North Carolina Cooperative Extension Service
NC STATE UNIVERSITY
College of Agriculture and Life Sciences
Prestage Department of Poultry Science
Scott Hall / Campus Box 7608
Raleigh, NC 27695-7608

919.515.2621 (phone)
919.515.7070 (fax)

FIRST CYCLE REPORT OF THE FORTIETH 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 (NCSU) and the North Carolina Department of Agriculture and Consumer Services. The flock is maintained at the Piedmont Research Station-Poultry Unit, Salisbury, North Carolina. Mrs. Teresa Herman is Piedmont Research Station Superintendent; Mrs. Kelly Brannan 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 here represents the analysis of the first production cycle and molt of the 40th North Carolina Layer Performance and Management Test. Performance summary tables are available for each strain, molt, density and production system tested. First production cycle and molt data were collected for 18 strains and 3 production systems: Conventional Cage, Colony Housing System, and Enriched Colony Housing System.

Copies of current and past reports are maintained for public access at
http://www.ces.ncsu.edu/depts/poulsci/tech_manuals/layer_reports/40_first_cycle report.pdf .

For further information, contact:

Dr. Kenneth E. Anderson
Poultry Science Department
North Carolina State University
Box 7608
Raleigh, NC 27695-7608
Phone (919) 515-5527
FAX (919) 515-7070
ken_anderson@ncsu.edu

[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.

40th NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST
Volume 40 No. 3

Report on the First Laying Cycle and Molt

DESCRIPTION OF DATA TABLE STATISTICS

First cycle performance data for white and brown-egg strains in the 3 production systems are reported for 17-69 weeks of age (1st Cycle) and 69-73 weeks of age (Molt). Data for Conventional Cage systems are reported in Tables 13 to 34. Data for the Colony Housing System and the Enriched Colony Housing System for the same time periods are in Tables 35 to 56. Mortality Summary data are in Tables 57 and 58.

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Dates of Importance:

Eighteen strains were accepted or acquired in accordance with the rules and regulations of the test. The eggs were placed into trays and set on May 10, 2016 and were pulled from the hatchers on June 1, 2016. Eleven commercial white-egg strains and 7 commercial brown-egg strains participated in the current test. Table 1 shows the strains included, the source of the laying stock (Breeder), and the 5 total test environments (Conventional Cage, Colony Housing System, Enriched Colony Housing System, Cage Free, and Free-Range Environment). This report covers the 3 production systems used for the first laying cycle and molt data collection.

Table 1. 40th North Carolina Layer Performance and Management Test Strain Code Assignments

Strain No.	Source of Stock	Source Code	Strain	Participation[1]
1	ISA	ISA	Bovans White	C, CS, ECS
2	ISA	ISA	Shaver White	C, CS, ECS
3	ISA	ISA	Dekalb White	C, CS, ECS, CF
4	ISA	ISA	Babcock White	C, CS, ECS, CF
5	ISA	ISA	B 400 White	C, CS, ECS
6	Hy-Line	HL	W-80	C, CS, ECS, CF
7	Hy-Line	HL	W-36	C, CS, ECS, CF
8	Hy-Line	HL	White Exp	CF, R
9	Lohmann	L	LSL Lite	C, CS, ECS, CF
10	H&N	H&N	H&N Nick Chick	C, CS, ECS, CF
11	Novogen	N	Novowhite	C, CS, ECS, CF
12	ISA	ISA	Bovans Brown	C, CS, ECS, CF
13	ISA	ISA	ISA Brown	C, CS, ECS, CF
14	Hy-Line	HL	Brown	C, CS, ECS, CF, R
15	Hy-Line	HL	Silver Brown	C, CS, ECS, CF, R
16	Lohmann	L	LB Lite	C, CS, ECS, CF, R
17	Novogen	N	Novobrown	C, CS, ECS, CF
18	Tetra Americana	TA	TETRA Brown	C, CS, ECS, CF

[1] Identifies the test environments each strain participated in: Conventional Cage=C; Colony Housing System=CS; Enriched Colony Housing System=ECS; Cage Free=CF; Free-Range=R.
This report covers the 3 test environments that were tracked through molting (C, CS, ECS). The dashed line separates white-egg and brown-egg strains.

Experimental Components of Importance:

Samples of fertile eggs provided from the breeding Companies were set and hatched concurrently as described in the hatch report (Hatch/Serology Report Vol. 40, No. 1. At hatch, the chicks were sexed according to breeder recommendations, (*i.e.* feather, color, or vent sexing) to remove the males.

The rearing phase took place in the pullet brood/grow environment. At the conclusion of the 16-wk rearing phase, the pullets were moved to the conventional cage, colony housing system, or enriched colony housing system then transitioned to the laying phase. At the initiation of the layer test, the strains of white and brown-egg hens were equally represented in each test environment.

The first cycle production records of the laying phase commenced on August 28, 2016 (17 weeks of age) and continued through the molt period which was induced on September 27, 2017 (69 weeks of age) and ended on October 25, 2017 (73 weeks of age). This report includes production data summarized for 17 to 69 weeks, and 69 to 73 weeks for each production system tracked through molting. Tables showing the changes in body weights from 17 to 69 weeks of age and the weight loss during the molt period are included in the molt period information.

Table 2. 40th North Carolina Layer Performance and Management Test Strain Code Assignments for the First-Cycle Report

Strain No.	Source of Stock	Source Code	Strain	Participation[1]
1	ISA	ISA	Bovans White	C, CS, ECS
2	ISA	ISA	Shaver White	C, CS, ECS
3	ISA	ISA	Dekalb White	C, CS, ECS
4	ISA	ISA	Babcock White	C, CS, ECS
5	ISA	ISA	B 400 White	C, CS, ECS
6	Hy-Line	HL	W-80	C, CS, ECS
7	Hy-Line	HL	W-36	C, CS, ECS
9	Lohmann	L	LSL Lite	C, CS, ECS
10	H&N	H&N	H&N Nick Chick	C, CS, ECS
11	Novogen	N	Novowhite	C, CS, ECS
12	ISA	ISA	Bovans Brown	C, CS, ECS
13	ISA	ISA	ISA Brown	C, CS, ECS
14	Hy-Line	HL	Brown	C, CS, ECS
15	Hy-Line	HL	Silver Brown	C, CS, ECS
16	Lohmann	L	LB Lite	C, CS, ECS
17	Novogen	N	Novobrown	C, CS, ECS
18	Tetra Americana	TA	TETRA Brown	C, CS, ECS

[1] Identifies the test environments each strain participated in: Conventional Cage=C; Colony Housing System=CS; Enriched Colony Housing System=ECS. The dashed line separates white-egg and brown-egg strains.

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 and production system.

Pullet Housing and Management:

Housing: The hens used in this study were reared in an environment similar to what they would be in during the laying phase (40th NCLP&MT Grow Report, Vol. 40, No. 2). White-egg strains occupied approximately 60% of cage replicates, and brown-egg strains occupied the other 40 % in accordance with the # of white-egg strains and brown-egg strains tested. Individual hens were identified by strain assignment codes that indicated the cage arrangement, replicate identification numbers, and the strain. Brood-grow House 8 was used to rear the pullets for the conventional cage, colony housing system, and the enriched colony housing system. In brief, House 8 is an environmentally controlled, windowless brood-grow facility with 4 rooms, each containing 72 replicates within a 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. Each rearing replicate of 4 cages (13 chicks per 24" x 26" cage), housed one of the 11 white-egg and 7 brown-egg strains. The chicks were in the same cage during the entire 16-wk rearing period. Cage density was 310 cm^2 (48 in^2) per individual for both the white

and brown-egg layers. Strain codes were maintained by the PI and Unit Manager for identification of birds and record keeping. Birds were individually tagged at hatch for rearing. Pullets were fed *ad libitum*, and 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 40th NCLP&MT Grow Report.

Layer Housing:

At 16 wks, when transferred to the laying house, each pullet was identified with the laying house replicate number: row, level and replicate that identifies the strain to the unit manager and PI. Pullet transfer to laying houses (5 C and 7 CS and ECS) was done in accordance with NCSU IACUC approved methods. The pullets were randomly assigned by strains to the replicates in a way that replicates of white-egg and brown-egg strains were intermingled throughout the houses. Both houses contained a feeder system that allowed feed consumption to be determined by replicate and layer diet fed. Laying Hen Cage Facilities utilized in this test consist of two houses (Table 3). In all 3 test environments (ECS, CS, C), the area per hen was the same: 69 in^2 for white-egg strains and 80 in^2 for brown-egg strains.

Table 3. Replicate numbers and Hen populations in the Colony Housing System, Enriched Colony Housing System, and Conventional Cage System

House	Cage Style[1]	Egg Color	Molt Trtmt[2]	Number of Replicates	Hens per replicate	Hen No.	Total Hens
5	CS	White	NM	33	36	1,188	
5	ECS	White	NM	33	36	1,188	
5	CS	White	NA	33	36	1,188	
5	ECS	White	NA	33	36	1,188	4,752
5	CS	Brown	NM	21	31	651	
5	ECS	Brown	NM	21	31	651	
5	CS	Brown	NA	21	31	651	
5	ECS	Brown	NA	21	31	651	2,604
7	C	White	NM	44	28	1,232	
7	C	White	NA	44	28	1,232	
7	C	Brown	NM	28	24	672	
7	C	Brown	NA	28	24	672	3,808

[1]Conventional Cage=C; Colony Housing System=CS; Enriched Colony Housing System=ECS
[2]Molt treatment: NA=Non-anorexic molt, NM=Non molted

House 5 contained the Colony Housing Systems (CS) and Enriched Colony Housing Systems (ECS). It is a standard height, windowless, force ventilated laying house with battery style cages using a belt manure handling system. It has 4 banks of triple deck cages, two banks used for ECS and two banks used for CS. In house 5, each side of a bank was designated as a row, and each row was divided into nine 10' cage-row replicates of ECS and CS cages that were 21" high by 26" deep by 96" wide for a total area of 2,496 in^2 with a 2' space between cage sections for feed hoppers and feed recovery. The bird population was held constant at 36 white-egg strain hens per cage (69 in^2 per hen) or 31 brown-egg strain hens per cage (80 in^2 per hen). In House 5, the total population was 7,356 hens (Table 3).

House 7 contained the Conventional Cage systems. It is also a standard height, windowless, enclosed force ventilated laying house. The cages consisted of 4 rows of a Conventional Cage system, Tri-Deck Stacked Layer Cage System, Battery Style with Manure Belts. There was 60' of cage row with each side being designated a row. Each row was divided into six 10' cage-row sections with - two 16" high by 20" deep by 48" wide cages per section and a 24" space between cage sections for feed hoppers and feed recovery. This cage design provided for 144 experimental units, each consisting of 2 cages. The bird population was held constant at 14 white-egg strain hens/cage (69 in^2/hen) for 28 hens/replicate or 12 brown-egg strain hens/cage (80 in^2/hen) for 24 hens/replicate for 3,808 hens (Table 3).

Lighting

The lighting schedule for the hens in the C, CS, and ECS controlled environment facilities increased with hen age (Table 4).

Table 4. Layer House Lighting Schedules

Age	Date	Photo Period[1]
(weeks)		(Daylight hrs)
16-17	Sept. 21, 2016	10.0
17	Sept. 28, 2016	11.0
18	Oct. 5, 2016	11.5
19	Oct. 12, 2016	12.0
20	Oct. 19, 2016	12.5
21	Oct. 26, 2016	13.0
22	Nov. 2, 2016	13.5
23	Nov. 9, 2016	14.0
24	Nov. 16, 2016	14.25
25	Nov. 23, 2016	14.5
26	Nov. 30, 2016	14.75
27	Dec. 7, 2016	15.0
28	Dec. 14, 2016	15.25
29	Dec. 21, 2016	15.5
30	Dec. 28, 2016	15.75
31-69	Jan. 4, 2017	16.0
Molt Period		
69-72	Sept. 27, 2017	16.0
73-108	Oct. 25, 2017	16.0
109	Aug. 1, 2018	16.0

[1]Lighting schedules were the same for C, CS, and ECS.
[2]Light intensity was 0.5 to 0.7 ft candle at the second tier

FDA Egg Safety Testing

In accordance with the Egg Safety Rule and the NCLP&MT Egg Safety Plan, the cage, cage-free and range environments were tested for the presence of *Salmonella enteritidis* when pullets were between the ages of 14 and 16 weeks and layers were between the ages of 40 and 44 weeks. Environmental swabs were collected in accordance with our FDA Egg Safety Plan.

Salmonella Enteritidis assessment- On Monday, November 27, 2017, 23 environmental swabs were received from NCSU Prestage Department of Poultry Science (PI – Anderson) for Salmonella Enteritidis assessment of the 40th NCLP&MT. All swabs were pre-enriched overnight in sterile buffered peptone water (37C). Aliquots from each sample were then transferred to both TT and RV selective enrichment broths overnight (42C). Selective enrichments were then struck onto both BGS and XLT-4 selective agars. Twenty-two samples were negative on both BGS and XLT-4. Therefore, no further transfers were required. One sample was positive on both TT and RV enriched XLT-4. The sample was subsequently positive on LIA and TSI slants and for general *Salmonella* spp. Latex agglutination as well. However, the sample was negative for Group D agglutination so it was not *Salmonella enteritidis*. Both negative and positive controls grew appropriately through each stage of growth.

Layer Nutrition

Layer diets were identified as Diets D, E, F, G, H, I, M, N, and O which consisted of a pre-lay diet and a series of layer diets formulated to assure a daily protein, mineral and amino acid intake as shown below. 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 (Tables 5-7).

Table 5. Minimum Daily Intake of Nutrients Per Bird at Various Stages of Production

	Production Stage[1]			
Daily Intake	Pre-Peak > 87%	87-80%	80-70%	<70%
White-Egg Layers				
Protein[2](g/day)	19.00	18.0	17.00	16.00
Calcium (g/day)	4.00	4.10	4.20	4.30
Lysine (mg/day	820.00	780.00	730.00	690.00
TSAA (mg/day)	700.00	670.00	630.00	590.00
Brown-Egg Layers				
Protein[2](g/day)	20.00	19.00	18.00	17.00
Calcium (g/day)	4.00	4.00	4.10	4.20
Lysine (mg/day	830.00	820.00	780.00	730.00
TSAA (mg/day)	710.00	700.00	670.00	630.00

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[1]Predicted Production, as determined by Hen-Day Egg Production

[2]If the egg production was higher than predicted values, protein intake was increased by 1%

Table 6: Laying House Feeding Program

Rate of Production	Consumption (kg/100 Birds/Day)	Diet Fed	
		White-Egg Strains	Brown-Egg Strains
Pre-production (15-17 wks)	< 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

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

Table 7. Laying Periods Feed Formulations[1] D through G

Ingredients	D	E	F	G
	(lbs.)	(lbs.)	(lbs.)	(lbs.)
Corn	879.44	1166.03	1202.70	1240.88
Soybean meal	636.39	564.55	533.71	506.44
Fat (Lard)	10.00	10.00	-	-
D.L. Methionine	3.41	2.92	2.31	2.04
Soybean oil	45.85	25.90	36.29	25.06
Ground Limestone	124.15	122.36	121.69	110.55
Coarse Limestone	70.00	70.00	70.00	75.00
Bi-Carbonate	2.00	2.00	2.00	3.00
Phosphate Mono/D	21.93	21.50	17.93	26.03
Salt	6.96	6.41	5.88	5.00
Vit. premix	1.00	1.00	1.00	1.00
Min. premix	1.00	1.00	1.00	1.00
HyD3 Broiler(62.5 mg/lb)	-	-	0.50	-
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%	1.62	1.94	1.59	1.00
Avizyme	1.00	1.00	-	-
Ronozyme P-CT 540%	0.40	0.40	0.40	-
Calculated Analysis				
Protein %	19.43	18.10	17.50	17.00
ME kcal/kg	2926.00	2904.00	2882.00	2860.00
Calcium %	4.10	4.05	4.00	3.95
A. Phos. %	0.45	0.44	0.40	0.38
Lysine %	1.10	1.00	0.96	0.91
TSAA %	0.80	0.74	0.69	0.66

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[1] Feed formulations by Dr L. Minear, Consulting Nutritionist, and manufacturing by Land'O Lakes

Molting

Birds in the molt program (NA= non-anorexic molt) were to lose approximately 20±3% of their body weight. Half of the replicates in House 5 and House 7 were molted using a modified Non-anorexic Molt diet (low ME) as described in the procedural steps outlined below (Table 8). The other half served as full-fed control replicates (NM=non-molted) that were maintained according to the standard management program (Table 6). The molt program hens were fed a low protein, low energy diet with supplemental Ca for maintenance. They were allowed to consume all of the molt feed provided between feedings. The bulk density of the molt diet was approximately 2/3 of a typical layer diet. Two diets were provided during the molt period: first, Non-anorexic Molt, a low protein/energy diet, followed by Resting Diet (Table 9). The Non-anorexic Molt diet was formulated to provide nutrition for body maintenance, but allow loss of body weight. The Resting Diet was to provide layers with the nutrients needed to maintain a static body weight with no egg production. Because ambient temperature dictates the body maintenance demand of hens, diet was modified in response to house temperature. If the house temperature was 75 to 80°F, feed protein content was increased accordingly to compensate for metabolic heat needed to maintain a homeostatic body temperature.

