



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

FIRST CYCLE REPORT OF THE THIRTY FIRST

NORTH CAROLINA LAYER PERFORMANCE

AND MANAGEMENT TEST

Vol. 31, No. 3
May 1995

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.

The data presented herein represents the analysis of the first production cycle of the 31st North Carolina Layer Performance and Management Test. Performance summary tables are available examining open and closed housing types, population size, cage length, and density which examines combined results of cage length and population.

For further information contact:

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

The use of trade names in this publication does not imply endorsement by the North Carolina Cooperative Extension Service of the products named nor criticism of similar ones not mentioned.

Protocol Procedures Used

Entries:

Thirteen entries were accepted in accordance with the rules and regulations of the test. Nine white-egg and four brown-egg strains participated.

Dates of Importance:

The eggs were set on November 16, 1993 at the Piedmont Research Station (NCDA) Poultry Unit. The flock was hatched on December 8, 1993 and moved to laying facilities during April 4 to 7, 1994 at 17 weeks of age. The age of the flock at transfer was lowered to approximately 17 weeks due to current trends in the industry and requests of the breeding companies to move the flock prior to excessive egg production in the rearing houses.

First cycle production records commenced on April 12, 1994 (18 weeks of age) until molt was induced on February 14, 1995. The molt records commenced on February 14, 1995 (62 weeks of age) and ended on March 14, 1995 (66 weeks of age). This report includes production data summarized 18 to 62 weeks, and 62 to 66 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-egg 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 310 cm² (48 in²) 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-egg 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 310 cm² (48 in²). Refer to the 31st North Carolina Layer Performance and Management Test Growing Report (Vol. 31, 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. Strain, layer housing, and population are general descriptions of the main effects. Density is a combination of cage size and hen population per cage.

Strain

Samples of fertile eggs were provided from the breeding companies. All eggs were set and hatched concurrently. A total of nine white egg strains and four brown egg strains participated in the test. See the 31st Hatch Report (Vol. 31, 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

Four densities were used throughout the test. Hens were housed at either 310 cm² (48 in²), 361 cm² (56 in²), 413 cm² (64 in²), or 482 cm² (75 in²).

Population

Two hen populations were utilized for both brown-egg and white-egg layers, of 6 or 7 hens per cage. The hen population of 6 hens per cage resulted in replicates containing 24 or 18 hens per replicate depending on cage lengths of 61 cm or 81 cm. The 6 hen per cage population allowed for the densities of 361 cm² and 482 cm². The hen population of 7 hens per cage resulted in replicates containing 28 or 21 hens per replicate depending on cage lengths of 61 cm or 81 cm. Cage densities within the 7 hen per cage group were 310 cm² (48 in²) and 413 cm² (64 in²).

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

¹A new feed supplier was secured for the 31st NCLP&MT. This has eliminated feed quality problems affecting the performance of the hens on test.

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

Diet Identification¹

-----Layer Diet-----						
Ingredient	I	M	N	O	P	Q
-----Pounds Per Ton-----						
Corn	1136.49	1211.94	1233.32	1215.69	1318.20	1390.16
Corn Gluten Meal	100.00	85.00	50.00	50.00	25.00	25.00
Soybean Meal	346.86	314.14	300.80	223.71	216.04	162.24
Wheat Midds	109.19	103.88	147.81	256.18	200.00	200.00
Calcium Carbonate	178.31	168.03	158.33	155.44	150.20	145.85
DiCalcium Phos.	26.00	25.88	24.14	19.60	20.30	18.78
Sodium Bi-Carb.	17.56	17.69	16.77	14.52	15.70	15.71
Salt	5.00	5.00	5.00	5.00	5.00	5.00
Methionine	4.56	4.32	3.36	2.20	1.97	1.58
Lysine	3.80	3.91	1.97	1.80	2.61	3.37
Choline Chloride	5.04	4.91	4.71	4.60	4.46	4.37
Vitamin premix	2.00	2.00	2.00	2.00	2.00	2.00
Mineral premix	1.00	1.00	1.00	1.00	1.00	1.00
Fat	61.19	49.30	47.79	45.26	34.79	21.94
Mold Inhibitor	2.00	2.00	2.00	2.00	2.00	2.00
Tracer	1.00	1.00	1.00	1.00	1.00	1.00
Total	2000	2000	2000	2000	2000	2000
Protein %	17	16	15	14	13	12
Me kcal/kg	2925	2925	2925	2925	2925	2925
Calcium %	3.7	3.5	3.3	3.2	3.1	3.0
T. Phos %	.58	.57	.56	.54	.52	.50
Lysine %	.90	.85	.75	.65	.65	.60
TSAA %	.80	.75	.65	.55	.50	.45

LAYING PERIOD DIETS

Diet Identification¹

-----Layer Diets-----					
Ingredient	D	E	F	G	H
-----Pounds Per Ton-----					
Corn	772.07	819.01	934.81	1000.11	1068.72
Corn Gluten Meal	100.0	75.00	85.00	90.00	90.00
Soybean Meal	603.43	581.58	530.80	466.26	412.42
Wheat Midds	145.62	150.00	100.14	109.38	110.93
Calcium Carbonate	200.49	194.30	188.83	184.03	178.56
DiCalcium Phos.	21.20	23.15	24.36	24.02	24.91
Sodium Bi-Carb.	16.74	16.66	17.72	17.54	17.52
Salt	5.00	5.00	5.00	5.00	5.00
Methionine	3.54	4.50	4.82	5.45	5.06
Lysine		1.31		1.90	2.66
Choline Chloride	5.49	5.35	5.27	5.20	5.10
Vitamin premix	2.00	2.00	2.00	2.00	2.00
Mineral premix	1.00	1.00	1.00	1.00	1.00
Fat	120.42	118.14	97.25	85.11	73.12
Mold Inhibitor	2.00	2.00	2.00	2.00	2.00
Tracer	1.00	1.00	1.00	1.00	1.00
Total	2000	2000	2000	2000	2000
Protein %	22	21	20	19	18
ME kcal/kg	2925	2925	2925	2925	2925
Calcium %	4.10	4.00	3.90	3.80	3.70
T. Phos. %	.59	.60	.59	.58	.58
Lysine %	1.14	1.15	1.02	1.00	.95
TSAA %	.90	.90	.90	.90	.85

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 (See egg size distribution). 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. An analysis of the causes of mortality isolated the differences to the mortality level (see table following). The percentages in this table represent the causes of mortality as part of the total mortality which occurred.

CAUSE OF MORTALITY IN THE 31st NCLP&MT AS A PERCENTAGE OF TOTAL

<u>Strain</u>	<u>Prolapse/Cannibalism</u>	<u>Molt</u>	<u>Normal</u>	<u>Other</u>
<u>White</u>	%	%	%	%
Hy-Line (W-36)	13.0 ^B	5.9 ^C	67.0 ^A	14.1
Hy-Line (W-77)	9.2 ^C	48.5 ^A	37.7 ^{BC}	4.6
H & N (Nick Chick)	28.0 ^{ABC}	17.7 ^{BC}	53.4 ^{AB}	0.8
Bovans (White)	20.2 ^{BC}	17.4 ^{BC}	53.9 ^{AB}	8.4
ISA (Experimental)	27.3 ^{ABC}	23.7 ^B	45.7 ^{AB}	3.3
ISA (Babcock B-300)	21.7 ^{ABC}	28.1 ^{AB}	47.4 ^{AB}	2.8
Shaver (White)	38.9 ^A	20.6 ^{BC}	35.3 ^{BC}	5.2
Shaver (2000)	29.6 ^{AB}	28.3 ^{AB}	39.5 ^{BC}	2.6
Dekalb (Delta)	26.4 ^{ABC}	49.6 ^A	21.5 ^C	2.5
<u>Brown</u>				
Bovans (Brown)	12.9	34.5	44.0	8.6
ISA (Brown)	23.9	25.3	46.2	4.6
H & N (Brown Nick)	16.0	24.0	54.6	5.4
Hy-Line (Brown)	25.5	14.7	52.6	7.2

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

A severe trim technique at 6 days was used, however, due to the differences in chick size among the strains at this time could have affected the trim. The table above gives the breakdown of mortality by four general classes: prolapse/cannibalism, molt period losses, normal mortality, and other (unable to determine cause).

Statistical Analyses and Separation of Means:

Analyses of variance (ANOVA) were performed on all data. Separate analyses were conducted for white-egg 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 utilizing the General Linear Model (GLM) procedure of SAS, with main effects of strain, layer house, and cage size and population. Density analysis is derived from the cage size and population interaction. First and second order interactions were tested for significance. Mean differences were separated via the PDIF option of the GLM procedure.

DESCRIPTION OF DATA TABLE STATISTICS

First cycle performance of white-egg and brown-egg strains are shown on Tables 1-24. The molt period performance of the white and brown egg strains are shown on Tables 25 to 32.

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 Density Allocations:

White and Brown Hens per Cage	Cage Size		Floor Space per Bird	Feeder Space per Bird	Water Nipples per Cage
	Width	Depth			
6	61 cm	35.5 cm	361 cm ² (56 in ²)	10.2 cm 4 in	3
6	82 cm	35.5 cm	482 cm ² (75 in ²)	13.7 cm 5.4 in	3
White and Brown Hens per Cage	Cage Size		Floor Space per Bird	Feeder Space per Bird	Water Nipples per Cage
	Width	Depth			
7	61 cm	35.5 cm	310 cm ² (48 in ²)	8.7 cm 3.4 in	3
7	82 cm	35.5 cm	413 cm ² (64 in ²)	11.7 cm 4.6 in	3

Hen Housed Eggs per Bird:

The total number of eggs produced divided by the number of birds housed at 133 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 133 and 434 days of age. Mortality which occurred during the molt period were reported separately.

