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FIRST CYCLE REPORT OF THE THIRTY NINTH NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST[1]

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The North Carolina Layer Performance and Management Tests are conducted under the auspices of the North Carolina Layer Performance and Management Program, Prestage Department of Poultry Science, Cooperative Extension Service at North Carolina State University and the North Carolina Department of Agriculture and Consumer Services. The flock is maintained at the Piedmont Research Station-Poultry Unit, Salisbury, North Carolina. Mr. Joe Hampton is Piedmont Research Station Superintendent; Mr. Aaron Sellers is Poultry Unit Manager of the flock; Dr. Ramon D. Malheiros, Research Associate is coordinator of data compilation and statistical analysis; and Dr. K. E. Anderson is Project Leader. The purpose of this program is to assist poultry management teams in evaluation of commercial layer stocks and management systems.

The data presented herein represents the analysis of the first production cycle and molt of the 39th North Carolina Layer Performance and Management Test. Performance summary tables are available for each strain, molt, density and the production systems of Enrichable Cage, Enriched Environmental Housing, and Conventional Battery Style Cage System.

Copies of current and past reports are maintained for public access at http://www.ces.ncsu.edu/depts/poulsci/tech_manuals/layer_reports/39_first_cycle report.pdf .

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[1]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.

39th NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST
Volume 39 No. 3

Report on the First Laying Cycle and Molt

Dates of Importance:

Twenty entries were hatched on July 31, 2013. There were twelve commercial white egg strains, and eight commercial brown egg strains that are participating in the current test. The chicks were all sexed according to their genetics (vent, feather, or color), vaccinated for Marek's disease, and wing banded for identification before being transferred to the brood/grow houses.

Table 1, shows the source of the laying stock, strain which was entered, and which environments the strains are participating in the test. Table 54, is a list of the breeder, source of eggs, and entry status of each strain. This report will only present the production data from the hens in Houses 5 and 7 representing the production systems are conventional battery cages (C), enrichable cages (EC), and the enriched environmental housing system (ECS).

Experimental Components of Importance:

The rearing phase for the systems of conventional battery cage, enrichable cage, and enriched environmental housing system grow phase were completed at 16 wks after which the pullets were moved to the laying phase during their 17th wk of age.

First cycle production records commenced on November 27, 2013 (17 weeks of age), through the molt period which was induced on November 24, 2014. The molt records commenced on November 24, 2014 (69 weeks of age), and ended on December 22, 2014 (73 weeks of age). This report includes production data summarized from 17 to 69 weeks, and 69 to 73 weeks for each production system and density. A table showing the changes in body weights from 17 to 69 wk of age and the weight loss during the molt period is included in the molt period information.

For the layer tests, a maximum of approximately 830 and minimum of 300 white and brown egg pullets/strain were placed at the initiation of the layer portion of the test depending on which of the test environments the strain was entered into.

Strain--Samples of fertile eggs were provided from the breeders according to the rules, which govern the conductance of the test. All eggs were set and hatched concurrently (**39th Hatch/Serology Report Vol. 39, No. 1**) as described in the hatch report. However, due to hatch complications, additional chicks had to be acquired and delivered to the station fortunately the added chicks had hatch dates that were within 2 days. At hatch the chicks were sexed to remove the males. All strains were sexed according to breeder recommendations, (*i.e.* feather, color, or vent sexing).

Table 1. 39th North Carolina Layer Performance and Management Test Strain Code Assignments and Participation

Strain No.	Source of Stock	Source Code	Strain	Participation[1]
1	Hendrix-genetics	ISA	Bovans White	C, EC, ECS
2	Hendrix-genetics	ISA	Shaver White	C, EC, ECS
3	Hendrix-genetics	ISA	Dekalb White	C, CF, EC, ECS
4	Hendrix-genetics	ISA	Babcock White	C, EC, ECS
5	Hendrix-genetics	ISA	B-400	C, EC, ECS
6	Hy-Line Int.	HL	W-36	C, CF, EC, ECS
7	Hy-Line Int.	HL	CV-26	C, CF
8	Hy-Line Int.	HL	CV-24	C, CF, EC, ECS
9	Hy-Line Int.	HL	CV-22	C, CF, R
10	Lohmann	L	LSL Lite	C, CF, EC, ECS
11	H&N International	L	H&N Nick Chick	C, CF, EC, ECS
12	Novogen	N	White	C, CF, EC, ECS
13	Tetra Americana	TA	TETRA Amber	C, CF, EC, ECS
14	Tetra Americana	TA	TETRA Brown	C, CF, EC, ECS
15	Novogen	N	Brown	C, CF, EC, ECS
16	Lohmann	L	LB-Lite	C, CF, EC, ECS
17	Hy-Line Int.	HL	Silver Brown	C, CF, EC, ECS, R
18	Hy-Line Int.	HL	Brown	C, CF, EC, ECS, R
19	Hendrix-genetics	ISA	ISA Brown	C, CF, EC, ECS
20	Hendrix-genetics	ISA	Bovans Brown	C, CF, EC, ECS

[1] Participation for each strain in the different components of the tests are indicated by the following codes, a strain may have more than one code: Cage=C; Enrichable Cage=EC; Enriched Colony Housing System=ECS; Cage Free = CF; Range = R

Pullet Housing and Management:

Housing: The pullets were reared in the environment to which they would be in during the laying phase (**39th NCLP&MT Grow Report, Vol.39, No. 2**). White egg strains occupied approximately 60 % and brown egg strains occupied the other 40 % of cage replicates. Individual hens were identified by strain assignment codes that indicate the cage arrangement, replicate identification numbers, and the strain assignments for brood-grow House 8. Strain codes are maintained by the PI and Unit Manager for identification of birds and record keeping. Individual birds were identified by a permanent identification tag which at the time they were transferred to the laying house each hen was retagged with the laying house replicate number; indicate room, row, level and replicate. The replicate number identifies individuals from the strain to the unit manager and PI. All aspects of the laying phase were kept the same.

House 8 – This was the Brood/Grow system used to rear the pullets for the conventional battery cage, enrichable cage, and the enriched environmental housing system. In brief House 8, is an environmentally controlled windowless brood-grow facility with 4 rooms each containing 72 replicates within a Big Dutchman quad-deck cage layout. This allows for a total of 3,744 pullets per room. This study utilized all 4 rooms for a total of 11,062 pullets. The white and brown egg strains were randomly assigned to the replicates in a restricted randomized manner with the restrictions being that all strains were approximately equally represented in all rooms, rows, and levels, as described in the grow report (**39th NCLP&MT Grow Report, Vol.39, No. 2**). Thirteen white-egg or brown-egg chicks were in the same cage (13 per 24" x 26" cage) during the entire 16 wk rearing period. Rearing density was 310 cm^2 (48 in^2) for both the white and brown-egg layers.

Pullet Management and Nutrition:

Pullets were fed *ad libitum* by hand daily. Feed consumption and body weights were monitored bi-weekly beginning at 2 weeks of age. All mortality was recorded daily, but mortality attributed to the removal of males (sex slips) and accidental deaths from a replicate have been excluded from the 39th NCLP&MT Grow Report.

Layer Housing and Cage Layout Description:

The pullets were moved to the laying facilities, Houses 5 and 7 in accordance with NCSU IACUC approved methods. The strains of pullets were randomly assigned to the replicate cages with white egg strains occupying approximately 60% and brown egg strains the other 40% of the replicates being intermingled throughout the houses. Both houses contain a feeder system that allows feed consumption to be determined by replicate. The replicates are equipped with feed hoppers to supply and monitor feed consumption for each individual replicate and the feed is distributed by an automatic feeding system. 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. Laying Hen Cage Facilities reported in this test consist of two houses shown in Table 2.

House 5 is a standard height windowless forced ventilated laying house with battery style cages using a belt manure handling system. It has 5 banks of FDI triple deck cages, three of which are Enriched Environmental Housing Systems and two banks with Enrichable Cages. As with the other houses, each side of a bank has been designated as a row and each row is divided into 9 8-foot replicates/level. The replicates contain either four 24" cages or a single 96" cage. The 96 in cages were equipped with a nesting area 24w x 12d x 19h in (288 in^2) and 2 roost ¾ x 2 x 48 in positioned 3 in off the floor, the total length of 96 in, scratch area is 24w x 12d in (288 in^2). The cages in both houses are 26" deep therefore; when the bird population is held constant at 9 hens per cage, in the 24" and 36 or 18 hens per cage, in the 96" cages, the densities are 69, 69, and 139 in^2, respectively. House 5 population is 8,262 hens.

House 7 is a standard windowless enclosed force ventilated house. The cages consist of 4 rows of a FDI Tri-Deck Stacked Layer Cage System (Battery Style with Manure Belts). There is 60' of cage row with each side being designated a row. Each row is divided into six 10' cage row sections consisting of 4 cages /section with a 24" space between cage sections for feed hoppers

and feed recovery. The waste collection system consists of manure belt cleaning. This will provide for 144 experimental units each consisting of 4 - 24" x 20" cages. Two densities were examined, 69 in^2 which allowed for 7 hens/cage for a total of 28 hens/replicate and at 120 in^2 which allowed for 4 hens/cage for a total of 16 hens/rep. resulting in a house total of 3,168 hens.

Table 2. Replicate numbers and Hen populations in the Enrichable Cage, Enriched Environmental Housing, and Conventional Battery Style Cage System

House	Cage Style[1]	Number of Replicates	Hens per replicate	Hen No.	Total Hens
5	EC	104	36	3,744	
5	ECS	79	36	2,844	
5	ECS	76	18	1,368	7,956
7	C	62	28	1,736	
7	C	77	16	1,232	2,968

[1]Cage=C; Enrichable Cage=EC; Enriched Colony Housing System=ECS

FDA Egg Safety Plan Testing

In accordance with the Egg Safety Rule and the NCLP&MT Egg Safety Plan the cage, cage-free and range hen environments were tested between the ages of 40 and 44 weeks for the presence of *Salmonella enteritidis*. All of the environments were found to be negative for *Salmonella enteritidis*.

Lighting Schedule

The lighting schedule for the hens in controlled environment facilities are outlined in Table 3.

Table 3. Layer House Lighting[2] Schedules

		Light Control Houses	
		5	7
Age	Date	Photo Period[1]	
		(Daylight Hours)	(Daylight Hours)
16-17 weeks	Nov 19, 2013	10.0	10.0
17 Weeks[1]	Nov. 27, 2013	11.0	11.0
18 Weeks	Dec. 4, 2013	11.5	11.5
19 Weeks	Dec. 11, 2013	12.0	12.0
20 Weeks	Dec. 18, 2013	12.5	12.5
21 Weeks	Dec. 24, 2013	13.0	13.0
22 Weeks	Jan. 1, 2014	13.5	13.5
23 Weeks	Jan. 8, 2014	14.0	14.0
24 Weeks	Jan. 15, 2014	14.25	14.25
25 Weeks	Jan. 22, 2014	14.5	14.5
26 Weeks	Jan. 29, 2014	14.75	14.75
27 Weeks	Feb. 5, 2014	15.0	15.0
28 Weeks	Feb. 12, 2014	15.25	15.25
29 Weeks	Feb. 19, 2014	15.5	15.5
30 Weeks	Feb. 26, 2014	15.75	15.75
31 Weeks	March 5, 2014	16.0	16.0
Molt Period			
Through 69 Weeks	Nov. 25, 2014	16.0	9.0
73 Weeks	Dec. 23, 2014	16.0	9.0
73 Weeks	Dec. 23, 2014	16.0	15.5
74 weeks	Dec. 30, 2014	16.0	16.0
74 Weeks through end of test (109 wk[2])	Dec. 30, 2014 to Sept. 1, 2015	16.0	16.0

[1]Lighting schedules were the same for all of the birds throughout the study except for the natural light in the range huts.
[2]Light intensity for Houses 5, and 7 was 0.5 to 0.7 ft candle at the second tier

Test Design:

The arrangement for the laying test involved a completely randomized design and the main effects were set up in a factorial arrangement. The main effects within Houses 5 and 7 were strain, density, and production system. Following are general descriptions of the main effects:

Strain - Strains were provided from the breeders according to the rules, which govern the conductance of the test. Fertile eggs were set and hatched concurrently (**39th Hatch/Serology Report Vol. 39, No. 1**) as described in the hatch report. Additional chicks had to be acquired and delivered to the station to provide adequate bird numbers, fortunately the added chicks had hatch dates that were within 2 days of the layer test hatch.

Density - In Houses 5 and 7, all individual replicates within each block contained one strain of layers. The cage density in House 5 was dictated by the cage size 243.8 or 60.9 cm and populations of 36, 18, or 9 hens/cage (Table 4). House 7 all cages were 60.9 cm density was dictated by the hen population in the cage of either 7 or 5 hens/cage.

Table 4. Population and Density Allocations in Enrichable Cage, Enriched Environmental Housing, and Battery Style Conventional Cage System

House	Hens per Cage	Cage Size Width Depth	Floor Space per Bird	Feeder Space per Bird	Water Nipples per Cage
5	36[1]	243.8 cm x 66.0 cm	447 cm^2 (69 in^2)	6.8 cm (2.7 in)	6
5	18[2]	243.8 cm x 66.0 cm	894 cm^2 (138 in^2)	13.5 cm (5.3 in)	6
5	9	60.9 cm x 66.0 cm	447 cm^2 (69 in^2)	6.8 cm (2.7 in)	2
7	7	60.9 cm x 50.8 cm	442 cm^2 (69 in^2)	8.7 cm (3.4 in)	2
7	4	60.9 cm x 50.8 cm	773 cm^2 (120 in^2)	15.2 cm (6.0 in)	2

[1]Nest area was 51.6 cm^2/hen, Scratch area 51.6 cm^2/hen and the roost space was 6.8 cm/hen
[2]Nest area was 103.2 cm^2/hen, Scratch area 103.2 cm^2/hen and the roost space was 13.5 cm/hen

Layer Management (Molting):

The non-molted hens were in House 5. The full fed control replicates were maintained according to the standard management program as outlined previously.

The molt was conducted utilizing all conventionally caged hens in House 7. The non-anorexic molt program hens were fed a low protein, low energy diet with supplemental Ca for maintenance. It was designed to keep hens out of production and provide balanced nutrition for body maintenance only. The diet is bulky, such that a full trailer load will only weigh 2/3 of a normal full load. The birds in the replicates being molted were weighted on days 7 and 9 to predict body weight loss. Then weighed every other day until target weight was reached at which time that replicate and sister replicates were provided the resting diet until the end of the molting period. The induced molt was started at 69 wks of age. The standard weight loss curve developed was utilized to manage the non-anorexic molt program.

Procedural steps:

Day -7	Sample of birds will be weighed to determine the pre-molt weight. Target weight loss (20 % body weight) will be calculated using the pre-molt weight.
Day 0	NA program instigated with the remaining layer feed being removed and replaced with the NA molt diet and daylight hours reduced. Controlled light housing, reduce the day length to 9 hr. Remove morbid birds before commencement of molt program.
Day + 7	Body weights taken on 2 replicates from each strain and density in Houses 5 and 7.
Day + 9	Body weights taken on 2 replicates from each strain and density in Houses 5 and 7. From the daily weight loss the day post initiation (Day 0) when the hens would be predicted to reach 20% weight loss. This is verified by body weight.
Day +28	Body weights were taken then the birds were fed layer diet and light stimulated.

Specific monitored criteria for all of the molt programs include the following:

The birds to attain approximately 20% body weight loss + 3%. Maintain house temperature at 80± 5° F, but the birds should not pant. House temperature management reacted to ambient environmental temperatures and weight loss rates.

The post-molt production period light schedule (Table 2) is the guide by which the lights will be adjusted following the molt. Actual house conditions and the flock's reaction to the NCSU Non-Fasting Molting Program may affect how the light stimulation will actually be given. In general the hens ceased egg production by Day 6-10 of the molt program. However, some of the Brown egg strains never achieved 0 egg production. The hens were allowed to consume all of the molt feed provided between feedings. The molting ration is designed to keep hens out of production, and to provide for skeletal and muscle maintenance. Livability was excellent with this program.

Layer Nutrition:

Laying hen diets are identified as Diets D, E, F, G, H, I, M, N, and O which consist of a pre-lay diet and a series of layer diets formulated to assure a daily protein, mineral and amino acid intake as shown in Table 5. Feed was offered ad libitum in accordance with the guidelines that all birds should receive acceptable nutrient intake at all times depending on the bird's age and production rate as shown in the Laying House Feeding Program Table 6.

The diets provided during the molt, consisted of a low protein/energy diet and a Resting Diet described in the Molt Diets Table which follow. The molt diets were formulated to provide nutrition for body maintenance. The Resting Diet provides layer with the nutrients needed to maintain a static body weight with no egg production.

Table 5. Minimum Daily Intake of Nutrients per Bird at Various Stages of Production in the 39th NCLP&MT

Production Stage	Pre-Peak > 87%	87-80%	80-70%	<70%
White Egg Layers				
Protein[1](g/day)	19	18	17	16
Calcium (g/day)	4.0	4.1	4.2	4.3
Lysine (mg/day	820	780	730	690
TSAA (mg)day)	700	670	630	590
Brown Egg Layers				
Protein[1](g/day)	20	19	18	17
Calcium (g/day)	4.0	4.0	4.1	4.2
Lysine (mg/day	830	820	780	730
TSAA (mg)day)	710	700	670	630

[1] If the egg production is higher than predicted values protein intake should be increased by 1%

Note: House temperatures dictate the body maintenance demand of the hen if the house temperature is 75 to 80°F feed protein content should be increased accordingly to compensate for metabolic heat needed to maintain a homeostatic body temperature. If the house temperature is at or above 85°F no adjustment is needed.

Table 6 : NCLP&MT Laying House Feeding Program

Rate of Production	Consumption Per (kg/100 Birds/Day)	Diet Fed	
		White Egg Strains	Brown Egg Strains
Weeks 15-17	< 9.52	D	D
Pre-Peak and > 90%	< 9.52 - 10.43	D	E
	10.43 - 12.20	E	F
	12.25 ->13.11	F	G
90-80%	10.43 - 11.29	F	G
	11.34 - 12.20	G	H
	12.25 ->13.11	H	I
70-80%	10.43 - 11.29	H	I
	11.34 - 12.20	I	M
	12.25 ->13.11	M	N
< 70%	10.43 - 11.29	M	N
	11.34 - 12.20	N	O
	12.25 ->13.11	O	O

Note: Low house temperatures and egg production higher than breeder guides for any given hen age will require an adjustment to the dietary phase feeding program to ensure the hens are in a positive nutrient status.

Table 7. 39th NCLP&MT Laying Periods Feed Formulations[1] D through H

Ingredients	D	E	F	G	H
Corn	879.44	1166.03	1202.7	1240.88	1285.39
Soybean meal	636.39	564.55	533.71	506.44	473.06
Fat (Lard)	10.00	10.00			15.68
D.L. Methionine	3.41	2.92	2.31	2.04	1.80
Soybean oil	45.85	25.90	36.29	25.06	
Ground Limestone	124.15	122.36	121.69	110.55	111.82
Coarse Limestone	70.00	70.00	70.00	75.00	75.00
Bi-Carbonate	2.00	2.00	2.00	3.00	2.00
Phosphate Mono/D	21.93	21.50	17.93	26.03	23.89
Salt	6.96	6.41	5.88	5.00	5.48
Vit. premix	1.00	1.00	1.00	1.00	1.00
Min. premix	1.00	1.00	1.00	1.00	1.00
HyD_3 Broiler (62.5 mg/lb)			0.50		
Prop Acid 50% Dry	1.00	1.00	1.00	1.00	1.00
T-Premix	1.00	1.00	1.00	1.00	1.00
.06% Selenium Premix	1.00	1.00	1.00	1.00	1.00
Choline Cl 60%	1.62	1.94	1.59	1.00	0.87
Avizyme	1.00	1.00			
Ronozyme P-CT 540%	0.40	0.40	0.40		
Total	2000.00	2000.00	2000.00	2000.00	2000.00
Calculated Analysis					
Protein %	19.43	18.10	17.50	17.00	16.37
ME kcal/kg	2926.0	2904.0	2882	2860.0	2843.0
Calcium %	4.10	4.05	4.00	3.95	3.95
A. Phos. %	0.45	0.44	0.40	0.38	0.35
Lysine %	1.10	1.00	0.96	0.91	0.87
TSAA %	0.80	0.74	0.69	0.66	0.63

[1]Feeds were manufactured by Southern States

Table 8. 39th NCLP&MT Laying Periods Feed Formulations I through O

Ingredients	I	M	N	O
Corn	1330.70	1315.29	1303.73	1290.76
Soybean meal	440.37	417.79	378.54	337.65
Wheat Midds		39.27	89.80	145.56
D.L. Methionine	1.56	1.24	1.14	0.78
Lysine 78.8%	2.23	0.10		
Ground Limestone	115.69	119.22	123.59	124.94
Coarse Limestone	75.00	75.00	75.00	75.00
Bi-Carbonate	2.00	2.00	2.00	2.00
Phosphate Mono/D	21.74	19.89	16.49	14.00
Salt	5.20	5.10	4.71	4.31
Vit. premix	1.00	1.00	1.00	1.00
Min. premix	1.00	1.00	1.00	1.00
Prop Acid 50% Dry	1.00	1.00	1.00	1.00
T-Premix	1.00	1.00	1.00	1.00
.06% Selenium Premix	1.00	1.00	1.00	1.00
Choline Cl 60%	0.52	0.10		
Total	2000.00	2000.00	2000.00	2000.00
Calculated Analysis				
Protein %	15.87	15.49	14.93	14.37
ME kcal/kg	2821.9	2800.0	2777.8	2755.8
Calcium %	4.00	4.05	4.10	4.10
A. Phos. %	0.33	0.31	.28	0.26
Lysine %	0.91	0.80	0.75	0.71
TSAA %	0.60	0.58	0.56	0.53

[1]Feeds were manufactured by Southern States

Table 9. 39th NCLP&MT Laying Periods Feed Formulations Molt and Resting Diets

Ingredient	Molt Diets	
	Low ME	Resting
Corn	702.50	1427.70
Soybean Hulls	1164.77	226.00
Soybean Meal 48%		117.00
Wheat Midds	18.26	186.50
Coarse Limestone	17.78	16.50
Phosphate Mono/D	69.84	4.00
Salt	9.16	5.00
Methionine	2.69	1.30
Vit. premix	1.00	1.00
Min. premix	1.00	1.00
T - Premix	1.00	1.00
Fat	9.99	10.00
MYC-OUT 65	1.00	2.00
0.06% Sel Premix	1.00	1.00
Total	2000	2000
Calculated Analysis		
Protein %	9.92	11.75
Me kcal/kg	1650	2859
Calcium %	1.33	3.80
T. Phos %	0.88	0.44
Lysine %	0.42	0.55
TSAA %	0.35	0.49

Data Collection Schedule and Procedures:

Age at 50% Production (Maturity)—The first day at which the birds in the individual replicates achieved 50% production.

