

North Carolina AGRICULTURAL EXPERIMENT STATION

**ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 1958**  
(Three copies to be given to the SES examiner)

1. PROJECT (Fund, number, and title): Hatch H-16, TESTING INBRED LINES OF SWINE.
2. DEPARTMENTS AND COOPERATING AGENCIES: Animal Industry
3. PERSONNEL: E. U. Dillard, A. J. Clawson, T. N. Blumer and E. R. Barrick
4. RESEARCH ACCOMPLISHMENTS OF THE YEAR (Confidential information should be so marked):

Fifty spring and 56 fall litters were farrowed at the Central Research Station in 1957. These litters were not all in the breeding project but six representative pigs from each of six lines of breeding were fed out for evaluation of feed efficiency and were slaughtered for carcass evaluation data. In this study there was no significant difference in feed required per pound of gain between the various cross breed groups in comparison to two pure bred groups. The inbred Tamworth line gained slower and required the most feed per pound of gain. Carcasses from the 3 breed rotational cross and from purebred Hampshires were superior to the other groups tested.

Twelve Tamworth x Duroc and Tamworth x Poland gilts were bred in the fall of 1957 and taken to the Research Station at Rocky Mount. The performance of these gilts and of their pigs will be compared to the performance of rotational crossbred gilts maintained at the station.

5. USEFULNESS OF FINDINGS (Benefits to agriculture and the general public and contributions to science):  
The testing of the inbred line of Tamworths maintained at Central Research Station seems advisable. More information is needed on the breed sequence to use in crossbreeding programs for production of market hogs.
6. WORK PLANNED FOR NEXT YEAR:  
The inbred Tamworth line will be further tested for combining ability with lines from Oklahoma and Iowa. Comparison of the three breed rotation with certain purebreds will be continued.
7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:  
"Breeding for Quality Pork."  
Research and Farming Vol. XV: No. 4. Spring 1957

8. Prepared by \_\_\_\_\_ Approved \_\_\_\_\_ (Director).  
Date \_\_\_\_\_ Date \_\_\_\_\_

**NORTH CAROLINA**

AGRICULTURAL EXPERIMENT STATION

**ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 1957**

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1. PROJECT: (Fund, number, and title): **HATCH 16, TESTING INBRED LINES OF SWINE.**
2. DEPARTMENTS AND COOPERATING AGENCIES: **Animal Industry**
3. PERSONNEL: **E. U. Dillard, A. J. Clawson, T. N. Blumer and E. R. Barrick**
4. PROGRESS OF RESEARCH HIGHLIGHTING PRINCIPAL ACCOMPLISHMENTS OF THE YEAR (Confidential information should be so marked):

Twenty-eight spring litters and 40 fall litters were farrowed at the Central Research Station in 1956. Not all of these were in the breeding project but representative pigs of each line were slaughtered for carcass evaluation data.

Carcass information was obtained on 33 head of hogs of the 1956 spring farrowings with representatives of the Duroc and Tamworth breeds and the three-breed rotation. Large differences between nutritional regimes were present, but differences by breeding group were small. Certain carcass data were obtained on approximately 100 fall farrowed pigs which definitely favored the three breed rotation group in comparison with other groups.

One inbred line being developed at the North Carolina Agricultural Experiment Station has been moved to the Tidewater Research Station and will be used in the research project.

Inbred boars were purchased from Oklahoma A. & M. and from Iowa State College for use in the testing program with the inbred Tamworth group at Raleigh.

5. USEFULNESS OF FINDINGS (when results may justifiably be expressed in terms of public benefits):

Systematic rotation of breeds for the production of market hogs seems advisable. An ever increasing number of farmers are going to crossbreeding for the production of market hogs.

6. WORK PLANNED FOR NEXT YEAR:

The inbred Tamworth line will be tested for combining ability with lines from Oklahoma and Iowa. The W. C. Red Line now at the Tidewater Research Station will be used in a selection study. Comparison will continue for this year of the three breed rotation with certain purebreds including a newly established purebred Hampshire group.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

G. N. Bolick, H. A. Stewart and E. U. Dillard.

Comparison of a three-breed rotational crossbreeding program with an inbred and an outbred population in Swine. (Abstract) Journal of Animal Science 15: 222-23

See also Carmon *et al.* Project S-74.

8. Prepared by..... Approved.....  
(Director).

Date..... Date.....



North Carolina

AGRICULTURAL EXPERIMENT STATION

ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 19 56

(Three copies to be given to the OES examiner)

1. PROJECT: (Fund, number, and title): **E-J, Sec. 5, 62, TESTING INBRED LINES OF SWINES**

2. DEPARTMENTS AND COOPERATING AGENCIES: **Animal Industry**

3. PERSONNEL: **E. U. Dillard, A. J. Clawson, E. R. Barrick, T. H. Blumer**

4. PROGRESS OF RESEARCH HIGHLIGHTING PRINCIPAL ACCOMPLISHMENTS OF THE YEAR (Confidential information should be so marked):

Thirty-one spring litters and thirty fall litters were farrowed in the swine project. Most of the pigs weaned were used in nutrition investigations but replicated by litter or breeding group for information on performance by breed or line.

To evaluate the breeding groups in post weaning performance and carcass characteristics six spring farrowed barrows from each group (at least two litters represented) were fed to a final weight of approximately 200 pounds. There was less than three pounds average difference between the groups in final live weight and only a three percent difference in dressing percent with the Durocs and Red-Berkshire-Yorkshire groups dressing highest. In carcass length the Red Line hogs excelled and they also carried slightly less fat back. The Duroc's were shortest but the Red Berkshire-Yorkshire group had slightly more backfat. In loin area and carcass score the Inbred Tamworths exceeded the other lines.

Considerable sickness was experienced by the fall farrowed pigs and by some of the sows resulting in less than satisfactory performance for most groups.

