North Carolina Cooperative Extension Service

NC STATE UNIVERSITY

College of Agriculture and Life Sciences
Extension Poultry Science
Scott Hall/Campus Box 7608
Raleigh, North Carolina 27695

919-515-2621 (phone)
919-515-7070 (fax)

REPORT ON PULLET REARING PERIOD OF THE THIRTY EIGHTH NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST AND ALTERNATIVE MANAGEMENT TEST[1]

Vol. 38, No. 2
July, 2010

The North Carolina Layer Performance and Management Test is conducted under the auspices of the Cooperative Extension Service at North Carolina State University and the North Carolina Department of Agriculture and Consumer Services. The flock is maintained at the Piedmont Research Station, Salisbury, North Carolina. Mr. Joe Hampton is the Piedmont Research Station Superintendent; Mr. Kelly Snider is Resident Manager of the flock; Pam Jenkins is the Statistical Research Assistant; and Dr. K. E. Anderson is Project Leader. The purpose of this program is to assist poultry industry personnel in North Carolina, across the country, and internationally in the evaluation of commercial layer stocks and management systems. The data presented herein represents the analysis of the rearing period for the 38th North Carolina Layer Performance and Management Test.

Copies of current and past reports are maintained for public access at http://www.ces.ncsu.edu/depts/poulsci/tech_manuals/layer_reports/38_grow_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.

38th NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST
Volume 38 No. 2

Report on Pullet Rearing Period

Dates of Importance:

Nineteen entries were hatched on January 6, 2010. There were eleven commercial white egg strains, seven commercial brown egg strains, and one heritage brown egg strain that are participating in the current test. The chicks were all sexed according to their genetics (vent, feather, or color), vaccinated for Marek's disease, and wing banded for identification before being transferred to the brood/grow house. Tables 1, shows the source of the laying stock, strain which was entered, and participation in the test environments and Table 17, provides the breeder, source of eggs, and entry status of each strain(Cage, Cage Free, or Range Environment).

The rearing phase for the range, cage free, and the cage reared pullets complete the grow phase at 16 weeks, then transitioned to the laying phase during their 17th week of age.

Table 1. 38th North Carolina Layer Performance and Management Test Strain Code Assignments and

Strain No.	Source of Stock	Source Code	Strain	Participation[1]
1	Hy-Line	HL	W-36	C
2	Hy-Line	HL	W-98	C, CF
3	Lohmann	L	H&N Nick Chick	C
4	Lohmann	L	LSL Lite	C
5	ISA	ISA	Bovans White	C
6	ISA	ISA	Shaver White	C
7	ISA	ISA	Dekalb White	C
8	ISA	ISA	Babcock White	C
9	ISA	ISA	EXP. White	C
10	Novogen	N	White	C
11	ISA	ISA	Bovans Robust	C
12	Hy-Line	HL	Brown	C, CF, R
13	Hy-Line	HL	Silver Brown	C, CF, R
14	Tetra Americana	TA	TETRA Brown	C, CF
15	Tetra Americana	TA	TETRA Amber	C, CF
16	ISA	ISA	Brown	C, CF
17	ISA	ISA	Bovans Brown	C, CF
18	Novogen	N	Brown	C
19	NCSU	NC	BPR	C, CF, R

[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; Cage Free = CF; Range = R

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. The pullet rearing facilities consisted of a Quad-deck cage system in a light tight house; slat-litter floor pen house which was curtain sided, and range houses with paddocks [See **Pullet Housing**]. The breeders selectively entered strains for participation in the various production environments so pullets could be reared in accordance with 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. 38, No. 1). A total of eleven commercial white egg strains, seven commercial brown egg strains, and one heritage brown egg strain are participating in the current test. At hatch the chicks were sexed to remove the males. All strains were sexed according to breeder recommendations, (*i.e.* feather, color, or vent sexing).

For the layer test, a minimum of approximately 760 white and brown egg pullets/strain were wanted for placement at the initiation of the layer portion of the test. 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 white egg and brown egg replicates being intermingled throughout the rooms within the house. The white egg strains occupied approximately 58 % of the house and brown egg strains occupied the other 42 % of House 8 and 92 % of House 2. Strain assignment codes indicate the cage/pen arrangement, replicate identification numbers, and the strain assignments for brood-grow House 2 and 8. 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; indicate room, row, level and replicate within room-row-level-replicate, for the four digits, respectively they also indicate the rearing environment. The replicate number identifies the strain to the unit manager and PI.