Table 8. Modified Non-Anorexic Molt Procedural Steps

Date	Molt Day	Activity[1]	Transition to resting diet by Strain based on 20% BW loss[2]
Sept 19	-7	All strains, all replicates weighed	
Sept 27	0	All molt replicates switched to molt feed, all replicates weighed-back	
Oct 4	7	House 5: all 18 strains weighed	House 5: 6 strains
		House 7: all 18 strains weighed	House 7: 6 strains
Oct 6	9	House 5: remaining 12 strains weighed	House 5: 4 strains
		House 7: remaining 12 strains weighed	House 7: no changes
Oct 9	12	House 5: remaining 8 strains weighed	House 5: no changes
		House 7: remaining 12 strains weighed	House 7: no changes
Oct 13	16	House 5: remaining 8 strains weighed	House 5: 2 strains
		House 7: remaining 12 strains weighed	House 7: 3 strains
Oct 16	1d	House 5: remaining 6 strains weighed	House 5: 2 strains
		House 7: remaining 9 strains weighed	House 7: no changes
Oct 18	21[3]	House 5: 10 strains weighed	House 5: 10 strains Lay Diet E
		House 7: 4 strains weighed	House 7: 4 strains Lay Diet E
Oct 20	23	House 5: remaining strains weighed	House 5: 1 strains
		House 7: remaining strains weighed	House 7: 1 strains
Oct 25-26	28	Molt end, weigh-back feed	Remaining strains switched to E
	29	All strains, all replicates weighed	

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[1]The strains progressed independently through the molt program in accordance with their weight loss

[2]All replicates for a strain x house treatment with an increase in mortality hens, based on body weight, were immediately returned to Layer Diet E

The strains progressed independently through the molt program in accordance with their weight loss based on body weights taken during the molt. After attaining 20% (±3%) BW loss, a strain was transitioned to the resting diet. In general, the hens ceased egg production by Day 6-10 of the molt program. However, some of the brown-egg strains never achieved zero egg production. Livability

was excellent with this program. Regardless of body weight, strains within the systems with an increase in mortality greater than 2.5% hens were immediately returned to Layer Diet E (Table 8). In contrast to replicates in the molt program, the full-fed control replicates were maintained on layer diets as prescribed by consumption and egg production.

Conditions for the molt program

House temperatures were to remain at 80± 5º F, but were regulated so the birds did not pant. The lighting was increased to 16 hours of light per day (Table 4).

Table 9. Laying Periods Feed Formulations[1] Molt and Resting Diets

Ingredient	Molt Diets	
	Low ME[2]	Resting
	(lbs.)	(lbs.)
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
.06% Sel Premix	1.00	1.00
Total	2000.00	2000.00
Calculated Analysis		
Protein %	9.92	11.75
Me kcal/kg	1650.00	2859.00
Calcium %	1.33	3.80
T. Phos %	0.88	0.44
Lysine %	0.42	0.55
TSAA %	0.35	0.49

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[1]Feed formulations by Dr L. Minear, Consulting Nutritionist and were manufactured by Land'O Lakes

[2]Low ME = Non-anorexic molt diet (NA).

Data Collection – Terms, Schedule and Procedures:

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

Breeder (Strain)-- Short identification codes of the breeder and strain of the stock were developed

(Tables 1, 2 and 59). Body weights--Birds were weighed at start of 1st cycle (17 wks), end of 1st cycle (69 wks), and start of the 2nd cycle (73 wk). Body weight gain for the 1st cycle was reported for each strain-test environment. In the Molt period, lowest body weight, percent weight loss, and 73-wk body weight for each strain-test environment were reported.

Egg Income--Egg income per hen housed was calculated using the test's egg production values, the current production year calendar and applying the regional 3-year average egg prices (11/27/2015 to 11/25/2017, Table 10) 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).

Table 10. Three-year Regional Average Egg Prices

Grade	Size	$/Dozen[1]
A	Extra Large	1.54
A	Large	1.40
A	Medium	1.07
A	Small	0.78
A[2]	Pee Wee	0.39
B[3]	All	0.74
Checks[3]	All	0.74

[1]Price per dozen calculated from the SE Regional Egg Prices reported to USDA-AMS
[2]Prices are estimates based upon the formula provided by D.D. Bell (Small x 0.5)
[3]Prices are estimates based upon the formula provided by D.D. Bell (Large x 0.53)

Egg Production--All eggs that had the potential of being marketed were credited toward the test unit's (replicate's) egg production, regardless of the shell condition at the time of collection. All eggs were collected and recorded daily. Egg production was summarized at 28-day intervals, and was reported on a Hen-Housed and Hen-Day basis.

1. Hen Housed Egg Production (per Bird): The total number of eggs produced divided by the number of birds housed.
2. Hen Day Egg Production: The average daily number of eggs produced per 100 hens (%)

Egg Weight--At 28-day intervals, all eggs produced in the previous 24-hour period were weighed and sorted by size (See egg size distribution). Average egg weight (g/hen), and egg mass (g), as well as percentages of eggs within each size category were reported.

1. Egg Mass: The average daily production of egg mass in grams per hen day.
2. 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 Quality--At 28-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.

Egg Size Distribution--At 28-day intervals, all eggs produced within the previous 24 hours were weighed and sorted according to current USDA standards for egg size classifications (Table 11). There has been blending of egg size in this test using the weight cutoff of 23.5 between medium

and large eggs. This maximizes the number of USDA large eggs just as would occur in a commercial plant. Size distribution was reported as the proportion of eggs falling into each size category.

Table 11. USDA Egg Weights Used to Establish the Egg Size Distribution

Size Category	Ounces[1]/Dozen	Grams/Egg
Pee Wee	< 18	<42.6
Small	18 – 21	42.6 < 56.8
Medium	21 - 24	49.7 < 56.8
Large	24 – 27	56.8 -63.9
Extra Large	> 27	>63.9

[1]1 oz. = 28.4 g

Feed Consumption --All feed offered for consumption was recorded for each replicate. At 28-day intervals, feed not consumed was weighed back to calculate daily feed consumption (kg feed/100 hens/day). Values were combined to determine overall feed consumption between 17 – 69 wks expressed in units of daily feed intake.

Feed Conversion--The grams of eggs produced per gram of feed consumed calculated at 28-day intervals.

Feed Costs--Calculation of feed cost per hen housed using the kilograms of feed consumed and the average price of each diet per ton based on the actual feed prices for each feed delivery. Calculated costs for the complete production cycle (Table 12).

Table 12. The Average Contract Feed Prices for Feed Purchases during the First Cycle and Molt.

Diets	Price ($) / Ton
D	338.60
E	326.06
F	318.08
G	306.49
Molt Diet LP/LE	261.33
Resting	252.80

Grade Information-- The average grade, according to USDA grading standards, of all eggs sampled over all sampling periods. Grades were determined by personnel trained in accordance with the USDA grading standards (USDA Egg Grading Manual).

Mortality--All mortalities were recorded daily, and when possible, the potential causes of the mortalities were documented. Mortalities due to obvious accidents were not included in numbers reported. Veterinarians collected mortality samples for necropsy at intervals during the 1st cycle, and percent mortality during 1st Cycle (17-69 wks) and Molt (69-73 wks) were reported separately (Table 57 and 58).

Statistical Analyses and Separation of Means:

All data were subjected to ANOVA utilizing the GLM procedure of JMP with main effects of strain, density, and production system used herein. Separate analyses were conducted for white and brown-egg strains, the densities within production systems, and between the conventional cage, colony housing system and enriched colony housing system. Significant differences ($P < 0.01$) within white and brown-egg strains were noted by differing letters among columns of means. First and second order interactions were tested for significance. The LS Means from the GLM Procedure were separated via the PDIFF option.

Table 13. Effect of White-Egg Strain on Performance of Hens (17-69 wks) in Conventional Cages

Breeder (Strain)	Density[1] (in^2/hen)	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs per Bird Housed (#)	Hen-Day Egg Production[2] (%)	Egg Mass (g/HD)[3]	Mortality (%)	Age at 50% Production (Weeks)
Bovans White	69	9.97^{bcde}	0.51	307^{abc}	87.11	51.70	9.82^{ab}	20.2^{abc}
Shaver White	69	9.71^{def}	0.54	312^{abc}	89.35	53.16	9.37^{ab}	19.2^{c}
Dekalb White	69	10.60^{a}	0.51	320^{ab}	89.95	54.60	7.14^{ab}	20.1^{abc}
Babcock White	69	10.22^{abc}	0.53	325^{a}	90.34	55.06	2.68^{b}	20.0^{bc}
ISA B-400	69	9.43^{f}	0.57	324^{a}	90.26	54.25	3.12^{ab}	19.9^{c}
Hy-Line W-80	69	9.76^{cdef}	0.51	299^{c}	86.41	51.12	12.50^{a}	20.4^{abc}
Hy-Line W-36	69	9.60^{ef}	0.51	302^{bc}	83.58	49.96	1.34^{b}	20.6^{a}
Lohmann LSL Lite	69	10.16^{abcd}	0.52	305^{bc}	86.32	53.07	5.35^{ab}	20.4^{ab}
H&N Nick Chick	69	10.31^{ab}	0.52	307^{abc}	87.09	54.94	8.93^{ab}	20.5^{a}
Novogen Novowhite	69	10.30^{ab}	0.50	296^{c}	85.83	52.56	12.49^{a}	20.3^{abc}
All Strains	69	10.03	0.52	310	87.62	53.11	7.27	20.2

40th NCLP&MT

[1]In each test environment (C, CS, ECS), all white-egg strains were housed at the same density (in^2/hen)

[2]The average daily number of eggs produced per 100 hens (%)

[3]HD = hen day

a,b,c,d,e, f - Different letters denote significant differences (P<0.01) for comparisons made among strains.

Table 14. Effect of White-Egg Strain on Egg Weight and Egg Size Distribution of Hens (17-69 wks) in Conventional Cages.

Breeder (Strain)	Density[1] (in^2/hen)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans White	69	58.34[b]	0.13	6.00	5.45	37.87[a]	50.53[c]
Shaver White	69	58.59[ab]	0.23	4.87	4.30	36.94[a]	53.65[bc]
Dekalb White	69	59.64[ab]	0.00	5.21	4.26	29.45[abc]	61.08[abc]
Babcock White	69	60.02[ab]	0.15	4.71	3.84	29.29[abc]	62.01[abc]
ISA B-400	69	59.28[ab]	0.05	3.67	5.49	33.70[abc]	57.09[bc]
Hy-Line W-80	69	58.08[b]	0.31	6.27	4.35	38.39[a]	50.68[c]
Hy-Line W-36	69	58.67[ab]	0.00	5.39	5.36	34.88[ab]	54.37[bc]
Lohmann LSL Lite	69	60.86[ab]	0.00	4.92	4.23	22.98[cd]	67.86[ab]
H&N Nick Chick	69	61.63[a]	0.14	4.85	3.62	17.32[d]	74.08[a]
Novogen Novowhite	69	60.08[ab]	0.00	4.94	4.53	25.02[bcd]	65.52[ab]
All Strains	69	59.52	0.10	5.08	4.54	30.58	59.69

40th NCLP&MT

[1]In each test environment (C, CS, ECS), all white-egg strains were housed at the same density

a,b,c,d,- Different letters denote significant differences (P<0.01), comparisons made among strains

Table 15. Effect of White-Egg Strain on Egg Quality, Income and Feed Costs of Hens (17-69 wks) in Conventional Cages

Breeder (Strain)	Density[1] (in^2/hen)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	1st Cycle Egg Income ($/hen)	1st Cycle Feed Costs ($/hen)
Bovans White	69	93.44	0.23	6.00	0.34	35.99^{bc}	13.08^{abcd}
Shaver White	69	93.22	0.46	6.20	0.11	37.22^{ab}	12.74^{bcd}
Dekalb White	69	94.41	0.22	5.29	0.08	37.75^{a}	13.91^{a}
Babcock White	69	93.57	0.33	5.90	0.20	37.75^{a}	13.41^{abc}
ISA B-400	69	93.15	0.42	6.37	0.07	37.53^{ab}	12.38^{d}
Hy-Line W-80	69	94.53	0.29	5.14	0.16	36.09^{bc}	12.81^{bcd}
Hy-Line W-36	69	93.87	0.25	5.68	0.19	34.88^{c}	12.60^{cd}
Lohmann LSL Lite	69	92.86	0.48	6.46	0.20	36.29^{abc}	13.33^{abc}
H&N Nick Chick	69	94.62	0.33	5.01	0.04	37.20^{ab}	13.53^{ab}
Novogen Novowhite	69	95.27	0.50	4.12	0.11	36.33^{abc}	13.47^{abc}
All Strains	69	93.89	0.35	5.60	0.15	36.70	13.12

40th NCLP&MT

[1] In each test environment (C, CS, ECS), all white-egg strains were housed at the same density.

a,b,c,d - Different letters denote significant differences (P<0.01), comparisons made among strain average values.

Table 16. Effect of Brown-Egg Strain on Performance of Hens (17–69 wks) in Conventional Cages

Breeder (Strain)	Density[1] (in^2/hen)	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed (#)	Hen-Day Egg Production[2] (%)	Egg Mass (g/HD)[3]	Mortality (%)	Age at 50% Production (Days)
Bovans Brown	80	10.60^{ab}	0.49	301^{ab}	84.79	52.45	6.77^{ab}	140.75^{a}
ISA Brown	80	10.49^{ab}	0.51	314^{a}	87.20	53.98	3.12^{b}	140.88a
Hy-Line Brown	80	10.22^{b}	0.47	288^{b}	81.05	48.43	5.73^{ab}	139.25^{ab}
Hy-Line Silver Brown	80	10.62^{a}	0.46	298^{ab}	85.32	49.08	9.89^{ab}	138.62^{ab}
Lohmann LB-Lite	80	10.22^{b}	0.50	284^{b}	83.34	50.90	22.40^{a}	137.25^{b}
Novogen Novobrown	80	10.44^{ab}	0.50	300^{ab}	84.50	52.31	8.85^{ab}	140.00^{ab}
TETRA Brown	80	10.48^{ab}	0.47	292^{ab}	82.00	49.76	7.29^{ab}	138.88^{ab}
All Strains	80	10.44	0.48	297	84.03	50.99	9.15	139.38

40th NCLP&MT

[1]In each test environment (C, CS, ECS), all brown-egg strains were housed at the same density (in^2/hen).

[2]The average daily number of eggs produced per 100 hens (%)

[3]HD = hen day

a.b - Different letters denote significant differences (P<0.01), comparisons made among strain average values.

Table 17. Effect of Brown-Egg Strain on Egg Weight and Egg Size Distribution of Hens (17–69 wks) in Conventional Cages

Breeder (Strain)	Density[1] (in^2/hen)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans Brown	80	61.01[a]	0.10	2.52	5.62	24.91[c]	66.86[a]
ISA Brown	80	60.99[a]	0.00	1.88	6.21	23.92[c]	68.00[a]
Hy-Line Brown	80	59.30[ab]	0.00	1.16	7.06	33.98[b]	57.81[a]
Hy-Line Silver Brown	80	57.02[b]	0.00	2.65	8.11	53.57[a]	35.67[b]
Lohmann LB-Lite	80	60.49[a]	0.00	2.30	5.85	29.26[bc]	62.59[a]
Novogen Novobrown	80	61.05[a]	0.40	3.14	4.36	22.83[c]	69.27[a]
TETRA Brown	80	60.15[a]	0.15	2.04	5.84	30.53[ab]	61.44[a]
All Strains	80	60.00	0.09	2.24	6.15	31.28	60.23

40th NCLP&MT

[1] In each test environment (C, CS, ECS), all brown-egg strains were housed at the same density (in^2/hen).

a,b,c, - Different letters denote significant differences (P<0.01), comparisons made among strains.