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-Housed and 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 and used to calculate egg income.

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 in the pilot processing facility and handled as they would be in a commercial off-line facility. In period 1, statistical estimates were made for those replicates where quality information was missing due to late onset of maturity from sister replicates.

Egg Size Distribution--At twenty-eight day intervals, all eggs produced within the previous 24 hours were weighed and sorted according to current USDA standards for egg size. In period 1, statistical estimates were made for those replicates where size distributions were missing due to late onset of maturity from sister replicates.

Egg Income--Egg income was calculated using current production year calendar and applying a 3 year average egg price on egg production and quality evaluation.

Feed Consumption and Conversion--All feed offered for consumption was recorded for each replicate. At twenty-eight day intervals, feed not consumed was weighed back and feed consumption was calculated. Daily feed intake (kg/100 hens/day) was calculated and reported for each strain.

Feed Costs--Feed costs were based on the actual current feed prices for each feed delivery which were calculated and summarized for the complete production cycle.

Body weights—Birds were weighed and weights recorded at housing (17 wk), end of 1st cycle (69 wks), and start of the 2nd cycle (73 wk). Body weight gain for the 1st cycle was calculated and reported for each strain. In the Molt period lowest body weight, percent weight loss, 73 wk body weights were taken or calculated and reported for each strain.

Mortality--All mortalities were recorded daily, and obvious accidents were not included in reported mortalities.

Statistical Analyses and Separation of Means:

All data were subjected to ANOVA utilizing the GLM procedure of JMP11 (SAS, 2014), with main effects of strain, density, and production system used herein. Period was accounted for in the model within each of the production systems. Separate analyses were conducted for white and brown egg strains, the densities within production systems and between the enrichable and enriched colony housing system. Within each production system the Strain and Strain x Density/Housing System interactions were tested for significance. The LSMeans differences from the GLM Procedure were separated via the Tukey HSD option. Comparisons of overall production systems of Density or Housing System were tested for significance and their LS Means from the GLM Procedure were separated via the Student's t option. Significant differences ($P < 0.01$) within white and brown egg strains are noted by differing letters among columns of means.

DESCRIPTION OF DATA TABLE STATISTICS

First cycle performance of white and brown egg strains in the three production systems are reported from 119-483 days of age and 483-511 days of age for comparative purposes. Conventional cage systems and densities are in Table 13 to 17, and the molt period performance and weight loss data of the white and brown egg strains are shown on Tables 18 to 25. The Enrichable and Enriched Colony Housing System and densities from 119-483 days of age and 483-511 days of age for comparative purposes are in Tables 26 to 49 and the body weights Tables 50 to 54.

Breeder (Strain): Short identification codes developed for strain and breeder of the stock are shown in Table 1 and 55. .

Hen Housed Eggs per Bird: The total number of eggs produced divided by the number of birds housed at 119 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 119 through 483 days of age (1st Cycle) and 483 through 511 (Molt) which are reported separately. The hens in the Enrichable and Enriched systems were not molted but the period 483 to 511 days are reported separately for comparative purposes.

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 (g) for each period sampled. Weight of all eggs collected from previous 24 hours divided by the number of eggs collected.

Egg Income: The calculated income per hen housed at 119 days, from egg production using current production year calendar then calculating the regional average egg prices 11/27/2011 to 12/25/2014. Using the regional weighted average prices for small lots, USDA Grade A and Grade A, white eggs in cartons, from nearby retail outlets of eggs based in North Carolina (USDA-AMS, RA_PY001). The egg price used for the eggs from House 7 where the hens were molted were valued using the B grade price.

Table 10. Three Year Regional Average Egg Prices

Grade	Size	$/Dozen 1st Cycle
A	Extra Large	1.4445
A	Large	1.4179
A	Medium	1.1385
A	Small	0.9408
A[1]	Pee Wee	0.4612
B[2]	All	0.7367
Checks[2]	All	0.7367

[1]Prices are estimates based upon the formula provided by D.D. Bell (Small x 0.5)
[2]Prices are estimates based upon the formula provided by D.D. Bell (Large x 0.53)

Grade Information:

The average grade of all eggs sampled according to USDA grading standards over all sampling periods. Grades are established by personnel trained in USDA grading standards.

Egg Size Distribution:

Following are the size classifications used for establishing the USDA egg size grading. There has been blending of egg size in this test with the weight cutoff between medium and large being 23.5. This maximizes the number of USDA large eggs just as would occur in a commercial plant. The proportion of the eggs falling into the following size categories are reported in the tables.

Table 11. USDA Egg Weights Used To Establish The Egg Size Distribution Weighted for Large Eggs.

Size Category	Ounces/Dozen
Pee Wee	< 18
Small	18 – 21
Medium	21 - 23.5
Large	23.5 – 27
Extra Large	> 27

Feed Cost:

The calculated feed cost per hen housed at 119 days, using the kilogram/diet consumed and the average price of each diet per ton.

Table 12. The Average Contract Feed Price For Feed Purchases During The First Cycle.

Diets	Price Per Ton
D	380.40
E	380.34
F	363.29
G	342.90
H	326.60
Molt Diet LP/LE	277.00
Resting	270.00

Metric Conversions:

1 lb. = 453.6 g	1 g = .03527 oz.
1 lb. = .4536 kg	1 kg = 2.204 lb.
1 oz. = 28.35 g	1 g = 1000 mg
	1 kg = 1000 g

TABLE 13. EFFECT OF WHITE EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN CONVENTIONAL BATTERY CAGES

Breeder (Strain)	Density[1] (in^2/hen)	Feed Consumption (kg/100/hen/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
Bovans White	69	10.18^{efghi}	0.501^{bcdef}	310.55^{abcd}	85.33^{bcdefg}	51.79^{fghi}	2.70	144.25^{abcdef}
	120	11.02^{abcd}	0.490^{defg}	315.45^{efg}	86.64^{abcde}	53.80^{bcdef}	4.70	142.75^{abcdef}
	Average	10.60^{AB}	0.495^{BC}	313.00^{AB}	85.99^{CDE}	52.79^{DE}	3.70	143.50^{BCDE}
Shaver White	69	9.60^{ij}	0.543^{a}	316.70^{abc}	86.93^{abcd}	52.88^{efghi}	4.48	140.50^{f}
	120	10.10^{fghij}	0.539^{ab}	325.00^{a}	89.32^{a}	54.22^{bcde}	1.58	140.75^{ef}
	Average	9.83^{DE}	0.541^{A}	320.85^{A}	88.14^{AB}	53.55^{CD}	3.02	140.63^{F}
Dekalb White	69	10.33^{defghi}	0.503^{abcdef}	314.97^{abcd}	86.50^{abcde}	52.79^{efghi}	3.17	142.67^{abcdef}
	120	10.96^{abcde}	0.492^{defg}	321.12^{ab}	88.23^{ab}	54.79^{abcde}	3.12	141.75^{cdef}
	Average	10.64^{AB}	0.497^{BC}	318.04^{A}	87.37^{ABC}	53.79^{CD}	3.14	142.21^{CDEF}
Babcock White	69	9.98^{fghij}	0.546^{a}	320.60^{abc}	88.12-^{abc}	55.36^{abc}	1.20	141.67^{bcdef}
	120	11.28^{ab}	0.495^{cdefg}	324.72^{a}	89.22^{a}	56.45^{a}	1.58	140.75ef
	Average	10.63^{AB}	0.521^{AB}	322.66^{A}	88.67^{A}	55.90^{A}	1.39	141.21^{EF}
ISA B-400	69	10.11^{efghij}	0.529^{abcd}	314.27^{abcd}	86.19^{abcdef}	53.89^{bcdef}	3.97	143.67^{abcdef}
	120	11.05^{abcd}	0.493^{defg}	314.90^{abcd}	86.45^{abcde}	54.70^{abcde}	1.58	144.50^{abcdef}
	Average	10.58^{AB}	0.511^{BC}	314.58^{AB}	86.32^{BCD}	54.30^{BC}	2.77	144.08^{ABCD}
Hy-Line W-36	69	9.28^{j}	0.525^{abcde}	296.37^{bcd}	81.29^{hij}	49.46^{jkl}	3.20	146.33^{ab}
	120	10.72^{bcdef}	0.458^{g}	300.02^{abcd}	82.29^{ghij}	49.28^{kl}	2.08	146.25^{a}
	Average	10.00^{CDE}	0.492^{C}	298.19^{BC}	81.79^{F}	49.37^{G}	2.64	146.29^{A}
Hy-Line CV-26	69	9.24^{j}	0.502^{bcdefg}	288.27^{d}	79.07^{j}	46.88^{m}	3.57	145.00^{abcde}
	120	9.92^{ghij}	0.479^{fg}	293.70^{cd}	80.69^{ij}	47.72^{lm}	0	144.50^{abcdef}
	Average	9.58^{E}	0.490^{C}	290.98^{C}	79.88^{F}	47.30^{H}	1.78	144.75^{ABC}
Hy-Line CV-24	69	9.78^{hij}	0.512^{abcdef}	302.33^{abcd}	82.85^{fghi}	50.67^{ijk}	7.57	146.33^{ab}
	120	10.67^{bcdefg}	0.496^{cdefg}	316.92^{abc}	86.85^{abcd}	53.35^{cdefg}	9.40	142.25^{abcdef}
	Average	10.22^{BCD}	0.504^{BC}	309.63^{AB}	84.85^{DE}	52.01^{EF}	8.48	144.29^{ABCD}
Hy-Line CV-22	69	9.69^{ij}	0.520^{abcdef}	304.03^{abcd}	83.35^{efghi}	51.01^{hijk}	5.17	142.33^{abcdef}
	120	10.61^{bcdefgh}	0.484^{efg}	308.82^{abcd}	84.76^{defg}	51.45^{ghij}	4.70	141.25^{def}
	Average	10.15^{BCD}	0.502^{BC}	306.43^{ABC}	84.06^{E}	51.21^{F}	4.93	141.79^{DEF}
Lohmann LSL Lite	69	10.05^{fghij}	0.526^{abcde}	314.50^{abcd}	86.25^{abcdef}	52.90^{cdefghi}	5.93	144.67^{abcdef}
	120	11.22^{abc}	0.487^{defg}	319.85^{ab}	87.92^{abc}	55.07^{abcd}	1.58	145.75^{abc}
	Average	10.64^{AB}	0.507^{BC}	317.18^{A}	87.09^{ABC}	54.03^{BCD}	3.75	145.21^{AB}
H&N Nick Chick	69	9.85^{ghij}	0.536^{abc}	308.80^{abcd}	84.74^{cdefgh}	53.32^{cdefgh}	4.77	145.33^{abcd}
	120	11.15^{abcd}	0.497^{cdefg}	325.48^{a}	89.35^{a}	56.40^{a}	4.70	144.00^{abcdef}
	Average	10.50^{ABC}	0.517^{ABC}	317.14^{A}	87.04^{ABC}	54.86^{ABC}	4.73	144.67^{ABC}
Novogen White	69	10.40^{cdefghi}	0.520^{abcdef}	316.03^{abcd}	86.52^{abcde}	55.05^{abcde}	5.97	145.33^{abcd}
	120	11.58^{a}	0.482^{fg}	326.87^{ab}	88.69^{a}	55.75^{ab}	6.28	144.25^{abcdef}
	Average	10.99^{A}	0.501^{BC}	319.95^{A}	87.60^{ABC}	55.37^{AB}	6.12	144.79^{ABC}
All Strains	69	9.87	0.522^{Z}	308.95^{Z}	84.76^{Z}	52.17	4.30	144.00^{Y}
	120	10.85	0.491^{Y}	315.82^{Y}	86.70^{Y}	53.60	3.44	143.23^{Z}

[1]All strains were housed such that each strain is equally represented in each density.
ABCDEFGH - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcdefghijklm - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.
Mortality percentage prior to analyzes was transformed in Square Root Asin

TABLE 14. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN CONVENTIONAL BATTERY CAGES

Breeder	Density[1]	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
(Strain)	(in^2/hen)	(g/egg)	(%)	(%)	(%)	(%)	(%)
Bovans	69	59.04^{efgh}	0	8.18	9.57^{ab}	26.21^{a}	55.61^{ef}
White	120	61.06^{abcd}	0	4.96	8.07^{ab}	19.94^{abcd}	67.04^{abc}
	Average	60.05^{BCDE}	0	6.57	8.82^{ABC}	23.08	61.33^{BCDE}
Shaver	69	59.66^{cdefgh}	0	6.71	9.27^{ab}	26.09^{ab}	57.69^{def}
White	120	59.12^{defgh}	0	5.13	9.41^{ab}	25.17^{abc}	60.31^{bcde}
	Average	59.39^{EF}	0	5.92	9.34^{ABC}	25.63	59.00^{DE}
Dekalb	69	58.93^{defgh}	0	6.09	8.33^{ab}	24.03^{abcd}	61.46^{bcde}
White	120	60.53^{abcdefg}	0	5.45	6.46^{ab}	20.50^{abcd}	67.40^{abc}
	Average	59.73^{CDE}	0	5.77	7.40^{ABC}	22.26	64.43^{ABCD}
Babcock	69	61.38^{abc}	0	3.70	8.50^{ab}	20.48^{abcd}	67.08^{abcd}
White	120	61.96^{ab}	0.63	4.50	8.26^{ab}	14.56^{d}	71.83^{a}
	Average	61.67^{A}	0.32	4.10	8.38^{ABC}	17.52	69.45^{A}
ISA	69	60.78^{abcdefg}	0	7.20	5.19^{ab}	19.72^{abcd}	67.79^{abc}
B-400	120	61.42^{abc}	0	7.21	5.08^{ab}	15.73^{cd}	71.54^{a}
	Average	61.10^{ABC}	0	7.21	5.14^{C}	17.72	69.67^{A}
Hy-Line	69	59.95^{bcdefgh}	0	6.70	10.68^{ab}	22.79^{abcd}	59.28^{bcdef}
W-36	120	58.66^{fgh}	0	7.26	12.35^{ab}	24.06^{abcd}	55.77^{ef}
	Average	59.31^{EF}	0	6.98	11.51^{AB}	23.43	57.52^{EF}
Hy-Line	69	58.50^{h}	0	7.86	13.67^{a}	28.92^{a}	49.10^{f}
CV-26	120	58.12^{h}	0	8.36	11.72^{ab}	25.96^{ab}	54.02^{ef}
	Average	58.31^{F}	0	8.11	12.72^{A}	27.44	51.56^{F}
Hy-Line	69	59.56^{cdefgh}	0.84	5.33	9.52^{ab}	26.54^{ab}	57.61^{cdef}
CV-24	120	59.75^{cdefgh}	0	7.52	7.10^{ab}	25.13^{abc}	60.15^{bcde}
	Average	59.66^{DEF}	0.42	6.42	8.31^{ABC}	25.83	58.88^{DE}
Hy-Line	69	58.77^{cdefgh}	1.28	4.24	6.82^{ab}	27.28^{a}	60.26^{bcde}
CV-22	120	59.67^{cdefgh}	0	5.26	8.26^{ab}	25.62^{ab}	60.73^{bcde}
	Average	59.72^{CDEF}	0.64	4.75	7.54^{ABC}	26.45	60.49^{CDE}
Lohmann	69	60.78^{abcdefg}	0	5.23	8.19^{ab}	22.92^{abcd}	63.41^{abcde}
LSL Lite	120	60.81^{abcde}	0	4.02	7.98^{ab}	19.71^{abcd}	67.59^{abc}
	Average	60.69^{ABCD}	0	4.62	8.09^{ABC}	21.32	65.50^{ABC}
H&N	69	60.82^{abcdef}	0	5.23	7.94^{ab}	20.28^{abcd}	66.51^{abcd}
Nick Chick	120	61.53^{abc}	0.96	5.90	3.80^{b}	21.25^{abcd}	67.75^{ab}
	Average	61.18^{AB}	0.48	5.56	5.87^{BC}	20.77	67.13^{AB}
Novogen	69	62.35^{a}	0	7.29	4.39^{ab}	15.56^{bcd}	72.79^{a}
White	120	61.55^{abc}	0	6.71	5.07^{ab}	20.38^{abcd}	67.79^{ab}
	Average	61.95^{A}	0	7.00	4.73^{C}	17.97	70.29^{A}
All	69	60.35	0.18	6.15	8.50	23.55^{Y}	61.55^{Z}
Strains	120	60.13	0.13	6.02	7.80	21.50^{Z}	64.33^{Y}

[1]All strains were housed such that each strain is equally represented in each density

ABCDEF - Different letters denote significant differences (P<.01), comparisons made among strain average values.

abcdef - Different letters denote significant differences (P<.01) in the strain*density interactions.

YZ - Different letters denote significant differences (P<.01), comparisons made among density average values

TABLE 15. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN CONVENTIONAL BATTERY CAGES

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Bovans	69	94.42	2.59	2.50^{ab}	0.48	35.00^{ab}	15.31^{bcdefg}
White	120	98.20	0.13	1.53^{ab}	0.15	35.93^{ab}	16.58^{abcde}
	Average	96.31	1.36	2.01^{AB}	0.32	35.46^{ABCD}	15.94^{AB}
Shaver	69	97.61	0	2.10^{ab}	0.29	34.79^{ab}	14.44^{fg}
White	120	96.14	0.15	3.71^{ab}	0	37.20^{a}	15.16^{bcdefg}
	Average	96.87	0.07	2.90^{AB}	0.15	35.99^{ABC}	14.80^{BC}
Dekalb	69	97.42	0	2.15^{ab}	0.43	35.62^{ab}	15.55^{abcdefg}
White	120	96.20	0.57	2.74^{ab}	0.49	36.96^{a}	16.50^{abcde}
	Average	96.81	0.28	2.45^{AB}	0.46	36.29^{AB}	16.03^{AB}
Babcock	69	96.87	0.28	2.43^{ab}	0.41	37.26^{a}	15.01^{bcdefg}
White	120	96.60	0.72	2.42^{ab}	0.27	37.44^{a}	16.98^{ab}
	Average	96.74	0.50	2.42^{AB}	0.34	37.3^{A}	15.99^{AB}
ISA	69	96.89	0.25	2.35^{ab}	0.51	35.58^{ab}	15.23^{bcdefg}
B-400	120	96.20	0.28	3.02^{ab}	0.49	36.00^{ab}	16.62^{abcde}
	Average	96.55	0.27	2.69^{AB}	0.50	35.79^{ABCD}	15.93^{AB}
Hy-Line	69	96.07	0	3.19^{ab}	0.74	33.10^{ab}	13.97^{fg}
W-36	120	95.31	0.32	3.77^{ab}	0.60	33.55^{ab}	16.12^{abcdef}
	Average	95.69	0.16	3.48^{AB}	0.67	33.32^{CD}	15.04^{BC}
Hy-Line	69	96.78	0.11	2.48^{ab}	0.63	32.45^{b}	13.91^{g}
CV-26	120	98.13	0.46	1.41^{ab}	0	33.82^{ab}	14.94^{cdefg}
	Average	97.46	0.28	1.94^{AB}	0.31	33.13^{D}	14.42^{C}
Hy-Line	69	97.52	0.64	1.59^{ab}	0.25	33.67^{ab}	14.70^{defg}
CV-24	120	98.42	0	1.46^{ab}	0.12	35.31^{ab}	16.06^{abcdefg}
	Average	97.97	0.32	1.52^{B}	0.18	34.44^{BCD}	15.38^{ABC}
Hy-Line	69	95.70	0.14	4.04^{ab}	0.12	34.43^{ab}	14.58^{efg}
CV-22	120	95.25	0	4.60^{a}	0.15	35.53^{ab}	15.98^{abcdefg}
	Average	95.47	0.07	4.32^{A}	0.13	34.98^{ABCD}	15.28^{ABC}
Lohmann	69	97.64	0.24	1.92^{ab}	0.20	35.46^{ab}	15.13^{bcefg}
LSL Lite	120	96.03	0	3.12^{ab}	0.85	36.70^{ab}	16.90^{abc}
	Average	96.84	0.12	2.52^{AB}	0.52	36.08^{ABC}	16.01^{AB}
H&N	69	97.10	0.46	2.31^{ab}	0.13	35.40^{ab}	14.82^{cdefg}
Nick Chick	120	97.25	0.27	1.98^{ab}	0.50	37.34^{a}	16.79^{abcd}
	Average	97.17	0.36	2.14^{AB}	0.32	36.37^{AB}	15.80^{ABC}
Novogen	69	98.96	0.27	0.77^{b}	0	35.51^{ab}	15.64^{abcdefg}
White	120	98.08	0.30	1.62^{ab}	0	36.78^{ab}	17.43^{a}
	Average	98.52	0.28	1.20^{B}	0	36.15^{ABC}	16.53^{A}
All	69	96.92	0.42	2.32	0.35	34.85^{Z}	14.86^{Z}
Strains	120	96.82	0.27	2.61	0.30	36.05^{Y}	16.34^{Y}

