International Journal of Veterinary Sciences and Animal Husbandry

ISSN: 2456-2912
VET 2023; 8(6): 24-28
© 2023 VET
www.veterinarypaper.com
Received: 02-08-2023
Accepted: 04-09-2023

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Growth performance of HD-K75 Pigs in the original nucleus Herd

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Abstract
Investigation was carried out to study the growth performance of HD-K75 pigs at original nucleus herd (ICAR-All India Co-ordinate Research Project on Pig, Assam Agricultural University, Khanapara, Guwahati, Assam). Body weights and daily body weight gain along with the effects of generation of birth and sex on them were studied. Data pertaining to 889 animals from 3rd crop of 14th, 15th, 16th and 17th generation born to 103 dams and 35 sires were utilized. Least-squares means (LSM) for body weights were found to be 0.994±0.002,9.845±0.009, 12.140±0.019, 27.821±0.033, 48.038±0.037 and 74.972±0.027 kg at birth, weaning, 2, 4, 6 and 8 months of age. LSM for daily body weight gain during birth to weaning, weaning to 8 months and birth to 8 months of age was 210.765±0.194, 328.937±0.141 and 308.248±0.113g. Highly significant effect of generation of birth and sex were observed in body weights and daily body weight gain. Pigs born to Generation 4 showed higher values for most of the studied traits. Body weights and daily body weight gain were significantly higher in males during earlier ages and in females shown during later ages.

Keywords: HD-K75, body weight, daily body weight gain

Introduction
Pig is bestowed with high prolificacy, faster growth rate, shorter generation interval and higher dressing percentage. They are mostly reared for meat purpose. The demand for high quality pork and pork products has recently increased worldwide. The production performance of indigenous pigs of Assam is low. Hence, to improve the performance, a new variety of pig developed by ICAR- All India Co-ordinate Research Project (AICRP) on pig, Assam Agricultural University, Khanapara, Guwahati, Assam, India by crossing Hampshire with indigenous pigs (Doom) i.e. HD-K75 (75% Hampshire and 25% indigenous). These pigs proved to have high production performance and better adaptability in prevailing condition of Assam and gaining popularity too. This enabled to availability of quality piglets to the pig farmers of Assam as well as neighbouring states. Further, one of the most important factors which have direct impact on profitability of a swine enterprise is the growth performance. To be well acquainted with the performance of pigs in a farm will maximise profit. A study on growth performance especially the body weight at different ages as well as the daily body weight gains is needed to access the growth performance. Selections based on growth parameters can be used as a selection criterion of different categories of pigs in a breeding farm. Also for early selection of pigs, pre-weaning growth characteristics are the best indicator. Pigs with higher body weight at birth and weaning results positive growth throughout the life span. Keeping in view of these aspects, the present investigation was carried out to study the growth traits of pigs namely body weight at different ages and daily body weight gain at different age groups in HD –K 75 in original nucleus herd.

Materials and Methods
The performance record of 889 progenies from 35 sires and 103 dams of breeding stock maintained at ICAR-All India Co-ordinate Research Project (AICRP) on pig, Assam Agricultural University, Khanapara, Guwahati, Assam over the period from 2012 to 2018 belonging to 14th, 15th, 16th and 17th generation constituted the materials of the present investigation.

Traits considered for the present study were growth traits *viz.* body weight at birth, weaning (42 days), 2, 4, 6 and 8 months and average daily body weight gain (g) during birth to weaning, weaning to 8 months and birth to 8 months**.** The individual animal was weighed in the morning hours before feeding and watering by using platform weighing balance. The daily body weight gain (in grams) was calculated by following method (Steel and Torrie, 1981) [34].

$$Average\ daily\ body\ weight\ gain = \frac{W_2 - W_1}{T_2 - T_1}$$

Where

W_1 and W_2: initial weight and final weight of the animal, T_1 and T_2: initial time and final time unit at which W_1 and W_2 were measured. The data were classified according to generation and sex of the animals (Table1). The means and their Standard Errors (SE) were calculated on adjusted data as per standard statistical procedure given by Snedecor and Cochran (1967) [16]. The least-square technique (Harvey, 1975) [16] was used to study the effects of various genetic and non-genetic factors *viz*. generation and sex of the animal. Duncan's Multiple Range Test (DMRT) as modified by Kramer (1957) [21] was used for pair wise comparison of means in order to test the significance of difference among the different sub classes in respect of various traits.

The Mathematical models employed in the Least-Squares Analysis for growth traits:

$$Y_{ijk} = \mu + G_i + S_j + E_{ijk}$$

where,

Y_{ijk} - record of k^{th} individual belong to i^{th} generation and j^{th} sex.

