North Carolina
Cooperative Extension Service
NORTH CAROLINA STATE UNIVERSITY
COLLEGE OF AGRICULTURE & LIFE SCIENCES

Extension Poultry Science • Scott Hall, Box 7608 • Raleigh, NC 27695-7608 • Tel: (919) 515-2621 FAX: (919) 515-7070

FINAL REPORT OF THE THIRTIETH

NORTH CAROLINA LAYER PERFORMANCE

AND MANAGEMENT TEST

Vol. 30, No. 4
June 1994

The North Carolina Layer Performance and Management Test is conducted under the auspices of the Cooperative Extension Service at North Carolina State University and the North Carolina Department of Agriculture. The flock is maintained at the Piedmont Research Station, Salisbury, North Carolina. Mr. Raymond Coltrain is Piedmont Research Station Superintendent; Mr. Ed Radford is Resident Manager of the flock; and Dr. K. E. Anderson is Project Leader. The purpose of this program is to assist poultrymen in evaluation of commercial layer stocks and management systems.

For further information contact:

Kenneth E Anderson

Dr. Kenneth E. Anderson
Poultry Science Department
North Carolina State University
Box 7608
Raleigh, NC 27695-7608

30TH NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST

Protocol Procedures Used

Entries:

Twelve entries were accepted in accordance with the rules and regulations of the test. Eight white egg and four brown egg strains participated.

Dates of Importance:

The eggs were set on January 27, 1992 and hatched on February 19, 1992. The pullets were moved to laying facilities on June 22 to 25, 1992 (18 weeks of age). First cycle production records commenced on June 30, 1992 (19 weeks of age) until molt was induced on May 5, 1993. The second cycle records commenced on May 18, 1993 (66 weeks of age) until the flock was closed out on February 21, 1994 (105 weeks of age). This report includes production data summarized 19 to 63 weeks, 66 to 105 weeks, and 19 to 105 weeks.

Pullet Housing:

House 6 - is an environmentally controlled brood-grow facility with 4 banks of triple-deck cages. Each side of each bank was assigned a row number, and each 3-cage section within each row and level/row was assigned a replicate number. For statistical analysis pairs of rows were designated as blocks. Thus, each block consisted of two rows containing 8 replicates on each level, plus one extra cage on each level of each row. The white and brown-egg strains were randomly assigned to the replicates in the house. Entrant strains were assigned to the replicates in a restricted randomized manner with the restrictions being that all strains were approximately equally represented in all rows and levels. Chicks were brooded in the center level of cages on paper within each of the replicate series (i.e. the 3 cage levels) within each row. Each center-cage-level replicate was filled with 90 white-egg (30 per 61 x 51 cm cage) and 90 brown-egg (30 per 61 x 51 cm cage) pullets on the day of hatch. At 42 days of age, 1/3 of the birds in each brooding replicate were moved to the top cages, and 1/3 were moved to the bottom cages for a final rearing allowance of 290 cm^2 (48 in^2) for the white-egg and brown-egg pullets.

House 8 - is an open-sided brood-grow facility with six rows of 122 cm wide by 102 cm deep single deck cages with each cage assigned a replicate number. The white and brown-egg strains were randomly assigned to the replicates in each house. Entrant strains were assigned to the replicates in a restricted randomized manner with the restrictions being that all strains were approximately equally represented in all rows. Forty white-egg or brown-egg females were started and grown in each replicate with a final rearing space allowance of 290 cm^2 (48 in^2). Refer to the 30th North Carolina Layer Performance and Management Test Growing Report (Vol. 30, No. 2) for details of pullet management, nutrition, and performance.

Pullets from all strain and pullet housing combinations were moved to both laying houses randomly over a three-day period. Photoperiod in both laying facilities was 16.5 hours light, 7.5 hours dark, with artificial illumination provided by compact fluorescent lamps.

Test Design:

The test was a factorial arrangement of treatments. Main effects were strain, layer housing, and density. The following are general descriptions of the main effects:

Strain

Samples of fertile eggs were provided from the breeders. All eggs were set and hatched concurrently. A total of eight white egg strains and four brown egg strains participated in the test. See the Hatch Report (Vol. 30, No. 1) for details.

Layer Housing

Two lay houses (4 and 5) were utilized. House 4 is a high rise, environmentally controlled facility with three banks of four-deck high cages. Each side of each bank was designated as a row, and each row was divided into nine eight-foot replicate blocks/level. The replicate blocks contain cages that are either 61 or 81 cm wide. All cages are 35.5 cm deep. House 5 is a standard height open-sided laying house with a flush manure handling system. It has two banks of triple deck cages and two banks with four levels of cages. Again, each side of a bank was designed as a row and each row was divided into nine eight-foot replicate blocks/level. The replicate blocks contain cages that are either 61 or 81 cm wide. All cages are 35.5 cm deep. Both houses contain feeder systems which allow feed consumption to be determined per replicate block. The white-egg and brown-egg strains were assigned to the replicates in a restricted randomized manner, with the restrictions being that all strains were approximately equally represented in all rows, levels and cage sizes.

Density

Two densities were used throughout the test. Hens were housed at either 361 cm^2 (56 in^2) or 482 cm^2 (75 in^2). Hen populations were held constant at placement to 6 hens per cage with 24 or 18 hens per replicate depending on cage lengths of 61 cm or 81 cm.

Layer Management and Nutrition:[1]

Layer diets are identified as Diets D, E, F, G, H, I, M, N, O, P, and Q. Formulations are presented in the succeeding section. Feed was offered ad libitum in accordance with the following guidelines:

MINIMUM DAILY INTAKE OF NUTRIENTS PER BIRD
AT VARIOUS STAGES OF PRODUCTION

Production Stage	> 87% and Pre-Peak	87-80%	80-70%	<70%
White-Egg Layers				
Protein (g/day)	19	18	17	16
Calcium (g/day)	3.8	3.8	4.0	4.0
Lysine (mg/day)	820	780	730	690
TSAA (mg/day)	700	670	630	590
Brown Egg Layers				
Protein (g/day)	20	19	18	17
Calcium (g/day)	3.8	3.8	3.8	4.0
Lysine (mg/day)	830	820	780	730
TSAA (mg/day)	710	700	670	630

[1]A problem was incurred with the feed during peak production, at 28 weeks of age. The commercial mill switched to new crop corn without notification. The corn had two problems associated with it: first, it was low in protein by 1%; second, it contained fusarium toxin. This was rectified in subsequent feed deliveries, however, production was depressed for a short period of time.

LAYING HOUSE FEEDING PROGRAM

Rate of Production	Consumption Per 100 Birds/Day (kg)	Diet Fed	
		White Egg Strains	Brown Egg Strains
Weeks 19-20	< 9.52	D	D
Pre-Peak and > 87%	< 9.52	F	E
	9.57-10.39	G	F
	10.43-11.29	I	H
	11.34-12.20	N	M
	12.25-13.11	P	O
	>13.15	Q	Q
80-87%	< 9.52	G	F
	9.57-10.39	H	G
	10.43-11.29	M	I
	11.34-12.20	O	N
	12.25-13.11	Q	P
	>13.15	Q	Q
70-80%	< 9.52	H	G
	9.57-10.39	I	H
	10.43-11.29	N	M
	11.34-12.20	P	O
	12.25-13.11	Q	Q
	>13.15	Q	Q
< 70%	< 9.52	I	H
	9.57-10.39	M	I
	10.43-11.29	O	N
	11.34-12.20	Q	O
	12.25-13.11	Q	Q
	>13.15	Q	Q
Post-Molt < 70%	< 9.52	G	F
	9.57-10.39	H	G
	10.43-11.29	M	I
	11.34-12.20	O	N
	12.25-13.11	Q	P
	>13.15	Q	Q

LAYING PERIOD DIETS

Ingredient	Diet Identification[1]					
	D	E	F	G	H	I
	Pounds per Ton					
Corn	959.6	1029.2	1113.1	1184.6	1245.8	1312.0
Soybean Meal	737.3	679.7	624.8	574.7	530.6	485.4
Wheat Midds						.6
Limestone	200.1	194.2	184.7	179.5	174.1	167.3
Methionine	.8	.8	.3	.6	.7	.9
Dical Phos	28.4	28.2	26.8	24.3	24.0	22.5
Salt	6.2	5.6	5.5	5.4	5.4	5.3
Vit. premix	2.0	2.0	2.0	2.0	2.0	2.0
Min. premix	1.0	1.0	1.0	1.0	1.0	1.0
Poultry Fat	61.6	56.3	38.8	24.9	13.4	
Mold Inhibitor	2.0	2.0	2.0	2.0	2.0	2.0
Tracer	1.0	1.0	1.0	1.0	1.0	1.0
Total	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0
Protein %	22.0	20.9	19.9	19.0	18.2	17.4
ME kcal/kg	2871.0	2900.0	2900.0	2900.0	2900.0	2900.0
Calcium %	4.20	4.08	3.88	3.75	3.64	3.49
T. Phos. %	.62	.61	.59	.56	.55	.53
Lysine %	1.28	1.20	1.13	1.06	1.00	.93
TSAA %	.75	.72	.67	.66	.64	.63

[1]Diets in crumblized form.

APPENDIX F (continued)
LAYING PERIOD DIETS

Ingredient	Diet Identification[1] M	N	O	P	Q
	Pounds per Ton				
Corn	1327.5	1340.9	1357.3	1369.7	1385.4
Soybean Meal	441.9	404.8	370.3	348.3	309.6
Wheat Midds	36.4	66.8	87.1	96.8	123.4
Limestone	160.8	154.2	152.7	153.4	148.4
Methionine	1.2	1.4	1.6	1.7	1.9
Dical Phos	21.2	20.9	20.0	19.1	18.9
Salt	5.0	5.0	5.0	5.0	5.0
Vit. premix	2.0	2.0	2.0	2.0	2.0
Min. premix	1.0	1.0	1.0	1.0	1.0
Poultry Fat					
Mold Inhibitor	2.0	2.0	2.0	2.0	2.0
Tracer	1.0	1.0	1.0	1.0	1.0
Choline Cl					.1
l-Lysine					1.3
Total	2000.0	2000.0	2000.0	2000.0	2000.0
Protein %	16.7	16.1	15.5	15.1	14.5
ME kcal/kg	2900.0	2900.0	2900.0	2900.0	2900.0
Calcium %	3.35	3.22	3.18	3.18	3.07
T. Phos. %	.52	.52	.50	.50	.49
Lysine %	.88	.83	.78	.75	.75
TSAA %	.62	.61	.59	.59	.58

[1]Diets in crumblized form.

Data Collection Schedule and Procedures:

Egg Production--All eggs that had the potential of being marketed were credited toward the test unit's (replicate) egg production, regardless of the shell condition at the time of collection. All eggs were collected and recorded daily. Egg production was summarized at twenty-eight day intervals, and was calculated and reported on a hen-day basis.

Egg Weight--At twenty-eight day intervals, all eggs produced in the previous 24-hour period were weighed and sorted by size. Extra large, large, medium, small, and pee wee categories were defined as having a minimum weight of 27, 24, 21, 18 and < 18 ounces per dozen, respectively. Percentages of eggs within each size category, average egg weight (g), and egg mass (g) were calculated and reported.

Egg Quality--At twenty-eight day intervals, all eggs produced within the previous 24 hours were examined by candling light and graded according to current USDA standards for egg quality. Eggs were graded at the point of production with no handling prior to examination. Egg income was calculated using three-year regional average prices for farm value of eggs based on egg production and quality evaluation.

Feed Consumption--All feed offered for consumption was recorded for each unit. At twenty-eight day intervals, feed not consumed was weighed and feed consumption was calculated. Daily feed intake (kg/100 hens/day) was calculated and reported for each strain. Feed costs were based on average regional prices and were calculated and summarized for complete production cycles.

Mortality--All mortalities were recorded daily, categorized as to the cause, and obvious accidents were not included in reported mortalities. In this test, mortalities were higher than normal in most of the strains represented. An analysis of the causes of mortality shows that most of the mortality was caused by cannibalism and prolapse (see table below). The following table summarizes the causes of mortality as they were recorded.

CAUSE OF MORTALITY IN THE 30th NCLP&MT

Strain	Prolapse/Cannibalism	Molt	Other
White	%	%	%
Shaver (White)	16.4^{A}	1.9^{CD}	3.2
Hisex (White)	11.8^{A}	2.4^{BCD}	4.9
ISA Babcock (B300-A)	13.0^{A}	5.0^{AB}	5.1
ISA Babcock (B300-B)	12.5^{A}	7.2^{A}	5.7
HyLine (W-36)	4.5^{B}	$.2^{D}$	3.4
H & N ("Nick Chick")	15.1^{A}	2.1^{CD}	6.3
DeKalb (Delta)	15.5^{A}	3.5^{BC}	3.5
DeKalb (XL-Link)	14.3^{A}	2.1^{CD}	3.5
Brown			
Hisex (Brown)	14.8	6.1	3.4
ISA (Brown)	14.9	5.0	4.2
HyLine (Brown)	9.9	3.0	3.2
H & N ("Brown Nick")	17.4	5.8	5.1

^{A,B,C,D} - Different letters denote significant differences ($P<.01$).

The differences in mortality between groups may be due to the beak trimming technique used. Beaks were severely trimmed at 6 days. However, due to the chick size differences among the strains the trim was not as effective as it should have been. This allowed for some regrowth of the beak which may have encouraged the establishment of the pecking habit. Hopefully, this problem has been remedied.

Statistical Analyses and Separation of Means:

Analyses of variance were performed on all data. Separate analyses were conducted for white and brown egg strains. Significant differences ($P < .01$) within white and brown egg strains are noted by differing letters among columns of means. All data were subjected to ANOVA (Analysis of Variance procedure) utilizing the GLM (general linear models) procedure of SAS (Statistical Analysis Systems), with main effects of strain, layer house, and density. First and second order interactions were tested for significance. Mean differences were separated via the PDIFF option of the GLM procedure.

DESCRIPTION OF DATA TABLE STATISTICS

First cycle performance of white and brown egg strains are shown on Tables 1-12. The second cycle performance of the white and brown egg strains are shown on Tables 13 to 24 and Tables 25 to 36 show the overall flock performance of both cycles.

Breeder (Strain):

Short identification codes of the breeder and strain of the stock were developed. See more complete information following data tables.

Layer House:

"Open" denotes performance in the curtain-sided flush facility. "Closed" denotes performance in the controlled environment high rise facility.

