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

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The North Carolina Layer Performance and Management Test is 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, Salisbury, North Carolina. Mr. Joe Hampton is the Piedmont Research Station Superintendent; Mr. Aaron Sellers is Resident Manager of the flock; Pam Jenkins is the Statistical Research Assistant; and Dr. K. E. Anderson is the Director for the program and 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 first production cycle and molt of the 38th North Carolina Layer Performance and Management Test (Cage Production). Performance summary tables are available for each strain, and molt treatment.

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

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

38th NORTH CAROLINA LAYER PERFORMANCE AND MANAGEMENT TEST
Volume 38 No. 3

Report on First Laying Cycle and Molt

Entries and Strains:

A total of eleven white egg, seven brown egg strains, and one heritage strain were entered for a total of nineteen strains that were accepted in accordance with the rules and regulations of the test. The strain names and egg color designations are shown in Table 1. In this report the production data will only represent the hens which are housed in cages (Participation C).

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

In the layer test, approximately 760 white and brown egg type pullets/strain were placed at the initiation of the rearing portion of the test. However, if the number of hens needed were below the prescribed numbers, they were divided as equally as possible between the levels and replicates within the layer house and placement into the layer test was adjusted appropriately.

Dates of Importance:

The nineteen entries were hatched on January 6, 2010. 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. Table 1, shows the source of the laying stock, strain which was entered, and participation in the test environments and Table 36, 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 wks, then transitioned to the laying phase during their 17th wk of age. First cycle production records commenced on May 5, 2010 (17 weeks of age), through the molt period which was induced on May 4, 2011. The molt records commenced on May 4, 2011 (69 weeks of age), and ended on June 1, 2011 (73 weeks of age). This report includes production data summarized from 17 to 69 weeks, and 69 to 73 weeks. A table showing the changes in body weights from 17 to 69 wk of age and the weight loss during the molt period is included in the molt period information.

Pullet Housing:

The chicks were randomly assigned to the growing cages with white egg and brown egg replicates being intermingled throughout the house. The white egg strains occupied approximately 58 % of the house and brown egg strains occupied the other 42 % of the house. All strains were assigned to be represented as equally as possible in each of room, row, and levels.

The chicks from the brown egg strains destined for the range study were randomly assigned to the growing pens throughout House 2. This work will not be reported further until the single cycle report.

House 8--is an environmental controlled closed brood-grow facility with 3 banks of quad-deck cages in each room. Each room was assigned a number, each side of each bank was assigned a row number, 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 consisted 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 test in House 8 using 3 rearing rooms of 11,232. The white and brown-egg strains were randomly assigned to the replicates in the house. Entrant strains were assigned to the replicates in a restricted randomized manner with the restrictions being that all strains were approximately equally represented in all rows, levels, and rooms. The chicks were brooded in the same cage during the entire 17 wk 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" x 26" cage) pullets on the day of hatch for a rearing allowance of 48 in^2, 4.7 cm (1.8 in) of feeder space/bird and 1:6.5 nipple drinkers to bird ratio. The same numbers of pullets were grown in each replicate for both white and brown-egg strains. The room dividers were removed for this test so that all birds were essentially reared in a contiguous house.

Layer Housing:

The hens were randomly assigned to the replicate cages with white egg and brown egg strains being inter-mingled throughout the houses. The white egg strains occupied 58% of the house and brown egg strains occupied the other 42%. All strains were assigned to be represented as equally as possible in all rows, and levels.

Laying Hen Cage Facilities reported in this test consist of two houses. House 4 is a high rise, environmentally controlled facility with three banks of Quad-deck (4-tier) high cages. There are a total of 216 replicates which can support 4,428 hens. House 5 is a standard height totally enclosed force ventilated laying house with a scraper pit manure handling system. It has 2 banks of tri-deck (3 levels) cages and two banks with quad-deck (4 levels) cages. There are a total of 252 replicates in house 5 which can support 5,166 hens.

Table 2. Description of Replicates and Hen populations in the Cage Layer Housing

House	Replicates	Hens/rep.	hens/cage	Hen No.	Total Hens
4	108	21	7	2,268	
4	108	20	5	2,160	4,428
5	126	21	7	2,646	
5	126	20	5	2,520	5,166

Cage Layout Description

In both houses, each side of a bank was designated as a row and each row was divided into 9 8-foot replicates/level. The replicates are equipped with feed hoppers to supply and monitor feed consumption for each individual replicate and the feed is distributed by an automatic feeding system. The white-egg and brown-egg strains were assigned to the replicates in a restricted randomized manner, with the restrictions being that all strains were approximately equally represented in all rows, levels and cage sizes.

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 and 5 were strain and density. Following are general descriptions of the main effects:

Strain

The samples of fertile eggs from commercial breeder flocks were provided directly by the breeders involved. All eggs were set and hatched concurrently. A total of eleven white egg strains, 7 brown egg strains, and 1 heritage strain participated in the test. See the 38th Hatch Report (Vol. 38, No. 1) for details.

Density

In Houses 4 and 5, all individual replicateswithin each block contained one strain of layers. The cage density in both houses was dictated by the cage size that was either 61 or 81 cm wide and 41 cm deep. This allowed for two density combinations of 73 in^2 (471 cm^2) at 7 hens/cage (81 x 41 cm) and 77 in^2 (497 cm^2) at 5 hens/cage (61x 41 cm).

Table 3. Population and Density Allocations in Houses 4 and 5

Hens per Cage	Cage Size Width Depth	Floor Space per Bird	Feeder Space per Bird	Water Nipples per Cage
5	61 cm x 40.7 cm	497 cm^2 (77 in^2)	12.2 cm 4.8 in	2
7	81.2 cm x 40.7 cm	471 cm^2 (73 in^2)	11.6 cm 4.6 in	2

Table 4. Laying House and Molting Lighting Schedules

Age	Date	House 4	House 5
		(Light Hours)	(Light Hours)
Housing Pullets	April 28 to May 5, 2010	10.0	10.0
17 Weeks[1]	May 5, 2010	11.0	11.0
18 Weeks	May 12, 2010	11.5	11.5
19 Weeks	May 19, 2010	12.0	12.0
20 Weeks	May 26, 2010	12.5	12.5
21 Weeks	June 2, 2010	13.0	13.0
22 Weeks	June 9, 2010	13.5	13.5
23 Weeks	June 16, 2010	14.0	14.0
24 Weeks	June 23, 2010	14.25	14.25
25 Weeks	June 30, 2010	14.5	14.5
26 Weeks	July 7, 2010	14.75	14.75
27 Weeks	July 14, 2010	15.0	15.0
28 Weeks	July 21, 2010	15.25	15.25
29 Weeks	July 28, 2010	15.5	15.5
30 Weeks	Aug. 4, 2010	15.75	15.75
31 Weeks	Aug. 11, 2010	16.0	16.0
Through 69 Weeks	May 4, 2011	16.0	16.0
73 Weeks through 85 Weeks	June1, 2011 Aug. 24, 2011	See Molt Lighting Program	

Layer Management (Molting):

The molt was conducted utilizing all hens involved in the layer test except for rows 1 and 2 in both Houses 4 and 5.

Full Fed Control (NM) replicates were assigned rows 1 1nd 2 and were maintained according to the standard management program as outlined previously. The laying house will be partitioned such that the lighting program will be consistent for maximum egg production.

Non-anorexic Molt Program (NA) hens were fed a low protein, low energy diet with supplemental Ca for maintenance. It was designed to keep hens out of production and provide balanced nutrition for body maintenance only. The diet is bulky, such that a full trailer load will only weigh 2/3 of a normal full load. The birds in the replicates being molted were weighted every other day until target weight was reached then that replicate and sister replicates were returned to the resting diet until the end of the molting period. The induced molt was started at 69 wks of age.

The research project was to develop a standard weight loss curve which can be utilized by the egg industry in managing a non-anorexic molt program. Body weights were taken every other day. On 2 selected strains body weights were taken daily.

Procedural steps:

Day -7 Sample of birds will be weighed to determine the pre-molt weight. Target weight loss (25 % body weight) will be calculated using the pre-molt weight.

Day 0 NA program instigated with the remaining layer feed being removed and replaced with the NA molt diet and daylight hours reduced. Controlled light housing, reduce the day length to 9 hr. Remove morbid birds before commencement of molt program.

Day +28 Body weights were taken then the birds were fed layer diet and light stimulated.

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

The birds to attain approximately 25% body weight loss. Maintain house temperature at 80$\pm$ 5^{o} F, but the birds should not pant. House temperature management reacted to ambient environmental temperatures and weight loss rates.

The 1st post-molt production period light schedule is the guide by which the lights will be adjusted following the molt. Actual house conditions and the flock's reaction to the NCSU Non-Fasting Molting Program may affect how the light stimulation will actually be given. In general the hens ceased egg production by Day 6-10 of the molt program. However, some of the Brown egg strains never achieved 0 egg production. The hens were allowed to consume all of the molt feed provided between feedings. The molting ration is designed to keep hens out of production, and to provide for skeletal and muscle maintenance. Livability was excellent with this program. There was a house effect for the molting program. The hens in House 4 lost weight at a slower rate than did those hens in House 5. This was attributed to a 4-7°F higher temperature in House 4.

Table 5. Molting Lighting Schedules

Age	Date	House 4	House 5
		(Light Hours)	(Light Hours)
Through 69 Weeks	May 4, 2011	16.0	16.0
69 Weeks	May 4, 2011	9.0 hr	9.0 hr
73 Weeks	June 1, 2011	15.5	15.5
74 weeks	June 8, 2011	16.0	16.0
75 Weeks through end of test (110 wk)	June 15, 2011 to Feb. 18, 2012	16.0	16.0

Layer Nutrition:

Layer diets are identified as Diets D, E, F, G, H, I, M, N, and O which consist of a pre-lay diet and a series of layer diets formulated to assure a daily protein, mineral and amino acid intake as shown 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 Table.

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

Table 6. Minimum Daily Intake of Nutrients Per Bird at Various Stages of Production in the 38th NCLP&MT

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

[1] If the egg production is higher than predicted values protein intake should be increased by 1%
Note: House temperatures dictate the body maintenance demand of the hen if the house temperature is 75 to 80°F feed protein content should be increased accordingly to compensate for metabolic heat needed to maintain a homeostatic body temperature. If the house temperature is at or above 85°F no adjustment is needed.