[1]All strains were housed such that each strain is equally represented in each density.
ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcdefg - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 16. EFFECT OF BROWN EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN CONVENTIONAL BATTERY CAGES

Breeder (Strain)	Density[1] (in^2/hen)	Feed Consumption (kg/100/hen/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
TETRA Amber	69	10.48^{bcde}	0.466^{defg}	301.27^{cdef}	82.61^{gh}	49.20^{ef}	4.76	145.33^{ab}
	120	11.09^{abcd}	0.460^{fg}	316.82^{abcd}	86.90^{bcd}	51.06^{de}	6.25	142.75^{abc}
	Average	10.79^{AB}	0.463^{C}	309.04	84.76^{ABC}	50.13^{B}	5.51	144.04^{AB}
TETRA Brown	69	10.32^{bcdef}	0.474^{bcdefg}	303.15^{bcdef}	82.43^{fgh}	49.63^{ef}	17.86	142.50^{abc}
	120	11.30^{abc}	0.455^{g}	310.15^{abcdef}	85.19^{cdefg}	50.94^{def}	3.12	140.00^{bc}
	Average	10.81^{AB}	0.464^{C}	303.65	83.81^{BC}	50.28^{B}	10.49	141.25^{ABC}
Novogen Brown	69	10.06^{ef}	0.508^{abc}	305.27^{bcdef}	83.62^{efgh}	51.46^{cde}	7.14	143.00^{abc}
	120	11.10^{abcd}	0.480^{bcdefg}	312.12^{abcdef}	85.72^{cdef}	53.59^{bc}	1.56	141.00^{bc}
	Average	10.58^{AB}	0.494^{B}	308.69	84.67^{ABC}	52.53^{A}	4.35	142.00^{ABC}
Lohmann LB-Lite	69	9.81^{ef}	0.501^{abcd}	297.03^{ef}	81.53^{h}	49.54^{ef}	3.57	142.00^{abc}
	120	11.16^{ab}	0.494^{abcdef}	326.72^{a}	89.78^{a}	55.32^{ab}	4.69	141.25^{bc}
	Average	10.48^{ABC}	0.497^{AB}	311.88	85.66^{AB}	52.43^{A}	4.13	141.62^{BC}
Hy-Line Silver Brown	69	10.09^{ef}	0.479^{bcdefg}	304.17^{cdef}	83.57^{efgh}	48.73^{f}	1.19	143.33^{abc}
	120	11.46^{a}	0.458^{g}	322.98^{ab}	88.63^{ab}	52.59^{cd}	3.12	139.00^{c}
	Average	10.77^{AB}	0.468^{C}	313.57	86.10^{A}	50.65^{B}	2.16	141.67^{BC}
Hy-Line Brown	69	9.53^{f}	0.506^{abc}	294.77^{f}	81.00^{h}	48.56^{f}	1.19	140.00^{bc}
	120	10.40^{cde}	0.506^{abc}	313.27^{abcde}	86.07^{bcde}	52.35^{cd}	1.56	139.50^{c}
	Average	9.96^{C}	0.506^{AB}	304.02	83.54^{C}	50.46^{B}	1.38	139.75^{C}
ISA Brown	69	9.61^{ef}	0.529^{a}	302.63^{cdef}	82.99^{fgh}	51.48^{cde}	1.76	147.00^{a}
	120	10.94^{abcd}	0.508^{ab}	323.10^{ab}	88.78^{ab}	55.76^{a}	3.15	143.00^{abc}
	Average	10.27^{BC}	0.519^{A}	312.87	85.88^{AB}	53.62^{A}	3.94	145.00^{A}
Bovans Brown	69	10.36^{de}	0.497^{abcde}	308.17^{bcdef}	84.57^{defg}	52.33^{cd}	6.25	142.25^{abc}
	120	11.59^{a}	0.471^{cdefg}	319.48^{abc}	87.74^{abc}	54.16^{ab}	3.12	143.50^{abc}
	Average	10.97^{A}	0.484^{BC}	313.82	86.15^{A}	53.74^{A}	4.69	142.87^{ABC}
All Strains	69	10.03^{Z}	0.495^{Y}	302.06^{Z}	82.79^{Z}	50.12^{Z}	5.84	143.18^{Y}
	120	11.13^{Y}	0.479^{Z}	318.08^{Y}	87.32^{Y}	53.35^{Y}	3.32	141.25^{Z}

[1]All strains were housed such that each strain is equally represented in each density.
ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcdefgh - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.
Mortality percentage prior to analyzes was transformed in Square Root Asin

TABLE 17. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN CONVENTIONAL BATTERY CAGES

Breeder (Strain)	Density[1] (in^2/hen)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
TETRA Amber	69	58.08^{ef}	0	5.00	14.56^{ab}	30.49^{abcde}	49.74^{def}
	120	57.34^{f}	0	4.60	13.12^{ab}	34.19^{ab}	47.56^{ef}
	Average	57.71^{E}	0	4.80	13.84^{AB}	32.34^{AB}	48.65^{CD}
TETRA Brown	69	59.48^{abcdef}	0	4.81	9.62^{abc}	29.54^{abcde}	55.73^{bcde}
	120	58.94^{cdef}	0	3.85	8.88^{abc}	32.19^{abcd}	54.85^{bcdef}
	Average	59.21^{CD}	0	4.33	9.25^{BC}	30.86^{AB}	55.29^{BC}
Novogen Brown	69	60.56^{abc}	0.74	3.15	11.13^{abc}	25.13^{bcde}	59.72^{abcd}
	120	61.40^{a}	0	2.88	6.87^{bc}	20.33^{e}	69.83^{a}
	Average	60.98^{A}	0.37	3.02	9.00^{BC}	22.73^{C}	64.77^{A}
Lohmann LB-Lite	69	60.17^{abcd}	0	5.10	11.29^{abc}	27.44^{abcde}	55.99^{bcde}
	120	60.24^{abd}	2.88	3.67	4.85^{c}	24.27^{cde}	63.88^{ab}
	Average	60.20^{ABC}	1.44	4.39	8.07^{C}	25.85^{BC}	59.93^{AB}
Hy-Line Silver Brown	69	57.54^{f}	0	4.26	16.77^{a}	36.13^{a}	42.72^{f}
	120	58.62^{def}	0	2.90	13.67^{ab}	32.40^{abc}	50.69^{def}
	Average	58.08^{DE}	0	3.58	15.22^{A}	34.27^{A}	46.70^{D}
Hy-Line Brown	69	59.02^{cdef}	0	2.18	10.36^{abc}	35.00^{ab}	52.18^{cdef}
	120	60.14^{abcd}	0	1.98	8.62^{bc}	26.86^{abcde}	62.52^{abc}
	Average	59.58^{BC}	0	2.08	9.49^{BC}	30.93^{AB}	57.35^{B}
ISA Brown	69	60.03^{abcde}	2.56	3.85	6.69^{bc}	24.31^{bcdef}	62.54^{abc}
	120	61.40^{a}	0	4.96	5.71^{c}	20.75^{de}	68.50^{a}
	Average	60.72^{AB}	1.28	4.40	6.20^{C}	22.53^{C}	65.52^{A}
Bovans Brown	69	60.64^{abc}	0	3.69	11.52^{abc}	21.67^{de}	63.02^{ab}
	120	61.03^{ab}	0	3.02	7.04^{bc}	20.52de	68.46^{a}
	Average	60.84^{A}	0	3.36	9.28^{BC}	21.60^{C}	65.74^{A}
All Strains	69	59.89	0.41	4.00	11.49^{Y}	28.71	55.20^{Z}
	120	59.44	0.36	3.48	8.59^{Z}	26.56	60.79^{Y}

[1]All strains were housed such that each strain is equally represented in each density.
ABCDE - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcdef - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 18. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN CONVENTIONAL BATTERY CAGES

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
TETRA	69	96.92	0.30	2.26	0.53	33.88^{cd}	15.55^{abcde}
Amber	120	97.82	0.14	2.04	0	35.19^{abc}	16.47^{abc}
	Average	97.37	0.22	2.15	0.26	34.54^{AB}	16.01^{A}
TETRA	69	96.07	0.46	2.88	0.59	31.36^{d}	15.32^{cde}
Brown	120	97.02	0.59	2.13	0.26	34.34^{abc}	16.76^{abc}
	Average	96.55	0.52	2.50	0.42	33.35^{B}	16.04^{A}
Novogen	69	97.07	0.71	1.89	0.34	33.67^{cd}	14.93^{cde}
Brown	120	98.14	0.12	1.47	0.26	36.53^{abc}	16.48^{abc}
	Average	97.60	0.41	1.68	0.30	35.10^{AB}	15.70^{AB}
Lohmann	69	97.33	0	2.34	0.32	33.66^{cd}	14.54^{de}
LB-Lite	120	96.97	0.14	2.12	0.77	37.70^{a}	16.57^{abc}
	Average	97.15	0.07	2.23	0.54	35.68^{A}	15.56^{AB}
Hy-Line	69	97.47	0.23	2.09	0.20	34.73^{abcd}	15.00^{cde}
Silver Brown	120	97.39	0.27	2.20	0.13	36.68^{abc}	17.00^{ab}
	Average	97.43	0.25	2.15	0.16	35.70^{A}	15.99^{A}
Hy-Line	69	96.84	0.21	2.62	0.32	33.87^{cd}	14.14^{e}
Brown	120	95.28	0.54	3.87	0.30	35.89^{abc}	15.45^{bde}
	Average	96.07	0.38	3.24	0.31	34.88^{AB}	14.79^{B}
ISA	69	96.41	0.85	2.54	0.19	35.00^{abc}	14.24^{e}
Brown	120	97.24	0.42	2.22	0.13	37.36^{ab}	16.24^{abcd}
	Average	96.82	0.63	2.38	0.16	36.18^{A}	15.24^{AB}
Bovans	69	97.62	0.43	1.77	0.18	34.77^{abcd}	15.36^{cde}
Brown	120	96.51	0.62	2.87	0	37.39^{ab}	17.20^{a}
	Average	97.03	0.52	2.32	0.09	36.08^{A}	16.28^{A}
All	69	96.97	0.40	2.30	0.33	33.87^{Z}	14.88^{Z}
Strains	120	97.05	0.36	2.36	0.23	36.51^{Y}	16.52^{Y}

[1]All strains were housed such that each strain is equally represented in each density.
AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcde - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 19. EFFECT OF WHITE EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN CONVENTIONAL BATTERY CAGES USING THE NON-ANOREXIC MOLT PROGRAM

Breeder (Strain)	Density[1] (in^2/hen)	Feed Consumption (kg/100/hen/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)
Bovans White	69	5.16	0.06	3.78^{abc}	13.42^{abcd}	3.24	0.90
	120	5.94	0.04	4.38^{abc}	15.62^{abcd}	2.29	0
	Average	5.55^{AB}	0.05	4.08^{AB}	14.52^{AB}	2.76	0.45
Shaver White	69	4.55	0	3.88^{abc}	13.84^{abcd}	0	0
	120	3.99	0	4.50^{ab}	15.95^{abc}	0	1.58
	Average	4.27^{AB}	0	4.19^{A}	14.89^{A}	0	0.79
Dekalb White	69	5.76	0.13	3.90^{abc}	13.87^{abcd}	7.34	2.80
	120	5.68	0.05	4.68^{a}	16.74^{a}	2.52	0
	Average	5.72^{A}	0.09	4.29^{A}	15.30^{A}	4.93	1.40
Babcock White	69	4.78	0.04	3.17^{abc}	11.33^{abcd}	2.08	0
	120	4.75	0	3.20^{abc}	11.31^{abcd}	0	1.58
	Average	4.76^{AB}	0.02	3.18^{ABC}	11.32^{ABC}	1.04	0.79
ISA B-400	69	4.95	0	3.13^{abc}	11.01^{abcd}	0	2.40
	120	4.79	0.03	2.82^{abc}	9.82^{cd}	1.66	1.58
	Average	4.87^{AB}	0.02	2.98^{ABC}	10.42^{BC}	0.83	1.99
Hy-Line W-36	69	63.93	0.05	2.57^{bc}	9.05^{cd}	1.86	0
	120	3.94	0	2.85^{abc}	10.08^{abcd}	0	0
	Average	3.94^{B}	0.02	2.71^{C}	9.57^{C}	0.93	0
Hy-Line CV-26	69	4.5	0	2.43^{c}	8.65^{d}	0	1.20
	120	3.92	0.04	3.60^{abc}	12.82^{abcd}	2.01	0
	Average	4.25^{AB}	0.02	3.17^{ABC}	10.73^{ABC}	1.00	0.60
Hy-Line CV-24	69	4.86	0.05	3.40^{abc}	12.01^{abcd}	2.61	1.20
	120	4.67	0.08	4.65^{a}	16.50^{ab}	4.53	1.58
	Average	4.76^{AB}	0.07	4.02^{ABC}	14.26^{AB}	3.57	1.39
Hy-Line CV-22	69	5.08	0.09	3.00^{abc}	10.75^{abcd}	4.28	0
	120	4.05	0.06	2.80^{abc}	10.03^{bcd}	2.32	0
	Average	4.57^{AB}	0.07	2.90^{BC}	10.39^{BC}	3.30	0
Lohmann LSL Lite	69	5.28	0	3.63^{abc}	12.87^{abcd}	0	1.20
	120	4.31	0.04	4.05^{abc}	14.34^{abcd}	2.43	1.58
	Average	4.80^{AB}	0.02	3.84^{ABC}	13.61^{ABC}	1.22	1.39
H&N Nick Chick	69	5.14	0	3.13^{abc}	11.61^{abcd}	0	0
	120	4.99	0	4.22^{abc}	15.08^{abcd}	0	0
	Average	5.07^{AB}	0	3.68^{ABC}	13.12^{ABC}	0	0
Novogen White	69	5.08	0.05	3.60^{abc}	12.62^{abcd}	2.83	3.57
	120	4.65	0.04	3.75^{abc}	13.43^{abcd}	2.54	0
	Average	4.87^{AB}	0.05	3.68^{ABC}	13.02^{ABC}	2.68	1.78
All Strains	69	4.93	0.04	3.30^{Z}	11.72^{Z}	2.02	1.10
	120	4.64	0.03	3.79^{Y}	13.48^{Y}	1.69	0.66

[1]All strains were housed such that each strain is equally represented in each density.

ABCD - Different letters denote significant differences (P<.01), comparisons made among strain average values.

abcd - Different letters denote significant differences (P<.01) in the strain*density interactions.

YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 20. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN CONVENTIONAL BATTERY CAGES USING THE NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
(Strain)	(in^2/hen)	(g/egg)	(%)	(%)	(%)	(%)	(%)
Bovans	69	50.00	0	12.50	12.50	25.00^{ab}	0
White	120	70.00	0	0	0	0^{b}	25.00
	Average	60.00	0	6.25	6.25	12.50^{AB}	12.50
Shaver	69	59.70	0	0	0	0^{b}	0
White	120	60.00	0	0	0	0^{b}	0
	Average	59.80	0	0	0	0^{B}	0
Dekalb	69	53.30	0	0	0	100.00^{a}	0
White	120	55.00	0	0	0	25.00^{ab}	0
	Average	54.60	0	0	0	62.50^{A}	0
Babcock	69	50.00	0	16.67	0	16.67^{AB}	0
White	120	61.30	0	0	0	0^{b}	0
	Average	55.60	0	8.33	0	8.33^{AB}	0
ISA	69	60.80	0	0	0	0^{b}	0
B-400	120	50.00	0	0	0	25.00^{ab}	0
	Average	55.40	0	0	0	12.50^{AB}	0
Hy-Line	69	62.50	0	0	0	16.67^{ab}	16.67
W-36	120	59.00	0	0	0	0^{b}	0
	Average	60.70	0	0	0	8.33^{AB}	8.33
Hy-Line	69	59.00	0	0	0	0^{b}	0
CV-26	120	60.00	0	0	0	25.00^{ab}	0
	Average	59.50	0	0	0	12.50^{AB}	0
Hy-Line	69	60.00	0	0	0	0^{b}	33.33
CV-24	120	50.00	0	25.00	0	0^{b}	25.00
	Average	55.00	0	12.50	0	0^{B}	29.17
Hy-Line	69	55.00	0	0	0	66.67^{ab}	0
CV-22	120	70.00	0	0	0	0^{b}	25.00
	Average	62.50	0	0	0	33.33^{AB}	12.50
Lohmann	69	59.60	0	0	0	0^{b}	0
LSL Lite	120	60.00	0	0	0	25.00^{ab}	0
	Average	59.80	0	0	0	12.50^{AB}	0
H&N	69	60.40	0	0	0	0^{b}	0
Nick Chick	120	60.70	0	0	0	0^{b}	0
	Average	60.30	0	0	0	0^{B}	0
Novogen	69	60.00	0	0	0	0^{b}	33.33
White	120	60.00	0	0	0	25.00^{ab}	0
	Average	60.00	0	0	0	12.50^{AB}	16.17
All	69	57.50	0	2.43	1.04	18.75	6.94
Strains	120	59.60	0	2.08	0	10.42	6.25

[1]All strains were housed such that each strain is equally represented in each density

AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.

ab - Different letters denote significant differences (P<.01) in the strain*density interactions

TABLE 21. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN CONVENTIONAL BATTERY CAGES USING THE NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Bovans	69	50.00	0	0	0	0.65^{ab}	0.43
White	120	25.00	0	0	0	0.75^{ab}	0.50
	Average	37.50	0	0	0	0.70^{AB}	0.47^{AB}
Shaver	69	0	0	0	0	0.67^{ab}	0.38
White	120	0	0	0	0	0.77^{ab}	0.33
	Average	0	0	0	0	0.72^{AB}	0.36^{AB}
Dekalb	69	66.67	0	0	0	0.67^{ab}	0.48
White	120	25.00	0	0	0	0.81^{a}	0.48
	Average	45.83	0	0	0	0.74^{A}	0.48^{A}
Babcock	69	33.33	0	0	0	0.54^{ab}	0.40
White	120	0	0	0	0	0.55^{ab}	0.40
	Average	16.17	0	0	0	0.55^{ABC}	0.40^{AB}
ISA	69	0	0	0	0	0.54^{ab}	0.41
B-400	120	25.00	0	0	0	0.48^{ab}	0.40
	Average	12.50	0	0	0	0.51^{BC}	0.41^{AB}
Hy-Line	69	33.33	0	0	0	0.44^{b}	0.33
W-36	120	0	0	0	0	0.46^{ab}	0.33
	Average	16.17	0	0	0	0.46^{C}	0.33^{B}
Hy-Line	69	0	0	0	0	0.42^{b}	0.38
CV-26	120	25.00	0	0	0	0.62^{ab}	0.33
	Average	12.50	0	0	0	0.52^{ABC}	0.36^{AB}
Hy-Line	69	33.33	0	0	0	0.58^{ab}	0.41
CV-24	120	50.00	0	0	0	0.80^{a}	0.5239
	Average	41.67	0	0	0	0.69^{AB}	0.40^{AB}
Hy-Line	69	66.67	0	0	0	0.52^{ab}	0.43
CV-22	120	25.00	0	0	0	0.48^{ab}	0.34
	Average	45.83	0	0	0	0.50^{BC}	0.38^{AB}
Lohmann	69	0	0	0	0	0.62^{ab}	0.44
LSL Lite	120	25.00	0	0	0	0.69^{ab}	0.36
	Average	12.50	0	0	0	0.66^{ABC}	0.40^{AB}
H&N	69	0	0	0	0	0.54^{ab}	0.43
Nick Chick	120	0	0	0	0	0.73^{ab}	0.42
	Average	0	0	0	0	0.63^{ABC}	0.42^{AB}
Novogen	69	33.33	0	0	0	0.62^{ab}	0.42
White	120	25.00	0	0	0	0.65^{ab}	0.39
	Average	29.17	0	0	0	0.63^{ABC}	0.41^{AB}
All	69	26.39	0	2.77	0	0.57^{Z}	0.41
Strains	120	18.75	0	0	0	0.65^{Y}	0.39

[1]All strains were housed such that each strain is equally represented in 0each density.
ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values.
ab - Different letters denote significant differences (P<.01) in the strain*density interactions
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 22. EFFECT OF BROWN EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN CONVENTIONAL BATTERY CAGES USING THE NON-ANOREXIC MOLT PROGRAM

Breeder (Strain)	Density[1] (in^2/hen)	Feed Consumption (kg/100/hen/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)
TETRA Amber	69	5.77^{ab}	0.130	5.00^{abcd}	17.92^{abcde}	7.49	0
	120	5.60^{ab}	0.265	7.55^{a}	26.93^{a}	14.80	0
	Average	5.69^{AB}	0.197	6.27^{A}	22.42^{A}	11.14	0
TETRA Brown	69	5.67^{ab}	0	4.30^{cd}	15.38^{bcde}	0	0
	120	6.40^{a}	0.145	6.10^{abcd}	21.91^{abcde}	8.51	0
	Average	6.04^{A}	0.073	5.20^{ABC}	18.65^{ABC}	4.25	0
Novogen Brown	69	5.87^{ab}	0.227	6.27^{abcd}	22.35^{abcd}	13.29	0
	120	5.31^{ab}	0.257	6.58^{abc}	22.95^{abc}	13.36	3.15
	Average	5.59^{AB}	0.242	6.42^{A}	22.65^{AB}	13.32	1.58
Lohmann LB-Lite	69	4.52^{b}	0.110	3.70^{d}	13.20^{de}	5.02	3.57
	120	5.39^{ab}	0.280	7.18^{ab}	25.64^{ab}	14.98	0
	Average	4.95^{B}	0.195	5.44^{ABC}	19.42^{AB}	10.00	1.78
Hy-Line Silver Brown	69	5.52^{ab}	0.177	5.20^{abcd}	18.56^{abcde}	9.73	0
	120	5.08^{ab}	0.117	5.80^{abcd}	20.71^{abcde}	6.16	0
	Average	5.30^{AB}	0.147	5.50^{AB}	19.63^{AB}	7.96	0
Hy-Line Brown	69	5.06^{ab}	0.127	4.30^{cd}	15.37^{cde}	6.64	0
	120	4.74^{b}	0.085	3.52^{d}	12.59^{e}	4.08	0
	Average	4.90^{B}	0.106	3.91^{BC}	13.98^{BC}	5.38	0
ISA Brown	69	4.74^{b}	0.110	3.70^{d}	13.14^{de}	4.86	0
	120	5.44^{ab}	0.175	5.90^{abcd}	21.12^{abcde}	9.45	0
	Average	5.09^{AB}	0.142	4.80^{ABC}	17.31^{ABC}	7.16	0
Bovans Brown	69	5.58^{ab}	0.060	3.70^{d}	13.20^{de}	3.28	0.90
	120	4.80^{ab}	0.097	3.85^{d}	13.78^{de}	4.86	0
	Average	5.19^{AB}	0.079	3.78^{C}	13.49^{C}	4.07	0.45
All Strains	69	5.34	0.118	4.52^{Z}	16.14^{Z}	6.29	0.56
	120	5.35	0.178	5.81^{Y}	20.70^{Y}	9.52	0.39

[1]All strains were housed such that each strain is equally represented in each density.

ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values.

abcde - Different letters denote significant differences (P<.01) in the strain*density interactions

YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 23. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN CONVENTIONAL BATTERY CAGES USING THE NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
(Strain)	(in^2/hen)	(g/egg)	(%)	(%)	(%)	(%)	(%)
TETRA	69	56.20	0	8.33	0	58.33	0
Amber	120	55.00	0	0	29.25	33.50	37.50
	Average	55.60	0	4.17	14.63	45.92	18.75
TETRA	69	59.10	0	0	0	0	0
Brown	120	65.00	0	0	0	25.00	25.00
	Average	62.00	0	0	0	12.50	12.50
Novogen	69	59.30	0	0	16.67	44.33	39.00
Brown	120	58.00	0	0	0	77.25	22.75
	Average	58.60	0	0	8.33	60.79	30.88
Lohmann	69	55.80	0	0	11.00	44.33	11.00
LB-Lite	120	58.30	0	0	8.25	75.00	16.75
	Average	57.00	0	0	9.63	59.67	13.88
Hy-Line	69	52.50	0	8.33	33.33	58.33	0
Silver Brown	120	60.00	0	0	0	41.75	8.25
	Average	56.20	0	4.17	16.67	50.04	4.12
Hy-Line	69	61.70	0	0	0	50.00	16.67
Brown	120	50.00	0	0	0	25.00	25.00
	Average	55.80	0	0	0	37.50	20.83
ISA	69	57.50	0	0	0	33.33	33.33
Brown	120	57.80	0	0	25.00	33.25	16.75
	Average	57.60	0	0	12.50	33.29	25.04
Bovans	69	55.00	0	0	0	50.00	0
Brown	120	60.00	0	0	0	20.75	29.25
	Average	57.50	0	0	0	35.38	14.62
All	69	57.30	0	2.08	7.62	42.33	12.50
Strains	120	58.00	0	0	7.81	41.44	22.66

[1]All strains were housed such that each strain is equally represented in each density.

TABLE 24. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN CONVENTIONAL BATTERY CAGES USING THE NON-ANOREXIC MOLT PROGRAM

Breeder (Strain)	Density[1] (in^2/hen)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
TETRA Amber	69	66.67	0	0	0	0.64	0.48^{ab}
	120	100.00	0	0	0	0.85	0.47^{ab}
	Average	83.33	0	0	0	0.74	0.48^{AB}
TETRA Brown	69	0	0	0	0	0	0.48^{ab}
	120	50.00	0	0	0	0.44	0.54^{a}
	Average	25.00	0	0	0	0.22	0.51^{A}
Novogen Brown	69	88.89	11.11	0	0	0.64	0.49^{ab}
	120	83.33	16.67	0	0	0.64	0.45^{ab}
	Average	86.11	13.89	0	0	0.64	0.47^{AB}
Lohmann LB-Lite	69	66.67	0	0	0	0.29	0.38^{b}
	120	100.00	0	0	0	0.84	0.45^{ab}
	Average	83.33	0	0	0	0.57	0.42^{B}
Hy-Line Silver Brown	69	83.33	16.67	0	0	0.45	0.46^{ab}
	120	50.00	0	0	0	0.34	0.43^{ab}
	Average	66.67	8.33	0	0	0.39	0.44^{AB}
Hy-Line Brown	69	66.67	0	0	0	0.35	0.43^{ab}
	120	25.00	25.00	0	0	0.14	0.40^{b}
	Average	45.83	12.50	0	0	0.25	0.41^{B}
ISA Brown	69	66.67	0	0	0	0.28	0.40^{b}
	120	75.00	0	0	0	0.51	0.46^{ab}
	Average	70.83	0	0	0	0.40	0.43^{AB}
Bovans Brown	69	50.00	0	0	0	0.26	0.47^{ab}
	120	37.50	12.50	0	0	0.28	0.40^{ab}
	Average	43.75	6.25	0	0	0.27	0.44^{AB}
All Strains	69	61.11	3.47	0	0	0.36	0.45
	120	65.10	6.77	0	0	0.50	0.45

[1]All strains were housed such that each strain is equally represented in each density.
AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.
ab - Different letters denote significant differences (P<.01) in the strain*density interactions.

TABLE 25. EFFECT OF WHITE EGG STRAIN AND DENSITY ON BODY WEIGHT OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN CONVENTIONAL BATTERY CAGES USING THE NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	17 Wk Body Wt	69 Wk Body Wt	1st Cycle Wt Gain	Lowest Body Wt	Molt Wt Loss	73 Wk Body Wt	Days to 0% Production
(Strain)	(in^2/hen)	(kg)	(kg)	(%)	(kg)	(%)	(kg)	
Bovans	69	1.26	1.78	42.9	1.41	20.2	1.48	4.5
White	120	1.28	1.85	48.4	1.48	20.5	1.44	2.8
	Average	1.27	1.81	45.7	1.44	20.4	1.46	3.6^{AB}
Shaver	69	1.31	1.80	36.6	1.44	20.0	1.45	5.8
White	120	1.31	1.98	52.7	1.53	22.7	1.50	6.0
	Average	1.31	1.89	44.3	1.48	21.7	1.48	5.9^{A}
Dekalb	69	1.30	1.77	36.2	1.39	21.5	1.40	5.3
White	120	1.30	1.80	38.5	1.35	25.6	1.52	4.0
	Average	1.30	1.78	37.7	1.37	23.6	1.46	4.7^{AB}
Babcock	69	1.35	1.90	43.0	1.48	22.1	1.44	4.7
White	120	1.36	2.04	52.9	1.59	22.1	1.52	3.5
	Average	1.36	1.97	47.8	1.54	22.3	1.48	4.1^{AB}
ISA	69	1.22	1.70	37.7	1.32	22.4	1.36	4.7
B-400	120	1.20	1.82	49.2	1.46	19.8	1.38	3.8
	Average	1.21	1.76	43.8	1.40	21.0	1.37	4.2^{AB}
Hy-Line	69	1.56	1.82	36.5	1.46	19.8	1.46	3.3
W-36	120	1.21	1.92	61.2	1.54	19.8	1.50	3.3
	Average	1.38	1.87	47.8	1.50	19.8	1.48	3.3^{B}
Hy-Line	69	1.22	1.73	41.0	1.36	20.8	1.38	4.0
CV-26	120	1.22	1.84	50.8	1.48	19.6	1.43	3.3
	Average	1.22	1.78	45.9	1.42	20.2	1.40	3.6^{AB}
Hy-Line	69	1.29	1.79	39.5	1.45	19.0	1.44	4.0
CV-24	120	1.30	1.85	44.6	1.36	26.5	1.58	3.5
	Average	1.30	1.82	41.5	1.41	23.1	1.51	3.8^{AB}
Hy-Line	69	1.31	1.88	42.7	1.50	20.2	1.57	5.0
CV-22	120	1.30	1.93	47.7	1.50	21.8	1.52	4.3
	Average	1.30	1.90	45.4	1.50	21.1	1.54	4.6^{AB}
Lohmann	69	1.27	1.72	36.2	1.36	20.9	1.34	4.7
LSL Lite	120	1.28	1.85	46.9	1.38	25.9	1.46	2.8
	Average	1.28	1.79	41.4	1.37	23.5	1.40	3.7^{AB}
H&N	69	1.34	1.74	28.4	1.38	20.1	1.43	5.0
Nick Chick	120	1.29	1.84	41.9	1.42	22.8	0.72	4.5
	Average	1.31	1.79	35.1	1.40	21.2	1.07	4.8^{AB}
Novogen	69	1.34	1.79	33.6	1.40	21.2	1.38	3.3
White	120	1.26	1.99	58.7	1.39	25.1	1.43	4.8
	Average	1.30	1.89	46.2	1.45	23.3	1.41	4.0^{AB}
All	69	1.31	1.78^{Y}	38.2^{Y}	1.41	24.2^{Y}	1.43	4.5^{Z}
Strains	120	1.28	1.89^{Z}	49.2^{Z}	1.47	19.6^{Z}	1.42	3.9^{Y}

[1]All strains were housed such that each strain is equally represented in each density.
ABCD - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcd - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 26. EFFECT OF BROWN EGG STRAIN AND DENSITY ON BODY WEIGHT OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN CONVENTIONAL BATTERY CAGES USING THE NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	17 Wk Body Wt	69 Wk Body Wt	1st Cycle Wt Gain	Lowest Body Wt	Molt Wt Loss	73 Wk Body Wt	Days to 0% Production
(Strain)	(in^2/hen)	(kg)	(kg)	(%)	(kg)	(%)	(kg)	
TETRA	69	1.67	2.30	37.1	1.85	19.6	1.90	6.7
Amber	120	1.60	2.18	36.3	1.74	20.2	1.86	5.0
	Average	1.63	2.24	36.8	1.80	19.6	1.88	5.8
TETRA	69	1.58	1.96	23.4	1.55	20.4	1.69	5.5
Brown	120	1.63	2.06	27.0	1.64	20.9	1.76	6.0
	Average	1.61	2.01	24.8	1.60	20.9	1.72	5.8
Novogen	69	1.67	2.03	21.0	1.63	19.7	1.73	5.3
Brown	120	1.59	2.06	31.4	1.64	20.4	1.78	5.5
	Average	1.63	2.05	26.4	1.64	20.0	1.76	5.4
Lohmann	69	1.63	1.96	21.5	1.54	21.4	1.61	6.7
LB-Lite	120	1.64	2.12	30.5	1.68	20.8	1.74	5.8
	Average	1.63	2.04	26.4	1.60	21.1	1.68	6.2
Hy-Line	69	1.62	2.01	25.9	1.60	19.9	1.75	7.7
Silver Brown	120	1.64	2.36	48.2	1.90	19.5	1.88	5.5
	Average	1.63	2.19	36.8	1.76	20.1	1.81	6.6
Hy-Line	69	1.61	1.96	21.7	1.55	20.4	1.66	6.7
Brown	120	1.65	2.14	30.3	1.72	19.6	1.80	4.0
	Average	1.63	2.05	25.8	1.64	20.5	1.73	5.3
ISA	69	1.53	1.91	24.8	1.52	20.9	1.64	5.0
Brown	120	1.59	2.20	37.7	1.72	22.3	1.82	5.0
	Average	1.56	2.06	31.4	1.62	21.4	1.73	5.0
Bovans	69	1.56	2.00	28.2	1.60	20.0	1.70	5.5
Brown	120	1.62	2.06	27.8	1.65	19.4	1.70	3.5
	Average	1.59	2.03	27.7	1.63	19.7	1.70	4.5
All	69	1.61	2.02	25.5[Y]	1.60[Y]	20.3	1.71	5.0
Strains	120	1.62	2.15	34.0[Z]	1.71[Z]	20.5	1.79	6.1

[1]All strains were housed such that each strain is equally represented in each density.

Y Z - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 27. EFFECT OF WHITE EGG STRAIN AND PRODUCTION SYSTEM ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Production System	Feed Consumption (kg/100/hen/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
Bovans White	69 EC	10.28^{efg}	0.505^{bcdef}	311.82^{ab}	85.48^{D}	50.93^{d}	7.78^{ab}	144.90^{abc}
	69 ECS	10.51^{bcdef}	0.492^{def}	311.22^{ab}	84.74^{def}	50.87^{d}	17.06^{ab}	146.14^{a}
	Average	10.40^{BC}	0.499^{BC}	311.52^{ABC}	85.11^{B}	50.90^{BC}	12.42^{AB}	145.52^{A}
Shaver White	69 EC	10.16^{fg}	0.542^{abc}	307.19^{ab}	83.79^{defg}	50.89^{d}	16.67^{ab}	142.00^{bcd}
	69 ECS	10.50^{bcdef}	0.540^{abcd}	318.28^{ab}	85.56^{bcde}	51.91^{cd}	30.55^{a}	140.50^{d}
	Average	10.33^{CD}	0.541^{A}	312.74^{ABC}	84.68^{B}	51.40^{B}	23.61^{A}	141.25^{C}
Dekalb White	69 EC	10.56^{abcdef}	0.503^{bcdef}	309.92^{ab}	84.92^{def}	51.18^{cd}	7.22^{ab}	144.40^{abcd}
	69 ECS	10.48^{bcdefg}	0.508^{bcdef}	311.31^{ab}	85.18^{cdef}	51.54^{cd}	9.03^{ab}	144.25^{abcd}
	Average	10.52^{ABC}	0.506^{B}	310.62^{ABC}	85.05^{B}	51.36^{B}	8.12^{AB}	144.32^{AB}
Babcock White	69 EC	10.31^{defg}	0.560^{a}	314.52^{ab}	86.32^{bcd}	52.84^{abc}	3.09^{b}	141.50^{cd}
	69 ECS	11.09^{a}	0.539^{abcd}	327.38^{a}	89.54^{a}	54.27^{ab}	11.80^{ab}	140.50^{d}
	Average	10.55^{A}	0.549^{A}	320.95^{AB}	87.93^{A}	53.55^{A}	7.44^{B}	140.00^{C}
ISA B-400	69 EC	10.63^{abcde}	0.532^{abcd}	321.48^{a}	88.17^{abc}	54.63^{a}	5.96^{ab}	144.40^{abcd}
	69 ECS	10.68^{abcde}	0.551^{ab}	325.21^{a}	88.61^{ab}	54.75^{a}	17.50^{ab}	141.00^{d}
	Average	10.49^{ABC}	0.542^{A}	323.35^{A}	88.39^{A}	54.69^{A}	11.73^{AB}	142.70^{BC}
Hy-Line W-36	69 EC	10.11^{fg}	0.483^{ef}	297.80^{b}	81.72^{gh}	48.79^{f}	3.14^{b}	146.17^{a}
	69 ECS	9.89^{g}	0.493^{bcdef}	298.27^{ab}	81.81^{fgh}	48.22^{f}	4.63^{ab}	145.33^{abcd}
	Average	10.00^{D}	0.488^{BC}	298.04^{C}	81.73^{D}	48.51^{D}	3.84^{B}	145.75^{A}
Hy-Line CV-24	69 EC	10.83^{abc}	0.474^{ef}	309.24^{ab}	84.57^{def}	50.90^{de}	10.00^{ab}	144.60^{abcd}
	69 ECS	10.80^{abcd}	0.464^{ef}	295.24^{b}	80.70^{h}	48.93^{ef}	11.11^{ab}	145.75^{abc}
	Average	10.82^{A}	0.469^{C}	302.23^{C}	82.63^{CD}	49.91^{C}	10.56^{AB}	145.18^{AB}
Lohmann LSL Lite	69 EC	10.83^{abc}	0.493^{bcdef}	309.41^{ab}	84.63^{defg}	51.55^{cd}	13.20^{ab}	146.00^{ab}
	69 ECS	10.68^{abcde}	0.498^{bcdef}	310.94^{ab}	84.85^{def}	51.60^{cd}	13.19^{ab}	144.75^{abcd}
	Average	10.61^{ABC}	0.496^{BC}	310.18^{ABC}	84.74^{B}	51.57^{B}	13.20^{AB}	145.38^{AB}
H&N Nick Chick	69 EC	10.49^{bcdef}	0.500^{bcdef}	307.67^{ab}	84.20^{defg}	51.52^{cd}	9.26^{ab}	145.33^{ab}
	69 ECS	10.66^{abcde}	0.497^{bcdef}	309.98^{ab}	84.44^{defg}	51.63^{cd}	15.97^{ab}	145.75^{abc}
	Average	10.57^{ABC}	0.499^{BC}	308.82^{ABC}	84.32^{BC}	51.58^{B}	12.62^{AB}	145.54^{A}
Novogen White	69 EC	10.38^{cdefg}	0.519^{abcde}	309.07^{ab}	84.59^{def}	52.31^{bcd}	11.11^{ab}	144.60^{abcd}
	69 ECS	10.49^{ab}	0.480^{ef}	304.77^{ab}	82.70^{efgh}	50.91^{de}	20.55^{ab}	145.00^{abcd}
	Average	10.66^{AB}	0.500^{BC}	306.92^{BC}	83.64^{BCD}	51.61^{B}	15.83^{AB}	144.80^{AB}
All Strains	69 EC	10.43^{Z}	0.511	309.81	84.84	51.55	8.74^{Y}	144.39
	69 ECS	10.62^{Y}	0.506	311.26	84.81	51.46	15.14^{Z}	143.90

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
ABCD - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcdefgh - Different letters denote significant differences (P<.01) in the strain*housing system interactions
YZ - Different letters denote significant differences (P<.01), comparisons made among production system average values.
Mortality percentage prior to analyzes was transformed in Square Root Asin

TABLE 28. EFFECT OF WHITE EGG STRAIN AND PRODUCTION SYSTEM ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Production System	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans White	69 EC	58.46^{h}	0^{ab}	7.72	14.00^{ab}	25.97	51.83^{de}
	69 ECS	58.97^{efgh}	0^{ab}	7.74	12.37^{ab}	25.18	54.63^{cde}
	Average	58.72^{EF}	0	7.73^{AB}	13.19^{AB}	25.57	53.23^{C}
Shaver White	69 EC	59.64^{cdefg}	0.04^{ab}	6.28	10.38^{ab}	24.73	58.26^{abc}
	69 ECS	59.78^{abcdefg}	0^{ab}	4.75	11.86^{ab}	24.22	58.66^{abc}
	Average	59.71^{CD}	0.02	5.52^{AB}	11.12^{BC}	24.48	58.46^{B}
Dekalb White	69 EC	59.17^{efgh}	0^{ab}	6.33	11.48^{ab}	24.27	57.62^{abcd}
	69 ECS	59.22^{defgh}	0^{ab}	6.87	10.52^{ab}	23.43	58.78^{abc}
	Average	59.19^{DE}	0	6.60^{AB}	11.00^{BC}	23.85	58.20^{B}
Babcock White	69 EC	60.29^{abcd}	0^{ab}	5.32	11.06^{ab}	22.39	60.91^{ab}
	69 ECS	59.65^{bcdefg}	0.52^{a}	5.08	11.98^{ab}	23.34	58.52^{abc}
	Average	59.97^{BC}	0.26	5.20^{AB}	11.52^{ABC}	22.87	59.71^{AB}
ISA B-400	69 EC	60.88^{a}	0.05^{ab}	5.30	8.79^{b}	21.47	64.04^{a}
	69 ECS	60.81^{ab}	0^{ab}	4.35	9.28^{ab}	22.25	63.64^{a}
	Average	60.85^{A}	0.03	4.83^{B}	9.03^{C}	21.86	63.84^{A}
Hy-Line W-36	69 EC	58.75^{gf}	0^{ab}	7.68	14.63^{ab}	22.45	54.93^{bcde}
	69 ECS	58.02^{h}	0^{ab}	8.30	17.08^{a}	25.58	48.59^{e}
	Average	58.38^{F}	0	7.99^{AB}	15.85^{A}	24.02	51.76^{C}
Hy-Line CV-24	69 EC	58.97^{efgh}	0^{ab}	5.88	13.77^{ab}	22.40	57.80^{abc}
	69 ECS	58.86^{abcdefg}	0^{ab}	8.21	11.03^{ab}	22.63	57.69^{abcd}
	Average	59.41^{CD}	0	7.04^{AB}	12.40^{ABC}	22.52	57.75^{B}
Lohmann LSL Lite	69 EC	59.90^{abcdef}	0^{ab}	6.25	11.93^{ab}	22.48	59.26^{abc}
	69 ECS	59.66^{bcdefg}	0^{ab}	5.05	10.80^{ab}	24.03	59.66^{abc}
	Average	59.78^{BCD}	0	5.65^{AB}	11.36^{ABC}	23.26	59.46^{AB}
H&N Nick Chick	69 EC	59.97^{abcde}	0^{ab}	6.13	9.73^{ab}	22.84	61.15^{ab}
	69 ECS	60.14^{abcde}	0^{ab}	5.35	11.01^{ab}	22.45	60.82^{abc}
	Average	60.05^{BC}	0	5.74^{AB}	10.37^{B}	22.64	60.99^{AB}
Novogen White	69 EC	60.57^{abc}	0^{ab}	5.24	9.82^{ab}	21.76	63.07^{a}
	69 ECS	60.51^{abc}	0.01^{ab}	5.31	10.84^{ab}	22.13	61.34^{ab}
	Average	60.54^{AB}	0	5.28^{AB}	10.33^{BC}	21.95	62.20^{AB}
All Strains	69 EC	59.66	0.01	6.21	11.56	23.08	58.89
	69 ECS	59.66	0.05	6.10	11.68	23.52	58.23

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
ABCDEF - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcdefgh - Different letters denote significant differences (P<.01) in the strain*production system interactions.