Feed Consumption:

The kilograms of feed consumed daily per 100 hens.

Feed Conversion:

The grams 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 133 days, from egg production using three-year regional average egg prices as follows:

<u>Grade</u>	<u>Size</u>	<u>Cents/Dozen</u>
A	Extra Large	72.8
A	Large	72.8
A	Medium	63.4
A	Small	52.5
A	Pee Wee	26.2
B	All	26.2
Cracks	All	38.6

Feed Cost:

The calculated feed cost per hen housed at 133 days, using average price per ton.

<u>Diets</u>	<u>Price Per Ton</u>
D	171.70
E	165.10
F	158.40
G	154.40
H	151.40
I	145.20
M	140.60
N	133.30
O	129.50
P	127.20
Q	131.20

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 USDA large eggs. The proportion of the eggs falling into the following size categories:

<u>Size Category</u>	<u>Ounces/Dozen</u>
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, 31ST NCLP&MT
(133-434 DAYS)

Breeder (Strain)	Laying House	Feed Cons. (kg/100 hens/d)	Feed Conver. (g egg/ g feed)	Eggs Per Bird Housed	Egg Produc- tion (HD%)	Egg Mass (g/HD)	Mortal- ity (%)	Age at 50% Pro- duction (Days)
Hy-Line (W-36)	Closed	10.4	.43	229.5	75.8	45.1	4.2	155
	Open	10.5	.42	227.9	74.8	45.0	2.3	155
	Average	10.4 ^D	.43 ^{BC}	228.7 ^{BC}	75.3 ^B	45.1 ^E	3.3 ^D	155 ^{AB}
Hy-Line (W-77)	Closed	11.3	.41	230.2	75.8	46.2	3.4	144
	Open	11.1	.42	239.3	78.6	47.5	3.0	142
	Average	11.2 ^B	.41 ^{CD}	234.8 ^{AB}	77.2 ^{AB}	46.8 ^{BCD}	3.2 ^D	143 ^E
H & N (Nick Chick)	Closed	11.5	.40	229.0	77.1	47.2	7.5	155
	Open	11.6	.41	232.5	78.9	48.7	10.8	153
	Average	11.5 ^A	.41 ^D	230.7 ^{ABC}	78.0 ^A	47.9 ^{AB}	9.2 ^{AB}	154 ^{ABCD}
Bovans (White)	Closed	10.8	.42	231.9	77.5	45.8	4.8	153
	Open	10.7	.42	229.7	77.4	45.9	5.9	151
	Average	10.7 ^C	.42 ^{BC}	230.8 ^{ABC}	77.4 ^{AB}	45.9 ^{DE}	5.4 ^{CD}	152 ^D
ISA (Experimental)	Closed	10.7	.43	224.9	75.0	47.0	7.1	155
	Open	10.7	.44	225.6	76.2	47.8	10.7	151
	Average	10.7 ^C	.44 ^A	225.3 ^C	75.6 ^B	47.4 ^{ABC}	8.9 ^{AB}	153 ^{CD}
ISA (Babcock B-300)	Closed	11.1	.43	234.0	79.6	48.0	11.0	142
	Open	11.1	.43	231.3	78.4	47.4	12.7	143
	Average	11.1 ^B	.43 ^{AB}	232.6 ^{ABC}	79.0 ^A	47.7 ^{AB}	11.8 ^A	142 ^E
Shaver (White)	Closed	11.2	.40	225.3	75.7	45.9	8.9	157
	Open	11.2	.40	227.8	75.5	46.2	9.0	155
	Average	11.2 ^B	.40 ^D	226.6 ^C	75.6 ^B	46.0 ^E	9.0 ^{AB}	156 ^A
Shaver (2000)	Closed	11.5	.40	223.2	74.1	46.5	7.5	156
	Open	11.6	.41	228.9	77.1	48.3	8.9	153
	Average	11.6 ^A	.40 ^D	226.0 ^C	75.6 ^B	47.4 ^{ABC}	8.2 ^{BC}	154 ^{ABCD}
Dekalb (Delta)	Closed	11.2	.43	237.7	77.9	48.7	2.9	154
	Open	11.1	.44	238.5	78.9	48.9	4.7	151
	Average	11.1 ^B	.43 ^{AB}	238.1 ^A	78.4 ^A	48.8 ^A	3.8 ^D	153 ^{CD}
All Strains	Closed	11.1	.42	229.5	76.5	46.7	6.4	152
	Open	11.1	.42	231.3	77.3	47.3	7.6	150
	Average	11.1	.42	230.4	76.9	47.0	7.0	151

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, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Laying House	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hy-Line (W-36)	Closed	58.6	2.5	5.8	18.1	45.5	29.5
	Open	59.0	2.2	4.9	16.5	43.0	33.3
	Average	58.8 ^c	2.4 ^A	5.3 ^A	17.3 ^{AB}	44.2 ^{AB}	31.4 ^D
Hy-Line (W-77)	Closed	60.5	1.2	3.9	16.1	40.4	37.9
	Open	60.0	1.5	3.5	16.9	40.8	37.2
	Average	60.2 ^B	1.3 ^B	3.7 ^B	16.5 ^B	40.6 ^{CDE}	37.5 ^{BC}
H & N (Nick Chick)	Closed	60.1	1.8	4.9	14.2	42.1	37.5
	Open	60.8	2.0	3.5	12.6	40.8	41.5
	Average	60.5 ^B	1.9 ^{AB}	4.2 ^{AB}	13.4 ^C	41.4 ^{BCD}	39.5 ^B
Bovans (White)	Closed	58.4	2.4	5.4	19.0	47.2	26.5
	Open	58.6	2.3	4.8	18.3	46.2	28.3
	Average	58.5 ^C	2.3 ^A	5.1 ^A	18.7 ^A	46.7 ^A	27.4 ^B
ISA (Experimental)	Closed	61.8	1.9	3.5	11.1	38.3	45.3
	Open	62.0	1.5	2.9	10.6	37.3	47.7
	Average	61.9 ^A	1.7 ^{AB}	3.2 ^B	10.9 ^B	37.8 ^{BF}	46.5 ^A
ISA (Babcock B-300)	Closed	60.0	1.2	4.5	14.3	44.0	35.6
	Open	60.2	1.2	3.2	14.2	43.4	36.7
	Average	60.1 ^B	1.2 ^B	3.8 ^B	14.3 ^C	43.7 ^{ABC}	36.2 ^{BC}
Shaver (White)	Closed	59.5	2.6	4.2	14.2	45.9	33.5
	Open	60.1	2.8	4.1	12.2	44.2	37.0
	Average	59.8 ^B	2.7 ^A	4.2 ^{AB}	13.2 ^{CD}	45.0 ^A	35.3 ^C
Shaver (2000)	Closed	61.9	2.1	3.2	11.6	35.9	47.1
	Open	61.8	1.9	3.9	9.7	36.7	47.3
	Average	61.8 ^A	2.0 ^{AB}	3.6 ^B	10.6 ^B	36.3 ^F	47.2 ^A
Dekalb (Delta)	Closed	61.7	1.5	3.7	10.7	39.1	45.1
	Open	61.2	1.1	3.0	11.8	41.7	42.3
	Average	61.4 ^A	1.3 ^B	3.3 ^B	11.3 ^{DE}	40.4 ^{DE}	43.7 ^A
All Strains	Closed	60.3	1.9	4.3	14.4	42.0	37.6
	Open	60.4	1.8	3.8	13.6	41.6	39.0
	Average	60.3	1.8	4.1	14.0	41.8	38.2

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, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Laying House	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income (\$/hen)	Feed Costs (\$/hen)
Hy-Line (W-36)	Closed	95.2	2.3	2.3	0.1	12.98	5.06
	Open	95.5	2.0	2.4	0.0	12.81	5.09
	Average	95.4	2.1	2.4	0.1	12.90 ^B	5.07 ^{CD}
Hy-Line (W-77)	Closed	95.0	2.0	2.9	0.1	13.01	5.56
	Open	95.8	1.5	2.7	0.0	13.60	5.47
	Average	95.4	1.8	2.8	0.0	13.31 ^{AB}	5.51 ^A
H & N (Nick Chick)	Closed	95.2	2.4	2.4	0.0	13.01	5.40
	Open	96.0	1.7	2.3	0.0	13.32	5.38
	Average	95.6	2.1	2.3	0.0	13.16 ^{AB}	5.39 ^A
Bovans (White)	Closed	95.4	2.1	2.4	0.0	13.04	5.18
	Open	96.1	1.5	2.5	0.0	12.93	5.08
	Average	95.8	1.8	2.4	0.0	12.99 ^B	5.13 ^{CD}
ISA (Experimental)	Closed	95.3	2.6	2.1	0.0	12.84	5.09
	Open	95.6	2.1	2.1	0.2	12.93	4.91
	Average	95.4	2.4	2.1	0.1	12.88 ^B	5.00 ^D
ISA (Babcock B-300)	Closed	94.2	3.5	2.3	0.0	13.15	5.24
	Open	95.8	1.8	2.2	0.1	13.06	5.17
	Average	95.0	2.7	2.2	0.1	13.11 ^B	5.20 ^{BC}
Shaver (White)	Closed	96.2	1.9	1.7	0.1	12.81	5.20
	Open	96.0	2.1	1.8	0.0	12.95	5.17
	Average	96.1	2.0	1.8	0.0	12.88 ^B	5.18 ^{BC}
Shaver (2000)	Closed	94.6	2.6	2.7	0.0	12.64	5.44
	Open	96.3	1.5	2.2	0.0	13.07	5.35
	Average	95.5	2.0	2.5	0.0	12.86 ^B	5.39 ^A
Dekalb (Delta)	Closed	94.3	2.7	3.0	0.0	13.51	5.41
	Open	95.3	1.5	3.2	0.1	13.67	5.29
	Average	94.8	2.1	3.1	0.0	13.59 ^A	5.35 ^{AB}
All Strains	Closed	95.0	2.5	2.4	0.0	13.00	5.29
	Open	95.8	1.7	2.4	0.0	13.15	5.21
	Average	95.4	2.1	2.4	0.0	13.08	5.25