Table 7. 38th NCLP&MT Laying House Feeding Program

Rate of Production	Consumption Per 100 Birds/Day (kg)	Diet Fed: White Egg Strains	Diet Fed: Brown Egg Strains
Weeks 17-26	< 9.52	D	D
Pre-Peak and > 87%	< 9.52	D	D
	9.57-10.39	F	E
	10.43-11.29	H	G
	11.34-12.20	I	H
	12.25-13.11	M	I
	>13.15	N	M
80-87%	< 9.52	F	E
	9.57-10.39	G	F
	10.43-11.29	I	H
	11.34-12.20	M	I
	12.25-13.11	N	M
	>13.15	O	N
70-80%	< 9.52	H	G
	9.57-10.39	I	H
	10.43-11.29	M	I
	11.34-12.20	N	M
	12.25-13.11	O	N
	>13.15	O	O
< 70%	< 9.52	H	G
	9.57-10.39	I	H
	10.43-11.29	N	M
	11.34-12.20	O	N
	12.25-13.11	O	O
	>13.15	O	O

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

Table 8. 38th NCLP&MT Laying Periods Feed Formulations D through H

Ingredients	D	E	F	G	H
Corn	866.71	925.46	997.91	1068.19	1131.97
Soybean meal	663.18	621.10	552.33	499.80	457.65
Wheat Midds					
Fat (Tallow)	110.88	102.43	87.73	74.61	64.32
Gluten Meal 60%	95.83	88.37	100.00	99.23	90.80
D.L. Methionine	3.08	2.89	2.52	2.26	2.48
Lysine 78.8%					
Soybean Hulls					
Ground Limestone	132.42	133.70	135.07	134.02	132.50
Coarse Limestone	75.00	75.00	75.00	75.00	75.00
Bi-Carbonate	3.00	3.00	3.00	3.00	3.00
Phosphate Mono/D	36.77	34.73	32.84	30.36	28.79
Salt	6.00	5.99	5.95	5.93	5.92
Vit. premix	1.00	1.00	1.00	1.00	1.00
Min. premix	1.00	1.00	1.00	1.00	1.00
Mold Inhibitor	1.00	1.00	1.00	1.00	1.00
T-Premix	1.00	1.00	1.00	1.00	1.00
.06% Selenium Premix	1.00	1.00	1.00	1.00	1.00
Choline Cl 60%	2.14	2.33	2.65	2.59	2.57
Calculated Analysis					
Protein %	22.0	21.0	20.00	19.00	18.0
ME kcal/kg	2926.0	2926.0	2926.0	2926.0	2926.0
Calcium %	4.45	4.45	4.45	4.40	4.35
T. Phos. %	0.71	0.68	0.65	0.61	0.59
Lysine %	1.15	1.09	1.00	0.93	0.87
TSAA %	0.89	0.85	0.81	0.77	0.75

Table 9. 38th NCLP&MT Laying Periods Feed Formulations I through O

Ingredients	I	M	N	O
Corn	1199.47	1258.28	1309.81	1371.93
Soybean meal	406.08	363.91	340.24	333.87
Wheat Midds				
Fat (Tallow)	52.26	43.80	38.85	14.71
Gluten Meal 60%	89.84	82.64	61.54	25.79
D.L. Methionine	2.02	1.62	1.75	1.80
Lysine 78.8%				
Soybean Hulls				
Ground Limestone	158.82	160.10	161.33	167.71
Coarse Limestone	50.00	50.00	50.00	50.00
Bi-Carbonate	3.00	3.00	3.00	3.00
Phosphate Mono/D	26.79	24.75	22.60	20.30
Salt	5.90	5.89	5.89	5.89
Vit. premix	1.00	1.00	1.00	1.00
Min. premix	1.00	1.00	1.00	1.00
Mold Inhibitor	1.00	1.00	1.00	1.00
T-Premix	1.00	1.00	1.00	1.00
.06% Selenium Premix	1.00	1.00	1.00	1.00
Choline Cl 60%	0.83	1.02		
Calculated Analysis				
Protein %	17.00	16.00	15.00	14.00
ME kcal/kg	2926.0	2926.0	2926.0	2860.0
Calcium %	4.35	4.35	4.35	4.45
T. Phos. %	0.56	0.52	0.49	0.47
Lysine %	0.80	0.74	0.70	0.68
TSAA %	0.70	0.65	0.62	0.58

Table 10. 38th NCLP&MT Laying Periods Feed Formulations Molt and Resting Diets

Ingredient	Molt Diet s	
	Low ME	Resting
Corn	702.50	1427.70
Corn Gluten Meal		
Soybean Hulls	1164.77	226.00
Soybean Meal 48%		117.00
Wheat Midds	18.26	186.50
Coarse Limestone	17.78	16.50
Phosphate Mono/D	69.84	4.00
Bentonite		
Salt	9.16	5.00
Methionine	2.69	1.30
Choline Chloride		
Vit. premix	1.00	1.00
Min. premix	1.00	1.00
T - Premix	1.00	1.00
Fat	9.99	10.00
MYC-OUT 65	1.00	2.00
.06% Sel Premix	1.00	1.00
Total	2000	2000
Calculated Analysis		
Protein %	9.92	11.75
Me kcal/kg	1650	2859
Calcium %	1.33	3.80
T. Phos %	0.88	0.44
Lysine %	0.42	0.55
TSAA %	0.35	0.49

Data Collection Schedule and Procedures:

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

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

Egg Weight--At twenty-eight day intervals, all eggs produced in the previous 24-hour period were weighed and sorted by size (See egg size distribution). Percentages of eggs within each size category, average egg weight (g), and egg mass (g) were calculated and reported.

Egg Quality--At twenty-eight day intervals, all eggs produced within the previous 24 hours were examined by candling light and graded according to current USDA standards for egg quality. Eggs were graded in the pilot processing facility and handled as they would be in a commercial off-line facility.

Egg Size Distribution--At twenty-eight day intervals, all eggs produced within the previous 24 hours were weighed and sorted according to current USDA standards for egg size.

Egg Income--Egg income was calculated using current year regional average prices for farm value of eggs based on egg production and quality evaluation.

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

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

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

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

Statistical Analyses and Separation of Means:

All data were subjected to ANOVA utilizing the GLM procedure of SAS, with main effects of strain and density. Separate analyses were conducted for white and brown egg strains. Significant differences ($P < 0.01$) within white and brown egg strains are noted by differing letters among columns of means. The layer houses were not significant, therefore, data for houses 4 and 5 were pooled in this analysis. First and second order interactions were tested for significance. The LS Means from the GLM Procedure were separated via the PDIFF option.

DESCRIPTION OF DATA TABLE STATISTICS

First cycle performance of white and brown egg strains are shown on Tables 14 to 19. The molt period performance and weight loss data of the white and brown egg strains are shown on Tables 20 to 27.

Breeder (Strain):

Short identification codes of the breeder and strain of the stock were developed. See more complete information following data tables in Table .

Hen Housed Eggs per Bird:

The total number of eggs produced divided by the number of birds housed at 119 days.

Hen Day Egg Production:

The average daily number of eggs produced per 100 hens per day.

Egg Mass:

The average daily production of egg mass in grams per hen day.

Mortality:

The percentage of birds which died between 119 through 462 days of age and 462 through 490 which occurred during the molt period are reported separately

Feed Consumption:

The kilograms of feed consumed daily per 100 hens.

Feed Conversion:

The grams of egg produced per gram of feed consumed.

Egg Weight:

The average egg weight (gms) for each period sampled. Weight of all eggs collected from previous 24 hours divided by the number of eggs collected.

Egg Income:

The calculated income per hen housed at 119 days, from egg production using current year regional average egg prices 1/7/2011 to 12/25/2008.

Table 11. Three Year Regional Average Egg Prices

Grade	Size	$/Dozen 1st Cycle
A	Extra Large	1.19
A	Large	1.16
A	Medium	0.93
A	Small	0.79
A	Pee Wee	0.39
B	All	0.61
Checks	All	0.61

Grade Information:

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

Egg Size Distribution:

Following are the size classifications used for establishing the USDA egg size grading. There has been blending of egg size

in this test with the weight cutoff between medium and large being 23.5. This maximizes the number of USDA large eggs just as would occur in a commercial plant. The proportion of the eggs falling into the following size categories are reported in the tables.

Table 12. USDA Egg Weights Used To Establish The Egg Size Distribution Weighted for Large Eggs.

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

Feed Cost:

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

Table 13. The Average Contract Feed Price For Feed Purchases During The First Cycle.

Diets	Price Per Ton
D	325.30
E	333.13
F	344.43
G	360.23
H	376.58
I	399.70
Molt Diet LP/LE	336.40
Resting	362.00

Metric Conversions:

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

TABLE 14. EFFECT OF WHITE EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 38th NCLP&MT (119-483 DAYS)

Breeder	Density[1]	Feed Consumption	Feed Conversion	Eggs Per Bird Housed	Egg Production	Egg Mass	Mortality	Age at 50% Production
(Strain)	(in^2/hen)	(kg/100/hen/d)	(g egg/g feed)		(HD%)	(g/HD)	(%)	(Days)
Hy-Line	73	9.8	0.50	294.6	82.1	49.5	1.8	145.8
W-36	77	10.1	0.49	299.1	82.9	50.3	1.6	146.5
	Average	10.0^{D}	0.49^{AB}	296.9^{DE}	82.5^{E}	49.9^{C}	1.7^{E}	146.1^{B}
Hy-Line	73	10.9	0.47	293.3	82.5	52.2	4.8	140.7
W-98	77	10.8	0.49	292.1	84.0	53.6	6.3	139.5
	Average	10.8^{ABC}	0.48^{B}	292.7^{E}	83.3^{DE}	52.9^{B}	5.5^{ABCDE}	140.1^{E}
H&N	73	10.7	0.48	301.9	85.5	52.7	7.0	143.9
Nick Chick	77	11.0	0.48	307.3	87.2	54.0	5.0	142.7
	Average	10.8^{ABC}	0.48^{B}	304.6^{ABCD}	86.3^{AB}	53.4^{AB}	6.0^{ABCD}	143.3^{CD}
Lohmann	73	11.0	0.48	300.1	86.1	53.0	9.5	144.9
LSL-Lite	77	11.0	0.48	311.0	87.4	53.8	5.0	144.9
	Average	11.0^{A}	0.48^{B}	305.6^{ABC}	86.8^{AB}	53.4^{AB}	7.3^{ABC}	144.9^{BC}
Bovans	73	10.5	0.49	299.4	86.6	52.5	10.6	144.2
White	77	10.7	0.48	305.3	87.0	52.5	8.1	146.0
	Average	10.6^{BC}	0.48^{B}	302.3^{BCD}	86.8^{AB}	52.5^{B}	9.4^{A}	145.1^{BC}
Shaver	73	9.8	0.50	298.1	84.0	50.6	4.8	149.5
White	77	10.0	0.50	305.1	85.3	51.0	2.1	149.5
	Average	9.9^{D}	0.50^{A}	301.6^{CD}	84.6^{CD}	50.8^{C}	3.4^{CDE}	149.5^{A}
DeKalb	73	10.9	0.48	309.7	86.2	53.1	4.4	142.8
White	77	11.0	0.48	310.6	87.1	54.0	4.3	143.8
	Average	10.9^{AB}	0.48^{B}	310.2^{AB}	86.7^{AB}	53.6^{AB}	4.3^{BCDE}	143.3^{CD}
ISA Babcock	73	11.0	0.49	311.5	86.5	54.1	2.0	143.2
White	77	10.9	0.49	313.9	87.4	54.6	3.1	141.5
	Average	11.0^{AB}	0.49^{AB}	312.7^{A}	86.9^{A}	54.4^{A}	2.5^{DE}	142.3^{DE}
ISA	73	10.3	0.51	300.4	86.1	52.7	7.7	141.1
Exp. White	77	10.7	0.50	313.5	87.2	53.6	4.2	141.0
	Average	10.5^{C}	0.50^{A}	307.0^{ABC}	86.7^{AB}	53.1^{B}	5.9^{ABCD}	141.0^{DE}
Novogen	73	10.8	0.48	299.0	84.4	53.4	7.0	146.3
White	77	10.7	0.48	304.8	84.7	52.9	3.8	146.2
	Average	10.8^{ABC}	0.48^{B}	301.9^{CD}	84.5^{CD}	53.1^{B}	5.4^{BCDE}	146.2^{B}
Bovans	73	10.6	0.49	300.0	85.4	52.7	8.1	146.4
Robust	77	10.6	0.49	301.2	85.4	52.7	7.0	144.0
	Average	10.6^{BC}	0.49^{AB}	300.6^{CDE}	85.4^{BC}	52.7^{B}	7.5^{AB}	145.2^{BC}
All	73	10.6	0.49	300.7^{Z}	85.0^{Z}	52.4^{Z}	6.2	144.4
Strains	77	10.7	0.49	305.8^{Y}	86.0^{Y}	53.0^{Y}	4.6	144.1