Population and Space Allocations of White and Brown Egg Strains:

Hens per Cage	Cage Size Width Depth	Floor Space per Bird	Feeder Space per Bird	Water Nipples per Cage
6	61 cm x 35.5 cm	361 cm^2 (56 in^2)	10.2 cm 4 in	3
6	82 cm x 35.5 cm	482 cm^2 (74.7 in^2)	13.7 cm 5.4 in	3

Hen Housed Eggs per Bird:

The total number of eggs produced divided by the number of birds housed at 126 days.

Hen Day Egg Production:

The average daily number of eggs produced per 100 hens per day.

Egg Mass:

The average daily production of egg mass in grams per hen day.

Mortality:

The percentage of birds which died between 126 and 441 days of age and between 462 and 728 days of age. Mortality which occurred during the molt period was reported separately in Tables 13 to 16 in the first cycle report (Vol. 30, No. 3).

Feed Consumption:

The kilograms of feed consumed daily per 100 hens.

Feed Conversion:

The gram of egg produced per gram of feed consumed.

Egg Weight:

The average egg weight of period samples in grams per egg.

Egg Income:

The calculated income per hen housed at 126 days, from egg production using three-year regional average egg prices as follows:

Grade	Size	Cents/Dozen
A	Extra Large	79.2
A	Large	79.2
A	Medium	69.1
A	Small	57.4
A	Pee Wee	28.7
B	All	28.7
Cracks	All	41.9

Feed Cost:

The calculated feed cost per hen housed at 126 days, using average price per ton.

Diets	Price Per Ton
D	168.86
E	164.35
F	159.05
G	161.58
H	148.42
I	144.57
M	142.76
N	137.13
O	137.82
P	128.77
Q	139.76

Grade Information:

The average grade of eggs according to USDA grading standards.

Egg Size Distribution:

These are the USDA size classifications of the eggs. There has been no blending of egg size in this test to maximize the number of eggs in any one of USDA egg size categories. Eggs were individually weighed and sorted into the appropriate USDA size category. The proportion of the eggs falling into the following size categories:

Size Category	Ounces/Dozen
Pee Wee	< 18
Small	18 - 21
Medium	21 - 24
Large	24 - 27
Extra Large	> 27

Metric Conversions:

1 lb = 453.6 g
1 lb = .4536 kg

1 oz = 28.35 g

1 g = .03527 oz
1 kg = 2.204 lb

1 g = 1000 mg
1 kg = 1000 g

TABLE 1. EFFECT OF LAYING HOUSE ON PERFORMANCE OF WHITE EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Laying House	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
Shaver	Closed	12.0	.38	236.8	80.7	48.5	12.4	155
(White)	Open	11.7	.39	230.3	79.6	48.4	14.1	156
	Average	11.8^{BC}	$.38^{C}$	233.5^{CD}	80.1^{BC}	48.4^{CD}	13.2^{A}	156
Hisex	Closed	12.3	.39	236.5	79.3	48.9	6.8	148
(White)	Open	12.1	.40	235.8	79.1	49.4	7.9	149
	Average	12.2^{A}	$.39^{BC}$	236.2^{BCD}	79.2^{C}	49.1^{BC}	7.3^{BC}	148
ISA/Babcock	Closed	12.4	.41	247.3	83.4	51.2	9.9	144
(B300-A)	Open	11.9	.43	242.8	83.4	51.5	12.8	143
	Average	12.1^{AB}	$.42^{A}$	245.0^{AB}	83.4^{A}	51.3^{A}	11.3^{AB}	144
ISA/Babcock	Closed	12.2	.41	248.8	83.6	50.8	8.9	142
(B300-B)	Open	11.9	.43	247.7	84.4	51.6	10.2	141
	Average	12.0^{AB}	$.42^{A}$	248.3^{A}	84.0^{A}	51.2^{A}	9.5^{AB}	141
Hy-Line	Closed	10.7	.42	242.1	79.8	47.5	3.3	155
(W-36)	Open	10.5	.44	240.1	79.3	48.0	4.2	155
	Average	10.6^{D}	$.43^{A}$	241.1^{ABC}	79.5^{C}	47.8^{D}	3.7^{C}	155
H & N	Closed	12.3	.39	236.9	81.5	51.0	11.7	153
("Nick Chick")	Open	12.1	.41	233.5	81.4	51.9	12.9	154
	Average	12.2^{A}	$.40^{B}$	235.2^{CD}	81.5^{B}	51.4^{A}	12.3^{AB}	153
Dekalb	Closed	11.8	.40	222.5	80.5	50.0	17.7	154
(Delta)	Open	11.7	.41	225.8	79.0	49.8	12.2	152
	Average	11.7^{C}	$.40^{B}$	224.2^{E}	79.8^{C}	49.9^{B}	15.0^{A}	153
Dekalb	Closed	12.3	.38	231.3	80.2	49.4	12.2	152
(XL-Link)	Open	12.1	.39	229.0	80.0	49.3	12.3	153
	Average	12.2^{A}	$.39^{C}$	230.2^{DE}	80.1^{BC}	49.4^{BC}	12.2^{AB}	153
All Strains	Closed	12.0	.40	237.8	81.1	49.7	10.4	150
	Open	11.8	.41	235.6	80.8	50.0	10.8	150
	Average	11.9	.41	236.6	80.9	49.8	10.6	150

A,B,C,D,E - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 2. EFFECT OF LAYING HOUSE ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF WHITE EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Laying House	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Shaver	Closed	59.6	1.0	6.2^{W}	18.4^{UV}	44.4^{TUV}	30.0^{YZ}
(White)	Open	61.3	0.6	0.8^{YZ}	15.9^{VW}	46.6^{T}	36.1^{WXY}
	Average	60.4^{EF}	0.8	3.5	17.1	45.5	33.1
Hisex	Closed	61.4	0.9	5.2^{WX}	13.2^{WXY}	38.5^{XYZ}	42.3^{TUVW}
(White)	Open	62.7	0.5	0.7^{YZ}	11.5^{XY}	40.5^{VWX}	46.8^{ST}
	Average	62.1^{BC}	0.7	2.9	12.4	39.5	44.6
ISA/Babcock	Closed	61.2	0.2	5.3^{WX}	16.3^{VW}	39.2^{WXY}	39.0^{VWX}
(B300-A)	Open	61.9	0.3	0.9^{YZ}	13.1^{WXY}	46.0^{TU}	39.7^{UVWX}
	Average	61.6^{CD}	0.3	3.1	14.7	42.6	39.3
ISA/Babcock	Closed	60.6	0.5	5.1^{WX}	15.7^{VW}	42.0^{UVWX}	36.7^{WX}
(B300-B)	Open	61.4	0.9	0.6^{Z}	13.9^{WX}	46.6^{T}	38.0^{VWX}
	Average	61.0^{DE}	0.7	2.9	14.8	44.3	37.3
Hy-Line	Closed	59.1	0.8	8.0^{V}	20.2^{U}	43.3^{TUVW}	27.8^{Z}
(W-36)	Open	61.1	0.4	1.8^{Y}	17.8^{UV}	44.9^{TUV}	35.1^{XY}
	Average	60.1^{F}	0.6	4.9	19.0	44.1	31.4
H & N	Closed	62.0	0.9	4.5^{X}	13.1^{WXY}	35.8^{YZ}	45.8^{TU}
("Nick Chick")	Open	64.1	0.4	0.3^{Z}	8.2^{Z}	34.3^{Z}	56.8^{R}
	Average	63.0^{A}	0.6	2.4	10.6	35.1	51.3
Dekalb	Closed	61.6	0.7	4.8^{X}	15.3^{VW}	35.9^{YZ}	43.4^{TUV}
(Delta)	Open	63.3	0.8	0.8^{YZ}	10.2^{YZ}	35.5^{YZ}	52.8^{RS}
	Average	62.4^{AB}	0.7	2.8	12.7	35.7	48.1
Dekalb	Closed	61.2	1.1	5.6^{WX}	14.5^{WX}	38.4^{XYZ}	40.5^{UVWX}
(XL-Link)	Open	62.0	0.9	1.1^{YZ}	14.4^{WX}	41.7^{UVWX}	41.8^{TUVW}
	Average	61.6^{CD}	1.0	3.3	14.4	40.0	41.2
All Strains	Closed	60.8	0.7	5.6	15.8	39.7	38.2
	Open	62.2	0.6	0.9	13.1	42.0	43.4
	Average	61.6	0.7	3.1	14.4	40.9	40.9

A,B,C,D,E,F - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 3. EFFECT OF LAYING HOUSE ON EGG QUALITY, INCOME AND FEED COSTS OF WHITE EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Laying House	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Shaver	Closed	96.5	1.9	1.3	0.3	14.59	5.80
(White)	Open	97.4	1.2	1.1	0.2	14.57	4.83
	Average	97.0^{AB}	1.6^{BC}	1.2^{BC}	0.2	14.58^{CDE}	5.32^{BC}
Hisex	Closed	95.5	2.8	1.5	0.3	14.64	6.07
(White)	Open	95.6	2.1	1.9	0.4	14.86	5.20
	Average	95.6^{C}	2.5^{A}	1.7^{AB}	0.3	14.75^{BCD}	5.64^{A}
ISA/Babcock	Closed	94.6	2.8	2.3	0.3	15.23	6.06
(B300-A)	Open	96.2	2.1	1.4	0.2	15.34	5.00
	Average	95.4^{C}	2.5^{A}	1.9^{A}	0.3	15.29^{AB}	5.53^{AB}
ISA/Babcock	Closed	96.3	1.7	1.6	0.3	15.48	5.98
(B300-B)	Open	96.4	2.0	1.3	0.3	15.59	5.05
	Average	96.4^{ABC}	1.9^{A}	1.5^{ABC}	0.3	15.54^{A}	5.52^{AB}
Hy-Line	Closed	98.0	0.8	0.9	0.3	14.96	5.36
(W-36)	Open	97.0	1.0	1.2	0.8	15.06	4.58
	Average	97.5^{A}	0.9^{B}	1.0^{C}	0.5	15.01^{ABC}	4.97^{D}
H & N	Closed	96.3	2.3	1.1	0.3	14.76	5.89
("Nick Chick")	Open	96.0	2.3	1.4	0.4	14.83	4.99
	Average	96.2^{BC}	2.3^{A}	1.2^{BC}	0.3	14.79^{BCD}	5.44^{AB}
Dekalb	Closed	95.3	2.8	1.9	0.1	13.78	5.39
(Delta)	Open	96.4	2.1	1.3	0.3	14.30	4.80
	Average	95.9^{BC}	2.4^{A}	1.6^{ABC}	0.2	14.04^{E}	5.10^{CD}
Dekalb	Closed	95.6	2.2	1.6	0.6	14.25	5.89
(XL-Link)	Open	96.2	1.7	1.9	0.3	14.39	5.01
	Average	95.9^{BC}	2.0^{A}	1.8^{AB}	0.4	14.32^{DE}	5.45^{AB}
All Strains	Closed	96.0	2.2	1.5	0.3	14.71	5.81
	Open	96.4	1.8	1.4	0.4	14.87	4.93
	Average	96.2	2.0	1.5	0.3	14.79	5.35

A,B,C,D,E -Different letters denote significant differences ($P<.01$), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 4. EFFECT OF DENSITY ON PERFORMANCE OF WHITE EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
Shaver	361	11.5	.39	228.5	79.0	47.4	16.0	156
(White)	482	12.2	.38	238.6	81.3	49.5	10.5	155
Hisex	361	11.8	.40	228.6	77.1	47.9	9.3	150
(White)	482	12.7	.39	243.7	81.3	50.3	5.4	147
ISA/Babcock	361	11.7	.42	239.8	81.7	50.2	10.5	145
(B300-A)	482	12.5	.42	250.3	85.2	52.4	12.2	143
ISA/Babcock	361	11.7	.42	239.3	81.4	49.5	11.0	142
(B300-B)	482	12.3	.43	257.2	86.7	52.9	8.1	140
Hy-Line	361	10.4	.43	238.9	78.4	47.1	3.1	155
(W-36)	482	10.9	.42	243.3	80.6	48.5	4.4	155
H & N	361	11.8	.40	227.9	79.6	50.0	14.9	155
("Nick Chick")	482	12.6	.40	242.5	83.3	52.9	9.6	152
Dekalb	361	11.3	.41	219.8	77.6	48.7	13.0	154
(Delta)	482	12.1	.40	228.6	81.9	51.1	16.9	152
Dekalb	361	11.9	.39	230.6	79.1	48.6	12.6	152
(XL-Link)	482	12.6	.38	229.7	81.1	50.1	11.9	153
All Strains	361	11.5^B	$.41^A$	231.7^B	79.2^B	48.7^B	11.3	151
	482	12.2^A	$.40^B$	241.7^A	82.7^A	51.0^A	9.9	150

A,B, - Different letters denote significant differences (P<.01).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 5. EFFECT OF DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF WHITE EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Shaver	361	60.0	1.2	3.7	18.3	46.3	30.5
(White)	482	60.9	0.4	3.2	16.0	44.7	35.7
Hisex	361	62.1	0.6	3.1	12.0	38.7	45.6
(White)	482	62.0	0.8	2.8	12.7	40.3	43.5
ISA/Babcock	361	61.5	0.1	3.0	15.6	43.1	38.2
(B300-A)	482	61.6	0.4	3.2	13.8	42.2	40.5
ISA/Babcock	361	61.0	0.8	3.1	14.6	44.2	37.3
(B300-B)	482	61.1	0.6	2.6	15.0	44.4	37.4
Hy-Line	361	60.1	0.7	4.5	19.3	44.8	30.8
(W-36)	482	60.1	0.5	5.4	18.7	43.3	32.1
H & N	361	62.5	0.6	2.6	12.0	36.2	48.5
("Nick Chick")	482	63.5	0.6	2.2	9.3	33.9	54.0
Dekalb	361	62.7	0.4	2.7	12.1	36.1	48.6
(Delta)	482	62.2	1.0	2.9	13.3	35.3	47.5
Dekalb	361	61.4	0.9	3.5	14.8	41.7	39.1
(XL-Link)	482	61.7	1.1	3.2	14.1	38.4	43.2
All Strains	361	61.4	0.7	3.3	14.8	41.4	39.8
	482	61.6	0.7	3.2	14.1	40.3	41.7

*There are no significant differences among these means.
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 6. EFFECT OF DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF WHITE EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Shaver	361	97.0	1.6	1.3	0.1	14.21	5.07
(White)	482	97.0	1.6	1.1	0.4	14.96	5.56
Hisex	361	95.4	2.2	2.1	0.2	14.29	5.36
(White)	482	95.7	2.7	1.2	0.4	15.21	5.91
ISA/Babcock	361	95.4	2.1	2.1	0.4	14.96	5.32
(B300-A)	482	95.4	2.8	1.6	0.2	15.61	5.73
ISA/Babcock	361	96.0	2.0	1.8	0.3	14.93	5.30
(B300-B)	482	96.8	1.7	1.2	0.4	16.14	5.73
Hy-Line	361	97.4	0.7	1.4	0.5	14.88	4.86
(W-36)	482	97.7	1.1	0.7	0.6	15.14	5.08
H & N	361	96.2	2.3	1.3	0.3	14.31	5.19
("Nick Chick")	482	96.1	2.3	1.2	0.4	15.28	5.69
Dekalb	361	96.1	1.9	1.7	0.3	13.81	4.94
(Delta)	482	95.7	2.9	1.4	0.0	14.27	5.26
Dekalb	361	95.6	2.2	2.0	0.3	14.34	5.32
(XL-Link)	482	96.1	1.7	1.6	0.5	14.31	5.58
All Strains	361	96.1	1.9	1.7^{A}	0.3	14.47^{B}	5.17^{B}
	482	96.3	2.1	1.2^{B}	0.4	15.11^{A}	5.57^{A}

A,B - Different letters denote significant differences (P<.01).

