THE PATTERN OF EGG LAYING IN DOMESTIC FOWLS KEPT IN WARM HUMID TROPICS

By

ORJI, B.I. and L.N. NWAKALOR

*Department of Animal Science,
University of Nigeria, Nsukka*

Short running title: Egg laying patterns in fowls

Correspondence to:

DR. B.I. ORJI,

*Department of Animal Science,
University of Nigerian, Nsukka.*

ABSTRACT

Oviposition times, sequence of laying, lag time, laying intensity, egg weights and specific gravity of two commercial hybrids, Hypeco Gold Line (HGL) and Shavers Black (SB), were studied with 192 individually caged birds (96 of each) over a forty six day period. The most frequent sequence size was three for HGL and two for SB, the longest egg sequence for HGL was 43 while that of SB was 22. The interval between successive eggs ranged from 23.00 to 27.67 hours for HGL and from 23.56 to 27.80 hours for SB. The laying intensity was 72.10 and 63.54 per cent for HGL and SB respectively. The mean egg weight was 62.83 ± 0.38 g for HGL and 68.81 ± 0.39 g for SB; the egg weight tended to decrease from the first to the last egg in a sequence. The mean specific gravity of the eggs were 1.057 ± 0.003 and 1.056 ± 0.005 for HGL and SB respectively. The peak of lay was between 0900 to 1000 hours in both crosses with 99 per cent of all eggs being laid between 0600 and 1800 hours. Over 70 per cent of the eggs were laid before 12 noon in both cases.

INTRODUCTION

The pattern of egg laying has been shown to be cyclical and characteristic (Payne and Ortman, 1956; Parker, 1968) which attributes are known both to be affected by environmental conditions and to affect the weights and specific gravities of the eggs produced. With the increasing importance and utilization of exotic hybrids in commercial egg production in Nigeria, the need arises to study the egg laying characteristic of these birds under the local conditions. The experiment was therefore aimed at studying the egg laying

characteristics of two commercial cross-breeds — Hypeco Gold Line (HGL) an essentially Rhode Island Red Cross and Shavers Black (SB), a White Leghorn/Rhode Island cross to determine the oviposition times and the pattern of their distribution; the characteristic sequence lengths of the hens and their relationship to the egg weights and egg specific gravity; the lag times and their pattern of occurrence; and the laying intensity of the birds.

MATERIALS AND METHODS

Location:

The experiment was conducted in the poultry unit of the University of Nigeria farm at Nsukka and lasted for 46 days from November, 1979 to February, 1980. The climatic data for Nsukka taken from the University of Nigeria Meteorological Station over the period 1975 to 1980 show that the natural daylength is 12 to 13 hours, maximum daily temperatures 27.0 to 32.8°C, minimum daily temperatures 19.2 to 22.9°C, relative humidity 36.0—89.2%, and total annual rainfall 1597 mm.

Experimental birds:

One hundred and ninety two commercial hybrid chicken made up of equal numbers of Hypeco Gold Line (HGL) and Shavers Black (SB) were randomly taken from the main flock kept at the farm for

Key Words: Pattern, Egg-laying, Domestic fowls

the study. The birds were about 13 months of age and had been in lay for about 7 months. They were housed singly in cages. Feed (Table 1) and water were supplied *ad libitum*.

TABLE 1:

Percentage Composition of Feed

Crude Protein...	16.08
Crude Fibre.	4.98
Ether Extract....	3.23
Ash	12.40
Nitrogen Free Extract. . .	51.66

Experimental procedure:

Eggs were collected daily at 1800 hours for the individual oviposition records of the hens. From this, sequence length and pauses were calculated. Egg collection was also done hourly between 0600 and 1800 hours for 24 days for data on the pattern of laying through the day, egg weights, specific gravity, lag times and intervals between lay.

Statistical analysis:

The sequence length and its frequency distribution, the mean times of lay in relation to the position of eggs in the sequence, the intervals between lay and the time lag between eggs in sequences were all calculated. The distribution pattern of ovipositions during the day was illustrated in a histogram. Comparisons were also made between the crossbreds. The statistical procedures were according to Steel and Torrie (1960).

RESULTS

Egg laying sequence:

The distribution pattern of the laying sequences of the hens is shown in Table for Hypeco Gold Line and Table 3 for the Shavers Black.