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

A,B,C,D,E - Different letters denote significant differences (P<.01), comparisons made among strain average values.

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

TABLE 15. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 38th NCLP&MT (119-483 DAYS)

Breeder (Strain)	Density[1] (in^2/hen)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hy-Line	73	59.3	0.3	6.8	11.0	27.6	53.9
W-36	77	59.8	0.4	4.2	12.7	25.7	56.8
	Average	59.5^{DE}	0.3	5.5^{BCD}	11.9^{A}	26.6^{BC}	55.4^{DE}
Hy-Line	73	62.6	0.1	4.0	9.7	15.3	70.6
W-98	77	63.0	0.3	3.9	9.1	14.5	72.1
	Average	62.8^{A}	0.2	3.9^{D}	9.4^{B}	14.9^{F}	71.4^{A}
H&N	73	60.7	0.1	4.8	9.7	23.7	61.4
Nick Chick	77	60.9	0.2	5.2	10.0	21.7	62.7
	Average	60.8^{BC}	0.2	5.0^{BCD}	9.8^{AB}	22.7^{CDE}	62.1^{BC}
Lohmann	73	60.5	0.0	6.8	8.0	25.2	59.6
LSL-Lite	77	60.3	0.1	5.5	10.2	23.6	60.4
	Average	60.4^{CD}	0.1	6.1^{AB}	9.1^{B}	24.4^{CD}	60.0^{CD}
Bovans	73	59.3	0.3	5.4	12.3	28.5	53.2
White	77	59.1	0.4	6.6	11.2	29.1	52.6
	Average	59.2^{EF}	0.3	6.0^{ABC}	11.7^{A}	28.8^{B}	52.9^{EF}
Shaver	73	58.6	0.2	7.2	10.2	34.6	47.6
White	77	58.6	0.5	8.3	9.0	33.9	48.2
	Average	58.6^{F}	0.4	7.7^{A}	9.6^{B}	34.2^{A}	47.9^{F}
DeKalb	73	60.6	0.2	6.0	8.8	23.2	61.8
White	77	60.7	0.3	6.2	8.2	20.6	64.5
	Average	60.7^{BC}	0.2	6.1^{AB}	8.5^{B}	21.9^{DE}	63.1^{BC}
ISA Babcock	73	61.6	0.1	3.6	8.8	19.9	67.1
White	77	61.6	0.3	4.6	8.9	19.9	65.8
	Average	61.6^{B}	0.2	4.1^{CD}	8.8^{B}	19.9^{E}	66.5^{AB}
ISA	73	60.4	0.2	4.8	10.1	24.8	59.9
Exp. White	77	60.5	0.2	4.8	9.4	24.7	60.6
	Average	60.5^{CD}	0.2	4.8^{BCD}	9.7^{AB}	24.7^{BCD}	60.2^{CD}
Novogen	73	61.9	0.1	4.5	7.8	20.3	66.7
White	77	61.0	0.2	5.7	8.8	23.9	61.1
	Average	61.5^{B}	0.1	5.1^{BCD}	8.3^{B}	22.1^{DE}	63.9^{BC}
Bovans	73	60.5	0.2	6.5	9.4	21.2	62.5
Robust	77	60.6	0.3	5.8	9.7	23.7	59.9
	Average	60.5^{C}	0.2	6.1^{AB}	9.6^{B}	22.4^{DE}	61.2^{BC}
All	73	60.5	0.2	5.5	9.6	24.0	60.4
Strains	77	60.6	0.3	5.5	9.7	23.7	60.4

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

A,B,C,D,E,F - Different letters denote significant differences (P<.01), comparisons made among strain average values.

TABLE 16. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 38th NCLP&MT (119-483 DAYS)

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Hy-Line	73	96.0	1.8	1.8	0.4	26.90	12.58
W-36	77	96.4	1.0	2.5	0.1	27.61	13.17
	Average	96.2^{AB}	1.4^{D}	2.1^{A}	0.3	27.26^{D}	12.88^{CD}
Hy-Line	73	94.6	2.9	2.3	0.3	27.12	13.97
W-98	77	94.3	3.8	1.7	0.2	27.01	13.44
	Average	94.4^{C}	3.3^{A}	2.0^{AB}	0.3	27.06^{D}	13.70^{ABC}
H&N	73	95.8	2.4	1.5	0.3	27.93	13.67
Nick Chick	77	96.5	1.8	1.3	0.3	28.49	13.65
	Average	96.2^{AB}	2.1^{BCD}	1.4^{ABC}	0.3	28.21^{ABC}	13.66^{ABC}
Lohmann	73	96.5	2.3	0.8	0.4	27.74	13.69
LSL-Lite	77	95.9	2.5	1.4	0.2	28.75	14.31
	Average	96.2^{AB}	2.4^{ABCD}	1.1^{C}	0.3	28.25^{ABC}	14.00^{AB}
Bovans	73	95.6	2.3	1.7	0.3	27.38	13.13
White	77	95.2	3.0	1.6	0.2	27.87	13.60
	Average	95.4^{ABC}	2.7^{ABC}	1.7^{ABC}	0.2	27.62^{BCD}	13.36^{BCD}
Shaver	73	95.0	2.2	2.5	0.3	27.13	12.58
White	77	95.9	2.2	1.7	0.2	27.85	12.74
	Average	95.4^{ABC}	2.2^{BCD}	2.1^{AB}	0.2	27.49^{CD}	12.66^{D}
DeKalb	73	96.6	2.0	1.4	0.1	28.79	14.15
White	77	96.6	1.9	1.2	0.2	28.84	14.17
	Average	96.6^{A}	2.0^{CD}	1.3^{BC}	0.1	28.81^{A}	14.16^{AB}
ISA Babcock	73	95.2	2.8	1.6	0.4	28.88	14.34
White	77	95.9	2.2	1.3	0.6	28.99	14.17
	Average	95.5^{ABC}	2.5^{ABC}	1.5^{ABC}	0.5	28.94^{A}	14.25^{A}
ISA	73	96.2	2.2	1.4	0.2	27.83	12.95
Exp. White	77	96.2	2.2	1.2	0.4	29.02	13.84
	Average	96.2^{AB}	2.2^{BCD}	1.3^{BC}	0.3	28.42^{AB}	13.40^{ABCD}
Novogen	73	95.0	2.4	2.0	0.6	27.61	13.88
White	77	95.6	2.2	2.0	0.3	28.15	13.75
	Average	95.3^{ABC}	2.3^{ABCD}	2.0^{AB}	0.4	27.88^{BCD}	13.82^{AB}
Bovans	73	94.7	3.6	1.4	0.3	27.49	13.49
Robust	77	95.1	2.7	1.5	0.6	27.54	13.43
	Average	94.9^{BC}	3.2^{AB}	1.5^{ABC}	0.4	27.51^{CD}	13.46^{ABCD}
All	73	95.6	2.4	1.7	0.3	27.71^{Z}	13.49
Strains	77	95.8	2.3	1.6	0.3	28.19^{Y}	13.66

[1]All strains were housed such that each strain is equally represented in each density.
A,B,C,D - Different letters denote significant differences (P<.01), comparisons made among strain average values.
Y,Z - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 17. EFFECT OF BROWN EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 38th NCLP&MT (119-483 DAYS)

Breeder (Strain)	Density[1] (in^2/hen)	Feed Consumption (kg/100/hen/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)	Age at 50% Production (Days)
Hy-Line	73	10.5	0.49	292.9	82.1	52.2	4.0	145.8
Brown	77	10.7	0.49	303.5	83.8	53.4	0.8	143.3
	Average	10.6	0.49^{A}	298.2^{AB}	83.0^{B}	52.8^{AB}	2.4^{C}	144.5^{AB}
Hy-Line	73	10.7	0.47	302.7	84.7	50.3	2.6	143.5
Silver Brown	77	10.8	0.46	302.4	85.6	50.8	5.0	143.4
	Average	10.8	0.46^{BC}	302.5^{AB}	85.2^{A}	50.6^{D}	3.8^{BC}	143.5^{AB}
TETRA	73	10.8	0.46	283.8	80.4	50.8	7.0	144.3
Brown	77	10.8	0.47	282.5	82.0	51.7	8.8	142.2
	Average	10.8	0.47^{B}	283.2^{C}	81.2^{C}	51.2^{CD}	7.9^{AB}	143.2^{BC}
TETRA	73	10.6	0.46	295.4	82.9	49.3	5.5	141.1
Amber	77	11.0	0.44	292.2	83.7	49.1	7.3	140.5
	Average	10.8	0.45^{C}	293.8^{B}	83.3^{B}	49.2^{E}	6.4^{ABC}	140.8^{C}
ISA	73	10.9	0.48	297.7	83.5	53.3	5.1	146.8
Brown	77	11.2	0.47	302.6	85.5	54.0	6.2	144.9
	Average	11.0	0.48^{AB}	300.1^{AB}	84.5^{AB}	53.7^{A}	5.7^{ABC}	145.8^{A}
Bovans	73	10.6	0.49	304.1	84.8	52.8	5.6	144.5
Brown	77	10.9	0.49	305.8	85.3	53.7	2.7	144.2
	Average	10.8	0.49^{A}	305.0^{A}	85.0^{A}	53.2^{AB}	4.1^{ABC}	144.4^{AB}
Novogen	73	10.9	0.47	290.2	83.5	51.4	9.9	144.7
Brown	77	10.9	0.47	297.6	84.5	52.6	6.2	144.7
	Average	10.9	0.47^{B}	293.9^{B}	84.0^{AB}	52.0^{BC}	8.1^{A}	144.7^{AB}
All	73	10.7	0.47	295.3	83.1^{Z}	51.4^{Z}	5.7	144.4
Strains	77	10.9	0.47	298.1	84.3^{Y}	52.2^{Y}	5.3	143.3
NCSU Barred	73	9.1	0.32	191.5	55.0	29.9	4.7	159.0
Plym. Rock	77	9.9	0.30	183.6	55.2	31.0	9.5	171.7

[1]All strains were housed such that each strain is equally represented in each density.
A,B,C,D - Different letters denote significant differences (P<.01), comparisons made among strain average values.
Y,Z - Different letters denote significant differences (P<.01), comparisons made among density average values.