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 4. EFFECT OF POPULATION ON PERFORMANCE OF WHITE EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Hens/ Cage	Feed Cons. (kg/100 hens/d)	Feed Conver. (g egg/ g feed)	Eggs Per Bird Housed	Egg Produc- tion (HD%)	Egg Mass (g/HD)	Mortal- ity (%)	Age at 50% Pro- duction (Days)
Hy-Line (W-36)	6	10.5	.43	232.0	76.4	45.8	2.9	156
	7	10.3	.42	225.4	74.2	44.3	3.6	154
Hy-Line (W-77)	6	11.3	.41	235.2	77.1	46.9	2.9	143
	7	11.2	.41	234.3	77.3	46.8	3.5	143
H & N (Nick Chick)	6	11.6	.41	235.3	79.1	48.7	8.0	153
	7	11.5	.40	226.2	76.9	47.2	10.3	155
Bovans (White)	6	10.9	.42	236.0	78.6	46.8	5.1	150
	7	10.6	.42	225.6	76.3	44.9	5.7	154
ISA (Experimental)	6	10.8	.43	232.1	77.2	48.4	7.4	151
	7	10.6	.43	218.5	74.0	46.3	10.3	155
ISA (Babcock B-300)	6	11.3	.43	234.3	80.1	48.4	12.9	142
	7	11.0	.43	231.0	77.9	47.0	10.8	143
Shaver (White)	6	11.3	.41	229.1	76.6	46.5	7.1	156
	7	11.1	.40	224.0	74.7	45.6	10.9	157
Shaver (2000)	6	11.7	.41	229.8	76.4	48.0	7.0	153
	7	11.4	.40	222.3	74.9	46.9	9.4	156
Dekalb (Delta)	6	11.2	.44	242.0	79.6	49.5	3.6	151
	7	11.1	.43	234.2	77.3	48.1	4.0	154
All Strains	6	11.2 ^A	.42	234.0 ^A	77.9 ^A	47.7 ^A	6.3	151 ^B
	7	11.0 ^B	.42	226.8 ^B	75.9 ^B	46.3 ^B	7.6	152 ^A

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

TABLE 5. EFFECT OF POPULATION ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF WHITE-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Hens/ Cage	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hy-Line (W-36)	6	58.8	2.2	5.7	18.2	43.4	31.3
	7	58.7	2.5	5.0	16.4	45.1	31.5
Hy-Line (W-77)	6	60.4	1.5	4.4	15.7	41.1	37.4
	7	60.0	1.1	3.0	17.4	40.1	37.7
H & N (Nick Chick)	6	60.6	1.9	4.0	13.6	42.7	38.6
	7	60.3	1.9	4.4	13.2	40.2	40.4
Bovans (White)	6	58.8	2.3	5.5	17.8	46.9	27.7
	7	58.2	2.3	4.7	19.5	46.5	27.0
ISA (Experimental)	6	62.0	1.5	2.9	11.0	37.3	47.3
	7	61.8	2.0	3.6	10.7	38.4	45.6
ISA (Babcock B-300)	6	60.1	1.5	3.9	14.3	44.1	35.8
	7	60.0	0.9	3.7	14.3	43.3	36.5
Shaver (White)	6	59.8	2.6	3.8	13.2	46.6	34.2
	7	59.9	2.8	4.5	13.2	43.5	36.4
Shaver (2000)	6	61.9	1.7	3.4	11.0	36.4	47.3
	7	61.8	2.3	3.8	10.3	36.3	47.1
Dekalb (Delta)	6	61.4	1.1	3.7	11.0	41.6	42.5
	7	61.5	1.4	3.0	11.5	39.2	44.8
All Strains	6	60.4	1.8	4.2	14.0	42.2	38.0
	7	60.3	1.9	4.0	14.0	41.4	38.6

*There are no significant differences among these means.

TABLE 6. EFFECT OF POPULATION ON EGG QUALITY, INCOME AND FEED COSTS OF WHITE-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Hens/ Cage	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income (\$/hen)	Feed Costs (\$/hen)
Hy-Line (W-36)	6	96.2	2.0	1.8	0.0	13.14	5.14
	7	94.6	2.3	3.0	0.1	12.66	5.01
Hy-Line (W-77)	6	95.1	2.1	2.7	0.1	13.33	5.56
	7	95.7	1.4	2.9	0.0	13.28	5.47
H & N (Nick Chick)	6	96.0	1.9	2.1	0.0	13.50	5.54
	7	95.3	2.2	2.5	0.0	12.83	5.24
Bovans (White)	6	95.7	2.0	2.3	0.0	13.28	5.25
	7	95.8	1.6	2.5	0.0	12.70	5.01
ISA (Experimental)	6	96.1	2.0	1.8	0.1	13.33	5.13
	7	94.8	2.7	2.4	0.1	12.44	4.88
ISA (Babcock B-300)	6	94.2	3.6	2.2	0.1	13.16	5.21
	7	95.9	1.8	2.3	0.0	13.06	5.19
Shaver (White)	6	96.2	2.1	1.7	0.0	13.05	5.26
	7	96.1	2.0	1.9	0.0	12.71	5.11
Shaver (2000)	6	94.4	2.3	3.2	0.1	13.03	5.55
	7	96.5	1.8	1.7	0.0	12.68	5.24
Dekalb (Delta)	6	95.4	1.6	2.9	0.1	13.87	5.42
	7	94.2	2.5	3.3	0.0	13.31	5.28
All Strains	6	95.5	2.2	2.3	0.1	13.30 ^A	5.34 ^A
	7	95.4	2.0	2.5	0.0	12.85 ^B	5.16 ^B

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

TABLE 7. EFFECT OF CAGE SIZE ON PERFORMANCE OF WHITE-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Cage Length (cm) ¹	Feed Cons. (kg/100 hens/d)	Feed Conver. (g egg/ g feed)	Eggs Per Bird Housed	Egg Produc- tion (HD%)	Egg Mass (g/HD)	Mortal- ity (%)	Age at 50% Pro- duction (Days)
Hy-Line (W-36)	61	10.2	.42	221.7	73.0	43.4	3.3	156
	81	10.7	.43	235.7	77.6	47.0	3.2	154
Hy-Line (W-77)	61	11.0	.41	230.0	76.1	46.0	4.8	142
	81	11.4	.41	239.6	78.3	46.7	1.6	144
H & N (Nick Chick)	61	11.4	.41	224.3	76.6	47.2	10.1	155
	81	11.7	.41	237.2	79.4	48.7	8.2	153
Bovans (White)	61	10.5	.42	226.8	76.5	45.1	6.7	151
	81	10.9	.42	234.8	78.3	46.6	4.0	153
ISA (Experimental)	61	10.6	.43	214.8	73.3	46.0	12.0	153
	81	10.9	.44	235.7	77.9	48.7	5.7	152
ISA (Babcock B-300)	61	10.9	.42	226.2	76.7	46.2	12.3	144
	81	11.4	.43	239.1	81.3	49.2	11.4	141
Shaver (White)	61	11.1	.39	215.2	72.9	44.4	9.8	156
	81	11.3	.41	237.9	78.3	47.7	8.2	157
Shaver (2000)	61	11.3	.40	213.8	72.7	45.5	10.3	155
	81	11.8	.41	238.3	78.6	49.3	6.1	154
Dekalb (Delta)	61	11.0	.43	230.9	76.5	47.6	4.7	152
	81	11.3	.44	245.4	80.3	50.0	2.9	153
All Strains	61	10.9 ^B	.42	222.6 ^B	74.9 ^B	45.7 ^B	8.2 ^A	152
	81	11.3 ^A	.42	238.2 ^A	78.9 ^A	48.3 ^A	5.7 ^B	151

¹All cages are 35.5 cm deep with length being either 61 or 81 cm.

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

TABLE 8.

EFFECT OF CAGE SIZE ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF WHITE-EGG STRAINS,
31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Cage Length (cm) ¹	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hy-Line (W-36)	61	58.6	2.3	5.3	18.5	43.8	30.9
	81	59.0	2.4	5.3	16.0	44.6	31.9
Hy-Line (W-77)	61	60.1	1.4	4.2	16.1	40.8	37.0
	81	60.4	1.3	3.3	16.9	40.4	38.1
H & N (Nick Chick)	61	60.6	1.8	3.9	13.4	40.6	40.6
	81	60.3	1.9	4.5	13.4	42.3	38.4
Bovans (White)	61	58.3	2.6	4.9	19.6	47.9	25.1
	81	58.7	2.0	5.4	17.7	45.5	29.6
ISA (Experimental)	61	62.0	1.7	3.2	10.1	38.5	46.5
	81	61.8	1.7	3.3	11.6	37.1	46.4
ISA (Babcock B-300)	61	60.0	1.5	3.9	14.4	43.0	36.4
	81	60.2	0.9	3.7	14.1	44.4	35.9
Shaver (White)	61	59.8	2.4	4.6	12.9	44.4	36.2
	81	59.8	3.0	3.7	13.4	45.7	34.4
Shaver (2000)	61	61.8	2.0	3.6	10.0	37.2	46.9
	81	61.9	2.0	3.5	11.3	35.4	47.5
Dekalb (Delta)	61	61.5	1.2	3.6	10.8	41.0	43.4
	81	61.4	1.4	3.1	11.7	39.8	43.9
All Strains	61	60.3	1.9	4.1	14.0	41.9	38.1
	81	60.4	1.8	4.0	14.0	41.7	38.5

¹All cages are 35.5 cm deep with length being either 61 or 81 cm.