House 2 – is a slat-litter facility which contains 24 pens (12' x 18') for a total sq ft of 216. There were 227 chicks at approximately 883 cm^2 for the cage free birds (137 in^2) and 306 chicks at approximately 656 cm^2 (102 in^2) started in each pen for the range and cage free birds with the other rearing protocol being identical to the cage reared hens. At 12 weeks of age the birds which are to be used on the range were moved to their respective range facility where the completion of the rearing will be done allowing for standardization of floor area in all cage free rearing pens for the grow phase. The pullets would be housed at approximately 929 cm^2 (144 in^2) per hen for a total hen population of 216 hens/pen. Until the pullets are 12 wk of age the house will serve dual purpose for brooding and rearing of both the range and cage free birds. The house is being set up

to include whole house heat capabilities. Roosts will be included in the rearing pen to allow the pullets to learn to utilize vertical space. This improves the use of nests as a hen.

House 8 - is an environmentally controlled windowless brood-grow facility with 3 banks of quad-deck cages in each room. Each room has been assigned a number and each bank has been assigned a row number, and each cage section within each row and level/row has been assigned a replicate number, for statistical analysis pairs of rows have been designated as blocks. Thus, each block consists of two rows containing 24 Replicates on all levels. This allows for a total of 3,744 pullets per room resulting in a total pullet count. For this study 3 rooms will be utilized in House 8 for a total of 9,600 pullets. The white and brown egg strains will be randomly assigned to the replicates within the house. Entrant strains will be assigned to the replicates in a restricted randomized manner with the restrictions being that all strains are approximately equally represented in all rooms, rows, and levels, as described earlier under the experimental design. All chicks will be brooded in the same cage during the entire 16 wk rearing period. Paper will be placed on the cage floor for the first 7 days within each of the replicate series within each row. Each cage within the replicate will be filled with 13 white-egg or brown-egg (13 per 24" x 26" 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.

Range housing --The pullets for the range facilities were reared on litter at a density of 656 cm^2/pullet to 12 weeks of age. They had access to feed, nipple waterers, and roosts (See House 2) in order to make them familiar with that behavior and facilitate nest box usage. All other rearing procedures and vaccinations were the same as their cage reared flock mates. At 12 weeks of age the pullets were moved to the range facility for the final grow phase. The range hut provided a minimum of 929 cm^2/pullet, 13 cm of roosting space/pullet, and 1 nest/8 hens. The range hut had a timer and light powered via battery and solar cell, supplemental propane heater for winter conditions to maintain a interior temperature above 7.2° C (45 F) which is the lower level of the chickens Effective Thermal Neutral Zone (eTNZ) where body temperature will be maintained via a feed intake increase. The hens had access to the outdoors throughout the day and night hours and appeared to return to the range hut during the dark for roosting and protection. Husbandry, lighting and supplemental feed were allocated on the same basis as flock mates in cages in order to minimize the variables between flock mates as much as possible. Range density was based upon a 500 hen/acre static equivalency 8.04 m^2/hen (86 ft^2/hen). The range paddocks were 21.3 m x 21.3 m (70' x 70') and were enclosed by a fence 1.8 m (6 ft) with the lower chain link section being 1.2 m (4 ft). In order to facilitate range forage replenishment the paddocks were divided in half and a 4 week rotation was implemented. One week prior to the rotation the fallow paddock is mowed so the forage is at ~ 15 cm (6) in height.

Pullet Management and Nutrition:

Pullets were fed *ad libitum* by hand daily. Feed consumption and body weights were monitored bi-weekly beginning at 2 weeks of age. All mortality was recorded daily, but mortality attributed to the removal of males (sex slips) and accidental deaths from a replicate have been excluded from the 38th NCLP&MT Grow Report.

Table 2. Diet Formulations for the Brood-Grow Periods

	Diet[1] Identification			
Ingredient	Starter	Grower	Developer	Pre-Lay[2]
Corn	1139.8	1159.9	1215.0	1136.7
Fat (Tallow)	---	10.0	10.0	50.4
Soybean meal	532.2	321.8	252.1	633.2
Soybean Hulls	---	---	15.0	---
Wheat Midds	165.8	269.9	300.0	---
Gluten Meal 60%	75.1	150.0	100.0	---
D.L. Methionine	1.3	1.9	3.1	2.7
Lysine 78.8%	4.8	5.0	2.4	---
Oyster Shell	---	---		70.0
Limestone	30.9	32.7	53.2	70.8
Bi-Carbonate	2.5	2.5	2.5	2.5
Phosphate Mono/D	33.5	32.5	33.4	19.4
Salt	6.7	6.3	6.3	6.3
Vit. Premix	1.0	1.0	1.0	1.0
Min. premix	1.0	1.0	1.0	1.0
Mold Inhibitor	2.0	2.0	2.0	1.0
T-Premix	1.0	1.0	1.0	1.0
.06% Sel. Premix	1.0	1.0	1.0	1.0
Choline Cl 60%	1.5	1.5	1.0	2.6
Ronozyme P-CT 540%	---	---	---	0.4
Total	2000	2000	2000	2000
Protein %	20.0	16.8	15.0	20.0
ME kcal/kg	2816	2800	2800	2926
Calcium %	1.00	1.00	1.40	3.01
T. Phos. %	0.76	0.78	0.76	0.53
Lysine %	1.2	0.95	0.75	1.10
TSAA %	0.70	0.73	0.66	0.77