TABLE 18. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 38th NCLP&MT (119-483 DAYS)

Breeder (Strain)	Density[1] (in^2/hen)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hy-Line	73	62.8	0.0	1.3	8.3	20.5	69.6
Brown	77	62.9	0.1	1.2	7.9	20.2	70.3
	Average	62.8^{A}	0.0	1.3^{C}	8.1^{C}	20.4^{C}	69.9^{A}
Hy-Line	73	58.7	0.4	3.7	13.4	37.5	44.8
Silver Brown	77	58.5	0.0	2.9	15.3	34.2	47.4
	Average	58.6^{D}	0.2	3.3^{B}	14.4^{A}	35.9^{A}	46.1^{D}
TETRA	73	62.2	0.0	3.1	8.9	19.8	67.6
Brown	77	62.2	0.1	2.9	8.8	21.1	66.9
	Average	62.2^{AB}	0.1	3.0^{B}	8.8^{BC}	20.5^{C}	67.3^{AB}
TETRA	73	58.7	0.1	5.2	13.7	32.5	48.0
Amber	77	57.7	0.0	7.7	15.3	36.0	40.8
	Average	58.2^{D}	0.1	6.5^{A}	14.5^{A}	34.3^{A}	44.4^{D}
ISA	73	62.8	0.0	3.5	6.8	19.5	69.9
Brown	77	62.2	0.2	3.8	8.7	20.2	67.0
	Average	62.5^{AB}	0.1	3.6^{B}	7.7^{C}	19.9^{C}	68.4^{A}
Bovans	73	61.4	0.0	2.7	9.4	25.9	61.9
Brown	77	62.1	0.1	2.1	8.8	23.6	65.1
	Average	61.7^{BC}	0.1	2.4^{BC}	9.1^{BC}	24.8^{B}	63.5^{BC}
Novogen	73	60.6	0.3	3.3	10.2	26.5	59.4
Brown	77	61.5	0.2	2.8	10.7	22.8	63.2
	Average	61.0^{C}	0.3	3.0^{B}	10.4^{B}	24.7^{B}	61.3^{C}
All	73	61.0	0.1	3.3	10.1	26.0	60.2
Strains	77	61.0	0.1	3.3	10.8	25.5	60.1
NCSU Barred	73	52.5	1.3	19.0	26.3	36.6	16.1
Plym. Rock	77	52.7	2.0	17.2	26.6	36.1	17.0

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

A,B,C,D - Different letters denote significant differences (P<.01), comparisons made among strain average values.

TABLE 19. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 38th NCLP&MT (119-483 DAYS)

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Hy-Line	73	96.1	1.5^{de}	2.1	0.3	27.61	13.88
Brown	77	96.3	1.8^{bcde}	1.7	0.3	28.61	14.64
	Average	96.2^{AB}	1.6	1.9	0.3	28.11^{AB}	14.26
Hy-Line	73	95.7	2.5^{bcd}	1.5	0.3	27.72	14.36
Silver Brown	77	97.3	1.0^{e}	1.5	0.2	28.01	14.33
	Average	96.5^{A}	1.8	1.5	0.2	27.87^{AB}	14.34
TETRA	73	94.9	2.2^{bcde}	2.4	0.5	26.30	14.09
Brown	77	95.3	2.9^{bcd}	1.6	0.2	26.36	14.02
	Average	95.1^{ABC}	2.6	2.0	0.4	26.33^{C}	14.05
TETRA	73	95.0	2.9^{bcd}	1.7	0.4	26.85	14.22
Amber	77	96.3	1.7^{bcde}	1.9	0.2	26.45	14.25
	Average	95.6^{AB}	2.3	1.8	0.3	26.65^{C}	14.24
ISA	73	93.4	4.8^{a}	1.6	0.3	27.57	14.56
Brown	77	94.8	3.6^{a}	1.5	0.2	28.08	14.80
	Average	94.1^{C}	4.2	1.5	0.2	27.83^{AB}	14.68
Bovans	73	96.4	1.6^{cde}	1.9	0.2	28.51	14.31
Brown	77	95.3	3.0^{bc}	1.5	0.2	28.56	14.50
	Average	95.8^{AB}	2.3	1.7	0.2	28.54^{A}	14.41
Novogen	73	94.7	3.1^{b}	1.9	0.3	26.77	14.11
Brown	77	95.3	2.9^{bcd}	1.6	0.2	27.60	14.34
	Average	95.0^{BC}	3.0	1.7	0.3	27.18^{BC}	14.23
All	73	95.2	2.7	1.9	0.3	27.33	14.22
Strains	77	95.8	2.4	1.6	0.2	27.67	14.41
NCSU Barred	73	87.4	9.0	2.9	0.7	15.36	12.13
Plym. Rock	77	94.2	3.2	1.5	1.1	15.06	12.54

[1]All strains were housed such that each strain is equally represented in each density.
A,B,C - Different letters denote significant differences (P<.01), comparisons made among strain average values.
a,b,c,d,e - Different letters denote significant differences (P<.01) in the strain*density interactions.

TABLE 20. EFFECT OF WHITE EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-MOLTED

Breeder	Density[1]	Feed Consumption	Feed Conversion	Eggs Per Bird Housed	Egg Production	Egg Mass	Mortality
(Strain)	(in^2/hen)	(kg/100/hen/d)	(g egg/g feed)		(HD%)	(g/HD)	(%)
Hy-Line	73	9.9	0.53	21.3	78.0	51.5	0.0
W-36	77	10.3	0.52	22.3	80.9	53.7	1.3
	Average	10.1^{C}	0.52	21.8	79.4	52.6^{C}	0.6
Hy-Line	73	11.8	0.50	22.6	84.1	59.0	0.0
W-98	77	13.0	0.45	24.7	83.8	58.1	0.0
	Average	12.4^{AB}	0.48	23.7	84.0	58.6^{A}	0.0
H&N	73	12.4	0.48	22.4	87.2	58.6	1.2
Nick Chick	77	11.7	0.50	23.0	86.5	58.6	0.0
	Average	12.0^{AB}	0.49	22.7	86.8	58.6^{A}	0.6
Lohmann	73	12.1	0.51	21.8	92.4	60.7	0.0
LSL-Lite	77	12.0	0.48	22.6	85.0	56.1	0.0
	Average	12.0^{AB}	0.49	22.2	88.7	58.4^{AB}	0.0
Bovans	73	11.8	0.48	22.6	88.1	56.7	1.2
White	77	12.1	0.49	22.8	89.3	58.9	0.0
	Average	11.9^{AB}	0.49	22.7	88.7	57.8^{AB}	0.6
Shaver	73	10.9	0.51	23.7	86.5	55.4	0.0
White	77	11.3	0.48	23.0	85.0	53.0	1.7
	Average	11.1^{BC}	0.49	23.3	85.7	54.2^{BC}	0.8
DeKalb	73	12.9	0.45	25.4	87.8	57.4	1.2
White	77	13.1	0.45	23.6	85.9	57.5	3.8
	Average	13.0^{A}	0.45	24.5	86.8	57.5^{AB}	2.5
ISA Babcock	73	12.1	0.52	25.4	92.1	63.5	0.0
White	77	11.4	0.49	23.1	83.4	56.0	0.0
	Average	11.7^{AB}	0.51	24.2	87.7	59.7^{A}	0.0
ISA	73	11.2	0.51	22.5	86.7	56.8	0.0
Exp. White	77	11.8	0.47	21.1	82.5	55.1	1.7
	Average	11.5^{BC}	0.49	21.8	84.6	55.9^{ABC}	0.8
Novogen	73	11.7	0.48	22.0	82.5	55.6	0.0
White	77	11.4	0.50	22.7	85.5	56.8	1.3
	Average	11.5^{BC}	0.49	22.4	84.0	56.2^{ABC}	0.6
Bovans	73	11.2	0.52	22.7	86.6	58.2	1.2
Robust	77	12.4	0.46	21.9	85.9	57.0	2.5
	Average	11.8^{AB}	0.49	22.3	86.2	57.6^{AB}	1.9
All	73	11.6	0.50	22.9	86.5	57.6	0.4
Strains	77	11.9	0.48	22.8	84.9	56.4	1.1