Table 18. Effect of Brown-Egg Strain on Egg Quality, Income and Feed Costs of Hens (17–69 wks) in Conventional Cages

Breeder (Strain)	Density[1] (in^2/hen)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans Brown	80	93.52^{bc}	0.34	8.51^{ab}	0.14	35.26^{ab}	13.91
ISA Brown	80	93.48^{a}	0.43	5.81^{b}	0.22	36.77^{a}	13.77
Hy-Line Brown	80	92.98^{c}	0.44	8.84^{ab}	0.25	33.42^{b}	13.42
Hy-Line Silver Brown	80	92.74^{a}	0.32	5.96^{ab}	0.24	35.20^{ab}	13.95
Lohmann LB-Lite	80	92.31^{abc}	0.41	6.95^{ab}	0.33	34.82^{ab}	13.43
Novogen Novobrown	80	91.01^{ab}	1.02	5.80^{b}	0.20	35.52^{ab}	13.71
TETRA Brown	80	90.47^{abc}	0.26	7.00^{ab}	0.00	34.12^{b}	13.77
All Strains	80	92.36	0.46	6.98	0.20	35.01	13.71

40th NCLP&MT

[1] In each test environment (C, CS, ECS), all brown-egg strains were housed at the same density (in^2/hen).

a,b,c, - Different letters denote significant differences (P<0.01), comparisons made among strains.

Table 19. Effect of White-Egg Strain in Non-Molted Program on Performance of Hens (69-73 wks) in Conventional Cages (Non-Molted)

Breeder (Strain)	Molt[1]	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed (#)	Egg Production (HD%)[2]	Egg Mass (g/HD)[2]	Mortality (%)
Bovans White	NM	10.82[ab]	0.51[ab]	23.04[ab]	87.77	54.58	0.00
Shaver White	NM	10.84[ab]	0.52[ab]	21.95[ab]	89.82	56.48	2.93
Dekalb White	NM	12.70[a]	0.46[b]	23.49[ab]	90.31	56.68	0.00
Babcock White	NM	10.86[ab]	0.55[ab]	24.97[a]	93.78	59.48	0.89
ISA B-400	NM	9.70[b]	0.059[a]	24.58[a]	91.11	57.35	0.00
Hy-Line W-80	NM	10.46[ab]	0.54[ab]	21.79[ab]	87.94	55.90	2.00
Hy-Line W-36	NM	10.07[ab]	0.53[ab]	22.66[ab]	82.45	53.40	0.00
Lohmann LSL Lite	NM	11.78[ab]	0.47[ab]	22.07[ab]	83.43	55.08	0.96
H&N Nick Chick	NM	11.85[ab]	0.50[ab]	22.56[ab]	87.07	59.75	2.00
Novogen Novowhite	NM	11.60[ab]	0.46[b]	18.82[b]	83.75	53.95	3.23
All Strains	NM	11.07	0.51	22.60	87.74	56.26	1.20

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt

[2]HD = hen day

a,b - Different letters denote significant differences (P<0.01), comparisons made among strain average values.

Table 20. Effect of White-Egg Strain in Non-Molted Program on Egg Weight and Egg Size Distribution of Hens (69–73 wks) in Conventional Cages (Non-Molted)

Breeder (Strain)	Molt[1]	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans White	NM	62.14^{c}	0.00	0.00	0.00	31.50^{a}	68.50^{a}
Shaver White	NM	62.90^{bc}	0.00	0.00	0.00	22.75^{ab}	76.00^{ab}
Dekalb White	NM	62.78^{c}	0.00	0.00	0.00	15.00^{ab}	85.00^{ab}
Babcock White	NM	63.43^{bc}	0.00	0.00	0.00	24.25^{ab}	74.75^{ab}
ISA B-400	NM	62.92^{bc}	0.00	0.00	0.00	21.75^{ab}	78.25^{ab}
Hy-Line W-80	NM	63.59^{bc}	0.00	0.00	0.00	17.00^{ab}	82.00^{ab}
Hy-Line W-36	NM	64.74^{bc}	0.00	0.00	0.00	12.50^{ab}	85.50^{ab}
Lohmann LSL Lite	NM	66.04^{ab}	0.00	0.00	0.00	9.75^{ab}	90.25^{ab}
H&N Nick Chick	NM	68.60^{a}	0.00	0.00	0.00	2.00^{b}	98.00^{a}
Novogen Novowhite	NM	64.48^{bc}	0.00	0.00	0.00	12.50^{ab}	86.50^{ab}
All Strains	NM	64.16	0.00	0.00	0.00	16.90	82.48

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

a,b,c - Different letters denote significant differences (P<0.01), comparisons made among strains .

Table 21. Effect of White-Egg Strain in Non-Molted Program on Egg Quality, Income and Feed Costs of Hens (69-73 wks) in Conventional Cages (Non-Molted)

Breeder (Strain)	Molt[1]	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans White	NM	87.25	0.00	12.75	0.00	3.13	1.10
Shaver White	NM	82.00	2.25	14.50	1.25	3.26	1.02
Dekalb White	NM	93.00	0.00	7.00	0.00	3.14	1.01
Babcock White	NM	85.00	1.00	14.25	0.00	3.38	1.00
ISA B-400	NM	84.75	1.00	14.25	0.00	3.29	0.94
Hy-Line W-80	NM	86.00	3.00	11.00	0.00	3.17	0.94
Hy-Line W-36	NM	92.75	0.00	6.50	1.00	2.80	0.93
Lohmann LSL Lite	NM	79.25	3.25	17.50	0.00	3.12	0.90
H&N Nick Chick	NM	85.50	0.00	14.50	0.00	3.21	0.87
Novogen Novowhite	NM	86.75	1.75	10.50	1.00	2.98	0.84
All Strains	NM	86.22	1.22	12.28	0.32	3.15	0.96

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

Table 22. Effect of Brown-Egg Strain in Non-Molted Program on Performance of Hens (69-73 wks) in Conventional Cages (Non-Molted)

Breeder (Strain)	Molt[1]	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Hen Housed (#)	Hen Day Egg Production[2] (%)	Egg Mass (g/HD)[3]	Mortality (%)
Bovans Brown	NM	11.14	0.47	22.14	83.47	52.62	0.00
ISA Brown	NM	11.11	0.48	22.69	83.78	53.65	1.04
Hy-Line Brown	NM	10.56	0.47	20.70	77.78	49.65	2.17
Hy-Line Silver Brown	NM	11.43	0.42	20.40	78.48	47.18	0.00
Lohmann LB-Lite	NM	10.96	0.46	14.80	78.19	50.65	3.84
Novogen Novobrown	NM	11.32	0.48	20.84	84.69	54.32	1.25
TETRA Brown	NM	10.86	0.46	20.68	80.67	50.38	0.00
All Strains	NM	11.05	0.46	20.32	81.00	51.21	1.19

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

[2]The average daily number of eggs produced per 100 hens (%)

[3]HD = hen day

Table 23. Effect of Brown-Egg Strain in Non-Molted Program on Egg Weight and Egg Size Distribution of Hens (69-73 wks) in Conventional Cages (Non-Molted)

Breeder (Strain)	Molt[1]	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans Brown	NM	63.01[a]	0.00	0.00	0.00	15.25[b]	85.00[ab]
ISA Brown	NM	64.08[a]	0.00	0.00	0.00	10.50[b]	89.50[a]
Hy-Line Brown	NM	63.80[a]	0.00	0.00	0.00	16.75[ab]	81.75[ab]
Hy-Line Silver Brown	NM	60.08[b]	0.00	0.00	0.00	44.50[a]	55.50[b]
Lohmann LB-Lite	NM	64.75[a]	0.00	0.00	0.00	10.75[b]	82.25[ab]
Novogen Novobrown	NM	64.15[a]	0.00	0.00	0.00	18.00[ab]	82.00[ab]
TETRA Brown	NM	62.45[ab]	0.00	1.00	0.00	26.00[ab]	73.00[ab]
All Strains	NM	63.19	0.00	0.14	0.00	20.25	78.43

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

a,b - Different letters denote significant differences (P<0.01), comparisons made among strains.

Table 24. Effect of Brown-Egg Strain in Non-Molted Program on Egg Quality, Income and Feed Costs of Hens (69-73 wks) in Conventional Cages (Non-Molted)

Breeder (Strain)	Molt[1]	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans Brown	NM	86.75	0.00	13.25	0.00	2.99	0.96
ISA Brown	NM	88.50	1.25	10.00	0.00	3.01	0.96
Hy-Line Brown	NM	83.75	1.25	13.50	1.50	2.80	0.91
Hy-Line Silver Brown	NM	93.25	0.00	7.00	0.00	2.70	0.99
Lohmann LB-Lite	NM	78.00	2.50	16.50	3.25	2.76	0.95
Novogen Novobrown	NM	87.00	0.00	13.00	0.00	3.03	0.98
TETRA Brown	NM	82.75	0.00	17.50	0.00	2.93	0.94
All Strains	NM	85.71	0.71	12.96	0.68	2.89	0.95

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

Table 25. Effect of White-Egg Strain in the Non-Anorexic Molt Program on Performance of Hens (69-73 wks) in Conventional Cages (Molted)

Breeder (Strain)	Molt[1]	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed (#)	Hen Day Egg Production[2] (%)	Egg Mass (g/HD)[3]	Mortality (%)
Bovans White	NA	6.58^{ab}	0.08	2.48^{b}	10.27^{c}	4.7	0.96^{b}
Shaver White	NA	8.09^{a}	0.17	5.79^{a}	23.04^{ab}	14.23	4.85^{ab}
Dekalb White	NA	7.92^{ab}	0.11	4.17^{ab}	16.34^{abc}	9.50	1.79^{b}
Babcock White	NA	7.16^{ab}	0.11	4.62^{ab}	17.64^{abc}	9.00	17.06^{a}
ISA B-400	NA	7.39^{ab}	0.16	6.35^{a}	23.81^{a}	12.42	5.39^{ab}
Hy-Line W-80	NA	6.88^{ab}	0.12	3.17^{b}	13.46^{bc}	10.30	1.09^{b}
Hy-Line W-36	NA	5.10^{b}	0.09	3.08^{b}	11.10^{c}	5.80	0.00^{b}
Lohmann LSL Lite	NA	7.06^{ab}	0.13	4.24^{ab}	16.18^{abc}	8.57	2.78^{b}
H&N Nick Chick	NA	7.73^{ab}	0.14	4.47^{ab}	17.90^{abc}	10.57	1.89^{ab}
Novogen Novowhite	NA	8.04^{a}	0.18	5.94^{a}	23.68^{a}	13.70	5.80^{ab}
All Strains	NA	7.20	0.14	4.43	17.34	10.67	4.16

40th NCLP&MT

[1]All strains were equally represented in either NA=Non-anorexic molt and NM=Non molted treatments

[2]The average daily number of eggs produced per 100 hens (%)

[3]HD = hen day

a,b,c - Different letters denote significant differences (P<0.01), comparisons made among strains.

Table 26. Effect of White-Egg Strain in the Non-Anorexic Molt Program on Egg Weight and Egg Size Distribution of Hens (69-73 wks) in Conventional Cages (Molted)

Breeder (Strain)	Molt[1]	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans White	NA	50.00	0.00	0.00	100.00[a]	0.00	0.00
Shaver White	NA	57.22	0.00	0.00	0.00[b]	39.00	61.00
Dekalb White	NA	55.00	0.00	0.00	0.00[b]	50.00	50.00
Babcock White	NA	60.00	0.00	0.00	0.00[b]	50.00	50.00
ISA B-400	NA	51.67	0.00	0.00	20.75[b]	62.50	16.75
Hy-Line W-80	NA	60.00	0.00	0.00	0.00[b]	50.00	50.00
Hy-Line W-36	NA	50.00	0.00	0.00	0.00[b]	100.00	0.00
Lohmann LSL Lite	NA	53.33	0.00	0.00	0.00[b]	83.33	16.67
H&N Nick Chick	NA	56.67	0.00	0.00	0.00[b]	44.33	55.67
Novogen Novowhite	NA	58.33	0.00	0.00	0.00[b]	50.00	50.00
All Strains	NA	55.33	0.00	0.00	7.95	54.35	37.69

40th NCLP&MT

[1]All strains were equally represented in either NA=Non-anorexic molt and NM=Mon molt treatments

a,b - Different letters denote significant differences (P<0.01), comparisons made among strains

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Table 27. Effect of White-Egg Strain in the Non-Anorexic Molt Program on Egg Quality, Income and Feed Costs of Hens (69-73 wks) in Conventional Cages (Molted)

Breeder (Strain)	Molt[1]	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans White	NA	100.00	0.00	0.00	0.00	0.08	0.57[ab]
Shaver White	NA	83.33	0.00	16.66	0.00	0.70	0.70[a]
Dekalb White	NA	50.00	50.00	0.00	0.00	0.36	0.68[ab]
Babcock White	NA	50.00	50.00	0.00	0.00	0.00	0.62[ab]
ISA B-400	NA	100.00	0.00	0.00	0.00	0.77	0.64[ab]
Hy-Line W-80	NA	50.00	50.00	0.00	0.00	0.14	0.59[ab]
Hy-Line W-36	NA	100.00	0.00	0.00	0.00	0.10	0.44[b]
Lohmann LSL Lite	NA	83.33	16.67	0.00	0.00	0.43	0.61[ab]
H&N Nick Chick	NA	100.00	0.00	0.00	0.00	0.47	0.67[ab]
Novogen Novowhite	NA	100.00	0.00	0.00	0.00	0.60	0.69[a]
All Strains	NA	84.78	13.04	2.17	0.00	0.36	0.62

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

a,b - Different letters denote significant differences (P<0.01), comparisons made among strains

Table 28. Effect of Brown-Egg Strain in the Non-Anorexic Molt Program on Performance of Hens (69-73 wks) in Conventional Cages (Molted)

Breeder (Strain)	Molt[1]	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed (#)	Hen Day Egg Production[2] (%)	Egg Mass (g/HD)[3]	Mortality (%)
Bovans Brown	NA	7.82	0.08	12.71[b]	3.24[b]	6.43	0.00
ISA Brown	NA	6.29	0.11	13.28[b]	3.62[ab]	7.30	0.00
Hy-Line Brown	NA	7.71	0.11	15.26[ab]	3.89[ab]	8.55	1.09
Hy-Line Silver Brown	NA	7.15	0.17	22.20[a]	5.42[a]	11.90	0.00
Lohmann LB-Lite	NA	7.64	0.12	16.34[ab]	4.00[ab]	8.83	0.00
Novogen Novobrown	NA	6.98	0.08	12.67[b]	3.28[b]	6.10	3.37
TETRA Brown	NA	6.77	0.11	16.24[ab]	4.28[ab]	9.97	0.00
All Strains	NA	7.20	0.12	15.53	3.96	8.71	0.64

40th NCLP&MT

All strains were equally represented in either NA=Non-anorexic molt and NM=non-molted treatments

[2]The average daily number of eggs produced per 100 hens (%)

[3]HD=hen day

a,b - Different letters denote significant differences (P<0.01), comparisons made among strains

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Table 29. Effect of Brown-Egg Strain in the Non-Anorexic Molt Program on Egg weight and Egg Size Distribution of Hens (69-73 wks) in Conventional Cages (Molted)

Breeder (Strain)	Molt[1]	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans Brown	NA	53.33	0.00	0.00	0.00	50.00	33.33
ISA Brown	NA	53.33	0.00	0.00	0.00	50.00	50.00
Hy-Line Brown	NA	55.83	0.00	0.00	20.75	20.75	58.25
Hy-Line Silver Brown	NA	53.50	0.00	5.00	9.25	54.25	31.50
Lohmann LB-Lite	NA	52.50	0.00	0.00	0.00	83.33	16.64
Novogen Novobrown	NA	50.00	0.00	0.00	50.00	50.00	0.00
TETRA Brown	NA	60.00	0.00	0.00	0.00	11.00	89.00
All Strains	NA	54.31	0.00	0.91	5.45	44.68	46.64

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

Table 30. Effect of Brown-Egg Strain in the Non-Anorexic Molt Program on Egg Quality, Income and Feed Costs of Hens (69-73 wks) in Conventional Cages (Molted)

