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REPORT OF THE FORTY FIRST NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST FROM 17 TO 69 WEEKS OF AGE[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. Robert Graham is Piedmont Research Station Superintendent; Herbert Ledford and Holly Giaquinto as interim Poultry Unit Manager of the flock; Dr. Ishab Poudel, Research Scholar, is coordinator of data compilation and statistical analysis, and Dr. Kenneth 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 a 17 to 69 week production cycle of the 41st North Carolina Layer Performance and Management Test. Performance summary tables are available for each strain and production system tested. This production cycle data was collected for 9 strains and 2 production systems: Conventional Cage, Cage free Housing Systems.

Copies of current and past reports are maintained for public access at
http://www.ces.ncsu.edu/depts/poulsci/tech_manuals/layer_reports/41st 17-69 wk cycle report.pdf

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

41st NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST
Volume 41 No. 2

Report on the 17-69 week Laying Cycle

DESCRIPTION OF DATA TABLE STATISTICS

First cycle performance data for white and brown-egg strains in the 2 production systems are reported for 17-69 weeks of age. Data for Conventional Cage systems are reported in Tables 10 to 15. Data for the Cage-free System for the same time periods are in Tables 16 to 21. Mortality Summary data are in Figure 1.

Index of Tables **Page**

Dates of Importance:

Nine entries were accepted or acquired in accordance with the rules and regulations of the test. Six commercial white egg strains and three commercial brown egg strains entered and participated in the current test. This layer test protocol was developed such that the chicks were received directly from the breeder's or egg industry hatcheries at the onset of the grow period. Therefore, the chicks arrived the week of August 22, 2023 and were 16 weeks of age the week of December 12, 2023. For each strain, the final body weights and feed weigh backs collected were at the close of their 16th week. This report covers the 2 production systems used for the first laying cycle.

Experimental Components of Importance:

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, and cage free 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 rearing phase for the cage reared, and cage-free pullets was complete when the pullets reached 16 weeks of age. They were transitioned into the laying phase during their 17th week of age with the first cycle production records of the laying phase commenced on December 12, 2023 (designated as 17 weeks of age) and continued through

December 12, 2024 (69 weeks of age). This report includes production data summarized for 17 to 69 weeks for each production system. Tables showing the changes in body weights from 17 to 69 weeks of are included in the information.

Table 1. 41st North Carolina Layer Performance and Management Test Strain Code Assignments

Strain No.	Breeder	Source Code[1]	Strain	Participation[2]
1	Hendrix-genetics	BRDR	Shaver	Cage/Cage-free
2	Hendrix-genetics	BRDR	Dekalb	Cage/Cage-free
3	Hendrix-genetics	BRDR	Babcock	Cage/Cage-free
4	Hy-Line Int	IND	W-36	Cage/Cage-free
5	Lohmann	IND	LSL-Lite	Cage/Cage-free
6	TETRA Americana	BRDR	White	Cage/Cage-free
7	Hendrix-genetics	BRDR	Bovans Brown	Cage/Cage-free
8	Hy-Line Int	IND	Hy-Line Brown	Cage/Cage-free
9	TETRA Americana	BRDR	Brown	Cage/Cage-free

[1]Source code indicates that the chicks had extensive distribution in United States and were provided by Egg Industry=IND; or a Breeder Company=BRDR

[2] Participation for each strain in the different components of the tests are indicated as Cage or Cage-free

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 4 (Cage-free) and 7 (Conventional Cage) 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 (41st NCLP&MT Grow Report, Vol. 41, No. 1). White-egg strains and brown-egg strains occupied replicates in each system proportionally in accordance with the number of white-egg strains and brown-egg strains tested. Identification numbers that identified the house and replicate assignment codes that indicated the strain as well identified individual hens. Brood-grow House 8 was used to rear the pullets for the conventional cage housing system and House 4 was the brood-grow for cage-free housing. Chicks tagged upon arrival for strain and rearing replicate identification. Pullets were fed *ad libitum*, and feed consumption and body weights were monitored bi-weekly and reported in (NCLP&MT Vol.41, No.1).

