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REPORT ON PULLET REARING PERIOD OF THE FOURTIETH NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST AND ALTERNATIVE 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, Cooperative Extension Service at North Carolina State University and the North Carolina Department of Agriculture and Consumer Services. The flock is maintained at the Piedmont Research Station-Poultry Unit, Salisbury, North Carolina. Mr. Joe Hampton is Piedmont Research Station Superintendent; Mrs. Teresa Herman 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.

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

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

40th NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST
Volume 40 No. 2

Report on Pullet Rearing Period

Dates of Importance:

Eighteen entries 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 seven commercial brown egg strains are participating in the current test. Table 1 shows the source of the laying stock (Breeder), the strain which was entered, and the test environments the breeders selected for each strain (Cage, Cage Free, or Range Environment).

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, EC, ECS
2	ISA	ISA	Shaver White	C, EC, ECS
3	ISA	ISA	Dekalb White	C, EC, ECS, CF
4	ISA	ISA	Babcock White	C, EC, ECS, CF
5	ISA	ISA	B 400 White	C, EC, ECS
6	Hy-Line	HL	W-80	C, EC, ECS, CF
7	Hy-Line	HL	W-36	C, EC, ECS, CF
8	Hy-Line	HL	White Exp	CF, R
9	Lohmann	L	LSL Lite	C, EC, ECS, CF
10	H&N	H&N	H&N Nick Chick	C, EC, ECS, CF
11	Novogen	N	Novowhite	C, EC, ECS, CF
12	ISA	ISA	Bovans Brown	C, EC, ECS, CF
13	ISA	ISA	ISA Brown	C, EC, ECS, CF
14	Hy-Line	HL	Brown	C, EC, ECS, CF, R
15	Hy-Line	HL	Silver Brown	C, EC, ECS, CF, R
16	Lohmann	L	LB Lite	C, EC, ECS, CF, R
17	Novogen	N	Novobrown	C, EC, ECS, CF
18	Tetra Americana	TA	TETRA Brown	C, EC, ECS, CF

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

The chicks were all sexed according to their genetics (vent, feather, or color), vaccinated for Marek's and IBD disease, and banded for identification before being transferred to the brood/grow houses. For further information Table 20, provides the breeder, source of eggs, and entry status of each strain.

The rearing phase for the cage reared, cage free, and range pullets was completed when the pullets were 16 weeks of age. They were then transitioned to the laying phase during their 17th week of age.

Experimental Design:

The rearing portion of the test was a factorial arrangement of rearing environments and strain were the main effects. The analyses were done by each rearing environment of a Quad-deck cage system in a light tight house; slat-litter floor pen house, environmentally controlled, and range houses with paddocks. The pullets were reared in the environment in accordance with the lay environment they would be placed in and grown on range standards as practiced by specialty egg producers.

Strain--Samples of fertile eggs were provided from the breeders according to the rules, which govern the conductance of the test. All eggs were set and hatched concurrently (Hatch/Serology Report Vol. 40, No. 1) as described in the hatch report.

For the layer test, a maximum of approximately 860 and minimum of 300 white and brown egg pullets/strain were placed at the initiation of the test depending on which portion of the test the strain was entered into. If the number of pullets hatched were below the prescribed numbers, the chicks were divided as equally as possible between the levels and replicates within the grow house and placement into the layer test would be adjusted appropriately.

PULLET HOUSING AND MANAGEMENT:

Housing: The chicks were weighed then randomly assigned to the growing replicates with the white egg and brown egg replicates being intermingled throughout the rooms or pens within the houses. The white egg strains occupied approximately 60 % of the house and brown egg strains occupied the other 40 % of rearing cage replicates, white egg strains occupied approximately 50 % and brown egg strains occupied the other 50 % of cage free floor replicates, and white egg strains occupied approximately 25 % and brown egg strains occupied the other 75 % of range replicates. Individual chicks were identified by strain assignment codes that indicate the cage/pen arrangement, replicate identification numbers, and the strain assignments for each brood-grow House 8, 4, and range houses 1, 2 and 3. Strain codes are maintained by the PI and Unit Manager for identification of birds and record keeping. Individual birds are identified by a permanent identification tag which identifies the replicate number (room, row, level and cage) within each house, respectively and color indicates the rearing environment. The replicate number identifies individuals from the strain to the unit manager and PI.

House 8 - is an environmentally controlled windowless brood/grow facility with 3 banks of quad-deck cages in each of 4 rooms. Each room had been assigned a number, each bank assigned a row number, and each cage section within each row and level per row assigned a replicate number. For statistical analysis the room was designated as a block. Each block consists of six rows containing 72 replicates on all levels, allowing for a total of 3,744 pullets per room for rooms 1-4 and 19 replicates in room 1 will be utilized in House 8 for a total of 12,220 pullets.

The white and brown egg strains were randomly assigned to the replicates within the house and room. Strains were assigned to the replicates in a restricted randomized manner with the restrictions being that all strains were approximately equally represented in all rooms, rows, and levels, as described earlier under the experimental design. All chicks were brooded in the same cage during the entire 16 week rearing period. Paper was placed on the cage floor for the first 7 days within each of the replicate series within each row. Each cage within the replicate was filled with 13 white-egg or brown-egg (13 per 24 in x 26 in cage) pullets on the day of hatch for a rearing allowance of 310 cm^2 (48 in^2) for the white and brown-egg layers.