μ - overall population mean common to all observations.

G_i - effect of i^{th} generation (1, 2, 3 and 4)

S_j - effect of sex (1 and 2)

E_{ijk} - random error associated with each observation assumed to be normally and independently distributed with mean zero and variance σ_e^2.

Table 1: Classification of data

Sl. no	Generation	Description
1.	14^{th} generation (G_1)	The animals belong to the 3^{rd} crop of 14^{th} generation (2012) of HD-K75 were included in this group.
2.	15^{th} generation (G_2)	The animals belong to the 3^{rd} crop of 15^{th} generation (2014) of HD-K75 were included in this group.
3.	16^{th} generation (G_3)	The animals belong to the 3^{rd} crop of 16^{th} generation (2016) of HD-K75 were included in this group.
4.	17^{th} generation (G_4)	The animals belong to the 3^{rd} crop of 17^{th} generation (2018) of HD-K75 were included in this group
Sex		
1.	S_1	Male
2.	S_2	Female

Results and Discussions

The least-squares means (LSM) for body weights of HD-K75 were found to be 0.994±0.002, 9.845±0.009, 12.140±0.019, 27.821±0.033, 48.038±0.037 and 74.972±0.027 kg at birth, weaning, 2, 4, 6 and 8 months of age, respectively (Table 2). Kalita *et al.* (2001) [18] and Deka *et al.* (2003) [11] observed similar findings for weaning weight in graded pigs (¼ I. ¾ H), and Khatun (2018) [20] reported comparable weights at birth, weaning, 2, 4, 6 and 8 months of age in graded (¼ I. ¾ H) pigs. A higher body weight were reported Phookan *et al.* (2013) [28] at birth in graded (¼ I. ¾ H), Kumar *et al.* (2018) [22] at birth, weaning in 2, 4,6 and 8 months of age in graded (¼ I. ¾ H) at AICRP on Pig, Ranchi, Sharma *et al.* (2019) [31] at birth and weaning in Hampshire pigs and Naha *et al.* (2020) at weaning in Landly pigs. However, comparatively lower body weights were reported by Kalita *et al.* (2001) [18] and Deka *et al.* (2003) [11] lower body weight at 4,6 and 8 months of age in graded (¼ I. ¾ H), Banik *et al.* (2013) [2] in Niang Megha and Ghungroo pigs maintained at ICAR-NRC on pigs, Rani, Phookan *et al.*(2013) [28] at 4,6,8 months of age in graded (¼ I. ¾ H), Kumar *et al.* (2018) [22] lower body weight in 2, 4,6 and 8 months of age in graded (¼ I. ¾ H) at AICRP on Pig, Ranchi, Gaur *et al.* (2019) [15] in graded (¼ I. ¾ L) pigs of 2 months age and Chaudhary *et al.* (2020) [5] at 2, 4,6 and 8 months of age in graded (¼ I. ¾ L) pigs.

Table 2: Least Square Means and Standard Errors for body weight (kg) of HD-K75 pigs at birth, weaning, 2, 4, 6 and 8 months of age

Effects	Birth	Weaning (42 days)	2 month	4 month	6 month	8 month
Overall	0.994±0.002(889)	9.845±0.009(864)	12.140±0.019(854)	27.821±0.033(808)	48.038 ± 0.037(782)	74.972 ± 0.027(756)
Generation						
G1	$0.968±0.004^{a}$(172)	$9.702±0.020^{a}$(167)	$11.982±0.043^{a}$(165)	$27.602±0.074^{a}$(160)	48.118±0.082(158)	$75.084±0.059^{a}$(154)
G2	$0.97±0.003^{a}$(235)	$9.780±0.017^{b}$(226)	$12.084±0.036^{ab}$(224)	$27.573 ±0.063^{a}$(215)	47.917±0.071(208)	$74.651±0.052^{b}$(196)
G3	$0.998±0.003^{b}$(237)	$9.925±0.017^{c}$(231)	$12.393±0.036^{c}$(228)	$28.010±0.063^{b}$(218)	47.960±0.070(208)	$75.034 ±0.052^{a}$(202)
G4	$1.033±0.003^{c}$(245)	$9.975±0.016^{c}$(240)	$12.101±0.035^{b}$(237)	$28.098±0.064^{b}$(215)	48.157±0.073(208)	$75.120±0.053^{a}$(204)
Sex						
1	$1.015±0.002^{a}$(473)	$9.923±0.012^{a}$(456)	$12.306±0.026^{a}$(449)	$28.150±0.045^{a}$(428)	$48.259±0.051^{a}$(411)	$74.569±0.037^{a}$(393)
2	$0.973±0.002^{b}$(416)	$9.768±0.013^{b}$(408)	$11.970±0.027^{b}$(405)	$27.492±0.048^{b}$(380)	$47.817±0.053^{b}$(371)	$75.375±0.039^{b}$(363)

NB: The least square means and standard errors with different superscripts differ significantly at $P<0.05$. Within parentheses are the numbers of observations.

