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Egg Production Curve Models of Commercial Bovans Goldline Layers Reared in Oil Producing Environment Of Niger Delta, Nigeria

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ABSTRACT

The fact that specific breeds of livestock were developed to achieve specific objectives has been reported by several researchers but few or little information are available on the performance of these specific breeds in varied ecozones, hence a 365 days laying period of Bovans Goldline layers, a Nigerian commercial laying strain was assessed in oil producing environment of Niger Delta, Nigeria. Results of the experiment revealed a better fit for the quadratic function in predicting egg production curve with coefficient of determination (R^2) values of 80.65± 0.8, 71.14±0.65, 82.50±0.07 and 73.08±0.02 per cent were obtained for linear, inverse, quadratic and exponential functions fitted for the data. However, better performance was recorded in months of June through August but later declined till February. Hence it can be stressed as a point of findings that period of year and ecological zone has influence on performance of Bovans Goldline layers in oil producing zone of Niger Delta, Nigeria.

Keywords: Bovans Goldline; Hen day; oil environment; curve fitting; coefficient of determination

INTRODUCTION

Several mathematical functions, vis linear, inverse, quadratic (Spiegel, 1972) and exponential (Bordy *et al.*, 1923) etc have been used to describe the egg production curve in laying birds. These functions explain the variability in egg production data to a great extent comparable to simple linear regression equations. In this study linear, inverse, quadratic and exponential model were taken into consideration to assess their efficiencies in explaining the egg production curve in a Nigerian commercial poultry bird (Bovans Goldline) reared in oil producing environment of Niger Delta, Nigeria.

MATERIALS AND METHODS

Experimental Site

The study was conducted in the Poultry Research Centre (PRC) of the Delta State polytechnic, Ozoro, Nigeria. The research station is located along latitudes 5^0 30^1 and 5^0 15^1 N and longitude .It has an annual rainfall temperature and relative humidity of 33^0c and 76 % respectively. The area falls within the major oil producing area of Nigeria (FRN, 2007).

Experimental Birds and Management

Two hundred and fifty (250) Bovans Goldline layers managed under battery cage system with an open-sided house were used for this experiment. Each bird was placed inlaying cage fitted with trap-nets for a period of 52 weeks .There were provisions of one hour of artificial lighting at 03.30h and 19.30h. Water and feed troughs were made of PVC pipe through which feed the layers diet used were 16.20 % crude protein and 2606 kcal/kg metabolizable energy.

Data Collection

Data were obtained from daily egg collection. This was done twice daily (09.00h and 16.00h) between March, 2016 and February, 2017. Individual hen's daily egg production was recorded up to February, 2017. Mortality and cooling temperature relative humidity during this period were also recorded.

Statistical Analysis

Data derived from the various statistical formulas were subjected to statistical analysis of variance while mean, standard deviation and coefficient of variation (CV %) were obtained using the GLM procedure of SAS (2005). Egg production curve was obtained by plotting the corresponding egg production on age (months). Different mathematical functions viz, linear, quadratic and exponential functions were used to describe the variability in the egg production of the birds. The functions were fitted to average monthly egg production. The mathematical model adopted for the functions are

Linear (Spiegel, 1972)

$Y= a+bx$

Inverse (Spiegel, 1972)

$Y=a+a,+a_2t^2$

Quadratic (Spiegel,1973)

$Y= (a+bt+ct^2)^{-t}$

Experimental (Brody *et al.,* 1923)

$-Yt =Ae^{-et}$

Where,

Y= Egg production at period of time t,

a = Initial egg production
b = Slope of the curve
c = the rate of change

The efficiency of these functions was compared by using the value coefficient of determination (R^2), mean deviations and closeness of observed curve to the predicted curve.
Following formula was used in computing the R^2 values.
R^2 = Sum of Square due to regression
Total Sum of Square due to the dependent variance

RESULTS AND DISCUSSION
The monthly egg production obtained in this study showed a low hen day egg production value of 39.4 % and poor performance of hen housed egg production of 25.6 % .This can be attributable to poor management practices and high ambient temperature can be implicated for such poor performance because the average hen days value of 162.57 obtained was not typical of Bovans Goldline layers that well managed (Table 1). These findings disagreed with the report of Carey *et al.,* 1995 which stated that in areas where the climate is hot and humid, commercial hybrid laying birds produce average hen days between 180 and 200 eggs per year.

