investigations; (5) trans-

12. Agreement: (Cont'd.)

portation facilities for use in connection with these investigations.

(e) The Bureau of Plant Industry agrees to furnish advice and consultation in connection with these investigations.

13. Limitations of Expenditures by the Government:

The expenditures of the United States government will not exceed $25,000 each for the Forest Service and the Bureau of Animal Industry for the fiscal year ending June 30, 1941. The amount thereafter will be determined by appropriations by Congress. No additional funds over those now being spent by the Bureau of Plant Industry in the area are anticipated.

14. Limitation of Expenditures by the Cooperating States:

The annual cost to the various cooperating agencies in the States will be determined by the land, facilities and personnel furnished in these investigations. It is estimated that these services will be at least equal in value to those furnished by the U. S. Department of Agriculture.

15. Publication of Results:

The results obtained through the progress of this work are to be compiled under the supervision of the leaders. The results of the experimental work herein outlined may be published jointly or by any of the cooperators, but manuscripts proposed for publication by any party shall be submitted to the other parties for suggestions and approval before publication. In the event of disagreement, any party may publish results on its own responsibility giving proper acknowledgment of cooperation.

16. Use of Government Frank:

The cooperating States may use franked envelopes and labels bearing the address of the Forest Service or of the Bureaus of Animal or Plant Industry, for transmitting to these Bureaus scientific data and material pertaining to the work of this project that are exclusively for the use of the United States Government.

17. Disposition of Products Fees, etc., arising out of the Work:

In most cases the products from this project will be disposed of by the party owning them, but in the event that property belonging to one of the parties is to be disposed of by any of the other cooperating agencies, said party will make such disposition strictly in accordance with authorized instruction from the party that owns said property. Such authority for disposition of property owned by any of the coop-

17. Disposition of Products: (Contd): erating State stations will be granted only by the Director of that station or his duly authorized representative, and, likewise, authority for disposition of property owned by the Forest Service, and the Bureaus of Animal or Plant Industry will be granted only by the Chief of the Service concerned or his duly authorized representative.

18. Provision for Termination: Any of the parties to this memorandum of understanding may terminate its participation by written notice within 90 days prior to the end of any fiscal year. Such termination on the part of a State cooperator will not nullify this memorandum of understanding in respect to the remaining agencies. This memorandum of understanding shall remain in force until June 30, 1960, unless terminated earlier by mutual agreement.

SIGNATURES: IN WITNESS WHEREOF, the parties to this memorandum of understanding have executed this instrument on the date set opposite their signature.

Aug 7 1940 — Date
act I O Schaub — Director, North Carolina Agricultural Experiment Station

Aug-8-1940 — Date
W Kerr Scott — Commissioner, North Carolina Department of Agriculture

Aug 19, 1940 — Date
S V Stort — Director, Georgia Coastal Plain Experiment Station

Aug. 19 1940 — Date
H P Stuckey — Director, Georgia Experiment Station

Date
Chief, Forest Service

Aug. 27, 1940 — Date
Acting M. A. McCall — Chief, Bureau of Plant Industry

AUG 27 1940 — Date
A. W. Miller — Acting Chief, Bureau of Animal Industry

APPROVED:
AUG 29 1940 — Date
R. M. Trullinger — Acting Chief, Office of Experiment Stations

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

PROJECT OUTLINE

Project No. S46-ai17

1. Title: Beef Cattle Especially Adapted to the Coastal Plains Region of North Carolina and Similar Areas.

2. Objective(s)

1 - To learn whether beef cattle resulting from crossing grade Hereford cows to Brahman and Africander bulls are more productive in the Coas al Plains Region (particularly for reed-grazing) than high-grade Herefords.

2 - If the crossbreds are more productive, to develop a relatively pure-breeding strain from one or both of the crossbred groups.

3. Reasons for Undertaking Investigations*

It is well known that the British breeds of beef cattle do not perform as satisfactorily as Brahmans or Africanders in tropical or sub-tropical climates. Crosses of the common beef breeds with either the Brahman or the Africander also perform better in such climates than do the British breeds.

Reed grazing in Eastern North Carolina is potentially important for beef production. It is desirable, therefore, to know what kind of cattle will be most productive in the area and in particular whether cattle carrying Brahman or Africander blood will enjoy the same advantage demonstrated in slightly more extreme(tropical) climates. If they are better by even a portion of the amount by which they excel the British breeds in some other portions of the United States, their use in the area would be of tremendous economic importance.