*There are no significant differences among these means.

TABLE 9. EFFECT OF CAGE SIZE ON EGG QUALITY, INCOME AND FEED COSTS OF WHITE-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Cage Length (cm) ¹	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income (\$/hen)	Feed Costs (\$/hen)
Hy-Line (W-36)	61 81	95.8 95.0	1.6 2.7	2.6 2.2	0.0 0.1	12.56 13.23	4.94 5.20
Hy-Line (W-77)	61 81	94.8 96.0	2.1 1.5	3.1 2.5	0.0 0.1	12.95 13.66	5.38 5.64
H & N (Nick Chick)	61 81	94.7 96.5	2.3 1.8	3.0 1.7	0.0 0.0	12.74 13.59	5.23 5.55
Bovans (White)	61 81	96.0 95.5	1.6 2.0	2.4 2.5	0.0 0.0	12.74 13.24	4.98 5.28
ISA (Experimental)	61 81	95.4 95.5	2.7 2.0	1.8 2.4	0.1 0.1	12.28 13.49	4.80 5.21
ISA (Babcock B-300)	61 81	94.4 95.6	3.4 2.0	2.1 2.3	0.1 0.1	12.67 13.54	5.04 5.36
Shaver (White)	61 81	96.0 96.3	2.2 1.9	1.8 1.8	0.0 0.1	12.26 13.50	5.06 5.30
Shaver (2000)	61 81	95.2 95.7	2.2 1.9	2.6 2.3	0.0 0.0	12.15 13.56	5.19 5.59
Dekalb (Delta)	61 81	95.0 94.6	1.7 2.5	3.3 2.9	0.0 0.0	13.22 13.97	5.23 5.47
All Strains	61 81	95.3 95.6	2.2 2.0	2.5 2.3	0.0 0.1	12.62 ^B 13.53 ^A	5.10 ^B 5.40 ^A

¹All cages are 35.5 cm deep with length being either 61 or 81 cm.

TABLE 10.

DENSITY EFFECTS ON PERFORMANCE OF WHITE-EGG STRAINS, DUE TO THE ADDITIVE EFFECTS OF CAGE SIZE AND POPULATION 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Density (cm ² /hen)	Cage Length /Pop ¹	Feed Cons. (kg/100 hens/d)	Feed Conv. (g egg/ g feed)	Eggs Per Bird Housed	Egg Produc- tion (HD%)	Egg Mass (g/HD)	Mortal- ity (%)	Age at 50% Pro- duction (Days)
Hy-Line (W-36)	310	61/7	10.1	.41	216.3	71.5	42.3	4.9	157
	361	61/6	10.3	.43	227.1	74.5	44.6	1.7	156
	413	81/7	10.6	.43	234.6	77.0	46.3	2.4	152
	482	81/6	10.7	.43	236.9	78.3	47.0	4.1	156
Hy-Line (W-77)	310	61/7	11.1	.41	225.7	75.1	45.6	5.4	143
	361	61/6	11.0	.41	234.3	77.1	46.4	4.3	142
	413	81/7	11.3	.42	243.0	79.5	47.9	1.6	144
	482	81/6	11.5	.41	236.1	77.1	47.4	1.5	145
H & N (Nick Chick)	310	61/7	11.3	.40	221.8	75.7	46.5	9.9	157
	361	61/6	11.5	.41	226.8	77.4	47.9	10.2	154
	413	81/7	11.6	.41	230.6	78.0	47.8	10.7	153
	482	81/6	11.8	.41	243.8	80.8	49.5	5.8	152
Bovans (White)	310	61/7	10.4	.42	220.3	75.2	43.9	7.3	153
	361	61/6	10.7	.43	233.3	77.9	46.4	6.1	149
	413	81/7	10.8	.42	231.0	77.4	45.9	4.1	155
	482	81/6	11.1	.42	238.6	79.2	47.2	4.0	151
ISA (Experimental)	310	61/7	10.4	.42	205.2	71.4	44.8	14.7	156
	361	61/6	10.7	.44	224.4	75.1	47.3	9.3	151
	413	81/7	10.9	.44	231.7	76.6	47.8	5.9	153
	482	81/6	11.0	.45	239.8	79.2	49.6	5.6	152
ISA (Babcock B-300)	310	61/7	10.8	.42	224.9	75.9	45.8	11.8	144
	361	61/6	11.0	.42	227.4	77.4	46.7	12.7	143
	413	81/7	11.2	.43	237.1	80.0	48.3	9.8	141
	482	81/6	11.6	.43	241.1	82.7	50.1	13.1	142
Shaver (White)	310	61/7	11.1	.39	210.8	72.5	44.3	12.3	156
	361	61/6	11.0	.40	219.6	73.4	44.4	7.2	155
	413	81/7	11.2	.41	237.2	76.8	46.8	9.4	157
	482	81/6	11.5	.42	238.7	79.8	48.6	6.9	156
Shaver (2000)	310	61/7	11.2	.40	210.7	72.5	45.3	11.9	157
	361	61/6	11.4	.40	216.8	72.8	45.7	8.7	154
	413	81/7	11.7	.41	233.9	77.2	48.5	7.0	155
	482	81/6	12.0	.41	242.7	80.0	50.2	5.2	152
Dekalb (Delta)	310	61/7	11.0	.43	229.0	76.0	47.4	4.4	153
	361	61/6	10.9	.43	232.8	77.1	47.8	5.0	152
	413	81/7	11.2	.43	239.5	78.5	48.8	3.7	155
	482	81/6	11.4	.44	251.2	82.2	51.2	2.2	151
All Strains	310	61/7	10.8	.41	218.3	74.0	45.1	9.2	153
	361	61/6	11.0	.42	226.9	75.9	46.3	7.3	151
	413	81/7	11.1	.42	235.4	77.9	47.6	6.0	152
	482	81/6	11.4	.42	241.0	79.9	49.0	5.4	151

*There are no significant differences among these means.

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7.

TABLE 11.

DENSITY EFFECTS ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF WHITE-EGG STRAINS, DUE TO THE ADDITIVE EFFECTS OF CAGE SIZE AND POPULATION 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Density ¹ (cm ²)	Cage Length /Pop ¹	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hy-Line (W-36)	310	61/7	58.3	2.7	4.2	17.8	45.9	29.5
	361	61/6	58.9	1.9	6.5	19.1	41.7	32.2
	413	81/7	59.2	2.4	5.7	14.9	44.2	33.6
	482	81/6	58.7	2.5	5.0	17.2	45.0	30.3
Hy-Line (W-77)	310	61/7	60.2	1.5	3.5	16.0	39.4	38.8
	361	61/6	59.9	1.3	4.9	16.2	42.2	35.3
	413	81/7	59.8	0.8	2.6	18.7	40.8	36.7
	482	81/6	61.0	1.7	4.0	15.1	40.1	39.4
H & N (Nick Chick)	310	61/7	60.4	2.2	4.0	13.0	38.8	41.8
	361	61/6	60.9	1.4	3.8	13.8	42.4	39.3
	413	81/7	60.2	1.5	4.7	13.3	41.6	39.0
	482	81/6	60.4	2.4	4.3	13.4	43.0	37.8
Bovans (White)	310	61/7	57.8	2.8	4.9	19.8	48.7	23.9
	361	61/6	58.8	2.5	4.9	19.3	47.1	26.4
	413	81/7	58.7	1.9	4.5	19.3	44.3	30.2
	482	81/6	58.7	2.1	6.2	16.2	46.6	29.1
ISA (Experimental)	310	61/7	61.9	2.2	3.4	9.1	38.9	46.2
	361	61/6	62.2	1.3	2.9	11.1	38.1	46.8
	413	81/7	61.8	1.8	3.7	12.2	37.8	45.0
	482	81/6	61.8	1.6	2.9	11.0	36.4	47.9
ISA (Babcock B-300)	310	61/7	59.9	1.0	4.0	13.1	42.5	38.2
	361	61/6	60.0	2.0	3.9	15.7	43.5	34.7
	413	81/7	60.1	0.8	3.5	15.5	44.1	34.9
	482	81/6	60.3	1.0	4.0	12.8	44.7	37.0
Shaver (White)	310	61/7	60.0	2.7	4.4	12.6	42.7	37.6
	361	61/6	59.6	2.1	4.8	13.3	46.1	34.8
	413	81/7	59.8	2.8	4.7	13.7	44.2	35.1
	482	81/6	59.9	3.2	2.8	13.1	47.1	33.6
Shaver (2000)	310	61/7	61.6	2.2	4.0	9.4	37.5	46.9
	361	61/6	62.0	1.8	3.3	10.6	37.0	46.9
	413	81/7	61.9	2.5	3.6	11.2	35.0	47.4
	482	81/6	61.9	1.5	3.4	11.5	35.8	47.7
Dekalb (Delta)	310	61/7	61.7	1.4	3.3	10.6	40.4	44.3
	361	61/6	61.3	1.0	4.0	11.0	41.6	42.5
	413	81/7	61.3	1.4	2.7	12.4	37.9	45.3
	482	81/6	61.5	1.3	3.4	11.0	41.6	42.6
All Strains	310	61/7	60.2	2.1	4.0	13.5	41.6	38.6
	361	61/6	60.4	1.7	4.3	14.4	42.2	37.7
	413	81/7	60.3	1.8	4.0	14.6	41.1	38.6
	482	81/6	60.4	1.9	4.0	13.5	42.3	38.3

*There are no significant differences among these means.

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7.