For the cage-free and range pullets, chicks were brooded and grown within the production environment for which they were intended during the laying phase. They were housed such that all of the chicks from one brooding replicate went to a pen or range pen to minimize social disruption.

House 4 – is an environmentally controlled windowless high-rise house modified to accommodate 36 replicates of cage free egg production. The house was set up to provide whole house heat capabilities serves dual purpose for brood/grow and production of the cage free birds. The house was divided into 36 pens which are 2.43 m x 3.05 m (8.0 ft x 10 ft). Sixty five chicks provided a minimum of 929 cm^2/pullet (144 in^2) were started in each pen with the rearing protocol being as similar to the cage reared pullets as possible. Feeder and waterer space was designed to meet UEP Guidelines for cage free facilities.

Range housing --The pullets for the range facilities were reared on litter in the range huts designed for whole house heat capabilities. There were 65 chicks started were provided a minimum of 929 cm^2/pullet (144 in^2) started in each pen 4 m x 2 m (12.1 ft x 6.6 ft). The slats were covered with landscape cloth and a layer of wood shavings. The litter was removed at 6 wks so the pullets could become accustomed to slats after the brooding period. Pullets were provided 13 cm of roosting space per bird. The range houses have timers for light control and supplemental propane heater for brooding. Heat was provided until the birds were fully feathered, and also provide heat during cool conditions to maintain an interior temperature within the Thermal Neutral Zone (TNZ) where body temperature was maintained. At 12 weeks of age, the range pullets were allowed access to their respective range paddocks where the completion of the rearing was done. They had free access to the outdoors throughout the day and night but were enticed to return to the range house during the dark for roosting and protection. Husbandry, lighting and supplemental feed was allocated on the same basis as flock mates in cage-free and cages in order to minimize the variables between flock mates. Range density was based upon research of 721 bird/acre static equivalency 5.56 m^2/hen (60 ft^2/hen). The range pens are 18.3 m x 18.3 m (60 ft x 60 ft) and are enclosed by a fence 1.8 m (6 ft). In order to facilitate range forage replenishment, each of the paddocks were divided in half with a diagonal fence providing 2.78 m^2/hen (30 ft^2/hen) and rotated every 4 wks. One week prior to rotation, the paddocks were mowed to an approximate height of 15 cm (6 in.). Hen movement was controlled by an access gate. The veranda area was 3.04 m x 4.6 m (10 ft x15 ft) of shaded, bare dirt. Each range house has 8 nipple drinkers inside each pen and 8 nipple drinkers outside. Tube feeders were inside each pen and a covered feeder was outside providing 6.4 cm of feeder space per pullet.

Pullet Management and Nutrition: Pullets were fed *ad libitum* by hand daily. Feed consumption and body weights were monitored bi-weekly beginning at 2 weeks of age. All mortality was

recorded daily, but mortality attributed to the chick quality, removal of males (sex slips) and accidental deaths from a replicate have been excluded from the 40th NCLP&MT Grow Report.

Table 2. Diet Formulations for the Brood-Grow Periods

	Diet[1] Identification				
Ingredient	Starter	Grower	Developer	Developer2	Pre-Lay[2]
Corn	1192.0	1172.0	1193.0	1165.1	1298.9
Fat (Lard)	10.0	10.0	10.0	10.0	18.5
Soybean meal	592.0	426.0	316.0	295.4	500.0
Soybean Hulls	---	---	---	29.4	---
Wheat Midds	127.0	316.0	365.0	400.0	---
D.L. Methionine	4.1	3.1	2.9	2.3	3.3
Lysine 78.8%	1.6	2.3	2.1	1.9	---
Coarse Limestone	---	---	---	---	50.0
Limestone	34.0	37.0	80.0	62.4	102.4
Bi-Carbonate	2.0	2.0	1.5	2.0	1.3
Phosphate Mono/D	20.5	16.4	14.3	17.7	19.0
Salt	6.0	6.0	6.3	4.8	6.2
L-Vit. Premix	1.0	1.0	1.0	1.0	1.0
Min. premix	1.0	1.0	1.0	1.0	1.0
HyD3 (62.5 mg/lb)	1.0	0.5	---	---	---
Prop Acid 50% Dry	2.0	2.0	2.0	2.0	2.0
T-Premix	2.0	2.0	2.0	2.0	1.0
.06% Sel. Premix	1.0	1.0	1.0	1.0	1.0
Choline Cl 60%	1.4	1.3	1.5	1.6	1.2
Ronozyme P-CT 540%	0.4	0.4	0.4	0.4	0.4
Amprol 25 25%	1.0	---	---	---	---
Total	2000	2000	2000	2000	2000
Protein %	20.0	17.6	15.5	15.4	17.0
ME kcal/kg	2926	2860	2805	2772	2893
Calcium %	1.00	1.0	1.8	1.5	3.25
A. Phos. %	0.50	0.48	0.45	0.45	0.50
Lysine %	1.15	0.98	0.83	0.80	0.92
TSAA %	0.86	0.74	0.67	0.64	0.73

[1]Diets were acquired from Southern States Cooperative in mash form and Lance Minear, Nutritionist for Southern States, provided assistance in formulation.
[2]This Pre-lay diet will be fed through 20 weeks or 5% production.