4. Previous Work and present status of investigations in the field of this project:

The original use of Brahman cattle in the southern portions of the United States was stimulated by the fact that even rather dilute infusions of Brahman blood gave a measurable increase in resistance to "tick fever". Subsequently, that disease was essentially eradicated in this country. By that time, however, it had been recognized that cattle carrying Brahman blood, being more heat-resistant, performed better in warm climates than the British breeds. The result was that cattlemen in the extreme southern portions of the United States continued to raise them.

*Including economic justification

4. Prev. work, etc. (cont.)

The King Ranch, in Texas, used Brahman bulls extensively in their Shorthorn cow herd and, by selecting the inter-breeding the best crossbred animals and their descendants, developed the Santa Gertrudis breed. These cattle perform more satisfactorily on the King Ranch than either Shorthorns or Herefords.

The United States Department of Agriculture has crossed Brahman and Angus cattle at their field station at Jeanerette, Louisiana. They find the crossbreds superior to Angus and are now in the process of developing from them a new beef breed adapted to that area. Significantly, these cattle developed at Jeanerette perform more satisfactorily there than do the Santa Gertrudis developed in Southern Texas, where the annual rainfall is considerably less.

Africanders were imported into the United States in 1931 by the King Ranch. Angus-Africander crosses have been made at Jeanerette but were not as satisfactory there as the Brahman crosses. Africander-Hereford crosses, however, made at the King Ranch have been reported highly successful.

It is pertinent to inquire why the proposed research should begin with first crosses instead of with cattle already developed at other places, i. e., with the Santa Gertrudis breed or with cattle obtained from Jeanerette. The climate in eastern North Carolina, however, differs from that in either Southern Texas or Southern Louisiana. Annual rainfall is twice as great as on the King Ranch and the mean temperature less than in Louisiana. Further, the predominant forage type is different than in those areas. While information on the specific adaptability of animals to different climatic conditions and types of feed is inadequate, there is ample reason to believe that breeds of livestock are better adapted, on the average, to the conditions under which they are developed than to other conditions.

At the same time, even though one or both of the two strains mentioned above were well adapted to Eastern North Carolina, there still would be good reason for developing a third. Hybrid vigor has been demonstrated in cattle. To utilize this phenomenon in the production of superior market animals it is necessary to have unrelated strains to cross. From that standpoint a good strain based on the Hereford and Africander breeds should be very desirable since it would be most divergent genetically from either of the now existing strains. (Neither of them contain either Africander or Hereford breeding).

5. Outline of Procedure:

The female foundation stock is comprised of the overflow females from the grade Hereford herd at Hofmann Forest. About 15 females were bred to the Africander bull and an equal number to the Brahman bull in 1944. Between 35 and 40 females were mated to each in 1945. It is anticipated that the number of breeding females in each group will be increased to between 75 and 100. The production of F_1's will continue until this number F_1 and F_2 females are available. Since grade Herefords will be produced at the Forest each year, the two crossbred groups can be compared to them as well as to each other. The comparative growth rates of the F_1's and grade Herefords should be established within 3 or 4 years. This and data on the calf production of the F_1 females will be the basis

5. Outline of Procedure (cont.)

for deciding whether either of the crosses show sufficient promise to justify using it as a foundation from which to attempt the development of a new strain.

All F_1 females excepting only decidedly inferior ones will be retained for breeding. They will be bred as two-year-olds to bulls of their own F_1 group. Intense selection based on growth rate, conformation, vigor, temperament and mothering ability will be practiced starting with the F_2 generation. Both the records of individuals and of their progeny when available will be considered.

If when the F_3 generation has been reached the animals in either group are deficient in a specific trait or traits, some females will be backcrossed to bulls of either parent breed, or outcrossed to bulls of another breed. The extent of such matings cannot be forecast.

The data to be recorded is as follows:

1. On calves
   a. At birth or shortly after - date of birth, sex, weight (if practical) and color.
   b. At weaning - weight, conformation, condition, and color.
   c. At beginning and end of each grazing season until maturity (for those retained - weight and conformation.

2. On cows - weight and condition at or shortly after calving and at weaning time. Conformation will be recorded at weaning time.

3. On bulls - weight, condition and conformation at beginning of breeding season; and per cent of cows bred that conceived.

4. On all animals - pedigrees and coefficients of inbreeding; and all unusual characteristics of a specific nature.

These records will be supplemented by suitable pictures.

Conformation and finish will be scored on numerical scales. Conformation scores shall be based on (a) compactness, (b) loin, (c) quarter[1], and (d) thrift.

[1] Quarter will be evaluated considering levelness of rump as well as fullness and depth of the entire rear quarters.

Notes will be made of outstanding faults.

Periodic slaughter tests will be made to check on carcass quality.

Whenever possible rate of gain and efficiency of food utilization of steers of the new strains and of Hereford steers will be compared within the structure of nutrition experiments.