Layer Housing:

At 16 wks, the pullets were transferred to the laying house, each pullet was then identified with the laying house replicate number: row, level and replicate that identifies the strain to the unit manager and PI. Pullets in House 8 were moved to cage laying house in accordance with industry standards, which were UEP Animal Care Certified conditions and approved by NCSU IACUC.

The laying replicates were randomly assigned by strains in a way that white-egg and brown-egg strains were intermingled throughout the house. The houses contained feeder systems that allowed feed consumption to be determined by replicate and layer diet fed.

Issue for Notation: Initially the birds were moved into House 5 with Conventional Cages (C) and Colony Housing Systems (CS). It is a standard height, windowless, force ventilated laying house with battery style cages using a belt manure handling system. It has 4 rows of triple deck cages, consisting of a bank of cages on each side of the row. There were 2 banks of C, 2 banks of CS, and 4 banks of ECS. 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 C, CS, and ECS cages that were 21" high by 26" deep by 24", 48" or 96" wide, respectively. There was 2' space between cage sections for feed hoppers and feed recovery. The bird population for C and CS were held constant at 31 white-egg strain hens or 31 brown-egg strain hens per replicate (80 in^2 per hen). In House 5, the ECS replicates contained 21 hens per replicate (118.9 in^2 per hen). **During the 24th week of production there was a power interruption in House 5 along with an alarm system failure. More than 50% of the hens in the house were lost due to Hyperthermia. Immediately upon discovery power was restored and the staff rehoused the survivors into House 7 (described below) upon discussion with the sponsors it was decided to continue the test to its conclusion at 102 wks with 2 production systems C and CF. Due to the unexpected mortality that is not directly related to the performance of the strains being compared. None of the mortalities that occurred as a result of the power interruption were included in the mortality overview. It was suggested that mortality figures and some of the production results after week 24 of production be interpreted with care, taking into consideration this special circumstance. Readers will encounter sufficient information in this report and on the original data files to recalculate some of these metrics to meet their individual needs.**

Table 2. Replicate numbers and Hen populations in the Conventional Cage and Cage-free Systems after 24 weeks of age

House	System[1]	Egg Color	Density	Number of Replicates	Hens per replicate	Hen No.	Total Hens
4	CF	White	192	24	60	1,440	
4	CF	Brown	192	12	60	720	2,160
7	C	White	80	44	24	1,056	
7	C	Brown	80	28	24	672	1,728

[1]Conventional Cage=C; Cage-free System=CF

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 44 experimental units for the white egg strains and 28 replicates for the brown egg strains, each consisting of 2 cages. The bird population at housing was 12 white-egg and brown-egg strain hens/cage (80 in^2/hen) for 24 hens/replicate for a total of 1,728 hens.

House 4 – is a slat-litter facility which contains 36 pens (8' x 10') for a total of 80 sq ft/pen with the laying protocol being identical to the C hens. The house is set up to include whole house heat capabilities so the birds reared in the facility will also spend the lying phase in that pen. There were 60 hens at approximately 1238 cm^2 for the cage free birds (192 in^2) started in each pen cage free birds with the rearing protocol being identical to the cage reared hens. Feeder and waterer space designed to meet UEP Guidelines for cage free facilities. Roosts (378 in) were included in the rearing pen to allow the pullets to learn to utilize vertical space. There were 9 nipple drinkers and 2 tube feeders in each pen and nest boxes (5 hens/nest).