Pullets were fed *ad libitum* throughout the brood grow period. The chicks for each strain were provided with Starter feed containing Amprol during the initial brooding period, followed by Grower, Developer, and Developer 2 diets that are shown in the diet formulation section Table 2 as needed. Thus, the replicates for each strain in brood-grow House 8, 4 and the 3 range houses were provided feed to achieve the breeder recommended body weights at each weigh interval. Pullets of each strain in each house were transitioned independently to the next rearing diet at the point of achieving target body weight goals or after a prescribed time interval. Expected feed

transition intervals were; starter, 0 to 6 weeks; grower 6 to 9 weeks; developer, 9 to 11 weeks; Developer 2, 11 to16 weeks; Pre-lay diet 16 to 17 weeks. However, the goal for each strain was to the breeder recommended body weights which dictated rearing diet changes. Generally, in this flock, the birds in the cage rearing (House 8) were consistently heavier than the guidelines meaning that the dietary regimens were administered as discussed previously with the inclusion of the Developer 2 diet. The Starter, Grower, and Developer, diets were administered in order to maintain a growth pattern and target weights as closely as possible to the breeder recommendations. The pre-lay diet was provided no later than the last week in the rearing facility.

Pullet Vaccination, and Beak Trimming:

Pullet vaccination and beak trimming schedules are outlined in Table 3. Pullets were not re-trimmed at any point in the rearing period.

Table 3. Pullet Vaccination and Beak Trimming Schedule for the 40th NCLP&MT

Age	Date	Event
Hatch	June 1	Marek's Rispens in combo with IBD-HVT (Vaxxitek) vaccination sub Q by injection in neck
Hatch		Live ST – Zoetis Poulvac ST spray
Hatch		IBD-HVT via aerosol spray
Day 6-8	June 6-8	Precision Beak Trim[1] all replicates throughout the flock using 11/64" precision guide.
Day 10	June 10	1st Newcastle (B1) and Bronchitis (Mass.) vaccination Via aerosol spray (Triple Vac)
Day 15	June 16	Live ST – LAH Megan Egg spray
Day 35		2nd Newcastle (LaSota) and Bronchitis (Mass.) vaccination via aerosol
	July 6	spray (ComboVac) Ark
Day 70	August 10	3th Newcastle (LaSota) and Bronchitis (Mass. Ark)) vaccination via aerosol spray (ComboVac)
Day 84	August 24	Fowl Pox and Avian Encephalomyelitis vaccination via the wig web
Day 98	Sept. 7	LAH Killed ND-IB-SE Breast Muscle
Day 105	Sept. 14	4th Newcastle (Lasota) and Bronchitis (Mass. Ark) vaccination via aerosol spray (ComboVac)

[1] Beak trimming was done within all of the production rearing systems in accordance with United Egg Producers Animal Care Program. Beak trimming began at 6 days of age using a Lyons Precision beak trimmer with a 11/64 in guide hole. The trim was a block cut with an approximate blade temp of 1,100 °F (dull red). Beak trimming should be completed within 3 days in all systems.

Lighting Schedule

The pullet lighting schedule for the controlled environment facilities, cage, cage free, and range rearing are outlined in Table 4. When the pullets were allowed on range they were on natural light with matching supplemental light in the range hut matching the program used in House 8 and 4. The curtains were uncovered in the range houses at 4 weeks of age with supplemental light being the same as in house 8.

Table 4. Pullet House Light Schedule for the 40th NCLP&MT

Age	Date (2016)	Light Intensity	Photoperiod (hr)
Days 1-2	June 1 to 3	10 ftc. (100 lux)	24
Day 3	June 3	1 ftc. (10 lux)	23
Day 7	June 7	1 to 0.5 flc. (10 to 5 lux)	22
Day 14	June 14	1 to 0.5 flc. (10 to 5 lux)	20
Day 17	June 17	1 to 0.5 flc. (10 to 5 lux)	18
Day 20	June 20	1 to 0.5 flc. (10 to 5 lux)	16
Day 23	June 23	1 to 0.5 flc. (10 to 5 lux)	14
Day 26	June 26	1 to 0.5 flc. (10 to 5 lux)	12
Week 4 through	June 28	1 to 0.5 flc. (10 to 5 lux)	10
Week 12	August 23	1 to 0.5 flc. (10 to 5 lux)	10
Week 13 – 16 (House 4 & 8)	August 30 to Sept. 20	1 to 0.5 flc. (10 to 5 lux)	10
Week 13 – 16 (Range)	June 21 to Sept. 20	Natural Day length with supplement same as above	
Housing of Pullets	Sept. 20	Working Intensity	10

FDA EGG SAFETY PLAN TESTING

In accordance with the Egg Safety Rule and the NCLP&MT Egg Safety Plan the cage, cage-free and range pullet environments were tested between the ages of 14 and 16 weeks for the presence of *Salmonella enteritidis*. All of the environments were found to be negative for *Salmonella enteritidis.*

DESCRIPTION OF DATA TABLE STATISTICS

Rearing period performance of white egg and brown egg strains are shown in Tables 5-7 and 8-10, respectively for House 8. The House 4, cage free floor rearing data, is shown in Tables 11-13. The Range Houses 1, 2, and 3 rearing data, is shown in Tables 14-16. Following are the descriptions of the observations taken throughout the rearing period. Data presented in this report will be in metric.