Table 2 showed the mean, standard deviation and coefficient of variation of egg production of Bovans Goldline layers .The result revealed that the range of the value coupled with the obtained coefficient of variation for this trait suggest lapses in the management practices. Such lapses which may have arisen from high ambient temperature and high relative humidity that results to low percentage of hen day production and hen housed production. Carry *et al.,* 1995 reported that the optimal laying temperature was between 11^0C and 26^0C. A humidity level above 75 per cent will cause a reduction in egg laying. The reduction of egg production of Bovans Goldline layers may be attributed to the gas flares radiations to the environment may increase the ambient temperature.

Table 1: Egg Production Schedule of Bovans Goldline layers reared in oil producing environment of Niger Delta, Nigeria

Months (days)	% of flock Laying	No. of bird Laying	Total Hen Days	No.of Eggs laid	Mean Temp (⁰c)	Mean RH (%)
March(31)	41.6	104	3224	1248	35	75
April(30)	51.2	128	3840	1536	34	76
May(31)	60.0	150	4650	1800	32	78
June(30)	68.8	172	5160	2064	34	75
July(31)	84.0	210	6510	2520	35	76
August(31)	82.0	205	6355	2460	35	75
September(30)	80.0	200	6000	2400	32	75
October(31)	76.8	192	5952	2394	32	75
November(30)	69.6	174	5220	2088	35	75
January(31)	50.0	125	4092	1500	32	76
February(28)	50.0	125	3500	1500	32	76
Total (365) days						

Table 2: Mean (X) standard (SD) and coefficient of variation (CV %) of egg production of Boyans Goldline layer

Months (Days)	No of birds laying	Mean (X)	Standard deviation (SD)	Coefficient of variation (CV %)
March(31)	104	18.73	4.74	25.31
April (30)	128	15.21	3.70	24.35
May (31)	150	12.99	3.65	28.10
June (30)	172	11.33	2.51	22.15
July (31)	210	9.28	2.23	24.03
August(31)	205	9.50	2.26	23.79
September (30)	200	9.74	2.25	23.10
October (31)	192	10.15	2.54	28.34
November (30)	174	11.20	2.42	21.61
December (31)	156	12.49	3.54	28.34
January (31)	125	14.76	3.72	25.20
February (28)	125	15.58	3.68	23.62
Total (356) days				

Carey *et al.*, 1995, reported that when the temperature rises above 28⁰C the production and quality of eggs decrease. Seasonal temperature rises above 28⁰C the production and quality of eggs decreases. Seasonal temperature increase can reduce egg production by about 10 per cent. The graph in Figure 2 shows the number of egg produced over a period of 12 months for 250 birds. Egg production rises rapidly and decreased from the month of July (20 weeks of age of first laying to 42 weeks of age) on average a bird produce 156 eggs over a twelve-month period, averaging three eggs per week per bird.

In egg production cycle, figure 1 shows that from the month of March in observed egg production, there were increases in egg production from 41.6 % to 84 % production. The period from August to December, egg production declined up to 62.4 % while from January to February egg production recorded was 50 %. These findings disagree with the report of Banejee, 2005 who observed 65 % of egg production within the same season.