TABLE 29. EFFECT OF WHITE EGG STRAIN AND PRODUCTION SYSTEM ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Production System	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans White	69 EC	96.47	0.40	2.52	0.63	35.22^{ab}	15.37^{abc}
	69 ECS	94.83	0.50	4.38	0.31	35.17^{ab}	15.71^{abc}
	Average	95.65	0.45	3.45	0.47	35.19^{ABC}	15.54^{AB}
Shaver White	69 EC	95.80	0.38	3.38	0.48	34.96^{ab}	15.19^{bc}
	69 ECS	93.62	0.42	5.00	0.95	35.79^{ab}	15.70^{abc}
	Average	94.71	0.40	4.19	0.72	35.38^{ABC}	15.44^{AB}
Dekalb White	69 EC	97.16	0.40	1.88	0.58	35.48^{ab}	15.78^{abc}
	69 ECS	92.75	0.55	6.10	0.58	35.19^{ab}	15.68^{abc}
	Average	94.96	0.48	3.99	0.58	35.34^{ABC}	15.73^{AB}
Babcock White	69 EC	96.72	0.62	2.10	0.60	36.04^{ab}	15.42^{abc}
	69 ECS	93.50	0.80	5.05	0.68	36.79^{a}	16.56^{a}
	Average	95.11	0.71	3.58	0.64	36.42^{A}	15.99^{A}
ISA B-400	69 EC	96.12	0.32	2.82	0.72	36.96^{a}	15.91^{abc}
	69 ECS	93.82	0.45	5.20	0.55	36.91^{a}	15.97^{abc}
	Average	94.97	0.38	4.01	0.64	36.94^{A}	15.94^{A}
Hy-Line W-36	69 EC	96.64	0.54	2.46	0.34	33.70^{b}	14.95^{c}
	69 ECS	93.57	0.37	5.23	0.77	32.87^{b}	14.81^{c}
	Average	95.10	0.45	3.85	0.55	33.28^{C}	14.88^{B}
Hy-Line CV-24	69 EC	96.38	0.46	2.98	0.14	35.22^{ab}	16.20^{abc}
	69 ECS	93.60	0.38	5.50	0.58	33.04^{b}	16.14^{abc}
	Average	94.99	0.42	4.24	0.36	34.13^{BC}	16.17^{A}
Lohmann LSL Lite	69 EC	97.15	0.42	2.30	0.15	35.55^{ab}	15.76^{abc}
	69 ECS	92.90	1.15	5.45	0.52	35.21^{ab}	15.96^{abc}
	Average	95.02	0.79	3.88	0.34	35.38^{ABC}	15.86^{A}
H&N Nick Chick	69 EC	95.95	0.87	2.75	0.40	35.31^{ab}	15.68^{abc}
	69 ECS	93.90	0.65	4.58	0.88	35.07^{ab}	15.94^{abc}
	Average	94.92	0.76	3.66	0.64	35.19^{ABC}	15.81^{A}
Novogen White	69 EC	96.70	0.16	2.82	0.32	35.63^{ab}	15.50^{abc}
	69 ECS	93.94	0.52	5.02	0.52	34.59^{ab}	16.39^{ab}
	Average	95.32	0.34	3.92	0.42	35.11^{ABC}	15.95^{A}
All Strains	69 EC	96.51^{Y}	0.46	2.60^{Y}	0.44	35.40	15.57^{Z}
	69 ECS	93.64^{Z}	0.58	5.15^{Z}	0.63	35.06	15.88^{Y}

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abc - Different letters denote significant differences (P<.01) in the strain*production system interactions
YZ - Different letters denote significant differences (P<.01), comparisons made among production system average values.

TABLE 30. EFFECT OF BROWN EGG STRAIN AND PRODUCTION SYSTEM ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder	Production System	Feed Consumption	Feed Conversion	Eggs Per Bird Housed	Egg Production	Egg Mass	Mortality	Age at 50% Production
(Strain)		(kg/100/hen/d)	(g egg/g feed)		(HD%)	(g/HD)	(%)	(Days)
TETRA	69 EC	10.46^{bc}	0.456^{bc}	293.78^{ab}	80.49^{bcde}	46.53^{fgh}	7.14^{ab}	145.00^{abc}
Amber	69 ECS	10.60^{abc}	0.442^{c}	283.01^{ab}	77.69^{ef}	44.55^{h}	1.39^{b}	145.50^{abc}
	Average	10.53^{BC}	0.449^{C}	288.40^{AB}	79.09^{BC}	45.54^{C}	4.27^{AB}	145.25^{AB}
TETRA	69 EC	10.20^{cd}	0.475^{abc}	276.75^{b}	75.57^{f}	45.21^{gh}	14.82^{a}	143.67^{abc}
Brown	69 ECS	10.38^{bcd}	0.464^{abc}	282.18^{ab}	77.28^{ef}	45.84^{fgh}	5.56^{ab}	145.00^{abc}
	Average	10.29^{CD}	0.469^{BC}	279.46^{B}	76.43^{D}	45.52^{C}	10.19^{A}	144.33^{ABC}
Novogen	69 EC	10.28^{cd}	0.513^{a}	293.64^{ab}	80.45^{bcde}	48.80^{abcde}	7.78^{ab}	144.00^{abc}
Brown	69 ECS	10.49^{bc}	0.510^{a}	297.85^{ab}	81.75^{abc}	49.82^{abc}	3.34^{ab}	144.00^{abc}
	Average	10.39^{BCD}	0.512^{A}	295.74^{AB}	81.10^{AB}	49.31^{A}	5.56^{AB}	144.00^{ABC}
Lohmann	69 EC	10.36^{bcd}	0.497^{abc}	301.64^{ab}	82.72^{ab}	49.72^{abc}	4.79^{ab}	145.00^{abc}
LB-Lite	69 ECS	10.36^{bcd}	0.484^{abc}	294.17^{AB}	80.74^{bcde}	48.48^{abcdef}	4.48^{ab}	145.75^{abc}
	Average	10.36^{CD}	0.491^{AB}	297.91^{AB}	81.73^{A}	49.10^{A}	4.13^{AB}	145.38^{AB}
Hy-Line	69 EC	10.55^{abc}	0.483^{abc}	297.54^{ab}	81.59^{abcd}	47.14^{defg}	5.79^{ab}	143.50^{abc}
Silver Brown	69 ECS	10.79^{ab}	0.487^{abc}	303.42^{ab}	83.20^{ab}	47.60^{bcdefg}	6.94^{ab}	141.50^{bc}
	Average	10.67^{AB}	0.485^{ABC}	300.48^{A}	82.39^{A}	47.37^{B}	6.37^{AB}	142.50^{BC}
Hy-Line	69 EC	10.28^{cd}	0.518^{a}	285.52^{ab}	78.46^{def}	47.03^{efg}	0.46^{b}	141.17^{c}
Brown	69 ECS	10.65^{abc}	0.494^{abc}	289.23^{ab}	79.35^{cdef}	47.64^{cdefg}	4.44^{ab}	142.20^{abc}
	Average	10.47^{BC}	0.506^{AB}	287.38^{AB}	78.90^{C}	47.34^{B}	2.45^{B}	141.68^{C}
ISA	69 EC	10.03^{d}	0.499^{abc}	293.07^{ab}	80.41^{bcde}	48.91^{abcde}	3.70^{ab}	147.33^{a}
Brown	69 ECS	10.37^{bcd}	0.504^{ab}	308.91^{a}	84.74^{a}	50.87^{a}	4.45^{ab}	146.00^{abc}
	Average	10.20^{D}	0.501^{AB}	300.99^{A}	82.57^{A}	49.89^{A}	4.08^{AB}	146.67^{A}
Bovans	69 EC	10.64^{abc}	0.473^{abc}	296.33^{ab}	81.30^{bcd}	49.06^{abcd}	3.57^{ab}	146.43^{ab}
Brown	69 ECS	10.96^{a}	0.472^{abc}	299.50^{ab}	82.12^{abc}	49.92^{ab}	5.56^{ab}	146.00^{abc}
	Average	10.80^{A}	0.472^{BC}	297.92^{AB}	81.74^{A}	49.49^{A}	4.56^{AB}	146.21^{A}
All	69 EC	10.58^{Z}	0.489	292.28	80.13	47.80	6.01	144.51
Strains	69ECS	10.35^{Y}	0.482	294.78	80.86	48.09	4.39	144.49

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
ABCD - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcdefgh - Different letters denote significant differences (P<.01) in the strain*production system interactions
YZ - Different letters denote significant differences (P<.01), comparisons made among production system average values.
Mortality percentage prior to analyzes was transformed in Square Root Asin

TABLE 31. EFFECT OF BROWN EGG STRAIN AND PRODUCTION SYSTEM ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Production System	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
TETRA Amber	69 EC	56.83^{cd}	0.03	7.10^{a}	21.67^{ab}	29.24	41.57^{c}
	69 ECS	56.51^{cd}	0.48	7.88^{a}	22.25^{abc}	28.06	41.13^{c}
	Average	56.67^{B}	0.26	7.49^{A}	21.96^{A}	28.65^{ABC}	41.35^{B}
TETRA Brown	69 EC	59.15^{ab}	0	4.77^{ab}	15.67^{bcde}	26.61	52.67^{ab}
	69 ECS	58.56^{abc}	0	4.38^{ab}	15.79^{bcde}	28.77	51.00^{ab}
	Average	58.86^{A}	0	4.58^{ABC}	15.73^{B}	27.69^{ABC}	51.83^{A}
Novogen Brown	69 EC	59.91^{a}	0	3.66^{ab}	11.89^{de}	26.09	57.92^{a}
	69 ECS	60.19^{a}	0	3.24^{ab}	13.49^{de}	25.86	57.09^{a}
	Average	60.05^{A}	0	3.45^{BC}	12.69^{B}	25.98^{BC}	57.51^{A}
Lohmann LB-Lite	69 EC	59.03^{a}	0	5.78^{ab}	12.78^{de}	24.97	56.24^{a}
	69 ECS	59.04^{ab}	0	4.96^{ab}	13.32^{de}	24.27	56.92^{a}
	Average	59.04^{A}	0	5.37^{AB}	13.05^{B}	24.62^{C}	56.58^{A}
Hy-Line Silver Brown	69 EC	57.12^{bcd}	0.12	4.50^{ab}	19.23^{abcd}	32.75	43.29^{bc}
	69 ECS	55.56^{d}	0.01	4.46^{ab}	25.31^{a}	31.84	38.47^{c}
	Average	56.49^{B}	0.06	4.48^{ABC}	22.27^{A}	32.30^{A}	40.88^{B}
Hy-Line Brown	69 EC	59.42^{a}	0.05	2.31^{b}	15.59^{de}	30.00	53.74^{a}
	69 ECS	59.50^{a}	0	1.61^{b}	12.23^{de}	31.83	53.86^{a}
	Average	59.46^{A}	0.08	1.96^{C}	12.91^{B}	30.92^{AB}	53.80^{A}
ISA Brown	69 EC	59.90^{a}	0	4.37^{ab}	11.43^{e}	27.59	56.40^{a}
	69 ECS	58.96^{a}	0.51	2.80^{ab}	14.40^{cde}	28.69	53.25^{a}
	Average	59.43^{A}	0.25	3.58^{BC}	12.92^{B}	28.14^{ABC}	54.82^{A}
Bovans Brown	69 EC	59.48^{a}	0.03	3.70^{ab}	15.53^{bcde}	25.57	54.80^{a}
	69 ECS	60.44^{a}	0	3.60^{ab}	13.83^{de}	26.51	55.78^{a}
	Average	59.96^{A}	0.02	3.65^{BC}	14.68^{B}	26.04^{BC}	55.29^{A}
All Strains	69 EC	58.86	0.04	4.52	15.22	27.85	52.08
	69 ECS	58.63	0.12	4.12	16.33	28.23	50.94

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcde - Different letters denote significant differences (P<.01) in the strain*production system interactions.

TABLE 32. EFFECT OF BROWN EGG STRAIN AND PRODUCTION SYSTEM ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Production System	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
TETRA Amber	69 EC	96.13^{abc}	0.34	2.90^{bcd}	0.66	32.45^{abc}	15.48^{ab}
	69 ECS	92.58^{d}	0.42	6.62^{a}	0.38	30.55^{c}	15.68^{ab}
	Average	94.35	0.38	4.76	0.52	31.50^{B}	15.58^{AB}
TETRA Brown	69 EC	95.33^{abcd}	0.20	3.83^{abcd}	0.63	31.09^{bc}	15.09^{ab}
	69 ECS	92.87^{bcd}	0.60	5.87^{abc}	0.70	31.43^{abc}	15.38^{ab}
	Average	94.10	0.40	4.85	0.67	31.26^{B}	15.23^{AB}
Novogen Brown	69 EC	96.50^{abc}	0.34	2.58^{cd}	0.62	33.61^{abc}	15.21^{ab}
	69 ECS	92.70^{d}	0.62	5.94^{ab}	0.72	33.35^{abc}	15.55^{ab}
	Average	94.60	0.48	4.26	0.67	33.50^{AB}	15.38^{AB}
Lohmann LB-Lite	69 EC	96.70^{ab}	0.45	2.32^{d}	0.50	34.44^{ab}	15.34^{ab}
	69 ECS	92.92^{cd}	0.38	5.52^{abcd}	1.18	33.06^{abc}	15.34^{ab}
	Average	94.81	0.41	3.92	0.84	33.75^{A}	15.34^{AB}
Hy-Line Silver Brown	69 EC	97.05^{a}	0.08	2.65^{bcd}	0.22	33.45^{abc}	15.61^{ab}
	69 ECS	95.20^{abcd}	0.10	4.70^{abcd}	0	33.45^{abc}	15.97^{ab}
	Average	96.12	0.09	3.68	0.11	33.45^{AB}	15.79^{AB}
Hy-Line Brown	69 EC	95.85^{abcd}	0.37	3.27^{bcd}	0.57	32.45^{abc}	15.23^{ab}
	69 ECS	94.06^{abcd}	0.22	5.20^{abcd}	0.56	32.74^{abc}	15.76^{ab}
	Average	94.96	0.29	4.23	0.56	32.59^{AB}	15.50^{AB}
ISA Brown	69 EC	95.93^{abcd}	0.98	2.57^{cd}	0.52	33.59^{abc}	14.83^{b}
	69 ECS	94.06^{abcd}	0.22	5.30^{abcd}	0.44	34.95^{a}	15.36^{ab}
	Average	95.00	0.60	3.93	0.48	34.27^{A}	15.10^{B}
Bovans Brown	69 EC	95.44^{abcd}	0.43	3.43^{bcd}	0.68	33.49^{abc}	15.75^{ab}
	69 ECS	94.70^{abcd}	0.16	4.48^{abcd}	0.68	33.91^{abc}	16.22^{a}
	Average	95.07	0.29	3.95	0.68	33.70^{A}	15.99^{A}
All Strains	69 EC	96.12^{Y}	0.40	2.94^{Y}	0.58	33.07	15.66^{Y}
	69 ECS	93.63^{Z}	0.34	5.45^{Z}	0.55	32.94	15.32^{Z}

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcd - Different letters denote significant differences (P<.01) in the strain*production system interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among production system average values.

TABLE 33. EFFECT OF WHITE EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder	Density[1]	Feed Consumption	Feed Conversion	Eggs Per Bird Housed	Egg Production	Egg Mass	Mortality	Age at 50% Production
(Strain)	(in^2/hen)	(kg/100/hen/d)	(g egg/g feed)		(HD%)	(g/HD)	(%)	(Days)
Bovans	69 ECS	10.51^{abc}	0.492^{cde}	311.22^{abc}	84.47^{efg}	50.87^{fg}	17.06	146.14^{a}
White	138 ECS	10.80^{ab}	0.501^{abcde}	317.25^{abc}	86.78^{abcde}	53.13^{bcde}	9.52	143.14^{abcd}
	Average	10.66^{AB}	0.496^{C}	314.24^{ABC}	85.76^{C}	52.00^{B}	13.30	144.64^{A}
Shaver	69 ECS	10.50^{abc}	0.540^{ab}	318.28^{abc}	85.56^{bcdef}	51.91^{cdef}	30.55	140.50^{cd}
White	138 ECS	10.53^{abc}	0.527^{abcd}	319.98^{abc}	87.67^{abcd}	53.52^{abcde}	2.78	142.00^{abcd}
	Average	10.52^{B}	0.534^{AB}	318.83^{AB}	86.61^{BC}	52.72^{B}	16.17	141.25^{B}
Dekalb	69 ECS	10.48^{bc}	0.508^{abcde}	311.31^{abc}	85.18^{cdefg}	51.54^{ef}	9.03	144.25^{abcd}
White	138 ECS	10.66^{ab}	0.500^{abcde}	322.68^{ab}	88.51^{ab}	53.33^{bcde}	4.17	142.25^{abcd}
	Average	10.57^{AB}	0.504^{ABC}	316.99^{ABC}	86.84^{BC}	52.44^{B}	6.60	143.25^{AB}
Babcock	69 ECS	11.09^{a}	0.539^{abc}	327.78^{a}	89.54^{a}	54.27^{ab}	11.80	140.50^{cd}
White	138 ECS	10.72^{ab}	0.538^{abc}	325.23^{ab}	89.33^{a}	55.64^{a}	3.33	141.20^{bcd}
	Average	10.90^{A}	0.538^{A}	326.30^{A}	89.44^{A}	54.96^{A}	7.57	140.85^{B}
ISA	69 ECS	10.68^{ab}	0.551^{a}	325.21^{ab}	88.61^{ab}	54.74^{ab}	17.50	141.00^{bcd}
B-400	138 ECS	10.95^{ab}	0.518^{abcde}	321.20^{abc}	87.96^{abc}	54.84^{ab}	6.95	139.75^{d}
	Average	10.81^{AB}	0.534^{AB}	323.20^{A}	88.28^{AB}	54.79^{A}	12.22	140.38^{B}
Hy-Line	69 ECS	9.89^{cd}	0.493^{abcde}	298.27^{bc}	81.81^{gh}	48.22^{h}	4.63	145.33^{abc}
W-36	138 ECS	9.79^{d}	0.503^{abcde}	299.15^{abc}	82.07^{fgh}	49.02^{gh}	1.85	145.67^{abc}
	Average	9.84^{C}	0.498^{BC}	298.71^{C}	81.94^{D}	48.62^{D}	3.24	145.50^{A}
Hy-Line	69 ECS	10.80^{ab}	0.464^{e}	295.21^{c}	80.70^{h}	48.93^{gh}	11.11	145.75^{ab}
CV-24	138 ECS	10.67^{ab}	0.483^{de}	310.53^{abc}	85.17^{cdefg}	51.67^{def}	6.95	145.25^{abc}
	Average	10.74^{AB}	0.474^{C}	302.87^{BC}	82.93^{D}	50.30^{C}	9.03	145.50^{A}
Lohmann	69 ECS	10.68^{ab}	0.498^{abcde}	310.94^{abc}	84.85^{cdefg}	51.60^{def}	13.19	144.75^{abc}
LSL Lite	138 ECS	10.77^{ab}	0.503^{abcde}	319.88^{abc}	87.34^{abcde}	54.10^{abc}	11.11	144.25^{abcd}
	Average	10.73^{AB}	0.500^{BC}	315.14^{ABC}	86.10^{C}	52.85^{B}	12.15	144.50^{A}
H&N	69 ECS	10.66^{ab}	0.497^{abcde}	309.98^{abc}	84.44^{defg}	51.63^{def}	15.97	145.75^{ab}
Nick Chick	138 ECS	10.85^{ab}	0.495^{abcde}	315.70^{abc}	86.60^{abcde}	53.82^{abcd}	6.94	144.25^{abcd}
	Average	10.76^{AB}	0.496^{C}	312.84^{ABC}	85.52^{C}	52.73^{B}	11.46	145.00^{A}
Novogen	69 ECS	10.95^{ab}	0.480^{de}	304.77^{abc}	82.70^{fgh}	50.90^{fg}	20.55	145.00^{abc}
White	138 ECS	10.77^{ab}	0.513^{abcde}	318.44^{abc}	87.24^{abcde}	54.47^{ab}	7.78	143.67^{abcd}
	Average	10.86^{AB}	0.496^{C}	316.61^{ABC}	84.97^{C}	52.69^{B}	14.17	144.33^{A}
All	69 ECS	10.62	0.506	311.26^{Z}	84.81^{Z}	51.46^{Z}	15.14^{Z}	143.90
Strains	138 ECS	10.65	0.508	316.94^{Y}	86.86^{Y}	53.36^{Y}	3.14^{Y}	143.14

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS
ABCD - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcdefgh - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.
Mortality percentage prior to analyzes was transformed in Square Root Asin