Management and feeding practice will conform with recommendations arising from research now in progress on beef production in the reed-grazing area of Eastern North Carolina. Calves will be marked and dehorned at birth or as soon as possible thereafter. Males not to be retained as possible herd sires will be castrated at weaning time.

6. Probable duration of project:

All phases of the performance of the F_1 generations will have been satisfactorily measured within ten years. In addition complete data on some F_2, and on growth rate and conformation on a few F_3 individuals will have been gathered. The course of the project beyond that time will depend on this information, hence a revision of the project should be made at that time.

7. Date of nintiation: 1944

SIGNATURES OF APPROVAL

1. Approval of Project Leaders

Date June 25, 1945 — R. E. Comstock
Title Assoc. in Charge Animal Breeding Research

Date June 25, 1945 — J. E. Foster
Title Assoc. in Charge Beef Cattle and Sheep

Date Sept. 19, 1945 — H. A. Stewart
Title Assoc. Professor Animal Husbandry

2. Approval of Heads of Departments or Cooperating Agencies

Date Aug. 1, 1945 — Earl H. Hostetler
Head, Animal Husbandry Section

Date Sept. 26, 1945 — J. H. Hilton
Head, Dept. of Animal Industry

3. Approval of Committee on Experiment Station Projects

Date 12/10/45 — R. W. Cummings
Chairman of Committee

4. Approval of Director

Date 1/1/46 — L. D. Baver
Director, North Carolina Agricultural Experiment Station

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

PROJECT OUTLINE

Project No.	S46-ai17
Date	
Submitted	
Approved	
Revised	

1. Title Beef Cattle Especially Adapted to the Coastal Plains Region of North Carolina and similar areas.

2. Objective(s)

1 - To learn whether beef cattle resulting from crossing grade Hereford cows to Brahman and Africander bulls are more productive in the Coastal Plains Region (particularly for reed-grazing) than high-grade Herefords.

2 - If the crossbreds are more productive, to develop a relatively pure-breeding strain from one or both of the crossbred groups.

3. Reasons for Undertaking Investigations*

It is well known that the British breeds of beef cattle do not perform as satisfactorily as Brahmans or Africanders in tropical or sub-tropical climates. Crosses of the common beef breeds with either the Brahman or the Africander also perform better in such climates than do the British breeds.

Reed grazing in Eastern North Carolina is potentially important for beef production. It is desirable, therefore, to know what kind of cattle will be most productive in the area and in particular whether cattle carrying Brahman or Africander blood will enjoy the same advantage demonstrated in slightly more extreme (tropical) climates. If they are better by even a portion of the amount by which they excel the British breeds in some other portions of the United States, their use in the area would be of tremendous economic importance.

*Including economic justification

4. Previous work and present status of investigations in the field of this project:

The original use of Brahman cattle in the Southern portions of the United States was stimulated by the fact that even rather dilute infusions of Brahman blood gave a measurable increase in resistance to "tick fever". Subsequently, that disease was essentially eradicated in this country. By that time, however, it had been recognized that cattle carrying Brahman blood, being more heat-resistant, performed better in warm climates than the British breeds. The result was that cattlemen in the extreme Southern portions of the United States continued to raise them.

The King Ranch, in Texas, used Brahman bulls extensively in their Shorthorn cow herd and, by selecting the inter-breeding the best crossbred animals and their descendants, developed the Santa Gertrudis breed. These cattle perform more satisfactorily on the King Ranch than either Shorthorns or Herefords.

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It is pertinent to inquire why the proposed research should begin with first crosses instead of with cattle already developed at other places, i. e., with the Santa Gertrudis breed or with cattle obtained from Jeanerette. The climate in Eastern North Carolina, however, differs from that in either Southern Texas or Southern Louisiana. Annual rainfall is twice as great as on the King Ranch and the mean temperature less than in Louisiana. Further, the predominant forage type is different than in those areas. While information on the specific adaptability of animals to differing climatic conditions and types of feed is inadequate, there is ample reason to believe that breeds of livestock are better adapted, on the average, to the conditions under which they are developed than to other conditions.

At the same time, even though one or both of the two strains mentioned above were well adapted to Eastern North Carolina, there still would be good reason for developing a third. Hybrid vigor has been demonstrated in cattle. To utilize this phenomenon in the production of superior market animals it is necessary to have unrelated strains to cross. From that standpoint a good strain based on the Hereford and Africander breeds should be very desirable since ~~they~~ it would be most divergent genetically from either of the now existing strains. (Neither of them contain either Africander or Hereford breeding).

