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Genetic evaluation of growth and production performance and short term selection response for egg mass in Gramapriya female line chicken

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ABSTRACT

A comprehensive study was carried out in Gramapriya female line (PD-3) with respect to growth, production, selection response and population structure utilizing the data generated for the last 7 generations at ICAR-Directorate of Poultry Research, Hyderabad, Telangana. The average fertility was 71.89% and hatchability was 80.52% on fertile egg set and 57.08% on total egg set. The least squares means (LSMs) for body weight at 4 and 6 weeks of age were 168.06±0.01 and 320.10±0.02 g, respectively. The heritability estimates from sire and dam components of variance were moderate to high for both body weight and shank length (0.27 to 0.35). The correlation coefficients (genetic and phenotypic) between body weights and shank length were positive and high in magnitude except with day old body weight. Age at sexual maturity (ASM) was 171.47±0.01 days in PD-3 population. The part period egg production (EP 40) at 40 weeks of age was 75.60±0.01 eggs with an egg mass (EM 40) of 4,157.19±0.99 g. The h^2 estimates for ASM, EW 40, EP 40 and EM 40 were 0.16±0.07, 0.42±0.11, 0.18±0.07 and 0.15±0.06, respectively, which were moderate to high in magnitude. The egg production at 40 weeks of age was negatively associated with ASM, body weight and egg weight at different ages. Egg mass had significant positive association with egg production and egg weight at 40 weeks of age. The selection intensity (i) ranged from 0.32 to 0.85 while, rate of inbreeding ranged between 0.0031 and 0.0033 in PD-3 line. The direct selection response was 151.54 g on genetic scale and 79.75 on phenotypic scale for primary trait of selection, EM 40 over the last 7 generations. Realized and estimated heritability estimates were 0.29 and 0.15, respectively for EM 40. The study concluded that, PD-3 population was in ideal condition with respect to growth and production performance. Positive selection response for primary trait EM 40 was observed in the population maintaining both egg production and egg weight, the important traits for sustainable rural poultry farming.

Keywords: Body weight, Chicken, Egg production, Genetic evaluation, Gramapriya, Heritability, Selection response

Genetic evaluation of pureline population is important to assess the population status with respect to different economic traits in poultry. Purelines developed through genetic selection are being used to develop crossbreds for backyard poultry farming involving native and exotic strains for backyard poultry farming (Ayyagari 2008, Padhi *et al.* 2016). The inheritance pattern of different economic traits and their association with other traits is essential in planning the breeding programs. Lot of focus has been given to the backyard poultry development by Government due to its proven potential for nutritional and livelihood improvements across the rural and tribal populations. Gramapriya female line (PD-3) is used as the female parent line of Gramapriya; a proven backyard variety known for its egg laying capacity in rural and tribal areas of the country. Genetic improvement of egg production without compromising the egg weight in female lines is very important to improve the production in terminal crosses. Egg mass has been the important economic trait in poultry to maintain the optimum required standards for both egg production and egg weight in the population as heavier eggs in large numbers are desirable for sustainable rural poultry production.

Genetic progress in the population is determined by the response to selection for primary trait as well as other correlated traits. The phenotypic response indicates the continuous source of additive and non-additive genetic variation in the selected population over the generations. Estimation of direct response to selection is very important in a selection experiment, but the magnitude and direction of correlated responses are also significant in developing effective breeding strategies for the improvement of the productivity (Rajkumar *et al.* 2016).

The studies on female parent lines of rural poultry germplasm with respect to genetic analysis and selection response are limited. Therefore, a comprehensive study in PD-3 population was carried out with respect to reproduction, growth, production and short term selection response for primary and correlated traits.

MATERIALS AND METHODS

Experimental population: PD-3 line was evolved from

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Dahlem Red, an exotic chicken breed from Germany over the last 20 years. The birds had reddish brown plumage and single comb. Birds lay brown coloured eggs. The data from 3500–4000 chicks and 450 hens maintained in each generation at ICAR-Directorate of Poultry Research experimental farm were utilized. The PD-3 line was under selection for higher 40 week egg mass (40 EM) for the last 7 generations.