Breeder (Strain)	Molt[1]	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans Brown	NA	83.33	0.00	0.00	12.50	0.25	0.68
ISA Brown	NA	83.33	16.67	0.00	0.00	0.36	0.54
Hy-Line Brown	NA	100.00	0.00	0.00	0.00	0.48	0.66
Hy-Line Silver Brown	NA	90.75	4.25	5.00	0.00	0.74	0.62
Lohmann LB-Lite	NA	83.33	0.00	16.67	0.00	0.43	0.66
Novogen Novobrown	NA	100.00	0.00	0.00	0.00	0.19	0.60
TETRA Brown	NA	89.00	11.00	0.00	0.00	0.42	0.58
All Strains	NA	90.00	4.54	3.18	1.78	0.41	0.62

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

Table 31. Effect of White-Egg Strain in Non-Molted Program on Body Weight of Hens (69-73 wks) in Conventional Cages (Non-Molted)

Breeder (Strain)	Molt[1]	17-Wk Body Wt (kg)	69-Wk Body Wt (kg)	1st Cycle Wt Gain (%)	73-Wk Body Wt (kg)
Bovans White	NM	1.10	1.73^{abc}	57.48^{ab}	1.81
Shaver White	NM	1.16	1.76^{abc}	52.11^{ab}	1.82
Dekalb White	NM	1.13	1.68^{c}	48.75^{ab}	1.71
Babcock White	NM	1.18	1.88^{a}	59.48^{ab}	1.88
ISA B-400	NM	1.13	1.68^{c}	48.63^{ab}	1.69
Hy-Line W-80	NM	1.16	1.87^{ab}	60.62^{ab}	1.87
Hy-Line W-36	NM	1.12	1.83^{abc}	62.74^{a}	1.79
Lohmann LSL Lite	NM	1.16	1.72^{bc}	48.92^{ab}	1.76
H&N Nick Chick	NM	1.24	1.76^{abc}	41.51^{b}	1.80
Novogen Novowhite	NM	1.13	1.72^{bc}	52.15^{ab}	1.72
All Strains	NM	1.15	1.76	53.24	1.78

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

a,b,c- Different letters denote significant differences (P<0.01), comparisons made among strains

Table 32. Effect of White-Egg Strain in the Non-Anorexic Molt Program on Body Weight of Hens (69-73 wks) in Conventional Cages (Molted)

Breeder	Molt[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)		(kg)	(kg)	(%)	(kg)	(%)	(kg)	
Bovans White	NA	1.16	1.76	51.48	1.35^{b}	23.55	1.46^{c}	6.75^{b}
Shaver White	NA	1.16	1.76	51.70	1.41^{ab}	19.64	1.52^{abc}	13.00^{a}
Dekalb White	NA	1.13	1.70	46.64	1.36^{b}	20.33	1.47^{bc}	7.50^{ab}
Babcock White	NA	1.18	1.83	55.34	1.49^{ab}	19.83	1.65^{a}	5.75^{b}
ISA B-400	NA	1.13	1.74	50.11	1.36^{b}	21.29	1.54^{abc}	7.00^{ab}
Hy-Line W-80	NA	1.16	1.76	52.36	1.34^{b}	23.76	1.52^{abc}	7.00^{ab}
Hy-Line W-36	NA	1.12	1.86	62.50	1.52^{a}	17.87	1.52^{abc}	9.25^{ab}
Lohmann LSL Lite	NA	1.16	1.76	47.41	1.38^{ab}	21.99	1.46^{c}	7.25^{ab}
H&N Nick Chick	NA	1.24	1.78	51.40	1.33^{b}	24.51	1.49^{bc}	7.25^{ab}
Novogen Novowhite	NA	1.13	1.74	45.46	1.39^{ab}	20.04	1.62^{ab}	5.00^{b}
All Strains	NA	1.17	1.77	51.44	1.39	21.28	1.52	7.58

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt

a,b,c - Different letters denote significant differences (P<0.01), comparisons made among strains

Table 33. Effect of Brown-Egg Strain in Non-Molted and the Non-Anorexic Molt Program on Body Weight of Hens (69-73 wks) in Conventional Cages (Non-Molted)

Breeder (Strain)	Molt[1]	17-Wk Body Wt (kg)	69-Wk Body Wt (kg)	1st Cycle Wt Gain (%)	73-Wk Body Wt (kg)
Bovans Brown	NM	1.40	2.03	44.89	2.06
ISA Brown	NM	1.30	2.05	57.96	2.05
Hy-Line Brown	NM	1.40	2.05	46.26	2.06
Hy-Line Silver Brown	NM	1.46	2.06	41.42	2.11
Lohmann LB-Lite	NM	1.40	1.90	36.67	1.88
Novogen Novobrown	NM	1.39	2.04	47.64	2.18
TETRA Brown	NM	1.40	2.01	44.20	2.05
All Strains	NM	1.39	2.02	45.57	2.05

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt

Table 34. Effect of Brown-Egg Strain in the Non-Anorexic Molt Program on Body Weight of Hens (69-73 wks) in Conventional Cages (Molted)

Breeder (Strain)	Molt[1]	17-Wk Body Wt (kg)	69-Wk Body Wt (kg)	1st Cycle Wt Gain (%)	Lowest Body Wt (kg)	Molt Wt Loss (%)	73-Wk Body Wt (kg)	Days to 0% Production
Bovans Brown	NA	1.39	1.98	42.17	1.70	14.40	1.74[ab]	6.25[b]
ISA Brown	NA	1.40	2.02	45.10	1.70	15.85	1.68[ab]	6.75[b]
Hy-Line Brown	NA	1.45	1.98	36.45	1.65	16.54	1.62[ab]	8.50[ab]
Hy-Line Silver Brown	NA	1.47	2.02	37.46	1.78	11.87	1.80[ab]	19.25[a]
Lohmann LB-Lite	NA	1.41	1.93	37.12	1.62	15.93	1.59[b]	10.75[ab]
Novogen Novobrown	NA	1.49	1.94	30.33	1.74	10.10	1.82[ab]	6.75[b]
TETRA Brown	NA	1.44	2.06	42.50	1.81	12.00	1.8[4a]	10.25[ab]
All Strains	NA	1.44	1.99	38.75	1.71	13.81	1.72	9.78

40th NCLP&MT

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

a,b- - Different letters denote significant differences (P<.01), comparisons made among strains

Table 35. Effect of White-Egg Strain and Housing System[1,2] on Performance of Hens (17-69 wks) in Colony Housing System and Enriched Colony Housing Systems

Breeder (Strain)	Housing System[1]	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed (#)	Hen Day Egg Production[3] (%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
Bovans	CS	10.43	0.47	290^{bcdefg}	84.12	49.94	13.8^{8abcde}	142.50
White	ECS	10.26	0.49	303^{abcd}	86.73	51.14	9.27^{bcdef}	140.67
	Average	10.34^{B}	0.48	297	85.43	50.54	11.57^{AB}	141.58^{CD}
Shaver	CS	9.91	0.48	269^{efgh}	82.33	48.08	35.18^{a}	138.33
White	ECS	9.90	0.52	301^{abcde}	87.76	51.66	13.42^{abcde}	137.17
	Average	9.90^{CD}	0.50	285	85.04	49.87	24.30^{A}	137.75^{F}
Dekalb	CS	10.64	0.46	284^{cdefg}	83.43	49.58	17.58^{abcde}	141.00
White	ECS	10.37	0.50	311^{abc}	88.64	52.92	6.97^{cdef}	140.50
	Average	10.50^{AB}	0.48	298	86.04	51.25	12.27^{AB}	140.75^{DE}
Babcock	CS	10.43	0.48	258^{gh}	83.59	50.81	31.03^{ab}	138.17
White	ECS	10.27	0.53	330^{a}	91.10	55.03	0.93^{f}	137.50
	Average	10.35^{AB}	0.50	294	87.10	52.92	15.98^{AB}	137.83^{F}
ISA	CS	9.67	0.46	256^{h}	76.28	44.97	20.37^{abcd}	139.00
B-400	ECS	9.84	0.54	320^{ab}	89.74	53.39	4.17^{ef}	137.83
	Average	9.76^{D}	0.50	288	83.01	49.18	12.27^{AB}	138.42^{EF}
Hy-Line	CS	10.28	0.46	280^{bcdefgh}	81.54	48.36	13.43^{abcde}	144.00
W-80	ECS	10.21	0.49	293^{bcdef}	86.25	51.08	14.35^{abcde}	143.50
	Average	10.25^{BC}	0.48	287	83.89	49.72	13.89^{A}	143.75^{ABC}
Hy-Line	CS	9.63	0.51	296^{bcdef}	83.70	49.60	3.73^{def}	144.50
W-36	ECS	9.58	0.51	299^{abcde}	83.72	49.62	3.72^{ef}	145.17
	Average	9.60^{D}	0.51	298	83.71	49.61	3.72^{B}	144.83^{A}
Lohmann	CS	10.81	0.44	264^{fgh}	78.97	48.60	21.75^{abc}	143.50
LSL Lite	ECS	10.30	0.51	297^{bcde}	86.88	53.14	12.03^{abcdef}	143.67
	Average	10.56^{AB}	0.47	281	82.92	50.87	16.89^{A}	143.58^{ABC}
H&N	CS	10.91	0.45	271^{defgh}	80.07	49.72	21.28^{abc}	144.33
Nick Chick	ECS	10.67	0.51	304^{abcd}	88.08	54.96	12.50^{bcdef}	144.83
	Average	10.79^{A}	0.48	288	84.08	52.34	16.89^{A}	144.58^{AB}
Novogen	CS	10.78	0.47	288^{bcdefgh}	84.53	51.23	19.93^{abcde}	142.67
Novowhite	ECS	10.32	0.50	304^{abcd}	86.87	52.67	8.80^{cdef}	141.50
	Average	10.55^{AB}	0.48	296	85.70	51.95	14.37^{A}	142.08^{BCD}
	CS	10.35	0.47^{Y}	276^{Z}	81.86^{Z}	49.09	19.81^{Y}	141.80
All	ECS	10.17	0.51^{Z}	306^{Y}	87.58^{Y}	52.56	8.61^{Z}	141.23
Strains	Average	10.26	0.49	291	84.72	50.82	14.21	141.52

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

[2]All strains were equally represented in each production system and CS and ECS hens were housed at 69 in^2/hen.

[3]The average daily number of eggs produced per 100 hens (%)

AB,C,D,E,F - Different letters denote significant differences (P<0.01), comparisons made among strains using average of CS and ECS values.

a,b,c,d,e,f,g,h, - Different letters denote significant differences (P<0.01), comparisons made among each strain-housing combination

Y,Z – Different letters denote significant differences (P<0.01), overall comparison of CS vs. ES housing system using average for all strains

Table 36. Effect of White-Egg Strain and Housing System[1,2] on Egg Weight and Egg Size Distribution of Hens (c) in Colony Housing System and Enriched Colony Housing Systems

Breeder (Strain)	Housing System[1]	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans	CS	58.27	1.42	6.09	4.84	34.83	52.82
White	ECS	58.03	0.00	6.10	6.50	38.50	48.89
	Average	58.15^{B}	0.71	6.10	5.67	36.66^{AB}	50.60^{CD}
Shaver	CS	57.68	0.13	6.16	5.40	41.80	46.51
White	ECS	58.10	0.06	5.12	6.50	38.71	49.61
	Average	57.89^{B}	0.10	5.64	5.95	40.25^{A}	47.76^{D}
Dekalb	CS	58.47	0.41	6.20	4.98	36.57	51.84
White	ECS	58.75	0.00	5.54	5.19	32.89	56.38
	Average	58.61^{AB}	0.20	5.87	5.08	34.73^{AB}	53.89^{BCD}
Babcock	CS	59.93	0.00	4.52	5.33	26.56	63.59
White	ECS	59.56	0.06	3.91	7.04	30.31	58.68
	Average	59.74^{AB}	0.03	4.221	6.18	28.44^{BCD}	60.41^{ABC}
ISA	CS	58.36	0.00	5.44	5.65	37.41	51.50
B-400	ECS	58.67	0.00	4.93	6.75	34.68	53.63
	Average	58.51^{AB}	0.00	5.19	6.20	36.04A^{B}	51.62^{BCD}
Hy-Line	CS	58.18	0.16	7.28	6.10	34.85	51.60
W-80	ECS	58.17	0.50	6.01	6.63	37.84	49.01
	Average	58.18^{B}	0.33	6.65	6.37	36.35^{AB}	49.90^{CD}
Hy-Line	CS	58.41	0.00	5.02	7.57	37.74	49.67
W-36	ECS	58.32	0.00	3.76	8.59	38.70	48.95
	Average	58.37^{B}	0.00	4.39	8.08	38.22^{A}	49.32^{CD}
Lohmann	CS	60.56	0.00	4.35	7.47	24.45	63.73
LSL Lite	ECS	59.97	0.10	5.77	4.70	26.42	63.00
	Average	60.27^{AB}	0.05	5.06	6.08	25.44^{CD}	63.37^{AB}
H&N	CS	60.91	0.00	6.04	4.87	19.83	69.25
Nick Chick	ECS	60.99	0.00	5.63	4.51	20.67	69.18
	Average	60.95^{A}	0.00	5.84	4.69	20.25^{D}	68.34^{A}
Novogen	CS	59.60	0.00	6.15	4.91	30.51	58.43
Novowhite	ECS	59.53	0.00	5.13	7.11	27.56	60.19
	Average	59.57^{AB}	0.00	5.64	6.01	29.04^{BC}	54.52^{ABCD}
	CS	59.04	0.21	5.73	5.71	32.45	55.74
All	ECS	59.01	0.07	5.19	6.35	32.63	55.21
Strains	Average	59.02	0.14	5.46	6.03	32.54	55.47

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

[2]All strains were equally represented in each production system and CS and ECS hens were housed at 69 in^2/hen.

A,B,C,D, - Different letters denote significant differences (P<0.01), comparisons made among strains using average of CS and ECS values.

Table 37. Effect of White-Egg Strain and Housing System[1,2] on Egg Quality, Income and Feed Costs of Hens (17-69 wks) in Colony Housing System and Enriched Colony Housing Systems

Breeder (Strain)	Housing System[1]	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans	CS	91.87	0.15	7.74	0.23	34.55^{abc}	13.65
White	ECS	90.15	0.18	9.18	0.49	35.00^{abc}	13.37
	Average	91.01	0.16^{A}	8.46^{A}	0.36	34.77^{ABC}	13.51^{BC}
Shaver	CS	92.73	0.26	6.86	0.15	34.44^{abc}	12.92
White	ECS	92.48	0.45	6.85	0.22	35.90^{abc}	12.94
	Average	92.61	0.35^{AB}	6.85^{ABC}	0.18	35.17^{ABC}	12.93^{CD}
Dekalb	CS	91.06	0.14	8.46	0.33	34.18^{bc}	13.93
White	ECS	91.36	0.43	7.68	0.53	36.14^{abc}	13.54
	Average	91.21	0.29^{AB}	8.07^{ABC}	0.43	35.16^{ABC}	13.73^{AB}
Babcock	CS	91.23	0.18	8.28	0.30	35.64^{abc}	13.66
White	ECS	90.77	0.34	8.37	0.52	36.88^{ab}	13.37
	Average	91.00	0.27^{AB}	8.33^{AB}	0.41	36.26^{A}	13.52^{ABC}
ISA	CS	90.87	0.26	8.59	0.27	30.90^{d}	12.68
B-400	ECS	93.49	0.35	5.89	0.26	36.72^{ab}	12.83
	Average	92.18	0.31^{AB}	7.24^{ABC}	0.26	33.81^{C}	12.76^{D}
Hy-Line	CS	93.10	0.38	6.34	0.18	33.36^{cd}	13.45
W-80	ECS	90.99	0.44	8.35	0.26	34.90^{abc}	13.33
	Average	92.05	0.41^{AB}	7.34^{ABC}	0.22	34.13^{BC}	13.39^{BC}
Hy-Line	CS	93.14	0.30	6.30	0.26	34.24^{bc}	12.61
W-36	ECS	93.52	0.13	6.12	0.22	34.41^{abc}	12.51
	Average	93.33	0.22^{AB}	6.21^{C}	0.24	34.33^{ABC}	12.56^{D}
Lohmann	CS	92.69	0.35	6.77	0.19	33.82^{bcd}	14.13
LSL Lite	ECS	93.56	0.36	5.98	0.10	36.38^{abc}	13.45
	Average	93.13	0.36^{AB}	6.37^{BC}	0.14	35.10^{ABC}	13.79^{AB}
H&N	CS	91.54	0.88	7.26	0.37	34.26^{bc}	14.323
Nick Chick	ECS	92.94	0.73	5.86	0.48	37.40^{a}	13.91
	Average	92.24	0.81^{A}	6.56^{ABC}	0.42	35.84^{AB}	14.12^{A}
Novogen	CS	92.23	0.63	7.20	0.09	35.62^{abc}	14.12
Novowhite	ECS	92.26	0.56	6.92	0.26	35.85^{abc}	13.46
	Average	92.25	0.59^{AB}	7.06^{ABC}	0.17	35.73^{ABC}	13.79^{AB}
	CS	92.05	0.35	7.38	0.24	34.10^{Z}	13.55^{Y}
All	ECS	92.15	0.40	7.12	0.33	35.96^{Y}	13.27^{Z}
Strains	Average	92.10	0.38	7.25	0.28	35.03	13.41