Breeder (Strain):

Short identification of the breeder and strain of the stock is shown Table 1, with more complete details in Table 20 following the data tables.

Protein per Bird to 112 Days:

Cumulative protein intake per bird through 112 days was based on calculated values.

Metabolizable Energy per Bird to 112 Days:

Cumulative metabolizable energy intake per bird trough 112 days was based upon calculated values.

Lysine intake per Bird to 112 Days:

Cumulative Lysine intake per bird through 112 days was based on calculated values.

Total Sulfur Amino Acids (TSAA) intake per Bird to 112 Days:

Cumulative TSAA intake per bird through 112 days was based on calculated values.

Feed Cost per Bird to 112 Days:

Calculated feed cost per bird to 112 days. Using average contract feed prices for the rearing period.

Starter	$350.35 /Ton
Grower	$309.55 /Ton
Developer	$281.97 /Ton
Developer 2	$275.75 /Ton
Pre-Lay Diet	$303.80 /Ton

Livability 1-112 Days:

The percentage of the birds housed which survived during days 1-112. Chick quality, males and accidental deaths, which were removed, are excluded from the analysis of livability in the first days post-hatch. During the hatch we house all chicks and do not sort weak chicks/ saved as a result of a late hatch resulting in low chick numbers.

Flock Uniformity at 112 Days:

The percentage of the pullets with body weights falling within ±10% of the mean body weight at 112 days of age. This is based on the individual body weight from a sample of 100 pullets from 9 replicates representing each strain and environment. In the cage free and range houses 100 pullets were weighed from the pens.

Body Weights (0, 2, 4, 6, 8....16 Weeks):

Initial body weights were taken at time of placement in the brood/grow houses 8, 4, and range houses 1, 2, and 3. Thereafter, bi-weekly average body weights of all birds within representative

cages and pens were collected. Sample sizes for these were approximately 60 birds/strain/brood-grow house. Cages and pens selected were, as much as possible, a representative sample from all house locations and strains.

Feed Consumption (1-2, 3-4, 5-6....16, 1-16 Weeks):

Feed consumption per bird within the time periods indicated. The last column in the table is the cumulative feed intake per bird throughout the growing period. Estimated feed consumed was calculated using pullet days which compensates for males removed from the flock at any time. Feed consumption weights were tabulated on a bi-weekly basis in houses 8, 4, and range houses 1, 2 and 3 then after 12 weeks of age the time the range pullets were allowed access to the range houses and a final feed weight was taken at 16 weeks. In this study there was no attempt to measure the feed wasted in the cage system or the forage disappearance on the paddocks.

The paddock forage was a mixture of pasture grasses to provide both cool and warm season forage. The paddocks were well established having been maintained as forage for more than 6 years. Prior to the construction of the range paddock fences for this trial clover was no-till drilled into the paddocks.

Statistical Analyses and Separation of Means:

Analyses of variance were performed on all data using the GLM procedure of JMP analysis package SAS Institute (2009)[2]. Separate analyses were conducted for white and brown egg strains in each environment. Significant differences ($P<.01$) within white and brown egg strains are noted by different letters among columns of means.

Metric Conversions

English to Metric	Metric to English
1 lb. = 453.6 g	1 g = .03527 oz
1 lb. = .4536 kg	1 kg = 2.204 lb
1 oz. = 28.35 g	1 g = 1000 mg
	1 kg = 1000 g
1 in = 2.54 cm	1 m = 39.4 in = 3.28 ft
1 in^2 = 6.45 cm^2	

[2]SAS Institute Inc. 2009. SAS 9.1.3 Help and Documentation, Cary, NC: SAS Institute Inc., 2000-2004. Web page http://www.sas.com/presscenter/guidelines.html

Table 5. Bi-weekly Body Weights of White-Egg Entries, 40th NCLP&MT, Cage-reared

Strain	(Weeks of Age) 0	2	4	6	8	10	12	14	16
	(kg)								
Bovans White	.040^{C}	0.129^{BCDE}	0.280^{ABC}	0.461^{D}	0.624^{D}	0.801^{C}	0.944^{D}	0.994^{CD}	1.077^{D}
Shaver White	.038^{D}	0.126^{DE}	0.281^{ABC}	0.471^{CD}	0.634^{BCD}	0.834^{ABC}	0.976^{BCD}	0.978^{D}	1.080^{D}
Dekalb White	.038^{E}	0.127^{CDE}	0.276^{BC}	0.477^{BCD}	0.663^{ABC}	0.849^{ABC}	0.998^{ABCD}	1.056^{ABC}	1.133^{ABCD}
Babcock White	.038^{E}	0.127^{CDE}	0.283^{ABC}	0.503^{A}	0.680^{A}	0.882^{A}	1.032^{A}	1.084^{A}	1.171^{A}
B 400 White	.037^{E}	0.121^{E}	0.269^{C}	0.455^{D}	0.633^{CD}	0.822^{BC}	0.965^{CD}	1.030^{ABCD}	1.101^{BCD}
HL-W-80	.044^{A}	0.134^{ABC}	0.288^{AB}	0.475^{BCD}	0.648^{ABCD}	0.827^{BC}	0.970^{BCD}	1.028^{ABCD}	1.109^{ABCD}
HL-W-36	.043^{B}	0.130^{ABCD}	0.281^{ABC}	0.458^{D}	0.635^{BCD}	0.808^{C}	0.954^{CD}	1.020^{BCD}	1.090^{CD}
L-LSL Lite	.038^{E}	0.135^{AB}	0.294^{A}	0.497^{AB}	0.679^{A}	0.869^{AB}	1.020^{AB}	1.068^{AB}	1.156^{AB}
H&N-Nick Chick	.037^{E}	0.135^{AB}	0.290^{AB}	0.488^{ABC}	0.674^{A}	0.867^{AB}	1.003^{ABC}	1.050^{ABC}	1.142^{ABC}
N-Novowhite	.039^{D}	0.138^{A}	0.294^{A}	0.496^{AB}	0.670^{AB}	0.860^{AB}	0.993^{ABCD}	1.028^{ABCD}	1.112^{ABCD}
Average	.039	0.130	0.283	0.478	0.654	0.841	0.985	1.033	1.117