[1]Diets were acquired from Southern States Cooperative in mash form and Lance Minear, Nutritionist for Southern States, provided assistance in formulation.

[2]This Prelay diet was fed through 23 weeks.

Each pullet placed was provided with Starter feed containing Amprol during the initial brooding period, followed by Grower and Developer diets that are shown in the diet formulation section Table 2. Thus, the white-egg and brown-egg replicates in brood-grow House 8 and House 2 were given the starter feed to achieve the breeder recommended body weights at each weigh interval. Pullets in each house were moved independently on to the next tier 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 12 weeks; developer 12 to 16 weeks; Pre-lay diet 16 to 17 weeks. The strains were grown to the breeder recommended body weights. Generally, in this flock, the birds grew in accordance with the guidelines meaning that the dietary regimen was administered as discussed previously. 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 earlier than the last week in the rearing facility through the 23rd week of age.

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

Age	Date	Event
Hatch	January 6, 2010	MVT Marek's vaccination by injection in neck
Day 6-8	January 12-14, 2010	Precision Beak Trim[1] all replicates throughout the
Day 10	January16, 2010	1st Newcastle (B1) and Bronchitis (Mass.) vaccination Via aerosol spray (Combo Vac)
Day 35	February 24, 2010	2nd Newcastle and Bronchitis B1 Type LaSota Strain Mass. Type Live Virus, vaccination via aerosol spray (TripleVac)
Day 63	March 10, 2010	3rd Newcastle and Bronchitis B1 Type LaSota Strain Mass. Type Live Virus, vaccination via aerosol spray (TripleVac)
Day 70	March 17, 2010	Fowl Pox and Avian Encephalomyelitis Live Virus PT Blen vaccination via the wig web
Day 105	April 21, 2010	4th Newcastle and Bronchitis B1 Type LaSota Strain Mass. Type Live Virus, vaccination via aerosol spray (TripleVac)
Week 74	June 10, 2011	5th Newcastle (LaSota) and Bronchitis (Mass.) vaccination via aerosol spray (ComboVac)

Beak trimming was begun at 6 days of age using a Lyons Precision beak trimmer, with a 7/64" guide hole. The trim was a block cut with an approximate blade temp of 1100° F (dull red). Beak trimming was completed in less than 3 days.

Lighting Schedule

The lighting schedule for the pullet controlled environment facility, floor, and range rearing are outlined in Table 4. Then the pullets were moved from the floor house to the range they were on natural light with matching supplemental light in the range hut matching the program used in house 8. The curtains were uncovered in the floor house 2 at 14 weeks of age with supplemental light being the same as in house 8.

Table 4. Pullet House Lighting Schedules[1]

Age	Date	Light Intensity	Photoperiod (hr)
Days 1-2	Jan. 6-7, 2010	10 ftc. (100 lux)	24
Day 3	Jan. 8, 2010	1 ftc. (10 lux)	23
Week 1	Jan. 13, 2010	1 to 0.5 flc. (10 to 5 lux)	22
Week 2	Jan. 20, 2010	1 to 0.5 flc. (10 to 5 lux)	20
Week 3	Jan. 27, 2010	1 to 0.5 flc. (10 to 5 lux)	18
Week 4	Feb. 3, 2010	1 to 0.5 flc. (10 to 5 lux)	16
Week 5	Feb. 10, 2010	1 to 0.5 flc. (10 to 5 lux)	14
Week 6	Feb. 17, 2010	1 to 0.5 flc. (10 to 5 lux)	12
Week 7 through	Feb. 24, 2010	1 to 0.5 flc. (10 to 5 lux)	10
Week 12	March 31, 2010	1 to 0.5 flc. (10 to 5 lux)	10
House 8: Cage Rearing			
Week 13 – 16	April 7 to 28, 2010	1 to 0.5 flc. (10 to 5 lux)	10
House 2: Floor Rearing			
Week 13 – 14	April 7 to 28, 2010	1 to 0.5 flc. (10 to 5 lux)	10
Week 15 – 16	April 7 to 28, 2010	Curtain opened, natural day length with supplement same as House 8	
Range House 1 and 2: Range Grow			
Week 13 – 16 (Range)	April 7 to 28, 2010	Natural Day length with supplement same as House 8	
Housing of Pullets commences	April 28, 2010	Working Intensity	10

[1]Lighting schedules were the same for all of the birds through12 weeks of age.