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

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

TABLE 21. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-MOLTED

Breeder (Strain)	Density[1] (in^2/hen)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hy-Line	73	66.2	0.0	0.0	0.0	21.7	78.3
W-36	77	66.3	0.0	0.0	0.0	21.3	77.3
	Average	66.3^{BCD}	0.0	0.0	0.0	21.5^{BC}	77.8^{AB}
Hy-Line	73	70.2	0.0	0.0	0.0	1.9	93.7
W-98	77	69.4	0.0	0.0	0.0	8.1	91.9
	Average	69.8^{A}	0.0	0.0	0.0	5.0^{C}	92.8^{A}
H&N	73	67.2	0.0	0.0	0.0	17.1	82.9
Nick Chick	77	67.8	0.0	0.0	0.0	15.8	81.4
	Average	67.5^{BC}	0.0	0.0	0.0	16.4^{C}	82.2^{A}
Lohmann	73	65.7	0.0	0.0	0.0	23.4	76.6
LSL-Lite	77	65.9	0.0	0.0	0.0	20.1	79.9
	Average	65.8^{CD}	0.0	0.0	0.0	21.7^{BC}	78.3^{AB}
Bovans	73	64.3	0.0	0.0	0.0	34.5	61.0
White	77	65.9	0.0	0.0	0.0	30.8	69.2
	Average	65.1^{DE}	0.0	0.0	0.0	32.6^{AB}	65.1^{BC}
Shaver	73	64.0	0.0	0.0	0.0	35.7	64.3
White	77	62.4	0.0	0.0	0.0	57.0	43.0
	Average	63.2^{E}	0.0	0.0	0.0	46.4^{A}	53.7^{C}
DeKalb	73	65.3	0.0	0.0	0.0	23.7	74.8
White	77	66.9	0.0	0.0	0.0	19.0	81.0
	Average	66.1^{BCD}	0.0	0.0	0.0	21.4^{BC}	77.9^{AB}
ISA Babcock	73	69.0	0.0	0.0	0.0	13.0	87.0
White	77	67.1	0.0	0.0	0.0	16.4	82.4
	Average	68.0^{AB}	0.0	0.0	0.0	14.7^{C}	84.7^{A}
ISA	73	65.5	0.0	0.0	0.0	22.5	77.6
Exp. White	77	66.7	0.0	0.0	0.0	12.3	87.7
	Average	66.1^{BCD}	0.0	0.0	0.0	17.4^{BC}	82.6^{A}
Novogen	73	67.4	0.0	0.0	0.0	17.8	82.3
White	77	66.5	0.0	0.0	0.0	18.1	81.9
	Average	66.9^{BCD}	0.0	0.0	0.0	17.9^{BC}	82.1^{A}
Bovans	73	67.1	0.0	0.0	0.0	18.2	80.4
Robust	77	66.5	0.0	0.0	0.0	24.7	75.3
	Average	66.8^{BCD}	0.0	0.0	0.0	21.5^{BC}	77.9^{AB}
All	73	66.5	0.0	0.0	0.0	20.8	78.1
Strains	77	66.5	0.0	0.0	0.0	22.1	77.4

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

A,B,C,D - Different letters denote significant differences (P<.01), comparisons made among strain average values.

TABLE 22. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-MOLTED

Breeder (Strain)	Density[1] (in^2/hen)	Grade A (%)	Grade B (%)	Cracks (%)	Loss (%)	Egg Income ($/hen)	Feed Costs ($/hen)
Hy-Line	73	98.5	1.5	0.0	0.0	2.09	1.21
W-36	77	91.6	3.2	3.9	1.4	2.07	1.27
	Average	95.0	2.3	2.0	0.7	2.08	1.24^{C}
Hy-Line	73	91.2	4.4	0.0	4.4	2.01	1.44
W-98	77	97.2	2.8	0.0	0.0	2.41	1.72
	Average	94.2	3.6	0.0	2.2	2.21	1.58^{AB}
H&N	73	98.3	0.0	1.7	0.0	2.19	1.42
Nick Chick	77	93.0	2.8	1.3	2.9	2.11	1.40
	Average	95.7	1.4	1.5	1.5	2.15	1.41^{BC}
Lohmann	73	97.2	2.8	0.0	0.0	2.12	1.27
LSL-Lite	77	100.0	0.0	0.0	0.0	2.23	1.43
	Average	98.6	1.4	0.0	0.0	2.17	1.35^{BC}
Bovans	73	92.6	1.5	1.4	4.6	2.01	1.35
White	77	92.7	5.6	1.7	0.0	2.17	1.38
	Average	92.6	3.6	1.5	2.3	2.09	1.36^{BC}
Shaver	73	93.9	3.7	2.4	0.0	2.26	1.33
White	77	95.2	0.0	4.8	0.0	2.19	1.36
	Average	94.6	1.9	3.6	0.0	2.22	1.35^{BC}
DeKalb	73	85.3	4.9	8.3	1.6	2.26	1.68
White	77	96.4	0.0	3.6	0.0	2.29	1.60
	Average	90.9	2.5	5.9	0.8	2.27	1.64^{A}
ISA Babcock	73	93.9	2.2	3.8	0.0	2.43	1.49
White	77	97.5	0.0	1.3	1.3	2.20	1.41
	Average	95.7	1.1	2.5	0.6	2.32	1.45^{ABC}
ISA	73	94.3	2.9	2.9	0.0	2.16	1.31
Exp. White	77	93.8	2.0	4.2	0.0	2.02	1.35
	Average	94.1	2.4	3.5	0.0	2.09	1.33^{C}
Novogen	73	95.3	3.1	1.7	0.0	2.12	1.39
White	77	95.1	3.5	1.5	0.0	2.19	1.35
	Average	95.2	3.3	1.6	0.0	2.15	1.37^{BC}
Bovans	73	95.5	1.7	1.5	1.4	2.14	1.31
Robust	77	95.2	4.8	0.0	0.0	2.10	1.42
	Average	95.3	3.2	0.7	0.7	2.12	1.37^{BC}
All	73	94.2	2.6	2.1	1.1	2.16	1.38
Strains	77	95.2	2.2	2.0	0.5	2.18	1.43

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

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

TABLE 23. EFFECT OF WHITE EGG STRAIN AND DENSITY ON BODY WEIGHT OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-MOLTED

Breeder	Density[1]	17 Wk Body Wt	69 Wk Body Wt	1st Cycle Wt Gain	Lowest Body Wt	Molt Wt Loss	73 Wk Body Wt
(Strain)	(in^2/hen)	(kg)	(kg)	(%)	(kg)	(%)	(kg)
Hy-Line	73	1.23	1.81	47.4	1.76	3.0	1.76
W-36	77	1.19	1.77	48.1	1.74	0.1	1.77
	Average	1.21^{CDE}	1.79^{BC}	47.7^{B}	1.75^{BCD}	1.5^{ABC}	1.76^{BCD}
Hy-Line	73	1.29	2.06	59.0	1.94	5.3	1.95
W-98	77	1.28	2.04	59.3	1.93	5.5	1.93
	Average	1.29^{AB}	2.05^{A}	59.2^{A}	1.93^{A}	5.4^{A}	1.94^{A}
H&N	73	1.27	1.79	40.8	1.77	-1.5	1.81
Nick Chick	77	1.30	1.91	47.6	1.90	-0.7	1.93
	Average	1.28^{AB}	1.85^{BC}	44.2^{BC}	1.83^{ABC}	-1.1^{BC}	1.87^{AB}
Lohmann	73	1.23	1.81	47.5	1.81	-1.0	1.83
LSL-Lite	77	1.27	1.77	39.0	1.75	-0.6	1.78
	Average	1.25^{BCD}	1.79^{BCD}	43.3^{BC}	1.78^{BCD}	-0.8^{BC}	1.80^{ABCD}
Bovans	73	1.20	1.73	44.3	1.73	-2.1	1.77
White	77	1.15	1.74	51.3	1.72	-1.0	1.76
	Average	1.18^{E}	1.74^{CD}	47.8^{B}	1.72^{CD}	-1.5^{BC}	1.76^{BCD}
Shaver	73	1.20	1.68	40.6	1.68	-1.9	1.71
White	77	1.19	1.62	35.6	1.61	-1.9	1.65
	Average	1.19^{DE}	1.65^{D}	38.1^{C}	1.65^{D}	-1.9^{BC}	1.68^{D}
DeKalb	73	1.24	1.78	42.7	1.71	3.4	1.71
White	77	1.28	1.88	46.6	1.82	2.6	1.82
	Average	1.26^{BC}	1.83^{BC}	44.7^{BC}	1.76^{BCD}	3.0^{AB}	1.77^{BCD}
ISA Babcock	73	1.32	1.87	41.4	1.87	-1.0	1.89
White	77	1.32	1.89	43.8	1.85	0.7	1.88
	Average	1.32^{A}	1.88^{B}	42.6^{BC}	1.86^{AB}	-0.2^{ABC}	1.88^{AB}
ISA	73	1.30	1.82	39.8	1.74	3.5	1.75
Exp. White	77	1.28	1.71	33.9	1.67	1.1	1.69
	Average	1.29^{AB}	1.77^{BCD}	36.8^{C}	1.70^{CD}	2.3^{ABC}	1.72^{CD}
Novogen	73	1.29	1.82	41.4	1.82	-2.2	1.86
White	77	1.26	1.82	44.0	1.82	-2.5	1.86
	Average	1.27^{AB}	1.82^{BC}	42.7^{BC}	1.82^{ABC}	-2.3^{C}	1.86^{ABC}
Bovans	73	1.20	1.74	44.8	1.73	-0.6	1.75
Robust	77	1.30	1.85	41.9	1.84	-1.2	1.87
	Average	1.25^{BCD}	1.79^{BC}	43.4^{BC}	1.79^{BC}	-0.9^{BC}	1.81^{ABC}
All	73	1.25	1.81	44.5	1.78	0.4	1.80
Strains	77	1.26	1.82	44.6	1.78	0.2	1.81

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

A,B,C,D,E - Different letters denote significant differences (P<.01), comparisons made among strain average values.