The HGL showed a mode of 3-egg sequence, with the longest sequence containing 43 eggs. About 78 per cent of the sequence were of 5-egg length or less. For the SB, the mode was a 2-egg sequence and the longest sequence contained 22

TABLE 2

Frequency Distribution of the Sequence Length of the Hypeco Gold Line

<i>Sequence Length (no of eggs)</i>	<i>No. Observed</i>	<i>Relative Frequency</i>	<i>Sequence length (No. of eggs)</i>	<i>No. Observed</i>	<i>Relative Frequency</i>
1	115	17.80	16	1	0.16
2	117	18.11	17	3	0.47
3	118	18.27	18	3	0.47
4	89	13.97	19	4	0.63
5	56	8.79	20	2	0.31
6	29	4.55	21	1	0.16
7	20	3.14	22	1	0.16
8	22	3.45	23	2	0.31
9	13	2.04	24	1	0.16
10	10	1.57	25	1	0.16
11	4	0.63	30	1	0.16
12	9	1.41	32	1	0.16
13	4	0.63	38	1	0.16
14	3	0.47	41	1	0.16
15	4	0.63	43	1	0.16

ORJI and NWAKALOR

eggs. Of all the sequences in the SB, approximately 92 per cent was of the 5-egg length or less. The sequences were separated by pauses of 1 to 4 days with one day pause forming over 86 per cent of all the pauses in both groups.

Daily pattern of egg laying:

The patten of spread of egg laying during the day is shown in Figure 1. In both crossbreds, the peak of lay was between 0900 and 1000 hours, while 75.75 and 70.82 per cent of all the eggs from the

HGL and SB respectively were laid before 12 noon. About 99 per cent of all eggs were laid between 0600 and 1700 hours. Less than one per cent of the eggs were laid after 1800 hours.

Oviposition times, intervals between Lay and Lag times:

The times of oviposition of eggs in relation to their position in the sequence in the two crossbreds are presented in Table 4. The interval between consecutive eggs among the HGL was 24.94 hours, range

TABLE 3
Frequency Distribution of the Sequence Length of the Shavers Black

Sequence Length	No. Observed	Relative Frequency	Sequence Length	No. Observed	Relative Frequency
1	264	27.36	9	5	0.52
2	299	30.98	10	1	0.10
3	185	19.17	11	1	0.10
4	64	8.70	12	1	0.10
5	51	5.28	13	1	0.10
6	34	3.52	14	3	0.31
7	16	1.66	22	1	0.10
8	19	1.97			

TABLE 4
Time of Lay and Interval between Successive Eggs
(a) HYPECO GOLD LINE

Position In sequence (18) +	Sequence length													
	1 (27)	2 (33)	3 (30)	4 (17)	5 (9)	6 (8)	7 (3)	8 (3)	9 (2)	10 (1)	11 (2)	12 (0)	13 (1)	14 (1)
1	13:06 + +	9:25	9:47	8:50	8:25	8:01	8:00	9:40	8:40	7:30	9:00	8:00		7:00
2		12:18	11:29	10:34	10:07	10:00	9:23	9:40	9:40	8:30	9:00	10:00		9:00
3			12:02	11:00	10:07	10:50	10:00	10:00	10:40	9:30	10:00	10:00		11:00
4				14:30	12:20	11:20	11:00	10:00	10:40	9:30	10:00	11:00		10:00
5					15:00	13:00	11:53	10:00	11:00	10:30	10:00	11:30		10:00
6						16:13	12:13	10:20	11:20	10:00	12:00	11:00		10:00
7							15:30	10:40	12:00	10:30	11:00	11:30		11:00
8								12:00	12:40	11:00	11:00	11:30		11:00
9									12:00	12:00	13:00	12:30		10:00
10										15:30	13:00	12:30		10:00
11											15:00	13:00		11:00
12												14:00		11:00
13														13:00
14														14:00

+ + Figures in brackets indicate number of eggs used in determining mean oviposition times
+ + Oviposition times expressed in hours and minutes.

TABLE 4 Contd.