TABLE 34. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder	Density[1]	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
(Strain)	(in^2/hen)	(g/egg)	(%)	(%)	(%)	(%)	(%)
Bovans	69 ECS	58.90^{ghi}	0.31	8.10	12.04^{abc}	25.21	54.58^{de}
White	138 ECS	60.02^{abcdefg}	3.44	3.53	7.97^{c}	25.48	59.46^{bcd}
	Average	59.46^{DE}	1.87	5.81	10.00^{B}	25.35^{AB}	57.02^{C}
Shaver	69 ECS	59.77^{cdefgh}	0	4.75	11.85^{abc}	24.27	58.67^{cd}
White	138 ECS	60.05^{abcdefg}	0.96	4.31	9.36^{abc}	23.31	61.90^{abcd}
	Average	59.91^{BCD}	0.48	4.53	10.61^{B}	23.79^{AB}	60.29^{ABC}
Dekalb	69 ECS	59.22^{efghi}	0	6.88	10.50^{abc}	23.42	58.83^{cd}
White	138 ECS	58.48^{hi}	2.23	3.02	13.67^{abc}	24.33	56.54^{cde}
	Average	58.85^{E}	1.11	4.95	12.08^{AB}	23.87^{AB}	57.68^{BC}
Babcock	69 ECS	59.65^{defghi}	0.52	5.08	11.96^{abc}	23.36	58.54^{cd}
White	138 ECS	61.31^{a}	0.37	4.55	7.01^{c}	20.01	67.86^{a}
	Average	60.48^{AB}	0.44	4.82	9.49^{B}	21.69^{AB}	63.20^{AB}
ISA	69 ECS	60.81^{abcd}	0	4.34	9.26^{abc}	22.29	63.62^{abc}
B-400	138 ECS	61.33^{ab}	1.44	3.02	8.03^{bc}	19.43	67.63^{ab}
	Average	61.07^{A}	0.72	3.68	8.65^{B}	20.86^{AB}	65.63^{A}
Hy-Line	69 ECS	58.02^{i}	0	8.31	17.10^{a}	25.54	48.51^{e}
W-36	138 ECS	59.01^{fghi}	2.99	1.41	16.13^{ab}	25.51	54.00^{de}
	Average	58.52^{E}	1.49	5.86	16.61^{A}	25.52^{AB}	51.26^{D}
Hy-Line	69 ECS	59.86^{abcdefgh}	0.27	8.20	11.04^{abc}	22.62	57.67^{cde}
CV-24	138 ECS	59.09^{fghi}	1.74	3.58	13.70^{abc}	22.15	59.00^{bcd}
	Average	59.47^{CDE}	1.00	5.89	12.37^{AB}	22.38^{AB}	58.34^{BC}
Lohmann	69 ECS	59.66^{defghi}	0	5.06	10.83^{abc}	23.98	59.71^{abcd}
LSL Lite	138 ECS	60.58^{ef}	2.25	3.48	9.51^{abc}	19.48	65.08^{abc}
	Average	60.12^{ABCD}	1.12	4.26	10.17^{B}	21.73^{AB}	62.39^{AB}
H&N	69 ECS	60.14^{abcdefg}	0	5.35	11.00^{abc}	22.38	60.83^{abcd}
Nick Chick	138 ECS	60.71^{abcde}	3.85	2.33	10.56^{abc}	18.85	64.54^{abc}
	Average	60.42^{ABC}	1.92	3.84	10.78^{B}	20.62^{AB}	62.68^{AB}
Novogen	69 ECS	60.51^{abcdef}	0.20	5.34	10.82^{abc}	22.13	61.31^{abcd}
White	138 ECS	61.20^{abc}	1.53	5.91	6.16^{c}	18.39	67.38^{ab}
	Average	60.86^{AB}	0.86	5.62	8.49^{B}	20.26^{B}	64.34^{A}
All	69 ECS	59.65^{Z}	0.13^{Z}	6.14^{Y}	11.54	23.52^{Y}	58.23^{Z}
Strains	138 ECS	60.18^{Y}	2.08^{Y}	3.51^{Z}	10.21	21.69^{Z}	62.34^{Y}

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS.
ABCDEFG - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcdefg - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 35. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Bovans	69 ECS	94.83	0.50	4.38	0.31	35.17^{abc}	15.71^{abc}
White	138 ECS	91.60	0.44	7.66	0.31	35.67^{abc}	16.17^{abc}
	Average	93.21	0.47	6.02	0.31	35.42^{AB}	15.94^{A}
Shaver	69 ECS	93.62	0.42	5.00	0.95	35.79^{abc}	15.70^{abc}
White	138 ECS	89.80	0.68	9.05	0.48	35.45^{abc}	15.77^{abc}
	Average	91.71	0.55	7.02	0.71	35.62^{AB}	15.74^{AB}
Dekalb	69 ECS	92.75	0.55	6.10	0.58	35.19^{abc}	15.68^{abc}
White	138 ECS	93.98	0	5.22	0.80	36.23^{abc}	15.96^{abc}
	Average	93.36	0.28	5.66	0.69	35.17^{AB}	15.82^{AB}
Babcock	69 ECS	93.50	0.80	5.05	0.68	36.79^{ab}	16.56^{a}
White	138 ECS	92.38	0.40	6.76	0.48	36.77^{ab}	16.06^{abc}
	Average	92.94	0.60	5.90	0.58	36.78^{A}	16.31^{A}
ISA	69 ECS	93.82	0.45	5.20	0.55	36.91^{a}	15.97^{abc}
B-400	138 ECS	90.00	0.28	8.90	0.82	35.89^{abc}	16.39^{abc}
	Average	91.91	0.36	7.05	0.69	36.40^{A}	16.18^{A}
Hy-Line	69 ECS	93.57	0.37	5.23	0.77	32.87^{c}	14.81^{bc}
W-36	138 ECS	93.13	0	6.17	0.73	33.30^{bc}	14.66^{c}
	Average	93.35	0.18	5.70	0.75	33.08^{C}	14.73^{B}
Hy-Line	69 ECS	93.60	0.38	5.50	0.58	33.04^{c}	16.14^{abc}
CV-24	138 ECS	93.38	0.15	6.35	0.12	34.87^{abc}	15.97^{abc}
	Average	93.49	0.26	5.92	0.35	33.96^{BC}	16.07^{A}
Lohmann	69 ECS	92.90	1.15	5.45	0.52	35.21^{abc}	15.96^{abc}
LSL Lite	138 ECS	93.18	0.20	6.35	0.25	36.24^{abc}	16.11^{abc}
	Average	93.04	0.68	5.90	0.39	35.72^{AB}	16.04^{A}
H&N	69 ECS	93.90	0.65	4.58	0.88	35.07^{abc}	15.94^{abc}
Nick Chick	138 ECS	93.58	0.50	5.80	0.12	35.77^{abc}	16.25^{abc}
	Average	93.74	0.58	5.19	0.50	35.42^{AB}	16.09^{A}
Novogen	69 ECS	93.74	0.52	5.02	0.52	34.59^{abc}	16.08^{abc}
White	138 ECS	90.56	0.66	8.00	0.78	35.58^{abc}	16.39^{ab}
	Average	92.25	0.59	6.51	0.65	35.09^{ABC}	16.24^{A}
All	69 ECS	93.64	0.58	5.15^{Y}	0.63	35.06	15.88
Strains	138 ECS	92.16	0.33	7.02^{Z}	0.49	35.58	15.94

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS.
ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abc - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 36. EFFECT OF BROWN EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Density[1] (in^2/hen)	Feed Consumption (kg/100/hen/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
TETRA Amber	69 ECS	10.60^{cdef}	0.442^{bc}	283.01	77.69^{bc}	44.55^{d}	1.39	145.50^{ab}
	138 ECS	11.04^{abcd}	0.432^{c}	290.02	79.44^{abc}	46.57^{bcd}	6.94	143.00^{ab}
	Average	10.82^{B}	0.437^{D}	286.52	78.57^{BC}	45.56^{C}	4.17	144.25^{ABC}
TETRA Brown	69 ECS	10.38^{ef}	0.464^{abc}	282.18	77.28^{bc}	45.84^{cd}	5.56	145.00^{ab}
	138 ECS	10.98^{abcde}	0.438^{bc}	278.31	76.31^{bc}	45.49^{cd}	1.85	140.33^{ab}
	Average	10.68^{BC}	0.450^{CD}	280.24	76.79^{C}	45.66^{C}	3.70	142.67^{ABC}
Novogen Brown	69 ECS	10.49^{def}	0.510^{a}	297.85	81.75^{abc}	49.82^{abc}	3.34	144.00^{ab}
	138 ECS	11.18^{ab}	0.439^{bc}	276.89	75.91^{c}	46.91^{bcd}	8.89	141.80^{ab}
	Average	10.84^{B}	0.475^{ABCD}	287.37	78.83^{BC}	48.36^{ABC}	6.11	142.90^{ABC}
Lohmann LB-Lite	69 ECS	10.36^{f}	0.485^{abc}	294.17	80.74^{abc}	48.49^{abcd}	3.48	145.75^{ab}
	138 ECS	10.44^{ef}	0.515^{a}	310.48	85.34^{a}	51.87^{a}	0	142.25_{ab}
	Average	10.40^{C}	0.500^{A}	302.32	83.04^{AB}	50.18^{AB}	1.74	144.00_{ABC}
Hy-Line Silver Brown	69 ECS	10.79^{bcdef}	0.487^{abc}	303.42	83.20^{ab}	47.73^{abcd}	6.94	141.50_{ab}
	138 ECS	10.981^{abcdef}	0.463^{abc}	304.12	83.43^{ab}	48.37^{abcd}	4.17	140.00^{ab}
	Average	10.85^{AB}	0.475^{ABCD}	303.77	83.32^{A}	48.05^{ABC}	5.56	140.75^{BC}
Hy-Line Brown	69 ECS	10.65^{cdef}	0.494^{ab}	289.23	78.35^{abc}	47.64^{abcd}	4.44	142.20^{ab}
	138 ECS	11.11^{abc}	0.458^{abc}	284.33	78.11^{bc}	47.81^{abcd}	0	139.40^{b}
	Average	10.88^{AB}	0.476^{BC}	286.78	78.73^{BC}	47.73^{BC}	2.22	140.80^{C}
ISA Brown	69 ECS	10.37^{f}	0.504^{a}	308.91	84.73^{a}	50.87^{ab}	4.45	146.00^{a}
	138 ECS	10.76^{bcdef}	0.480^{abc}	296.40	81.29^{abc}	50.71^{ab}	2.22	144.60^{ab}
	Average	10.56^{BC}	0.492^{AB}	302.65	83.01^{A}	50.79^{A}	3.34	145.30^{A}
Bovans Brown	69 ECS	10.96^{abcde}	0.472^{abc}	299.50	81.12^{abc}	49.93^{abc}	5.56	146.00^{a}
	138 ECS	11.40^{a}	0.444^{bc}	286.05	78.51^{abc}	49.28^{abc}	4.17	144.00^{ab}
	Average	10.18^{A}	0.458^{BCD}	292.78	80.31^{ABC}	49.60^{AB}	4.86	145.00^{AB}
All Strains	69 ECS	10.58^{Z}	0.482^{Z}	294.78	80.86	48.11	4.39	144.49^{Y}
	138 ECS	10.98^{Y}	0.459^{Y}	290.82	79.79	48.38	3.53	141.92^{Z}

[1]All strains were housed such that each strain is equally represented in each density.
Enrichable Cage=EC; Enriched Colony Housing System=ECS.
ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values
abcd - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.
Mortality percentage prior to analyzes was transformed in Square Root Asin

TABLE 37. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder	Density[1]	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
(Strain)	(in^2/hen)	(g/egg)	(%)	(%)	(%)	(%)	(%)
TETRA	69 ECS	56.51^{h}	0.48	7.89^{a}	22.24^{ab}	28.06^{abc}	41.14^{ef}
Amber	138 ECS	57.60^{fgh}	1.92	4.88^{ab}	16.00^{bcd}	29.67^{ab}	47.38^{def}
	Average	57.05^{D}	1.20	6.38^{A}	19.12^{A}	28.86^{ABC}	44.26^{C}
TETRA	69 ECS	58.56^{efg}	0	4.37^{ab}	15.81^{bcde}	28.77^{abc}	51.00^{cde}
Brown	138 ECS	59.09^{def}	3.41	3.54^{ab}	9.17^{cde}	29.02^{abc}	54.69^{cd}
	Average	58.83^{C}	1.71	3.96^{AB}	12.49^{B}	28.90^{ABC}	52.85^{B}
Novogen	69 ECS	60.19^{bcde}	0	3.24^{ab}	13.49^{cde}	25.86^{abc}	57.09^{bcd}
Brown	138 ECS	60.97^{abc}	0.68	2.66^{b}	7.05^{e}	20.46^{bc}	69.00^{a}
	Average	60.58^{AB}	0.34	2.95^{B}	10.27^{B}	23.16^{C}	63.01^{A}
Lohmann	69 ECS	59.04^{def}	0	4.68^{ab}	13.23^{cde}	24.27^{abc}	56.92^{bcd}
LB-Lite	138 ECS	60.01^{bcde}	0.56	4.13^{ab}	8.98^{de}	25.41^{abc}	60.75^{abc}
	Average	59.53^{BC}	0.28	4.40^{AB}	11.10^{B}	24.85^{BC}	58.84^{AB}
Hy-Line	69 ECS	56.18^{gh}	0.13	4.44^{ab}	25.28^{a}	31.65^{a}	38.71^{f}
Silver Brown	138 ECS	57.28^{fgh}	1.08	4.96^{ab}	17.99^{abc}	33.81^{a}	41.54^{ef}
	Average	57.05^{D}	0.60	4.70^{AB}	21.63^{A}	32.73^{A}	40.12^{C}
Hy-Line	69 ECS	59.50^{cde}	0	1.61^{b}	12.23^{cde}	31.83^{a}	53.86^{cd}
Brown	138 ECS	60.51^{abcd}	1.09	3.34^{ab}	7.42^{e}	27.64^{abc}	60.37^{abc}
	Average	60.00^{BC}	0.55	2.48^{B}	9.82^{B}	29.74^{AB}	57.11^{AB}
ISA	69 ECS	58.96^{def}	0.51	2.81^{ab}	14.40^{bcde}	29.69^{abc}	53.25^{cd}
Brown	138 ECS	61.67^{ab}	0	4.64^{ab}	7.17^{e}	18.91^{c}	69.09^{a}
	Average	60.31^{AB}	0.25	3.72^{AB}	10.78^{B}	23.80^{C}	61.17^{A}
Bovans	69 ECS	60.44^{abcd}	0	3.60^{ab}	13.83^{cde}	26.51^{abc}	55.78^{cd}
Brown	138 ECS	61.90^{a}	0.13	4.06^{ab}	8.14^{de}	20.42^{bc}	67.40^{ab}
	Average	61.17^{A}	0.07	3.83^{AB}	10.99^{B}	23.46^{C}	61.59^{A}
All	69 ECS	58.75^{Z}	0.14^{Z}	4.08	16.31^{Y}	28.20^{Y}	50.97^{Z}
Strains	138 ECS	59.88^{Y}	1.11^{Y}	4.02	10.24^{Z}	25.67^{Z}	58.78^{Y}

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS.
ABCD - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcdefg - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 38. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (119-483 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Density[1] (in^2/hen)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
TETRA Amber	69 ECS	92.58	0.42	6.62	0.38	30.55	15.68^{ab}
	138 ECS	91.18	1.40	7.20	0.25	31.87	16.37^{ab}
	Average	91.88	0.91	6.91	0.31	31.21	16.02^{AB}
TETRA Brown	69 ECS	92.87	0.60	5.87	0.70	31.43	15.38^{ab}
	138 ECS	93.67	0.17	6.03	0.17	31.26	16.29^{ab}
	Average	93.27	0.38	5.95	0.43	31.34	15.83^{AB}
Novogen Brown	69 ECS	92.70	0.62	5.94	0.72	33.39	15.55^{ab}
	138 ECS	92.62	0.54	6.38	0.50	31.44	16.59^{ab}
	Average	92.66	0.58	6.16	0.61	32.42	16.07^{AB}
Lohmann LB-Lite	69 ECS	92.92	0.38	5.52	1.18	33.06	15.34^{b}
	138 ECS	91.10	0.52.	8.12	0.25	34.83	15.47^{ab}
	Average	92.10	0.45	6.82	0.71	33.95	15.40^{B}
Hy-Line Silver Brown	69 ECS	95.20	0.10	4.70	0	33.46	15.97^{ab}
	138 ECS	94.10	0.32	4.82	0.72	33.62	16.17^{ab}
	Average	94.65	0.21	4.76	0.36	33.54	16.07^{AB}
Hy-Line Brown	69 ECS	94.06	0.22	5.20	0.56	32.74	15.76^{ab}
	138 ECS	91.92	0.48	7.10	0.52	31.91	16.47^{ab}
	Average	92.99	0.35	6.15	0.54	32.33	16.12^{AB}
ISA Brown	69 ECS	94.06	0.22	5.30	0.44	34.96	15.36^{b}
	138 ECS	92.42	0.10	7.26	0.20	33.69	15.95^{ab}
	Average	93.24	0.16	6.28	0.32	34.32	15.65^{B}
Bovans Brown	69 ECS	94.70	0.16	4.48	0.68	33.91	16.22^{ab}
	138 ECS	92.78	0.25	6.82	0.15	32.57	16.90^{a}
	Average	93.74	0.20	5.65	0.41	33.24	16.56^{A}
All Strains	69 ECS	93.63	0.34	5.45^{Y}	0.58	32.94	15.66^{Z}
	138 ECS	92.47	0.47	6.72^{Z}	0.34	32.65	16.28^{Y}

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS.
AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 39. EFFECT OF WHITE EGG STRAIN AND PRODUCTION SYSTEM ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder	Production System	Feed Consumption	Feed Conversion	Eggs Per Bird Housed	Egg Production	Egg Mass	Mortality*
(Strain)		(kg/100/hen/d)	(g egg/g feed)		(HD%)	(g/HD)	(%)
Bovans White	69 EC	11.45^{abc}	0.476^{ab}	24.85^{a}	87.38^{ab}	54.56^{ab}	3.33
	69 ECS	11.25^{abc}	0.468^{ab}	23.68^{ab}	83.69^{ab}	52.82^{ab}	1.39
	Average	11.35^{AB}	0.472^{AB}	24.27	85.53	53.69	2.36
Shaver White	69 EC	10.70^{bc}	0.478^{ab}	22.22^{ab}	78.85^{ab}	50.87^{ab}	0.93
	69 ECS	11.89^{abc}	0.455^{ab}	24.15^{ab}	83.16^{ab}	53.75^{ab}	3.47
	Average	11.30^{AB}	0.467^{AB}	23.18	81.00	52.31	2.20
Dekalb White	69 EC	11.20^{abc}	0.490^{ab}	24.38^{ab}	86.98^{ab}	54.91^{ab}	0.56
	69 ECS	11.10^{abc}	0.495^{ab}	24.41^{ab}	85.55^{ab}	54.68^{ab}	1.39
	Average	11.15^{AB}	0.492^{AB}	24.40	86.76	54.79	0.97
Babcock White	69 EC	10.7^{bc}	0.521^{a}	25.04^{a}	87.97^{a}	56.00^{ab}	1.85
	69 ECS	12.82^{a}	0.415^{ab}	23.30^{ab}	82.46^{ab}	52.98^{ab}	2.08
	Average	11.78^{A}	0.468^{AB}	24.17	85.22	54.49	1.97
ISA B-400	69 EC	10.98^{abc}	0.522^{a}	24.93^{a}	89.02^{a}	57.06^{a}	0
	69 ECS	10.98^{abc}	0.510^{ab}	24.32^{ab}	86.43^{ab}	56.10^{ab}	0.70
	Average	10.98^{AB}	0.516^{A}	24.62	87.73	56.58	0.35
Hy-Line W-36	69 EC	10.34^{c}	0.497^{ab}	22.47^{ab}	80.26^{ab}	51.25^{ab}	0
	69 ECS	10.08^{c}	0.480^{ab}	21.59^{ab}	79.10^{ab}	48.55^{ab}	0
	Average	10.21^{B}	0.488^{AB}	22.03	78.68	49.90	0
Hy-Line CV-24	69 EC	11.09^{abc}	0.488^{ab}	22.93^{ab}	81.91^{ab}	53.42^{ab}	0
	69 ECS	12.16^{ab}	0.442^{ab}	22.97^{ab}	82.02^{ab}	53.75^{ab}	0.70
	Average	11.62^{A}	0.465^{AB}	22.95	81.96	53.59	0.35
Lohmann LSL Lite	69 EC	11.95^{abc}	0.460^{ab}	24.35^{ab}	83.23^{ab}	55.24^{ab}	4.86
	69 ECS	11.86^{abc}	0.388^{b}	19.92^{b}	71.13^{b}	45.64^{b}	0
	Average	11.90^{A}	0.424^{B}	22.13	77.18	50.44	2.43
H&N Nick Chick	69 EC	11.27^{abc}	0.493^{ab}	23.89^{ab}	85.27^{ab}	55.49^{ab}	0.46
	69 ECS	12.03^{abc}	0.458^{ab}	23.96^{ab}	84.76^{ab}	55.11^{ab}	0.70
	Average	11.65^{A}	0.475^{AB}	23.92	85.10	55.30	0.58
Novogen White	69 EC	11.28^{abc}	0.500^{ab}	24.74^{ab}	86.12^{ab}	56.27^{ab}	1.12
	69 ECS	11.77^{abc}	0.428^{ab}	22.04^{ab}	76.92^{ab}	50.25^{ab}	1.67
	Average	11.53^{A}	0.464^{AB}	23.16	81.52	53.26	1.39
All Strains	69 EC	11.10^{Z}	0.492^{Z}	23.93	84.70	54.51	1.31
	69 ECS	11.59^{Y}	0.454^{Y}	23.03	81.42	52.36	1.21

Enrichable Cage=EC; Enriched Colony Housing System=ECS

AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.

abc - Different letters denote significant differences (P<.01) in the strain*production system interactions.