Rearing and management practices: The chicks were wing banded on day one and reared in a deep litter system, with a decreasing temperature schedule from 33°C during first week to 23°C at the end of fifth week in an open-sided house under standard management practices. The chicks were fed *ad lib.* with layer starter (2,800 Kcal ME and 18% CP) diet based on maize-soybean meal up to 6 weeks of age. The birds were maintained on a layer grower ration (2,700 Kcal ME and 18% CP) upto 16 weeks of age and on layer breeder ration (2,650 Kcal ME, 16.50% CP and 3.5% Calcium) up to the end of the 40 weeks of age. The birds were vaccinated against Marek's disease (1^{st} day), Newcastle disease (ND), Lasota (7^{th} and 30^{th} day), infectious bursal disease (14^{th} and 26^{th} day), fowl pox (6^{th} week), ND R_2B (9^{th} week), infectious bronchitis (IB) and ND inactivated (18^{th} week).

Traits measured: The data collected on 3500 chicks for juvenile and 1042 hens for production traits during S-7 generation were utilized for estimation of LSMs for different traits. Juvenile growth traits such as body weight (day old, 2, 4 and 6 weeks); shank length (4 and 6 weeks); adult body weight (20 and 40 weeks); production parameters like age at sexual maturity (ASM), egg weight (24, 28, 32, 36 and 40 weeks), egg production (28 and 40 weeks) and egg mass (40 weeks) were recorded. The response in the primary trait was estimated utilizing the 7 generations data.

Statistical analysis: The data recorded on PD-3 line in S-7 generation in a pedigreed mating with 50 sires 200 dams were analyzed using least squares technique (Harvey 1990) with a computer package and the hatch corrected data were utilized for estimating the genetic parameters. Genetic and phenotypic responses were determined by regression of control deviated means and population means, respectively over the 7 generations. The hatch corrected data were utilized for estimating the heritability estimates by variance component analysis (King and Henderson 1954). The effective population size, selection intensity, rate of inbreeding and realized heritability were estimated by standard procedure described by Falconer and Mackay (1997).

RESULTS AND DISCUSSION

Reproductive parameters: Reproductive traits like fertility and hatchability determine the reproductive efficiency of the line. The average fertility was 71.89% over the last 7 generations. The hatchability was 80.52% on fertile egg set and 57.08% on total egg set basis. The hatchability on total egg set was poor in PD-3 line over the generations. Higher fertility (92.90%) and hatchability (83.33%) rates were reported in Dahlem Red (PD-3) population (Rajkumar *et al.* 2015). High fertility (86.96%) and hatchability (FES: 81.21% and TES: 70.74%) was reported in *Aseel* which was under selection for improved growth (Mohan *et al.* 2008, Haunshi *et al.* 2012), while lower fertility (67.18%) and hatchability on total egg set (44.71%) in wild *Aseel* chickens (Rajkumar *et al.* 2017). Sankyan *et al.* (2015) observed higher fertility in native and its crosses with Dahlem Red than the present findings. The variations in fertility and hatchability might be due to the differences in age of the birds and environmental conditions. Generally, fertility is influenced by genetic, physiological, environmental factors, egg production rate, nutritional status, lighting, sperm quality and age of hen (Faruque *et al.* 2013).

Juvenile traits: Initial growth plays an important role in realizing the optimum productivity from the birds. Therefore, proper balanced ration with optimum crude protein and energy is essential during the juvenile phase for ideal growth which will also continue during growing and laying phases. The juvenile body weights in the present study were comparable to that reported by Jha *et al.* (2013) in Dahlem Red and its crosses with *desi* chicken. Higher juvenile body weights (than the present findings) were reported in two and three way crosses developed for rural poultry farming (Rajkumar *et al.* 2018; 2019). Rajkumar *et al.* (2016) reported higher juvenile body weights in PD-1 line than PD-3 line. The lower body weights in PD-3 line was well justified as it is the female line with layer inheritance evolved from Dahlem Red population over the years. The selection for egg production influences body weights negatively which might be another reason for lower body weights as the line was under selection for higher egg production earlier.

The heritability estimates from sire and dam components of variance were moderate to high (Table 1) for both body weights and shank length indicating scope for further improvement through selection and breeding techniques. The sire component h^2 gradually increased from two to six weeks of age indicating the presence and increase of additive effects with age. The dam component h^2 gradually decreased due to reduction of maternal effects as age