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 2, floor rearing data, is shown in Tables 11-13. The Hy-Line W-98 birds which were grown in the floor environment are shown at the bottom of Tables 11-13 (Not included in statistical analysis). The Range Huts 1 and 2, 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 17 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	$288.93 /Ton
Grower	$257.95 /Ton
Developer	$252.15 /Ton
Pre-Lay Diet	$303.60 /Ton

Livability 1-112 Days:

The percentage of the birds housed which survived during days 1-112. Males and accidental deaths, which were removed, are excluded from the analysis of livability.

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 pullets from each strain.

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

Initial body weights were taken at time of placement in the brood/grow house 8. Thereafter, bi-weekly average body weights of all birds within representative cages were collected. Sample sizes for these were approximately 60 birds/strain/brood-grow house. Cages selected were, as much as possible, a representative sample from all cage levels, rows, and strains. Body weights were taken on a bi-weekly basis in House 6 through 12 weeks of age at that time the range pullets were moved to the range hut and only a final body weight was taken at 16 weeks.

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 is cal-

culated using pullet days which compensates for males removed from the flock at any time. Feed weights were taken on a bi-weekly basis in House 6 through 12 weeks of age at that time the range pullets were moved to the range hut and only a final feed weight was taken at 16 weeks. In this study there was no attempt to measure the forage disappearance. Forage nutrient analysis is provided during grow phase of the rearing period. This may provide some insight as to the nutrient intake provided to the pullets through forage consumption.

The forage used is a mixture of pasture grasses to provide both cool and warm season forage. The paddocks are 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. The forage analysis when the pullets were moved to the range facilities on March 30 were; 92.6 % Dry Matter, 22.8 % Crude Protein, 24.9 % Crude Fiber, 0.48 % Ca, 0.46 % Phos.; on May 6 was 87.7 % Dry Matter, 13.9 % Crude Protein, 25.1 % Crude Fiber, 0.29 % Ca, 0.29 % Phos. There was no effort to measure forage or alternative food stuffs consumed on the paddocks.

Statistical Analyses and Separation of Means:

Analyses of variance were performed on all data using the GLM procedure of 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.

In the Cage-free housing there was no statistical analysis done with the Barred Plymouth Rocks and the Hy-Line W-98, and in the Range housing there was no statistical analysis conducted with the Barred Plymouth Rocks. The values reported are the means for each of those strains.

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, 38th NCLP&MT, Cage-reared

Breeder	(Weeks of Age) 0	2	4	6	8	10	12	14	16
	(kg)								
Hy-Line W-36	.038^{B}	0.111^{ABC}	0.261	0.424	0.592^{D}	0.786^{E}	0.950^{C}	1.069^{D}	1.168^{C}
Hy-Line W-98	.036^{D}	0.108^{ABC}	0.265	0.441	0.641^{AB}	0.841^{ABC}	1.017^{A}	1.149^{AB}	1.249^{A}
H&N Nick Chick	.038^{B}	0.108^{ABC}	0.270	0.448	0.639^{AB}	0.850^{A}	1.023^{A}	1.139^{ABC}	1.227^{AB}
Lohmann LSL-Lite	.038^{B}	0.112^{ABC}	0.274	0.450	0.650^{A}	0.861^{A}	1.027^{A}	1.167^{A}	1.233^{AB}
Bovans White	.038^{B}	0.113^{AB}	0.272	0.434	0.620^{BCD}	0.804^{CDE}	0.971^{BC}	1.099^{CD}	1.192^{BC}
Shaver White	.040^{A}	0.102^{CD}	0.264	0.431	0.604^{CD}	0.794^{DE}	0.971^{BC}	1.104^{BCD}	1.196^{BC}
Dekalb White	.037^{C}	0.102^{CD}	0.256	0.431	0.627^{ABC}	0.844^{AB}	1.019^{A}	1.169^{A}	1.244^{AB}
Babcock White	.036^{CD}	0.102^{CD}	0.263	0.440	0.627^{ABC}	0.852^{A}	1.037^{A}	1.183^{A}	1.263^{A}
ISA Exp. White	.036^{D}	0.097^{D}	0.252	0.430	0.615^{BCD}	0.832^{ABCD}	1.039^{A}	1.177^{A}	1.255^{A}
Novogen White	.037^{C}	0.104^{BCD}	0.259	0.432	0.632^{ABC}	0.828^{ABCD}	1.007^{AB}	1.140^{ABC}	1.217^{ABC}
Bovans Robust	.039^{B}	0.115^{A}	0.265	0.445	0.615^{BCD}	0.809^{BCDE}	1.005^{AB}	1.114^{ABC}	1.207^{ABC}
Average	.038	0.107	0.264	0.437	0.624	0.827	1.006	1.137	1.223