5. USEFULNESS OF FINDINGS (when results may justifiably be expressed in terms of public benefits):

The use of a three breed rotation for the production of market hogs should be recommended. The performance of inbred lines has been approximately equal to the performance of some outbred groups.

6. WORK PLANNED FOR NEXT YEAR:

One inbred line has been moved to the Tidewater Research Station and will be used in a selection study. The inbred Tamworth line and the 3-way cross groups will be continued and the Tamworth line will be expanded to provide animals which may be used in a better test of the line. The Red Berkshire-Yorkshire line will not be continued.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

Dillard, E. U., H. A. Stewart and Gerald Bolick. Feb. 1956. Inbreeding Effects on Performance as Observed in the Development of an Inbred Line of Tamworths. Paper presented at the Southern Agricultural Workers Meetings.

8. Prepared by..... Approved.....  
(Director)

Date..... Date.....

NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 19<sup>55</sup>  
(Three copies to be given to the OES examiner)

1. PROJECT: (Fund, number, and title): **B-J Sec. 5, 62 TESTING INBRED LINES OF SWINE**
2. DEPARTMENTS AND COOPERATING AGENCIES: **Animal Industry**
3. PERSONNEL: **E. U. Dillard, H. A. Stewart, M. B. Wise, E. R. Barrick**
4. NATURE OF RESEARCH AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked):

In the spring of 1954 a total of 176 live pigs were farrowed in 22 litters from inter se matings in the Tamworth, Red Line and Red Berkshire-Yorkshire groups. Ten litters with 71 live pigs were farrowed by purebred Duroc and 3 breed rotation gilts. Weaned weights per pig were heaviest for 3-way cross pigs followed in order by Red Line, Tamworth, RB-Y and Duroc. Rate of gain from weaning to 154 days of age for pigs in test lots was rather low because of hot dry season (.87 to 1.18 pounds per day by breed groups). The rate of gain was highest for the Red Line with 3-way crosses, RB-Y, Durocs and Tamworths following in order.

Representative animals were slaughtered from each breeding group. Length of carcass was greatest for Tamworth and Red Line hogs, but loin area of the RB-Y hogs was largest with that of the Tamworth a close second. In overall carcass desirability the different groups ranked about as follows: RB-Y, Tamworth, Red Line, 3-way cross, Duroc. When all data collected to date are included the 3-way cross moves ahead of the Red Line.

Weaned weights for fall farrowed pigs (22 litters) were heavier on the average than for spring farrowed pigs and post weaning rate of gain in paved feed lots is about 50-75% higher.

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

The use of line or breed crosses in the production of commercial hogs will increase the pounds of saleable product by the producer. The best ways to develop and test lines or breeds that will give maximum productivity have not been clearly defined. Inbred boars released by this station have received favorable comment by the producers who used them.

6. WORK PLANNED FOR NEXT YEAR:

The inbred groups and the three breed rotation will be continued. A group of Inbred Red Line hogs will also be maintained at one of the sub stations. Representatives of other breeds are to be introduced and a revision of the breeding project is underway.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

None

*final 1954 RB-Y - 141 days - 200#*

8. Prepared by \_\_\_\_\_ Approved \_\_\_\_\_  
(Director).

Date \_\_\_\_\_ Date \_\_\_\_\_

*RB-Y - less uniformity, some slow to grow - epistatic gene for W color skips copping out*

NORTH CAROLINA

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ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 1954

(Three copies to be given to the OES examiner)

*Lowell (vs)*

1. PROJECT: (Fund, number, and title): **BJ5 62 TESTING INBRED LINES OF SWINE**

2. DEPARTMENTS AND COOPERATING AGENCIES: **Animal Industry**

3. PERSONNEL: **H. A. Stewart, E. H. Hostetler and J. P. Asmerman**

4. NATURE OF RESEARCH AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked): In the spring of 1953 twenty-eight litters with a total of 250 pigs farrowed were obtained from inter se matings of the inbred lines of purebred Tamworth, N. C. Red Line and Red Berkshire-Yorkshire. Ten litters totaling 59 pigs farrowed were obtained from purebred Durocs and 3 breed rotation crossbreds. All pigs living at weaning were randomly assigned to lots and rate of gain data collected. Upon reaching market representative animals from each line were slaughtered and carcass data were collected. Feeding tests show daily rate of gain from weaning to approximately 160 pounds to be highest in the 3-way cross (1.37) followed in order by the N. C. Red Line (1.29), Duroc (1.26), Red Berkshire-Yorkshire (1.04) and Tamworth (1.02). Carcass evaluation revealed excellent qualities in the Red Berkshire-Yorkshire followed in order by the Tamworth, 3-way cross, N. C. Red Line and Duroc. Gilts were selected from each line and bred to propagate lines for further study.

*N. C. Red Line  
Tamworth  
Duroc  
Breed Rotation  
Crossbreds*

5. APPLICATION OF FINDINGS (expressed in terms of measurable public benefits if and when justified): High levels of total performance are most easily obtained through a systematic crossbreeding program. Inbreeding after crossing tends to segregate specific traits contributing to total value. (Reports from farmers are very favorable concerning production of releases of 3-way cross and N. C. Red Line stock.)

6. WORK PLANNED FOR NEXT YEAR: The inbred group and the three breed rotation will be continued. Tentative plans are to add purebred Berkshires and Hampshires to the herd so that these breeds and their crosses may be studied and evaluated.

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

8. Prepared by \_\_\_\_\_ Approved \_\_\_\_\_ (Director).  
Date \_\_\_\_\_ Date \_\_\_\_\_



NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 1953.....