^{ABCDE} Denotes significant differences between strains (P<0.01)

Table 6. Bi-weekly Feed Consumption of White-Egg Entries, 40th NCLP&MT, Cage-reared

Strain	(Weeks of Age) 1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-16
	(kg per bird)								
Bovans White	0.195^{AB}	0.379^{AB}	0.511	0.742	0.855	0.956	0.847^{BC}	0.916	5.401
Shaver White	0.193^{AB}	0.379^{AB}	0.516	0.728	0.848	0.949	0.823^{C}	0.957	5.393
Dekalb White	0.188^{B}	0.392^{AB}	0.530	0.749	0.865	0.947	0.886^{AB}	0.970	5.529
Babcock White	0.200^{AB}	0.383^{AB}	0.549	0.729	0.870	0.962	0.879^{AB}	0.951	5.524
B 400 White	0.190^{B}	0.367^{B}	0.531	0.760	0.862	0.976	0.901^{A}	0.939	5.528
HL-W-80	0.204^{A}	0.380^{AB}	0.519	0.733	0.852	0.960	0.864^{ABC}	0.932	5.445
HL-W-36	0.194^{AB}	0.394^{A}	0.502	0.761	0.875	0.998	0.889^{AB}	0.960	5.572
L-LSL Lite	0.201^{AB}	0.377^{AB}	0.535	0.730	0.846	0.944	0.898^{AB}	0.937	5.470
H&N-Nick Chick	0.200^{AB}	0.378^{AB}	0.539	0.748	0.858	0.956	0.890^{AB}	0.927	5.496
N-Novowhite	0.196^{AB}	0.384^{AB}	0.537	0.732	0.865	0.943	0.877^{AB}	0.949	5.483
Average	0.196	0.381	0.526	0.741	0.859	0.959	0.875	0.943	5.484

^{ABCD} Denotes significant differences between strains (P<0.01)

Table 7. Total Nutrient Intake, Feed Cost, Livability, and Flock Uniformity of White-Egg Entries, 40th NCLP&MT, Cage-reared

Strain	Protein	Met. Energy	Lysine	TSAA	Feed Cost	Livability (1-112 d)	Flock Uniformity (% of pullets within ±10% of *x*)
	----------(per bird to 112 days)----------						
	(kg)	(kcal)	(g)	(g)	($)	(%)	
Bovans White	1.008^{B}	17,203^{AB}	55.13^{B}	43.13^{B}	1.99^{AB}	99.89^{A}	85.33
Shaver White	1.002^{B}	17,117^{B}	54.78^{B}	43.00^{B}	1.98^{B}	99.91^{A}	91.43
Dekalb White	1.078^{A}	18,046^{A}	59.25^{A}	46.33^{A}	2.08^{A}	99.74^{AB}	86.36
Babcock White	1.063^{A}	17,803^{AB}	58.50^{A}	45.86^{A}	2.05^{AB}	99.90^{A}	89.28
B 400 White	1.067^{A}	17,870^{AB}	58.73^{A}	45.87^{A}	2.06^{AB}	99.86^{A}	92.67
HL-W-80	1.013^{B}	17,287^{AB}	55.36^{B}	43.36^{B}	2.00^{AB}	99.79^{AB}	86.43
HL-W-36	1.043^{AB}	17,813^{AB}	57.20^{AB}	44.67^{AB}	2.06^{AB}	99.42^{B}	88.00
L-LSL Lite	1.037^{AB}	17,520^{AB}	56.93^{AB}	44.60^{AB}	2.00^{AB}	99.90^{A}	88.67
H&N-Nick Chick	1.043^{AB}	17,618^{AB}	57.20^{AB}	44.87^{AB}	2.02^{AB}	99.87^{A}	89.33
N-Novowhite	1.037^{AB}	17,507^{AB}	56.87^{AB}	44.40^{AB}	2.00^{AB}	99.87^{A}	81.33
Average	1.039	17,572	56.96	44.58	2.02	99.82	87.90

^{AB} Denotes significant differences between strains (P<0.01)

Table 8. Bi-weekly Body Weights of White-Egg Entries, 40th NCLP&MT, Cage-free reared