[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 7. EFFECT OF LAYING HOUSE ON PERFORMANCE OF BROWN EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Laying House	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
Hisex	Closed	12.4	.36	226.9	75.5	48.7	7.0	156
(Brown)	Open	12.5	.39	233.6	78.4	51.1	9.3	155
	Average	12.5^{BC}	$.38^{C}$	230.2^{B}	77.0^{C}	49.9^{C}	8.2^{AB}	156^{A}
ISA	Closed	13.1	.41	245.7	3.1	54.2	10.6	144
(Brown)	Open	12.6	.43	244.6	84.1	55.4	12.5	144
	Average	12.8^{A}	$.42^{A}$	245.1^{A}	83.6^{A}	54.8^{A}	11.5^{A}	144^{C}
Hy-Line	Closed	12.6	.40	248.7	81.9	52.1	4.5	148
(Brown)	Open	12.5	.41	245.5	81.2	52.1	4.7	150
	Average	12.6^{B}	$.41^{B}$	247.1^{A}	81.5^{B}	52.1^{B}	4.6^{B}	149^{B}
H & N	Closed	12.3	.42	241.0	81.1	52.8	11.6	150
("Brown Nick")	Open	12.1	.43	241.5	80.7	53.2	9.0	149
	Average	12.2^{C}	$.42^{A}$	241.3^{A}	80.9^{B}	53.0^{B}	10.3^{A}	150^{B}
All Strains	Closed	12.6	.40	240.6	80.4	52.0	8.4	150
	Open	12.4	.42	241.3	81.1	53.0	8.9	150
	Average	12.5	.41	240.9	80.8	52.5	8.7	150

A,B,C - Different letters denote significant differences ($P<.01$), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 8. EFFECT OF LAYING HOUSE ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF BROWN EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Laying House	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hisex	Closed	63.9	0.6	2.9^{W}	9.2	29.2	58.2
(Brown)	Open	65.4	0.5	0.1^{Z}	4.8	28.1	66.5
	Average	64.7^{B}	0.5	1.5	7.0^{A}	28.6^{B}	62.3^{B}
ISA	Closed	65.1	0.5	1.0^{Y}	6.9	27.6	64.0
(Brown)	Open	66.0	0.3	0.0^{Z}	2.9	26.8	70.0
	Average	65.6^{A}	0.4	0.5	4.9^{B}	27.2^{B}	67.0^{A}
Hy-Line	Closed	63.5	0.4	2.2^{WX}	10.4	33.2	53.7
(Brown)	Open	64.5	0.6	0.3^{YZ}	5.6	33.0	60.4
	Average	64.0^{C}	0.5	1.2	8.0^{A}	33.1^{A}	57.1^{C}
H & N	Closed	64.8	0.3	1.8^{X}	9.4	27.9	60.7
("Brown Nick")	Open	66.1	0.1	0.2^{Z}	4.4	27.3	68.1
	Average	65.4^{A}	0.2	1.0	6.9^{A}	27.6^{B}	64.4^{AB}
All Strains	Closed	64.3	0.4	2.0	9.0	29.5	59.2
	Open	65.5	0.5	0.1	4.4	28.8	66.3
	Average	64.9	0.4	1.0	6.6	29.1	62.9

A,B,C - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

W,X,Y,Z - Different letters denote significant strain x housing interactions (P<.01).

TABLE 9. EFFECT OF LAYING HOUSE ON EGG QUALITY, INCOME AND FEED COSTS OF BROWN EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Laying House	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Hisex (Brown)	Closed	96.2	2.1	1.3	0.5	14.28	6.12
	Open	97.1	1.4	0.9	0.5	14.98	5.50
	Average	96.7	1.7	1.1	0.5	14.63^{B}	5.81^{AB}
ISA (Brown)	Closed	95.9	2.3	1.5	0.4	15.58	6.32
	Open	96.7	1.9	1.2	0.2	15.74	5.50
	Average	96.3	2.1	1.3	0.3	15.66^{A}	5.91^{A}
Hy-Line (Brown)	Closed	97.0	1.1	1.4	0.5	15.75	6.31
	Open	97.1	1.2	1.4	0.3	15.74	5.59
	Average	97.0	1.1	1.4	0.4	15.74^{A}	5.95^{A}
H & N ("Brown Nick")	Closed	96.5	2.2	1.2	0.1	15.29	6.03
	Open	96.8	1.4	1.5	0.4	15.53	5.29
	Average	96.7	1.8	1.3	0.2	15.41^{A}	5.66^{B}
All Strains	Closed	96.4	1.9	1.4	0.4	15.23	6.20
	Open	96.9	1.5	1.3	0.4	15.50	5.47
	Average	96.7	1.7	1.3	0.4	15.37	5.81

A,B - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 10. EFFECT OF DENSITY ON PERFORMANCE OF BROWN EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
Hisex	361	11.9	.37	219.5	74.4	48.0	11.1	157
(Brown)	482	13.0	.38	241.0	79.5	51.8	5.2	155
ISA	361	12.4	.43	240.7	82.7	53.9	12.4	145
(Brown)	482	13.3	.41	249.6	84.5	55.7	10.7	143
Hy-Line	361	12.1	.41	239.1	79.0	50.4	5.1	150
(Brown)	482	13.0	.41	255.1	84.1	53.9	4.0	148
H & N	361	11.8	.43	233.7	78.4	51.3	10.6	151
("Brown Nick")	482	12.6	.42	248.9	83.5	54.7	10.0	148
All Strains	361	12.1^{B}	.41	233.3^{B}	78.6^{B}	50.9^{B}	9.8	151^{A}
	482	13.0^{A}	.41	248.6^{A}	82.9^{A}	54.0^{A}	7.5	149^{B}

A,B - Different letters denote significant differences ($P<.01$).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 11. EFFECT OF DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF BROWN EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hisex	361	64.3	0.5	1.8	7.6	30.0	60.1
(Brown)	482	65.0	0.6	1.1	6.4	27.3	64.5
ISA	361	65.2	0.4	0.6	5.2	29.8	64.0
(Brown)	482	65.9	0.4	0.3	4.7	24.6	70.0
Hy-Line	361	63.8	0.3	1.3	7.9	36.4	54.1
(Brown)	482	64.2	0.8	1.2	8.1	29.9	60.0
H & N	361	65.3	0.2	1.0	7.3	28.7	62.7
("Brown Nick")	482	65.5	0.2	0.9	6.6	26.4	66.0
All Strains	361	64.7^B	0.3	1.2	7.0	31.2^A	60.2^B
	482	65.2^A	0.5	0.9	6.4	27.0^B	65.2^A

A,B - Different letters denote significant differences (P<.01).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 12. EFFECT OF DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF BROWN EGG STRAINS, 30TH NCLP&MT (133-441 DAYS)

Breeder (Strain)	Density (cm^2)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Hisex	361	93.3	1.9	1.4	0.4	13.92	5.46
(Brown)	482	97.0	1.6	0.8	0.6	15.35	6.16
ISA	361	96.4	1.8	1.5	0.3	15.38	5.63
(Brown)	482	96.2	2.4	1.2	0.3	15.94	6.19
Hy-Line	361	97.1	1.2	1.5	0.2	15.28	5.72
(Brown	482	97.0	1.1	1.3	0.5	16.21	6.18
H & N	361	96.3	2.0	1.5	0.3	14.88	5.40
("Brown Nick")	482	97.0	1.6	1.2	0.2	15.95	5.91
All Strains	361	96.5	1.7	1.5	0.3	14.86^{B}	5.55^{B}
	482	96.8	1.7	1.1	0.4	15.86^{A}	6.11^{A}

A,B - Different letters denote significant differences ($P<.01$).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 13. EFFECT OF LAYING HOUSE ON PERFORMANCE OF WHITE EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Laying House	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)
Shaver	Closed	12.3	.30	158.3	69.1	45.2	7.3
(White)	Open	12.0	.30	150.9	67.2	43.5	5.6
	Average	12.2^{AB}	$.30^{C}$	154.6^{B}	68.1^{A}	44.4^{B}	6.4^{BC}
Hisex	Closed	12.6	.29	152.6	62.4	41.9	10.4
(White)	Open	12.2	.30	147.1	62.3	41.8	10.4
	Average	12.4^{AB}	$.30^{C}$	149.9^{B}	62.4^{B}	41.9^{C}	10.4^{A}
ISA/Babcock	Closed	12.5	.33	157.4	69.2	46.3	8.0
(B300-A)	Open	12.1	.33	151.9	68.1	44.7	9.0
	Average	12.3^{AB}	$.33^{B}$	154.6^{B}	68.6^{A}	45.5^{AB}	8.5^{AB}
ISA/Babcock	Closed	12.7	.31	158.5	69.1	45.6	9.0
(B300-B)	Open	12.2	.33	148.8	69.6	46.0	11.9
	Average	12.4^{AB}	$.32^{B}$	153.6^{B}	69.4^{A}	45.8^{AB}	10.4^{A}
Hy-Line	Closed	10.9	.35	183.4	69.5	45.7	4.7
(W-36)	Open	10.9	.35	179.6	69.2	45.4	4.5
	Average	10.9^{C}	$.35^{A}$	181.5^{A}	69.3^{A}	45.5^{AB}	4.6^{C}
H & N	Closed	12.7	.33	159.4	70.1	47.7	8.2
("Nick Chick")	Open	12.4	.34	153.8	68.8	47.0	11.5
	Average	12.5^{A}	$.33^{AB}$	156.6^{B}	69.4^{A}	47.3^{A}	9.8^{AB}
Dekalb	Closed	12.3	.33	149.2	69.2	46.3	5.9
(Delta)	Open	11.9	.34	157.3	68.9	46.3	6.5
	Average	12.1^{B}	$.34^{AB}$	153.2^{B}	69.0^{A}	46.3^{AB}	6.2^{BC}
Dekalb	Closed	12.6	.32	161.9	69.5	46.2	4.6
(XL-Link)	Open	12.2	.33	156.5	68.6	45.3	7.5
	Average	12.4^{AB}	$.32^{B}$	159.2^{B}	69.1^{A}	45.7^{AB}	6.1^{BC}
All Strains	Closed	12.3	.32	160.1	68.5	45.6	7.3
	Open	12.0	.33	155.7	67.8	45.0	8.4
	Average	12.2	.32	157.8	68.2	45.3	7.8

A,B,C - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 14. EFFECT OF LAYING HOUSE ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF WHITE EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Laying House	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Shaver	Closed	65.4	0.2	0.1	2.2	29.1	68.6
(White)	Open	64.9	0.6	0.1	1.6	31.5	66.2
	Average	65.1[E]	0.4	0.1	1.9	30.3	67.4
Hisex	Closed	67.0	0.5	0.0	1.7	18.8	79.1
(White)	Open	67.2	0.3	0.1	1.1	19.5	79.0
	Average	67.1[B]	0.4	0.1	1.4	19.1	79.0
ISA/Babcock	Closed	66.8	0.4	0.0	1.4	21.3	76.9
(B300-A)	Open	65.8	0.2	0.0	1.8	28.5	69.6
	Average	66.3[CD]	0.3	0.0	1.6	24.9	73.2
ISA/Babcock	Closed	66.0	0.2	0.1	1.5	23.6	74.6
(B300-B)	Open	66.2	0.1	0.1	1.8	23.6	74.4
	Average	66.1[D]	0.2	0.1	1.7	23.6	74.5
Hy-Line	Closed	65.7	0.3	0.0	2.1	27.2	70.5
(W-36)	Open	65.6	0.3	0.0	1.7	29.2	68.8
	Average	65.6[DE]	0.3	0.0	1.9	28.2	69.6
H & N	Closed	68.0	0.4	0.1	0.9	14.2	84.6
("Nick Chick")	Open	68.2	0.4	0.0	1.0	15.0	83.6
	Average	68.1[A]	0.4	0.0	0.9	14.6	84.1
Dekalb	Closed	66.8	0.7	0.4	1.4	22.6	74.9
(Delta)	Open	67.2	0.1	0.0	2.6	22.8	74.4
	Average	67.0[BC]	0.4	0.2	2.0	22.7	74.6
Dekalb	Closed	66.2	0.8	0.0	1.6	24.7	72.9
(XL-Link)	Open	66.0	0.1	0.1	2.6	28.4	68.8
	Average	66.1[D]	0.4	0.1	2.1	26.5	70.9
All Strains	Closed	66.5	0.4	0.1	1.6	22.7	75.3
	Open	66.4	0.3	0.1	1.8	24.8	73.1
	Average	66.4	0.3	0.1	1.7	23.8	74.1