(Three copies to be given to the OES examiner)

1. PROJECT: (Fund, number, and title): BJ62-A114, TESTING INBRED LINES OF SWINE.

2. DEPARTMENTS AND COOPERATING AGENCIES: Animal Industry

3. PERSONNEL: H. A. Stewart, E. H. Hostetler and J. P. Amersman

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

Inbred lines of purebred Tamworth, N. C. Red Line, and Red Berkshire-Yorkshire are being continued. Four purebred Yorkshire sows were added to the breeding females in the latter line in anticipation of improving litter performance. Inter se matings from these progenies were made to produce litters in the spring of 1953. Purebred Duroc and 3 breed rotation crossbreds have been continued. Purebred Durocs and 3 way crosses have exhibited the highest and most consistent rates of gain, followed closely by Red Lines. These three breeding groups have gained faster than the Red Berkshire-Yorkshire group consistently. In carcass performance the Red Berkshire-Yorkshire group continue yielding high quality carcasses as well as did the 3 way group this year, sired by a Tamworth boar. The small sample of Tamworths slaughtered indicate excellent carcass qualities. Durocs continue to produce carcasses of lower value than the other groups.

5. APPLICATION OF FINDINGS (expressed in terms of measurable public benefits if and when justified): High levels of total performance are most easily obtained through a systematic crossbreeding program. Inbreeding after crossing tends to segregate specific traits contributing to total value.

6. WORK PLANNED FOR NEXT YEAR: The inbred groups will be continued, as will the groups of purebred Durocs and the 3 breed rotation. Additional crosses will be made between the lines.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

"Comparison of Pork Carcass Characteristics from Certain Breeding Groups"  
W. L. Brown, H. A. Stewart and T. N. Blumer  
(In press)

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

Date Feb 27 1953 Date.....

North Carolina

AGRICULTURAL EXPERIMENT STATION

ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 1952

(Three copies to be given to the OES examiner)

1. PROJECT: (Fund, number, and title): Bankhead-Jones EJ62-Ailk  
Testing Inbred Lines of Swine
2. DEPARTMENTS AND COOPERATING AGENCIES: Animal Industry
3. PERSONNEL: H.A. Stewart, E.H. Hostetler and J.P. Ammerman

4. NATURE OF RESEARCH AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked): Three inbred lines, purebred Tamworth, N.C. Red Line, and Red Berkshire-Yorkshire, are being continued. The N.C. Red Line is the result of mating Minn. #1 boars to Duroc sows, then mating the F<sub>1</sub> females to a Landroc boar from Purdue. After two generations of inter se matings, Tamworth breeding was introduced to improve carcass quality. The Red Berkshire-Yorkshire group were bred to produce an F<sub>3</sub> generation in 1952. Four purebred Yorkshire females were mated to a red F<sub>2</sub> boar for spring litters in 1952. Resulting pigs from this cross will be mated inter se, then combined with the rest of the line.

Red Line gilts weaned 59 pigs at 38 pounds while sows weaned 8.7 pigs at 39 pounds in spring litters. Fall litters averaged 8.6 pigs weaned at 31 pounds. Red Berkshire-Yorkshire F<sub>1</sub> gilts averaged 6.4 pigs at weaning at 28.3 pounds in spring litters. The same females weaned 7 pigs at 34.3 pounds in the fall. Tamworth inbreds gilts weaned about 4 pigs weighing 32 pounds in the spring and 7 pigs weighing 27 pounds in the fall.

The 3 way crossbred gilts failed for the first time to do better than the purebred Duroc gilts, both in number of pigs weaned and weaning weights. Red Line pigs on feed gained at about the same rate as purebred

5. APPLICATION OF FINDINGS (expressed in terms of measurable public benefits if and when justified): Identification and development of breeding groups of superior performance and their inclusion in a systematic cross breeding program should increase pork produced per sow.
6. WORK PLANNED FOR NEXT YEAR: The three inbred groups will be continued. The 3-way rotation and outbred Duroc comparisons will continue. Crosses between lines will be made to determine favorable breeding combinations.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

A Comparison of copper values in the blood serum of swine with that of other farm animals. H.A. Stewart, Gennard Matrone, J.A. Weybrew and Hartlee M. Barlee. Jour. An. Sci. 9:669. 1950 An abstract.

8. Prepared by H.A. Stewart Approved.....

Date 3-24-52 Date..... (Director).

Page 2

Bankhead-Jones BJ62-A114  
Testing Inbred Lines of Swine

4. (Cont'd)

Durocs and about .4 pound per day more than the Red Berk-York group. Red Berk-York carcasses continue to show carcasses superior to all other groups. About 20 Red Line boars have proved satisfactory in farm tests.

A Master's thesis in preparation deals with carcass data gathered from animals in this project.



NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

ANNUAL PROGRESS REPORT, FEDERAL-GRANT PROJECTS, 19<sup>51</sup>

(Three copies to be given to the OES examiner)

1. PROJECT: (Fund, number, and title): Bankhead-Jones 62-A114, Testing Inbred Lines of Swine.
2. DEPARTMENTS AND COOPERATING AGENCIES: Animal Industry
3. PERSONNEL: H. A. Stewart, E. H. Hostetler and J. P. Ammerman, Jr.
4. NATURE OF RESEARCH AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked):

The third replication for sow productivity was completed between gilts produced in the top crossing program. Comparisons were made in farrowing and carcass cut out quality between all lines of breeding. The general level of total sow productivity in all lines of breeding was much lower than previous years. Adverse environmental conditions caused large intra-group variations which concealed inter group differences. In total farrowing performance all groups did well. The rank of the females produced in the top cross program was in the same order as in the previous tests. Survival and weaned weight performance was low in all groups and rank in these measures was not consistent with other years. The 24 test litters, average 8.6 pigs, of which 7.8 pigs were alive at birth and 5.8 pigs were weaned at an average of 202 pounds per litter, or 34.7 pounds per pig. Females sired by Minnesota No. 1 boars again farrowed more pigs than any other group, an average of 11.5 pigs alive at birth. Ranking second, purebred Duroc litters averaged 8.8 pigs. Daughters of the Poland line boars were low with 5.8 pigs. This is the first year that the 3 Way cross females have failed to outproduce purebreds. The Durocs weaned 1 pig more and a total litter weight of 18.5 pounds more than the 3 Way group.