Strain	(Weeks of Age) 0	2	4	6	8	10	12	14	16
	(kg)								
Dekalb White	.038^{BC}	0.124	0.260^{ABC}	0.436^{ABC}	0.632^{ABC}	0.810^{AB}	0.920	1.000^{AB}	1.066
Babcock White	.036^{C}	0.120	0.254^{BC}	0.452^{AB}	0.644^{AB}	0.832^{AB}	0.956	0.994^{AB}	1.103
HL-W-80	.043^{A}	0.132	0.270^{ABC}	0.442^{ABC}	0.608^{ABC}	0.794^{BC}	0.922	1.028^{AB}	1.100
HL-W-36	.042^{AB}	0.118	0.258^{BC}	0.418^{BC}	0.582^{BC}	0.758^{CD}	0.880	0.972^{AB}	1.058
HL-White Exp	.042^{AB}	0.120	0.252^{C}	0.404^{C}	0.570^{C}	0.748^{D}	0.866	0.938^{B}	1.040
L-LSL Lite	.038^{BC}	0.138	0.274^{ABC}	0.462^{A}	0.650^{A}	0.832^{AB}	0.974	1.058^{A}	1.115
H&N-Nick Chick	.037^{C}	0.132	0.278^{AB}	0.464^{A}	0.650^{A}	0.834^{A}	0.970	1.032^{AB}	1.185
N-Novowhite	.038^{BC}	0.136	0.284^{A}	0.468^{A}	0.648^{A}	0.810^{AB}	0.952	1.014^{AB}	1.088
Average	.039	0.127	0.266	0.443	0.623	0.802	0.930	1.004	1.086

^{ABCD} Denotes significant differences between strains (P<0.01)

Table 9. Bi-weekly Feed Consumption of White-Egg Entries, 40th NCLP&MT, Cage-free reared

	(Weeks of Age)								
Strain	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-16
	(kg per bird)								
Dekalb White	0.233	0.324	0.584	0.510^{AB}	0.755^{AB}	0.718^{AB}	0.668	0.848	4.640^{ABC}
Babcock White	0.232	0.328	0.621	0.644^{A}	0.784^{A}	0.798^{A}	0.644	0.858	4.910^{A}
HL-W-80	0.212	0.334	0.453	0.585^{AB}	0.660^{BC}	0.704^{AB}	0.708	0.841	4.498^{BC}
HL-W-36	0.228	0.318	0.464	0.546^{AB}	0.664^{BC}	0.622^{B}	0.658	0.784	4.284^{CD}
HL-White Exp	0.218	0.306	0.459	0.431^{B}	0.570^{C}	0.626^{B}	0.603	0.766	3.979^{D}
L-LSL Lite	0.240	0.319	0.511	0.610^{AB}	0.720^{AB}	0.788^{A}	0.738	0.878	4.804^{AB}
H&N-Nick Chick	0.220	0.312	0.541	0.564^{AB}	0.734^{AB}	0.742^{AB}	0.666	0.843	4.620^{ABC}
N-Novowhite	0.224	0.334	0.539	0.618^{AB}	0.702^{AB}	0.738^{AB}	0.675	0.821	4.652^{ABC}
Average	0.226	0.322	0.521	0.564	0.699	0.717	0.670	0.830	4.548

^{ABC} Denotes significant differences between strains (P<0.01)

Table 10. Total Nutrient Intake, Feed Cost, Livability, and Flock Uniformity of White-Egg Entries, 40th NCLP&MT, Cage-free reared

Strain	Protein	Met. Energy	Lysine	TSAA	Feed Cost	Livability (1-112 d)	Flock Uniformity (% of pullets within ±10% of *x*)
	----------(per bird to 112 days)----------						
	(kg)	(kcal)	(g)	(g)	($)	(%)	
Dekalb White	0.807^{AB}	13,096^{ABC}	45.00	34.50^{AB}	1.58^{AB}	99.8	94.0
Babcock White	0.844^{A}	13,867^{A}	47.00	36.50^{A}	1.64^{A}	99.9	92.0
HL-W-80	0.797^{AB}	12,729^{ABC}	44.50	34.00^{AB}	1.55^{AB}	100.0	82.0
HL-W-36	0.766^{AB}	12,147^{BC}	43.00	33.00^{B}	1.49^{AB}	99.0	88.0
HL-White Exp	0.750^{B}	11,773^{C}	42.50	32.00^{B}	1.46^{B}	99.8	90.0
L-LSL Lite	0.810^{AB}	13,490^{A}	45.00	35.00^{AB}	1.60^{AB}	100.0	96.0
H&N-Nick Chick	0.794^{AB}	13,043^{ABC}	44.00	34.00^{AB}	1.54$_{AB}$	99.9	96.0
N-Novowhite	0.798^{AB}	13,135^{AB}	44.50	34.50^{AB}	1.55^{AB}	100.0	88.0
Average	0.796	12,910	44.44	34.19	1.55	99.80	90.75

^{ABC} Denotes significant differences between strains (P<0.01)