The R^2 values, standard error and constants for various functions fitted to average monthly egg production records have been represented in table 3. The egg production curve of the flock is showing in Figure 1. The curve was not completely linear and analysis of the curve fitting using linear, inverse, quadratic and exponential functions had coefficient of determination (R^2) of 80.65, 71.14, 82.50 and 72.08 respectively. Their corresponding estimates of standard error were 0.08, 0.65, 0.07 and 0.02 respectively (Table 3). These estimates express the reliability of the results. From the result, negligible difference can be said to exist between linear and quadratic functions hence accounting for the variance observed in egg production over a period of time (80.65 vs 82.50). Similarly, slight difference existed between inverse and exponential function (71.14 vs 73.08). R^2 values has been used by others workers to assess the predictability value of different mathematical functions (Orheruata *et al.,* 1997), Ibiwoye *et al.,* 1993 and Mbap *et al.,* 1998). Therefore with the relatively high R^2 value for linear and quadratic functions. These functions can be said to have reasonably predicted the egg production of layers used in this study. Examination of the result revealed that these functions estimated egg production curves, conversely, inverse and exponential function did not explain the ascending phase of egg production curves and thus their use in predicting egg production could be misleading. Also observed was a slightly higher egg production and thereafter a sharp decline egg production which is normal of general performance of livestock.

Table 3: Parameter estimates, standard error coefficient of determination value (R^2) and constants for various functions fitted to average monthly egg production of Bovans Goldline layers

Functions		Constants		Standard error	R^2
	A	b^1	b^2		(%)
Linear	1.02	0.23 0.02	-	0.08	80.65

Inverse	4.06	4.12 1.1	-	0.65	71.14
Quadratic	0.37	0.68 0.05	-0.008	0.07	88.50
Exponential	1.24	0.42 0.01	-	0.02	73.08

Table 4: Predicted average monthly egg production by fitting various functions

Months (days)	Observed egg production (%)	Linear	Predicted egg production (%) Inverse	quadratic	exponential
March (31)	41.6	58.5	56.7	38.8	58.5
April (30)	51.2	60.6	58.5	75.6	60.6
May (31)	60.0	63.7	60.4	80.2	66.4
June (30)	68.8	65.7	62.3	76.4	58.5
July (31)	84.0	68.5	58.6	75.0	70.1
August (31)	82.0	71.0	56.4	74.7	73.5
September (30)	80.0	74.3	54.3	72.5	75.6
October (31)	76.8	76.5	50.4	70.1	78.0
November (30)	69.6	80.0	-47.5	68.5	80.5
December (31)	62.4	82.5	-45.0	66.4	81.6
January (31)	52.8	85.0	42.8	64.9	82.5
February (28)	50.0	86.5	40.6	62.0	63.6
Total (365) days					

The quadratic function under estimated the egg production in the month of March and over estimated it from April to May. Thereafter, the curve range close to the mean egg production curve. This function showed very low initial egg production but higher peak production. So, the quadratic function will suit those layers who had initially low egg production but higher peak production (Table 4). The predicted monthly egg production for the month of June to September by the inverse function were lower than observed monthly egg production and thereafter, the expected graph ran close the observed graph. The expected curve for exponential were less close to the observed curve.

The exponential function did to lactation curve reported by Singh and Bhat (1978); Goodell and Sprevak (1984) and Kumar *et al.*, (1988) in cattle and which depicts the natural trend of low, high and low production patterns in livestock.

CONCLUSION AND RECOMMENDATION

From the study one can infer that the use of quadratic model could be suggested in describing the egg production environment of Niger Delta, Nigerian. Also, it is recommended that as heat prostration sets in, due to gas flare, measures should be taken to cool the poultry house.