Lighting

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

Table 3. Layer House Lighting Schedules

Age	Date	Photo Period[1]
(weeks)		(Daylight hrs)
16-17	Dec 12, 2023	10.0
17	Dec 19, 2023	11.0
18	Dec 26, 2023	11.5
19	Jan 2, 20234	12.0
20	Jan 9, 2024	12.5
21	Jan 16, 2024	13.0
22	Jan 23, 2024	13.5
23	Jan 30, 2024	14.0
24	Feb 6, 2024	14.25
25	Feb 13, 2024	14.5
26	Feb 20, 2024	14.75
27	Feb 27,2024	15.0
28	Mar 6, 2024	15.25
29	Mar 13, 2024	15.5
30	Mar 20. 2024	15.75
31-100	Mar 27, 2024 to Aug 6, 2025	16.0

[1]Lighting schedules were the same for C, and CF.
[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 41st 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, and G, which were used through 69 weeks of age. Diets 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 4. 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

[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 5. 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
Production 90-80%	10.43 - 11.29	F	G
	11.34 - 12.20	G	H
	12.25 - >13.11	H	I
Production 70-80%	10.43 - 11.29	H	I
	11.34 - 12.20	I	M
	12.25 - >13.11	M	N
Production < 70%	10.43 - 11.29	M	N
	11.34 - 12.20	N	O
	12.25 - >13.11	O	O

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

Table 6. Laying Periods Feed Formulations[1] D through G

Diet	Pre-lay Diet	D	E	F	G
Ingredients	(lbs.)	(lbs.)	(lbs.)	(lbs.)	(lbs.)
Corn	811.84	920.66	902.04	1009.14	1135.32
Soybean meal	725.41	641.70	671.12	614.08	557.74
Soybean oil	163.77	134.00	134.02	120.49	72.72
Ground Limestone	112.55	113.35	108.73	97.645	89.91
Coarse Limestone	112.55	113.35	108.72	97.645	89.91
Phosphate Mono/D	53.21	53.90	54.68	38.82	38.71
Salt	5.00	7.62	7.620	8.710	7.700
D.L. Methionine	7.67	8.42	6.070	6.470	1.000
Vit. premix	1.00	1.00	1.000	1.000	1.000
Min. premix	4.00	4.00	4.000	4.000	4.000
Selenium premix	1.00	1.00	1.000	1.000	1.000
Santoquin	1.00	1.00	1.000	1.000	1.000
Choline Chloride	1.00	1.00	-	-	-
Calculated values					
Protein%	20.50	19.00	19.50	18.50	17.50
ME kcal/kg	2921	2900	2900	2900	2900
Calcium %	5.03	5.06	4.90	4.30	4.00
A. Phos. %	0.60	0.60	0.61	0.46	0.45
Lysine %	1.16	1.05	0.90	1.02	0.95
TSAA %	1.00	1.00	0.90	0.90	0.61

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.

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 (2022 to 2024, 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 7. Federal-State Market News: Three-year Regional Average Egg Prices

Grade	Size	$/Dozen[1]
A	Extra Large	2.78
A	Large	2.70
A	Medium	2.23
A	Small	1.44
A_2	Pee Wee	0.72
B_3	All	1.43
Checks[3]	All	1.43

[1]Price per dozen calculated from the SE Regional Egg Prices reported to USDA-AMS Federal-State Market News

[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). Size distribution was reported as the proportion of eggs falling into each size category.

Table 8. 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 9. The Average NCSU Feed mill Feed Prices for Feed Purchases during the First Cycle

Diets	Price ($) / Ton
Pre-lay	499.82
D	499.82
E	473.64
F	464.05
G	410.21
H	391.23

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. All mortalities were necropsied by a Veterinarian during this production period.

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 10. Effect of White-Egg Strain on Performance of Hens (17-69 wks) in Conventional Cage System

Strain	Feed Consumption	Feed Conversion	Eggs per Hen[1]	HD[2] Egg Production	Egg Mass	Mortality	Age at 50% Production
	(g/hen/day)	(g egg/g feed)	(#)	(%)	(g/HD)	(%)	(Days)
Shaver White	103.33^{C}	0.561	335.82	93.83^{A}	53.86	1.07	138^{D}
Dekalb White	105.37^{B}	0.544	327.79	91.85^{B}	58.41	1.55	141^{BC}
Babcock White	107.16^{A}	0.551	328.81	92.01^{B}	59.90	1.02	140^{C}
Hy-Line W-36	99.35^{E}	0.513	294.85	84.05^{E}	56.92	1.67	146^{A}
Lohmann LSL-Lite	104.40^{BC}	0.539	320.34	90.24^{C}	57.46	1.34	143^{B}
TETRA White	101.23^{D}	0.521	302.18	86.23^{D}	53.29	3.60	142^{BC}
All Strains	103.47	0.538	318.30	89.70	56.92	1.71	141