TABLE 12. DENSITY EFFECTS ON EGG QUALITY, INCOME AND FEED COSTS OF WHITE-EGG STRAINS, DUE TO THE ADDITIVE EFFECTS OF CAGE SIZE AND POPULATION 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Density ¹ (cm ²)	Cage Length /Pop ¹	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income (\$/hen)	Feed Costs (\$/hen)
Hy-Line (W-36)	310	61/7	94.8	1.6	3.6	0.0	12.14	4.84
	361	61/6	96.7	1.6	1.7	0.0	12.99	5.05
	413	81/7	94.4	2.9	2.5	0.2	13.18	5.18
	482	81/6	95.6	2.4	1.9	0.1	13.29	5.23
Hy-Line (W-77)	310	61/7	95.3	1.4	3.3	0.0	12.72	5.36
	361	61/6	94.2	2.8	2.9	0.0	13.18	5.41
	413	81/7	96.1	1.5	2.5	0.0	13.85	5.58
	482	81/6	95.9	1.5	2.5	0.1	13.48	5.71
H & N (Nick Chick)	310	61/7	94.1	2.6	3.3	0.0	12.47	5.06
	361	61/6	95.3	2.0	2.6	0.0	13.01	5.41
	413	81/7	96.5	1.8	1.8	0.0	13.20	5.43
	482	81/6	96.6	1.9	1.6	0.0	13.98	5.67
Bovans (White)	310	61/7	96.0	1.5	2.5	0.0	12.35	4.87
	361	61/6	96.0	1.7	2.3	0.0	13.12	5.10
	413	81/7	95.7	1.7	2.5	0.1	13.05	5.15
	482	81/6	95.3	2.2	2.4	0.0	13.43	5.40
ISA (Experimental)	310	61/7	94.5	3.4	2.2	0.0	11.63	4.60
	361	61/6	96.3	2.1	1.5	0.2	12.93	4.99
	413	81/7	95.1	2.1	2.7	0.1	13.24	5.15
	482	81/6	95.9	1.9	2.0	0.1	13.73	5.26
ISA (Babcock B-300)	310	61/7	96.2	1.9	1.9	0.0	12.73	5.05
	361	61/6	92.7	4.9	2.3	0.1	12.61	5.03
	413	81/7	95.6	1.7	2.6	0.1	13.38	5.33
	482	81/6	95.6	2.3	2.1	0.0	13.70	5.40
Shaver (White)	310	61/7	96.1	2.2	1.7	0.0	11.94	5.00
	361	61/6	96.0	2.1	1.9	0.0	12.58	5.13
	413	81/7	96.1	1.8	2.0	0.1	13.48	5.22
	482	81/6	96.5	2.0	1.5	0.1	13.53	5.39
Shaver (2000)	310	61/7	96.3	1.9	1.8	0.0	12.04	5.08
	361	61/6	94.1	2.4	3.4	0.1	12.26	5.31
	413	81/7	96.7	1.7	1.6	0.0	13.33	5.41
	482	81/6	94.7	2.1	3.1	0.0	13.80	5.78
Dekalb (Delta)	310	61/7	94.4	2.2	3.5	0.0	13.06	5.19
	361	61/6	95.6	1.2	3.1	0.1	13.38	5.27
	413	81/7	94.0	2.9	3.1	0.0	13.57	5.37
	482	81/6	95.2	2.0	2.8	0.0	14.36	5.58
All Strains	310	61/7	95.3	2.1	2.6	0.0	12.34	5.00
	361	61/6	95.2	2.3	2.4	0.1	12.89	5.19
	413	81/7	95.6	2.0	2.4	0.1	13.36	5.31
	482	81/6	95.7	2.0	2.2	0.1	13.70	5.49

*There are no significant differences among these means.

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7.

TABLE 13. EFFECT OF LAYING HOUSE ON PERFORMANCE OF BROWN-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Laying House	Feed Cons. (kg/100 hens/d)	Feed Conver. (g egg/g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
Bovans (Brown)	Closed	12.2	.41	243.2	80.3	49.9	5.6	150
	Open	12.2	.41	238.0	80.0	49.8	9.2	148
	Average	12.2 ^A	.41 ^B	240.6 ^A	80.2 ^A	49.9	7.4	149 ^B
ISA (Brown)	Closed	11.7	.42	232.8	78.7	50.2	10.6	153
	Open	11.9	.42	237.5	79.0	49.9	8.4	150
	Average	11.8 ^{BC}	.42 ^A	235.2 ^A	78.9 ^{AB}	50.1	9.5	151 ^{AB}
H & N (Brown Nick)	Closed	11.5	.42	224.9	75.9	49.3	10.0	154
	Open	11.7	.42	226.7	76.9	49.6	10.5	151
	Average	11.6 ^C	.42 ^A	225.8 ^B	76.4 ^C	49.5	10.3	152 ^A
Hy-Line (Brown)	Closed	11.9	.40	235.9	78.0	48.3	5.5	150
	Open	11.9	.39	231.9	77.4	47.0	5.7	147
	Average	11.9 ^{AB}	.40 ^B	233.9 ^A	77.7 ^{BC}	47.7	5.6	149 ^B
All Strains	Closed	11.8	.41	234.2	78.2	49.4	7.9	152
	Open	11.9	.41	233.5	78.4	49.1	8.4	149
	Average	11.9	.41	233.9	78.3	49.3	8.2	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 14. EFFECT OF LAYING HOUSE ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF BROWN-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Laying House	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans (Brown)	Closed	61.5	1.0	3.7	11.1	40.6	43.1
	Open	61.5	0.9	2.7	11.2	41.7	43.7
	Average	61.5 ^C	0.9	3.2	11.2	41.2 ^A	43.4 ^C
ISA (Brown)	Closed	63.0	1.3	2.8	11.5	33.6	50.4
	Open	62.5	0.9	2.9	10.0	34.3	51.4
	Average	62.8 ^B	1.1	2.8	10.8	34.0 ^B	50.9 ^B
H & N (Brown Nick)	Closed	64.0	0.6	3.8	10.2	30.5	56.4
	Open	63.7	0.7	2.5	9.8	30.8	56.2
	Average	63.9 ^A	0.6	3.2	10.0	30.6 ^B	56.3 ^A
Hy-Line (Brown)	Closed	61.3	1.3	3.7	12.1	41.8	40.9
	Open	60.4	0.6	3.1	13.0	44.2	39.0
	Average	60.8 ^C	0.9	3.4	12.5	43.0 ^A	40.0 ^C
All Strains	Closed	62.5	1.1	3.5	11.2	36.6	47.7
	Open	62.0	0.8	2.8	11.0	37.8	47.6
	Average	62.2	0.9	3.1	11.1	37.1	47.7

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.

TABLE 15. EFFECT OF LAYING HOUSE ON EGG QUALITY, INCOME AND FEED COSTS OF BROWN-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Laying House	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income (\$/hen)	Feed Costs (\$/hen)
Bovans (Brown)	Closed	95.0	2.2	2.8	0.0	13.86	6.01
	Open	95.8	1.2	3.0	0.0	13.78	5.89
	Average	95.4	1.7	2.9	0.0	13.82 ^A	5.95 ^A
ISA (Brown)	Closed	94.6	3.3	2.1	0.0	13.24	5.65
	Open	95.9	1.7	2.4	0.0	13.65	5.78
	Average	95.2	2.5	2.3	0.0	13.44 ^{AB}	5.72 ^{BC}
H & N (Brown Nick)	Closed	94.8	2.6	2.6	0.0	13.08	5.55
	Open	95.1	2.2	2.7	0.0	13.06	5.59
	Average	95.0	2.4	2.6	0.0	13.07 ^B	5.57 ^C
Hy-Line (Brown)	Closed	94.4	2.4	3.1	0.1	13.38	5.84
	Open	94.9	1.5	3.6	0.0	13.28	5.87
	Average	94.7	1.9	3.4	0.1	13.33 ^B	5.86 ^{AB}
All Strains	Closed	94.7	2.6	2.7	0.0	13.39	5.76
	Open	95.4	1.7	2.9	0.0	13.44	5.78
	Average	95.1	2.1	2.8	0.0	13.42	5.77

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 POPULATION ON PERFORMANCE OF BROWN-EGG STRAINS,
31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Hens/ Cage	Feed Cons. (kg/100 hens/d)	Feed Conver. (g egg/ g feed)	Eggs Per Bird Housed	Egg Produc- tion (HD%)	Egg Mass (g/HD)	Mortal- ity (%)	Age at 50% Pro- duction (Days)
Bovans (Brown)	6	12.2	.41	246.2	81.5	50.7	6.8	148
	7	12.1	.40	234.9	78.9	49.1	8.0	150
ISA (Brown)	6	12.0	.42	241.0	80.2	51.0	7.2	151
	7	11.6	.42	229.3	77.6	49.1	11.8	152
H & N (Brown Nick)	6	11.8	.42	231.0	77.9	50.7	10.1	153
	7	11.4	.42	220.6	74.9	48.2	10.5	152
Hy-Line (Brown)	6	11.9	.41	239.8	79.5	48.9	5.2	147
	7	11.9	.39	228.0	75.9	46.5	6.1	150
All Strains	6	12.0 ^A	.42 ^A	239.5 ^A	79.8 ^A	50.3	7.3	150
	7	11.8 ^B	.41 ^B	228.2 ^B	76.8 ^B	48.2	9.1	151

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

TABLE 17. EFFECT OF POPULATION ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF BROWN-EGG
STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Hens/ Cage	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans (Brown)	6	61.5	0.8	2.9	11.0	41.7	43.7
	7	61.5	1.0	3.5	11.3	40.6	43.2
ISA (Brown)	6	63.0	0.8	2.9	9.4	33.7	52.8
	7	62.6	1.5	2.8	12.1	34.2	49.0
H & N (Brown Nick)	6	64.2	0.6	3.4	9.1	29.4	57.8
	7	63.6	0.7	2.9	10.8	31.8	54.8
Hy-Line (Brown)	6	60.9	0.7	3.3	13.5	43.1	39.2
	7	60.8	1.2	3.4	11.6	42.9	40.8
All Strains	6	62.4	0.7	3.1	10.7	37.0	48.4
	7	62.1	1.1	3.2	11.5	37.4	46.9

*There are no significant differences among these means.