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

Table 6. Bi-weekly Feed Consumption of White-Egg Entries, 38th NCLP&MT, Cage-reared

	(Weeks of Age)								
Breeder	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-16
	(kg per bird)								
Hy-Line W-36	0.220^{A}	0.479^{BC}	0.715	0.980	1.214^{B}	1.179	1.294	1.356	7.437
Hy-Line W-98	0.212^{ABC}	0.467^{BC}	0.711	0.990	1.228^{AB}	1.172	1.311	1.333	7.422
H&N Nick Chick	0.211^{ABC}	0.467^{BC}	0.700	0.961	1.200^{B}	1.156	1.283	1.353	7.329
Lohmann LSL-Lite	0.213^{ABC}	0.463^{BC}	0.695	0.938	1.194^{B}	1.156	1.264	1.347	7.269
Bovans White	0.214^{ABC}	0.455^{C}	0.667	0.933	1.181^{B}	1.153	1.268	1.342	7.212
Shaver White	0.219^{AB}	0.464^{BC}	0.688	0.975	1.191^{B}	1.195	1.312	1.377	7.421
Dekalb White	0.206^{BC}	0.523^{A}	0.731	1.023	1.285^{A}	1.198	1.351	1.422	7.738
Babcock White	0.210^{ABC}	0.476^{BC}	0.691	0.973	1.224^{B}	1.192	1.305	1.321	7.391
ISA Exp. White	0.201^{C}	0.490^{AB}	0.675	0.950	1.227^{AB}	1.161	1.319	1.380	7.403
Novogen White	0.201^{C}	0.462^{BC}	0.683	0.958	1.207^{B}	1.156	1.302	1.335	7.304
Bovans Robust	0.216^{AB}	0.452^{C}	0.665	0.947	1.200^{B}	1.127	1.278	1.359	7.246
Average	0.211	0.472	0.693	0.967	1.214	1.168	1.299	1.356	7.381

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

Table 7. Total Nutrient Intake, Feed Cost, Livability, and Flock Uniformity of White-Egg Entries, 38th NCLP&MT, Cage-reared

Breeder	Protein	Met. Energy	Lysine	TSAA	Feed Cost	Livability (1-112 d)	Flock Uniformity (% of pullets within ±10% of 0)
	----------(per bird to 112 days)----------						
	(g)	(kcal)	(g)	(g)	($)	(%)	
Hy-Line W-36	1231.5^{AB}	20844^{AB}	67.1^{AB}	51.3^{AB}	2.14^{AB}	99.70^{A}	90.0^{ABC}
Hy-Line W-98	1227.7^{B}	20801^{B}	66.9^{B}	51.2^{B}	2.14^{B}	99.09^{AB}	94.0^{AB}
H&N Nick Chick	1212.9^{B}	20544^{B}	66.1^{B}	50.6^{B}	2.11^{B}	99.04^{AB}	86.7^{BC}
Lohmann LSL-Lite	1202.6^{B}	20374^{B}	65.5^{B}	50.1^{B}	2.09^{B}	98.87^{AB}	83.3^{C}
Bovans White	1192.7^{B}	20213^{B}	64.9^{B}	49.7^{B}	2.07^{B}	98.72^{AB}	86.7^{BC}
Shaver White	1223.6^{B}	20795^{AB}	66.8^{B}	51.2^{AB}	2.13^{AB}	95.81^{BC}	84.8^{BC}
Dekalb White	1281.2^{A}	21689^{A}	69.8^{A}	53.4^{A}	2.23^{A}	92.88^{C}	91.1^{ABC}
Babcock White	1222.4^{B}	20718^{B}	66.5^{B}	51.0^{B}	2.13^{B}	98.72^{AB}	91.7^{ABC}
ISA Exp. White	1224.7^{B}	20752^{B}	66.7^{B}	51.1^{B}	2.13^{B}	92.15^{C}	99.2^{A}
Novogen White	1207.8^{B}	20473^{B}	65.7^{B}	50.4^{B}	2.10^{B}	98.55^{AB}	91.7^{ABC}
Bovans Robust	1198.4^{B}	20309^{B}	65.2^{B}	50.0^{B}	2.09^{B}	99.84^{A}	91.7^{ABC}
Average	1221.0	20687	66.5	50.9	2.12	97.63	90.2