^{A,B,C,D,E} - Different letters denote significant differences ($P<0.01$) for comparisons made among strains.

[1]The total number of eggs produced per hen

[2]HD = hen day

Table 11. Effect of White-Egg Strain on Egg Weight and Egg Size Distribution of Hens (17-69 wks) in Conventional Cage System.

Strain	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
	(g/egg)	(%)	(%)	(%)	(%)	(%)
Shaver White	62.42	0.02	2.88^{AB}	4.65^{ABC}	9.80^{ABC}	81.9^{BC}
Dekalb White	63.03	0.13	4.71^{AB}	3.12^{ABC}	7.59^{CD}	83.9^{B}
Babcock White	63.60	0.07	0.24^{C}	6.09^{AB}	5.50^{D}	87.6^{A}
Hy-Line W-36	62.22	0.00	1.02^{BC}	6.56^{A}	12.20^{AB}	79.5^{C}
Lohmann LSL-Lite	62.91	0.16	5.92^{A}	2.17^{C}	7.60^{CD}	83.8^{B}
TETRA White	62.08	0.26	6.59^{A}	2.57^{BC}	15.3^{A}	75.0^{D}
All Strains	62.70	0.11	3.56	4.19	9.67	81.9

^{A,B,C,D} - Different letters denote significant differences ($P<0.01$) for comparisons made among strains.

Table 12. Effect of White-Egg Strain on Egg Quality, Egg Income and Feed Costs of Hens (17-69 wks) in Conventional Cage System

Strain	Grade A	Grade B	Cracks	Loss	17-69 wks Egg Income	17-69 wks Feed Costs
	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Shaver White	92.77	1.81	5.23	0.17	60.43	17.67
Dekalb White	91.96	2.92	5.10	0.02	68.85	18.81
Babcock White	90.77	2.22	6.91	0.09	69.38	18.39
Hy-Line W-36	91.43	2.18	6.19	0.19	61.72	17.93
Lohmann LSL-Lite	90.32	3.09	6.49	0.10	67.95	19.08
TETRA White	90.73	2.96	6.25	0.06	65.26	18.52
All Strains	91.32	2.53	6.03	0.11	65.87	18.40

Table 13. Effect of Brown-Egg Strain on Performance of Hens (17–69 wks) in Conventional Cage System

Strain	Feed Consumption	Feed Conversion	Eggs per Hen[1]	HD[2] Egg Production	Egg Mass	Mortality	Age at 50% Production
	(g/hen/day)	(g egg/g feed)	(#)	(%)	(g/HD)[3]	(%)	(Days)
Bovans Brown	106.08^{B}	0.524^{B}	309.93	89.10	56.87	2.91	145^{A}
Hy-Line Brown	106.24^{B}	0.529^{A}	312.24	89.36	57.59	0.37	145^{A}
TETRA Brown	108.78^{A}	0.523^{AB}	310.12	88.60	56.95	2.64	141^{B}
All strains	107.03	0.525	310.76	89.02	57.14	1.97	143

^{A,B} - Different letters denote significant differences (P<0.01) for comparisons made among strains.
[1]The total number of eggs produced per hen
[2]HD = hen day

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

Strain	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
	(g/egg)	(%)	(%)	(%)	(%)	(%)
Bovans Brown	59.56	0.00	2.74	5.18	7.75	83.6
Hy-Line Brown	61.45	0.00	0.00	4.28	9.53	87.1
TETRA Brown	60.82	0.06	2.24	5.21	5.39	86.1
All strains	60.61	0.02	1.66	4.89	7.56	85.6