TABLE 24. EFFECT OF WHITE EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	Feed Consumption	Feed Conversion	Eggs Per Bird Housed	Egg Production	Egg Mass	Mortality[2]
(Strain)	(in^2/hen)	(kg/100/hen/d)	(g egg/g feed)		(HD%)	(g/HD)	(%)
Hy-Line	73	5.0	0.19	3.9	14.1	9.3	1.1
W-36	77	5.2	0.18	3.9	14.1	9.2	0.6
	Average	5.1^{F}	0.18^{BC}	3.9^{C}	14.1^{C}	9.3^{C}	0.8^{B}
Hy-Line	73	5.5	0.22	4.9	16.9	11.7	1.1
W-98	77	5.3	0.22	4.6	16.6	11.6	2.2
	Average	5.4^{EF}	0.22^{A}	4.7^{AB}	16.8^{BC}	11.7^{AB}	1.6^{AB}
H&N	73	6.0	0.18	4.1	16.0	10.7	2.7
Nick Chick	77	6.0	0.18	4.3	16.2	10.7	1.1
	Average	6.0^{CDE}	0.18^{BCD}	4.2^{BC}	16.1^{C}	10.7^{BC}	1.9^{AB}
Lohmann	73	6.4	0.17	4.1	16.4	10.9	3.7
LSL-Lite	77	6.2	0.17	4.3	16.1	10.7	1.7
	Average	6.3^{BCD}	0.17^{BCD}	4.2^{BC}	16.3^{C}	10.8^{BC}	2.7^{AB}
Bovans	73	6.5	0.15	3.5	14.4	9.4	1.1
White	77	6.3	0.16	4.0	16.0	10.3	4.5
	Average	6.4^{ABC}	0.15^{D}	3.7^{C}	15.2^{C}	9.9^{C}	2.8^{AB}
Shaver	73	5.7	0.16	3.7	14.3	9.1	2.7
White	77	5.6	0.18	4.2	15.3	9.7	1.7
	Average	5.7^{DEF}	0.17^{BCD}	3.9^{C}	14.8^{C}	9.4^{C}	2.2^{AB}
DeKalb	73	6.9	0.18	5.2	19.3	12.7	5.3
White	77	6.8	0.20	5.5	20.8	13.7	3.9
	Average	6.9^{AB}	0.19^{B}	5.3^{A}	20.0^{A}	13.2^{A}	4.6^{A}
ISA Babcock	73	6.2	0.16	3.8	14.3	9.6	2.1
White	77	6.1	0.16	4.0	15.0	10.0	2.2
	Average	6.1^{CD}	0.16^{CD}	3.9^{C}	14.6^{C}	9.8^{C}	2.2^{AB}
ISA	73	6.9	0.18	4.6	18.7	12.4	5.3
Exp. White	77	7.2	0.18	5.2	19.6	12.8	3.9
	Average	7.1^{A}	0.18^{BCD}	4.9^{A}	19.1^{AB}	12.6^{A}	4.6^{A}
Novogen	73	6.4	0.16	3.8	15.0	10.1	2.7
White	77	6.1	0.17	4.2	15.5	10.3	1.1
	Average	6.3^{BCD}	0.17^{BCD}	4.0^{C}	15.2^{C}	10.2^{BC}	1.9^{AB}
Bovans	73	6.5	0.15	3.6	15.1	9.9	5.8
Robust	77	5.9	0.18	4.0	15.9	10.4	2.8
	Average	6.2^{CD}	0.16^{CD}	3.8^{C}	15.5^{C}	10.2^{BC}	4.3^{A}
All	73	6.2	0.17	4.1	15.9	10.5	3.0
Strains	77	6.1	0.18	4.4	16.5	10.9	2.3

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

[2]Two strains W-98 and Dekalb White were utilized in a molt study which required periodic sampling of hens for body composition. This necessitated a correction in their mortality rate

A,B,C,D,E,F - Different letters denote significant differences (P<.01), comparisons made among strain average values.

TABLE 25. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
(Strain)	(in^2/hen)	(g/egg)	(%)	(%)	(%)	(%)	(%)
Hy-Line	73	65.8	0.0	0.0	0.0	22.6	77.5
W-36	77	65.4	0.0	0.0	0.0	25.7	74.3
	Average	65.6^{BC}	0.0	0.0	0.0	24.1^{BC}	75.9 ^{CD}
Hy-Line	73	69.3	0.0	0.0	0.0	3.5	95.9
W-98	77	69.9	0.0	0.0	0.0	1.6	98.4
	Average	69.6^{E}	0.0	0.0	0.0	2.5^{E}	97.2^{A}
H&N	73	66.5	0.0	0.0	0.0	22.6	77.4
Nick Chick	77	66.3	0.0	0.0	0.0	14.0	85.1
	Average	66.4^{CD}	0.0	0.0	0.0	18.3^{CD}	81.2 ^{BC}
Lohmann	73	66.3	0.0	0.0	0.0	22.3	77.7
LSL-Lite	77	66.1	0.0	0.0	0.0	14.0	86.0
	Average	66.2^{CD}	0.0	0.0	0.0	18.2^{CD}	81.9 ^{BC}
Bovans	73	65.6	0.0	0.0	0.0	25.8	74.2
White	77	64.5	0.0	0.0	0.0	31.8	68.2
	Average	65.1^{B}	0.0	0.0	0.0	28.8^{B}	71.2^{D}
Shaver	73	64.0	0.0	0.0	0.0	41.0	58.5
White	77	63.7	0.0	0.0	0.0	39.1	59.7
	Average	63.8^{A}	0.0	0.0	0.0	40.1^{A}	59.1^{E}
DeKalb	73	66.1	0.0	0.0	0.0	18.4	81.6
White	77	66.3	0.0	0.0	0.0	17.1	82.9
	Average	66.2^{CD}	0.0	0.0	0.0	17.8^{CD}	82.3 ^{BC}
ISA Babcock	73	66.9	0.0	0.0	0.0	13.4	86.6
White	77	67.0	0.0	0.0	0.0	15.6	84.4
	Average	67.0^{D}	0.0	0.0	0.0	14.5^{D}	85.5^{B}
ISA	73	66.8	0.0	0.0	0.0	18.0	81.3
Exp. White	77	65.7	0.0	0.0	0.0	24.5	75.5
	Average	66.2^{BCD}	0.0	0.0	0.0	21.3^{BCD}	78.4 ^{BCD}
Novogen	73	67.1	0.0	0.0	0.0	15.8	84.2
White	77	67.1	0.0	0.0	0.0	19.6	79.6
	Average	67.1^{CD}	0.0	0.0	0.0	17.7^{CD}	81.9 ^{BC}
Bovans	73	66.0	0.0	0.0	0.0	20.7	79.3
Robust	77	65.4	0.0	0.0	0.0	25.6	74.4
	Average	65.7^{BCD}	0.0	0.0	0.0	23.2^{BCD}	76.8 ^{BCD}
All	73	66.4	0.0	0.0	0.0	20.4	79.5
Strains	77	66.1	0.0	0.0	0.0	20.8	79.0

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

A,B,C,D - Different letters denote significant differences (P<.01), comparisons made among strain average values.

TABLE 26. EFFECT OF WHITE EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Hy-Line	73	95.0	1.4	3.6	0.0	0.37	0.54
W-36	77	94.9	0.6	4.6	0.0	0.37	0.56
	Average	94.9	1.0	4.1	0.0	0.37^{D}	0.55^{C}
Hy-Line	73	90.3	5.7	3.4	0.6	0.46	0.64
W-98	77	92.5	4.7	2.8	0.0	0.43	0.57
	Average	91.4	5.2	3.1	0.3	0.44^{BC}	0.61^{BC}
H&N	73	93.2	4.4	2.3	0.0	0.39	0.61
Nick Chick	77	96.6	1.6	0.9	0.9	0.41	0.63
	Average	94.9	3.0	1.6	0.4	0.40^{CD}	0.62^{BC}
Lohmann	73	94.7	3.0	2.3	0.0	0.40	0.64
LSL-Lite	77	95.6	2.2	2.2	0.0	0.41	0.64
	Average	95.1	2.6	2.3	0.0	0.40^{CD}	0.64^{B}
Bovans	73	92.2	3.7	4.2	0.0	0.33	0.63
White	77	95.9	2.0	2.1	0.0	0.38	0.62
	Average	94.0	2.8	3.1	0.0	0.36^{D}	0.62^{B}
Shaver	73	94.1	2.9	2.4	0.6	0.35	0.59
White	77	93.8	0.8	4.2	1.2	0.39	0.61
	Average	94.0	1.9	3.3	0.9	0.37^{D}	0.60^{BC}
DeKalb	73	97.3	1.8	0.9	0.0	0.50	0.74
White	77	95.9	2.8	1.3	0.0	0.53	0.73
	Average	96.6	2.3	1.1	0.0	0.52^{A}	0.73^{A}
ISA Babcock	73	95.3	1.3	3.5	0.0	0.37	0.66
White	77	92.7	2.6	4.7	0.0	0.38	0.64
	Average	94.0	2.0	4.1	0.0	0.38^{CD}	0.65^{B}
ISA	73	95.6	1.7	2.1	0.7	0.45	0.69
Exp. White	77	98.1	0.0	1.9	0.0	0.51	0.76
	Average	96.8	0.8	2.0	0.3	0.48^{AB}	0.73^{A}
Novogen	73	92.6	4.6	2.8	0.0	0.36	0.64
White	77	92.3	4.0	3.0	0.7	0.39	0.65
	Average	92.5	4.3	2.9	0.4	0.38^{CD}	0.65^{B}
Bovans	73	96.4	2.8	0.8	0.0	0.35	0.62
Robust	77	94.3	3.9	1.8	0.0	0.38	0.59
	Average	95.4	3.3	1.3	0.0	0.37^{D}	0.61^{BC}
All	73	94.2	3.0	2.6	0.2	0.39	0.64
Strains	77	94.8	2.3	2.7	0.3	0.42	0.64

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

A,B,C,D - Different letters denote significant differences (P<.01), comparisons made among strain average values.

TABLE 27. EFFECT OF WHITE EGG STRAIN AND DENSITY ON BODY WEIGHT OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	17 Wk Body Wt	66 Wk Body Wt	1st Cycle Wt Gain	Lowest Body Wt	Molt Wt Loss	70 Wk Body Wt	Days to 0% Production
(Strain)	(in^2/hen)	(kg)	(kg)	(%)	(kg)	(%)	(kg)	
Hy-Line	73	1.20	1.81	51.2	1.39	19.4	1.46	8.3
W-36	77	1.21	1.80	48.1	1.32	20.9	1.42	7.9
	Average	1.21^{FG}	1.80^{B}	49.6^{AB}	1.35^{B}	20.2	1.44^{CD}	8.1^{BCD}
Hy-Line	73	1.34	1.98	48.3	1.49	18.4	1.62	7.7
W-98	77	1.32	2.00	51.8	1.51	19.0	1.62	7.0
	Average	1.33^{AB}	1.99^{A}	50.0^{A}	1.50^{A}	18.7	1.62^{A}	7.3^{D}
H&N	73	1.26	1.83	45.6	1.39	20.3	1.46	8.7
Nick Chick	77	1.28	1.85	44.1	1.37	20.4	1.47	8.4
	Average	1.27^{DE}	1.84^{B}	44.8^{ABCD}	1.38^{B}	20.4	1.46^{BCD}	8.6^{BCD}
Lohmann	73	1.28	1.81	41.9	1.35	20.4	1.44	8.8
LSL-Lite	77	1.29	1.85	42.9	1.39	20.6	1.47	9.3
	Average	1.29^{CD}	1.83^{B}	42.4^{D}	1.37^{B}	20.5	1.46^{BCD}	9.1^{AB}
Bovans	73	1.21	1.82	50.6	1.35	18.5	1.48	7.2
White	77	1.20	1.75	46.8	1.33	17.5	1.45	8.0
	Average	1.20^{G}	1.79^{B}	48.7^{ABC}	1.34^{BC}	18.0	1.46^{BCD}	7.6^{CD}
Shaver	73	1.20	1.69	41.3	1.26	18.7	1.37	7.4
White	77	1.23	1.73	40.8	1.29	17.8	1.42	8.4
	Average	1.21^{FG}	1.71^{C}	41.0^{DE}	1.28^{C}	18.3	1.40^{D}	7.9^{BCD}
DeKalb	73	1.28	1.77	38.4	1.34	20.5	1.41	8.3
White	77	1.30	1.82	39.8	1.38	16.3	1.52	7.8
	Average	1.29^{BCD}	1.80^{B}	39.1^{DE}	1.36^{B}	18.4	1.47^{BCD}	8.1^{BCD}
ISA Babcock	73	1.35	1.92	42.6	1.45	21.9	1.50	8.6
White	77	1.35	1.94	44.0	1.47	19.9	1.56	8.9
	Average	1.35^{A}	1.93^{A}	43.3^{CD}	1.46^{A}	20.9	1.53^{B}	8.7^{ABC}
ISA	73	1.32	1.80	36.2	1.38	17.0	1.49	9.8
Exp. White	77	1.32	1.78	35.1	1.33	15.0	1.51	10.0
	Average	1.32^{ABC}	1.79^{B}	35.7^{E}	1.35^{B}	16.0	1.50^{BC}	9.9^{A}
Novogen	73	1.27	1.78	41.1	1.34	21.1	1.41	8.6
White	77	1.24	1.77	42.6	1.31	20.2	1.41	8.9
	Average	1.25^{DE}	1.78^{BC}	41.9^{D}	1.32^{BC}	20.7	1.41^{D}	8.7^{ABC}
Bovans	73	1.23	1.80	46.6	1.37	18.1	1.48	8.3
Robust	77	1.26	1.77	40.9	1.33	19.1	1.43	8.8
	Average	1.24^{EF}	1.79^{B}	43.8^{BCD}	1.35^{B}	18.6	1.45^{BCD}	8.6^{BCD}
All	73	1.27	1.82	44.0	1.37	19.5	1.47	8.3
Strains	77	1.27	1.82	43.4	1.37	18.8	1.48	8.5