Effect of generation: The least squares analysis of variance (Table 3) showed highly significant ($P<0.01$) effect of generation on body weights at all ages under the study except at 6 month age body weight. The body weights were significantly highest in G4 at birth, weaning, 4 months and 8 months except at 2 month age where body weight was highest at G3. Similar highly significant ($P<0.01$) effect of period of birth on body weight was reported by Phookan (2008) [29] in graded (75% H. 25%I) pigs and Khatun (2018) [20] in T&D Pigs. However, the effect of generation of the animals

observed by Roehe *et al.* (2009) [30] in Indigenous pigs of Edinburgh, Scotland, Oduro *et al.* (2009) [25] in Indigenous pigs in Northern Ghana and Khatun (2018) [20] in graded (75% H. 25%I) pigs were contrary with the present study. Corroborating with the present study, highly significant (P<0.01) effect of period of birth on body weight was reported by Shylla *et al.* (1991) [32] in Indigenous pigs of Assam, Nath (1993) [24] in graded (75% H.25%I) pigs, Bhowal (1997) [4], Deka (2000) [10] and Phookan (2008) [29] in graded (75% H.25%I) pigs, Khatun (2018) [20] in T&D Pigs. On the other hand, in indigenous pigs Chauhan *et al.* (1993) [8] observed non-significant effect in his study at AICRP on Pigs, IVRI. Generation to generation variation in body weights may be due to the difference in managemental system or may be due the effect of the season of birth of the piglets.

Effect of sex

The least-squares analysis of variance (Table 3) showed that the effect of sex on body weight at different ages of growth under study were highly significant (p<0.01). Significantly higher body weight was observed at all the stages of growth from birth upto 6 months of age in males. This might be due to influence of male hormone androgen.

Table 3: Least-Squares Analysis of variance for factors affecting body weight at different ages.

Sources Of Variation	Birth		Weaning (42 days)		2 months		4 months		6 months		8 months	
	DF	MSS	DF	MSS	DF	MSS	DF	MSS	DF	MSS	DF	MSS
Generation	3	0.182**	3	3.249**	3	6.545**	3	15.026**	3	2.757^{NS}	3	9.313**
Sex	1	0.395**	1	5.115**	1	23.566**	1	87.174**	1	38.173**	1	122.538**
Error	884	0.003	859	0.068	849	0.305	803	0.878	777	1.066	751	0.553
** : P < 0.01 NS: Not Significant												

However, comparatively higher body weight at 8 months of age was observed in female pigs (Table 2). This might be due to the hormonal changes occurred in females after attaining sexual maturity.

Similar effect of sex on body weights at different ages were reported by Deka *et al.* (2003) [11] and Phookan (2008) [29] in graded (75% H. 25%I) pigs maintained at ICAR-AICRP on Pigs, AAU, Khanapara, Banik *et al.* (2013) [2] in Ghungroo and Niang Megha pigs and Khatun (2018) [20] in T&D pigs at ICAR-MSP on Pigs, AAU, Khanapara. However, Kalita *et al.* (2001) [18], Khatun (2018) [20] and Bey (2018) [3] observed non significant effect of sex on body weight in graded (75% H.25%I) pigs.

Daily body weight gain

The average daily body weight gain (g) at different period of growth from birth to weaning, weaning to 8 month and birth to 8 month of age along with standard errors were found to be 210.765±0.194, 328.937±0.141 and 308.248±0.113 g respectively (Table 4).

Table 4: Least-Squares Means (LSM) with Standard Errors (SE) and results of DMRT for factors affecting daily body weight gain (g) at different periods of growth

Effect	Birth to weaning	Weaning to 8 months	Birth to 8 months
Overall	210.765±0.194 (864)	328.937±0.141 (756)	308.248±0.113 (756)
Generation			
G_1	207.950±0.436^a (167)	330.212±0.311^a (154)	308.814±0.249^a (154)
G_2	209.633±0.375^b (226)	330.006±0.275^a (196)	308.943±0.220^a (196)
G_3	212.548±0.371^c (231)	328.861±0.271^b (202)	308.483±0.217^a (202)
G_4	212.927±0.364^c (240)	326.671±0.270^c (204)	306.752±0.216^b (204)
Sex			
S_1	212.111±0.265^a (456)	326.549±0.195^a (393)	306.488±0.156^a (393)
S_2	209.418±0.280^b (408)	331.326±0.203^b (363)	310.008±0.162^b (363)
Least squares means for the factors with different superscripts differed significantly (p< 0.05), N : Number of observations			

Khatun (2018) [20] observed lower daily body weight gain (179.864±0.512) during pre-weaning period in Hampshire cross. In addition, Kaushik *et al.* (2013) [19] in Hampshire maintained at ICAR-NRC on Pigs and Banik *et al.* (2013) [2] in Ghungroo and Niang Megha pigs also found lower findings.