Table 1. Body weight, shank length and heritability estimates in PD-3 line

Traits	LSMs±SE	Heritability		
		Sire (h^2_S)	Dam (h^2_D)	Sire + Dam (h^2_{S+D})
Body weight (g)				
0 day	37.11±0.002	–	–	–
2 wks	79.41±0.006	0.18±0.10	0.51±0.11	0.35±0.08
4 wks	168.1±0.001	0.25±0.10	0.33±0.08	0.29±0.06
6 wks	320.1±0.04	0.33±0.12	0.20±0.10	0.27±0.08
Shank length (mm)				
4 wks	57.23±0.001	0.34±0.09	0.24±0.08	0.29±0.09
6wks	61.64±0.002	0.35±0.10	0.23±0.08	0.30±0.08

LSMs, Least squares means; wks, weeks.

advances. Similar trend was observed in shank length also (Table 1). The moderate to high heritability estimates for body weight and shank length reveal that the traits have larger additive variance indicating scope for improvement though these are not primary traits. The findings of higher h^2 estimates were in agreement with the previous reports, which reported higher h^2 estimates for juvenile growth traits (Rajkumar *et al.* 2010; 2012; Reddy *et al.* 2008). The growth traits are considered to be highly heritable traits. Lower h^2 estimates for body weight at 2, 4 and 6 weeks of age were documented in PD-1 line than the present findings (Rajkumar *et al.* 2016).

The correlation coefficients (genetic and phenotypic) between body weights and shank length were positive and high in magnitude except with day old body weight (Table 2). The positive significant association between body weight and shank length in chicken was well established as both are positively correlated traits (Rajkumar *et al.* 2011, 2012), which will help the breeder to improve both the traits employing selection on either of the traits. The body weight and shank length were not primary traits in PD-3 line, but definitely optimum growth rate during juvenile stage is essential for better growth and productivity during the laying stage.

Production traits: The LSMs for adult body weight at 20 and 40 weeks was 1322±0.15 and 1,731±0.21 g, respectively (Table 3). The adult body weights play an important role in onset of egg production. The body weight at laying was within the standard range for a layer bird for optimum production during the laying cycle. The optimum body weight at laying is also an important parameter which

Table 2. Genetic (above the diagonal) and phonotypic (below) correlation coefficients for juvenile traits

	BW0	BW2	SL4	BW4	SL6	BW6
BW0	*	0.56	0.39	0.43	0.42	0.37
BW2	0.16	*	0.77	0.72*	0.70	0.68
SL4	0.10	0.59	*	0.93*	0.91*	0.93*
BW4	0.14	0.54	0.69	*	0.92*	0.99*
SL6	0.15	0.47	0.59	0.78	*	0.98*
BW6	0.15	0.46	0.55	0.76	0.80	*

*Significant (P≤0.05). BW0, Day old body weight; BW2, Body weight at 2 weeks of age; BW4, Body weight at 4 weeks of age; BW6, Body weight at 6 weeks of age; SL4, Shank length at 4 weeks of age; SL6, Shank length at 6 weeks of age.

determines the onset and quantum of egg production in chicken. The adult body weights were similar to that reported by Jha *et al.* (2013) in Dahlem Red chicken, while lower body weights were reported by Chandan *et al.* (2019) in White Leghorn chicken.

ASM determines the egg number in a laying cycle as lesser the ASM, higher will be the production. Higher ASM than the present study was observed by Padhi *et al.* (2001) and Reddy *et al.* (2008), while Rajkumar *et al.* (2011, 2012) reported lower ASM (157–160 days) in Naked neck chicken. Chandan *et al.* (2019) in White Leghorn chicken (136.85 days) and Jha *et al.* (2013) in Dahlem Red (143.65 days) also recorded lower ASM than the present study. The variations observed in ASM might be due to the feeding and lighting schedule followed during the grower (pullets) stage of the birds and also due to the genetic makeup of the breed.

Egg weight was always one of the important parameters in selection in layers and also plays a major role in consumer preference and marketing. Better early egg weight allows the breeder to reproduce the birds at an early age in the breeders resulting in improved economics due to more number of saleable chicks. The egg weights observed in the present study were comparable to the findings of Jha *et al.* (2013) in Dahlem Red chicken. Lower egg weights than the present study were reported by Rajkumar *et al.* (2014) in Aseel chicken; Kumar *et al.* (2016) in Rhode Island Red and Chandan *et al.* (2019) in White Leghorn. The part period egg production at 40 weeks of age was 75.60±0.01 eggs with an egg mass of 4,157±0.99 g (Table 3). Almost similar egg production at 40 weeks of age (73 eggs) was reported in Dahlem Red by Jha *et al.* (2013). Higher egg production at 40 weeks of age was reported in Rhode Island Red (95.4 eggs) by Kumar *et al.* (2016) and in White Leghorn (103.92) by Chandan *et al.* (2019) than the present findings which might be due to the genetic makeup of the lines, environment and management practices followed during the experimentation.