TABLE 18. EFFECT OF POPULATION ON EGG QUALITY, INCOME AND FEED COSTS OF BROWN-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Hens/ Cage	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income (\$/hen)	Feed Costs (\$/hen)
Bovans (Brown)	6	96.1	1.5	2.3	0.0	14.25	6.01
	7	94.7	1.8	3.4	0.0	13.39	5.90
ISA (Brown)	6	95.0	2.6	2.4	0.0	13.82	5.87
	7	95.5	2.4	2.1	0.0	13.07	5.56
H & N (Brown Nick)	6	95.4	2.2	2.4	0.0	13.36	5.69
	7	94.5	2.6	2.9	0.0	12.78	5.45
Hy-Line (Brown)	6	94.8	2.1	2.9	0.1	13.68	5.88
	7	94.5	1.7	3.8	0.0	12.98	5.83
All Strains	6	95.4	2.1	2.5	0.1	13.78 ^A	5.86 ^A
	7	94.8	2.1	3.1	0.0	13.05 ^B	5.69 ^B

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

TABLE 19. EFFECT OF CAGE SIZE ON PERFORMANCE OF BROWN-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Cage Length (cm) ¹	Feed Cons. (kg/100 hens/d)	Feed Conver. (g egg/ g feed)	Eggs Per Bird Housed	Egg Produc- tion (HD%)	Egg Mass (g/HD)	Mortal- ity (%)	Age at 50% Pro- duction (Days)
Bovans (Brown)	61	11.9	.39	230.0	76.8	47.5	7.5	148
	81	12.4	.42	251.2	83.6	52.2	7.4	149
ISA (Brown)	61	11.5	.41	223.7	75.6	48.0	11.4	153
	81	12.1	.43	246.6	82.1	52.1	7.6	150
H & N (Brown Nick)	61	11.5	.41	219.2	74.5	48.2	11.4	152
	81	11.8	.43	232.5	78.3	50.7	9.2	153
Hy-Line (Brown)	61	11.7	.40	226.9	76.0	46.7	6.1	148
	81	12.1	.40	240.9	79.3	48.7	5.1	149
All Strains	61	11.7 ^B	.40 ^B	224.9 ^B	75.7 ^B	47.6 ^B	9.1	150
	81	12.1 ^A	.42 ^A	242.8 ^A	80.8 ^A	50.9 ^A	7.3	150

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7.

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

TABLE 20. EFFECT OF CAGE SIZE ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF BROWN-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Cage Length (cm) ¹	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans (Brown)	61	61.2	1.0	3.2	10.5	41.7	42.8
	81	61.8	0.9	3.1	11.8	40.6	44.0
ISA (Brown)	61	62.8	1.0	3.2	10.1	33.4	51.7
	81	62.7	1.2	2.5	11.4	34.5	50.1
H & N (Brown Nick)	61	63.9	0.5	3.4	10.2	29.5	56.8
	81	63.9	0.7	3.0	9.8	31.8	55.8
Hy-Line (Brown)	61	60.9	0.8	3.5	14.3	41.9	39.4
	81	60.8	1.1	3.3	10.7	44.0	40.6
All Strains	61	62.2	0.8	3.3	11.3	36.6	47.7
	81	62.3	1.0	3.0	10.9	37.7	47.7

*There are no significant differences among these means.

TABLE 21. EFFECT OF CAGE SIZE ON EGG QUALITY, INCOME AND FEED COSTS OF BROWN-EGG STRAINS, 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Cage Length (cm) ¹	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income (\$/hen)	Feed Costs (\$/hen)
Bovans (Brown)	61	95.2	2.1	2.7	0.0	13.11	5.77
	81	95.6	1.3	3.1	0.0	14.53	6.13
ISA (Brown)	61	95.0	2.4	2.6	0.0	12.74	5.51
	81	95.5	2.5	1.9	0.0	14.14	5.92
H & N (Brown Nick)	61	95.2	2.2	2.6	0.0	12.65	5.49
	81	94.8	2.6	2.6	0.0	13.49	5.65
Hy-Line (Brown)	61	94.9	1.9	3.2	0.0	12.94	5.73
	81	94.4	1.9	3.5	0.1	13.73	5.98
All Strains	61	95.0	2.2	2.8	0.0	12.86 ^B	5.62 ^B
	81	95.1	2.1	2.8	0.0	13.97 ^A	5.92 ^A

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7.

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

TABLE 22. DENSITY EFFECTS ON PERFORMANCE OF BROWN-EGG STRAINS, DUE TO THE ADDITIVE EFFECTS OF CAGE SIZE AND POPULATION 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Density ¹ (cm ²)	Cage Length /Pop ¹	Feed Cons. (kg/100 hens/d)	Feed Conv. (g egg/ g feed)	Eggs Per Bird Housed	Egg Produc- tion (HD%)	Egg Mass (g/HD)	Mortal- ity (%)	Age at 50% Pro- duction (Days)
Bovans (Brown)	310	61/7	11.9	.39	223.8	75.5	46.5	8.0	149
	361	61/6	12.0	.40	236.1	78.1	48.5	7.0	148
	413	81/7	12.3	.41	246.0	82.2	51.6	8.1	152
	482	81/6	12.5	.42	256.3	84.9	52.9	6.7	147
ISA (Brown)	310	61/7	11.2	.41	216.4	73.8	46.8	13.8	153
	413	61/6	11.8	.41	231.1	77.5	49.1	9.1	152
	361	81/7	12.0	.43	242.2	81.4	51.4	9.8	151
	482	81/6	12.2	.43	251.0	82.8	52.9	5.3	150
H & N (Brown Nick)	310	61/7	11.4	.41	211.2	72.6	46.7	12.8	150
	361	61/6	11.6	.42	227.1	76.4	49.8	10.0	154
	413	81/7	11.5	.43	230.1	77.1	49.7	8.2	155
	482	81/6	12.0	.43	234.8	79.5	51.6	10.1	152
Hy-Line (Brown)	310	61/7	11.6	.39	220.4	74.1	45.4	6.2	149
	361	61/6	11.8	.40	233.5	78.0	47.9	6.1	147
	413	81/7	12.2	.39	235.5	77.7	47.6	6.0	150
	482	81/6	12.0	.41	246.2	81.0	49.8	4.2	147
All Strains	310	61/7	11.5	.40	218.0	74.0	46.4	10.2	150
	361	61/6	11.8	.41	231.9	77.5	48.8	8.0	150
	413	81/7	12.0	.41	238.5	79.6	50.1	8.0	152
	482	81/6	12.2	.42	247.1	82.1	51.8	6.6	149

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7

TABLE 23. DENSITY EFFECTS ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF BROWN-EGG STRAINS, DUE TO THE ADDITIVE EFFECTS OF CAGE SIZE AND POPULATION 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Density ¹ (cm ²)	Cage Length /Pop ¹	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans (Brown)	310	61/7	61.0	1.3	3.7	10.9	42.4	41.1
	361	61/6	61.4	0.7	2.8	10.2	41.1	44.6
	413	81/7	62.0	0.8	3.4	11.7	38.9	45.3
	482	81/6	61.6	1.0	2.9	11.9	42.3	42.8
ISA (Brown)	310	61/7	62.7	1.3	2.9	11.8	31.6	51.5
	361	61/6	62.9	0.7	3.4	8.4	35.1	51.9
	413	81/7	62.4	1.6	2.7	12.5	36.8	46.5
	482	81/6	63.0	0.8	2.4	10.4	32.3	53.8
H & N (Brown Nick)	310	61/7	63.7	0.3	2.8	10.5	30.5	55.9
	361	61/6	64.1	0.8	3.9	9.8	28.4	57.7
	413	81/7	63.5	1.1	3.1	11.2	33.1	53.7
	482	81/6	64.2	0.4	2.8	8.4	30.5	57.9
Hy-Line (Brown)	310	61/7	60.9	0.9	3.6	14.4	40.4	40.6
	361	61/6	60.9	0.7	3.3	14.3	43.5	38.2
	413	81/7	60.6	1.5	3.2	8.7	45.4	40.9
	482	81/6	60.9	0.7	3.3	12.7	42.7	40.3
All Strains	310	61/7	62.1	0.9	3.2	11.9	36.2	47.3
	361	61/6	62.4	0.7	3.4	10.7	37.0	48.1
	413	81/7	62.2	1.2	3.1	11.0	38.5	46.6
	482	81/6	62.4	0.7	2.9	10.8	36.9	48.7

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7.

TABLE 24. DENSITY EFFECTS ON EGG QUALITY, INCOME AND FEED COSTS OF BROWN-EGG STRAINS, DUE TO THE ADDITIVE EFFECTS OF CAGE SIZE AND POPULATION 31ST NCLP&MT (133-434 DAYS)

Breeder (Strain)	Density (cm ²)	Cage Length /Pop ¹	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income (\$/hen)	Feed Costs (\$/hen)
Bovans (Brown)	310	61/7	94.2	2.6	3.2	0.1	12.62	5.73
	361	61/6	96.2	1.6	2.2	0.0	13.59	5.81
	413	81/7	95.3	1.1	3.7	0.0	14.15	6.07
	482	81/6	96.0	1.5	2.5	0.1	14.91	6.20
ISA (Brown)	310	61/7	94.7	2.8	2.5	0.0	12.24	5.31
	361	61/6	95.2	2.1	2.7	0.0	13.25	5.71
	413	81/7	96.2	2.0	1.8	0.0	13.90	5.81
	482	81/6	94.9	3.1	2.1	0.0	14.39	6.03
H & N (Brown Nick)	310	61/7	95.2	2.3	2.5	0.0	12.19	5.36
	361	61/6	95.1	2.1	2.7	0.0	13.11	5.63
	413	81/7	93.8	2.9	3.3	0.0	13.37	5.55
	482	81/6	95.7	2.3	2.0	0.1	13.62	5.75
Hy-Line (Brown)	310	61/7	95.4	1.7	3.0	0.0	12.59	5.67
	361	61/6	94.3	2.2	3.4	0.1	13.29	5.79
	413	81/7	93.6	1.8	4.7	0.0	13.37	6.00
	482	81/6	95.3	2.0	2.4	0.2	14.07	5.97
All Strains	310	61/7	94.9	2.3	2.8	0.0	12.41	5.51
	361	61/6	95.2	2.0	2.7	0.0	13.31	5.74
	413	81/7	94.7	2.0	3.4	0.0	13.70	5.86
	482	81/6	95.5	2.2	2.2	0.1	14.25	5.99

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7

TABLE 25.