A,B,C,D,E - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 15. EFFECT OF LAYING HOUSE ON EGG QUALITY, INCOME AND FEED COSTS OF WHITE EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Laying House	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Shaver	Closed	94.5	2.7	2.3	0.6	10.06	4.58
(White)	Open	94.8	2.3	2.4	0.5	9.60	4.42
	Average	94.7^{AB}	2.5^{AB}	2.3^{AB}	0.5	9.83^{B}	4.50
Hisex	Closed	92.9	3.5	3.0	0.7	9.61	4.98
(White)	Open	92.2	3.3	3.7	0.9	9.23	4.71
	Average	92.6^{C}	3.4^{A}	3.3^{A}	0.8	9.42^{B}	4.84
ISA/Babcock	Closed	93.9	3.1	2.4	0.7	9.95	4.63
(B300-A)	Open	94.0	2.9	2.5	0.7	9.62	4.38
	Average	93.9^{BC}	3.0^{A}	2.5^{AB}	0.7	9.79^{B}	4.51
ISA/Babcock	Closed	93.6	2.8	3.0	0.7	10.03	4.71
(B300-B)	Open	93.3	2.7	3.2	0.8	9.39	4.26
	Average	93.4^{BC}	2.7^{A}	3.1^{A}	0.7	9.71^{B}	4.48
Hy-Line	Closed	95.7	1.5	1.8	1.0	11.72	4.67
(W-36)	Open	95.9	1.8	1.5	0.9	11.49	4.60
	Average	95.8^{A}	1.7^{B}	1.6^{B}	1.0	11.60^{A}	4.63
H & N	Closed	94.3	2.0	3.1	0.6	10.13	4.72
("Nick Chick")	Open	93.4	3.6	2.5	0.6	9.71	4.53
	Average	93.8^{BC}	2.8^{A}	2.8^{A}	0.6	9.92^{B}	4.62
Dekalb	Closed	94.0	3.1	2.4	0.5	9.43	4.30
(Delta)	Open	93.4	3.7	2.4	0.5	9.93	4.42
	Average	93.7^{BC}	3.4^{A}	2.4^{AB}	0.5	9.68^{B}	4.36
Dekalb	Closed	93.7	3.1	2.3	1.0	10.18	4.78
(XL-Link)	Open	94.1	2.8	2.8	0.4	9.93	4.56
	Average	93.9^{BC}	2.9^{A}	2.5^{AB}	0.7	10.06^{B}	4.67
All Strains	Closed	94.1	2.7	2.5	0.7	10.14	4.67
	Open	93.9	2.9	2.6	0.7	9.86	4.49
	Average	94.0	2.8	2.6	0.7	9.99	4.57

A,B,C - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 16. EFFECT OF DENSITY ON PERFORMANCE OF WHITE EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)
Shaver	361	12.0	.30	149.3	67.9	43.9	5.7
(White)	482	12.3	.31	159.9	68.4	44.8	7.1
Hisex	361	12.3	.30	142.0	61.6	41.6	13.0
(White)	482	12.5	.30	157.7	63.1	42.1	7.9
ISA/Babcock	361	12.1	.33	153.1	68.2	45.1	9.4
(B300-A)	482	12.5	.33	156.2	69.1	46.0	7.6
ISA/Babcock	361	12.5	.31	140.6	67.1	44.6	13.3
(B300-B)	482	12.4	.34	166.6	71.6	47.1	7.6
Hy-Line	361	10.6	.35	180.1	68.3	44.5	4.8
(W-36)	482	11.2	.34	182.9	70.4	46.6	4.4
H & N	361	12.4	.33	147.1	68.6	46.4	10.7
("Nick Chick")	482	12.7	.34	166.0	70.3	48.2	8.9
Dekalb	361	11.8	.33	153.2	68.3	45.6	6.8
(Delta)	482	12.4	.34	153.3	69.8	46.9	5.5
Dekalb	361	12.0	.32	153.7	67.5	44.4	7.0
(XL-Link)	482	12.8	.32	164.6	70.7	47.0	5.1
All Strains	361	12.0^{B}	.32	152.4^{B}	67.2^{B}	44.5^{B}	8.9^{A}
	482	12.4^{A}	.33	163.4^{A}	69.2^{A}	46.1^{A}	6.7^{B}

A,B - Different letters denote significant differences ($P<.01$).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 17. EFFECT OF DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF WHITE EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Shaver	361	64.7	0.4	0.1	2.0	34.3^{A}	63.2^{G}
(White)	482	65.5	0.4	0.0	1.8	26.2^{BCD}	71.6^{DEF}
Hisex	361	67.4	0.4	0.0	1.2	15.8^{FG}	82.6^{AB}
(White)	482	66.8	0.4	0.1	1.6	22.4^{DEF}	75.4^{BCD}
ISA/Babcock	361	66.0	0.4	0.0	1.1	26.9^{BCD}	71.6^{DEF}
(B300-A)	482	66.6	0.2	0.0	2.0	22.9^{CDE}	74.8^{CDE}
ISA/Babcock	361	66.3	0.1	0.0	1.6	22.9^{CDE}	75.3^{BCD}
(B300-B)	482	65.9	0.2	0.1	1.7	24.3^{BCD}	73.6^{DEF}
Hy-Line	361	65.2	0.5	0.0	2.4	30.7^{AB}	66.5^{FG}
(W-36)	482	66.1	0.1	0.0	1.4	25.6^{BCD}	72.8^{DEF}
H & N	361	67.6	0.7	0.1	0.8	16.2^{EFG}	82.3^{ABC}
("Nick Chick")	482	68.6	0.1	0.0	1.1	12.9^{G}	86.0^{A}
Dekalb	361	66.8	0.3	0.5	2.1	22.4^{DEF}	74.7^{CDE}
(Delta)	482	67.1	0.5	0.0	1.9	23.0^{CDE}	74.6^{DE}
Dekalb	361	65.8	0.4	0.1	2.2	29.7^{ABC}	67.7^{EFG}
(XL-Link)	482	66.4	0.5	0.0	2.1	23.4^{CD}	74.0^{DE}
All Strains	361	66.2	0.4	0.1	1.7	24.9	73.0
	482	66.6	0.3	0.0	1.7	22.6	75.4

A,B,C,D,E,F,G - Different letters denote significant strain x density interactions (P<.01).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 18. EFFECT OF DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF WHITE EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Shaver	361	94.4	2.8	2.1	0.6	9.48	4.31
(White)	482	94.9	2.2	2.5	0.5	10.19	4.68
Hisex	361	92.1	3.5	3.3	1.1	8.89	4.63
(White)	482	93.0	3.3	3.3	0.4	9.95	5.06
ISA/Babcock	361	93.4	3.1	2.9	0.5	9.67	4.45
(B300-A)	482	94.4	2.8	2.0	0.9	9.90	4.56
ISA/Babcock	361	93.9	2.3	3.1	0.6	8.93	4.28
(B300-B)	482	93.0	3.1	3.1	0.9	10.49	4.69
Hy-Line	361	95.2	1.7	2.2	0.9	11.47	4.57
(W-36)	482	96.4	1.6	1.1	1.0	11.74	4.70
H & N	361	93.4	2.9	3.0	0.7	9.29	4.34
("Nick Chick")	482	94.2	2.7	2.6	0.5	10.56	4.91
Dekalb	361	93.6	3.5	2.4	0.6	9.67	4.31
(Delta)	482	93.8	3.4	2.4	0.4	9.69	4.41
Dekalb	361	93.9	2.9	2.6	0.7	9.72	4.49
(XL-Link)	482	93.9	3.0	2.4	0.7	10.40	4.86
All Strains	361	93.8	2.9	2.7	0.7	9.64^{B}	4.42^{B}
	482	94.2	2.7	2.4	0.7	10.36^{A}	4.73^{A}

A,B - Different letters denote significant differences ($P<.01$).

[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 19. EFFECT OF LAYING HOUSE ON PERFORMANCE OF BROWN EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Laying House	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)
Hisex	Closed	13.3	.25^{Z}	142.9	62.2	43.1	10.8
(Brown)	Open	13.0	.29^{WXY}	143.8	65.6	45.5	14.5
	Average	13.1	.27	143.4^{AB}	63.9	44.3	12.7
ISA	Closed	13.5	.28^{XYZ}	142.3	63.8	45.3	13.3
(Brown)	Open	13.1	.32^{W}	148.6	67.5	47.6	9.2
	Average	13.3	.30	145.5^{AB}	65.6	46.5	11.3
Hy-Line	Closed	13.1	.29^{WXY}	159.8	64.3	44.8	7.8
(Brown)	Open	12.9	.28^{YZ}	154.1	63.2	43.8	10.9
	Average	13.0	.28	157.0^{A}	63.7	44.3	9.3
H & N	Closed	13.2	.29^{XY}	137.9	65.0	46.0	12.5
("Brown Nick")	Open	12.8	.31^{WX}	139.3	63.9	45.5	15.6
	Average	13.0	.30	138.6^{B}	64.5	45.7	14.0
All Strains	Closed	13.3	.28	145.7	63.8	44.8	11.1
	Open	12.9	.30	146.5	65.1	45.6	12.6
	Average	13.1	.29	146.1	64.5	45.2	11.9

A,B - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.
W,X,Y,Z - Different letters denote significant strain x housing interactions (P<.01).

TABLE 20. EFFECT OF LAYING HOUSE ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF BROWN EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Laying House	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hisex	Closed	69.2	0.6	0.1	1.6	11.5	86.2
(Brown)	Open	69.4	0.6	0.0	0.8	12.1	86.5
	Average	69.3^{B}	0.6	0.0	1.2^{A}	11.8	86.4^{B}
ISA	Closed	71.0	0.3	0.0	0.4	8.2	91.1
(Brown)	Open	70.6	0.1	0.0	0.3	9.6	90.0
	Average	70.8^{A}	0.2	0.0	0.3^{B}	8.9	90.6^{A}
Hy-Line	Closed	69.7	0.3	0.1	0.5	10.9	88.2
(Brown)	Open	69.2	0.5	0.0	0.6	11.9	87.0
	Average	69.4^{B}	0.4	0.1	0.6^{AB}	11.4	87.6^{AB}
H & N	Closed	70.6	0.7	0.2	0.1	8.4	90.6
("Brown Nick")	Open	71.1	0.2	0.0	0.6	8.8	90.5
	Average	70.8^{A}	0.4	0.1	0.4^{B}	8.6^{B}	90.5^{A}
All Strains	Closed	70.1	0.5	0.1	0.7	9.8	89.0
	Open	70.1	0.4	0.0	0.6	10.6	88.5
	Average	70.1	0.4	0.0	0.6	10.2	88.8

A,B - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 21. EFFECT OF LAYING HOUSE ON EGG QUALITY, INCOME AND FEED COSTS OF BROWN EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Laying House	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Hisex	Closed	94.1	2.9	2.4	0.6	9.05	4.97
(Brown)	Open	95.5	2.6	1.1	0.8	9.18	4.65
	Average	94.8	2.7	1.7	0.7	9.11^{B}	4.81^{B}
ISA	Closed	93.3	3.9	2.3	0.6	9.01	4.90
(Brown)	Open	93.8	3.6	1.9	0.7	9.43	4.71
	Average	93.5	3.8	2.1	0.6	9.22^{AB}	4.80^{B}
Hy-Line	Closed	95.6	1.9	2.0	0.5	10.24	5.28
(Brown)	Open	94.7	2.9	2.1	0.4	9.82	5.16
	Average	95.1	2.4	2.0	0.4	10.03^{A}	5.22^{A}
H & N	Closed	93.1	3.8	2.3	0.8	8.66	4.57
("Brown Nick")	Open	94.0	3.6	1.9	0.5	8.83	4.52
	Average	93.5	3.7	2.1	0.7	8.75^{B}	4.54^{B}
All Strains	Closed	94.0	3.1	2.2	0.6	9.24	4.93
	Open	94.5	3.2	1.8	0.6	9.32	4.76
	Average	94.3	3.2	2.0	0.6	9.28	4.84

A,B - Different letters denote significant differences ($P<.01$), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 22. EFFECT OF DENSITY ON PERFORMANCE OF BROWN EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)
Hisex	361	12.7	.27	141.1	63.4	43.8	10.3
(Brown)	482	13.5	.27	145.7	64.4	44.9	15.0
ISA	361	13.1	.30	141.7	64.9	45.5	13.5
(Brown)	482	13.5	.30	149.2	66.3	47.4	9.0
Hy-Line	361	12.8	.26	151.3	61.6	42.6	10.0
(Brown)	482	13.3	.31	162.6	65.8	46.1	8.7
H & N	361	12.6	.29	136.6	63.3	44.9	15.3
("Brown Nick")	482	13.4	.31	140.6	65.7	46.6	12.8
All Strains	361	12.8^B	$.28^B$	142.7	63.3^B	44.2^B	12.3
	482	13.4^A	$.30^A$	149.5	65.5^A	46.2^A	11.3

A,B - Different letters denote significant differences (P<.01).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 23. EFFECT OF DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF BROWN EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hisex	361	69.0	0.6	0.0	1.2	13.5	84.6
(Brown)	482	69.5	0.6	0.1	1.2	10.1	88.1
ISA	361	70.2	0.1	0.0	0.1	11.5	88.3
(Brown)	482	71.4	0.3	0.0	0.6	6.3	92.8
Hy-Line	361	68.8	0.5	0.1	0.9	13.6	85.0
(Brown)	482	70.0	0.4	0.0	0.3	9.2	90.2
H & N	361	70.7	0.5	0.1	0.2	8.6	90.7
("Brown Nick")	482	71.0	0.4	0.1	0.5	8.6	90.4
All Strains	361	69.7^{B}	0.4	0.1	0.6	11.8^{A}	87.2^{B}
	482	70.5^{A}	0.4	0.0	0.6	8.5^{B}	90.4^{A}

A,B - Different letters denote significant differences (P<.01).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 24. EFFECT OF DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF BROWN EGG STRAINS, 30TH NCLP&MT (462-735 DAYS)

Breeder (Strain)	Density (cm^2)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Hisex	361	94.4	2.7	2.1	0.8	8.94	4.65
(Brown)	482	95.2	2.8	1.3	0.7	9.28	4.97
ISA	361	93.5	3.8	2.2	0.6	8.98	4.65
(Brown)	482	93.5	3.7	2.0	0.7	9.45	4.96
Hy-Line	361	94.6	2.3	2.6	0.6	9.63	5.11
(Brown	482	95.6	2.6	1.5	0.3	10.42	5.33
H & N	361	93.6	3.8	2.1	0.6	8.64	4.47
("Brown Nick")	482	93.5	3.6	2.2	0.7	8.86	4.61
All Strains	361	94.1	3.1	2.2	0.6	9.05	4.72
	482	94.5	3.2	1.8	0.6	9.50	4.97