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

[2]All strains were equally represented in each production system, and CS and ECS hens were housed at 69 in^2/hen

A,B,C,D - Different letters denote significant differences (P<0.01), comparisons made among strains using average of CS and ECS values.

a,b,c,d Y,Z - Different letters denote significant differences (P<0.01), comparisons made among each strain-housing combination

Table 38. Effect of Brown-Egg Strain and Housing System on Performance of (17-69 wks) in Colony Housing System and Enriched Colony Housing Systems

Breeder (Strain)	Housing System[1]	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed (#)	Hen Day Egg Production[2] (%)	Egg Mass (g/HD)[3]	Mortality (%)	Age at 50% Production (Days)
Bovans	CS	11.23	0.47	302	86.07	53.51	9.17	142.50
Brown	ECS	11.26	0.47	311	87.44	54.35	5.37	142.00
	Average	11.25^{A}	0.47^{AB}	307^{A}	86.75	53.93	7.27^{AB}	142.24^{A}
ISA	CS	10.90	0.48	306	86.80	53.64	4.85	141.00
Brown	ECS	10.67	0.50	312	87.24	53.53	5.92	141.33
	Average	10.78^{BC}	0.49^{A}	309^{A}	87.02	53.59	5.38^{B}	141.17^{AB}
Hy-Line	CS	10.82	0.48	306	86.15	52.31	6.45	138.67
Brown	ECS	10.78	0.48	307	85.73	51.89	2.70	138.00
	Average	10.80^{BC}	0.48^{AB}	307^{A}	85.94	52.10	4.58^{B}	138.33^{C}
Hy-Line	CS	11.14	0.44	300	85.87	50.02	9.17	140.17
Silver Brown	ECS	11.22	0.44	303	86.39	49.69	8.07	139.67
	Average	11.18^{A}	0.44^{B}	302^{AB}	86.13	49.86	8.62^{AB}	139.92^{BC}
Lohmann	CS	10.65	0.48	280	82.53	51.16	29.03	138.17
LB-Lite	ECS	10.56	0.49	296	84.89	52.70	12.37	139.33
	Average	10.61^{C}	0.48^{A}	288^{B}	83.71	51.93	20.70^{A}	138.75^{C}
Novogen	CS	11.13	0.48	298	86.11	54.54	16.13	141.50
Novobrown	ECS	10.90	0.48	306	85.35	53.06	5.38	141.00
	Average	11.01^{AB}	0.48^{AB}	302^{AB}	85.73	53.80	10.76^{AB}	141.25^{AB}
TETRA	CS	10.91	0.46	300	84.23	51.19	7.57	138.50
Brown	ECS	10.70	0.47	303	84.34	51.07	2.17	139.67
	Average	10.81^{BC}	0.47^{AB}	302^{AB}	84.29	51.13	4.87^{B}	139.08^{BC}
	CS	10.97	0.47	299^{Z}	85.40	52..4	11.77^{Y}	140.07
All	ECS	10.87	0.47	306^{Y}	85.91	52.33	6.00^{Z}	140.14
Strains	Average	10.92	0.47	302	85.65	52.33	8.88	140.11

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 80 in^2/hen

[2]The average daily number of eggs produced per 100 hens (%)

[3]HD=hen day

A,B,C - Different letters denote significant differences (P<0.01), comparisons made among strain average values.

Y,Z - Different letters denote significant differences (P<0.01), comparisons made among density average values.

Table 39. Effect of Brown-Egg Strain and Housing System on Egg Weight and Egg Size Distribution of Hens (17-69 wks) in Colony Housing System and Enriched Colony Housing Systems

Breeder (Strain)	Housing System[1]	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans	CS	61.23	0.00	3.59	5.55	22.62	68.24
Brown	ECS	61.19	0.00	2.54	6.56	23.20	67.70
	Average	61.21^{A}	0.00	3.07	6.05	22.91^{CD}	67.97^{A}
ISA	CS	60.85	0.00	4.22	6.31	22.11	67.36
Brown	ECS	60.48	0.00	2.86	6.00	25.50	65.64
	Average	60.67^{A}	0.00	3.54	6.16	23.80^{BCD}	66.50^{A}
Hy-Line	CS	60.14	0.00	1.81	5.99	32.35	59.85
Brown	ECS	59.99	0.04	0.81	7.53	29.13	62.49
	Average	60.07^{A}	0.02	1.31	6.76	30.74^{B}	61.17^{A}
Hy-Line	CS	57.66	0.00	3.18	7.42	46.27	43.12
Silver Brown	ECS	56.92	0.00	2.73	9.09	50.00	38.20
	Average	57.29^{B}	0.00	2.95	8.26	48.13^{A}	40.66^{B}
Lohmann	CS	61.31	0.00	2.19	6.84	22.44	68.53
LB-Lite	ECS	61.36	0.38	1.42	6.98	21.96	69.26
	Average	61.33^{A}	0.19	1.80	6.91	22.20^{CD}	68.90^{A}
Novogen	CS	62.30	0.00	3.45	5.11	18.40	73.04
Novobrown	ECS	61.10	0.00	4.04	5.17	22.29	68.50
	Average	61.70^{A}	0.00	3.74	5.14	20.34^{D}	70.77^{A}
TETRA	CS	60.22	0.00	1.31	8.21	27.39	63.08
Brown	ECS	59.91	0.18	2.02	6.63	30.12	61.03
	Average	60.07^{A}	0.09	1.67	7.42	28.76^{BC}	62.06^{A}
	CS	60.53	0.00	2.82	6.49	27.37	63.32
All	ECS	60.14	0.08	2.35	6.85	28.88	61.83
Strains	Average	60.33	0.04	2.58	6.67	28.12	62.58

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 80 in^2/hen

A,B,C,D - Different letters denote significant differences (P<0.01), comparisons made among strain average values.

Table 40. Effect of Brown-Egg Strain and Housing System on Egg Quality, Income and Feed Costs of Hens (17-69 wks) in Colony Housing System and Enriched Colony Housing Systems

Breeder (Strain)	Housing System[1]	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans	CS	87.66	0.46	11.43	0.80	35.56	14.66
Brown	ECS	89.31	0.74	9.67	0.28	35.97	14.64
	Average	88.48^{B}	0.60^{ABC}	10.55^{A}	0.54	35.76^{A}	14.65^{A}
ISA	CS	90.54	1.04	7.89	0.53	35.68	14.21
Brown	ECS	90.28	0.22	8.79	0.72	35.97	13.94
	Average	90.41^{AB}	0.64^{ABC}	8.33^{AB}	0.62	35.82^{A}	14.08^{BC}
Hy-Line	CS	88.95	0.36	10.02	0.66	35.06	14.16
Brown	ECS	88.04	0.52	10.94	0.49	34.61	14.02
	Average	88.50^{B}	0.44^{BC}	10.48^{A}	0.58	34.83^{AB}	14.08^{ABC}
Hy-Line	CS	91.39	0.51	7.52	0.52	34.76	14.52
Silver Brown	ECS	92.77	0.36	6.28	0.58	35.08	14.62
	Average	92.08^{A}	0.43^{BC}	6.90^{B}	0.55	34.92^{AB}	14.57^{AB}
Lohmann	CS	89.03	1.27	8.65	1.05	34.44	13.85
LB-Lite	ECS	87.64	0.82	10.17	1.46	34.57	13.79
	Average	88.33^{B}	1.04^{A}	9.41^{AB}	1.25	34.50^{AB}	13.82^{C}
Novogen	CS	89.44	1.13	8.73	0.69	36.27	14.53
Novobrown	ECS	88.76	0.88	9.72	0.64	34.85	14.19
	Average	89.10^{AB}	1.00^{AB}	9.23^{AB}	0.67	35.56^{AB}	14.36^{ABC}
TETRA	CS	88.97	0.57	9.55	0.91	34.02	14.22
Brown	ECS	86.94	0.21	12.05	0.80	33.71	13.95
	Average	87.95^{B}	0.39^{C}	10.80^{A}	0.85	33.87^{B}	14.09^{ABC}
	CS	89.42	0.76	9.11	0.74	35.11	14.31
All	ECS	89.11	0.53	9.66	0.71	34.96	14.17
Strains	Average	89.26	0.65	9.39	0.72	35.04	14.24

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 80 in^{2}/hen

A,B,C,D - Different letters denote significant differences (P<0.01), comparisons made among strain average values.

Table 41. Effect of White-Egg Strain and Housing System on Performance of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Non-Molted)

Breeder (Strain)	Housing System[1]	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed (#)	Hen Day Egg Production[2] (%)	Daily Egg Mass (g/HD)[3]	Mortality (%)
Bovans	CS	11.83	0.47	25.00	87.33	54.95	1.11
White	ECS	11.47	0.50	25.67	90.67	57.47	0.00
	Average	11.65^{AB}	0.48	25.33	89.00	56.21	0.56
Shaver	CS	10.33	0.49	23.33	82.00	50.36	5.49
White	ECS	10.80	0.52	25.67	92.00	56.77	0.00
	Average	10.57^{AB}	0.51	24.50	87.00	53.55^{ABC}	2.74
Dekalb	CS	12.53	0.44	24.33	87.00	54.57	2.19
White	ECS	11.70	0.49	25.00	90.00	55.87	0.00
	Average	12.12^{AB}	0.46	24.67	88.50	55.23^{ABC}	1.09
Babcock	CS	9.60	0.65	25.67	92.33	59.44	1.45
White	ECS	11.87	0.51	26.67	94.33	59.37	0.95
	Average	10.73^{AB}	0.58	26.17	93.33	59.40^{A}	1.20
ISA	CS	10.97	0.42	20.67	73.33	45.85	1.08
B-400	ECS	10.33	0.55	26.00	91.00	56.99	3.82
	Average	10.65^{AB}	0.48	23.33	82.17	51.42^{C}	2.45
Hy-Line	CS	11.57	0.46	24.33	83.33	53.05	5.56
W-80	ECS	11.40	0.49	24.67	88.00	55.79	0.00
	Average	11.48^{AB}	0.48	24.50	85.67	54.42^{ABC}	2.78
Hy-Line	CS	9.97	0.51	22.67	79.67	51.28	0.98
W-36	ECS	10.00	0.53	23.00	81.67	52.47	0.00
	Average	9.98^{B}	0.52	22.83	80.67	51.88B^{C}	0.49
Lohmann	CS	13.13	0.45	25.33	88.67	59.19	2.78
LSL Lite	ECS	11.40	0.53	25.67	90.67	59.47	0.98
	Average	12.27^{A}	0.49	25.50	89.67	59.33^{A}	1.88
H&N Nick Chick	CS	12.23	0.46	24.33	84.00	56.55	7.88
	ECS	11.57	0.52	25.67	89.00	59.66	4.10
	Average	11.90^{AB}	0.49	25.00	86.50	58.10^{AB}	5.99
Novogen No-vowhite	CS	12.50	0.42	22.67	79.33	51.78	4.17
	ECS	11.37	0.49	25.00	87.33	55.90	4.31
	Average	11.93^{AB}	0.46	23.83	83.33	53.84^{ABC}	4.24
	CS	11.47	0.47	23.83^{Z}	83.47^{Z}	53.70^{Z}	3.27
All	ECS	11.19	0.51	25.30^{Y}	89.70^{Y}	56.98^{Y}	1.42
Strains	Average	11.33	0.49	24.57	86.58	55.34	2.34

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 69 in^2/hen

[2]The average daily number of eggs produced per 100 hens (%)

[3]HD=hen day

A,B,C - Different letters denote significant differences (P<0.01), comparisons made among strain average values.

Y,Z - Different letters denote significant differences (P<0.01), comparisons made among density average values.

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Table 42. Effect of White-Egg Strain and Housing System on Egg Weight and Egg Size Distribution of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Non-Molted)

Breeder (Strain)	Housing System[1]	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans	CS	62.67	0.00	0.00	0.00	21.67	77.00
White	ECS	63.33	0.00	0.00	0.00	15.00	82.67
	Average	63.00^{CD}	0.00	0.00	0.00	18.33^{ABC}	79.83^{ABCD}
Shaver	CS	61.33	0.00	0.00	0.00	34.67	65.33
White	ECS	61.67	0.00	0.00	0.00	32.00	68.00
	Average	61.50^{D}	0.00	0.00	0.00	33.33^{A}	66.67^{D}
Dekalb	CS	62.67	0.00	0.00	0.00	20.33	79.67
White	ECS	62.33	0.00	0.00	0.00	26.00	71.33
	Average	62.50^{CD}	0.00	0.00	0.00	23.17^{AB}	75.50^{CD}
Babcock	CS	64.33	0.00	0.00	0.00	20.00	78.33
White	ECS	63.00	0.00	0.00	0.00	22.33	77.67
	Average	63.67^{BCD}	0.00	0.00	0.00	21.17^{AB}	78.00^{BCD}
ISA	CS	62.33	0.00	0.00	0.00	21.67	78.33
B-400	ECS	62.67	0.00	0.00	0.00	22.67	76.33
	Average	62.50^{CD}	0.00	0.00	0.00	22.17^{AB}	77.33^{BCD}
Hy-Line	CS	63.67	0.00	0.00	1.00	11.67	85.67
W-80	ECS	63.00	0.00	0.00	0.00	25.00	73.67
	Average	63.33^{CD}	0.00	0.00	0.50	18.33^{ABC}	79.67^{ABCD}
Hy-Line	CS	64.00	0.00	0.00	0.00	19.33	79.27
W-36	ECS	64.33	0.00	0.00	0.00	13.67	86.33
	Average	64.17^{BC}	0.00	0.00	0.00	16.50^{BC}	82.80^{ABC}
Lohmann	CS	66.67	0.00	0.00	0.00	4.33	95.67
LSL Lite	ECS	65.33	0.00	0.00	0.00	11.33	87.33
	Average	66.00^{AB}	0.00	0.00	0.00	7.83^{BC}	91.50^{AB}
H&N	CS	67.33	0.00	0.00	2.00	1.33	96.67
Nick Chick	ECS	67.00	0.00	0.00	0.00	4.67	92.67
	Average	67.17^{A}	0.00	0.00	1.00	3.00^{C}	94.67^{A}
Novogen	CS	65.33	0.00	0.00	0.00	7.67	92.33
Novowhite	ECS	64.00	0.00	0.00	0.00	15.67	83.00
	Average	64.67^{BC}	0.00	0.00	0.00	11.67^{BC}	87.67^{ABC}
	CS	64.03	0.00	0.00	0.30	16.27	82.83
All	ECS	63.67	0.00	0.00	0.00	18.83	79.90
Strains	Average	63.85	0.00	0.00	0.15	17.55	81.37

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 69 in^2/hen

A,B,C,D - Different letters denote significant differences (P<0.01), comparisons made among strain average values

Table 43. Effect of White-Egg Strain and Housing System on Egg Quality, Income and Feed Costs of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Non-Molted)

Breeder	Housing System[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)		(%)	(%)	(%)	(%)	($/hen)	($/hen)
Bovans	CS	84.00	0.00	15.00	1.33	2.92	1.19
White	ECS	82.67	1.33	16.00	0.00	3.00	1.15
	Average	83.33	0.67	15.50	0.67	2.96	1.17^{A}
Shaver	CS	88.33	1.33	10.33	0.00	2.82	1.04
White	ECS	86.00	0.00	14.00	0.00	3.07	1.08
	Average	87.17	0.67	12.17	0.00	2.95	1.06^{BC}
Dekalb	CS	88.00	0.00	12.00	0.00	2.93	1.26
White	ECS	89.00	1.00	8.33	1.33	2.94	1.18
	Average	88.50	0.50	10.17	0.67	2.94	1.22^{AB}
Babcock	CS	86.67	1.67	12.00	0.00	3.09	0.97
White	ECS	84.33	1.00	14.67	0.00	3.19	1.20
	Average	85.50	1.33	13.33	0.00	3.14	1.08^{ABC}
ISA	CS	84.00	0.00	16.00	0.00	2.49	1.10
B-400	ECS	82.00	1.00	16.00	1.00	3.11	1.04
	Average	83.00	0.50	16.00	0.50	2.80	1.07^{BC}
Hy-Line	CS	79.67	1.33	19.00	0.00	2.85	1.17
W-80	ECS	85.67	4.00	9.00	1.33	2.97	1.14
	Average	82.67	2.67	14.00	0.67	2.91	1.16^{ABC}
Hy-Line	CS	90.67	0.00	9.33	0.00	2.67	1.00
W-36	ECS	92.00	1.33	7.00	0.00	2.76	1.00
	Average	91.33	0.67	8.17	0.00	2.72	1.00^{C}
Lohmann	CS	79.33	1.67	19.00	0.00	3.05	1.32
LSL Lite	ECS	91.33	0.00	8.67	0.00	3.04	1.14
	Average	85.33	0.83	13.83	0.00	3.05	1.23^{A}
H&N	CS	76.00	2.00	22.00	0.00	2.93	1.23
Nick Chick	ECS	80.00	5.00	11.67	2.67	3.07	1.16
	Average	78.00	3.50	16.83	1.33	3.00	1.20^{AB}
Novogen	CS	86.67	5.00	8.33	0.00	2.79	1.26
Novowhite	ECS	87.67	1.33	10.01	1.00	2.99	1.14
	Average	87.17	3.17	9.17	0.50	2.89	1.20^{AB}
	CS	84.33	1.30	14.30	0.13	2.86^{Z}	1.15
All	ECS	86.07	1.60	11.53	0.73	3.01^{Y}	1.12
Strains	Average	85.20	1.45	12.91	0.43	2.94	1.14

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 69 in^2/hen

A,B,C- Different letters denote significant differences (P<0.01), comparisons made among strain average values.