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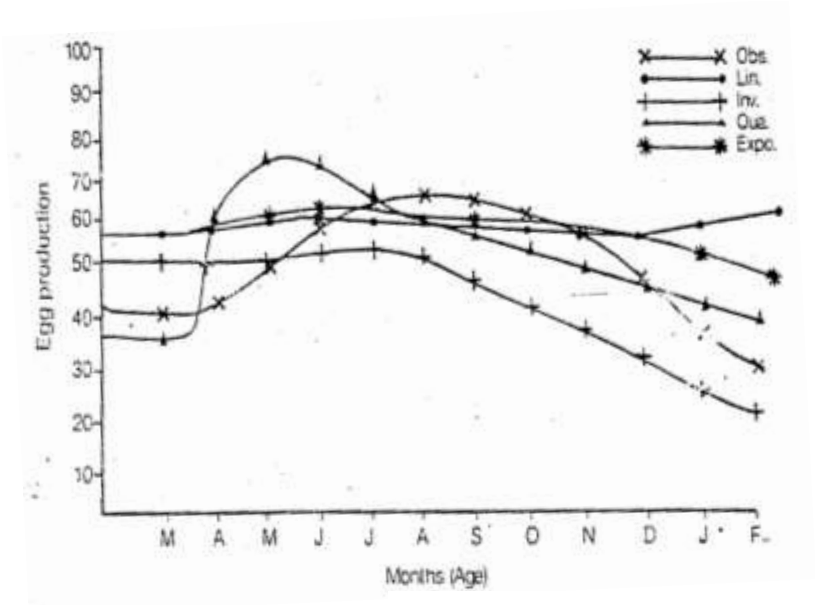

Months (Age)

Fig 1: Egg production curve of Bovans Goldline reared from (20 – 72 weeks) at Polytechnic Poultry Research Centre.

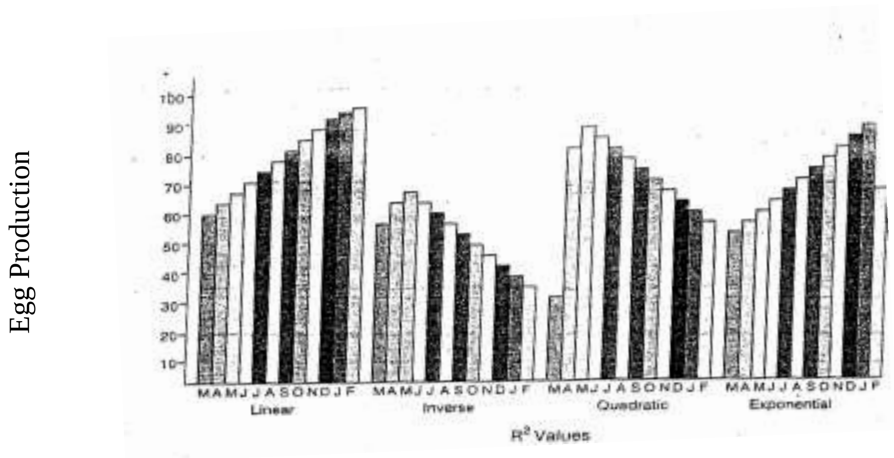

Fig. 2: Number of Eggs Produced over a period of time

Number of Eggs

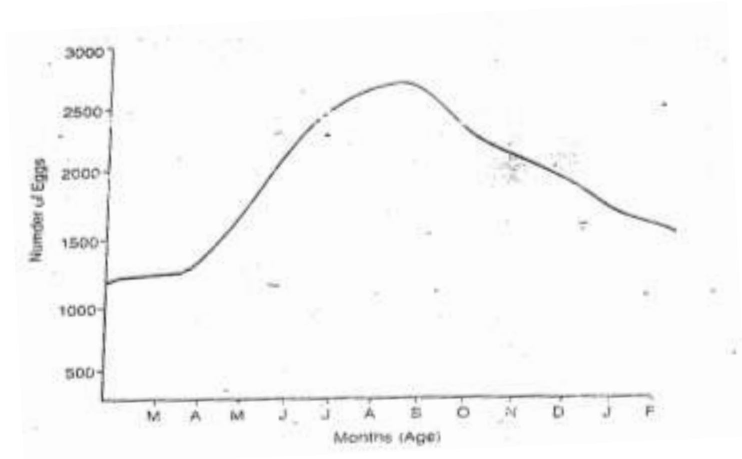

Fig. 3: Histogram of the distribution of Egg Production Curves according to the computed proportion of variation accounted for (R^2 Values) by linear, inverse, quadratic and exponential models.

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