The heritability estimates for production traits were low to high from sire and dam components of variance (Table 3). Heritability gives an idea about the proportion of variance that can be transmitted to the offsprings of next generation and helps the breeder to plan the breeding strategy for improvement of the productivity. The ASM was moderately heritable with 0.16±0.07 h^2 estimate in PD-3 line. The h^2 from dam component of variance was relatively high indicating the higher maternal effects for ASM in adult birds. The h^2 estimates of body weights at 20 and 40 weeks was moderate

Table 3. Growth and production performance of PD-3 line

Trait	LSMs±SE	Heritability		
		h^2_S	h^2_D	$h^2_{(S+D)}$
ASM (d)	171.47±0.01	0.07±0.07	0.24±0.11	0.16±0.07
BW 20 (g)	1322.25±0.15	0.28±0.13	0.21±0.14	0.25±0.09
BW 40 (g)	1730.92±0.21	0.31±0.12	0.36±0.12	0.33±0.08
EW 24 (g)	45.34±0.002	–	–	–
EW 28 (g)	50.22±0.003	0.63±0.18	0.26±0.10	0.45±0.12
EW 32 (g)	51.98±0.004	0.55±0.16	0.26±0.10	0.41±0.11
EW 36 (g)	54.08±0.004	0.87±0.21	0.20±0.08	0.53±0.13
EW 40 (g)	55.31±0.004	0.45±0.15	0.38±0.12	0.42±0.11
EP 40 (g)	75.60±0.01	0.12±0.08	0.24±0.11	0.18±0.07
EM 40 (g)	4157.19±0.99	0.13±0.07	0.17±0.10	0.15±0.06

LSMs, Least squares means; ASM, Age at sexual maturity; BW 20, Body weight at 20 weeks of age; BW 40, Body weight at 40 weeks of age; EW 24, Egg weight at 24 weeks of age; EW28, Egg weight at 28 weeks of age; EW32, Egg weight at 32 weeks of age; EW40, Egg weight at 40 weeks of age; EP 40, Egg production at 40 weeks of age; EM 40, Egg mass at 40 weeks of age.

Table 4. Genetic (above the diagonal) and phonotypic (below) correlation coefficients for production traits in PD-3 line

Parameter	BW20	BW40	ASM	EW24	EW28	EW32	EW36	EW40	EP28	EP40	EM40
BW20	*	0.91*	–0.31	0.51	0.71*	0.55*	0.45	0.38	0.12	–0.29	0.12
BW40	0.23	*	–0.06	0.42	0.71*	0.59*	0.58*	0.56*	–0.11	–0.23*	0.06
ASM	–0.10	0.01	*	0.35	0.12	0.22	0.25	0.19	–0.98**	–0.42*	–0.34
EW24	0.11	0.17	–0.11	*	0.77**	0.53*	0.41*	0.56*	0.15	–0.03	0.28
EW28	0.16	0.25	0.04	0.40	*	0.96**	0.81*	0.80*	–0.11	–0.12	0.30
EW32	0.11	0.25	0.10	0.30	0.55	*	0.91**	0.89**	–0.23	–0.16	0.34*
EW36	0.11	0.31	0.07	0.25	0.43	0.54	*	0.85*	–0.22	–0.24*	0.21
EW40	0.13	0.32	0.06	0.29	0.48	0.53	0.57	*	–0.31*	–0.36*	0.18
EP28	0.10	–0.05	–0.72	0.06	–0.06	–0.17	–0.12	–0.12	*	0.61*	0.48*
EP40	–0.18	–0.09	–0.51	0.04	–0.04	–0.10	–0.09	–0.41	0.62	*	0.85**
EM40	0.10	0.10	–0.48	0.15	0.13	0.11	0.09	0.23	0.57	0.94	*

ASM, Age at sexual maturity; BW 20, Body weight at 20 weeks of age; BW 40, Body weight at 40 weeks of age; EW 24, Egg weight at 24 weeks of age; EW 28, Egg weight at 28 weeks of age; EW 32, Egg weight at 32 weeks of age; EW 40, Egg weight at 40 weeks of age; EP 40, Egg production at 40 weeks of age; EM 40, Egg mass at 40 weeks of age.

to high. The higher h^2 for adult body weight was justified as the body weight was a highly heritable trait irrespective of age. Similar observations of moderate to high h^2 estimates for body weights were recorded by Reddy *et al.* (2008); Rajkumar *et al.* (2011; 2012) in Naked neck chicken. The variations in the heritability estimates might be attributed to breed, environmental effects and sampling errors during the experimentation. The non-genetic factors like environment and poor management might increase the residual variance and decrease the h^2 estimates (Adeyinka *et al.* 2006).