Y,Z - Different letters denote significant differences (P<0.01), comparisons made among density average values.

Table 44. Effect of Brown-Egg Strain and Housing System on Performance of Hens (69-73 Wks) in Colony Housing System and Enriched Colony Housing Systems (Non-Molted)

Breeder (Strain)	Housing System[1]	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed (#)	Hen Day Egg Production[2] (%)	Daily Egg Mass (g/HD)[3]	Mortality (%)
Bovans	CS	11.83	0.45	23.67	81.33	52.93	2.48
Brown	ECS	11.50	0.49	24.67	87.00	56.82	1.11
	Average	11.67	0.47	24.17	84.17	54.88	1.80
ISA	CS	11.40	0.46	24.33	81.67	52.45	8.89
Brown	ECS	11.20	0.51	25.00	88.67	57.00	1.15
	Average	11.30	0.48	24.67	85.17	54.73	5.02
Hy-Line	CS	12.83	0.41	23.33	82.00	51.94	1.28
Brown	ECS	11.20	0.46	23.00	80.67	51.11	2.30
	Average	12.02	0.43	23.17	81.33	51.52	1.79
Hy-Line	CS	11.50	0.44	23.67	83.67	50.86	0.00
Silver Brown	ECS	10.67	0.48	22.67	81.00	48.90	0.00
	Average	11.08	0.46	23.17	82.33	49.8	0.00
Lohmann	CS	11.23	0.45	24.00	77.00	50.60	14.69
LB-Lite	ECS	10.93	0.48	22.33	77.67	52.56	3.85
	Average	11.08	0.47	23.17	77.33	51.58	9.27
Novogen	CS	12.03	0.45	23.33	81.00	54.35	6.96
Novobrown	ECS	11.30	0.49	23.67	84.33	55.17	0.00
	Average	11.67	0.47	23.50	82.67	54.76	3.48
TETRA	CS	11.63	0.43	22.00	78.67	49.73	0.00
Brown	ECS	11.37	0.44	22.33	79.00	50.13	1.07
	Average	11.50	0.44	22.17	78.83	49.93	0.54
	CS	11.78	0.44	23.48	80.76	51.84	4.90
All	ECS	11.17	0.48	23.38	82.63	53.10	1.35
Strains	Average	11.47	0.46	23.43	81.69	52.47	3.13

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 80 in^2/hen

[2]The average daily number of eggs produced per 100 hens (%)

[3]HD=hen day

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Table 45. Effect of Brown-Egg Strain and Housing System on Egg Weight and Egg Size Distribution of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Non-Molted)

Breeder (Strain)	Housing System[1]	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans	CS	65.00	0.00	0.00	0.00	13.67	84.67
Brown	ECS	65.33	0.00	0.00	0.00	12.67	84.67
	Average	65.17^{AB}	0.00	0.00	0.00	13.17^{B}	84.67^{A}
ISA	CS	64.33	0.00	0.00	0.00	18.33	82.00
Brown	ECS	64.33	0.00	0.00	1.00	21.33	77.33
	Average	64.33^{AB}	0.00	0.00	0.50	19.83^{AB}	79.67^{AB}
Hy-Line	CS	63.67	0.00	0.00	0.00	20.67	78.33
Brown	ECS	63.00	0.00	0.00	2.33	22.00	74.33
	Average	63.33^{BC}	0.00	0.00	1.17	21.33^{AB}	76.33^{AB}
Hy-Line	CS	61.33	0.00	0.00	1.67	41.67	56.67
Silver Brown	ECS	60.33	0.00	0.00	0.00	39.33	61.00
	Average	60.83^{C}	0.00	0.00	0.83	40.50^{A}	58.83^{B}
Lohmann	CS	65.33	0.00	0.00	0.00	8.67	87.33
LB-Lite	ECS	68.00	0.00	0.00	0.00	6.33	92.33
	Average	66.67^{A}	0.00	0.00	0.00	7.50^{B}	89.83^{A}
Novogen	CS	67.00	0.00	0.00	0.00	6.00	94.00
Novobrown	ECS	65.67	0.00	0.00	0.00	15.67	82.00
	Average	66.33^{AB}	0.00	0.00	0.00	10.83^{B}	88.00^{A}
TETRA	CS	63.33	0.00	0.00	0.00	22.33	77.67
Brown	ECS	63.67	0.00	0.00	0.00	21.33	78.67
	Average	63.50^{ABC}	0.00	0.00	0.00	21.83^{AB}	78.17^{AB}
	CS	64.28	0.00	0.00	0.24	18.76	80.10
All	ECS	64.33	0.00	0.00	0.48	19.81	78.62
Strains	Average	64.31	0.00	0.00	0.36	19.28	79.36

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 80 in^2/hen

A,B,C - Different letters denote significant differences (P<0.01), comparisons made among strain average values

Table 46. Effect of Brown-Egg Strain and Housing System on Egg Quality, Income and Feed Costs of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Non-Molted)

Breeder (Strain)	Housing System[1]	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans	CS	68.67	2.67	27.00	1.67	2.79	1.19
Brown	ECS	81.00	6.67	10.33	2.67	2.96	1.16
	Average	74.83	4.67	18.67	2.17	2.88	1.17
ISA	CS	92.33	0.00	7.67	0.00	2.92	1.14
Brown	ECS	85.67	2.33	12.00	0.00	3.03	1.13
	Average	89.00	1.17	9.83	0.00	2.97	1.14
Hy-Line	CS	89.33	1.67	8.00	1.33	2.75	1.29
Brown	ECS	87.00	2.66	9.33	1.33	2.73	1.13
	Average	88.17	2.17	8.67	1.33	2.74	1.21
Hy-Line	CS	86.67	1.33	12.00	0.00	2.79	1.16
Silver Brown	ECS	93.67	3.67	2.33	0.00	2.75	1.07
	Average	90.17	2.50	7.17	0.00	2.77	1.12
Lohmann	CS	74.33	4.33	17.33	4.33	2.83	1.13
LB-Lite	ECS	83.00	0.00	17.00	0.00	2.64	1.10
	Average	78.67	2.17	17.17	2.17	2.74	1.12
Novogen	CS	82.33	1.33	16.33	0.00	2.85	1.21
Novobrown	ECS	82.33	2.33	12.67	2.33	2.80	1.13
	Average	82.33	1.83	14.50	1.17	2.82	1.17
TETRA	CS	79.67	5.00	15.33	0.00	2.70	1.17
Brown	ECS	77.00	1.67	21.33	0.00	2.69	1.43
	Average	78.33	3.33	18.33	0.00	2.69	1.16
	CS	81.90	2.33	14.81	1.05	2.80	1.18
All	ECS	84.24	2.76	12.14	0.90	2.80	1.12
Strains	Average	83.07	2.55	13.48	0.98	2.80	1.15

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 80 in^2/hen

Table 47. Effect of White-Egg Strain and Housing System on Performance of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Molted)

Breeder (Strain)	Housing System[1]	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed (#)	Hen Day Egg Production[2] (%)	Daily Egg Mass (g/HD)[3]	Mortality (%)
Bovans	CS	7.97	0.10	12.00	3.67	7.60	5.21
White	ECS	7.57	0.08	16.33	4.67	6.00	4.11
	Average	7.77^{ABC}	0.09	14.17	4.17	6.80	4.66
Shaver	CS	9.10	0.12	18.67	5.33	11.47	3.17
White	ECS	8.47	0.15	21.33	6.00	12.37	7.41
	Average	8.78^{A}	0.14	20.00	5.67	11.92	5.29
Dekalb	CS	7.83	0.11	15.00	4.00	8.57	3.34
White	ECS	7.27	0.13	17.00	5.00	9.20	2.92
	Average	7.55^{ABC}	0.12	16.00	4.50	8.88	3.13
Babcock	CS	8.30	0.10	21.00	6.67	7.80	17.33
White	ECS	6.33	0.08	13.00	4.00	4.83	12.09
	Average	7.32^{BC}	0.09	17.00	5.33	6.32	14.71
ISA	CS	7.73	0.11	20.00	5.67	8.33	1.19
B-400	ECS	6.57	0.12	14.00	4.33	8.23	7.48
	Average	7.15^{CD}	0.12	17.00	5.00	8.28	4.34
Hy-Line	CS	7.90	0.08	15.00	4.33	5.93	2.09
W-80	ECS	7.63	0.04	16.67	4.67	3.20	3.23
	Average	7.77^{ABC}	0.06	15.83	4.50	4.57	2.66
Hy-Line	CS	5.50	0.14	11.33	3.33	7.47	2.91
W-36	ECS	6.37	0.05	13.67	4.00	3.57	0.00
	Average	5.93^{D}	0.09	12.50	3.67	5.52	1.46
Lohmann	CS	6.97	0.11	11.67	3.33	7.47	1.19
LSL Lite	ECS	6.97	0.08	13.33	3.67	6.03	3.27
	Average	6.97^{CD}	0.10	12.50	3.50	7.75	2.22
H&N	CS	9.07	0.08	16.33	4.67	7.17	2.30
Nick Chick	ECS	7.97	0.04	14.33	4.33	3.43	6.13
	Average	8.52^{AB}	0.06	15.33	4.50	5.30	4.21
Novogen	CS	8.20	0.08	15.00	4.33	6.30	4.29
Novowhite	ECS	7.83	0.10	17.67	5.33	8.03	6.06
	Average	8.02	0.09	16.33	4.83	7.17	5.17
	CS	7.86^{Z}	0.10	15.60	4.53	7.81	4.30
All	ECS	7.30^{Y}	0.09	15.73	4.60	6.49	5.27
Strains	Average	7.58	0.09	15.67	4.57	7.15	4.78

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 69 in^2/hen

[2]The average daily number of eggs produced per 100 hens (%)

[3]HD=hen day

A.B.C.D - Different letters denote significant differences (P<0.01). comparisons made among strain average values.

Y.Z - Different letters denote significant differences (P<0.01). comparisons made among density average values.

Table 48. Effect of White-Egg Strain and Housing System on Egg Weight and Egg Size Distribution of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Molted)

Breeder (Strain)	Housing System[1]	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans	CS	63.33	0.00	0.00	0.00	33.33	66.67
White	ECS	33.33	33.34	11.10	33.33	22.23	0.00
	Average	48.33	16.67	5.55	16.67	27.78	33.33
Shaver	CS	61.10	0.00	0.00	22.23	24.44	46.67
White	ECS	58.50	0.00	0.00	8.33	76.67	15.00
	Average	59.80	0.00	0.00	15.28	50.56	30.83
Dekalb	CS	57.77	0.00	5.57	0.00	44.44	44.47
White	ECS	55.00	0.00	0.00	16.67	50.00	16.67
	Average	56.38	0.00	2.83	8.33	47.22	30.61
Babcock	CS	40.00	50.00	0.00	0.00	33.33	16.67
White	ECS	36.67	33.34	0.00	0.00	33.33	33.33
	Average	38.33	41.67	0.00	0.00	33.33	25.00
ISA	CS	37.23	33.36	0.00	11.10	44.44	11.10
B-400	ECS	58.20	0.00	5.55	0.00	79.17	15.28
	Average	47.72	16.68	2.78	5.55	61.80	13.19
Hy-Line	CS	38.33	0.00	0.00	0.00	50.00	16.67
W-80	ECS	20.00	66.67	0.00	0.00	33.33	0.00
	Average	29.17	33.33	0.00	0.00	41.67	8.33
Hy-Line	CS	66.67	0.00	0.00	0.00	33.33	66.67
W-36	ECS	23.33	66.67	0.00	0.00	0.00	33.33
	Average	45.00	33.33	0.00	0.00	16.67	50.00
Lohmann	CS	63.33	0.00	0.00	11.10	11.10	77.78
LSL Lite	ECS	40.00	0.00	0.00	0.00	16.67	50.00
	Average	51.66	0.00	0.00	5.55	13.89	63.89
H&N	CS	45.00	0.00	0.00	0.00	0.00	66.67
Nick Chick	ECS	20.00	66.67	0.00	0.00	0.00	33.33
	Average	32.50	33.33	0.00	0.00	0.00	50.00
Novogen	CS	41.10	0.00	33.34	44.43	22.23	0.00
Novowhite	ECS	40.00	0.00	33.33	16.67	50.00	0.00
	Average	40.55	0.00	33.33	30.55	36.17	0.00
	CS	51.37	8.34	0.57	4.44	31.88	43.58
All	ECS	38.50	26.67	1.11	5.83	32.81	24.69
Strains	Average	44.94	17.51	0.84	5.14	32.34	34.14

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 69 in^2/hen

Table 49. Effect of White-Egg Strain and Housing System on Egg Quality, Income and Feed Costs of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Molted)

Breeder (Strain)	Housing System[1]	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans	CS	83.33	0.00	16.67	0.00	0.41	0.69
White	ECS	44.44	0.00	22.23	0.00	0.32	0.65
	Average	63.88	0.00	19.45	0.00	0.37	0.67^{ABC}
Shaver	CS	93.33	0.00	0.00	6.67	0.55	0.79
White	ECS	70.00	0.00	30.00	0.00	0.70	0.73
	Average	81.66	0.00	15.00	3.33	0.62	0.76^{A}
Dekalb	CS	61.22	0.00	33.33	5.57	0.45	0.68
White	ECS	66.67	0.00	16.67	16.67	0.44	0.62
	Average	63.90	0.00	25.00	11.12	0.44	0.65^{ABC}
Babcock	CS	50.00	0.00	0.00	16.67	0.38	0.72
White	ECS	33.33	0.00	33.33	0.00	0.32	0.54
	Average	41.67	0.00	16.67	8.33	0.35	0.63^{BC}
ISA	CS	50.00	0.00	16.67	0.00	0.47	0.67
B-400	ECS	81.94	0.00	12.50	5.56	0.46	0.57
	Average	65.97	0.00	14.58	2.78	0.46	0.62^{CD}
Hy-Line	CS	50.00	0.00	16.67	0.00	0.34	0.68
W-80	ECS	33.33	0.00	0.00	0.00	0.18	0.66
	Average	41.66	0.00	8.33	0.00	0.26	0.67^{ABC}
Hy-Line	CS	100.00	0.00	0.00	0.00	0.39	0.48
W-36	ECS	33.33	0.00	0.00	0.00	0.17	0.55
	Average	66.67	0.00	0.00	0.00	0.28	0.51^{D}
Lohmann	CS	66.67	0.00	33.33	0.00	0.38	0.60
LSL Lite	ECS	66.67	0.00	0.00	0.00	0.35	0.60
	Average	66.67	0.00	16.67	0.00	0.36	0.60^{CD}
H&N	CS	66.67	0.00	0.00	0.00	0.36	0.78
Nick Chick	ECS	33.33	0.00	0.00	0.00	0.21	0.69
	Average	50.00	0.00	0.00	0.00	0.28	0.73^{AB}
Novogen	CS	66.67	0.00	0.00	0.00	0.35	0.71
Novowhite	ECS	66.67	0.00	0.00	0.00	0.47	0.67
	Average	66.67	0.00	0.00	0.00	0.41	0.69^{ABC}
	CS	68.79	0.00	11.67	2.90	0.41	0.68^{Z}
All	ECS	52.97	0.00	11.47	2.22	0.36	0.63^{Y}
Strains	Average	60.88	0.00	11.57	2.56	0.38	0.66

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 69 in^2/hen

A.B.C.D - Different letters denote significant differences (P<0.01). comparisons made among strain average values.