Time of lay and interval between successive eggs
(a) *SHAVERS BLACK*

Posotion in Sequence	Sequence Length							
	1	2	3	4	5	6	7	8
	(50) +	(95)	(64)	(25)	(14)	(8)	(4)	(7)
1	11.59 + +	9:11	8:30	8:14	8:09	8:30	7:30	7:51
2		12:59	11:02	9:53	9:30	9:38	9:15	9:17
3			14:38	11:29	10:26	10:08	9:45	10:43
4				14:48	11:47	10:38	10:00	10:17
5					14:39	11:38	10:30	10:17
6						13:08	11:00	10:51
7							14:00	11:43
8								14:51

+ Figures in brackets indicate number of eggs used in determining mean composition times

+ + Oviposition times expressed in hours and minutes

23.00 to 27.67 hours while for the SB it was 26.03 hours, range 23.56 to 27.80 hours.

The mean lag which represents the difference of the interval between successive eggs and 24 hours was 56 minutes in the HGL (range minus 1.00 hour to 3 hours 30 minutes) while for the SB, the mean lag was 1 hour 32 minutes (range minus 26 minutes to 3 hours 36 minutes). The lag time tended to diminish as the sequence size increased. For example, the mean lag times for the HGL and SB in a 3-egg sequence were 1 hour 8 minutes and 3 hours 4 minutes respectively; in an 8-egg sequence, the lag times were 20 minutes for the HGL and 1 hour in the SB (Table 5). Within the sequences, the lag time between the first three eggs laid and the last three eggs were higher than those of the intervening eggs in long sequences (Table 5). The lag between the initial ovipositions and the terminal oviposition decreased as the sequence size increased. The highest cumulative lag for the HGL was 8 hours 12 minutes while that of the SB was 7 hours 34 minutes.

Egg Weight:

The pattern of spread of egg laying dur-

HGL was 62.83 ± 0.38 g (range 51.3 to 79.9g) for the SB, this was 68.81 ± 0.39 g (range 55.0 to 92.5g). The variation in egg weights in relation to the position of the egg in the sequence is shown in Table 6 for the HGL and Table 7 for the SB. The first eggs in a sequence in general were heavier than eggs produced later in the sequence. Eggs laid in the morning hours were comparatively heavier than those laid later in the day (Table 8). The differences in weights between eggs laid from 0600 to 0700 hours and those laid from 1500 to 1800 hours were 6.36 and 3.19 g for the HGL and SB respectively.

Specific gravity:

The specific gravity of eggs from the HGL was 1.05 ± 0.003 (range 1.06 to 1.090), that of eggs from the SB was 1.056 ± 0.005 (range 1.011 to 1.114). The specific gravity of the eggs in relation to the time of lay is presented in Table 9. The specific gravity of the eggs laid later in the day tended to be slightly higher than that of eggs laid early in the day.

Intensity of lay:

In the 46 days of the experiment, the HGL hens laid 3,184 eggs as against 2,806

Fig 1: Frequency distribution of egg laying over the hours of the day.

Orji /Nwakalor, 1982.

ORJI and NWAHALOR

TABLE 5

Lag time in egg laying sequences

(a) HYPECO GOLD LINE

(Hours and minutes)

Sequence Length													
2	3	4	5	6	7	8	9	10	11	12	13	14	Mean
2:53	1:42	1:44	1:42	1:59	1:23	0:00	1:00	1:00	0:00	2:00	—	2:00	1:27
	0:33	0:26	0:00	0:50	0:37	0:20	1:00	1:00	1:00	0:00	—	2:00	0:42
		3:30	2:13	0:30	1:00	0:00	0:00	0:00	0:00	1:00		—1:00	0:43
			2:40	1:40	0:53	0:00	0:20	1:00	0:00	0:30		0:00	0:47
				3:13	0:20	0:20	0:20	—0:30	2:00	—0:30		0:00	0:39
					3:17	0:20	0:40	0:30	—1:00	0:30		1:00	0:45
						1:20	0:40	0:30	0:00	0:00		0:00	0:25
							—0:40	1:30	2:00	1:00		—1:00	0:34
								3:00	0:00	0:00		0:00	0:45
									2:00	0:30		1:00	1:10
										1:00		0:00	0:30
												2:00	2:00
												1:00	1:00
Mean	2:53	1:08	1:53	1:39	1:38	1:15	0:20	0:25	0:53	0:36	0:33	0:32	

TABLE 5 Contd.