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

Table 8. Bi-weekly Body Weights of Brown-Egg Entries, 38th NCLP&MT, Cage-reared

Breeder	(Weeks of Age)								
	0	2	4	6	8	10	12	14	16
	(kg)								
Hy-Line Brown	0.037^{B}	0.117^{A}	0.300^{AB}	0.501^{AB}	0.728^{ABC}	0.962^{AB}	1.146^{B}	1.289^{B}	1.399^{B}
Hy-Line S. Brown	0.041^{A}	0.116^{A}	0.305^{A}	0.522^{A}	0.767^{A}	1.007^{A}	1.179^{AB}	1.359^{A}	1.488^{A}
TETRA Brown	0.035^{C}	0.105^{B}	0.283^{C}	0.468^{C}	0.690^{C}	0.931^{B}	1.119^{B}	1.279^{B}	1.411^{B}
TETRA Amber	0.033^{D}	0.101^{B}	0.280^{C}	0.485^{BC}	0.710^{BC}	0.958^{AB}	1.151^{B}	1.319^{AB}	1.445^{AB}
ISA Brown	0.037^{B}	0.115^{A}	0.287^{BC}	0.499^{AB}	0.760^{AB}	1.015^{A}	1.227^{A}	1.360^{A}	1.450^{AB}
Bovans Brown	0.037^{B}	0.116^{A}	0.302^{AB}	0.506^{AB}	0.742^{ABC}	0.989^{AB}	1.169^{AB}	1.330^{AB}	1.439^{AB}
Novogen Brown	0.037^{B}	0.118^{A}	0.293^{ABC}	0.509^{AB}	0.733^{ABC}	1.004^{A}	1.218^{A}	1.381^{A}	1.496^{A}
Average	0.037	0.112	0.293	0.498	0.732	0.980	1.172	1.331	1.447

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

Table 9. Bi-weekly Feed Consumption of Brown-Egg Entries, 38th NCLP&MT, Cage-reared

	(Weeks of Age)								
Breeder	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-16
	(kg per bird)								
Hy-Line Brown	0.214^{AB}	0.471^{BC}	0.735^{BC}	0.999^{B}	1.298^{B}	1.207^{BC}	1.274^{B}	1.318^{C}	7.516
Hy-Line S. Brown	0.217^{AB}	0.463^{C}	0.747^{BC}	0.988^{B}	1.312^{B}	1.189^{C}	1.290^{B}	1.329^{BC}	7.536
TETRA Brown	0.204^{B}	0.466^{C}	0.707^{C}	1.002^{B}	1.336^{B}	1.211^{BC}	1.312^{B}	1.372^{BC}	7.609
TETRA Amber	0.210^{B}	0.498^{AB}	0.768^{AB}	1.108^{A}	1.473^{A}	1.304^{A}	1.443^{A}	1.514^{A}	8.318
ISA Brown	0.226^{A}	0.505^{A}	0.797^{A}	1.098^{A}	1.445^{A}	1.294^{AB}	1.408^{A}	1.416^{B}	8.190
Bovans Brown	0.219^{AB}	0.486^{ABC}	0.766^{AB}	1.011^{B}	1.351^{B}	1.206^{BC}	1.315^{B}	1.362^{BC}	7.714
Novogen Brown	0.210^{B}	0.483^{ABC}	0.760^{AB}	1.016^{B}	1.340^{B}	1.242^{ABC}	1.313^{B}	1.357^{BC}	7.721
Average	0.214	0.482	0.754	1.032	1.365	1.236	1.337	1.382	7.801

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

Table 10. Total Nutrient Intake, Feed Cost, Livability, and Flock Uniformity of Brown-Egg Entries, 38th NCLP&MT, Cage-reared

Breeder	Protein	Met. Energy	Lysine	TSAA	Feed Cost	Livability (1-112 d)	Flock Uniformity
	----------(per bird to 112 days)----------						(% of pullets within ±10% of x)
	(g)	(kcal)	(g)	(g)	($)	(%)	
Hy-Line Brown	1229.0^{B}	21071^{B}	66.1^{B}	51.3^{B}	2.16^{B}	100.00^{A}	92.7^{AB}
Hy-Line S. Brown	1231.9^{B}	21124^{B}	66.2^{B}	51.4^{B}	2.16^{B}	98.88^{A}	95.0^{A}
TETRA Brown	1240.8^{B}	21322^{B}	66.6^{B}	51.9^{B}	2.18^{B}	96.46^{A}	82.3^{BC}
TETRA Amber	1355.1^{A}	23306^{A}	72.7^{A}	56.2^{A}	2.38^{A}	81.87^{B}	80.7^{C}
ISA Brown	1337.8^{A}	22954^{A}	71.9^{A}	55.9^{A}	2.35^{A}	84.44^{B}	88.2^{ABC}
Bovans Brown	1262.3^{B}	21625^{B}	67.9^{B}	52.6^{B}	2.22^{B}	97.02^{A}	85.5^{ABC}
Novogen Brown	1262.0^{B}	21641^{B}	67.8^{B}	52.7^{B}	2.22^{B}	96.50^{A}	90.0^{ABC}
Average	1274.2	21865	68.5	53.2	2.24	93.55	87.7