(Continued on attached sheet)

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

A systematic crossbreeding program for pork production could increase the total pork produced per sow by 5 to 15 per cent. The average percentage of lean cuts and the area of lean in the loin muscle could be increased through a breeding program incorporating these traits in selection.

6. WORK PLANNED FOR NEXT YEAR:

The inbred line of Tamworths will be continued. The Red Line will be continued with some infusion of Minnesota No. 1 and Tamworth blood. Red Berkshire-Yorkshire F<sub>2</sub>s will be produced and measured. The 3 Way rotation and outbred Duroc groups will be continued. Boars from the inbred line will be tested in farmer herds.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

None

8. Prepared by H. A. Stewart Approved.....

(Director).

Date April 5, 1951 Date.....

4. NATURE OF WORK ETC. (Continued from Page 1)

Inbred lines of Tamworth, N. C. Red Line, Red Berkshire x Yorkshire, and Belted Red were continued. In spring litters, Red Line females weaned 7.7 pigs at 246 pounds while outbred Durocs weaned 7.5 pigs at 248 pounds. The Belted Red group weaned an average of but 4 pigs. The 2 purebred Yorkshire gilts bred to Red Berkshire boars farrowed an average of 6.5 pigs, weaning 6 at 147 pounds.

Samples of the pigs in 8 of the breeding groups were slaughtered for carcass appraisal. A total of 28 carcasses, with from 2 to 6 representatives of each group, were indexed for loin equivalent value and the loins were cut for area of eye muscle measurements. No purebred Tamworths were slaughtered. In an attempt to locate possible material to improve the loin cross section of the Red Line, comparisons were made between carcasses produced by mating females of the line to Red Line, Minnesota No. 1 and Tamworth boars. From this study it is apparent that the correlation between index value and carcass length and between index value and loin area is low. The Red Berkshire x Yorkshire carcasses had the highest index value, and the greatest loin area, 56.6 per cent and 8.5 square inches respectively. The Duroc, Red Belt, and Red Line carcass index values were nearly equal, about 43.5 per cent. The 3 Way group ranked second with 51.7 per cent. Both Minnesota No. 1 and Tamworth crosses increased the index value of Red Line carcasses by 7 to 10 per cent and increased eye muscle area 15 to 20 per cent. This indicates that heritability of eye muscle area and carcass quality may be great enough to make rapid genetic progress in establishing these traits in a population.

Because of the consistently poor performance of the belted group in sow productivity, feed lot performance, and carcass cut out tests, this line is being discontinued.

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UNITED STATES DEPARTMENT OF AGRICULTURE  
Agricultural Research Administration  
Bureau of Animal Industry  
Animal Husbandry Division

Agricultural Research Center  
Beltsville, Maryland

D-

June 29, 1950

Dr. H. A. Stewart  
In Charge, Animal Genetics  
University of North Carolina  
Raleigh, North Carolina

Dear Dr. Stewart:

Reference is made to your letter of June 26, stating you had disposed of the three Landrace-Duroc-Hampshire sows on Loan Agreement A.H. 134.15 to your station.

This will terminate the loan agreement. I wish to thank you for your cooperation in taking over this line and hope it can be used to advantage in your program and by farmers of the State.

Boars of this line seem to be combining well with crosses in the Pennsylvania program.

Very truly yours,

(S) JOHN H. ZELLER

John H. Zeller  
In Charge, Swine Investigations



NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

PROJECT OUTLINE

Project No.	BT62-A114...
Date	
Submitted	.....
Approved	.....
Revised	.....

1. Title **TESTING INBRED LINES OF SWINE**

2. Objective(s)

1. To learn whether hogs produced, using available inbred lines of swine in line-crosses or top-crosses, will be superior for commercial purposes to those obtained by crossing outcross members of the pure breeds.
2. If so, to learn which lines perform best under North Carolina conditions in order that (a) they can be recommended for multiplication by purebreeders who, in turn, would make them available to commercial producers, and (b) they can be used as foundation stock for the development of still better lines.
3. To develop new and useful inbred lines of swine.

3. Reasons for Undertaking Investigations\*

The U. S. Regional Swine Breeding Laboratory in cooperation with a number of State Experiment Stations has established 40 inbred lines of swine. The U. S. Department of Agriculture also has a number of lines in the process of development. These lines are the result of the most systematic effort that has yet been made to use available scientific information in swine improvement. They constitute a logical and promising source of breeding stock for the improvement of commercial swine.

The performance of the lines themselves and the few crosses that have been made among them indicate that they have real genetic merit. However, a testing program is needed before specific lines can be recommended for commercial use. The Regional Laboratory does not have the facilities for an extensive a testing program as would be desirable and, if it did, we could not be certain that lines which performed well in the Corn Belt would also do well in other areas.

In addition to bringing benefits of the Regional Laboratory's swine breeding work to North Carolina, this project will furnish the Laboratory workers information they need on the breeding value of the lines tested.

While some existing inbred lines will doubtless prove of value there are good reasons for the development of more lines. Thousands of inbred lines of corn have been tested yet better ones are constantly being developed. In like manner continued effort will in all probability result in better and better inbred lines of swine. Since the amount of hybrid vigor in crosses tends to be greater when the lines crossed are from divergent genetic sources and since at present there is no way of forecasting what combinations of genetic material will cross to greatest advantage, it is particularly important that lines be developed from breeds not yet used as foundation stock for inbred lines.

\*Including economic justification

It is entirely possible that the feed cost of pigs produced by crossing selected inbred lines will be fifty pounds or more lower per 100 pounds of live pork marketed than for pigs produced from outbred stock. If so, use of such pigs would mean from one and one-half to two and one-half million dollars a year to the swine producers of the State.