YZ - Different letters denote significant differences (P<.01), comparisons made among production system average values.

TABLE 40. EFFECT OF WHITE EGG STRAIN AND PRODUCTION SYSTEM ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Production System	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans White	69 EC	62.47[b]	0	0	0.66	32.00	56.00
	69 ECS	63.08[ab]	0	0	0	31.71	58.56
	Average	62.77[B]	0	0	0.33	31.86	57.28
Shaver White	69 EC	64.52[ab]	0	0	0	24.13	68.77
	69 ECS	64.61[ab]	0	0	0.83	9.28	72.24
	Average	64.56[AB]	0	0	0.42	16.71	70.50
Dekalb White	69 EC	63.17[ab]	0	0	0	33.63	60.90
	69 ECS	63.18[ab]	0	0	0	34.29	57.44
	Average	63.17[AB]	0	0	0	33.96	59.17
Babcock White	69 EC	63.66[ab]	0	0	0	28.26	66.74
	69 ECS	64.23[ab]	0	0	0	19.77	67.44
	Average	63.94[AB]	0	0	0	24.01	67.09
ISA B-400	69 EC	64.10[ab]	0	0	0	26.52	67.93
	69 ECS	64.90[ab]	0	0	0	13.92	74.68
	Average	64.50[AB]	0	0	0	20.22	71.30
Hy-Line W-36	69 EC	63.85[ab]	0	0	0	27.21	66.50
	69 ECS	62.97[ab]	0	0	0	12.39	74.28
	Average	63.41[AB]	0	0	0	19.80	70.39
Hy-Line CV-24	69 EC	65.18[ab]	0	0	0	26.41	68.05
	69 ECS	65.61[ab]	0	0	0	13.50	76.18
	Average	65.39[A]	0	0	0	19.96	72.11
Lohmann LSL Lite	69 EC	66.29[a]	0	0	0	5.98	85.44
	69 ECS	64.05[ab]	0	0	0	21.19	67.32
	Average	65.17[A]	0	0	0	13.58	76.38
H&N Nick Chick	69 EC	64.98[ab]	0	0	0	16.40	78.24
	69 ECS	65.07[ab]	0	0	0	13.33	75.00
	Average	65.02[AB]	0	0	0	14.87	76.62
Novogen White	69 EC	65.33[ab]	0	0	0	19.33	76.67
	69 ECS	65.48[ab]	0	0	0	8.40	76.48
	Average	65.41[A]	0	0	0	13.87	76.57
All Strains	69 EC	64.36	0	0	0.07	23.99	69.52
	69 ECS	64.31	0	0	0.08	17.78	69.96

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.
ab - Different letters denote significant differences (P<.01) in the strain* production system interactions

TABLE 41. EFFECT OF WHITE EGG STRAIN AND PRODUCTION SYSTEM ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Production System	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans White	69 EC	88.67	0	10.66	0.67	2.74^{ab}	1.28^{abc}
	69 ECS	90.27	0	8.80	0.92	2.69^{ab}	1.26^{abc}
	Average	89.47	0	9.73	0.80	2.74	1.27^{AB}
Shaver White	69 EC	92.90	0	6.43	0.67	2.56^{ab}	1.20^{bc}
	69 ECS	82.36	0.86	14.28	2.50	2.60^{ab}	1.33^{abc}
	Average	87.63	0.43	10.36	1.58	2.58	1.26^{AB}
Dekalb White	69 EC	94.53	0	4.63	0.83	2.83^{ab}	1.25^{abc}
	69 ECS	91.73	0	7.27	1.00	2.78^{ab}	1.24^{abc}
	Average	93.13	0	5.95	0.92	2.80	1.25^{AB}
Babcock White	69 EC	95.00	0	4.44	0.56	2.92^{a}	1.20^{bc}
	69 ECS	87.22	0	11.11	1.67	2.59^{ab}	1.44^{a}
	Average	91.11	0	7.78	1.11	2.75	1.32^{A}
ISA B-400	69 EC	94.46	0	4.21	1.33	2.89^{a}	1.23^{abc}
	69 ECS	88.60	1.04	8.63	1.72	2.73^{ab}	1.23^{abc}
	Average	91.53	0.52	6.42	1.53	2.81	1.23^{AB}
Hy-Line W-36	69 EC	93.71	0	4.70	1.59	2.58^{ab}	1.16^{c}
	69 ECS	86.67	0	13.33	0	2.42^{ab}	1.13^{c}
	Average	90.19	0	9.02	0.80	2.50	1.14^{B}
Hy-Line CV-24	69 EC	94.46	1.25	2.86	1.43	2.65^{ab}	1.24^{abc}
	69 ECS	89.68	0	9.45	0.86	2.60^{ab}	1.36^{ab}
	Average	92.07	0.62	6.15	1.14	2.63	1.30^{A}
Lohmann LSL Lite	69 EC	91.42	0	8.58	0	2.80^{ab}	1.34^{abc}
	69 ECS	88.52	0	11.48	0	2.56^{b}	1.33^{abc}
	Average	89.97	0	10.03	0	2.53	1.33^{A}
H&N Nick Chick	69 EC	94.64	0.56	3.65	1.15	2.77^{ab}	1.26^{abc}
	69 ECS	88.33	0	9.79	1.88	2.69^{ab}	1.35^{abc}
	Average	91.48	0.28	6.72	1.51	2.73	1.31^{A}
Novogen White	69 EC	96.00	0	4.00	0	2.85^{a}	1.26^{abc}
	69 ECS	84.88	2.00	11.79	1.33	2.43^{ab}	1.32^{abc}
	Average	90.44	1.00	7.90	0.67	2.64	1.29^{A}
All Strains	69 EC	93.58^{Y}	0.18	5.42^{Y}	0.82	2.76^{Y}	1.24^{Z}
	69 ECS	87.82^{Z}	0.39	10.59^{Z}	1.19	2.58^{Z}	1.30^{Y}

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abc - Different letters denote significant differences (P<.01) in the strain* production system interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among production system average values.

TABLE 42. EFFECT OF BROWN EGG STRAIN AND PRODUCTION SYSTEM ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Production System	Feed Consumption (kg/100/hen/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)
TETRA Amber	69 EC	10.87[ab]	0.454[ab]	22.79	80.67	49.36	1.59
	69 ECS	11.86[a]	0.382[b]	20.61	73.60	45.41	0
	Average	11.36	0.418	21.70	77.14	47.39	0.79
TETRA Brown	69 EC	11.22[ab]	0.427[ab]	21.57	75.11	48.03	2.78
	69 ECS	11.19[ab]	0.420[ab]	20.77	73.92	46.74	0.93
	Average	11.21	0.423	21.17	74.52	47.38	1.85
Novogen Brown	69 EC	11.01[ab]	0.458[ab]	22.50	79.45	50.31	1.67
	69 ECS	11.53[ab]	0.436[ab]	21.96	77.24	50.26	1.67
	Average	11.27	0.447	22.23	78.35	50.29	1.67
Lohmann LB-Lite	69 EC	10.97[ab]	0.473[a]	23.19	82.74	52.07	0.62
	69 ECS	11.70[ab]	0.442[ab]	22.71	79.98	51.61	2.08
	Average	11.33	0.458	22.95	81.36	51.84	1.35
Hy-Line Silver Brown	69 EC	11.54[ab]	0.447[ab]	23.52	83.98	51.56	0
	69 ECS	11.75[ab]	0.425[ab]	22.87	81.68	49.88	0
	Average	11.64	0.436	23.19	82.83	50.72	0
Hy-Line Brown	69 EC	10.33[b]	0.455[ab]	21.14	75.20	47.16	0.93
	69 ECS	11.54[ab]	0.414[ab]	21.08	75.28	47.49	0
	Average	10.94	0.434	21.11	75.24	47.52	0.46
ISA Brown	69 EC	10.68[ab]	0.462[a]	22.18	77.83	49.31	2.32
	69 ECS	10.93[ab]	0.464[a]	22.91	81.46	50.72	0.56
	Average	10.80	0.463	22.54	79.65	50.02	1.44
Bovans Brown	69 EC	11.48[ab]	0.446[ab]	22.38	79.78	50.93	0.79
	69 ECS	11.86[a]	0.438[ab]	22.93	81.76	52.00	0.56
	Average	11.67	0.442	22.66	80.77	51.46	0.68
All Strains	69 EC	11.01[Z]	0.453[Z]	22.41	79.35	49.84	1.34
	69ECS	11.54[Y]	0.428[Y]	21.98	78.12	49.31	0.72

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
ab - Different letters denote significant differences (P<.01) in the strain* production system interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among production system average values.

TABLE 43. EFFECT OF BROWN EGG STRAIN AND PRODUCTION SYSTEM ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Production System	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
TETRA Amber	69 EC	61.16^{cd}	0	0	1.12	49.85^{a}	44.23^{b}
	69 ECS	61.70^{bcd}	0	0	2.76	32.62^{ab}	55.08^{ab}
	Average	61.43^{BC}	0	0	1.94^{A}	41.23^{AB}	49.65^{B}
TETRA Brown	69 EC	63.96^{abcd}	0	0	0	22.67^{ab}	66.32^{ab}
	69 ECS	63.21^{abcd}	0	0	0	20.68^{ab}	62.92^{ab}
	Average	63.59^{A}	0	0	0^{B}	21.68^{B}	64.64^{AB}
Novogen Brown	69 EC	63.40^{abcd}	0	0	0	33.32^{ab}	64.58^{ab}
	69 ECS	65.05^{a}	0	0	0.71	12.32^{b}	74.63^{a}
	Average	64.23^{A}	0	0	0.36^{AB}	22.82^{B}	69.61^{A}
Lohmann LB-Lite	69 EC	62.93^{abcd}	0	0	0.46	33.40^{ab}	62.02^{ab}
	69 ECS	64.54^{ab}	0	0	0	18.18^{ab}	69.48^{ab}
	Average	63.73^{A}	0	0	0.28^{AB}	25.79^{B}	65.77^{AB}
Hy-Line Silver Brown	69 EC	61.39^{bcd}	0	0	0.83	49.84^{a}	46.82^{ab}
	69 ECS	61.10^{cd}	0	0	0	46.88^{a}	48.75^{ab}
	Average	61.25^{C}	0	0	0.42^{AB}	48.36^{A}	47.79^{B}
Hy-Line Brown	69 EC	62.72^{abcd}	0	0	0	35.37^{ab}	57.72^{ab}
	69 ECS	63.55^{abcd}	0	0	0	21.20^{ab}	67.49^{ab}
	Average	63.14^{AB}	0	0	0^{B}	28.29^{AB}	62.60^{AB}
ISA Brown	69 EC	63.36^{abcd}	0	0	0	34.47^{ab}	63.23^{ab}
	69 ECS	62.28^{abcd}	0	0	0	38.06^{ab}	50.48^{ab}
	Average	62.82^{ABC}	0	0	0^{B}	36.26^{AB}	56.86^{AB}
Bovans Brown	69 EC	63.87^{abcd}	0	0	0	33.25^{ab}	64.28^{ab}
	69 ECS	63.60^{abcd}	0	0	0	24.12^{ab}	63.00^{ab}
	Average	63.74^{A}	0	0	0^{B}	28.68^{AB}	63.64^{AB}
All Strains	69 EC	62.85	0	0	0.31	36.25^{Y}	58.66
	69 ECS	63.13	0	0	0.43	26.76^{Z}	61.48

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcd - Different letters denote significant differences (P<.01) in the strain* production system interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among production system average values.

TABLE 44. EFFECT OF BROWN EGG STRAIN AND PRODUCTION SYSTEM ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEMS

Breeder (Strain)	Production System	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
TETRA Amber	69 EC	95.20	0	4.80	0	2.65	1.22
	69 ECS	90.45	0	8.59	0.96	2.32	1.33
	Average	92.82	0	6.69	0.48	2.48^{AB}	1.27
TETRA Brown	69 EC	89.00	0	11.00	0	2.44	1.26
	69 ECS	83.64	0	16.36	0	2.29	1.25
	Average	86.32	0	13.68	0	2.37^{B}	1.25
Novogen Brown	69 EC	97.91	1.33	2.09	0	2.67	1.23
	69 ECS	87.67	0	11.00	0	2.47	1.29
	Average	92.79	0.67	6.55	0	2.57^{AB}	1.26
Lohmann LB-Lite	69 EC	96.02	0.64	3.34	0	2.72	1.23
	69 ECS	87.66	0	12.34	0	2.56	1.31
	Average	91.84	0.32	7.84	0	2.64^{A}	1.27
Hy-Line Silver Brown	69 EC	97.50	0	2.50	0	2.76	1.29
	69 ECS	95.62	0	4.38	0	2.67	1.32
	Average	96.56	0	3.44	0	2.72^{A}	1.30
Hy-Line Brown	69 EC	93.09	0	4.01	2.90	2.40	1.16
	69 ECS	88.70	0	11.30	0	2.38	1.29
	Average	90.89	0	7.66	1.45	2.39^{B}	1.22
ISA Brown	69 EC	97.70	0.56	1.74	0	2.62	1.20
	69 ECS	88.54	0	10.79	0.66	2.57	1.22
	Average	93.12	0.28	6.27	0.33	2.60^{AB}	1.21
Bovans Brown	69 EC	97.53	0	1.97	0.49	2.64	1.28
	69 ECS	87.12	0	9.48	3.41	2.52	1.33
	Average	92.33	0	5.72	1.95	2.58^{AB}	1.30
All Strains	69 EC	95.49^{Y}	0.15	3.93^{Y}	0.42	2.61^{Y}	1.23^{Z}
	69 ECS	88.67^{Z}	0.17	10.53^{Z}	0.63	2.47^{Z}	1.29^{Y}

AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.
YZ - Different letters denote significant differences (P<.01), comparisons made among production system average values.

TABLE 45. EFFECT OF WHITE EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder	Density[1]	Feed Consumption	Feed Conversion	Eggs Per Bird Housed	Egg Production	Egg Mass	Mortality
(Strain)	(in^2/hen)	(kg/100/hen/d)	(g egg/g feed)		(HD%)	(g/HD)	(%)
Bovans	69 ECS	11.25^{abc}	0.468^{abcd}	23.68^{ab}	83.69^{ab}	52.82^{ab}	1.39
White	138 ECS	11.38^{abc}	0.495^{abcd}	25.22^{a}	89.36^{a}	56.26^{ab}	1.39
	Average	11.32^{BC}	0.481	24.45^{AB}	86.52	54.54	1.39
Shaver	69 ECS	11.89^{abc}	0.455^{abcd}	24.15^{ab}	83.16^{ab}	53.75^{ab}	3.47
White	138 ECS	10.83^{abc}	0.545^{a}	25.45^{a}	90.89^{a}	58.97^{a}	0
	Average	11.36^{AB}	0.500	24.80^{AB}	87.02	56.36	1.74
Dekalb	69 ECS	11.10^{abc}	0.495^{abcd}	24.41^{ab}	86.55^{ab}	54.68^{ab}	1.39
White	138 ECS	10.96^{abc}	0.522^{abc}	25.84^{a}	91.21^{a}	57.38^{ab}	2.78
	Average	11.03^{AB}	0.509	25.12^{A}	88.84	56.03	2.08
Babcock	69 ECS	12.82^{a}	0.415^{cd}	23.30^{ab}	82.46^{ab}	52.98^{ab}	2.08
White	138 ECS	11.16^{abc}	0.532^{ab}	25.33^{a}	90.49^{a}	59.24^{a}	0
	Average	11.99^{A}	0.474	24.32^{AB}	86.48	56.11	1.04
ISA	69 ECS	10.98^{abc}	0.510^{abc}	24.32^{ab}	86.44^{ab}	56.10^{ab}	0.69
B-400	138 ECS	11.06^{abc}	0.512^{abc}	24.16^{ab}	85.52^{ab}	56.55^{ab}	1.39
	Average	11.02^{AB}	0.511	24.24^{AB}	85.98	56.32	1.04
Hy-Line	69 ECS	10.08^{bc}	0.480^{abcd}	21.59^{ab}	77.10^{ab}	48.55^{ab}	0
W-36	138 ECS	9.98^{c}	0.497^{abcd}	21.59^{ab}	77.11^{ab}	49.37^{ab}	0
	Average	10.03^{B}	0.488	21.59^{B}	77.10	48.96	0
Hy-Line	69 ECS	12.16^{ab}	0.442^{abcd}	22.97^{ab}	82.02^{ab}	53.75^{ab}	0.69
CV-24	138 ECS	10.89^{abc}	0.530^{abc}	25.17^{a}	89.90^{a}	57.55^{ab}	0
	Average	11.52^{A}	0.486	24.07^{AB}	85.96	55.65	0.35
Lohmann	69 ECS	11.86^{abc}	0.388^{d}	19.92^{b}	71.13^{b}	45.64^{b}	0
LSL Lite	138 ECS	11.28^{abc}	0.528^{abc}	25.03^{a}	89.40^{a}	59.23^{a}	0
	Average	11.57^{A}	0.458	22.47^{AB}	80.26	52.44	0
H&N	69 ECS	12.03^{abc}	0.458^{abcd}	23.96^{ab}	87.76^{ab}	55.11^{ab}	0.69
Nick Chick	138 ECS	11.29^{abc}	0.520^{abc}	25.11^{a}	88.65^{ab}	58.72^{a}	1.39
	Average	11.66^{A}	0.489	24.54^{AB}	86.81	56.91	1.04
Novogen	69 ECS	11.77^{abc}	0.428^{bcd}	22.04^{ab}	76.92^{ab}	50.25^{ab}	1.67
White	138 ECS	11.76^{abc}	0.514^{abc}	25.48^{a}	91.01^{a}	59.99^{a}	0
	Average	11.77^{A}	0.471	23.76^{AB}	83.96	55.12	0.83
All	69 ECS	11.59^{Y}	0.454^{Y}	23.03^{Z}	81.42^{Z}	52.36^{Z}	1.21
Strains	138 ECS	11.06^{Z}	0.519^{Z}	24.84^{Y}	88.36^{Y}	57.33^{Y}	0.69

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS
ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcd - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.
Mortality percentage prior to analyzes was transformed in Square Root Asin

TABLE 46. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder	Density[1]	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
(Strain)	(in^2/hen)	(g/egg)	(%)	(%)	(%)	(%)	(%)
Bovans	69 ECS	63.08	0	0	0	31.71	58.56
White	138 ECS	62.98	0	0	0	27.16	59.69
	Average	63.03^{B}	0	0	0	29.43^{A}	59.12
Shaver	69 ECS	64.61	0	0	0.83	9.28	72.24
White	138 ECS	64.90	0	0	0	1.32	76.54
	Average	64.75^{AB}	0	0	0.42	5.30^{AB}	74.39
Dekalb	69 ECS	63.18	0	0	0	34.29	57.44
White	138 ECS	62.99	0	0	0	23.10	65.41
	Average	63.08^{AB}	0	0	0	28.70^{A}	61.42
Babcock	69 ECS	64.23	0	0	0	19.77	67.44
White	138 ECS	65.46	0	0	0	6.35	66.32
	Average	64.84^{AB}	0	0	0	13.06^{AB}	66.88
ISA	69 ECS	64.90	0	0	0	13.92	74.68
B-400	138 ECS	66.08	0	0	0	0	71.44
	Average	65.49^{AB}	0	0	0	6.96^{AB}	73.06
Hy-Line	69 ECS	62.97	0	0	0	12.39	74.28
W-36	138 ECS	64.06	0	0	0	19.46	68.93
	Average	63.52^{AB}	0	0	0	15.92^{AB}	71.60
Hy-Line	69 ECS	65.61	0	0	0	13.50	76.18
CV-24	138 ECS	64.07	0	0	1.92	16.42	62.48
	Average	64.84^{AB}	0	0	0.96	14.96^{AB}	69.33
Lohmann	69 ECS	64.05	0	0	0	21.19	67.32
LSL Lite	138 ECS	66.25	0	0	0	6.61	82.82
	Average	65.15^{AB}	0	0	0	13.90^{AB}	75.07
H&N	69 ECS	64.98	0	0	0	13.33	75.00
Nick Chick	138 ECS	66.10	0	0	0	6.36	79.46
	Average	65.54^{AB}	0	0	0	9.84^{AB}	77.23
Novogen	69 ECS	65.48	0	0	0	8.40	76.48
White	138 ECS	65.93	0	0	0	0	76.75
	Average	65.70^{A}	0	0	0	4.20^{B}	76.61
All	69 ECS	64.31	0	0	0.08	17.78	69.96
Strains	138 ECS	64.88	0	0	0.19	10.68	70.98

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS.
AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.