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

Strain	Grade A	Grade B	Cracks	Loss	17-69 wks Egg Income	17-69 wks Feed Costs
	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Bovans Brown	93.30^{AB}	1.13	5.50	0.53	65.87	18.91
Hy-Line Brown	94.16^{A}	0.59	5.17	0.34	67.45	19.55
TETRA Brown	91.91^{B}	1.29	6.50	<0.01	64.54	18.66
All strains	93.13	1.00	5.70	0.292	65.95	19.06

^{A,B} - Different letters denote significant differences (P<0.01) for comparisons made among strains.

Table 16. Effect of White-Egg Strain on Performance of Hens (17-69 wks) in Cage-free Housing System

Strain	Feed Consumption	Feed Conversion	Eggs per Hen[1]	HD[2] Egg Production	Egg Mass	Mortality	Age at 50% Production
	(g/hen/day)	(g egg/g feed)	(#)	(%)	(g/HD)	(%)	(Days)
Shaver White	97.41^{BC}	0.537^{A}	295.05^{C}	87.69^{A}	53.08	0.137	143^{CD}
Dekalb White	101.57^{A}	0.532^{A}	320.71^{A}	88.01^{A}	54.89	0.107	145^{BC}
Babcock White	102.29^{A}	0.543^{A}	319.63^{A}	89.02^{A}	56.38	0.359	142^{D}
Hy-Line W-36	92.97^{D}	0.515^{B}	308.98^{B}	80.91^{C}	48.74^{C}	0.196	150^{A}
Lohmann LSL-Lite	99.16^{B}	0.535^{A}	325.13^{A}	88.59^{A}	53.97	0.031	146^{B}
TETRA White	96.35^{C}	0.515^{B}	322.54^{A}	84.66^{B}	50.37^{B}	0.253	145^{BC}
All Strains	98.29	0.538	315.34	86.48	52.91	0.180	145

^{A,B,C,D} - Different letters denote significant differences (P<0.01) for comparisons made among strains.

[1]The total number of eggs produced per hen

[2]HD = hen day

Table 17. Effect of White-Egg Strain on Egg Weight and Egg Size Distribution of Hens (17-69 wks) in Cage-free Housing System

Strain	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
	(g/egg)	(%)	(%)	(%)	(%)	(%)
Shaver White	60.35	0.06	2.34	6.07^{AB}	22.1^{B}	69.4^{B}
Dekalb White	60.01	0.11	1.67	5.15^{B}	15.6^{C}	77.1^{A}
Babcock White	61.32	0.27	1.16	6.04^{AB}	12.0^{C}	80.2^{A}
Hy-Line W-36	59.41	0.11	3.55	5.10^{B}	25.5^{AB}	65.4^{BC}
Lohmann LSL-Lite	59.66	0.78	3.01	5.19^{B}	22.8^{AB}	67.9^{B}
TETRA White	59.07	0.56	2.91	7.73^{A}	27.5^{A}	61.4^{C}
All Strains	59.97	0.31	2.44	5.88	20.9	70.2

^{A,B,C} - Different letters denote significant differences (P<0.01) for comparisons made among strains.

Table 18. Effect of White-Egg Strain on Egg Quality, Egg Income and Feed Costs of Hens (17-69 wks) in Cage-free Housing System

Strain	Grade A	Grade B	Cracks	Loss	17-69 wks Egg Income	17-69 wks Feed Costs
	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Shaver White	95.44	2.31	2.19	0.00	64.40^{B}	18.31^{B}
Dekalb White	93.44	4.17	2.07	0.00	70.10^{A}	19.09^{A}
Babcock White	92.56	3.46	3.85	0.06	70.55^{A}	18.66^{AB}
Hy-Line W-36	94.44	3.08	2.35	0.06	66.68^{B}	18.71^{B}
Lohmann LSL-Lite	94.00	3.27	2.48	0.13	69.88^{A}	18.86^{B}
TETRA White	93.51	3.86	2.44	0.06	70.23^{A}	18.77^{B}
All Strains	93.90	3.36	2.56	0.05	68.64	18.90

^{,B,C} - Different letters denote significant differences (P<0.01) for comparisons made among strains.