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

Little work of this type has been done. Clark *et al.* (1936) reported on top crosses made using boars of an inbred line founded in 1924. Winters *et al.* (1944) reported work involving a number of lines that have been developed in the Regional Swine Breeding Laboratory. The line-cross pigs performed very well. Those resulting from crosses of lines from different breeds performed better than those from crosses of lines from the same breed. However, the animals were not compared to pigs produced from crossing outbreeds of different breeds.

Scattered unpublished work done at the stations cooperating with the Regional Laboratory has in general been encouraging.

#### 5. Outline of Procedure:

##### Top-crosses.

Group 1. For comparison of growth rate and feed consumption.

In the fall of 1945 boars from each of four inbred lines will be mated to outbred Duroc gilts. In succeeding years five lines will be used in the production of top crosses. Two boars will be used from each line each year. Thus six different boars will be used from each line over a period of three years.

Group 2. For comparison of sow productivity and the production of replacement gilts.

Outbred Duroc females will be mated to Temworth boars for production of gilts to be used in top crosses (Group 1), in 1946. In succeeding years gilts produced in Group 1 will be mated the following fall to boars of a line not included in that group. Each year boars from a different line will be used for this purpose. Four gilts by the boars of each line used in Group 1 will be bred, two to each of the two boars to be used in Group 2. In this way a comparison of productivity will be obtained between the gilts of the different Group 1 top-crosses.

Two types of checks will be raised each year starting with 1947. Matings for (1) four litters of outbred Duroc pigs, and (2) six litters of crossbreeds produced in a three breed rotation system of crossing outbreeds will be made each year.

Development of new lines. The development of the Temworth line now being founded will be continued. A Duroc line founded on the best stock available in this area will be initiated and as soon as facilities permit a third line will be established. This line will be based on a breed of which few or no lines are now in existence, for example, the Spotted Poland China breed.



These lines will be developed using fall-farrowed pigs. They will be farrowed and carried on pasture until four months of age.

Additional details of procedure are appended.

All pigs will be full-fed, from self-feeders, on pasture. If alfalfa can be raised successfully on the available land it will be used as the pasture crop. Starting in 1947 each litter will be fed in a separate lot. A three year pasture rotation system will be followed.

Data to be recorded. The following data will be recorded:

- 1 - Litter size.
- 2 - Weights at birth, 56, 112, and 154 days.
- 3 - Body scores at 154 days on all pigs and at 112 days on boars of the inbred lines.
- 4 - Feed costs from weaning to 154 days on the pigs in the line testing program.
- 5 - Any unusual characteristics of interest.

6. Probable Duration of Project: **To be revised after five years.**

7. Date of Initiation: **1945**

8. Personnel:

Name	Department	Relation to Project
<b>H. A. Stewart</b>		<b>Leader</b>
<b>B. E. Cosstock</b>		<b>Leader</b>
<b>E. H. Hostetler</b>		<b>Adviser</b>
J. P. Ammerman, Jr.		Assistant

9. Cooperation:

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 <sup>(1)</sup>	Total
1. Salaries						
<b>H. A. Stewart</b>	<b>\$1,727</b>					
2. Labor						
3. Travel						
4. Equipment & Supplies						
5. All Other						
Total					<b>3000</b>	

<sup>(1)</sup> Misc. Receipts

b. Proposed Future Budgets:

Year	Salaries	Total Expenditures	Estimated Income
1946-47	\$ 3500	\$ 12,000.00	\$ 8,000.00
1947-48	3500	12,000.00	8,000.00
1948-49	3500	12,000.00	8,000.00
1949-50	3500	12,000.00	8,000.00

11. General Remarks:

Projected matings in line testing phase of the work.

Boars are designated by letters (A, B, etc.) with subscript to denote line they are from.

1946 - Group 1

A<sub>1</sub> to 3 Duroc gilts  
B<sub>1</sub>to 3 Duroc gilts  
A<sub>2</sub>to 3 Duroc gilts  
B<sub>2</sub>to 3 Duroc gilts  
A<sub>3</sub>to 3 Duroc gilts  
B<sub>3</sub>to 3 Duroc gilts  
A<sub>4</sub>to 3 Duroc gilts  
B<sub>4</sub>to 3 Duroc gilts

- Group 2

A<sub>10</sub>to 6 Duroc females  
B<sub>10</sub>to 6 Duroc females

Source of lines

Line 1 is a Duroc line developed at Oklahoma.  
Line 2 is a Duroc line developed at Nebraska.  
Line 3 is the line known as Minn. No. 1, developed at  
Minnesota from a cross of the Landrace and Tamworth breeds.  
Line 4 is a Poland line developed at Minnesota.  
Line 10 is a Tamworth line being developed at N. C.

Note - One of the females bred to boars A<sub>1</sub> - B<sub>4</sub> will be culled at the end of the breeding season.

Form of analysis of variance of data to be collected in Group 1.

Variance due to	D. F.
Lines	3
Boars in lines	4
Litters by same boar	8
Pigs in litters	<u>N-16</u>
Total	N-1



1947 - Group 1

C<sub>1</sub> to 3 line 10 x Duroc gilts  
 D<sub>1</sub> to 3 line 10 x Duroc gilts  
 C<sub>2</sub> to 3 line 10 x Duroc gilts  
 D<sub>2</sub> to 3 line 10 x Duroc gilts  
 C<sub>3</sub> to 3 line 10 x Duroc gilts  
 D<sub>3</sub> to 3 line 10 x Duroc gilts  
 C<sub>4</sub> to 3 line 10 x Duroc gilts  
 D<sub>4</sub> to 3 line 10 x Duroc gilts  
 A<sub>5</sub> to 3 line 10 x Duroc gilts  
 B<sub>5</sub> to 3 line 10 x Duroc gilts  
 Duroc boar to 4 Duroc gilts

Three outbred Duroc gilts to each of 2 outbred boars of a breed other than Duroc.