EFFECT OF LAYING HOUSE ON SYNCHRONIZED MOLT OF WHITE-EGG STRAINS, 31ST NCLP&MT
(434-462 DAYS)

Breeder (Strain)	Laying House	Beginning Body Weight (kg)	Ending Body Weight (kg)	Weight Loss/Day (g)	Weight Loss (%)	Mortality (%)	Eggs Per Bird Housed
Hy-Line (W-36)	Closed	1.82	1.29	26	29.2	1.1	2.6
	Open	1.89	1.32	24	30.0	0.6	2.4
	Average	1.86 ^{BC}	1.31 ^B	25	29.6 ^{BC}	0.9 ^B	2.5 ^A
Hy-Line (W-77)	Closed	1.99	1.42	19	28.5	4.2	2.5
	Open	1.96	1.39	28	29.2	2.5	2.4
	Average	1.98 ^A	1.41 ^A	23	28.9 ^C	3.4 ^{AB}	2.4 ^{AB}
H & N (Nick Chick)	Closed	1.79	1.23	24	31.4	3.4	2.4
	Open	1.92	1.30	31	32.3	2.4	2.1
	Average	1.85 ^{BC}	1.26 ^{BCD}	28	31.9 ^{AB}	2.9 ^B	2.3 ^{BC}
Bovans (White)	Closed	1.78	1.24	26	30.8	1.5	2.3
	Open	1.88	1.35	16	28.1	1.0	2.2
	Average	1.83 ^{BC}	1.29 ^{BC}	21	29.4 ^{BC}	1.3 ^B	2.2 ^{BC}
ISA (Experimental)	Closed	1.62	1.09	20	32.7	3.3	2.3
	Open	1.74	1.17	24	32.4	4.8	1.8
	Average	1.68 ^D	1.13 ^E	22	32.6 ^A	4.1 ^{AB}	2.1 ^C
ISA (Babcock B300)	Closed	1.74	1.19	26	31.8	5.0	2.2
	Open	1.80	1.21	12	32.5	8.3	2.0
	Average	1.77 ^{CD}	1.20 ^{DE}	19	32.2 ^{AB}	6.7 ^A	2.1 ^C
Shaver (White)	Closed	1.92	1.30	24	32.4	2.1	2.5
	Open	1.98	1.30	39	34.2	4.9	2.0
	Average	1.95 ^A	1.30 ^B	32	33.3 ^A	3.5 ^{AB}	2.3 ^{BC}
Shaver (2000)	Closed	1.85	1.30	25	29.5	7.3	2.2
	Open	1.93	1.28	36	33.9	1.1	2.1
	Average	1.89 ^{AB}	1.29 ^{BC}	31	31.7 ^{AB}	4.2 ^{AB}	2.2 ^C
Dekalb (Delta)	Closed	1.81	1.24	14	31.7	5.8	2.3
	Open	1.83	1.20	39	34.6	2.8	2.3
	Average	1.82 ^{BC}	1.22 ^{CD}	27	33.2 ^A	4.3 ^{AB}	2.3 ^{ABC}
All Strains	Closed	1.81	1.26	23	30.9	3.7	2.4
	Open	1.88	1.28	28	31.9	3.2	2.1
	Average	1.85	1.27	25	31.4	3.5	2.3

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 26.

EFFECT OF POPULATION ON SYNCHRONIZED MOLT OF WHITE-EGG STRAINS, 31ST NCLP&MT
(434-462 DAYS)

Breeder (Strain)	Hens/ Cage	Beginning Body Weight (kg)	Ending Body Weight (kg)	Weight Loss/Day (g)	Weight Loss (%)	Mortality (%)	Eggs Per Bird Housed
Hy-Line (W-36)	6	1.86	1.31	30	29.2	0.7	2.8
	7	1.86	1.30	21	30.0	1.0	2.3
Hy-Line (W-77)	6	2.00	1.42	29	29.2	3.3	2.6
	7	1.95	1.40	18	28.5	3.4	2.3
H & N (Nick Chick)	6	1.88	1.26	25	32.9	3.5	2.5
	7	1.82	1.26	30	30.8	2.4	2.0
Bovans (White)	6	1.87	1.34	29	28.6	1.0	2.6
	7	1.79	1.25	13	30.3	1.5	1.9
ISA (Experimental)	6	1.69	1.16	18	31.7	3.8	2.3
	7	1.67	1.11	26	33.5	4.3	1.8
ISA (Babcock B300)	6	1.79	1.23	18	31.3	6.8	2.1
	7	1.75	1.17	19	33.1	6.5	2.1
Shaver (White)	6	1.95	1.28	42	34.2	3.3	2.4
	7	1.95	1.32	21	32.4	3.7	2.1
Shaver (2000)	6	1.89	1.29	33	31.9	4.7	2.2
	7	1.89	1.29	28	31.5	3.7	2.1
Dekalb (Delta)	6	1.83	1.23	36	33.1	2.6	2.5
	7	1.81	1.21	18	33.2	6.0	2.1
All Strains	6	1.86	1.28	29 ^A	31.3	3.3	2.4 ^A
	7	1.83	1.26	22 ^B	31.5	3.6	2.1 ^B

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

TABLE 27. EFFECT OF CAGE SIZE ON SYNCHRONIZED MOLT OF WHITE-EGG STRAINS, 31ST NCLP&MT
(434-462 DAYS)

Breeder (Strain)	Cage Length (cm) ¹	Beginning Body Weight (kg)	Ending Body Weight (kg)	Weight Loss/Day (g)	Weight Loss (%)	Mortality (%)	Eggs Per Bird Housed
Hy-Line (W-36)	61	1.83	1.28	23	29.9	0.4	2.2
	81	1.89	1.33	28	29.3	1.3	2.8
Hy-Line (W-77)	61	1.91	1.34	26	29.7	4.8	2.2
	81	2.04	1.47	21	28.0	1.9	2.6
H & N (Nick Chick)	61	1.82	1.24	34	31.8	1.8	2.2
	81	1.88	1.28	22	31.9	4.1	2.3
Bovans (White)	61	1.86	1.28	21	31.3	1.9	2.1
	81	1.81	1.31	21	27.6	0.6	2.4
ISA (Experimental)	61	1.69	1.13	25	33.3	2.4	1.8
	81	1.67	1.14	19	31.9	5.8	2.3
ISA (Babcock B300)	61	1.74	1.17	23	32.6	6.2	1.9
	81	1.80	1.23	14	31.8	7.1	2.3
Shaver (White)	61	1.90	1.26	34	33.8	3.9	2.1
	81	2.00	1.34	29	32.8	3.1	2.4
Shaver (2000)	61	1.88	1.27	36	32.3	3.9	1.9
	81	1.90	1.31	25	31.0	4.5	2.4
Dekalb (Delta)	61	1.81	1.20	19	33.7	2.3	2.2
	81	1.84	1.24	34	32.6	6.2	2.4
All Strains	61	1.83 ^B	1.24 ^B	27	32.0	3.1	2.1 ^B
	81	1.87 ^A	1.29 ^A	24	30.8	3.8	2.4 ^A

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7.

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

TABLE 28. DENSITY EFFECTS ON SYNCHRONIZED MOLT OF WHITE-EGG STRAINS, DUE TO THE ADDITIVE EFFECTS OF CAGE SIZE AND POPULATION 31ST NCLP&MT (434-462 DAYS)