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

A,B,C,D,E,F,G - Different letters denote significant differences (P<.01), comparisons made among molt program average values.

TABLE 28. EFFECT OF BROWN EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-MOLTED

Breeder	Density[1]	Feed Consumption	Feed Conversion	Eggs Per Bird Housed	Egg Production	Egg Mass	Mortality
(Strain)	(in^2/hen)	(kg/100/hen/d)	(g egg/g feed)		(HD%)	(g/HD)	(%)
Hy-Line	73	11.8	0.47	21.6	82.2	55.1	0.0
Brown	77	11.2	0.51	23.0	84.3	56.7	0.0
	Average	11.5	0.49	22.3^{AB}	83.3^{ABC}	55.9^{AB}	0.0
Hy-Line	73	10.5	0.50	22.5	83.6	52.0	1.2
Silver Brown	77	11.3	0.48	23.9	86.5	53.8	2.5
	Average	10.9	0.49	23.2^{A}	85.1^{AB}	52.9^{BC}	1.9
TETRA	73	10.7	0.44	19.0	70.6	46.9	1.2
Brown	77	12.4	0.44	19.8	80.6	54.8	1.3
	Average	11.5	0.44	19.4^{C}	75.6^{D}	50.8^{C}	1.2
TETRA	73	10.7	0.47	21.3	79.5	49.1	1.2
Amber	77	12.7	0.40	20.5	79.3	50.2	1.3
	Average	11.7	0.43	20.9^{BC}	79.4^{CD}	49.7^{C}	1.2
ISA	73	11.5	0.52	23.0	87.5	59.2	0.0
Brown	77	11.8	0.48	22.9	84.7	55.7	0.0
	Average	11.6	0.50	22.9^{A}	86.1^{A}	57.4^{A}	0.0
Bovans	73	11.1	0.50	23.1	86.3	55.7	1.6
Brown	77	11.8	0.50	23.2	87.3	59.2	0.0
	Average	11.5	0.50	23.2^{A}	86.8^{A}	57.4^{A}	0.8
Novogen	73	11.2	0.46	19.2	77.9	50.8	0.0
Brown	77	12.1	0.46	21.3	83.6	54.5	0.0
	Average	11.6	0.46	20.3^{C}	80.7^{BCD}	52.6^{BC}	0.0
All	73	11.1	0.48	21.4	81.1	52.7^{Z}	0.7
Strains	77	11.9	0.47	22.1	83.8	55.0^{Y}	0.7
NCSU Barred	73	9.1	0.30	11.7	44.0	26.6	0.0
Plym. Rock	77	11.5	0.24	10.9	43.2	26.2	0.0

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

A,B,C,D - Different letters denote significant differences (P<.01), comparisons made among strain average values.

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

TABLE 29. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-MOLTED

Breeder (Strain)	Density[1] (in^2/hen)	Egg Weight (g/egg)	Pee Wee (%)	Small (%)	Medium (%)	Large (%)	Extra Large (%)
Hy-Line	73	67.0	0.0	0.0	0.0	21.8	78.2
Brown	77	67.2	0.0	0.0	0.0	15.5	84.5
	Average	67.1^{A}	0.0	0.0	0.0	18.7^{C}	81.4^{A}
Hy-Line	73	62.2	0.0	0.0	1.6	56.2	42.3
Silver Brown	77	62.2	0.0	0.0	1.5	56.0	42.6
	Average	62.2^{B}	0.0	0.0	1.5	56.1^{A}	42.4^{C}
TETRA	73	66.4	0.0	0.0	0.0	22.0	78.0
Brown	77	67.9	0.0	0.0	0.0	27.0	73.0
	Average	67.2^{A}	0.0	0.0	0.0	24.5^{C}	75.5^{A}
TETRA	73	61.8	0.0	0.0	0.0	54.3	45.7
Amber	77	63.3	0.0	0.0	0.0	56.6	43.4
	Average	62.6^{B}	0.0	0.0	0.0	55.5^{A}	44.6^{C}
ISA	73	67.6	0.0	0.0	0.0	19.3	79.0
Brown	77	65.7	0.0	0.0	0.0	29.3	70.7
	Average	66.6^{A}	0.0	0.0	0.0	24.3^{C}	74.8^{A}
Bovans	73	64.5	0.0	0.0	0.0	31.3	68.8
Brown	77	67.8	0.0	0.0	0.0	21.4	78.6
	Average	66.1^{A}	0.0	0.0	0.0	26.3^{BC}	73.7^{AB}
Novogen	73	65.1	0.0	0.0	0.0	39.6	60.4
Brown	77	65.2	0.0	0.0	0.0	44.4	55.7
	Average	65.2^{A}	0.0	0.0	0.0	42.0^{AB}	58.0^{BC}
All	73	64.9	0.0	0.0	0.2	34.9	64.6
Strains	77	65.6	0.0	0.0	0.2	35.7	64.1
NCSU Barred	73	60.5	0.0	0.0	0.0	61.13	34.70
Plym. Rock	77	60.8	0.0	0.0	6.7	50.23	43.10

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

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

TABLE 30. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-MOLTED

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Hy-Line	73	98.6	0.0	1.4	0.0	2.12	1.39
Brown	77	95.3	3.0	1.8	0.0	2.22	1.37
	Average	96.9	1.5	1.6	0.0	2.17^{AB}	1.38
Hy-Line	73	96.9	3.1	0.0	0.0	2.16	1.25
Silver Brown	77	97.1	1.5	1.5	0.0	2.29	1.39
	Average	97.0	2.3	0.7	0.0	2.22^{A}	1.32
TETRA	73	95.6	3.1	1.4	0.0	1.83	1.29
Brown	77	93.0	3.5	3.6	0.0	1.88	1.35
	Average	94.3	3.3	2.5	0.0	1.85^{C}	1.32
TETRA	73	94.1	6.0	0.0	0.0	2.02	1.29
Amber	77	96.5	1.6	1.9	0.0	1.97	1.47
	Average	95.3	3.8	1.0	0.0	2.00^{BC}	1.38
ISA	73	94.7	3.6	0.0	1.8	2.16	1.35
Brown	77	92.1	4.6	3.4	0.0	2.16	1.42
	Average	93.4	4.1	1.7	0.9	2.16^{AB}	1.38
Bovans	73	95.4	4.6	0.0	0.0	2.23	1.34
Brown	77	91.5	5.9	2.7	0.0	2.19	1.41
	Average	93.4	5.2	1.3	0.0	2.21^{AB}	1.37
Novogen	73	93.9	6.1	0.0	0.0	1.83	1.23
Brown	77	98.5	1.5	0.0	0.0	2.07	1.38
	Average	96.2	3.8	0.0	0.0	1.95^{C}	1.31
All	73	95.6	3.8	0.4	0.3	2.05	1.30
Strains	77	94.9	3.0	2.1	0.0	2.11	1.40
NCSU Barred	73	95.8	0.0	0.0	4.2	1.05	1.08
Plym. Rock	77	93.3	6.7	0.0	0.0	1.02	1.32

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

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

TABLE 31. EFFECT OF BROWN EGG STRAIN AND POPULATION ON BODY WEIGHT OF HENS IN THE 38th NCLP&MT (483-511DAYS) NON-MOLTED

Breeder	Density[1]	17 Wk Body Wt	66 Wk Body Wt	1st Cycle Wt Gain	Lowest Body Wt	Molt Wt Loss	70 Wk Body Wt
(Strain)	(in^2/hen)	(kg)	(kg)	(%)	(kg)	(%)	(kg)
Hy-Line	73	1.47	2.05	39.9	2.04	-0.8	2.07
Brown	77	1.54	2.14	39.8	2.13	-1.4	2.17
	Average	1.50	2.10^{B}	39.8	2.08^{ABC}	-1.1	2.12^{ABC}
Hy-Line	73	1.54	2.16	41.0	2.11	2.2	2.12
Silver Brown	77	1.57	2.22	41.0	2.21	-4.6	2.31
	Average	1.55	2.19^{A}	41.0	2.16^{A}	-1.2	2.22^{A}
TETRA	73	1.48	1.98	33.8	1.93	2.4	1.93
Brown	77	1.48	2.01	36.1	1.99	-1.3	2.03
	Average	1.48	1.99^{B}	34.9	1.96^{C}	0.6	1.98^{C}
TETRA	73	1.56	2.14	36.8	2.10	0.1	2.13
Amber	77	1.55	2.18	40.6	2.18	-1.1	2.21
	Average	1.56	2.16^{AB}	38.7	2.14^{AB}	-0.5	2.17^{AB}
ISA	73	1.53	2.06	35.1	2.05	0.3	2.06
Brown	77	1.56	2.06	32.3	2.05	-1.2	2.08
	Average	1.54	2.06^{B}	33.7	2.05^{ABC}	-0.4	2.07^{BC}
Bovans	73	1.53	2.04	33.3	2.00	0.9	2.02
Brown	77	1.55	2.04	31.8	2.01	0.1	2.03
	Average	1.54	2.04^{B}	32.6	2.01^{BC}	0.5	2.02^{BC}
Novogen	73	1.56	2.05	31.0	1.98	2.5	2.00
Brown	77	1.54	2.04	32.3	2.01	0.4	2.03
	Average	1.55	2.04^{B}	31.7	1.99^{C}	1.5	2.01^{C}
All	73	1.52	2.07	35.8	2.03	1.1^{Y}	2.05
Strains	77	1.54	2.10	36.3	2.08	-1.3^{Z}	2.12
NCSU Barred	73	1.24	2.09	69.0	2.08	-1.6	2.12
Plym. Rock	77	1.27	2.20	73.7	2.19	-1.6	2.23