Table 19. Effect of Brown-Egg Strain on Performance of Hens (17–69 wks) in Cage-free Housing System

Strain	Feed Consumption	Feed Conversion	Eggs per Hen[1]	HD[2] Egg Production	Egg Mass	Mortality	Age at 50% Production
	(g/hen/day)	(g egg/g feed)	(#)	(%)	(g/HD)[4]	(%)	(Days)
Bovans Brown	99.54^{B}	0.490^{A}	294.98	80.98^{A}	49.43	0.90	148
Hy-Line Brown	102.5^{A}	0.468^{B}	281.90	77.42^{B}	48.78	0.48	152
TETRA Brown	102.6^{A}	0.468^{B}	283.16	77.47^{B}	48.65	5.05	147
All strains	101.5	0.475	286.68	78.63	48.95	2.14	149

^{A,B} - Different letters denote significant differences (P<0.01) for comparisons made among strains.
[1]The total number of eggs produced per hen
[2]HD = hen day

Table 20. Effect of Brown-Egg Strain on Egg Weight and Egg Size Distribution of Hens (17-69 wks) in Cage-free Housing System

Strain	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
	(g/egg)	(%)	(%)	(%)	(%)	(%)
Bovans Brown	63.25	0.06	1.51	5.15	19.67^{A}	71.3^{B}
Hy-Line Brown	63.90	0.00	2.02	4.41	13.61^{B}	79.5^{A}
TETRA Brown	63.74	0.00	2.15	4.60	14.70^{B}	78.2^{A}
All strains	63.63	0.02	1.89	4.72	16.00	76.3

^{A,B} - Different letters denote significant differences (P<0.01) for comparisons made among strains.

Table 21. Effect of Brown-Egg Strain on Egg Quality, Egg Income and Feed Costs of Hens (17-69 wks) in Cage-free Housing System