Table 11. Bi-weekly Body Weights of Brown-Egg Entries, 40th NCLP&MT, Cage-reared

Strain	(Weeks of Age)								
	0	2	4	6	8	10	12	14	16
	(kg)								
Bovans Brown	.037^{B}	0.135^{AB}	0.300^{B}	0.520^{BC}	0.732^{B}	0.967	1.139	1.182^{AB}	1.298^{AB}
ISA-Brown	.036^{C}	0.134^{AB}	0.291^{B}	0.522^{BC}	0.734^{AB}	0.931	1.117	1.163^{B}	1.275^{B}
HL-Brown	.040^{A}	0.135^{AB}	0.304^{AB}	0.543^{AB}	0.752^{AB}	0.987	1.156	1.222^{AB}	1.337^{AB}
HL-Silver Brown	.039^{A}	0.138^{A}	0.316^{A}	0.555^{A}	0.775^{A}	0.988	1.181	1.251^{A}	1.364^{A}
L-LB Lite	.035^{C}	0.131^{B}	0.296^{B}	0.517^{C}	0.730^{B}	0.942	1.142	1.175^{B}	1.307^{AB}
N-Novobrown	.036^{C}	0.133^{AB}	0.299^{B}	0.532^{ABC}	0.747^{AB}	0.978	1.158	1.212^{AB}	1.334^{AB}
TA-TETRA Brown	.039^{A}	0.133^{AB}	0.303^{AB}	0.532^{ABC}	0.746^{AB}	0.947	1.143	1.210^{AB}	1.303^{AB}
Average	.037	0.134	0.301	0.531	0.745	0.962	1.148	1.202	1.317

^{ABC} Denotes significant differences between strains (P<0.01)

Table 12. Bi-weekly Feed Consumption of Brown-Egg Entries, 39th NCLP&MT, Cage-reared

	(Weeks of Age)								
Strain	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-16
	(kg per bird)								
Bovans Brown	0.200^{A}	0.397	0.582	0.777	0.921	1.022	0.921^{A}	0.992^{A}	5.813^{A}
ISA-Brown	0.190^{AB}	0.385	0.570	0.743	0.893	0.978	0.852^{B}	0.948^{AB}	5.559^{C}
HL-Brown	0.194^{AB}	0.406	0.572	0.784	0.927	1.025	0.896^{AB}	0.958^{AB}	5.764^{ABC}
HL-Silver Brown	0.194^{AB}	0.392	0.587	0.797	0.923	1.042	0.913^{A}	0.952^{AB}	5.801^{AB}
L-LB Lite	0.186^{B}	0.392	0.552	0.748	0.895	0.997	0.853^{B}	0.976^{AB}	5.599^{BC}
N-Novobrown	0.195^{AB}	0.396	0.571	0.753	0.895	1.020	0.874^{AB}	0.954^{AB}	5.658^{ABC}
TA-TETRA Brown	0.188^{AB}	0.394	0.569	0.758	0.895	1.033	0.893^{AB}	0.926^{B}	5.657^{ABC}
Average	0.192	0.395	0.571	0.765	0.907	1.017	0.885	0.958	5.690

^{ABC} Denotes significant differences between strains (P<0.01)

Table 13. Total Nutrient Intake, Feed Cost, Livability, and Flock Uniformity of Brown-Egg Entries, 40th NCLP&MT, Cage-reared

Strain	Protein	Met. Energy	Lysine	TSAA	Feed Cost	Livability (1-112 d)	Flock Uniformity
	----------(per bird to 112 days)----------						(% of pullets within ±10% of x)
	(kg)	(kcal)	(g)	(g)	($)	(%)	
Bovans Brown	1.114	18,854[A]	60.93	47.64	2.15	99.98	85.71
ISA-Brown	1.074	17,962[B]	59.07	46.07	2.07	99.90	85.71
HL-Brown	1.105	18,697[AB]	60.53	47.27	2.14	99.81	86.00
HL-Silver Brown	1.113	18,827[A]	60.93	47.64	2.15	99.74	90.71
L-LB Lite	1.072	18,119[AB]	58.59	45.82	2.07	99.94	87.06
N-Novobrown	1.088	18,405[AB]	59.60	46.67	2.10	99.97	82.00
TA-TETRA Brown	1.085	18,359[AB]	59.47	46.27	2.10	99.98	86.00
Average	1.092	18,452	59.84	46.74	2.11	99.90	86.15

[AB] Denotes significant differences between strains (P<0.01)

Table 14. Bi-weekly Body Weights of Brown-Egg Entries, 40th NCLP&MT, Cage-free reared

	(Weeks of Age)								
Strain	0	2	4	6	8	10	12	14	16
	(kg per bird)								
Bovans Brown	.037^{ABC}	0.138	0.274^{AB}	0.456	0.668	0.864	1.052	1.140^{ABC}	1.218^{AB}
ISA-Brown	.036^{BC}	0.134	0.274^{AB}	0.450	0.668	0.892	1.038	1.122^{BC}	1.207^{AB}
HL-Brown	.039^{A}	0.137	0.274^{AB}	0.468	0.676	0.899	1.065	1.169^{AB}	1.222^{AB}
HL-Silver Brown	.039^{A}	0.138	0.290^{A}	0.472	0.690	0.928	1.096	1.212^{A}	1.302^{A}
L-LB Lite	.035^{C}	0.131	0.273^{B}	0.457	0.648	0.831	1.062	1.100^{C}	1.201^{B}
N-Novobrown	.036^{BC}	0.134	0.282^{AB}	0.468	0.660	0.888	1.086	1.158^{ABC}	1.243^{AB}
TA-TETRA Brown	.039^{A}	0.136	0.278^{AB}	0.472	0.678	0.914	1.082	1.178^{AB}	1.249^{AB}
Average	.038	0.135	0.277	0.463	0.668	0.889	1.068	1.150	1.230