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

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

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

TABLE 32. EFFECT OF BROWN EGG STRAIN AND DENSITY ON PERFORMANCE OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-ANOREXIC MOLT PROGRAM

Breeder (Strain)	Density[1] (in^2/hen)	Feed Consumption (kg/100/hen/d)	Feed Conversion (g egg/g feed)	Eggs Per Bird Housed	Egg Production (HD%)	Egg Mass (g/HD)	Mortality (%)
Hy-Line	73	5.3	0.20	4.1	15.3	10.2	0.5
Brown	77	4.8	0.21	4.2	15.1	10.0	2.2
	Average	5.1^{C}	0.20^{AB}	4.2^{B}	15.2^{B}	10.1^{B}	1.4
Hy-Line	73	5.4	0.21	4.9	18.1	11.3	1.6
Silver Brown	77	5.9	0.24	5.9	22.9	14.2	1.1
	Average	5.7^{AB}	0.23^{A}	5.4^{A}	20.5^{A}	12.8^{A}	1.4
TETRA	73	6.0	0.18	3.9	15.7	10.5	2.1
Brown	77	5.8	0.17	3.9	14.9	9.9	1.1
	Average	5.9^{A}	0.18^{C}	3.9^{B}	15.3^{B}	10.2^{B}	1.6
TETRA	73	5.1	0.17	3.6	14.1	8.9	3.2
Amber	77	5.0	0.22	4.5	17.9	11.0	2.3
	Average	5.1^{C}	0.20^{ABC}	4.1^{B}	16.0^{B}	10.0^{B}	2.7
ISA	73	5.1	0.19	3.6	14.1	9.4	3.7
Brown	77	5.1	0.19	3.7	14.4	9.4	3.9
	Average	5.1^{BC}	0.19^{BC}	3.7^{B}	14.3^{B}	9.4^{B}	3.8
Bovans	73	5.3	0.20	4.2	16.6	10.9	3.7
Brown	77	5.2	0.21	4.4	16.3	10.8	5.6
	Average	5.3^{BC}	0.21^{AB}	4.3^{B}	16.5^{B}	10.8^{B}	4.6
Novogen	73	5.4	0.18	3.6	14.4	9.3	3.7
Brown	77	5.3	0.19	3.9	15.3	9.9	4.4
	Average	5.3^{ABC}	0.18^{BC}	3.8^{B}	14.8^{B}	9.6^{B}	4.1
All	73	5.4	0.19^{Z}	4.0	15.5	10.1	2.7
Strains	77	5.3	0.20^{Y}	4.4	16.7	10.8	3.0

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

A,B,C,D - Different letters denote significant differences (P<.01), comparisons made among strain average values.

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

TABLE 33. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG WEIGHT AND EGG SIZE DISTRIBUTION OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	Egg Weight	Pee Wee	Small	Medium	Large	Extra Large
(Strain)	(in^2/hen)	(g/egg)	(%)	(%)	(%)	(%)	(%)
Hy-Line	73	67.1	0.0	0.6	0.0	17.7	81.0
Brown	77	66.4	0.0	1.0	0.0	18.4	80.6
	Average	66.7^{A}	0.0	0.8	0.0	18.1^{C}	80.8^{A}
Hy-Line	73	62.6	0.0	0.0	0.6	51.7	45.7
Silver Brown	77	62.2	0.0	0.0	0.0	50.7	49.3
	Average	62.4^{C}	0.0	0.0	0.3	51.2^{A}	47.5^{C}
TETRA	73	66.9	0.0	0.0	0.0	17.6	81.4
Brown	77	66.7	0.0	0.0	0.0	23.9	76.1
	Average	66.8^{A}	0.0	0.0	0.0	20.8^{C}	78.7^{A}
TETRA	73	63.4	0.0	0.0	0.8	48.5	49.8
Amber	77	62.1	0.0	0.8	0.0	58.7	40.5
	Average	62.8^{C}	0.0	0.4	0.4	53.6^{A}	45.2^{C}
ISA	73	66.5	0.0	0.0	0.0	28.2	71.8
Brown	77	65.6	0.0	0.0	0.0	26.8	73.2
	Average	66.1^{AB}	0.0	0.0	0.0	27.5^{BC}	72.5^{AB}
Bovans	73	65.6	0.0	0.0	0.0	26.1	73.9
Brown	77	66.2	0.0	0.0	0.7	20.2	78.6
	Average	65.9^{AB}	0.0	0.0	0.3	23.2^{C}	76.2^{A}
Novogen	73	64.3	0.0	0.0	0.0	38.4	61.6
Brown	77	65.2	0.0	0.0	0.0	32.2	67.0
	Average	64.7^{B}	0.0	0.0	0.0	35.3^{B}	64.3^{B}
All	73	65.2	0.0	0.1	0.2	32.6	66.5
Strains	77	64.9	0.0	0.3	0.1	33.0	66.5

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

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

TABLE 34. EFFECT OF BROWN EGG STRAIN AND DENSITY ON EGG QUALITY, INCOME AND FEED COSTS OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-ANOREXIC MOLT PROGRAM

Breeder	Density[1]	Grade A	Grade B	Cracks	Loss	Egg Income	Feed Costs
(Strain)	(in^2/hen)	(%)	(%)	(%)	(%)	($/hen)	($/hen)
Hy-Line	73	95.4	1.9	2.0	0.7	0.39	0.56
Brown	77	96.9	1.4	1.7	0.0	0.40	0.51
	Average	96.2	1.7	1.9	0.4	0.40^{B}	0.53^{AB}
Hy-Line	73	90.1	4.8	3.0	2.1	0.44	0.58
Silver Brown	77	97.6	1.7	0.7	0.0	0.57	0.59
	Average	93.9	3.2	1.9	1.1	0.51^{A}	0.58^{A}
TETRA	73	90.0	5.7	3.3	1.0	0.36	0.58
Brown	77	92.0	5.4	2.6	0.0	0.36	0.59
	Average	91.0	5.6	2.9	0.5	0.36^{B}	0.59^{A}
TETRA	73	92.4	3.9	2.8	0.9	0.34	0.50
Amber	77	94.1	2.7	3.3	0.0	0.43	0.49
	Average	93.3	3.3	3.0	0.4	0.38^{B}	0.49^{B}
ISA	73	93.5	5.2	1.3	0.0	0.35	0.51
Brown	77	93.4	3.5	3.1	0.0	0.35	0.50
	Average	93.5	4.3	2.2	0.0	0.35^{B}	0.50^{B}
Bovans	73	96.9	0.9	2.3	0.0	0.41	0.53
Brown	77	93.6	3.8	2.1	0.6	0.41	0.55
	Average	95.2	2.3	2.2	0.3	0.41^{B}	0.54^{AB}
Novogen	73	95.6	3.6	0.8	0.0	0.34	0.50
Brown	77	95.5	2.8	0.9	0.9	0.37	0.52
	Average	95.6	3.2	0.8	0.4	0.36^{B}	0.51^{B}
All	73	93.4	3.7	2.2	0.7	0.38^{Z}	0.54
Strains	77	94.7	3.0	2.1	0.2	0.41^{Y}	0.54

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

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

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

TABLE 35. EFFECT OF BROWN EGG STRAIN AND SYNCHRONIZED MOLT ON BODY WEIGHT OF HENS IN THE 38th NCLP&MT (483-511 DAYS) NON-ANOREXIC MOLT PROGRAM

Breeder (Strain)	Molt Density[1] (in^2/hen)	17 Wk Body Wt (kg)	66 Wk Body Wt (kg)	1st Cycle Wt Gain (%)	Lowest Body Wt (kg)	Molt Wt Loss (%)	70 Wk Body Wt (kg)	Days to 0% Production
Hy-Line	73	1.47	2.12	43.9	1.59	24.7	1.60	9.4
Brown	77	1.51	2.10	39.3	1.53	27.1	1.53	10.1
	Average	1.49^{C}	2.11^{BC}	41.6^{A}	1.56^{BC}	25.9	1.56^{BC}	9.8^{ABC}
Hy-Line	73	1.60	2.20	38.2	1.67	22.4	1.71	10.1
Silver Brown	77	1.56	2.23	42.5	1.72	19.7	1.79	10.8
	Average	1.58^{AB}	2.22^{A}	40.4^{A}	1.70^{A}	21.0	1.75^{A}	10.4^{AB}
TETRA	73	1.50	2.06	37.5	1.56	19.4	1.66	9.0
Brown	77	1.46	2.00	37.2	1.56	17.2	1.65	9.1
	Average	1.48^{C}	2.03^{CD}	37.4^{AB}	1.56^{BC}	18.3	1.66^{AB}	9.1^{BC}
TETRA	73	1.54	2.04	33.0	1.53	25.0	1.53	9.9
Amber	77	1.52	2.12	39.1	1.58	25.2	1.59	11.6
	Average	1.53^{BC}	2.08^{BC}	36.1^{ABC}	1.56^{BC}	25.1	1.56^{BC}	10.7^{A}
ISA	73	1.52	2.05	36.9	1.53	25.3	1.53	8.2
Brown	77	1.55	2.06	32.7	1.49	26.3	1.51	9.6
	Average	1.54^{ABC}	2.05^{BCD}	34.8^{ABC}	1.51^{BC}	25.8	1.52^{C}	8.9^{C}
Bovans	73	1.53	1.96	28.6	1.48	22.3	1.52	9.2
Brown	77	1.53	1.99	29.9	1.50	18.6	1.62	9.4
	Average	1.53^{BC}	1.98^{D}	29.2^{C}	1.49^{C}	20.4	1.57^{BC}	9.3^{ABC}
Novogen	73	1.59	2.11	32.6	1.58	24.8	1.58	9.1
Brown	77	1.61	2.13	32.1	1.60	23.9	1.62	8.3
	Average	1.60^{A}	2.12^{B}	32.3^{BC}	1.59^{B}	24.4	1.60^{BC}	8.7^{C}
All	73	1.54	2.08	35.8	1.56	23.4	1.59	9.3
Strains	77	1.54	2.09	36.1	1.57	22.6	1.62	9.8

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

A,B,C - Different letters denote significant differences (P<.01), comparisons made among molt program average values.

Table 36 . 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