Lag time in egg laying sequences

(Hours and minutes)

(b) SHAVERS BLACK

Laying Sequence (Hours and minutes)							
3:48	2:32	1:39	1:21	1:08	1:45	1:26	1:57
	3:36	2:36	0:56	0:30	0:30	1:26	1:36
		3:19	1:21	0:30	0:30	—0:26	1:36
			2:52	1:00	0:30	0:00	1:06
				2:30	0:30	0:34	1:11
					3:00	0:52	1:56
						3:08	3:08
Mean	3:48	3:40	2:31	1:38	0:56	1:06	1:00

for the SB, giving overall average daily production rate of 72.10 and 63.54 per cent, respectively. In terms of egg mass, these were respectively, 200.5 and 193.1 kg of egg for the HGL and SB.

DISCUSSION

Previous reports (Parker, 1968; Gilbert and Wood-Gush, 1971) show that hens lay in cycles or sequences and that the overall production of a hen, which is the critical factor in egg laying, is related to the sequence size of the individual hens. Good layers usually lay in longer sequence than poor layers. These findings are confirmed by the results of the present investigation. Both crossbreds laid their eggs in cycles or sequences which varied

from 1 to 42. The sequences were separated by pauses of 1 to 4 days duration. The HGL which had longer sequences had on the whole, larger total egg production than SB. Both the sequence size and the pattern of spread of the sequences are in line with the report of Gilbert and Wood-Gush (1971) for hens, and Kosin and Abplanalp (1951) for turkeys.

The number of eggs laid per hour is not evenly spread through the 24 hour day; 99 per cent of the eggs were laid during the day while the hens were more or less inactive at night. The distribution of laying between morning and afternoon is also not uniform. Hays (1953) reported that 64 to 65 percent of the chicken eggs were laid

TABLE 6

Egg weight and its relationship to the position of egg in the sequence means $\pm$ SE (g) — Hypeco Gold Line

Position of egg in Sequence	Sequence Length											
2-egg Seq. (27 Samples)	65.89	63.31										
	± 1.13	± 1.31										
3— (33) +	64.64	62.42	61.42									
	± 0.95	± 0.78	± 0.79									
4— (30)	62.88	61.73	60.20	60.49								
	± 0.36	± 0.78	± 0.73	± 0.70								
5— (17)	65.50	63.56	62.01	62.08	62.66							
	± 1.40	± 0.90	± 0.98	± 0.94	± 0.96							
6— (9)	67.39	64.94	66.24	63.81	64.21	63.45						
	± 1.56	± 2.15	± 2.72	± 2.32	± 2.55	± 2.40						
7— (8)	64.05	61.94	60.63	60.08	60.00	59.68	60.36					
	± 1.49	± 1.09	± 0.57	± 0.92	± 0.87	± 0.84	± 1.06					
8— (3)	64.73	60.80	64.33	64.23	64.73	62.76	61.30	63.73				
	± 1.23	± 2.48	± 0.90	± 0.57	± 0.20	± 0.61	± 1.55	± 1.39				
9— (3)	62.50	62.10	61.87	60.90	62.70	62.40	62.40	61.57	62.63			
	± 2.58	± 2.87	± 0.60	± 3.10	± 2.07	± 2.69	± 1.80	± 3.14	± 3.60			
10— (2)	64.75	63.70	61.10	61.20	61.80	62.00	61.90	60.85	61.15	60.45		
	± 2.45	± 1.20	± 1.00	± 1.30	± 1.30	± 2.10	± 2.40	± 1.96	± 2.05	± 1.05		
11— (1)	62.20	62.00	58.40	58.90	58.00	58.50	55.90	54.50	54.30	55.10		
12— (2)	70.75	67.80	66.15	65.20	66.50	66.70	64.05	64.75	64.05	62.60	61.85	62.40
	± 7.75	± 6.10	± 5.75	± 3.30	± 5.40	± 2.00	± 1.55	± 1.25	± 1.35	± 2.10	± 1.25	± 1.90
13—	—	—	—	—	—	—	—	—	—	—	—	—
Nil												
14—	67.10	64.00	62.60	61.50	61.50	61.80	59.70	60.50	60.40	60.50	55.00	54.50
Means	65.09	63.19	62.27	61.84	62.56	61.85	61.17	61.22	60.55	59.71	57.32	58.45
											57.20	54.00