*There are no significant differences among these means.
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 25. EFFECT OF LAYING HOUSE ON PERFORMANCE OF WHITE EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Laying House	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality[1] (%)
Shaver	Closed	12.2	.34	395.1	74.9	46.8	20.9
(White)	Open	11.9	.34	381.1	73.4	46.0	22.6
	Average	12.0^{BC}	$.34^{C}$	388.1^{BC}	74.1^{B}	46.4^{CD}	21.7^{A}
Hisex	Closed	12.4	.34	389.2	70.9	45.4	18.6
(White)	Open	12.2	.35	382.9	70.7	45.6	20.6
	Average	12.3^{A}	$.35^{C}$	386.0^{BC}	70.8^{C}	45.5^{D}	19.6^{A}
ISA/Babcock	Closed	12.4	.37	404.6	76.3	48.7	21.8
(B300-A)	Open	12.0	.38	394.7	75.7	48.1	24.7
	Average	12.2^{AB}	$.37^{B}$	399.6^{B}	76.0^{AB}	48.4^{AB}	23.3^{A}
ISA/Babcock	Closed	12.4	.36	407.3	76.4	48.2	22.2
(B300-B)	Open	12.0	.38	396.5	77.0	48.8	28.3
	Average	12.2^{AB}	$.37^{B}$	401.9^{AB}	76.7^{A}	48.5^{AB}	25.2^{A}
Hy-Line	Closed	10.8	.38	425.5	74.7	46.6	8.0
(W-36)	Open	10.7	.39	419.7	74.2	46.7	9.1
	Average	10.8^{D}	$.39^{A}$	422.6^{A}	74.4^{B}	46.6^{CD}	8.5^{B}
H & N	Closed	12.5	.36	396.2	75.8	49.3	21.8
("Nick Chick")	Open	12.3	.37	387.3	75.1	49.4	26.0
	Average	12.4^{A}	$.37^{B}$	391.7^{BC}	75.5^{AB}	49.4^{A}	23.9^{A}
Dekalb	Closed	12.0	.37	371.7	74.8	48.1	25.2
(Delta)	Open	11.8	.37	383.2	74.0	48.0	21.3
	Average	11.9^{C}	$.37^{B}$	377.4^{C}	74.4^{B}	48.1^{AB}	23.2^{A}
Dekalb	Closed	12.5	.35	393.1	74.8	47.8	19.0
(XL-Link)	Open	12.2	.36	385.5	74.3	47.3	21.0
	Average	12.3^{A}	$.35^{C}$	389.3^{BC}	74.6^{B}	47.5^{BC}	20.0^{A}
All Strains	Closed	12.2	.36	397.8	74.8	47.6	19.7
	Open	11.9	.37	391.4	74.3	47.5	21.7
	Average	12.0	.36	394.4	74.5	47.6	20.7

A,B,C - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.
[1]Mortality includes birds lost during first cycle, molt, and second cycle.

TABLE 26. EFFECT OF LAYING HOUSE ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF WHITE EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Laying House	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Shaver	Closed	62.5	0.6	3.1	10.3	36.7	49.3
(White)	Open	63.1	0.6	0.4	8.7	39.0	51.2
	Average	62.8^{D}	0.6	1.8^{B}	9.5^{AB}	37.9^{A}	50.2^{D}
Hisex	Closed	64.2	0.7	2.6	7.4	28.6	60.7
(White)	Open	65.0	0.4	0.4	6.3	30.0	62.9
	Average	64.6^{B}	0.5	1.5^{BC}	6.9^{CD}	29.3^{C}	61.8^{B}
ISA/Babcock	Closed	64.0	0.3	2.7	8.8	30.2	58.0
(B300-A)	Open	63.8	0.2	0.4	7.4	37.3	54.6
	Average	63.9^{C}	0.3	1.6^{BC}	8.1^{BC}	33.8^{B}	56.3^{C}
ISA/Babcock	Closed	63.3	0.3	2.6	8.6	32.8	55.6
(B300-B)	Open	63.8	0.5	0.3	7.8	35.1	56.2
	Average	63.5^{C}	0.4	1.5^{BC}	8.2^{BC}	34.0^{B}	55.9^{C}
Hy-Line	Closed	62.4	0.5	4.0	11.2	35.2	49.1
(W-36)	Open	63.3	0.4	0.9	9.7	37.0	52.0
	Average	62.9^{D}	0.5	2.5^{A}	10.4^{A}	36.1^{AB}	50.5^{D}
H & N	Closed	65.0	0.6	2.3	7.0	25.0	65.2
("Nick Chick")	Open	66.1	0.4	0.2	4.6	24.6	70.2
	Average	65.5^{A}	0.5	1.2^{C}	5.8^{D}	24.8^{D}	67.7^{A}
Dekalb	Closed	64.2	0.7	2.6	8.3	29.3	59.1
(Delta)	Open	65.2	0.4	0.4	6.4	29.1	63.6
	Average	64.7^{B}	0.6	1.5^{BC}	7.4^{C}	29.2^{C}	61.4^{B}
Dekalb	Closed	63.7	0.9	2.8	8.0	31.6	56.7
(XL-Link)	Open	64.0	0.5	0.6	8.5	35.0	55.3
	Average	63.9^{C}	0.7	1.7^{B}	8.3^{BC}	33.3^{B}	56.0^{C}
All Strains	Closed	63.7	0.6	2.8	8.7	31.2	56.7
	Open	64.3	0.4	0.5	7.4	33.4	58.3
	Average	64.0	0.5	1.6	8.0	32.4	57.5

A,B,C,D - Different letters denote significant differences ($P<.01$), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 27. EFFECT OF LAYING HOUSE ON EGG QUALITY, INCOME AND FEED COSTS OF WHITE EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Laying House	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Shaver	Closed	95.5	2.3	1.8	0.4	24.66	10.38
(White)	Open	96.1	1.8	1.7	0.4	24.17	9.25
	Average	95.8^{AB}	2.0^{B}	1.8^{BC}	0.4	24.41^{BC}	9.81^{BC}
Hisex	Closed	94.2	3.1	2.2	0.5	24.25	11.05
(White)	Open	93.9	2.7	2.8	0.6	24.09	9.91
	Average	94.1^{C}	2.9^{A}	2.5^{A}	0.5	24.17^{BC}	10.48^{A}
ISA/Babcock	Closed	94.2	2.9	2.4	0.5	25.18	10.69
(B300-A)	Open	95.1	2.5	2.0	0.4	24.96	9.38
	Average	94.7^{C}	2.7^{AB}	2.2^{AB}	0.5	25.07^{BC}	10.03^{AB}
ISA/Babcock	Closed	95.0	2.3	2.3	0.5	25.50	10.69
(B300-B)	Open	94.8	2.3	2.3	0.6	24.98	9.31
	Average	94.9^{BC}	2.3^{AB}	2.3^{AB}	0.5	25.24^{AB}	10.00^{AB}
Hy-Line	Closed	96.9	1.2	1.3	0.6	26.68	10.03
(W-36)	Open	96.4	1.4	1.3	0.8	26.55	9.18
	Average	96.7^{A}	1.3^{C}	1.3^{C}	0.7	26.62^{A}	9.61^{BC}
H & N	Closed	95.3	2.2	2.1	0.5	24.89	10.61
("Nick Chick")	Open	94.7	3.0	1.9	0.5	24.54	9.52
	Average	95.0^{BC}	2.6^{AB}	2.0^{AB}	0.5	24.71^{BC}	10.07^{AB}
Dekalb	Closed	94.7	3.0	2.1	0.3	23.20	9.69
(Delta)	Open	94.9	2.9	1.8	0.4	24.23	9.23
	Average	94.8^{BC}	2.9^{A}	2.0^{AB}	0.3	23.72^{C}	9.46^{C}
Dekalb	Closed	94.6	2.7	1.9	0.8	24.44	10.67
(XL-Link)	Open	95.1	2.2	2.3	0.3	24.33	9.57
	Average	94.9^{BC}	2.5^{AB}	2.1^{AB}	0.6	24.38^{BC}	10.12^{AB}
All Strains	Closed	95.1	2.5	2.0	0.5	24.85	10.48
	Open	95.1	2.4	2.0	0.5	24.73	9.42
	Average	95.1	2.4	2.0	0.5	24.79	9.92

A,B,C - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 28. EFFECT OF DENSITY ON PERFORMANCE OF WHITE EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality[2] (%)
Shaver	361	11.8	.34	377.7	73.4	45.7	23.6
(White)	482	12.2	.34	398.5	74.9	47.1	19.9
Hisex	361	12.0	.35	370.6	69.4	44.8	24.0
(White)	482	12.6	.34	401.4	72.2	46.2	15.2
ISA/Babcock	361	11.9	.38	392.9	74.9	47.6	23.8
(B300-A)	482	12.5	.37	406.4	77.1	49.2	22.7
ISA/Babcock	361	12.1	.36	380.0	74.3	47.0	30.1
(B300-B)	482	12.4	.38	423.8	79.1	50.0	20.3
Hy-Line	361	10.5	.39	419.0	73.4	45.8	8.3
(W-36)	482	11.0	.38	426.2	75.5	47.5	8.8
H & N	361	12.1	.37	375.0	74.1	48.2	27.8
("Nick Chick")	482	12.7	.37	408.5	76.8	50.6	20.0
Dekalb	361	11.5	.37	373.0	73.0	47.2	22.6
(Delta)	482	12.3	.37	381.9	75.9	49.0	23.9
Dekalb	361	12.0	.36	384.3	73.4	46.5	21.2
(XL-Link)	482	12.7	.35	394.3	75.9	48.5	18.8
All Strains	361	11.7^B	.36	384.1^B	73.2^B	46.6^B	22.7^A
	482	12.3^A	.36	405.1^A	75.9^A	48.5^A	18.7^B

A,B - Different letters denote significant differences ($P<.01$).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.
[2]Mortality includes birds lost during first cycle, molt, and second cycle.

TABLE 29. EFFECT OF DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF WHITE EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Shaver	361	62.4	0.8	1.9	10.1	40.3	46.8
(White)	482	63.2	0.4	1.6	8.9	35.5	53.6
Hisex	361	64.8	0.5	1.5	6.6	27.3	64.1
(White)	482	64.4	0.6	1.4	7.1	31.4	59.4
ISA/Babcock	361	63.8	0.2	1.5	8.3	35.0	54.9
(B300-A)	482	64.1	0.3	1.6	7.9	32.5	57.6
ISA/Babcock	361	63.6	0.5	1.6	8.1	33.6	56.3
(B300-B)	482	63.5	0.4	1.4	8.4	34.3	55.5
Hy-Line	361	62.6	0.6	2.3	10.8	37.8	48.6
(W-36)	482	63.1	0.3	2.7	10.1	34.5	52.5
H & N	361	65.1	0.7	1.3	6.4	26.2	65.4
("Nick Chick")	482	66.0	0.3	1.1	5.2	23.4	70.0
Dekalb	361	64.7	0.4	1.6	7.1	29.2	61.7
(Delta)	482	64.7	0.7	1.4	7.6	29.2	61.1
Dekalb	361	63.6	0.6	1.8	8.5	35.7	53.4
(XL-Link)	482	64.1	0.8	1.6	8.1	30.9	58.6
All Strains	361	63.8	0.5	1.7	8.3	33.1	56.4
	482	64.1	0.5	1.6	7.9	31.5	58.5

*There are no significant differences among these means.
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 30. EFFECT OF DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF WHITE EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Shaver	361	95.7	2.2	1.7	0.4	23.68	9.38
(White)	482	95.9	1.9	1.8	0.4	25.14	10.24
Hisex	361	93.8	2.9	2.7	0.7	23.19	9.99
(White)	482	94.3	3.0	2.3	0.4	25.16	10.97
ISA/Babcock	361	94.4	2.6	2.5	0.5	24.64	9.77
(B300-A)	482	94.9	2.8	1.8	0.5	25.51	10.30
ISA/Babcock	361	94.9	2.2	2.4	0.4	23.86	9.58
(B300-B)	482	94.9	2.4	2.1	0.6	26.63	10.43
Hy-Line	361	96.3	1.2	1.8	0.7	26.35	9.43
(W-36)	482	97.0	1.3	0.9	0.8	26.89	9.78
H & N	361	94.8	2.6	2.1	0.5	23.59	9.54
("Nick Chick")	482	95.1	2.5	1.9	0.5	25.84	10.59
Dekalb	361	94.8	2.7	2.1	0.4	23.48	9.25
(Delta)	482	94.7	3.2	1.9	0.2	23.96	9.67
Dekalb	361	94.7	2.5	2.3	0.5	24.05	9.80
(XL-Link)	482	95.0	2.4	2.0	0.6	24.71	10.43
All Strains	361	94.9	2.4	2.2	0.5	24.10	9.59
	482	95.2	2.4	1.8	0.5	25.48	10.30

A,B - Different letters denote significant differences (P<.01).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

TABLE 31. EFFECT OF LAYING HOUSE ON PERFORMANCE OF BROWN EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Laying House	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality[1] (%)
Hisex	Closed	12.8	.31^{Z}	369.9	68.8^{Z}	45.9	21.9
(Brown)	Open	12.7	.34^{Y}	377.4	72.0^{Y}	48.3	28.8
	Average	12.8^{B}	.32	373.6^{B}	70.4	47.1^{C}	25.3^{A}
ISA	Closed	13.3	.35^{Y}	388.0	73.4^{XY}	49.7	27.2
(Brown)	Open	12.9	.38^{W}	393.2	75.8^{X}	51.5	25.0
	Average	13.1^{A}	.36	390.6^{AB}	74.6	50.6^{A}	26.1^{A}
Hy-Line	Closed	12.9	.35^{Y}	408.4	73.1^{Y}	48.5	15.5
(Brown)	Open	12.7	.34^{Y}	399.7	72.2^{Y}	48.0	18.7
	Average	12.8^{B}	.35	404.0^{A}	72.6	48.2^{BC}	17.1^{B}
H & N	Closed	12.8	.35^{XY}	378.9	73.1^{Y}	49.4	29.2
("Brown Nick")	Open	12.4	.37^{WX}	380.8	72.3^{Y}	49.4	29.0
	Average	12.6^{B}	.36	379.9^{B}	72.7	49.4^{AB}	29.1^{A}
All Strains	Closed	13.0	.34	386.3	72.1	48.4	23.5
	Open	12.7	.36	387.8	73.1	49.3	25.4
	Average	12.8	.35	387.1	72.6	48.9	24.4

A,B - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.
W,X,Y,Z - Different letters denote significant strain x housing interactions (P<.01).
[1]Mortality includes birds lost during first cycle, molt, and second cycle.