TABLE 47. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Bovans	69 ECS	90.28	0	8.80	0.92	2.69	1.26^{abc}
White	138 ECS	86.85	0	11.83	1.32	2.81	1.28^{abc}
	Average	88.56	0	10.31	1.12	2.75	1.27^{AB}
Shaver	69 ECS	82.36	0.86	14.28	2.50	2.60	1.33^{abc}
White	138 ECS	77.86	0	22.14	0	2.73	1.22^{abc}
	Average	80.11	0.43	18.21	1.25	2.66	1.27^{AB}
Dekalb	69 ECS	91.73	0	7.27	1.00	2.78	1.24^{abc}
White	138 ECS	88.51	0	11.49	0	2.92	1.23^{abc}
	Average	90.12	0	9.38	0.50	2.85	1.24^{AB}
Babcock	69 ECS	87.22	0	11.11	1.67	2.559	1.44^{a}
White	138 ECS	72.67	0	27.33	0	2.63	1.25^{abc}
	Average	79.95	0	19.22	0.83	2.61	1.34^{A}
ISA	69 ECS	88.60	1.04	8.63	1.72	2.73	1.23^{abc}
B-400	138 ECS	71.44	0	27.16	1.39	2.48	1.24^{abc}
	Average	80.02	0.52	17.90	1.56	2.61	1.23^{AB}
Hy-Line	69 ECS	86.67	0	13.33	0	2.42	1.13^{bc}
W-36	138 ECS	88.39	0	11.61	0	2.44	1.12^{c}
	Average	87.53	0	12.47	0	2.43	1.12^{B}
Hy-Line	69 ECS	89.68	0	9.45	0.86	2.60	1.36^{ab}
CV-24	138 ECS	80.82	0	18.05	1.14	2.71	1.22^{abc}
	Average	85.25	0	13.75	1.00	2.66	1.29^{A}
Lohmann	69 ECS	88.52	0	11.48	0	2.26	1.33^{abc}
LSL Lite	138 ECS	89.42	0	10.58	0	2.85	1.26^{abc}
	Average	88.97	0	11.03	0	2.55	1.30^{A}
H&N	69 ECS	88.33	0	9.79	1.88	2.69	1.35^{abc}
Nick Chick	138 ECS	85.82	0	14.18	0	2.81	1.26^{abc}
	Average	87.08	0	11.99	0.94	2.75	1.30^{A}
Novogen	69 ECS	84.88	2.00	11.79	1.33	2.43	1.32^{abc}
White	138 ECS	76.75	0	22.07	1.18	2.70	1.32^{abc}
	Average	80.81	1.00	16.93	1.25	2.57	1.32^{A}
All	69 ECS	87.82^{Y}	0.39	10.59^{Y}	1.19	2.58	1.30^{Y}
Strains	138 ECS	81.85^{Z}	0	17.64^{Z}	0.50	2.71	1.24^{Z}

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS.
AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abc - Different letters denote significant differences (P<.01) in the strain*density interactions
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 48. EFFECT OF BROWN EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder	Density[1]	Feed Consumption	Feed Conversion	Eggs Per Bird Housed	Egg Production	Egg Mass	Mortality
(Strain)	(in^2/hen)	(kg/100/hen/d)	(g egg/g feed)		(HD%)	(g/HD)	(%)
TETRA Amber	69 ECS	11.86	0.382[b]	20.61	73.60	45.41	0
	138 ECS	11.23	0.420[ab]	21.61	77.18	47.35	0
	Average	11.55	0.401[B]	21.11	75.39	46.38	0
TETRA Brown	69 ECS	11.19	0.420[ab]	20.77	73.92	46.74	0.93
	138 ECS	11.51	0.420[ab]	21.48	76.70	48.25	0
	Average	11.35	0.420[AB]	21.12	75.31	47.49	0.46
Novogen Brown	69 ECS	11.53	0.436[ab]	21.96	78.41	50.26	1.67
	138 ECS	10.97	0.454[ab]	22.19	77.24	49.62	2.22
	Average	11.25	0.445[AB]	22.07	77.83	49.94	1.95
Lohmann LB-Lite	69 ECS	11.70	0.442[ab]	22.71	79.98	51.16	2.08
	138 ECS	10.92	0.505[a]	24.32	85.87	55.16	1.39
	Average	11.31	0.474 [AB]	23.51	82.93	53.39	1.74
Hy-Line Silver Brown	69 ECS	11.75	0.425[ab]	22.87	81.68	49.88	0
	138 ECS	12.07	0.425[ab]	23.50	83.94	51.52	0
	Average	11.91	0.425[AB]	23.19	82.81	50.69	0
Hy-Line Brown	69 ECS	11.54	0.414[ab]	21.08	75.28	47.89	0
	138 ECS	11.26	0.412[ab]	20.50	73.22	46.46	0
	Average	11.40	0.413[AB]	20.79	74.25	47.17	0
ISA Brown	69 ECS	10.93	0.464[ab]	24.09	81.46	50.72	0.56
	138 ECS	11.58	0.492[ab]	22.91	85.54	56.78	1.11
	Average	11.26	0.078[A]	23.50	83.50	53.75	0.83
Bovans Brown	69 ECS	11.86	0.438[ab]	22.93	81.76	52.00	0.56
	138 ECS	11.28	0.480[ab]	23.38	83.11	53.50	1.39
	Average	11.57	0.459[AB]	23.15	82.43	52.75	0.97
All Strains	69 ECS	11.54	0.428	21.98	78.12	49.31	0.72
	138 ECS	11.35	0.451	22.63	80.50	51.08	0.76

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS.
AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.
ab - Different letters denote significant differences (P<.01) in the strain*density interactions.
Mortality percentage prior to analyzes was transformed in Square Root Asin

TABLE 49. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder	Density[1]	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
(Strain)	(in^2/hen)	(g/egg)	(%)	(%)	(%)	(%)	(%)
TETRA	69 ECS	61.70^{cd}	0	0	2.76	32.62^{ab}	55.08
Amber	138 ECS	61.40^{cd}	0	0	0	42.12^{a}	48.07
	Average	61.55^{BC}	0	0	1.38	37.37^{AB}	51.58
TETRA	69 ECS	63.21^{abcd}	0	0	0	20.68^{ab}	62.96
Brown	138 ECS	62.92^{bcd}	0	0	0	31.84^{ab}	61.01
	Average	63.06^{ABC}	0	0	0	26.26^{AB}	61.99
Novogen	69 ECS	65.05^{ab}	0	0	2.50	12.32^{ab}	74.63
Brown	138 ECS	63.19^{bcd}	0	0	0.71	22.37^{ab}	65.19
	Average	64.12^{A}	0	0	1.61	17.35^{B}	69.91
Lohmann	69 ECS	64.54^{abc}	0	0	0	18.18^{ab}	69.71
LB-Lite	138 ECS	64.25^{abcd}	0	0	0	9.92^{ab}	68.71
	Average	64.39^{A}	0	0	0	14.04^{B}	69.09
Hy-Line	69 ECS	61.10^{d}	0	0	0	46.88^{a}	48.75
Silver Brown	138 ECS	61.34^{cd}	0	0	0	40.38^{a}	52.73
	Average	61.22^{C}	0	0	0	43.63^{A}	50.74
Hy-Line	69 ECS	63.55^{abcd}	0	0	0	21.20^{ab}	67.49
Brown	138 ECS	63.39^{abcd}	0	0	1.43	22.96^{ab}	63.89
	Average	63.47^{AB}	0	0	0.71	22.08^{AB}	65.69
ISA	69 ECS	66.41^{a}	0	0	0	38.06^{a}	50.48
Brown	138 ECS	62.28^{bcd}	0	0	0	3.33^{b}	74.28
	Average	64.34^{A}	0	0	0	20.70^{B}	62.38
Bovans	69 ECS	63.60^{abcd}	0	0	0	24.12^{ab}	63.00
Brown	138 ECS	64.26^{abcd}	0	0	0	26.50^{ab}	64.35
	Average	63.93^{A}	0	0	0	25.31	63.68
All	69 ECS	63.13	0	0	0.43	26.76	61.48
Strains	138 ECS	63.39	0	0	0.49	24.93	62.28

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS.
ABC - Different letters denote significant differences (P<.01), comparisons made among strain average values.
abcd - Different letters denote significant differences (P<.01) in the strain*density interactions.

TABLE 50. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEMS

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
TETRA	69 ECS	90.45	0	8.59	0.96	2.32	1.33
Amber	138 ECS	90.20	1.67	5.86	2.27	2.43	1.26
	Average	90.32	0.83	7.22	1.62	2.38	1.29
TETRA	69 ECS	83.64	0	16.36	0	2.29	1.25
Brown	138 ECS	92.86	0	4.76	2.38	2.45	1.29
	Average	88.25	0	10.56	1.19	2.37	1.27
Novogen	69 ECS	87.67	1.33	11.00	0	2.47	1.29
Brown	138 ECS	90.06	0	9.94	0	2.50	1.23
	Average	88.86	0.67	10.47	0	2.49	1.26
Lohmann	69 ECS	87.66	0	12.34	0	2.56	1.31
LB-Lite	138 ECS	78.62	0	21.38	0	2.61	1.22
	Average	83.14	0	16.86	0	2.58	1.27
Hy-Line	69 ECS	95.62	0	4.38	0	2.67	1.32
Silver Brown	138 ECS	93.11	0	6.89	0	2.70	1.35
	Average	94.37	0	5.63	0	2.69	1.34
Hy-Line	69 ECS	88.70	0	11.30	0	2.38	1.29
Brown	138 ECS	88.28	0	8.65	3.08	2.27	1.26
	Average	88.49	0	9.98	1.54	2.33	1.28
ISA	69 ECS	88.54	0	10.79	0.66	2.57	1.22
Brown	138 ECS	77.61	0	22.39	0	2.58	1.30
	Average	83.08	0	16.59	0.33	2.58	1.26
Bovans	69 ECS	87.12	0	9.48	3.41	2.52	1.33
Brown	138 ECS	90.85	0	6.65	2.50	2.64	1.26
	Average	88.98	0	8.06	2.95	2.58	1.30
All	69 ECS	88.67	0.16	10.53	0.63	2.47	1.29
Strains	138 ECS	87.70	0.21	10.82	1.28	2.52	1.27

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS.

TABLE 51. EFFECT OF WHITE EGG STRAIN AND PRODUCTION SYSTEM ON BODY WEIGHT OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEM: NON-MOLTED PROGRAM

Breeder (Strain)	Production System	17 Wk* Body Wt (kg)	69 Wk** Body Wt (kg)	1st Cycle Wt Gain (%)	73 Wk** Body Wt (kg)
Bovans White	69 EC	1.22	1.74	42.6	1.78
	69 ECS	1.22	1.64	34.4	1.72
	Average	1.22^{AB}	1.69	38.5	1.75
Shaver White	69 EC	1.35	1.66	23.0	1.71
	69 ECS	1.28	1.73	34.4	1.74
	Average	1.32^{A}	1.70	28.8	1.72
Dekalb White	69 EC	1.20	1.63	36.7	1.73
	69 ECS	1.20	1.61	35.0	1.72
	Average	1.20^{AB}	1.62	35.8	1.72
Babcock White	69 EC	1.28	1.78	39.1	1.79
	69 ECS	1.31	1.74	32.1	1.73
	Average	1.30^{AB}	1.76	35.4	1.76
ISA B-400	69 EC	1.22	1.67	36.9	1.68
	69 ECS	1.18	1.63	39.0	2.09
	Average	1.20^{AB}	1.65	37.5	1.88
Hy-Line W-36	69 EC	1.22	1.65	35.2	1.72
	69 ECS	1.20	1.60	33.3	1.57
	Average	1.21^{AB}	1.62	33.9	1.64
Hy-Line CV-26	69 EC	1.22	1.65	36.1	1.68
	69 ECS	1.12	1.74	54.5	1.87
	Average	1.17^{B}	1.70	44.4	1.77
Hy-Line CV-24	69 EC	1.22	1.62	32.8	1.62
	69 ECS	1.22	1.65	36.1	1.69
	Average	1.22^{AB}	1.64	34.4	1.66
Lohmann LSL Lite	69 EC	1.27	1.68	32.3	1.63
	69 ECS	1.22	1.58	29.5	1.97
	Average	1.24^{AB}	1.63	30.6	1.80
H&N Nick Chick	69 EC	1.21	1.66	36.4	1.71
	69 ECS	1.24	1.66	33.9	1.67
	Average	1.23^{AB}	1.66	35.0	1.69
Novogen White	69 EC	1.24	1.71	37.9	1.75
	69 ECS	1.22	1.64	34.4	1.64
	Average	1.23^{AB}	1.68	35.8	1.70
All Strains	69 EC	1.24	1.68	35.5	1.71
	69 ECS	1.22	1.66	36.1	1.76

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
AB - Different letters denote significant differences (P<.01), comparisons made among strain average values.
(*) All replicates in all strains were weight at 17 wks,
(**) Only a sample of replicates (2 per strain treatment) in each strain were weighted at 69 and 73 wks.

TABLE 52. EFFECT OF BROWN EGG STRAIN AND PRODUCTION SYSTEM ON BODY WEIGHT OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN ENRICHABLE AND ENRICHED COLONY HOUSING SYSTEM: NON-MOLTED PROGRAM

Breeder (Strain)	Production System	17 Wk* Body Wt (kg)	69 Wk** Body Wt (kg)	1st Cycle Wt Gain (%)	73 Wk** Body Wt (kg)
TETRA Amber	69 EC	1.50	2.10	40.0	2.07
	69 ECS	1.50	1.89	26.7	2.02
	Average	1.50	1.99	33.3	2.04
TETRA Brown	69 EC	1.64	1.94	18.3	1.81
	69 ECS	1.54	1.88	22.1	1.87
	Average	1.58	1.91	20.3	1.84
Novogen Brown	69 EC	1.60	1.79	11.9	1.95
	69 ECS	1.55	1.94	25.2	1.91
	Average	1.58	1.86	18.4	1.93
Lohmann LB-Lite	69 EC	1.44	1.79	25.0	1.82
	69 ECS	1.52	2.00	31.6	1.91
	Average	1.48	1.89	28.4	1.86
Hy-Line Silver Brown	69 EC	1.64	1.86	13.4	2.02
	69 ECS	1.42	1.98	39.4	1.98
	Average	1.53	1.92	25.5	2.00
Hy-Line Brown	69 EC	1.62	2.00	23.5	2.00
	69 ECS	1.53	1.87	22.2	2.38
	Average	1.58	1.94	22.8	2.19
ISA Brown	69 EC	1.47	1.92	31.3	1.92
	69 ECS	1.45	1.82	25.5	1.87
	Average	1.46	1.87	28.8	1.89
Bovans Brown	69 EC	1.52	1.98	30.3	1.99
	69 ECS	1.60	1.94	21.3	1.94
	Average	1.56	1.96	25.6	1.96
All Strains	69 EC	1.55	1.92	23.9	1.95
	69 ECS	1.51	1.92	26.5	1.98

Enrichable Cage=EC; Enriched Colony Housing System=ECS.
(*) All replicates in all strains were weight at 17 wks,
(**) Only a sample of replicates (2 per strain treatment) in each strain were weighted at 69 and 73 wks.

TABLE 53. EFFECT OF WHITE EGG STRAIN AND DENSITY ON BODY WEIGHT OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEM: NON-MOLTED PROGRAM

Breeder (Strain)	Density[1] (in^2/hen)	17 Wk* Body Wt (kg)	69 Wk** Body Wt (kg)	1st Cycle Wt Gain (%)	73 Wk** Body Wt (kg)
Bovans White	69 ECS	1.22	1.64^{ab}	34.4	1.72
	138 ECS	1.32	1.82^{ab}	37.9	1.86
	Average	1.27	1.73	36.2	1.79
Shaver White	69 ECS	1.28	1.73^{ab}	34.4	1.74
	138 ECS	1.34	1.92^{ab}	43.3	1.96
	Average	1.32	1.82	38.6	1.85
Dekalb White	69 ECS	1.20	1.61^{ab}	45.0	1.72
	138 ECS	1.20	1.74^{ab}	35.0	1.72
	Average	1.20	1.68	40.0	1.72
Babcock White	69 ECS	1.31	1.74^{ab}	48.1	1.73
	138 ECS	1.36	1.99^{a}	30.9	2.02
	Average	1.34	1.86	39.6	1.88
ISA B-400	69 ECS	1.18	1.63^{ab}	39.0	2.09
	138 ECS	1.23	1.72^{ab}	39.8	1.78
	Average	1.20	1.68	39.2	1.94
Hy-Line W-36	69 ECS	1.20	1.60^{ab}	33.3	1.57
	138 ECS	1.22	1.70^{ab}	39.3	1.70
	Average	1.21	1.65	36.4	1.64
Hy-Line CV-26	69 ECS	1.12	1.74^{ab}	54.5	1.87
	138 ECS	1.19	1.74^{ab}	46.2	1.79
	Average	1.16	1.74	50.0	1.83
Hy-Line CV-24	69 ECS	1.22	1.66^{ab}	36.1	1.69
	138 ECS	1.24	1.82^{ab}	46.8	1.75
	Average	1.23	1.74	41.5	1.72
Lohmann LSL Lite	69 ECS	1.22	1.58^{b}	29.5	1.97
	138 ECS	1.24	1.65^{ab}	33.1	1.69
	Average	1.23	1.62	30.9	1.83
H&N Nick Chick	69 ECS	1.24	1.66^{ab}	33.9	1.67
	138 ECS	1.24	1.83^{ab}	46.8	1.80
	Average	1.24	1.74	40.3	1.74
Novogen White	69 ECS	1.22	1.64^{ab}	34.4	1.64
	138 ECS	1.26	1.83^{ab}	46.0	1.87
	Average	1.24	1.74	40.3	1.76
All Strains	69 ECS	1.22	1.66^{Y}	36.1^{Y}	1.76
	138 ECS	1.26	1.80^{Z}	42.9^{Z}	1.81

[1]All strains were housed such that each strain is equally represented in each density.
Enriched Colony Housing System=ECS.
ab - Different letters denote significant differences (P<.01) in the strain*density interactions.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.
(*) All replicates in all strains were weight at 17 wks,
(**) Only a sample of replicates (2 per strain treatment) in each strain were weighted at 69 and 73 wks.

TABLE 54. EFFECT OF BROWN EGG STRAIN AND DENSITY ON BODY WEIGHT OF HENS IN THE 39th NCLP&MT (483-511 DAYS) IN THE ENRICHED COLONY HOUSING SYSTEM: NON-MOLTED PROGRAM

Breeder (Strain)	Density[1] (in^2/hen)	17 Wk* Body Wt (kg)	69 Wk** Body Wt (kg)	1st Cycle Wt Gain (%)	73 Wk** Body Wt (kg)
TETRA Amber	69 ECS	1.50	1.89	26.7	2.02
	138 ECS	1.55	2.04	31.0	2.15
	Average	1.52	1.96	28.9	2.07
TETRA Brown	69 ECS	1.54	1.88	22.1	1.87
	138 ECS	1.58	1.95	22.8	2.02
	Average	1.56	1.92	22.4	1.94
Novogen Brown	69 ECS	1.55	1.94	24.5	1.91
	138 ECS	1.58	1.94	22.8	2.02
	Average	1.56	1.94	23.7	1.97
Lohmann LB-Lite	69 ECS	1.52	2.00	31.6	1.90
	138 ECS	1.57	1.92	22.9	2.04
	Average	1.54	1.96	27.3	1.97
Hy-Line Silver Brown	69 ECS	1.42	1.98	39.4	1.98
	138 ECS	1.70	2.16	27.1	2.18
	Average	1.56	2.07	32.7	2.08
Hy-Line Brown	69 ECS	1.53	1.87	22.2	2.38
	138 ECS	1.64	2.08	28.0	2.09
	Average	1.58	1.98	25.3	2.24
ISA Brown	69 ECS	1.45	1.82	25.5	1.87
	138 ECS	1.48	2.06	39.2	2.06
	Average	1.46	1.94	32.9	1.96
Bovans Brown	69 ECS	1.60	1.94	21.3	1.94
	138 ECS	1.60	2.04	27.5	2.06
	Average	1.60	1.99	24.4	2.00
All Strains	69 ECS	1.51	1.92[Z]	26.5	1.98
	138 ECS	1.58	2.02[Y]	27.8	2.07

Enriched Colony Housing System=ECS.
YZ - Different letters denote significant differences (P<.01), comparisons made among density average values.
(*) All replicates in all strains were weighed at 17 wks,
(**) Only a sample of replicates (2 per strain treatment) in each strain were weighed at 69 and 73 wks.

Table 55. Entries in the 39th NCLP&MT by Breeder, Stock Suppliers, and Categories			
Breeder	Stock	Category[1]	Source
Hy-Line International 2583 240th Street Dallas Center, IA 50063	W-36 Hy-Line Brown Hy-Line Silver Brown CV22 CV24 CV26	I-A I-A III-A II-A II-A II-A	Hy-Line North America 4432 Highway 213, Box 309 Mansfield, GA 30255 (Same) (Same) (Same) (Same) (Same)
Lohmann Tierzucht Gmbh Am Seedeich 9-11 . P.O.Box 460 D-27454 Cuxhaven, Germany	Lohmann LSL-Lite Lohmann LB-Lite	I-A I-A	Hy-Line North America Elizabeth-town 79 Industrial Rd Elizabethtown, PA 17022 (Same)
H&N International 321 Burnett Ave South, Suite 300 Renton, Washington 98055	H&N "Nick Chick"	I-A	Feather Land Farms 32832 E. Peral Road Coberg, OR 97408
Instiut de Selection Animale (A Hen-drix Genetic Company) ISA North America 650 Riverbend Drive, Suite C Kitchener, Ontario N2K 3S2 Canada	Bovans White Dekalb White Bovans Brown Babcock White B 400 Shaver White ISA Brown	I-A I-A I-A II-A II-A I-A I-A	CPI-South Central Hatchery 5087 County Road 35 Bremen, AL 35033 (Same) (Same) Institute de Sélection Animale 650 Riverbend Dr. Suite C Kitchener, Ontario N2K 3S2 Canada (Same) Midwest Farms, LLC. 135 S. Epes St. Blackstone, VA 23824 (Same)
Tetra Americana, LLC 1105 Washington Road Lexington, GA 30648	TETRA Brown TETRA Amber	I-A I-A	CPI-MidAmerica Hatchery Lexington, GA 30648 (Same)
NOVOGEN S.A.S. Mauguérand – Le Foeil BP 265 22 800 QUINTIN - FRANCE	NOVOgen BROWN NOVOgen WHITE	I-A I-A	Morris Hatchery 18370 SW 232 Street, Goulds, FL 33170-5399 Pennovo Hatchery 621 Stevens Road Ephrata, PA 17522

[1] I = Extensive distribution in southeast United States A = Entry requested
II = Little or no distribution in southeast United States
III = Unavailable for commercial distribution in United States