The last two groups will constitute the outbred and crossbred check groups.

- Group 2

A<sub>11</sub> to 8 gilts produced from 1946, Group 1 matings. Two will be by the first boar from each of the lines used.

B<sub>11</sub> to 8 gilts produced from 1946, Group 1 matings. Two will be by the second boar from each of the lines used.

Note - Lines 5 and 11 have not yet been chosen. Again one gilt bred to each boar, except the Duroc, will be culled at the close of the breeding season.

Form of analyses of variance of data to be collected.

Group 1		Group 2	
<u>Variance due to</u>	<u>D.F.</u>	<u>Variance due to</u>	<u>D.F.</u>
Lines	6	Line*	3
Boars in lines	6	Boar**	1
Litters by same boar	15	Line x boar	3
Pigs in litters	N-28	Sows from same line bred to same boar	8
		Total	15
Total	N-1		

\*Line of boar that sired dams of Group 2 litters.

\*\*Refers to sires of Group 2 litters.

1948 - Group 1

E <sub>1</sub>	to 3	gilts produced from 1947, Group 2 matings
F <sub>1</sub>	to 3	" " " 1947, " 2 "
E <sub>2</sub>	to 3	" " " 1947, " 2 "
F <sub>2</sub>	to 3	" " " 1947, " 2 "
E <sub>3</sub>	to 3	" " " 1947, " 2 "
F <sub>3</sub>	to 3	" " " 1947, " 2 "
E <sub>4</sub>	to 3	" " " 1947, " 2 "
F <sub>4</sub>	to 3	" " " 1947, " 2 "
C <sub>5</sub>	to 3	" " " 1947, " 2 "
D <sub>5</sub>	to 3	" " " 1947, " 2 "

Duroc boar to four outbred and unrelated Duroc gilts.

Three gilts from last mating listed in Group 1, 1947, to each of two outbred boars of a breed not used in that mating.

Group 2

A<sub>12</sub> to 10 gilts produced from 1947, Group 1 matings. Two will be by the first boar from each of the lines used.

B<sub>12</sub> to 10 gilts produced from 1947, Group 1 matings. Two will be by the second boar from each of the lines used.

The analyses of variance will be similar to those for 1947.

## SIGNATURES OF APPROVAL

## 1. Approval of Project Leaders

Date 6-28-45 W. E. Comstock  
 Title Assoc. in Charge Animal Genetics Res.

Date 9-19-45 H. A. Stewart  
 Title Assoc. in Animal Genetics Research

Date .....

Title .....

## 2. Approval of Heads of Departments or Cooperating Agencies

Date 6-29-45 Earl H. Hostetter  
 Head, Animal Husbandry Section

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

Date .....

Head, .....

## 3. Approval of Committee on Experiment Station Projects

Date 10/11/45 R. W. Cunningham  
 Chairman of Committee

## 4. Approval of Director

Date .....

Director, North Carolina Agricultural  
Experiment Station

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

Date DEC 14 1945 R. W. Mulligan  
 Asst. Chief, Office of Experiment Stations



B962-A114

AGREEMENT FOR THE LOAN OF SWINE BREEDING STOCK  
OF THE BELTSVILLE MEAT-TYPE STRAINS TO  
STATE AGRICULTURAL EXPERIMENT STATIONS

This agreement, made and entered into this 8<sup>th</sup> day of July One Thousand Nine Hundred and Forty Nine by and between the Bureau of Animal Industry, United States Department of Agriculture, party of the first part and the North Carolina Agricultural Experiment Station, party of the second part, WITNESSETH:

The party of the first part, for and in consideration of the promises and agreements of the party of the second part, as hereinafter stated, as a part of the Bureau's Swine Breeding Project, does hereby agree as follows:

1. To place with the party of the second part the following:

Landrace-Duroc-Hampshire Sows No. 2981S ~~Landrace-Duroc-Hampshire Boar No. 341A~~  
3418  
3420  
3476  
3580  
3808

*Landrace-Duroc-Hampshire Boar # 6161  
(see attached letter dated 1/26/49)*

for use by the party of the second part until June 30, 1950, at which time the agreement is subject to renewal for a period of two years, when and if its provisions and the work carried out thereunder are satisfactory to both parties. These animals will be used basically for the promulgation of pure lines of breeding stock of this breeding within the State.

The party of the second part, in consideration of the promises and agreements of the party of the first part, as hereinbefore contained, does hereby agree as follows:

- To properly feed and care for the breeding animals so loaned by the party of the first part, as hereinbefore provided, and to maintain and promulgate pure lines of breeding stock of this breeding at the State Agricultural Experiment Station or one or more of its official subdivisions.
- To keep such breeding, feeding and production records as may be required by the party of the first part.
- To permit the party of the first part at any and all times to inspect all breeding and production records kept by the party of the second part in accordance with the terms of this agreement.
- To transport the said breeding animals from a point or points of origin to the North Carolina Agricultural Experiment Station or to its field stations within the State, and to return the same to the party of the first part to a point or points designated by the party of the first part upon the termination of this agreement.
- To return the animals in a condition satisfactory to the party of the first part or to pay to the party of the first part such sum as in the opinion of the

of the latter, shall compensate for any damages to the said animals as a result of negligence or mishandling by the party of the second part.

6. To save the United States Government harmless, during the period of this agreement, from any and all claims for damages to person or property caused by the animals furnished by the party of the first part or arising from their use by the party of the second part.

7. To give the party of the first part, the option of first choice of purchasing at a nominal agreed price any descendants from the animals loaned as may be needed for use in the Bureau's Swine Breeding Program.