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

Table 11. Bi-weekly Body Weights of Brown-Egg Entries, 38th NCLP&MT, Cage-free

	(Weeks of Age)								
Breeder	0	2	4	6	8	10	12	14	16
	(kg per bird)								
Hy-Line Brown	0.036^{B}	0.121^{AB}	0.275^{B}	0.458	0.655	0.894	1.046	1.208^{B}	1.339
Hy-Line S. Brown	0.041^{A}	0.127^{AB}	0.297^{A}	0.445	0.667	0.893	1.028	1.239^{B}	1.366
TETRA Brown	0.035^{BC}	0.112^{BC}	0.269^{BC}	0.416	0.649	0.880	1.036	1.212^{B}	1.320
TETRA Amber	0.033^{C}	0.105^{C}	0.249^{C}	0.444	0.645	0.871	1.029	1.216^{B}	1.377
ISA Brown	0.037^{B}	0.131^{A}	0.291^{AB}	0.452	0.697	0.953	1.121	1.297^{A}	1.397
Bovans Brown	0.036^{B}	0.124^{AB}	0.289^{AB}	0.416	0.675	0.885	1.049	1.228^{B}	1.372
Average	0 .037	0.120	0.278	0.440	0.664	0.896	1.051	1.231	1.359
Hy-Line W-98	0.036	0.112	0.270	0.400	0.618	0.794	0.948	1.094	1.221
Barred Plym. Rock	0.031	0.106	0.230	0.368	0.548	0.774	0.958	1.112	1.190

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

Table 12. Bi-weekly Feed Consumption of Brown-Egg Entries, 38th NCLP&MT, Cage-free

	(Weeks of Age)								
Breeder	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	1-16
	(kg per bird)								
Hy-Line Brown	0.158[B]	0.382	0.465	0.605	0.788	0.853	0.917	0.707	4.876
Hy-Line S. Brown	0.175[AB]	0.390	0.486	0.613	0.749	0.859	0.885	0.773	4.931
TETRA Brown	0.166[ABC]	0.375	0.393	0.634	0.789	0.871	0.898	0.737	4.864
TETRA Amber	0.151[C]	0.359	0.390	0.640	0.789	0.868	0.929	0.748	4.874
ISA Brown	0.179[A]	0.383	0.407	0.642	0.849	0.914	0.946	0.753	5.073
Bovans Brown	0.181[A]	0.401	0.427	0.666	0.804	0.885	0.933	0.763	5.060
Average	0.168	0.382	0.432	0.630	0.794	0.873	0.918	0.743	4.939
Hy-Line W-98	0.178	0.366	0.386	0.614	0.721	0.788	0.887	0.694	4.634
Barred Plym. Rock	0.100	0.313	0.303	0.575	0.730	0.892	0.863	0.807	4.538

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

Table 13. Total Nutrient Intake, Feed Cost, Livability, and Flock Uniformity of Brown-Egg Entries, 38th NCLP&MT, Cage-free

Breeder	Protein	Met. Energy	Lysine	TSAA	Feed Cost	Livability (1-112 d)	Flock Uniformity
	----------(per bird to 112 days)----------						(% of pullets within ±10% of *x*)
	(g)	(kcal)	(g)	(g)	($)	(%)	
Hy-Line Brown	817.7	13802	44.6	33.9	1.42	98.94[A]	87.2
Hy-Line S. Brown	815.6	13752	44.5	33.8	1.42	99.92[A]	81.3
TETRA Brown	804.6	13584	43.9	33.5	1.40	97.94[A]	77.3
TETRA Amber	814.4	13790	44.4	33.9	1.42	93.53[B]	88.0
ISA Brown	837.2	14157	45.7	34.9	1.45	96.47[AB]	78.7
Bovans Brown	839.7	14189	45.8	34.9	1.46	98.38[A]	84.0
Average	821.2	13871	44.8	34.1	1.43	97.42	83.2
Hy-Line W-98	765.3	12897	41.8	31.8	1.33	97.58	80.0
Barred Plym. Rock	707.2	11944	38.6	29.5	1.23	88.7	82.0