Effect of generation: Effect of generation in the present investigation was found to be highly significant (P < 0.01) during birth to weaning, weaning to 8 months and birth to 8 months of age (Table 5). The daily body weight gain during the period from birth to weaning was found to be significantly highest in Generation 3 and 4. The daily body weight gain during the period from weaning to 8 months was found to be similar in Generation 1 and 2 and significantly highest than rest. The daily body weight gain during the period from birth to 8 months was found to be similar in Generation 1, 2 and 3 and higher than Generation 4. Highly significant (p<0.01) effect of generation was also observed by Nath (1993) [24], Bhowal (1997) [4] in graded (¼ I.¾ H) pigs, Oduro *et al.* (2009) [25] in Indigenous pigs of Ghana, Roehe *et al.* (2009) [30] in Indigenous pigs of Edinburgh, Pandey *et al.* (2010) [26] in Desi pigs of Jharkhand and Carter *et al.* (2013) [5] in Indigenous pigs of Western Kenya, Khatun (2018) [20] in graded (¼ I.¾ H) pigs, Zotti *et al.* (2017) [35] in crossbred (Hampshire and Indigenous) pigs of Brazil and Khatun (2018) [20] in T&D pigs of AICRP on pigs, AAU, Khanapara. The significant effect of generation on pre weaning and post weaning daily body weight gain was observed by Banik *et al.* (2014) [1] in Hampshire pigs at NRC on pig.

Table 5: Least-Squares Analysis of variance for factors affecting daily body weight gain at different periods of growth.

Sources of variation	Birth to weaning		Weaning to 8 month		Birth to 8 month	
	DF	MSS	DF	MSS	DF	MSS
Generation	3	1139.805**	3	505.270**	3	203.322**
Sex	1	1560.169**	1	4304.080**	1	2336.476**
Error	859	31.785	751	14.924	751	9.555
** : $p< 0.01$						

Effect of sex:=

The influence of sex on daily body weight gain was found to be highly significant ($P<0.01$) as shown in Table 5. Significantly higher daily body weight gain was observed in male during birth to weaning whereas higher daily body weight gain was observed in females during weaning to 8 months and birth to 8 months of age respectively (Table 4). Highly significant effect of sex on pre weaning daily body weight gain was observed by Bhowal (1997) [4] in graded (¼ I.¾ H) pigs, Ferdoci (2001) [13] in Hampshire pigs at Kyredemkulai, Meghalaya and Kumari *et al.* (2007) [22] in Indigenous pigs maintained at Tamil Nadu Veterinary and Animal Sciences University (TANUVAS). Chauhan *et al.* (1993) [8], Gaur *et al.* (1997) [14], Oduro *et al.* (2009) [25], Carter *et al.* (2013) [5] and Faccin *et al.* (2020) studied Indigenous pigs and found significant effect and comparatively higher daily body weight gain in male was observed. However, Nath (1993) [24] in graded (¼ I.¾ H) pigs of AAU, Khanapara, Pandey *et al.* (1997) [27] in crossbred pigs of Tameworth and Desi of Birsa Agricultural University (BAU), Ranchi, Deka (1999) [9] and Khatun (2018) [20] in graded (¼ I.¾ H) pigs of AAU, Khanapara and Khatun (2018) [20] in T&D pigs at AICRP on pigs, AAU, Khanapara recorded that sex had no significant influence on pre and post weaning daily body weight gain.

Conclusion

The HD-K75 pigs developed by ICAR-AICRP on Pig, AAU, Khanapara, Guwahati, Assam is having a higher good growth performance with better adaptability in socio economic condition of Assam. Time to time study on growth performance of pigs in a nucleus herd is necessary to have an overview of performance over the years. Information about growth performance will assist in selection of pigs at an early age for better production. This can help in providing quality piglets to the farmers which will improve their economic status.

Acknowledgement: The authors sincerely acknowledge Indian Council of Agricultural Research and Assam Agricultural University, Jorhat for the needful support.

Conflict of interest

No conflict of interest was raised in the present study.

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