It is mutually understood and agreed by and between the parties hereto:

1. That the animals furnished to the party of the second part, under terms of this agreement, shall be subject to removal upon 10 days' written notice, in case the party of the first part shall deem that the objects of the work to be accomplished under this agreement are not being obtained, or upon failure of the party of the second part to fulfill the conditions of this agreement.

2. That all expenses for veterinary services necessary to be incurred while said animals are in the custody of the party of the second part shall be paid by the party of the second part.

3. That this agreement may be terminated at any time upon 10 days' written notice by either of the parties.

No member of or Delegate to Congress or resident commissioner, and no officer, agent, or employee of the Government, shall be admitted to any share or part of this agreement or to any benefit to arise thereupon.

IN WITNESS WHEREOF, the parties hereto have executed this agreement, the party of the second part on the day, month, and year first above written, and the party of the first part this 16th day of June, 1949.

BUREAU OF ANIMAL INDUSTRY,  
UNITED STATES DEPARTMENT OF AGRICULTURE

*W.E. Galt*  
B.T. Simms  
Chief of Bureau

North Carolina AGRICULTURAL EXPERIMENT STATION

By J. J. Johnston  
Director of Station

NORTH CAROLINA DEPARTMENT OF AGRICULTURE

By W. H. Stone

December 6, 1949

Memorandum to -

Professor E. H. Hostetler:

Re: B.A.I. Swine Loan Agreement A. H. 134.15

On October 24, 1949, the Animal Husbandry division of the Bureau of Animal Industry shipped the Landrace-Duroc-Hampshire boar No. 6161 to the Upper Coastal Plain Test Farm at Rocky Mount. This was arranged with Mr. John H. Zeller after the good performance of the sows obtained from him through the loan agreement and after a decision to retain the females for another litter.

Mr. Zeller has requested that we make a notation of this animal on our copy of the loan agreement. They have included him on their copy.

H. A. Stewart

Cc: Dr. D. W. Colvard  
Dr. R. W. Cummings

*Get copy of loan agreement*



**AGREEMENT FOR THE LOAN OF SWINE BREEDING STOCK  
OF THE BELTSVILLE MEAT-TYPE STRAINS TO  
STATE AGRICULTURAL EXPERIMENT STATIONS**

This agreement, made and entered into this \_\_\_\_ day of \_\_\_\_\_ One Thousand Nine Hundred and Forty Nine by and between the Bureau of Animal Industry, United States Department of Agriculture, part of the first part and the \_\_\_\_\_  
North Carolina Agricultural Experiment Station  
party of the second part, WITNESSETH:

The party of the first part, for and in consideration of the premises and agreements of the party of the second part, as hereinafter stated, as a part of the Bureau's Swine Breeding Project, does hereby agree as follows:

1. To place with the party of the second part the following:  
Landrace-Duroc-Hampshire Sows No. 29818

3418  
3420  
3476  
3580  
3808

for use by the party of the second part until June 30, 1950, at which time the agreement is subject to renewal for a period of two years, when and if its provisions and the work carried out thereunder are satisfactory to both parties. These animals will be used basically for the promulgation of pure lines of breeding stock of this breeding within the State.

The party of the second part, in consideration of the promises and agreements of the party of the first part, as hereinbefore contained, does hereby agree as follows:

1. To properly feed and care for the breeding animals so loaned by the party of the first part, as hereinbefore provided, and to maintain and promulgate pure lines of breeding stock of this breeding at the State Agricultural Experiment Station or one or more of its official subdivisions.
2. To keep such breeding, feeding and production records as may be required by the party of the first part.
3. To permit the party of the first part at any and all times to inspect all breeding and production records kept by the party of the second part in accordance with the terms of this agreement.
4. To transport the said breeding animals from a point or points of origin to the \_\_\_\_\_ North Carolina Agricultural Experiment Station or to its field stations within the State, and to return the same to the party of the first part to a point or points designated by the party of the first part upon the termination of this agreement.
5. To return the animals in a condition satisfactory to the party of the first part or to pay to the party of the first part such sum as in the opinion of the

of the latter, shall compensate for any damages to the said animals as a result of negligence or mishandling by the party of the second part.

6. To save the United States Government harmless, during the period of this agreement, from any and all claims for damages to person or property caused by the animals furnished by the party of the first part or arising from their use by the party of the second part.

7. To give the party of the first part, the option of first choice of purchasing at a nominal agreed price any descendants from the animals loaned as may be needed for use in the Bureau's Swine Breeding Program.

It is mutually understood and agreed by and between the parties hereto:

1. That the animals furnished to the party of the second part, under terms of this agreement, shall be subject to removal upon 10 days' written notice, in case the party of the first part shall deem that the objects of the work to be accomplished under this agreement are not being obtained, or upon failure of the party of the second part to fulfill the conditions of this agreement.

2. That all expenses for veterinary services necessary to be incurred while said animals are in the custody of the party of the second part shall be paid by the party of the second part.

3. That this agreement may be terminated at any time upon 10 days' written notice by either of the parties.

No member of or Delegate to Congress or resident commissioner, and no officer, agent, or employee of the Government, shall be admitted to any share or part of this agreement or to any benefit to arise thereupon.

IN WITNESS WHEREOF, the parties hereto have executed this agreement, the party of the second part on the day, month, and year first above written, and the party of the first part this 16th day of June, 1949

BUREAU OF ANIMAL INDUSTRY  
UNITED STATES DEPARTMENT OF AGRICULTURE

By \_\_\_\_\_  
Chief of Bureau

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

By \_\_\_\_\_  
Director of Station

NORTH CAROLINA DEPARTMENT OF AGRICULTURE

By \_\_\_\_\_

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

1. PROJECT: (Fund, number, and title): BANKHEAD-JONES An. Ind. BJ62-A114, TESTING INBRED LINES OF SWINE.
2. DEPARTMENTS AND COOPERATING AGENCIES:
3. PERSONNEL: H. A. Stewart, E. H. Hestetler and J. P. Ammerman, Jr.
4. NATURE OF WORK AND PRINCIPAL RESULTS OF THE YEAR (Confidential information should be so marked):

Tests for differences in rate of gain in the feedlot from 56 to 154 days and in carcass quality between topcrosses from 4 inbred lines, a 3 breed rotation cross and purebred Durocs was continued. The dams of all litters by inbred boars were sired by boars of a Poland x Landrace inbred line developed at Beltsville. The sire of the dams of the 3 way cross was a Duroc boar while their pigs were sired by a Tamworth.