Y.Z - Different letters denote significant differences (P<0.01). comparisons made among density average values.

Table 50. Effect of Brown-Egg Strain and Housing System on Performance of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Molted)

Breeder (Strain)	Housing System[1]	Feed Consumption (kg/100 hens/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed (#)	Hen Day Egg Production[2] (HD%)[3]	Daily Egg Mass (g/HD)[3]	Mortality (%)
Bovans	CS	7.43	0.13	4.00	14.33	9.37	13.17
Brown	ECS	8.53	0.16	6.00	22.00	13.73	0.00
	Average	7.98^{AB}	0.14^{A}	5.00^{AB}	18.17^{AB}	11.55^{AB}	6.58
ISA	CS	6.70	0.07	3.33	12.00	4.63	4.34
Brown	ECS	7.13	0.04	4.00	13.00	2.72	3.37
	Average	6.92^{BC}	0.05^{B}	3.67^{B}	12.50^{B}	3.68^{AB}	3.86
Hy-Line	CS	6.87	0.13	4.33	14.33	8.64	7.78
Brown	ECS	7.77	0.09	4.67	16.00	6.47	1.08
	Average	7.32^{ABC}	0.11^{AB}	4.50^{B}	15.17^{AB}	7.55^{AB}	4.43
Hy-Line	CS	7.70	0.15	5.67	19.33	11.27	1.08
Silver Brown	ECS	7.93	0.17	6.67	23.67	13.17	0.00
	Average	7.82^{ABC}	0.16^{A}	6.17^{A}	21.50^{A}	12.22^{A}	0.54
Lohmann	CS	7.30	0.04	4.00	14.00	3.21	5.71
LB-Lite	ECS	8.00	0.04	4.33	15.00	2.70	0.00
	Average	7.65^{ABC}	0.04^{B}	4.17^{AB}	14.50^{B}	2.96^{B}	2.86
Novogen	CS	8.30	0.12	4.33	15.00	9.72	13.40
Novobrown	ECS	8.30	0.07	3.67	12.67	5.39	5.38
	Average	8.30^{A}	0.09^{AB}	4.00^{B}	13.83^{B}	7.56^{AB}	9.39
TETRA	CS	6.73	0.06	3.33	12.00	4.05	5.75
Brown	ECS	6.80	0.10	4.33	15.33	6.70	0.00
	Average	6.77^{C}	0.08^{AB}	3.83^{B}	13.67^{B}	5.38^{AB}	2.87
	CS	7.29	0.10	4.14	14.43	7.27	7.32^{Z}
All	ECS	7.78	0.09	4.81	16.81	7.27	1.40^{Y}
Strains	Average	7.54	0.10	4.48	15.62	7.27	4.36

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 80 in^2/hen

[2]The average daily number of eggs produced per 100 hens (%)

[3]HD=hen day

A.B.C - Different letters denote significant differences (P<0.01). comparisons made among strain average values.

Y.Z - Different letters denote significant differences (P<0.01). comparisons made among density average values.

*Student's test

Table 51. Effect of Brown-Egg Strain and Housing System on Egg Weight and Egg Size Distribution of Hens (483-511 Days) in Colony Housing System and Enriched Colony Housing Systems (Molted)

Breeder (Strain)	Housing System[1]	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Bovans	CS	66.67	0.00	0.00	0.00	44.33	55.67
Brown	ECS	62.00	0.00	0.00	0.00	15.00	85.00
	Average	64.33	0.00	0.00	0.00	29.67	70.33
ISA	CS	43.33	0.00	0.00	0.00	33.33	33.33
Brown	ECS	20.00	0.00	0.00	0.00	0.00	33.33
	Average	31.67	0.00	0.00	0.00	16.67	33.33
Hy-Line	CS	61.00	0.00	0.00	0.00	47.22	52.78
Brown	ECS	37.78	0.00	0.00	11.11	33.33	11.11
	Average	49.39	0.00	0.00	5.56	40.28	31.94
Hy-Line	CS	59.17	0.00	0.00	8.33	46.67	45.00
Silver Brown	ECS	55.56	0.00	0.00	22.22	55.56	11.11
	Average	57.36	0.00	0.00	15.28	51.11	28.06
Lohmann	CS	21.67	0.00	0.00	0.00	0.00	33.33
LB-Lite	ECS	20.00	0.00	0.00	0.00	0.00	33.33
	Average	20.83	0.00	0.00	0.00	0.00	33.33
Novogen	CS	66.67	0.00	11.11	0.00	14.29	74.60
Novobrown	ECS	43.33	0.00	0.00	0.00	16.67	50.00
	Average	55.00	0.00	5.56	0.00	15.48	62.30
TETRA	CS	36.67	0.00	0.00	33.33	3.33	0.00
Brown	ECS	40.00	0.00	0.00	0.00	38.89	27.78
	Average	38.33	0.00	0.00	16.67	36.11	13.89
	CS	50.74	0.00	1.59	5.95	31.31	42.10
All	ECS	39.81	0.00	0.00	4.76	22.78	35.95
Strains	Average	45.27	0.00	0.79	5.36	27.04	39.03

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 80 in^2/hen

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Table 52. Effect of Brown-Egg Strain and Housing System on Egg Quality. Income and Feed Costs of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Molted)

Breeder (Strain)	Housing System[1]	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Bovans	CS	55.57	0.00	44.33	0.00	0.52	0.64
Brown	ECS	95.00	0.00	5.00	0.00	0.75	0.74
	Average	75.33	0.00	24.67	0.00	0.63^{AB}	0.69^{AB}
ISA	CS	66.67	0.00	0.00	0.00	0.25	0.58
Brown	ECS	33.33	0.00	0.00	0.00	0.15	0.62
	Average	50.00	0.00	0.00	0.00	0.20^{AB}	0.60^{BC}
Hy-Line	CS	83.33	0.00	16.66	0.00	0.50	0.59
Brown	ECS	55.56	0.00	0.00	11.11	0.31	0.67
	Average	69.44	0.00	8.33	5.56	0.40^{AB}	0.63^{ABC}
Hy-Line	CS	76.67	8.33	15.00	0.00	0.65	0.66
Silver Brown	ECS	72.22	5.56	11.11	11.11	0.67	0.69
	Average	74.44	6.94	13.06	5.56	0.66^{A}	0.68^{ABC}
Lohmann	CS	33.33	0.00	0.00	0.00	0.17	0.63
LB-Lite	ECS	33.33	0.00	0.00	0.00	0.15	0.69
	Average	33.33	0.00	0.00	0.00	0.165^{B}	0.66^{ABC}
Novogen	CS	79.37	0.00	20.63	0.00	0.51	0.71
Novobrown	ECS	66.67	0.00	0.00	0.00	0.29	0.71
	Average	73.02	0.00	10.32	0.00	0.40^{AB}	0.71^{A}
TETRA	CS	66.67	0.00	0.00	0.00	0.23	0.58
Brown	ECS	55.56	0.00	11.11	0.00	0.37	0.59
	Average	61.11	0.00	5.56	0.00	0.30^{AB}	0.58^{C}
	CS	65.96	1.19	13.80	0.00	0.40	0.63
All	ECS	58.81	0.79	3.89	3.17	0.38	0.67
Strains	Average	62.38	0.99	8.85	1.59	0.39	0.65

40th NCLP&MT

[1]Colony Housing System=CS; Enriched Colony Housing System=ECS

All strains were equally represented in each production system, and CS and ECS hens were housed at 80 in^2/hen

A.B.C - Different letters denote significant differences (P<0.01). comparisons made among strain average values.

Table 53. Effect of Non-Molted White-Egg Strains on Body Weight of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Non-Molted)

Breeder (Strain)	Molt[1]	17-Wk Body Wt (kg)	69-Wk Body Wt (kg)	1st Cycle Wt Gain (%)	73-Wk Body Wt (kg)
Bovans	CS	1.16	1.76	51.22	1.73
White	ECS	1.15	1.76	52.97	1.75
	Average	1.16^{abc}	1.76^{ab}	52.09	1.74^{abc}
Shaver	CS	1.10	1.68	52.32	1.69
White	ECS	1.11	1.68	51.43	1.72
	Average	1.11^{c}	1.68^{bc}	51.87	1.70^{bc}
Dekalb	CS	1.17	1.72	47.11	1.73
White	ECS	1.14	1.69	48.58	1.67
	Average	1.16^{abc}	1.71^{bc}	47.84	1.70^{bc}
Babcock	CS	1.22	1.90	55.57	1.89
White	ECS	1.15	1.83	59.73	1.80
	Average	1.19^{ab}	1.87^{a}	57.65	1.85^{a}
ISA	CS	1.13	1.55	37.71	1.67
B-400	ECS	1.00	1.64	49.29	1.63
	Average	1.11^{c}	1.59^{c}	43.49	1.65^{c}
Hy-Line	CS	1.16	1.82	56.76	1.79
W-80	ECS	1.14	1.73	51.27	1.75
	Average	1.15^{abc}	1.78^{ab}	54.01	1.77^{ab}
Hy-Line	CS	1.13	1.69	49.20	1.70
W-36	ECS	1.11	1.72	53.88	1.70
	Average	1.12^{bc}	1.70^{bc}	51.54	1.70^{bc}
Lohmann	CS	1.19	1.77	48.23	1.81
LSL Lite	ECS	1.22	1.72	41.73	1.70
	Average	1.21^{a}	1.75^{ab}	44.97	1.76^{abc}
H&N	CS	1.17	1.75	48.92	1.74
Nick Chick	ECS	1.22	1.70	39.15	1.70
	Average	1.20^{a}	1.72^{b}	44.04	1.72^{bc}
Novogen	CS	1.15	1.73	50.07	1.68
Novowhite	ECS	1.16	1.64	41.33	1.64
	Average	1.16^{abc}	1.68^{bc}	45.70	1.66^{bc}
	CS	1.16	1.74	49.71	1.74
All	ECS	1.15	1.71	48.93	1.71
Strains	Average	1.16	1.72	49.32	1.72

40th NCLP&MT

Colony Housing System=CS; Enriched Colony Housing System=ECS

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

a, b, c - Different letters denote significant differences (P<0.01), comparisons made among strains using average of CS and ECS values.

Table 54. Effect of Non-Molted Brown-Egg Strains on Body Weight of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Non-Molted)

Breeder (Strain)	Molt[1]	17-Wk Body Wt (kg)	69-Wk Body Wt (kg)	1st Cycle Wt Gain (%)	73-Wk Body Wt (kg)
Bovans	CS	1.40	2.00	42.58	2.06
Brown	ECS	1.42	1.92	35.40	1.98
	Average	1.41^{bc}	1.96^{bc}	38.99	2.02^{ab}
ISA	CS	1.35	2.05	51.42	1.95
Brown	ECS	1.40	1.92	37.36	1.95
	Average	1.38^{c}	1.99^{bc}	44.39	1.95^{b}
Hy-Line	CS	1.40	2.00	43.69	2.02
Brown	ECS	1.47	2.06	40.69	1.98
	Average	1.43^{abc}	2.03^{abc}	42.19	2.00^{ab}
Hy-Line	CS	1.53	2.18	41.83	2.17
Silver Brown	ECS	1.48	2.14	44.51	2.10
	Average	1.51^{a}	2.16^{a}	43.17	2.14^{a}
Lohmann	CS	1.49	1.99	33.31	1.96
LB-Lite	ECS	1.43	1.86	29.96	1.88
	Average	1.46^{abc}	1.92^{c}	31.64	1.92^{b}
Novogen	CS	1.50	2.11	41.46	2.05
Novobrown	ECS	1.45	2.01	38.22	1.96
	Average	1.47^{ab}	2.06^{ab}	39.84	2.01^{ab}
TETRA	CS	1.42	2.07	45.57	2.06
Brown	ECS	1.44	2.03	41.74	2.00
	Average	1.43^{abc}	2.05^{abc}	43.65	2.03^{ab}
	CS	1.44	2.06^{x}	42.84	2.04
All	ECS	1.44	1.99^{z}	38.27	1.98
Strains	Average	1.44	2.02	40.55	2.01

40th NCLP&MT

Colony Housing System=CS; Enriched Colony Housing System=ECS

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

a, b, c - Different letters denote significant differences (P<0.01), comparisons made among strains using average of CS and ECS values

y,z – Different letters denote significant differences (P<0.01), comparisons made among strain average for each housing systems

Table 55. Effect of Molted White-Egg Strains on Body Weight of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Molted)

Breeder (Strain)	Molt[1]	17-Wk Body Wt (kg)	69-Wk Body Wt (kg)	1st Cycle Wt Gain (%)	Lowest Body Wt (kg)	Molt Wt Loss (%)	73-Wk Body Wt (kg)	Days to 0% Production
Bovans	CS	1.17	1.72	47.75	1.37	20.30	1.60	8.33
White	ECS	1.20	1.73	43.72	1.33	22.85	1.62	8.67
	Average	1.18	1.73^{b}	45.74	1.35^{bcd}	21.58	1.61^{abc}	5.50
Shaver	CS	1.14	1.71	50.44	1.29	24.25	1.57	8.67
White	ECS	1.19	1.73	44.83	1.29	25.34	1.57	10.00
	Average	1.16	1.72^{b}	47.63	1.29^{cd}	24.79	1.57^{abc}	9.30
Dekalb	CS	1.19	1.74	46.05	1.34	23.00	1.62	8.33
White	ECS	1.19	1.64	37.97	1.26	23.44	1.60	9.33
	Average	1.19	1.69^{b}	42.01	1.30^{bcd}	23.22	1.56^{abc}	8.83
Babcock	CS	1.16	1.89	62.63	1.52	19.19	1.74	9.00
White	ECS	1.39	1.87	34.94	1.44	23.03	1.61	8.33
	Average	1.28	1.88^{a}	48.79	1.48^{a}	21.11	1.68^{ab}	8.67
ISA	CS	1.16	1.68	46.84	1.28	24.10	1.58	8.33
B-400	ECS	1.19	1.66	40.68	1.30	21.93	1.42	8.67
	Average	1.17	1.67^{b}	43.76	1.29^{d}	23.02	1.50^{c}	8.50
Hy-Line	CS	1.19	1.77	49.96	1.40	21.12	1.67	7.33
W-80	ECS	1.20	1.77	46.81	1.43	19.05	1.73	7.67
	Average	1.20	1.77^{ab}	48.38	1.41^{ab}	20.08	1.70^{a}	7.50
Hy-Line	CS	1.16	1.82	56.23	1.41	22.27	1.53	8.33
W-36	ECS	1.19	1.72	44.96	1.40	18.88	1.56	7.67
	Average	1.18	1.77^{ab}	50.60	1.41^{abc}	20.58	1.55^{bc}	8.00
Lohmann	CS	1.16	1.76	51.34	1.34	24.09	1.64	8.67
LSL Lite	ECS	1.25	1.68	34.18	1.34	20.17	1.53	8.33
	Average	1.21	1.72^{b}	42.76	1.34^{bcd}	22.13	1.58^{abc}	8.00
H&N	CS	1.18	1.75	47.95	1.35	22.61	1.71	7.00
Nick Chick	ECS	1.17	1.67	45.71	1.32	21.27	1.61	8.00
	Average	1.17	1.71^{b}	46.83	1.34^{bcd}	21.94	1.66^{ab}	7.50
Novogen	CS	1.17	1.74	48.65	1.31	24.64	1.61	8.00
Novowhite	ECS	1.19	1.69	41.77	1.27	24.47	1.62	6.33
	Average	1.18	1.72^{b}	45.21	1.29^{cd}	24.56	1.62^{abc}	7.16
	CS	1.17^{z}	1.76	50.78	1.36	22.56	1.63^{y}	8.20
All	ECS	1.22^{y}	1.72	41.56	1.34	22.04	1.58^{z}	8.20
Strains	Average	1.19	1.74	46.17	1.35	22.30	1.60	8.20