The h^2 estimates of egg weights were higher in magnitude (0.41 to 0.53) from sire component of variance (Table 3) in PD-3 line. The h^2 from sire and dam components was higher for egg weights indicating the presence of additive genetic effects for egg weights in addition to the maternal effects. Reddy *et al.* (2008), Rajkumar *et al.* (2011) and Chandan *et al.* (2019) observed comparable h^2 estimates for egg weights at 28, 32 and 40 weeks of age in different chicken breeds but in these studies the dam components of variance was higher. The 40 week egg production and egg mass were lowly heritable traits with h^2 estimates of 0.18±0.07 and 0.15±0.06, respectively in PD-3 line. The h^2 from dam component of variance was higher indicating the presence of maternal effects in addition to the additive effects for egg production as it was a sex limited trait. The h^2 estimates observed in PD-3 line were in agreement with the findings of Niknafs *et al.* (2012) for EP 40 (0.17±0.01) and EM 40 (0.16±0.01) in Majandaran chicken from Iran. Varied h^2 estimates ranging from low to high were documented for egg production in the literature (Jilani *et al.* 2007, Reddy *et al.* 2008, Rajkumar *et al.* 2011). Kumar *et al.* (2016) observed very low (0.061) estimates for h^2 in RIR population. However the present estimates are fairly reasonable keeping in view the low heritable nature of the trait. Changes in heritability over time may result from activation of different genes during the production cycle like early stage production was influenced by genes related sexual maturity whereas later stage (after seven months) by the genes related to persistency of egg production (Niknafs *et al.* 2012).

The correlation coefficients between 20 and 40 week body weights were significantly ($P \leq 0.05$) and positively associated in PD-3 line (Table 4). The heavier birds laid heavier eggs indicating the positive association between body weights and egg weights. The ASM and body weight at 20 and 40 weeks of age were negatively associated with low magnitude indicating that the heavier fast growing birds matured early. The ASM and egg weights also had positive correlations with low correlation coefficients; the birds matured late laid heavier eggs at all ages. The egg weights at different ages had significant ($P \leq 0.05$) positive correlation. The positive association between the body weights and egg weight at different weeks has been well established fact (Rajkumar *et al.* 2011, 2012; Adeyinka *et al.* 2006, Reddy *et al.* 2008). Both genetic and phenotypic correlations showed almost similar trend with varying magnitudes.

The egg production at 40 weeks of age was negatively associated with ASM, body weights and egg weights at different ages (Table 6). Egg production at 28 weeks of age also showed similar trend except with few traits which may be due to sampling error. The egg mass at 40 weeks of age and body weights had positive association between them with very low magnitude (r=0.06–0.12). Egg mass and ASM had negative association as the early matured birds laid smaller eggs resulting in lower egg mass. Egg mass and egg weights at different ages had positive association as larger eggs contributed more to the egg mass. The egg mass and egg production had a significant ($P \leq 0.05$) positive association in PD-3 line. The negative association of egg production with body weights and ASM is well documented phenomenon (Rajkumar *et al.* 2011, 2012; Reddy *et al.* 2008). The association between egg productions with all other traits was in agreement with the earlier studies in various chicken populations (Jilani *et al.* 2007, Reddy *et al.* 2008).

The effective population size (Ne) ranged from 154 to 160 in PD-3 line. The selection intensity (i) ranged from 0.32 to 0.85 while, rate of inbreeding ranged between 0.0031 and 0.0033, in the last 7 generations (Table 5). The

Table 5. Effective population size and rate of inbreeding in PD-3 population

Generation	No of sires	No of dams	Effective population size (Ne)	Rate of inbreeding (ΔF)	Selection intensity (i)
S–0	48	192	153.6	0.0033	
S-1	49	196	156.8	0.0032	0.32
S-2	50	200	160	0.0031	0.46
S-3	50	200	160	0.0031	0.71
S-4	50	200	160	0.0031	0.85
S-5	50	200	160	0.0031	0.72
S-6	50	200	160	0.0031	0.46
S-7	50	200	160	0.0031	0.79