^{ABC} Denotes significant differences between strains (P<0.01)

Table 15. Bi-weekly Feed Consumption of Brown-Egg Entries, 40th NCLP&MT, Cage-free reared

	(Weeks of Age)								
Strain	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-16
	(kg per bird)								
Bovans Brown	0.230	0.316	0.472	0.602	0.749	0.758	0.670	0.841	4.639
ISA-Brown	0.205	0.329	0.421	0.528	0.709	0.756	0.720	0.873	4.541
HL-Brown	0.213	0.318	0.508	0.586	0.780	0.822	0.672	0.788	4.688
HL-Silver Brown	0.198	0.323	0.471	0.620	0.801	0.869	0.845	0.910	5.037
L-LB Lite	0.222	0.318	0.451	0.584	0.742	0.797	0.776	0.844	4.733
N-Novobrown	0.224	0.320	0.475	0.569	0.731	0.757	0.758	0.927	4.763
TA-TETRA Brown	0.235	0.325	0.472	0.619	0.800	0.856	0.765	0.859	4.933
Average	0.218	0.321	0.470	0.587	0.759	0.804	0.739	0.853	4.751

Table 16. Total Nutrient Intake, Feed Cost, Livability, and Flock Uniformity of Brown-Egg Entries, 40th NCLP&MT, Cage-free reared

Strain	Protein	Met. Energy	Lysine	TSAA	Feed Cost	Livability (1-112 d)	Flock Uniformity
	----------(per bird to 112 days)----------						(% of pullets within ±10% of *x*)
	(kg)	(kcal)	(g)	(g)	($)	(%)	
Bovans Brown	0.822	13,134	46.0	35.0	1.60	99.9	84.0
ISA-Brown	0.802	12,842	45.0	34.5	1.57	100.0	84.0
HL-Brown	0.828	13,238	46.2	35.0	1.61	99.9	88.0
HL-Silver Brown	0.868	14,016	48.5	37.0	1.67	99.9	94.0
L-LB Lite	0.813	13,363	45.2	35.0	1.58	99.9	88.0
N-Novobrown	0.840	13,461	47.0	35.5	1.63	100.0	82.0
TA-TETRA Brown	0.847	13,658	47.0	36.0	1.63	99.9	90.0
Average	0.829	13,368	46.28	35.3	1.61	99.93	87.33

Table 17. Bi-weekly Body Weights of Brown-Egg Entries, 40th NCLP&MT on Range

	(Weeks of Age)								
Strain	0	2	4	6	8	10	12	14	16
	(kg)								
HL-White Exp[1]	.041	0.114	0.256	0.388	0.572	0.752	0.860	0.940	0.992
HL-Brown	.039[A]	0.120	0.279	0.440	0.677	0.891	1.048	1.199[A]	1.263[AB]
HL-Silver Brown	.039[A]	0.120	0.288	0.469	0.682	0.908	1.090	1.228[A]	1.328[A]
L-LB Lite	.035[B]	0.114	0.266	0.458	0.652	0.865	1.027	1.108[B]	1.223[B]

[AB] Denotes significant differences between strains (P<0.01)

[1] There are no statistics for the white range strain.

Table 18. Bi-weekly Feed Consumption of Brown-Egg Entries, 40th NCLP&MT on Range

	(Weeks of Age)								
Strain	1-2	3-4	5-6	7-8	9-10	11-12	13-14	14-16	1-16
	(kg per bird)								
HL-White Exp[1]	0.182	0.293	0.437	0.484	0.536	0.599	0.598	0.764	3.894
HL-Brown	0.182	0.318	0.468	0.600	0.847	0.736	0.790	0.971	4.795[AB]
HL-Silver Brown	0.174	0.326	0.555	0.674	0.729	0.852	0.819	1.000	5.247[A]
L-LB Lite	0.174	0.308	0.518	0.562	0.764	0.769	0.694	0.952	4.745[B]

[AB] Denotes significant differences between strains (P<0.01)

[1] There are no statistics for the white range strain.

Table 19. Total Nutrient Intake, Feed Cost, Livability, and Flock Uniformity of Brown-Egg Entries, 40th NCLP&MT on Range

Strain	Protein	Met. Energy	Lysine	TSAA	Feed Cost	Livability (1-112 d)	Flock Uniformity
	----------(per bird to 112 days)----------					(%)	(% of pullets within ±10% of *x*)
	(kg)	(kcal)	(g)	(g)	($)		
HL-White Exp	0.669	10,885	37.5	28.5	1.30	99.81	80.0
HL-Brown	0.815^{AB}	13,322^{AB}	45.2^{A}	34.5^{B}	1.59^{AB}	99.85	85.0
HL-Silver Brown	0.895^{A}	14,617^{A}	49.5^{A}	38.0^{A}	1.74^{A}	99.71	88.0
L-LB Lite	0.765^{B}	13,056^{B}	41.2^{B}	32.5^{B}	1.50^{B}	99.81	79.0

^{AB} Denotes significant differences between strains (P<0.01)

[1] There are no statistics for the white range strain.

Table 20. 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] I = Extensive distribution in southeast United States A = Entry requested
II = Little or no distribution in southeast United States
III = Unavailable for commercial distribution in United States