Breeder (Strain)	Density (cm ²)	Cage Length /Pop ¹	Beginning Body Wt. (kg)	Ending Body Wt. (kg)	Weight Loss/day (g)	Weight Loss (%)	Mortal -ity (%)	Eggs Per Bird Housed
Hy-Line (W-36)	310	61/7	1.76	1.24	23	29.6	0.9	2.0
	361	61/6	1.89	1.32	23	30.2	0.0	2.5
	413	81/7	1.95	1.36	19	30.4	1.2	2.6
	482	81/6	1.83	1.31	38	28.2	1.4	3.1
Hy-Line (W-77)	310	61/7	1.92	1.35	23	29.4	4.5	2.1
	361	61/6	1.90	1.33	30	30.0	5.2	2.4
	413	81/7	1.99	1.44	14	27.6	2.4	2.5
	482	81/6	2.10	1.51	28	28.3	1.4	2.7
H & N (Nick Chick)	310	61/7	1.77	1.22	39	30.9	3.6	2.2
	361	61/6	1.87	1.26	29	32.6	0.0	2.2
	413	81/7	1.88	1.30	21	30.7	1.2	1.8
	482	81/6	1.89	1.27	22	33.1	6.9	2.8
Bovans (White)	310	61/7	1.79	1.23	14	31.4	1.8	1.8
	361	61/6	1.93	1.33	29	31.1	2.1	2.3
	413	81/7	1.80	1.27	13	29.3	1.2	2.0
	482	81/6	1.82	1.35	29	26.0	0.0	2.8
ISA (Experimental)	310	61/7	1.70	1.13	33	33.2	2.7	1.6
	361	61/6	1.69	1.13	18	33.4	2.1	2.1
	413	81/7	1.64	1.09	20	33.7	6.0	2.1
	482	81/6	1.70	1.19	18	30.1	5.6	2.6
ISA (Babcock B300)	310	61/7	1.70	1.12	30	33.9	7.1	1.7
	361	61/6	1.77	1.22	16	31.2	5.2	2.0
	413	81/7	1.80	1.22	9	32.2	6.0	2.4
	482	81/6	1.80	1.24	20	31.4	8.3	2.3
Shaver (White)	310	61/7	1.93	1.29	25	33.3	2.7	1.9
	361	61/6	1.88	1.24	43	34.3	5.2	2.3
	413	81/7	1.98	1.35	18	31.6	4.8	2.3
	482	81/6	2.02	1.33	41	34.0	1.4	2.5
Shaver (2000)	310	61/7	1.88	1.24	38	34.1	2.7	1.9
	361	61/6	1.89	1.31	35	30.6	5.2	2.0
	413	81/7	1.91	1.35	19	28.9	4.8	2.2
	482	81/6	1.89	1.27	31	33.2	4.2	2.5
Dekalb (Delta)	310	61/7	1.78	1.17	5	34.3	3.6	2.0
	361	61/6	1.84	1.23	33	33.2	1.0	2.4
	413	81/7	1.84	1.25	30	32.2	8.3	2.2
	482	81/6	1.83	1.22	39	33.0	4.2	2.6
All Strains	310	61/7	1.80	1.22	25	32.2	3.3	1.9
	361	61/6	1.85	1.26	28	31.8	2.9	2.2
	413	81/7	1.86	1.29	18	30.7	4.0	2.2
	482	81/6	1.87	1.30	29	30.8	3.7	2.6

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7.

*There are no significant differences among these means.

TABLE 29. EFFECT OF LAYING HOUSE ON SYNCHRONIZED MOLT OF BROWN-EGG STRAINS,
31ST NCLP&MT (434-462 DAYS)

Breeder (Strain)	Laying House	Beginning Body Weight (kg)	Ending Body Weight (kg)	Weight Loss/ Day (g)	Weight Loss (%)	Mortal- ity (%)	Eggs Per Bird Housed
Bovans (Brown)	Closed	2.14	1.51	14	29.7	6.2	2.7
	Open	2.16	1.50	26	30.5	5.6	2.3
	Average	2.15	1.50	20	30.1	5.9	2.5
ISA (Brown)	Closed	2.15	1.54	25	28.4	2.9	2.4
	Open	2.17	1.56	34	28.1	3.8	2.3
	Average	2.16	1.55	30	28.2	3.4	2.4
H & N (Brown Nick)	Closed	2.16	1.56	24	27.8	3.3	2.4
	Open	2.22	1.54	36	30.5	5.3	2.1
	Average	2.19	1.55	30	29.2	4.3	2.2
Hy-Line (Brown)	Closed	2.19	1.57	33	28.4	2.8	2.8
	Open	2.27	1.62	28	28.8	2.3	2.1
	Average	2.23	1.60	30	28.6	2.6	2.4
All Strains	Closed	2.16	1.55	24	28.6	3.8	2.6
	Open	2.21	1.56	31	29.5	4.3	2.2
	Average	2.18	1.55	27	29.0	4.0	2.4

*There are no significant differences among these means.

TABLE 30. EFFECT OF POPULATION ON SYNCHRONIZED MOLT OF BROWN-EGG STRAINS,
31ST NCLP&MT (434-462 DAYS)

Breeder (Strain)	Laying House	Beginning Body Weight (kg)	Ending Body Weight (kg)	Weight Loss/Day (g)	Weight Loss (%)	Mortal- ity (%)	Eggs Per Bird Housed
Bovans (Brown)	6	2.14	1.52	17	29.1	3.3	2.7
	7	2.16	1.49	23	31.1	8.5	2.3
ISA (Brown)	6	2.21	1.60	39	27.9	3.3	2.6
	7	2.11	1.51	20	28.6	3.4	2.2
H & N (Brown Nick)	6	2.20	1.57	30	28.7	4.0	2.4
	7	2.18	1.53	29	29.6	4.6	2.1
Hy-Line (Brown)	6	2.24	1.61	30	28.1	4.5	2.9
	7	2.23	1.58	31	29.1	0.6	2.0
All Strains	6	2.20	1.57	29	28.5	3.8	2.6 ^A
	7	2.17	1.53	26	29.6	4.3	2.1 ^B

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

TABLE 31. EFFECT OF CAGE SIZE ON SYNCHRONIZED MOLT OF BROWN-EGG STRAINS,
31ST NCLP&MT (434-462 DAYS)

Breeder (Strain)	Cage Length (cm) ¹	Beginning Body Weight (kg)	Ending Body Weight (kg)	Weight Loss/Day (g)	Weight Loss (%)	Mortal- ity (%)	Eggs Per Bird Housed
Bovans (Brown)	61	2.16	1.49	21	30.9	7.5	2.0
	81	2.14	1.51	19	29.3	4.3	3.0
ISA (Brown)	61	2.18	1.55	31	29.0	3.1	2.2
	81	2.14	1.56	29	27.5	3.7	2.5
H & N (Brown Nick)	61	2.20	1.53	41	30.8	4.8	2.2
	81	2.17	1.57	19	27.5	3.8	2.3
Hy-Line (Brown)	61	2.19	1.53	35	29.9	1.6	2.3
	81	2.28	1.66	26	27.3	3.5	2.6
All Strains	61	2.18	1.52	32	30.1 ^A	4.3	2.2
	81	2.19	1.58	23	27.9 ^B	3.8	2.6

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7.

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

TABLE 32. DENSITY EFFECTS ON SYNCHRONIZED MOLT OF BROWN-EGG STRAINS, DUE TO THE ADDITIVE EFFECTS OF CAGE SIZE AND POPULATION 31ST NCLP&MT (432-462 DAYS)

Breeder (Strain)	Density (cm ²)	Cage Length /Pop ¹	Beginning Body Wt. (kg)	Ending Body Wt. (kg)	Weight Loss/day (g)	Weight Loss (%)	Mortal- ity (%)	Eggs Per Bird Housed
Bovans (Brown)	310	61/7	2.17	1.46	20	32.9	9.8	1.9
	361	61/6	2.15	1.53	23	28.8	5.2	2.2
	413	81/7	2.15	1.52	26	29.3	7.1	2.8
	482	81/6	2.14	1.51	11	29.4	1.4	3.2
ISA (Brown)	310	61/7	2.09	1.49	25	28.7	0.9	2.1
	361	61/6	2.26	1.61	36	29.2	5.2	2.3
	413	81/7	2.12	1.52	15	28.4	6.0	2.2
	482	81/6	2.17	1.59	43	26.5	1.4	2.8
H & N (Brown Nick)	310	61/7	2.14	1.50	43	30.2	4.5	1.9
	361	61/6	2.27	1.56	39	31.3	5.2	2.4
	413	81/7	2.21	1.57	16	28.9	4.8	2.3
	482	81/6	2.14	1.58	21	26.2	2.8	2.3
Hy-Line (Brown)	310	61/7	2.14	1.47	38	31.2	1.2	1.8
	361	61/6	2.24	1.60	33	28.6	2.1	2.8
	413	81/7	2.32	1.69	24	27.0	0.0	2.1
	482	81/6	2.24	1.62	28	27.7	6.9	3.0
All Strains	310	61/7	2.14	1.48	31	30.8	4.1	1.9
	361	61/6	2.23	1.57	33	29.5	4.4	2.4
	413	81/7	2.20	1.58	20	28.4	4.5	2.4
	482	81/6	2.17	1.58	26	27.4	3.1	2.8

¹Density was represented by a combination of cage size designated by lengths of 61 or 81 cm and hen population of either 6 or 7.

*There are no significant differences among these means.

Entries 31st NCLP&MT
Stock Suppliers and Categories

<u>Breeder</u>	<u>Stock</u>	<u>Category</u> ¹	<u>Source</u>
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	Hy-Line W-36	I-A	Hy-Line International 4432 Highway 213, Box 309 Mansfield, GA 30255
	Hy-Line W-77	I-A	(Same)
ISA/Babcock P.O. Box 280 Ithaca, NY 14850-0280	B-300	I-A	American Selected Products Milton Hatchery 55 Lawton Lane Milton, PA 17847
	Experimental	III-A	ISA Babcock P.O. Box 280 Ithaca, NY 14851
Shaver Poultry Breeding Farms Ltd. P.O. Box 400 Cambridge, Ontario Canada N1R5V9	Shaver White	I-A	American Selected Products Inc. Milton Hatchery 55 Lawton Lane Milton, PA 17847
	Shaver 2000	II-A	(Same)
Dekalb Ag Research Inc. 3100 Sycamore Road Dekalb, IL 60115	Delta	I-C ²	(See footnote)
Centurion Poultry 1471 Lane Creek Road Bogart, GA 30622	Bovans White	I-A	Centurion Poultry Inc. 1471 Lane Creek Road Bogart, GA 30622
	Bovans Brown	I-A	(Same)
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 1915 Sugar Grove Dallas Center, IA 50063
ISA/Babcock P.O. Box 280 Ithaca, NY 14850-0280	ISA Brown	I-A	American Selected Products Inc. Milton Hatchery 55 Lawton Lane Milton, PA 17847

- ¹ I = Extensive distribution in southeast United States
 II = Little or no distribution in southeast United States
 III = Unavailable for commercial distribution in United States
 A = Entry requested
 C = Entry not requested

²Entrance of these strains were requested by the North Carolina egg producers who secured the acquisition of the stock and appropriate fees. Procedures followed were in accordance with North Carolina Layer Performance and Management Test.