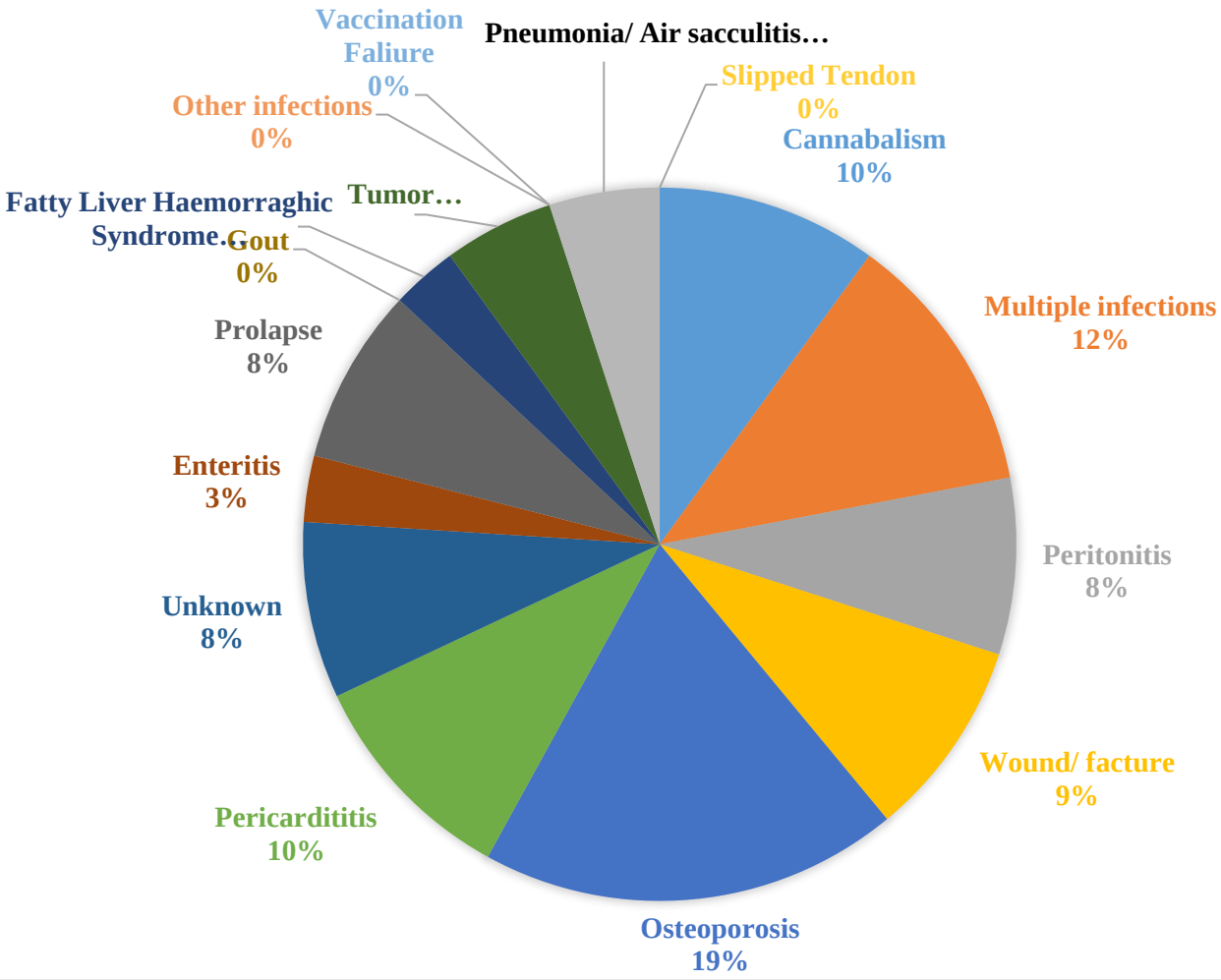
Strain	Grade A	Grade B	Cracks	Loss	17-69 wks Egg Income	17-69 wks Feed Costs
	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Bovans Brown	95.06	1.86	1.03	0.00	64.63	18.90
Hy-Line Brown	95.73	2.41	1.55	0.00	62.57	18.97
TETRA Brown	96.99	1.54	1.41	0.07	63.37	19.33
All strains	95.93	1.94	1.33	0.02	63.52	19.07

Table 22. Entries in the 41st NCLP&MT by Breeder, Stock, Categories, and Suppliers