TABLE 32. EFFECT OF LAYING HOUSE ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF BROWN EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Laying House	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hisex	Closed	66.6	0.6	1.5^{W}	5.4	20.3	72.2
(Brown)	Open	67.4	0.5	0.1^{Z}	2.8	20.1	76.5
	Average	67.0^{B}	0.6	0.8	4.1^{A}	20.2^{AB}	74.3^{B}
ISA	Closed	68.0	0.4	0.5^{Y}	3.7	17.9	77.6
(Brown)	Open	68.3	0.2	0.0^{Z}	1.6	18.2	80.0
	Average	68.2^{A}	0.3	0.2	2.6^{B}	18.1^{B}	78.8^{A}
Hy-Line	Closed	66.6	0.4	1.2^{WX}	5.5	22.1	70.9
(Brown)	Open	66.8	0.6	0.1^{YZ}	3.1	22.5	73.7
	Average	66.7^{B}	0.5	0.7	4.3^{A}	22.3^{A}	72.3^{B}
H & N	Closed	67.7	0.5	1.0^{X}	4.8	18.1	75.6
("Brown Nick")	Open	68.6	0.1	0.1^{Z}	2.5	18.0	79.3
	Average	68.1^{A}	0.3	0.5	3.6^{A}	18.1^{B}	77.4^{A}
All Strains	Closed	67.2	0.5	1.1	4.9	19.6	74.1
	Open	67.8	0.4	0.1	2.5	19.7	77.4
	Average	67.5	0.4	0.5	3.6	19.7	75.8

A,B - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.
W,X,Y,Z - Different letters denote significant strain x housing interactions (P<.01).

TABLE 33. EFFECT OF LAYING HOUSE ON EGG QUALITY, INCOME AND FEED COSTS OF BROWN EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Laying House	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Hisex	Closed	95.2	2.5	1.8	0.6	23.33	11.09
(Brown)	Open	96.3	2.0	1.0	0.7	24.16	10.15
	Average	95.7	2.2^{AB}	1.4	0.6	23.74^{B}	10.62^{B}
ISA	Closed	94.6	3.1	1.9	0.5	24.59	11.22
(Brown)	Open	95.2	2.8	1.6	0.4	25.17	10.20
	Average	94.9	2.9^{A}	1.7	0.5	24.88^{AB}	10.71^{AB}
Hy-Line	Closed	96.3	1.5	1.7	0.5	25.99	11.59
(Brown)	Open	95.9	2.1	1.7	0.3	25.55	10.75
	Average	96.1	1.8^{B}	1.7	0.4	25.77^{A}	11.17^{A}
H & N	Closed	94.8	3.0	1.7	0.4	23.96	10.59
("Brown Nick")	Open	95.4	2.5	1.7	0.5	24.36	9.80
	Average	95.1	2.7A	1.7	0.4	24.16^{B}	10.20^{B}
All Strains	Closed	95.2	2.5	1.8	0.5	24.47	11.12
	Open	95.7	2.4	1.5	0.5	24.81	10.22
	Average	95.5	2.4	1.6	0.5	24.65	10.65

A,B - Different letters denote significant differences (P<.01), comparisons made among strain average values. Differences among individual laying house and strain averages are not significant.

TABLE 34. EFFECT OF DENSITY ON PERFORMANCE OF BROWN EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Feed Cons (kg/100 hens/d)	Feed Conversion (g egg/ g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality[2] (%)
Hisex	361	12.3	.32	360.6	68.9	45.9	25.0
(Brown)	482	13.2	.33	386.6	71.9	48.3	25.7
ISA	361	12.7	.36	382.4	73.8	49.7	28.5
(Brown)	482	13.4	.36	398.8	75.4	51.5	23.6
Hy-Line	361	12.5	.33	390.4	70.3	46.5	18.0
(Brown)	482	13.1	.36	417.7	75.0	50.0	16.2
H & N	361	12.2	.36	370.3	70.8	48.1	28.9
("Brown Nick")	482	13.0	.37	389.4	74.6	50.7	29.3
All Strains	361	12.4^B	.34	375.9^B	71.0^B	47.5^B	25.1
	482	13.2^A	.35	398.1^A	74.2^A	50.1^A	23.7

A,B - Different letters denote significant differences (P<.01).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.
[2]Mortality includes birds lost during first cycle, molt, and second cycle.

TABLE 35. EFFECT OF DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF BROWN EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Density[1] (cm^2)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hisex	361	66.7	0.5	0.9	4.4	21.7	72.4
(Brown)	482	67.2	0.6	0.6	3.8	18.7	76.3
ISA	361	67.7	0.3	0.3	2.6	20.7	76.1
(Brown)	482	68.7	0.3	0.2	2.6	15.5	81.4
Hy-Line	361	66.3	0.4	0.7	4.4	25.0	69.6
(Brown)	482	67.1	0.6	0.6	4.2	19.5	75.1
H & N	361	68.0	0.3	0.6	3.7	18.7	76.7
("Brown Nick")	482	68.2	0.3	0.5	3.6	17.5	78.2
All Strains	361	67.2^{B}	0.4	0.6	3.8	21.5^{A}	73.7^{B}
	482	67.8^{A}	0.4	0.5	3.5	17.8^{B}	77.8^{A}

A,B - Different letters denote significant differences ($P<.01$).
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

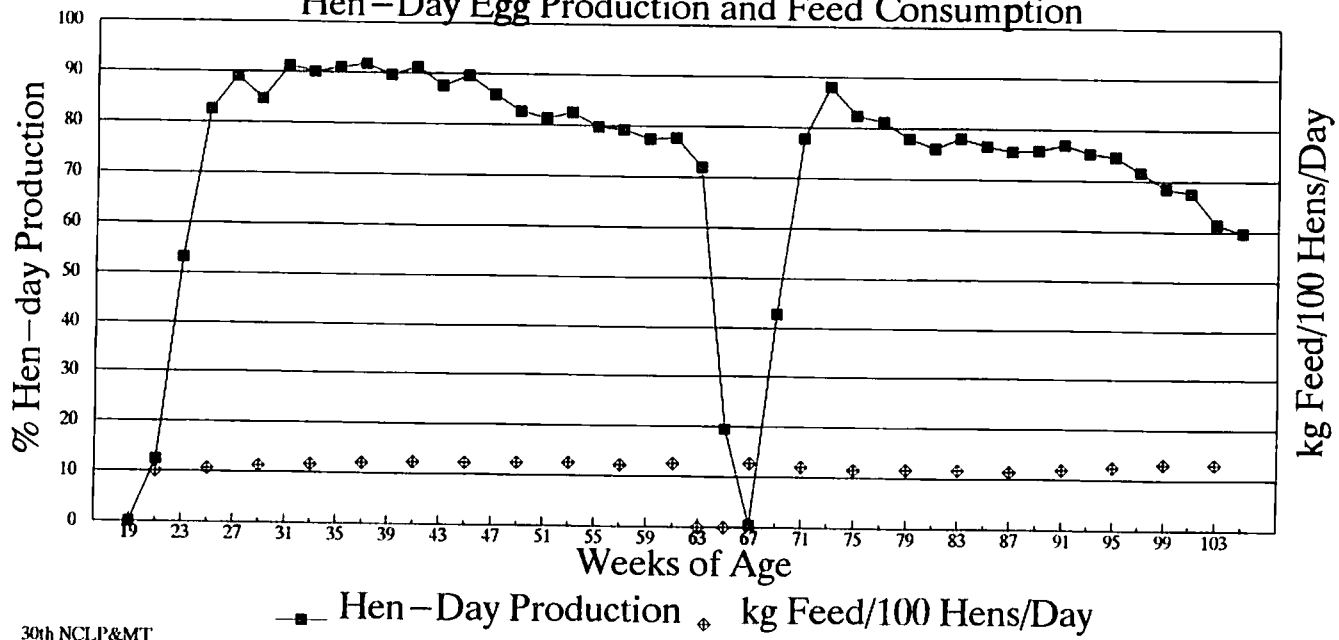
TABLE 36. EFFECT OF DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF BROWN EGG STRAINS, 30TH NCLP&MT (133-735 DAYS)

Breeder (Strain)	Density (cm^2)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Hisex	361	95.4	2.3	1.8	0.6	22.86	10.10
(Brown)	482	96.1	2.2	1.1	0.7	24.63	11.14
ISA	361	95.0	2.8	1.8	0.4	24.37	10.27
(Brown)	482	94.9	3.1	1.6	0.5	25.39	11.15
Hy-Line	361	95.9	1.7	2.0	0.4	24.91	10.83
(Brown	482	96.3	1.8	1.4	0.4	26.64	11.51
H & N	361	94.9	2.9	1.8	0.4	23.51	9.87
("Brown Nick")	482	95.3	2.6	1.7	0.5	24.81	10.52
All Strains	361	95.3	2.4	1.9	0.5	23.91^{B}	10.27^{B}
	482	95.6	2.4	1.4	0.5	25.36^{A}	11.08^{A}

A,B - Different letters denote significant differences (P<.01).

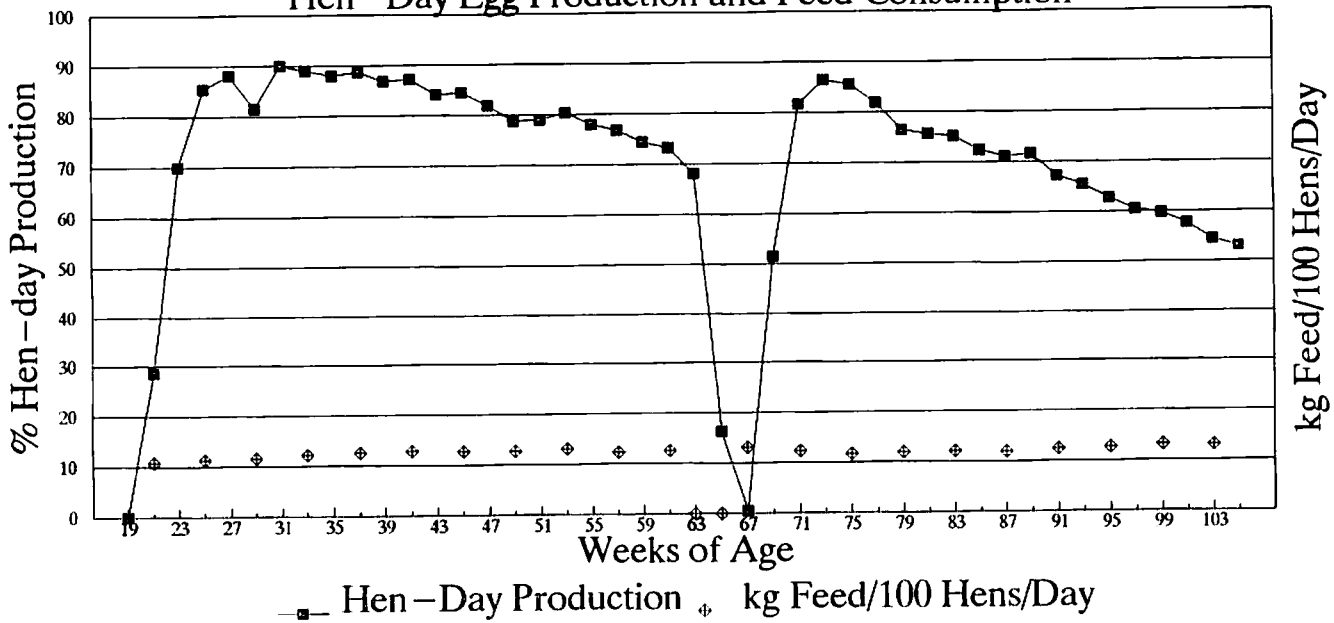
[1]The following is the conversion from square centimeters to square inches: 361 equals 56 square inches; 482 equals 74.7 square inches.

Figure 1. H & N International "Nick Chick" Strain
Hen–Day Egg Production and Feed Consumption



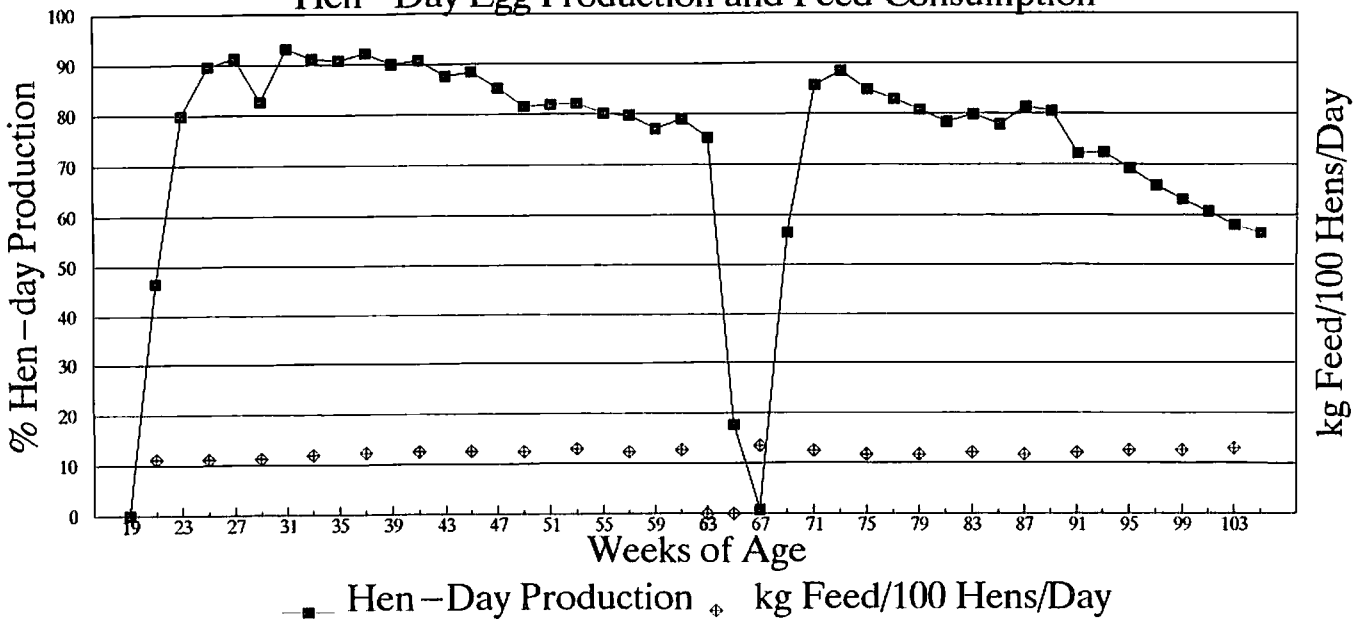
30th NCLP&MT
Feed problem was incurred at peak production (see page 4)