Three hundred and sixty-two (362) pigs were farrowed in 32 litters in the test for an average of 11.3 pigs. These litters averaged 9.07 pigs at weaning, weighing 301 pounds. Pigs by Minnesota "A" line Poland boars gained the most rapidly, 1.52 pounds per day while those by Minnesota No. 1 boars ranked second with 1.47 pounds. This may indicate that specific combining ability between the lines derived from Landrace is poor since the Minnesota No. 1 line has led the others in previous years and since the top cross this year was on females sired by a boar of Poland x Landrace breeding. (continued on attached sheet)

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

A 4 breed rotational crossbreeding program is recommended using boars of Landrace derived lines on sows of American breeds. Boars of another rapid growing lard breed are used on these crossbred females.

The females from this cross are then mated to a breed high in sow productivity, such as Yorkshire.

6. WORK PLANNED FOR NEXT YEAR:

The development of the inbred lines of Tamworth, N. C. Red line, a line from Red Berkshire x Yorkshire, and Belted Red will be continued. Specific combining ability between these lines and with Durocs, Polands and Berkshires will be tested. The 3 way rotation group will be continued.

7. PUBLICATIONS ISSUED OR MANUSCRIPTS PREPARED DURING THE YEAR:

None

8. APPROVED:

H. A. Stewart  
Project Leader.

\_\_\_\_\_  
Director.



4. NATURE OF WORK ETC. (continued from Page 1)

The average rate of gain for all lots sired by Duroc boars both inbred and outbred was the same 1.44 or 1.45, while the 3 way rotation pigs by the Tamworth boar grew at a significantly lower rate, 1.28 pounds per day. The year this group was sired by a Poland boar, 1947, they ranked second in rate of gain, next to the group by Minnesota No. 1 boars.

The 2 Minnesota lines continue to have the highest average carcass index of the top crossed groups although the differences between the means of the group were much smaller in 1949 than in the previous years. The carcasses from the 3 way cross appeared to be as good as the better group of top cross carcasses. Duroc carcasses again had a significantly lower index of value than any of the other groups.

Contributions which the Animal Industry Department of The North Carolina Agricultural Experiment Station can make toward the study of factors influencing baby pig losses.

**Problem:** Factors influencing baby-pig losses.

**Previous work and present status:** It has been estimated that the mortality of pigs between birth and weaning is at least 30 per cent (Phillips, R. W. and Zeller, J.H., Amer. Jour. Vet. Res. 2, 439, 1941; Progress Report, 1941, U.S.D.A., Bur. An. Ind.; Wilcox, R. H., Carroll, W. E., and Hornung, T. G., Ill. Agr. Exp. Sta. Bul. 390, 1933). Management, infectious disease, and nutrition each appear to play a role either separately or together. In many instances it may be difficult to determine the exact function of these factors; for instance, whether a disorder is of an infectious or of nutritional origin, or if a nutritional deficiency predisposes to infection. In any case, the part played by nutrition cannot be arbitrarily discounted if all the facts are to be considered.

Probable causes of death losses of baby pigs might be presented as follows:

1. Nutritional status of the infant pig.
2. The influence of nutritional status of the infant pig on its capacity to resist pathogenic infection.
3. Nutritional status of the sow.
4. Accidental losses associated with sow management and hog lot equipment.
5. Pathogenic causes.
6. Parasites.
7. Environmental conditions including temperature and humidity relationships.

Procedures (N.C. Agricultural Experiment Station):

The Animal Industry Division is well prepared to undertake intensive investigations of either number one (1) or number three (3) above, with preference given to number 1, i.e., the influence of nutritional status (per se) on pig losses. If funds were to be made available for a competent pathologist and some additional equipment, then numbers 1 and 2 could be carried on simultaneously.

Facilities available for the work:

Baby pigs  
 Baby pig betteries  
 Battery barn  
 Feed mixers and blending facilities  
 Heat, water, electricity  
 All chemical facilities for all types of analysis (blood, feed, etc.)  
 3 Spectrophotometers  
 5 Ovens  
 3 Analytical Balances  
 2 Centrifuges  
 Glassware of all kinds

Personnel (present):

3 Full-time personnel (partially allotted to other projects)  
 1 Animal physiologist  
 2 Half-time personnel (all allotted to other projects)  
 1 Veterinarian

Personnel needed:

2 Half-time (Nutrition)  
 2 " " (Animal Husbandry)

Experience of present personnel and status of infant pig work:

During the past year and a half infant pigs have been successfully reared in cages from one day of age to weaning weight without access to sow's milk. Valuable techniques in the handling, care and feeding of infant pigs have been acquired.



A report of findings to-date has been published in abstract form in the Journal of Animal Science 6: 492 (1947) by Weybrew, Stewart, Peterson and Matrone.

Experience thus far in 1948 have demonstrated without a doubt that infant pigs will die from causes that may be due to inadequate nutrition, or threshold levels that may permit pathogenic infections, that are not readily explainable from existing knowledge. Baby pig losses will continue until more is learned about the nutrition of the infant pig -- a field which has barely been touched on in scientific investigations.

Support for Baby Pig Project (1947-48)

Funds available	Source
\$7398	Research and Marketing
2000	Swift and Company
<u>600</u>	American Dry Milk Institute
\$9998	Total

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