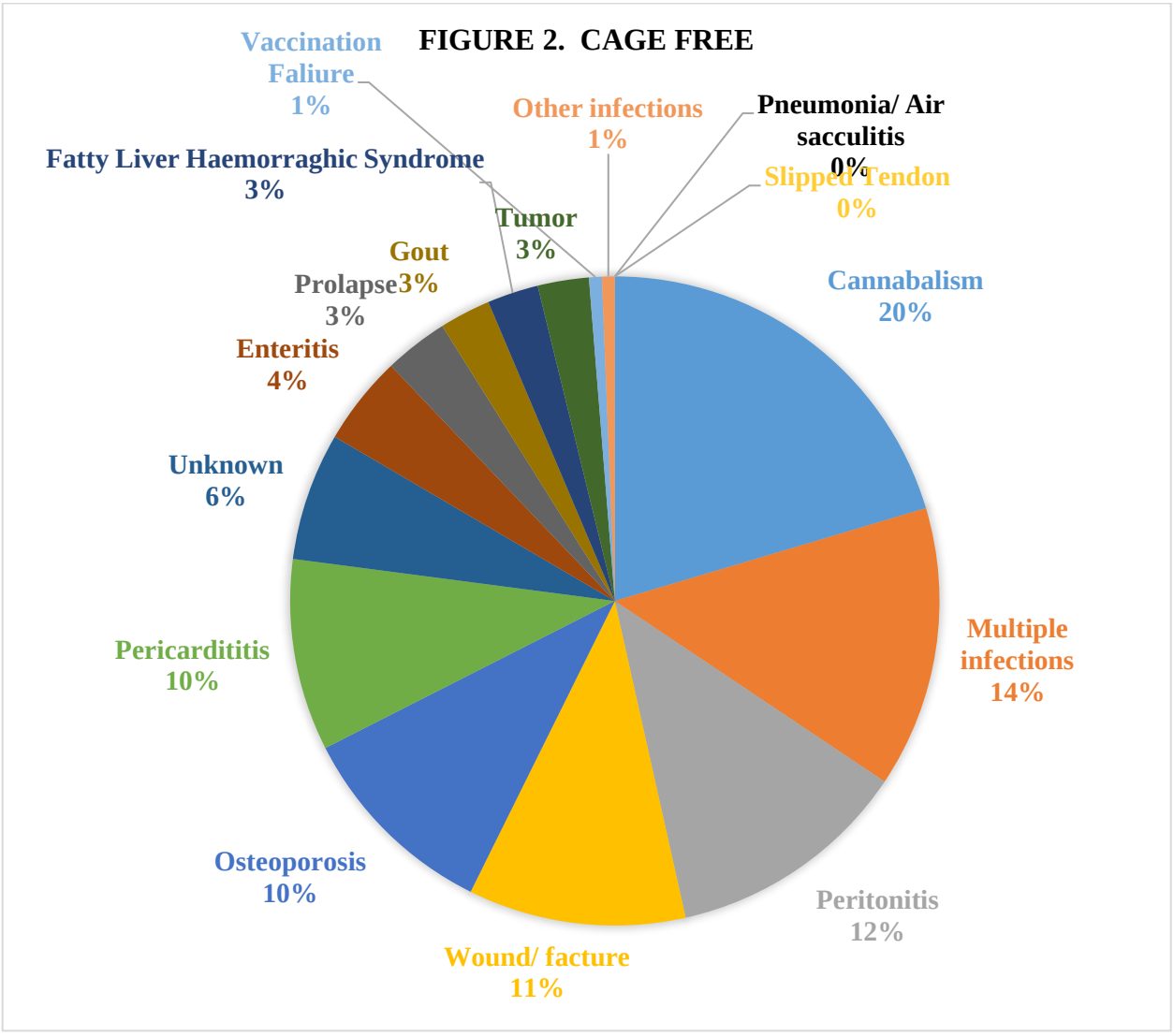
Breeder	Stock	Category[1]	Source
Hy-Line International 2583 240th Street Dallas Center, IA 50063	W-36	A-I	Industry
	Hy-Line Brown	A-I	Industry
Lohmann Tierzucht Gmbh Am Seedeich 9-11 . P.O.Box 460 D-27454 Cuxhaven, Germany	Lohmann LSL-Lite	A-I	Industry
Institut de Selection Animale (A Hendrix Genetic Company) ISA North America 650 Riverbend Drive, Suite C Kitchener, Ontario N2K 3S2 Canada	Shaver White	A-I	Hendrix-ISA LLC 621 Stevens Rd Ephrata, PA 17522
	Dekalb White	A-I	(Ephrata, PA)
	Bovans Brown	A-I	(Ephrata, PA)
	Babcock White	A-I	Institute de Sélection Animale 50 Franklin Road Cambridge, Ontario N1R 8G6 Canada
Tetra Americana, LLC 1105 Washington Road Lexington, GA 30648	TETRA White	A-I	Centurian Poultry
	TETRA Brown	A-I	

[1] Industry = Provided by Egg Industry, A = Entry requested I = Extensive distribution in southeast United States,

FIGURE 1. CONVENTIONAL CAGE



See comment related to mortalities on page 5 for clarification on what was included in this figure



See comment related to mortalities on page 5 for clarification on what was included in this figure