Figure 2. Hy−Line International "W−36" Strain
Hen−Day Egg Production and Feed Consumption



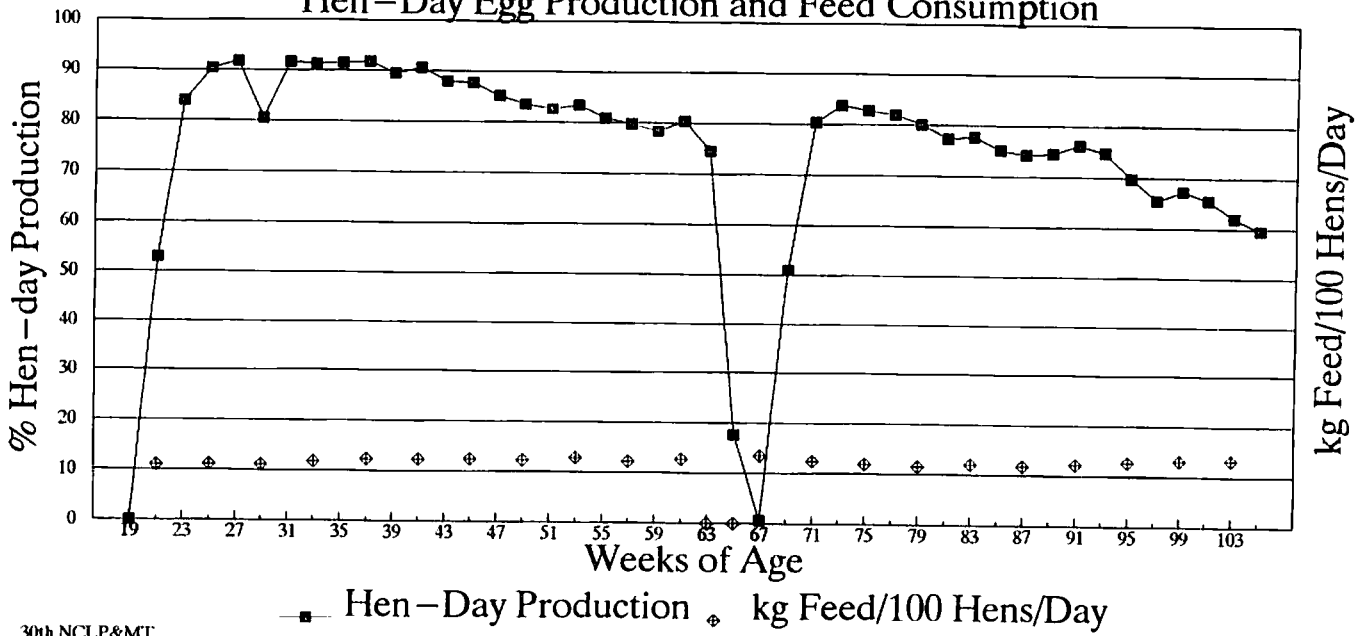
30th NCLP&MT
Feed problem was incurred at peak production (see page 4)

Figure 3. ISA/Babcock "B300−A" Strain
Hen−Day Egg Production and Feed Consumption



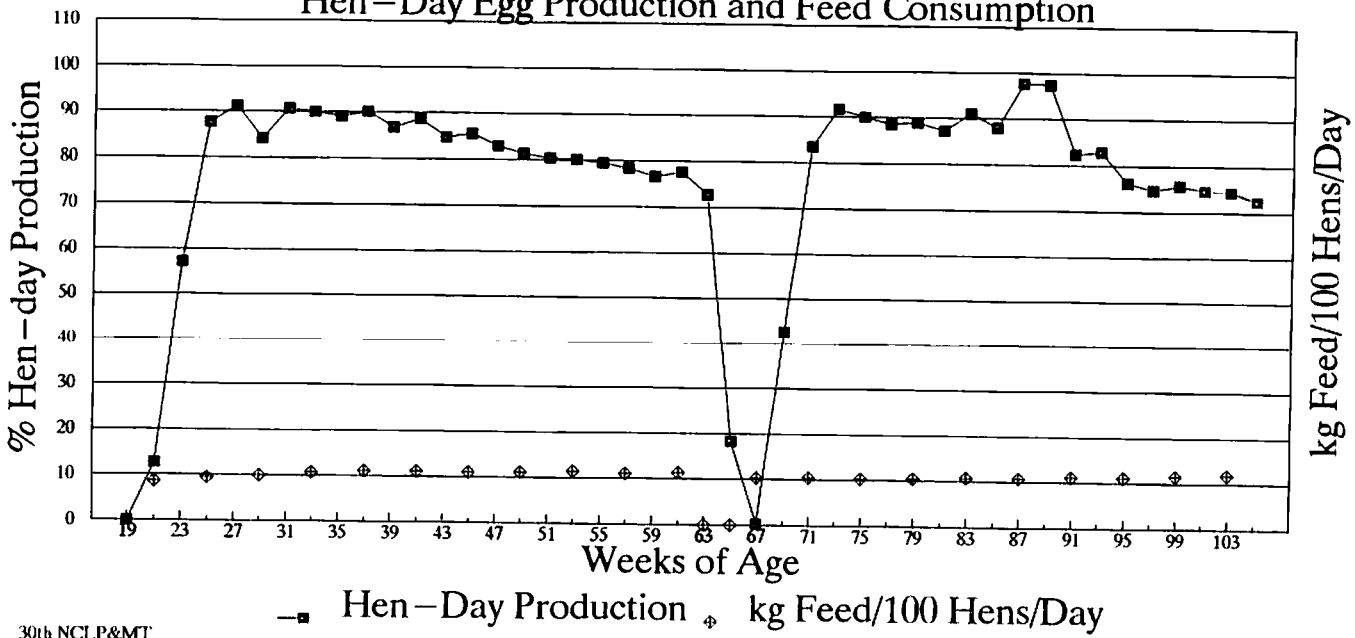
30th NCLP&MT
Feed problem was incurred at peak production (see page 4)

Figure 4. ISA/Babcock "B300−B" Strain
Hen−Day Egg Production and Feed Consumption



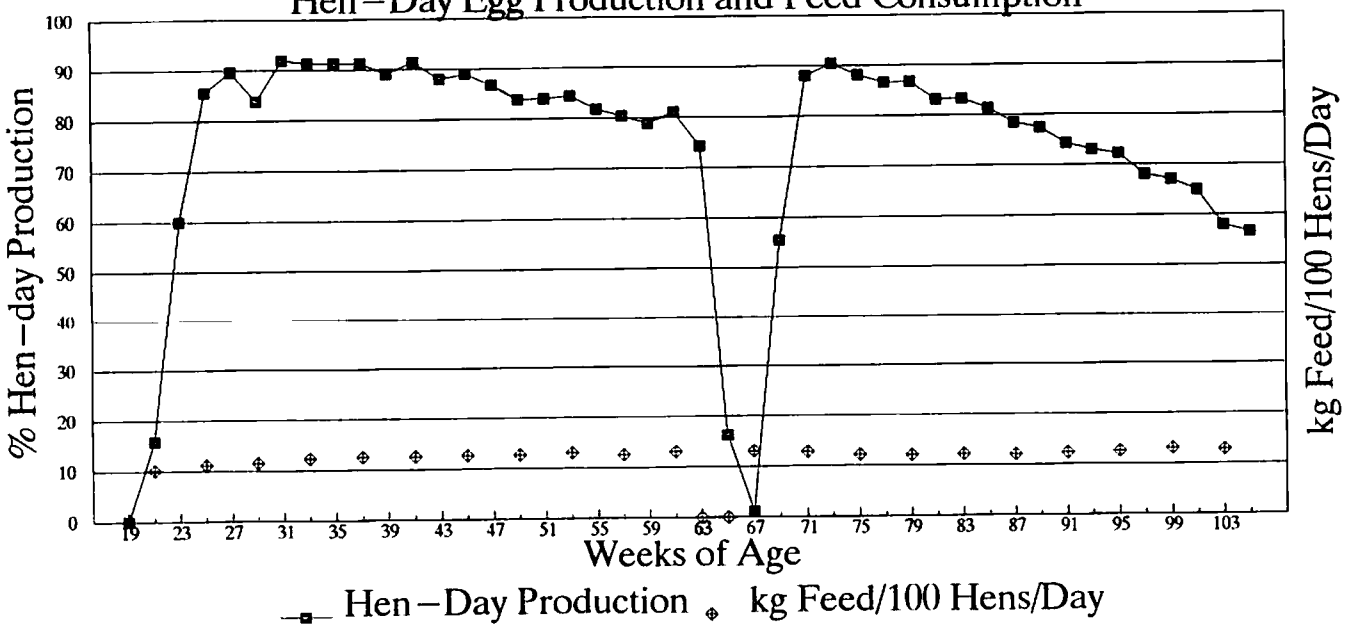
30th NCLP&MT
Feed problem was incurred at peak production (see page 4)

Figure 5. Euribrid Inc. "Hisex White" Strain
Hen–Day Egg Production and Feed Consumption



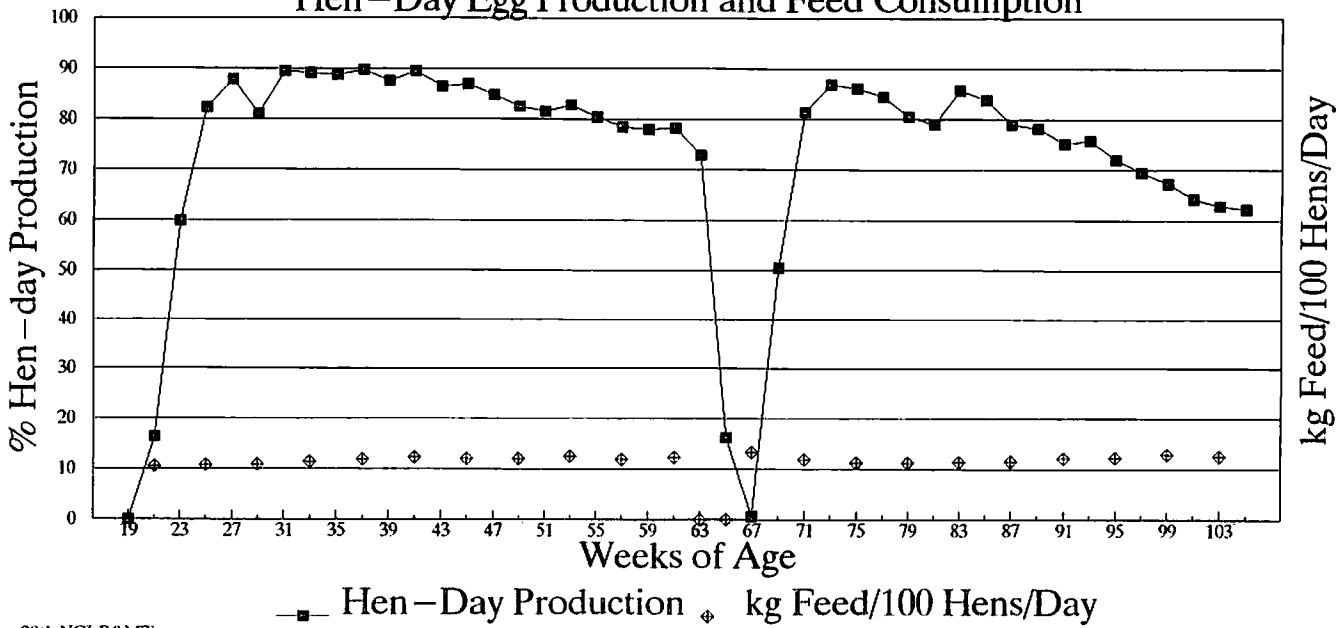
30th NCLP&MT
Feed problem incurred at peak production (see page 4)

Figure 6. Shaver "Saver White" Strain
Hen–Day Egg Production and Feed Consumption



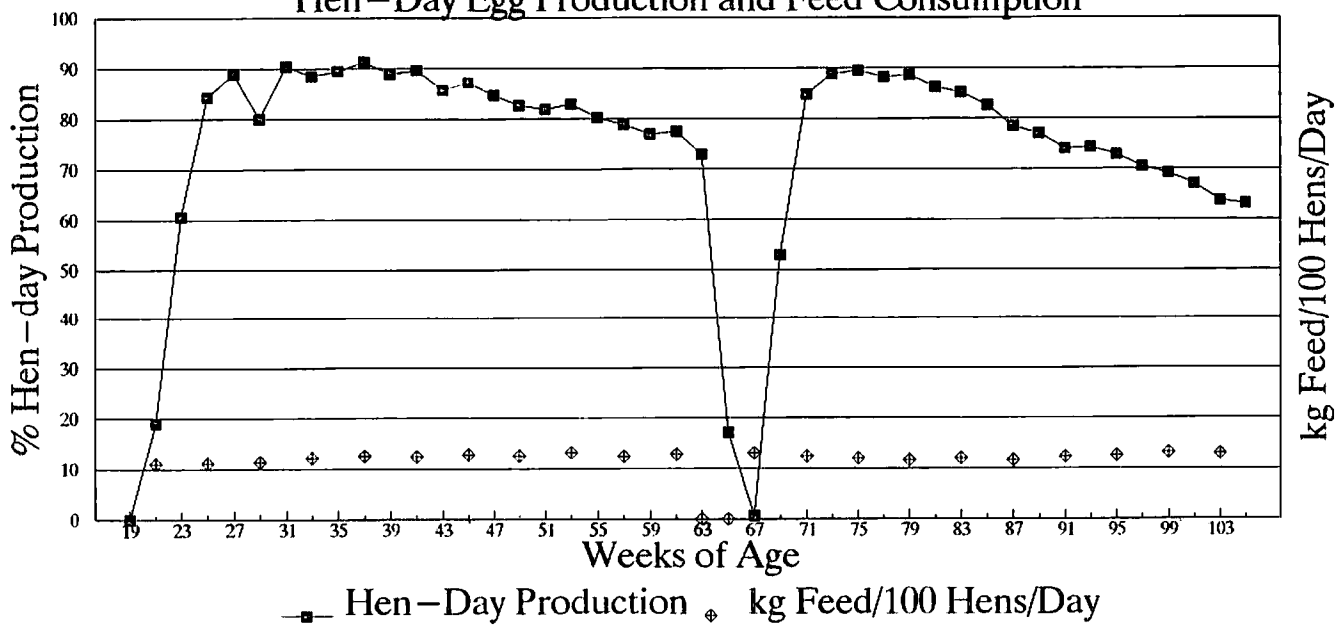
30th NCLP&MT
Feed problem incurred at peak production (see page 4)

