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Prediction of 40 Weeks Egg Production on the Basis of Part Egg Production and Part Cumulative Egg Production Traitsin Synthetic White Leghorn Strain

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ABSTRACT

A study of white leghorn strain maintained at the poultry farm of department of Animal Genetics and Breeding, LUVAS, Hisar, was conducted to investigate the possibility of prediction of the 40 week egg production based on part egg production and part cumulative egg production traits in synthetic White Leghorn strain.Egg production during 25 to 28 weeks (EPP_1), egg production during 28 to 32 weeks (EPP_2),egg production during 32 to 36 weeks (EPP_3),egg production during 36 to 40 weeks (EPP_4)presents part egg production traits and egg production upto 24 weeks of age(EP_{24}), Egg production upto 28 weeks of age(EP_{28}), Egg production upto 32 weeks of age(EP_{32}), Egg production upto 36 weeks of age(EP_{36})and Egg production upto 40 weeks of age(EP_{40}) present part cumulative egg production traits. Prediction equation for 40 weeks egg production showed highest coefficient of determination (96 %), when egg production at 36 weeks of age was taken in prediction equation with EPP_4.

Key words: *Part egg production, 40 wk, prediction equation*

INTRODUCTION

Poultry is one of the fastest growing segments of agricultural sector in India with an average growth rate of 4.94%. The total egg production in India is about 88139 millions and the per capita availability of 69 eggs per year[2] against ICMR recommendation of 180 eggs per year. Selection changes the genetic structure of population by changing gene and genotypic frequencies and hence, the genetic parameters are also liable to change in the every generation[4].The synthetic strain of white leghorn has undergone long-term selection for many generations on the basis of 40-week part-period egg production and is being maintained at this institute for development of egg type strain. It has now become a common practice among the breeders to practice selection based on part term egg production for improving the egg production at later stages. Partial egg production records can be considered as longitudinal data and can be analysed during the life of an animal by using linear or nonlinear functions.

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Random regression models (RRMs) are linear models, also called as finite-dimension models are used to measure initial milk production in dairy cows[5]. They can also be used to evaluate egg production in laying hens when partial laying periods are considered. The length of the part record that is likely to produce greatest improvement in egg production at later stages can also be identified. Egg production generally increases to a peak and then gradually decreases in the form of a curve when summarized on a monthly or weekly basis[1].

MATERIAL AND METHODS

The relevant data for the present investigation were collected from synthetic White Leghorn population, maintained at the poultry farm of department of Animal Genetics and Breeding, LUVAS, Hisar. The data were collected over five generations (2012-13 to 2016-17). The birds have been maintained under uniform practices of feeding, housing and management during the period of data recording as far as possible.Part egg production traits studied were egg production during 25 to 28 weeks (EPP_1), egg production during 28 to 32 weeks (EPP_2),egg production during 32 to 36 weeks (EPP_3),egg production during 36 to 40 weeks (EPP_4)and part cumulative egg production traits studied were egg production upto 24 weeks of age (EP_{24}), egg production upto 28 weeks of age (EP_{28}), egg production upto 32 weeks of age (EP_{32})and egg production upto 36 weeks of age (EP_{36}).

STATISTICAL ANALYSIS

Multiple Regression Analysis (MRA) as described by Draper and Smith[3] were used to predict breeding values of 40 weeks egg production from cumulative part egg production and other performance traits.

Prediction equation was as follow:

$$\hat{Y} = a + b_1X_1 + b_2X_2 + \ldots\ldots\ldots\ldots b_pX_p$$

Where,

$\hat{Y}$=a variable which is to be predicted (dependent)

$\hat{a}$= a constant (intercept)

b_i = partial regression of Y on i^{th} X traits

X_i = independent variables

The coefficient of determination was calculated on the basis of following formula:

$$R^2 = \frac{\text{Regression sum of squares}}{\text{Total sum of squares}} \times 100$$

RESULTS AND DISCUSSION

Twenty eight equations were developed for predicting 40 weeks egg production based on part egg production traits and cumulative part egg production traits. The developed equations were in different combination of two or three part egg production traits and part cumulative egg production traits. All developed equations had at least one part egg production trait and one part cumulative egg production trait. For prediction of 40 weeks egg production, part egg production traits considered were EPP_1, EPP_2, EPP_3, EPP_4 and part cumulative egg production traits considered were EP_{24}, EP_{28}, EP_{32} and EP_{36}. Predicted equations with their R^2 values are presented in Table 1. Prediction equation for 40 weeks egg production showed highest coefficient of determination (96 %), when egg production at 36 weeks of age was taken in prediction equation with EPP_4. However, when EP_{36} was taken into prediction equation with EPP_2 or EPP_3, the equation explained 90% of variation in EP40. EP_{28} along with EPP_1 explained 78% of the variation in 40 weeks egg production. Keeping in view the advancement of time, simplicity and accuracy of prediction, following equations were found to be most suitable for 40 weeks egg production:

1. $\hat{Y}$ = 2.23 + 1.23 EP_{36}
2. $\hat{Y}$= -12.97+ 1.33 EPP_4 + 1.10 EP_{36}