40th NCLP&MT

Colony Housing System=CS; Enriched Colony Housing System=ECS

[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

a, b, c, d - Different letters denote significant differences (P<0.01), comparisons made among strains using average of CS and ECS values

y,z – Different letters denote significant differences (P<0.01), comparisons made among strain average for each housing systems

Table 56. Effect of Molted Brown-Egg Strains on Body Weight of Hens (69-73 wks) in Colony Housing System and Enriched Colony Housing Systems (Molted)

Breeder (Strain)	Molt[1]	17-Wk Body Wt (kg)	69-Wk Body Wt (kg)	1st Cycle Wt Gain (%)	Lowest Body Wt (kg)	Molt Wt Loss (%)	73-Wk Body Wt (kg)	Days to 0% Production
Bovans	CS	1.42	2.06	45.54	1.74	15.43	1.91	7.33
Brown	ECS	1.39	2.02	44.84	1.64	18.49	2.00	6.67
	Average	1.40	2.04	45.19	1.69^{ab}	16.96^{ab}	1.95^{a}	7.00^{b}
ISA	CS	1.38	1.93	40.35	1.46	22.78	1.67	7.67
Brown	ECS	1.33	1.92	44.19	1.48	22.65	1.70	8.33
	Average	1.36	1.92	42.27	1.47^{b}	23.71^{a}	1.69^{b}	8.00^{ab}
Hy-Line	CS	1.46	2.01	38.19	1.72	14.64	1.78	10.00
Brown	ECS	1.31	1.98	51.43	1.60	17.26	1.92	10.33
	Average	1.38	2.00	44.81	1.68^{ab}	15.95^{ab}	1.85^{ab}	10.17^{ab}
Hy-Line	CS	1.47	2.08	41.93	1.59	23.45	2.04	10.33
Silver Brown	ECS	1.45	2.01	37.96	1.70	15.48	1.99	11.33
	Average	1.46	2.04	39.94	1.64^{ab}	16.46^{ab}	2.01^{a}	10.83^{a}
Lohmann	CS	1.36	1.91	39.91	1.50	21.47	1.59	8.00
LB-Lite	ECS	1.99	1.94	29.73	1.60	17.31	1.77	9.00
	Average	1.43	1.92	34.82	1.55^{ab}	19.39^{ab}	1.68^{b}	8.50^{ab}
Novogen	CS	1.46	2.02	38.44	1.83	8.99	1.91	7.67
Novobrown	ECS	1.40	1.93	38.21	1.76	9.14	1.92	9.00
	Average	1.43	1.98	38.33	1.80^{a}	9.06^{b}	1.92^{a}	8.30^{ab}
TETRA	CS	1.43	2.02	41.07	1.79	11.20	1.90	7.67
Brown	ECS	1.45	1.89	29.63	1.71	9.46	1.83	8.67
	Average	1.44	1.95	35.35	1.75^{ab}	10.33^{b}	1.86^{a}	8.17^{ab}
	CS	1.43	2.00	40.77	1.66	17.14	1.82	8.38
All	ECS	1.40	1.95	39.42	1.64	15.68	1.87	9.05
Strains	Average	1.42	1.98	40.10	1.65	16.41	1.85	8.71

40th NCLP&MT

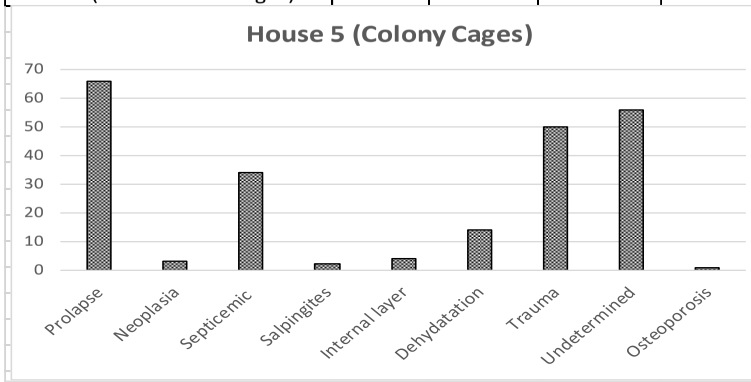
Colony Housing System=CS; Enriched Colony Housing System=ECS

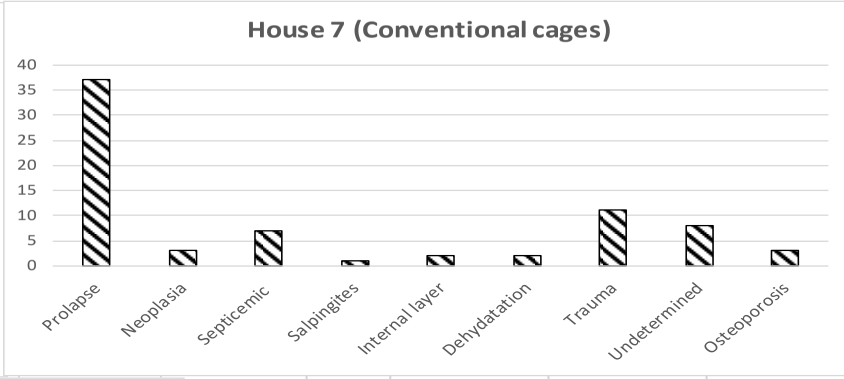
[1]All strains were equally represented in either NM=Non-molted or NA=Non-anorexic molt treatments

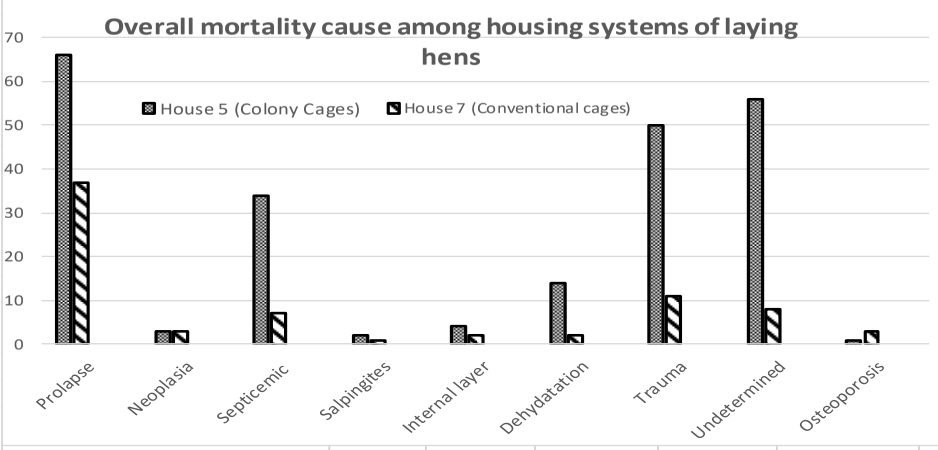
a, b - Different letters denote significant differences (P<0.01), comparisons made among strains using average of CS and ECS values

Table 57: Causes of Mortality in a Sub Sample of All mortalities (hens) in Conventional Cages and Colony Cage Systems from 17 to 78 weeks of age.

House	Prolapse	Neoplasia	Septicemic	Salpingites	Internal layer	Dehydatation	Trauma	Undetermined	Osteoporosis	Total
House 5 (Colony Cages)	66	3	34	2	4	14	50	56	1	230
House 7 (Conventional cages)	37	3	7	1	2	2	11	8	3	74







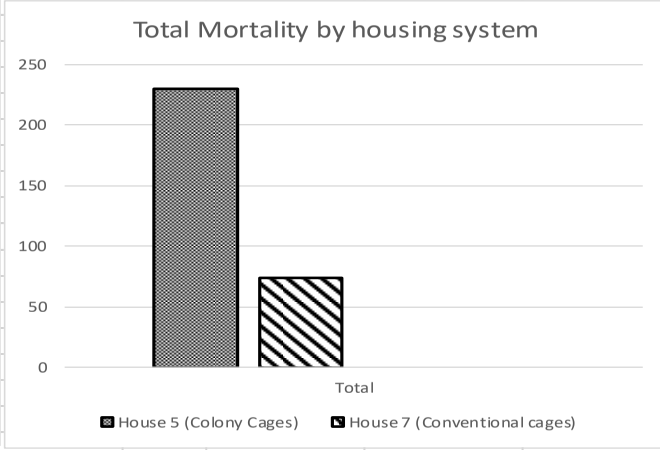
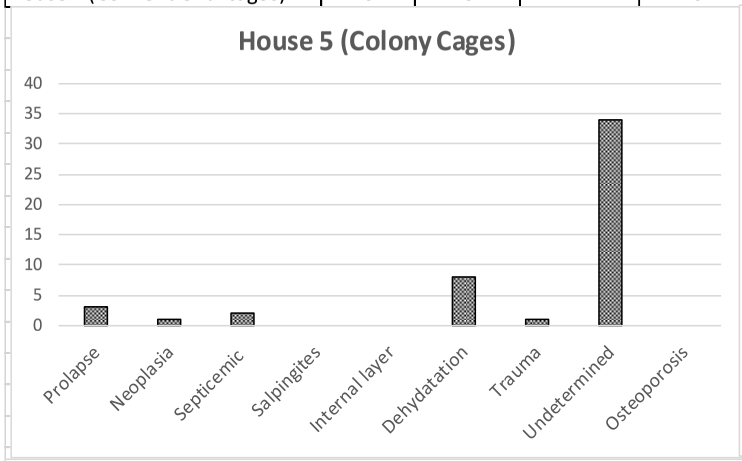
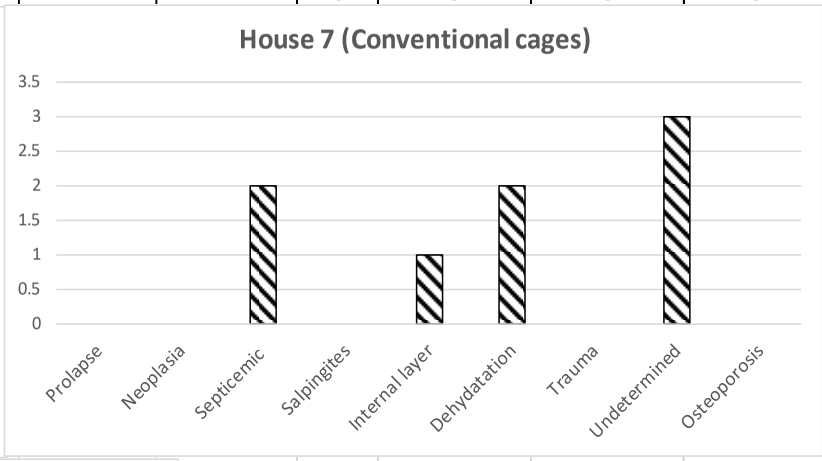
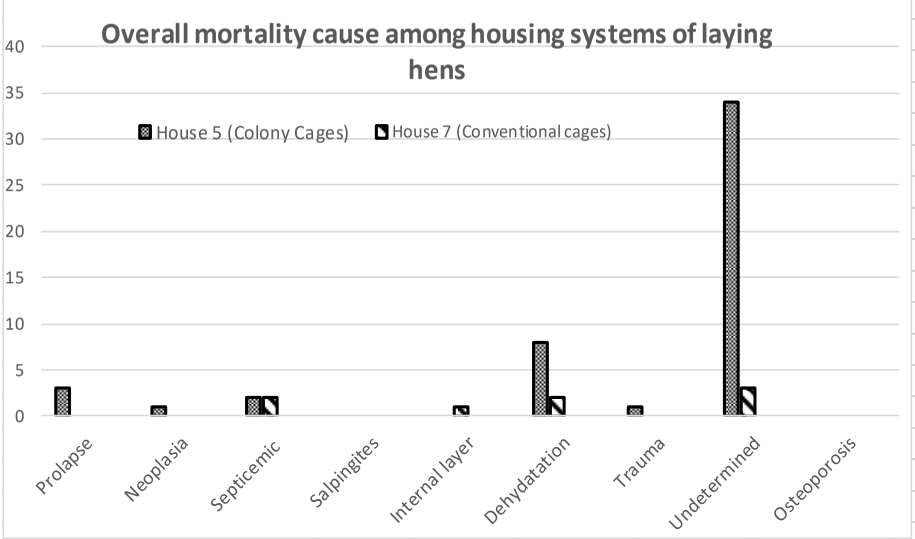


Table 58: Causes of mortality in a sub sample of all mortalities (hens) between the Conventional Cages and Colony Cage Systems from 69 -73 weeks (Molt Period)

House	Prolapse	Neoplasia	Septicemic	Salpingites	Internal layer	Dehydatation	Trauma	Undetermined	Osteoporosis	Total
House 5 (Colony Cages)	3	1	2	0	0	8	1	34	0	49
House 7 (Conventional cages)	0	0	2	0	1	2	0	3	0	8







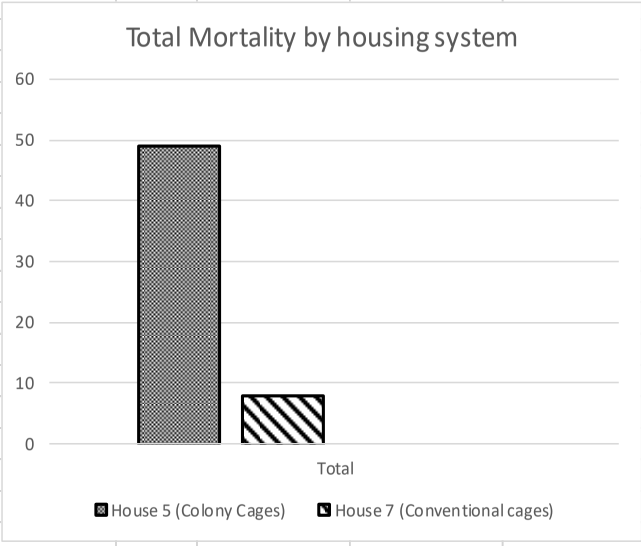


Table 59. Entries in the 40th NCLP&MT by Breeder, Stock Suppliers, and Categories

Breeder	Stock	Category[1]	Source
Hy-Line International 2583 240th Street Dallas Center, IA 50063	W-36	I-A	Hy-Line North America 4432 Highway 213, Box 309 Mansfield, GA 30255
	W-80	I-A	(Mansfield, PA)
	Hy-Line Brown	I-A	HyLine North America 79 Industrial Rd Elizabethtown, PA 17022
	Hy-Line Silver Brown	I-A	(Elizabethtown, PA)
	Hy-Line White Exp.	II-A	(Mansfield, PA)
Lohmann Tierzucht Gmbh Am Seedeich 9-11 . P.O.Box 460 D-27454 Cuxhaven, Germany	Lohmann LSL-Lite	I-A	Hy-Line North America 79 Industrial Rd Elizabethtown, PA 17022
	Lohmann LB-Lite	I-A	(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
Institut de Selection Animale (A Hendrix Genetic Company) ISA North America 650 Riverbend Drive, Suite C Kitchener, Ontario N2K 3S2 Canada	Bovans White	I-A	Hendrix-ISA LLC 621 Stevens Rd Ephrata, PA 17522
	Dekalb White	I-A	(Ephrata, PA)
	Bovans Brown	I-A	(Ephrata, PA)
	Babcock White	I-A	Institute de Sélection Animale 50 Franklin Road Cambridge, Ontario N1R 8G6 Canada
	B 400	I-A	(Cambridge, Ontario)
	Shaver White	I-A	(Ephrata, PA)
	ISA Brown	I-A	(Ephrata, PA)
Tetra Americana, LLC 1105 Washington Road Lexington, GA 30648	TETRA Brown	II-A	BABOLNA TETRA KFT Babolna TETRA Korisvolgy1 Uraiujfalu, Hungary-EU
NOVOGEN S.A.S. Mauguérand – Le Foeil BP 265 22 800 QUINTIN - FRANCE	NOVOgen BROWN	I-A	Morris Hatchery 4090 Campbell Road Gillsville, GA
	NOVOgen WHITE	I-A	(Gillsville, GA)

[1] A = Entry requested, I = Extensive distribution in southeast United States, II = Little or no distribution in southeast United States