Figure 7. Dekalb "Delta" Strain
Hen – Day Egg Production and Feed Consumption



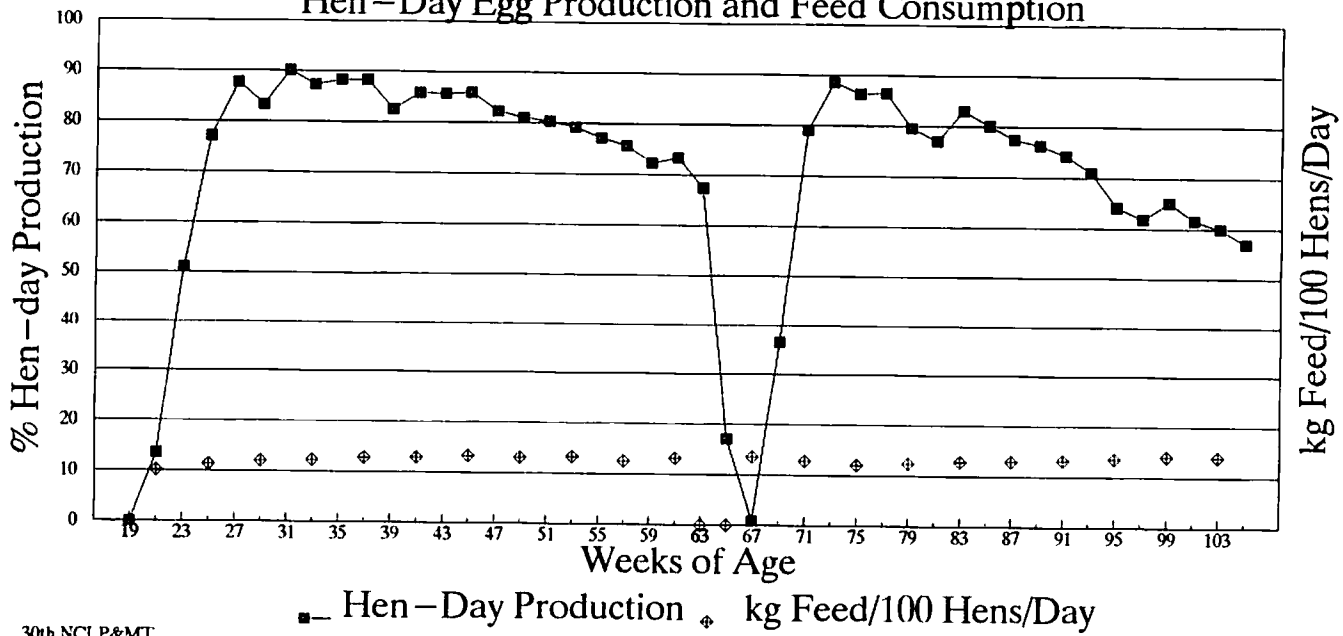
30th NCLP&MT
Feed problem incurred at peak production (see page 4)

Figure 8. Dekalb "XL– Link" Strain
Hen–Day Egg Production and Feed Consumption



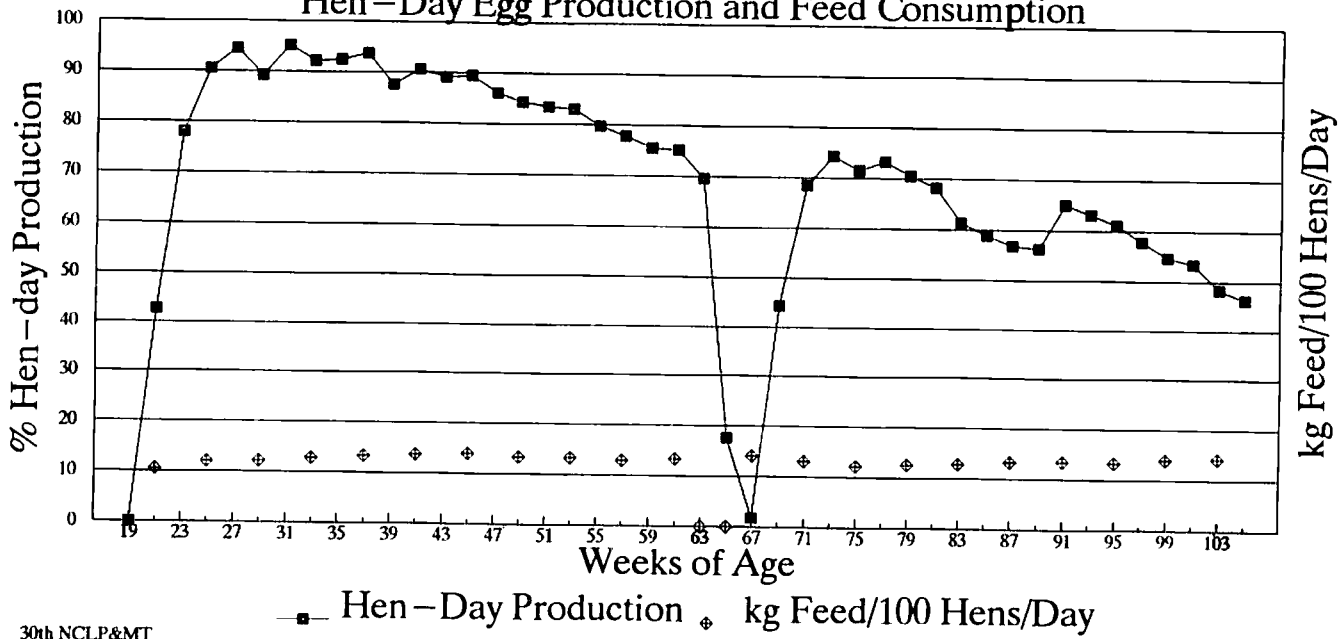
30th NCLP&MT
Feed problem incurred at peak production (see page 4)

Figure 9. H & N International "Brown Nick" Strain
Hen–Day Egg Production and Feed Consumption



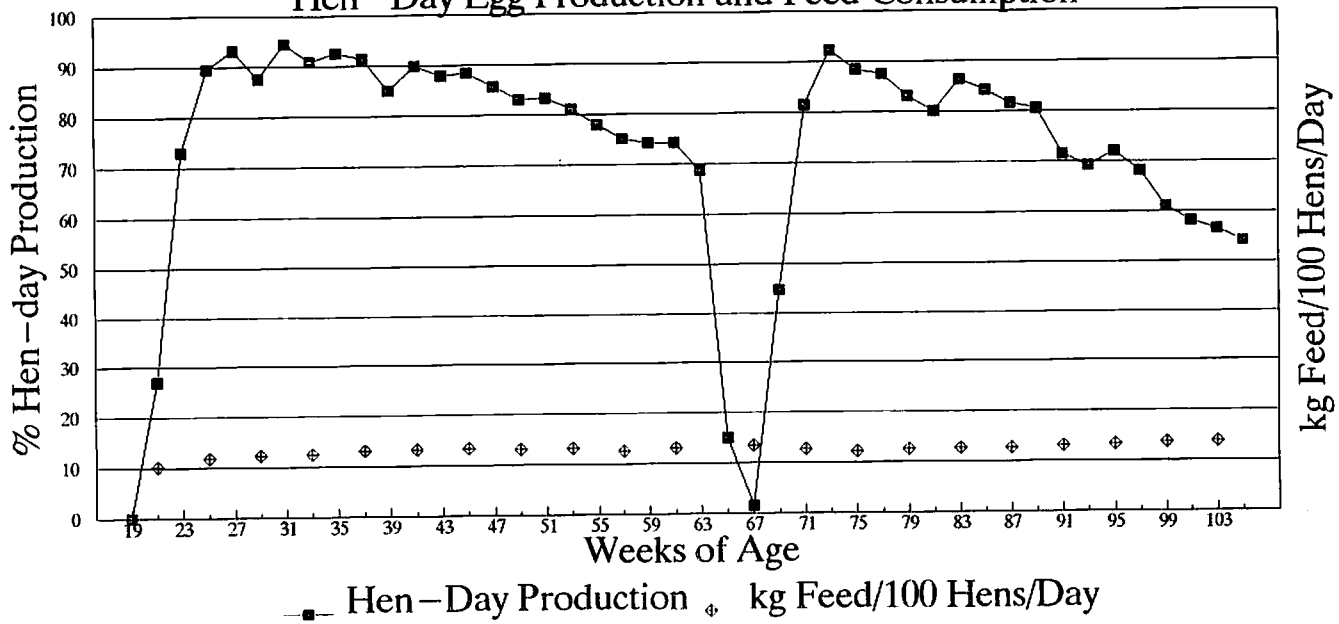
30th NCLP&MT
Feed problem incurred at peak production (see page 4)

Figure 10. Hy−Line International "Hy−Line Brown" Strain
Hen−Day Egg Production and Feed Consumption



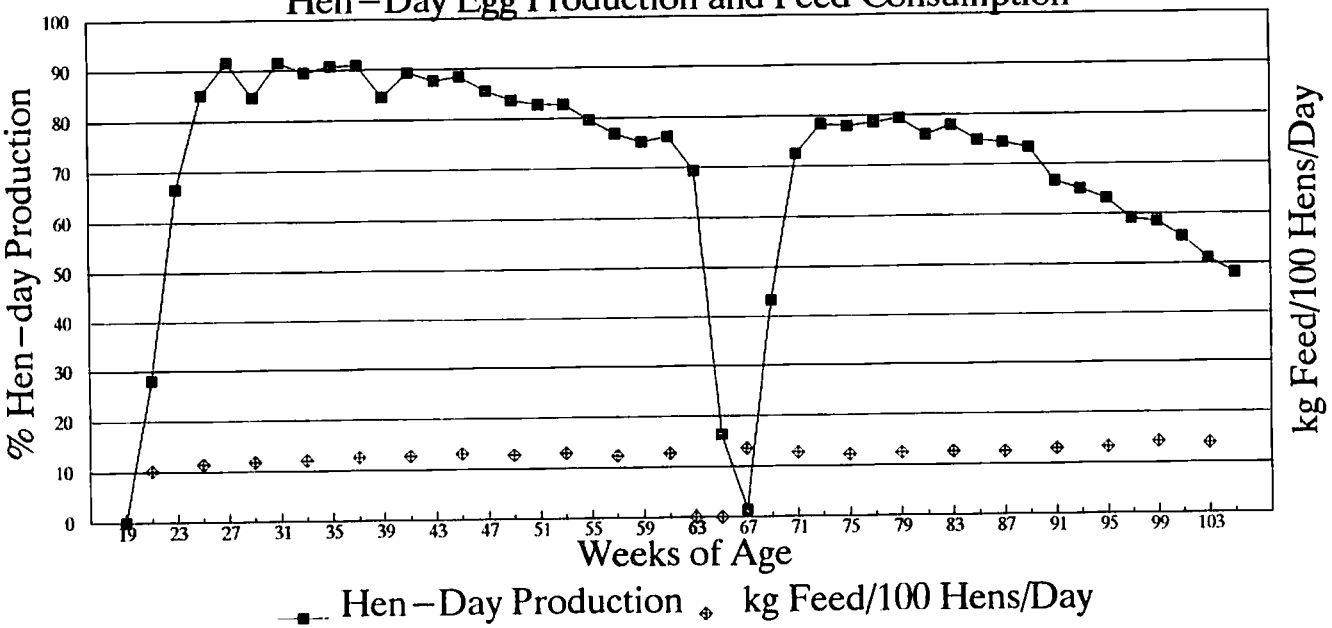
30th NCLP&MT
Feed problem incurred at peak production (see page 4)

Figure 11. ISA/Babcock "ISA Brown" Strain
Hen–Day Egg Production and Feed Consumption



30th NCLP&MT
Feed problem incurred at peak production (see page 4)

Figure 12. Euribrid Inc. "Hisex Brown" Strain
Hen–Day Egg Production and Feed Consumption



30th NCLP&MT
Feed problem incurred at peak production (see page 4)

Entries 30TH NCLP&MT

Stock Suppliers and Categories

Breeder	Stock	Category[1]	Source
H & N International 3825 154th Ave.,N.E. Redmond, WA 98052	"Nick Chick"	I-A	Wheelock Hatchery 2170 Wayne Road Chambersburg, PA 17201
Hy-Line International P.O. Box 310 Dallas Center, IA 50063	W-36	I-A	Hy-Line International 4432 Highway 213, Box 309 Mansfield, GA 30255
ISA/Babcock P.O. Box 280 Ithaca, NY 14850-0280	B300-A	I-A	Lititz Hatchery 631 W. Orange Street Lititz, PA 17543
	B300-B	II-A	(Same)
Euribrid Inc. Hisex Division P.O. Box 719 Troutman, NC 28166	Hisex White	I-A	Clock & DeCloux Inc. 1609 Trumansburg Road Ithaca, NY 14850
Shaver Poultry Breeding Farms Ltd. P.O. Box 400 Cambridge, Ontario CANADA N1R5V9	Shaver White	I-A	America Selected Products Inc. 575 Copeland Mill Rd., Suite 1-8 Westerville, OH 43081
Dekalb Ag Research Inc. 3100 Sycamore Road Dekalb, IL 60115	Delta	I-C	Entrance of these strains were requested by the North Carolina Egg producers who secured the acquisition of the stock and appropriate fees.
	XL-Link	I-C	Procedures followed were in accordance with North Carolina Layer Performance and Management Test.
H & N International 3825 154th Ave. N.E. Redmond, WA 98052	"Brown Nick"	I-A	Wheelock Hatchery 2170 Wayne Road Chambersburg, PA 17201
Hy-Line International P.O. Box 310 Dallas Center, IA 50063	Hy-Line Brown	I-A	Hy-Line International 4432 Highway 213, Box 309 Mansfield, GA 30255
ISA/Babcock P.O. Box 280 Ithaca, NY 14850-0280	ISA Brown	I-A	America Selected Products Inc. 575 Copeland Mill Rd., Suite 1-8 Westerville, OH 43081
Euribrid Inc. Hisex Division P.O. Box 719 Troutman, NC 28166	Hisex Brown	I-A	Clock & DeCloux Inc. 1609 Trumansburg Road Ithaca, NY 14850

[1] I = Extensive distribution in southeast United States
II = Little or no distribution in southeast United States
A = Entry requested
C = Entry not requested