Sr. No	Predicted equations	R^2 (%)
1	$\hat{Y}$ = 37.86+ 1.52 EPP_1+ 2.36EP_{24}	58
2	$\hat{Y}$ = 34.15+ 0.21 EPP_1+ 1.79EP_{28}	78
3	$\hat{Y}$ = 9.84 -0.06 EPP_1 +1.61 EP_{32}	76
4	$\hat{Y}$ = 2.10 -0.01 EPP_1+ 1.26EP_{36}	90
5	$\hat{Y}$ = -3.64+ 3.13 EPP_2+ 2.66EP_{24}	46
6	$\hat{Y}$ = -15.48+ 2.53 EPP_2+ 1.80EP_{28}	69
7	$\hat{Y}$ = -2.33 + 0.71 EPP_2+ 1.52EP_{32}	76
8	$\hat{Y}$ = 3.23 -0.06 EPP_2 +1.24 EP_{36}	90
9	$\hat{Y}$ = 5.34 -3.09 EPP_3 +2.26 EP_{24}	50
10	$\hat{Y}$ = -11.84 + 2.72 EPP_3 +1.68 EP_{28}	74
11	$\hat{Y}$ = -23.83+ 2.18 EPP_3 + 1.40 EP_{32}	83
12	$\hat{Y}$= -4.30+ 0.50 EPP_3 + 1.18EP_{36}	90
13	$\hat{Y}$ = 19.63+ 2.51 EPP_4+ 2.40EP_{24}	57
14	$\hat{Y}$ = 2.43+ 2.17 EPP_4 + 1.68 EP_{28}	78
15	$\hat{Y}$ = -16.27+ 1.91 EPP_4 + 1.40 EP_{32}	89
16	$\hat{Y}$ = -12.97+ 1.33 EPP_4 + 1.10 EP_{36}	96
17	$\hat{Y}$ = -11.77+ 1.39 EPP_1 + 2.53 EPP_2 + 2.28EP_{24}	66
18	$\hat{Y}$ = -15.38+ 1.39 EPP_1 + 2.52 EPP_2 +1.73EP_{28}	69
19	$\hat{Y}$ = -2.27+ 0.01EPP_1 + 0.71 EPP_2 +1.53EP_{32}	76
20	$\hat{Y}$ = 3.87- 0.11 EPP_1 -0.10 EPP_2 +1.27EP_{36}	90
21	$\hat{Y}$ = -8.74+ 1.14 EPP_1 + 2.71 EPP_3 +1.90 EP_{24}	71
22	$\hat{Y}$ = -12.81+ 0.29EPP_1 + 2.75 EPP_3 +1.50 EP_{28}	74
23	$\hat{Y}$ = -23.86 + 0.06 EPP_1 + 2.19 EPP_3 +1.37EP_{32}	83
24	$\hat{Y}$ = -4.04 + 0.06 EPP_1 + 0.48EPP_3 +1.19EP_{36}	90
25	$\hat{Y}$ = 3.63 + 1.36 EPP_1 + 2.25EPP_4 +2.04EP_{24}	77
26	$\hat{Y}$ = 1.72 + 0.26 EPP_1 + 2.18EPP_4 +1.53EP_{28}	78
27	$\hat{Y}$ = -16.26 + 0.01EPP_1 + 1.96EPP_4 +1.40EP_{32}	89
28	$\hat{Y}$ = -13.01 + 0.02EPP_1 + 1.34EPP_4 +1.09EP_{36}	96

The present findings of $R^2$are in close proximity with findings of Kumar *et al*.[6], who developed prediction equation for annual egg production up to 64 wk of age based on EN_{40}, EN_{44}, EN_{48}, EN_{52}, body weight at 16 wk of age and AFE in various combination. With increase in the length of recording egg numbers the R^2 values for such equations increased from 53.3 percent to 87.1 percent. Similarly, Sakunthala Devi[7] predicted the values of the coefficient of determination, R^2 for the regression equations predicting EP_{64} from the combination of respective part records and AFE were as 35.03, 49.27, 55.19, 62.48 and 77.96 percent, respectively. Abraham[1] adopted step wise regression analysis to estimate part term egg production up to 40 and 52 week of age from various segments of egg production, age and body weight at sexual maturity and formed prediction equation.

The prediction equations recommended were:

1. EP_{40} = 7.1450 + 1.387 (P1) + 0.966 (P2) + 1.444 (P3)
2. EP_{40} = 16.917 + 1.035 (EP_{36})
3. EP_{52} = 11.904 + 1.414 (P1) + 1.308 (P2) + 1.420 (P3) + 1.823 (P4)
4. EP_{52} = 35.081 + 1.149 (EP_{40})

The R^2 values of these equations were 82.5 per cent, 92.9 per cent, 70.2 per cent and 79.4 per cent, respectively.

Samari *et al*.[8], also developed simple and multiple regression equation for predicting total egg production from partial or cumulative egg production in a stock of white leghorn in Iraq and concluded that the choice of the favourable prediction equations in dealing with partial egg production were that depended on second and third month egg production, whereas first 3 or 4 months could be the best choices in case of cumulative egg production. These findings are in accordance with present investigation.

The primary objective of this study is to find prediction equations for 40 wk egg production that depends on partial or cumulative egg production as early selection criteria. When selection is based on partial or cumulative part then generation interval decreases. Results indicated that prediction equation based on EP_{36} alone or in combination $wEPP_4$ is the best for prediction of 40 week egg production.

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