5. Outline of Procedure:

The female foundation stock is comprised of the overflow females from the grade Hereford herd at Hofmann Forest. About 15 females were bred to the Africander bull and an equal number to the Brahman bull in 1944. Between 35 and 40 females were mated to each in 1945. It is anticipated that the number of breeding females in each group will be increased to between 75 and 100. The production of F_1's will continue until this number of F_1 and F_2 females are available.

Since grade Herefords will be produced at the Forest each year, the two cross-bred groups can be compared to them as well as to each other. The comparative growth rates of the F_1's and grade Herefords should be established within 3 or 4 years. This and data on the calf production of the F_1 females will be the basis for deciding whether either of the crosses show sufficient promise to justify using it as a foundation from which to attempt the development of a new strain.

All F_1 females excepting only decidedly inferior ones will be retained for breeding. They will be bred as two-year-olds to bulls of their own F_1 group. Intense selection based on growth rate, conformation, vigor, temperament and mothering ability will be practiced starting with the F_2 generation. Both the records of individuals and of their progeny when available will be considered.

If when the F_3 generation has been reached the animals in either group are deficient in a specific trait or traits, some females will be backcrossed to bulls of either parent breed, or outcrossed to bulls of another breed. The extent of such matings cannot be forecast.

The data to be recorded is as follows:

1. On calves
   a. At birth or shortly after - date of birth, sex, weight (if practical) and color.
   b. At weaning - weight, conformation, condition, and color.
   c. At beginning and end of each grazing season until maturity (for those retained) - weight and conformation.
2. On cows - weight and condition at or shortly after calving and at weaning time. Conformation will be recorded at weaning time.
3. On bulls - weight, condition and conformation at beginning of breeding season; and per cent of cows bred that conceived.
4. On all animals - pedigrees and coefficients of inbreeding; and all unusual characteristics of a specific nature.

These records will be supplemented by suitable pictures.

Conformation and finish will be scored on numerical scales. Conformation scores shall be based on (a) compactness, (b) loin, (c) quarter[1], and (d) thrift.

---

[1] Quarter will be evaluated considering levelness of rump as well as fullness and depth of the entire rear quarters.

Notes will be made of outstanding faults.

Periodic slaughter tests will be made to check on carcass quality.

Whenever possible rate of gain and efficiency of food utilization of steers of the new strains and of Hereford steers will be compared within the structure of nutrition experiments.

Management and feeding practice will conform with recommendations arising from research now in progress on beef production in the reed-grazing area of Eastern North Carolina. Calves will be marked and dehorned at birth or as soon as possible thereafter. Males not to be retained as possible herd sires will be castrated at weaning time.

6. Probable Duration of Project:

All phases of the performance of the F_1 generations will have been satisfactorily measured within ten years. In addition complete data on some F 2, and on growth rate and conformation on a few F_3 individuals will have been gathered. The course of the project beyond that time will depend on this information, hence a revision of the project should be made at that time.

~~6. Probable Duration of Project~~:

7. Date of Initiation: 1944

8. Personnel:

Name	Department	Relation to Project
R. E. Comstock		Leader
J. E. Foster		Leader
H. A. Stewart		Leader
E. H. Hostetler		Adviser
D. E. Brady		Adviser

9. Coöperation:

a. Interdepartmental

b. Other Agencies

10. Financial Support:

a. Proposed Budget 7-1-45 to 6-30-46

Items	ALLOCATION OF FUNDS					
	Bankhead-Jones	Purnell	Adams	State	Other	Total
1. Salaries						
2. Labor						
3. Travel				150		
4. Equipment & Supplies						
5. All Other				100		
Total				250		

b. Proposed Future Budgets: None till 1947

Year	Salaries	Total Expenditures	Estimated Income

11. General Remarks: It is expected that this project will need increased financial support beginning 7-1-47.

SIGNATURES OF APPROVAL

1. Approval of Project Leaders

Date 6-25-45 R. E. Comstock

Title Assoc. in charge An. Genetics Res.

Date 6-25-45 J. E. Foote

Title Assoc. in Charge Beef Cattle & Sheep Res.

Date 9-19-45 H. A. Stewart

Title Assoc. in Animal Genetics Research

2. Approval of Heads of Departments or Coöperating Agencies

Date 8-1-45 Earl N. Hostetler

Head, A.H. Section

Date Sept. 26, 1945 J. H. Hilton

Head, Dept. of Animal Industry

Date .....

Head, ...

3. Approval of Committee on Experiment Station Projects

Date 12/10/45 R W Cummings

Chairman of Committee

4. Approval of Director

Date 1/1/46 L. D. Baver

Director, North Carolina Agricultural Experiment Station

5. Approval of U. S. D. A.

Date .....

Chief, Office of Experiment Stations