+ Figures in brackets represent the number of eggs

before 12 noon whereas in the present study 76 and 71 per cent of the eggs were laid before 12 noon for the HGL and SB, respectively, which values although higher, confirm the same trend. In both crosses those hens that laid in long sequences in general started laying earlier in the morning hours than those that laid in shorter sequences. The intervals between successive eggs were generally 24 hours or less for the hens that laid in long sequences of 6 eggs and above; for those that laid in shorter cycles, the intervals were 25 hours and above. This pattern is in agreement with the findings of Parker (1968) that for hens laying in short-cycles the long interval between ovulations could take ovulation time beyond 2.00 p.m. after which most hens do not normally

ovulate.

The pattern of distribution of lag time in the two groups of hens were identical, being highest between the first two eggs and the last two eggs in a sequence and declining in between. The hens that laid in long sequences, 6 and above, had lag times approaching zero and at times negative, thus fitting the 24 hour rhythm for good layers (Parker, 1968). The decrease in lag time between the initial ovipositions and the terminal ovipositions as the sequence size increased (Table 5) agrees with an earlier report (cf. Fraps, 1955). With the highest commulative lag in both hybrids being 8 hours 12 minutes which is less than the normal daylength in Nsukka, and with the first egg of a long sequence being laid in the morning, it is

ORJI and NWAKALOR

TABLE 7
Egg weight and its relation to the position of eggs in the sequence
(Means $\pm$ SE, g) — Shavers Black

Position of egg in Sequence	Sequence Length							
	1	2	3	4	5	6	7	8
2-egg seq.	69.84	67.49						
(15)*	± 0.60	± 0.56						
3—	72.25	72.45	69.82					
(64)	± 0.65	± 0.64	± 0.82					
4—	71.31	68.73	67.45	67.45				
(35)	± 1.11	± 0.08	± 1.13	± 1.07				
5—	73.10	72.50	71.55	71.66	71.57			
(14)	± 1.12	± 1.40	± 1.45	± 1.47	± 1.70			
6—	70.15	67.94	66.00	66.74	66.05	66.13		
(8)	± 1.34	± 1.33	± 1.56	± 1.16	± 1.31	± 1.32		
7—	72.60	70.28	70.08	70.10	68.55	68.48	67.40	
(4)	± 3.16	± 3.16	± 3.69	± 4.24	± 3.93	± 4.63	± 4.47	
8—	69.76	68.33	66.29	65.17	66.44	65.60	66.13	66.73
(7)	± 2.46	± 2.30	± 2.00	± 2.07	± 2.29	± 2.17	± 2.23	± 2.50
Mean	71.29	69.67	68.51	68.22	68.15	66.74	66.77	66.73

*Figures in brackets represent the number of eggs

TABLE 8
Egg weight and time of lay

Egg weight $\pm$ S.E. (g)		
Time of lay	HGL	SB
6—7 am	64.01 $\pm$ 1.65	70.01 $\pm$ 1.34
7—8	62.44 $\pm$ 1.68	71.80 $\pm$ 1.33
8—9	62.15 $\pm$ 1.16	68.65 $\pm$ 1.28
9—10	60.82 $\pm$ 1.27	69.31 $\pm$ 1.35
10—11	62.17 $\pm$ 0.57	68.73 $\pm$ 1.03
11—12	61.49 $\pm$ 1.02	67.67 $\pm$ 1.20
12—1 pm	60.17 $\pm$ 1.20	66.80 $\pm$ 1.22
1—2	61.27 $\pm$ 1.29	69.79 $\pm$ 1.45
2—3	60.40 $\pm$ 1.78	71.09 $\pm$ 1.51
3—6	57.65 $\pm$ 3.72	66.83 $\pm$ 1.37

TABLE 9
Specific gravity in relation to time
of lay (Means $\pm$ SE, g)