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

Table 14. Bi-weekly Body Weights of Brown-Egg Entries, 38th NCLP&MT on Range

Breeder	0	2	4	6	8	10	12	14	16
	(Weeks of Age)								
	(kg)								
Hy-Line Brown	0.36	0.116	0.272	0.446	0.648	0.870	1.040	1.218	1.335
Hy-Line S. Brown	0.41	0.128	0.284	0.454	0.656	0.880	1.060	1.269	1.486
Barred Plym. Rock	0.031	0.104	0.236	0.360	0.544	0.732	0.936	1.128	1.230

Table 15. Bi-weekly Feed Consumption of Brown-Egg Entries, 38th NCLP&MT on Range

Breeder	1-2	3-4	5-6	7-8	9-10	11-12	13-14	14-16	1-16
	(Weeks of Age)								
	(kg per bird)								
Hy-Line Brown	0.152	0.379	0.473	0.571	0.792	0.852	0.961	0.919	5.099
Hy-Line S. Brown	0.171	0.384	0.497	0.591	0.764	0.819	1.023	1.057	5.303
Barred Plym. Rock	0. 145	0.313	0.303	0.575	0.730	0.892	1.007	0.873	4.838

Table 16. Total Nutrient Intake, Feed Cost, Livability, and Flock Uniformity of Brown-Egg Entries, 38th NCLP&MT on Range

Breeder	Protein	Met. Energy	Lysine	TSAA	Feed Cost	Livability (1-112 d)	Flock Uniformity
	(per bird to 112 days)						(% of pullets within ±10% of *x*)
	(g)	(kcal)	(g)	(g)	($)	(%)	
Hy-Line Brown	729.1[B]	12175[B]	40.1[B]	30.1[B]	1.26[B]	99.8	86.0
Hy-Line S. Brown	770.6[A]	12917[A]	42.3[A]	31.9[A]	1.33[A]	99.5	78.0
Barred Plym. Rock	793.2	13548	43.0	33.2	1.39	88.7	66.0

Table 17. Entries in the 38th 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 International 4432 Highway 213, Box 309 Mansfield, GA 30255
	Hy-Line Brown	I-A	(Same)
	W-98	I-A	Hy-Line International 17458 G. Avenue Perry, IA 50220
	Hy-Line Silver Brown	I-A	Dallas Center Research Farm 2418 N Ave. Dallas Center, IA 50063
Lohmann Tierzucht Gmbh Am Seedeich 9-11 . P.O.Box 460 D-27454 Cuxhaven, Germany	Lohmann LSL-Lite	I-A	Hy-Line North America 1755 West Lakes Parkway West Des Moines, IA 50266
H&N International 321 Burnett Ave South, Suite 300 Renton, Washington 98055	H&N "Nick Chick"	I-A	Feather Land Farms 32832 E. Peral Road Coberg, OR 97408
Instiut de Selection Animale (A Hendrix Genetic Company) ISA North America 650 Riverbend Drive, Suite C Kitchener, Ontario N2K 3S2 Canada	Bovans White	I-A	CPI-South Central Hatchery 5087 County Road 35 Bremen, AL 35033
	Bovans Robust	II-A	(Same)
	Bovans Brown	I-A	(Same)
	Babcock White	I-A	ISA North America 650 Riverbend Drive Kitchener, Ontario N2K 3S2 Canada
	Dekalb White	I-A	(Same)
	Experimental White	III-A	(Same)
	Shaver White	II-A	Brickland Hatchery Midwest Farms, LLC. 135 S. Epes St. Blackstone, VA 23824
	ISA Brown	II-A	Westwind Hatchery 8382 Lakeview St. Interlaken, NY 14847
North Carolina State University Dept of Poultry Science Box 7608 Raleigh, NC 27695	NCSU Barred Plymouth Rock	III-C	North Carolina State University Dept of Poultry Science Box 7608 Raleigh, NC 27695
Tetra Americana, LLC 1105 Washington Road Lexington, GA 30648	TETRA Brown	I-A	CPI-MidAmerica Hatchery 111 Stoddart Street Beaver Dam, WI 53916
	TETRA Amber	I-A	(Same)
NOVOGEN S.A.S. Mauguérand – Le Foeil BP 265 22 800 QUINTIN - FRANCE	NOVOgen WHITE	I-A	Kendrick Farm 25 Dr Breley Rd East Freetown, PA 02717
	NOVOgen BROWN	I-A	Highland Hills Farm 105 Hurricane Road Westmoreland, NH 03467

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