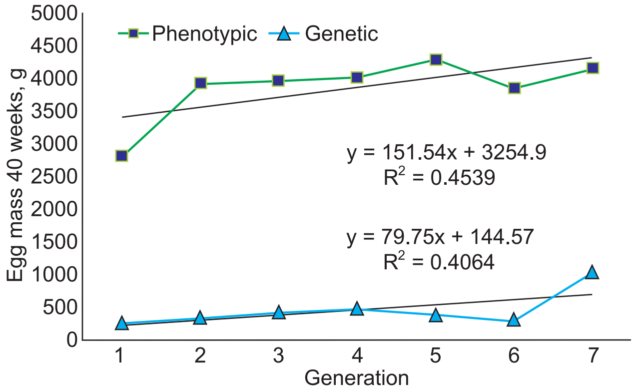

Fig 1. Direct genetic and phenotypic response for egg mass at 40 weeks of age, the primary trait.

selection records estimated from the number of sires and dams utilized for pedigreed mating indicated that the population was under ideal condition. Selection response was the function of effective population size (Ne) and the size of Ne was large enough to avoid any inbreeding in the population as evidenced by the low rate of inbreeding in the population. The larger Ne helps in improving the genetic response by reducing the inbreeding depression as well as preventing the loss of desirable alleles due to genetic drift in the population (Dunnington *et al.* 2013). The selection intensity appears to be less over the generations though it was positive with an increase of 79.75 g in EM 40. The low intensity might be due to the sample size used for selection which ranged from 400 to 450 hens in each generation over seven generations.

The direct genetic and phenotypic response to selection in primary trait EM 40 was 151.54 and 79.75 g (P<0.05), respectively (Fig. 1) over the last seven generations. The correlated genetic response in EP 40 and EW 40 was 0.29 eggs and 0.02 g, respectively (Table 6). The short term selection responses were in positive direction for the primary trait of selection (EM 40) indicating the improvement of the trait over the generations. In any selection experiment, the underlying genetic theory was that response for a quantitative trait would continue only if additive genetic variation remains in the population or if spontaneous mutations occurs that influence the performance of the trait under selection (Dickerson 1955, Falconer and Mackay 1997) and also due to epistasis and gene interaction that influence the phenotypic expression (Dunnington *et al.* 2013). In short term selection experiment over a few generations, the response to selection is primarily a function of the alleles segregating in the base population (Fuller *et al.* 2005). The positive response observed in egg mass might be due to the ideal breeding program without adverse effects of inbreeding depression, large effective population size and the pleiotropic effects of the loci for growth (Rajkumar *et al.* 2016).

Table 6. Direct and correlated response for production traits in each generation in PD-3 line

Parameter	Genetic response	Phenotypic response	Realized heritability	Estimated heritability
Direct response				
EM 40, g (primary trait)	151.54	79.75	0.29	0.15
Correlated response				
EP 40 (no)	0.29	0.73	0.06	0.18
EW 40 (g)	0.02	0.39	0.73	0.42

EM 40, Egg mass at 40 weeks of age; EP 40, Egg production at 40 weeks of age; EW 40, Egg weight at 40 weeks of age.

Realized and estimated heritability estimates were 0. 29 and 0.15, respectively for EM 40, the primary trait of selection in the population. Realized heritability estimates were lower than the estimated ones for EM 40 and EW 40, while higher for EP 40 (Table 6). The higher estimate of realized heritability for primary trait in the present study is in accordance with the reports of Reddy *et al.* (2013) in broiler chickens and Rajkumar *et al.* (2016) in PD-1 line. Higher realized heritability estimates in short term selection experiments are common due to the presence of high degree of variation in the base population which tends to reduce the variation over the period of time resulting in lower magnitudes of realized heritability. However, the realized heritability estimates for EP 40 was lower which might be attributable to reduced variation for the trait. Discrepancies between realized and estimated heritability estimates might be due to accumulation of inbreeding, changes in gene frequency and/or mutations (James 1990). The realized heritability is a function of linear regression of response over the generations which could only be an approximation as the response was never linear (Pinard *et al.* 1992) in a biological system.

The study concluded that, PD-3 population was in ideal condition with respect to growth and production performance. Positive selection response for primary trait EM 40 was observed in the population maintaining optimum levels for both egg production and egg weight, the important traits for sustainable rural poultry farming.

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