Time of Lay	HGL	SB
6 pm—6 am	1.053 $\pm$ 0.004	1.043 $\pm$ 0.005
6 am—7 am	1.053 $\pm$ 0.003	1.049 $\pm$ 0.002
7 am—8 am	1.055 $\pm$ 0.002	1.050 $\pm$ 0.008
8 am—9 am	1.055 $\pm$ 0.002	1.053 $\pm$ 0.005
9 am—10 am	1.055 $\pm$ 0.002	1.054 $\pm$ 0.003
10 am—11 am	1.055 $\pm$ 0.001	1.053 $\pm$ 0.004
11 am—12 noon	1.058 $\pm$ 0.001	1.056 $\pm$ 0.007
12 noon—13 pm	1.056 $\pm$ 0.001	1.057 $\pm$ 0.009
13 pm—14 pm	1.057 $\pm$ 0.009	1.060 $\pm$ 0.002
14 pm—15 pm	1.060 $\pm$ 0.003	1.074 $\pm$ 0.006
15 pm—16 pm	1.064 $\pm$ 0.002	1.058 $\pm$ 0.004
16 pm—17 pm	1.064 $\pm$ 0.005	1.0655 $\pm$ 0.006
17 pm—18 pm	1.058	—

thus theoretically possible, as earlier suggested by Gilbert and Wood-Gush (1971), that cycles of any length can occur in both crossbreds.

The heaviest eggs were produced early in the morning hours and the egg weights decreased with the length of the sequence. However, the difference between the average weights of the first and last eggs produced in a day (HGL 6.36g and SB 3.19g, equivalents of 9.9 and 4.6 per cent decrease, respectively) appears much

higher than 1.37g or 2.5 per cent reported by Wolford *et al* (1964) for chicken eggs. Similarly, the mean difference of 11.09g for the HGL and 4.56g for the SB, between the first and last eggs in their respective sequences is higher in absolute terms than the 1.15 to 1.86g decrease reported by Beunion and Warren (1933) between the first and last eggs in the clutch of chicken hens.

The specific gravity of the eggs in both

crossbred chicken showed the same type of relationship with the time of lay as was reported by Roland and Harms (1973), the specific gravity of the eggs tending to increase as the day advances.

In conclusion, with 72 and 64 per cent production rate, both crossbreds would be classed as good producers; however, the heavier unit egg weight of the SB does not adequately compensate for the higher total production of the HGL. The 6.94kg total egg weight difference between the two crossbreds within the experimental period could be very substantial especially if it required the same level of input to achieve that level of production.

ACKNOWLEDGEMENT

The authors are grateful to Messrs C.C. Eze and G.C.E. Njoku and the staff of the poultry unit, Department of Animal Science, University of Nigeria, Nsukka for their assistance in the collection of the data.

REFERENCES

- BEUNION, N.L. and D.C. WARREN (1933). Some factors affecting eggs size in domestic fowls ABA 1: 259.
- FRAPS, R.M. (1955). Egg production and fertility in poultry. In 'Progress in the Physiology of Farm Animals' by J. Hammond, Butterworth, London.

GILBERT, A.B. and A.G. WOOD-GUSH (1971). Ovu-latory and Ovipository cycles — In "Physiology and Biochemistry of the Domestic Fow", by D.J. Bell and B.M. Freeman (eds): Academic Press, London and New York.

HAYS, F.A. (1937). Hatchability as related to seasons and hour of laying. Poult. Sci. 16: 85 — 89.

KOSIN, I.L. and H. ABPLANALP (1951). The Pattern of egg laying in Turkeys. Poult. Sci. 30: 168 — 179.

PARKER, J.E. (1968). Reproductive physiology in poultry. In 'Reproduction in Farm Animals' by E.S.E. Hafez 2nd ed. Lea and Febiger, Philadelphia.

PAYNE, L. and L. ORTMAN (1956). Egg pattern in Turkey Poult. Sci. 35: 1201 — 1206.

ROLAND, D.A. and R.H. HARMS (1973). Specific gravity of eggs in relation to egg weight and time of ovaposition. Poult. Sci. 52: 2078 — 2079.

STEEL, R.G.D. and H.H. TORRIE (1960). Principles and procedures of Statistics. McGraw-Hill Book Coy Inc. New York.

WOLFORD, J.H., R.K. RINGER and T.H. COLEMAN (1964). Lagtime Interval between successive eggs and oviposition time in Turkeys. Poult. Sci. 43: 612—615.