Genetic Trend for Growth in a Closed Indian Herd of Landrace × Desi Crossbreds

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ABSTRACT : This study has objectives of to estimate the genetic and phenotypic trend for growth in a closed herd of Landrace × desi crossbreds. The possibility of early selection of boars was also investigated in order to reduce generation interval and thus, to enhance response per year in selection programmes. The data originated from Livestock Production Research (Pigs), Indian Veterinary Research Institute (IVRI), Izatnagar (UP), India - a unit of All India Coordinated research Project on Pigs (AICRP on Pigs). Data consisted of 891 crossbred piglets, progeny of 29 boars. The piglets were born in 132 parities of 72 sows between 8 years from 1987 to 1994. Records on weight at birth, at 2 weeks interval upto 8 weeks of age (W1, W2, …… W8) and at 16th week (W16) were used in this investigation. BLUP estimates of the sires were computed. Breeding value of each sire was estimated as twice of sire and sire group solutions. Phenotypic trend was estimated as regression of weight performance on year. Genetic trend was computed by estimating regression of breeding value of sires on time.

Average body weights ranged from 0.92 kg (W1) to 18.95 kg (W16) and showed a continuous increase over age. Heritabilities of the weight at 4th and 6th week were medium (0.29 and 0.14). Rest of the weights were highly heritable. The product moment and rank, both correlations were high between breeding value for W6 and W16 (0.68 and 0.70). This shows that sire selection for W6 can be successfully implemented in order to achieve sufficient genetic improvement in growth. Phenotypic trend was positive at all ages. The phenotypic regression coefficient ranged from 0.02 kg at birth to 0.40 kg at 16 weeks. Genetic trend was also positive. The regression coefficients of average breeding value of sires on time showed a range of 1.471 kg (0.021 to 1.492 kg) for different weights. These coefficients were significant and higher than their corresponding phenotypic regression coefficient.
(**Key Words**: Pigs, Crossbreds, Growth, Genetic Trend)

INTRODUCTION

Pig breeding programmes have been very successful in the improvement of animals by the simple expedient of focusing on a few traits of economic importance, particularly, growth efficiency and leanness (Haley, 1991). Selection on the basis of an index incorporating growth rate and fat thickness has been reported to improve the pigs genetically by reducing backfat thickness and increasing growth rate (Slanev and Vangelov, 1991). It was also suggested that investigations should be further carried out on these results continuing direct selection for growth.

Selection for growth in pigs is implemented at two stages in India. Piglets are formerly selected based on weaning weight and thereafter, selection of breeding pigs is done during post weaning period. However, medium heritability estimates of growth provides strong evidences for proper implementation of progeny testing scheme in order to get reasonable genetic improvement (Mani, 1993 and Bae et al., 1994).

Estimation of breeding values of boars using best linear unbiased prediction (BLUP) procedure is considered to be more advantageous than other procedure (Bampton, 1992; Brandt, 1993; Bae et al., 1994). If ranks of the sires for weight at postweaning stage are similar to that of preweaning stage, practical selection at early age of life can be recommended without sacrificing the total genetic improvement in growth. The genetic trend which expresses increase in genetic level of performance over unit period of time is an important tool for estimating actual genetic progress in a herd (Smith, 1966; Everett et al., 1967). No breeding programme can be considered effective till genetic trend received is positive and significant. This study has objectives of to estimate the genetic and phenotypic trend for growth in a closed herd of Landrace × desi crossbreds. The

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possibility of early selection of boars was also investigated in order to reduce generation interval and thus to enhance response per year in selection programmes.

MATERIALS AND METHODS

The data utilized for this study originated from Livestock Production Research (Pigs), Indian Veterinary Research Institute (IVRI), Izatnagar (UP), India - a unit of All India Coordinated Research Project on Pigs (AICRP on Pigs). All India Coordinated Research Project on Pigs was started in 1970 during Fourth Five Year Plan to study the performance of exotic breeds of pigs under different agroclimatic conditions. The IVRI centre came into existence during the year 1971, as one of the centres of the above project. The research work was only conducted on Landrace breed of pigs upto the Fifth Five Year Plan. Initially, the herd was comprised of 62 female and 12 male piglets of Landrace breed. To constitute this population, 50 females and 10 males pertaining to 3 sire lines from Government Bacon Factory, Gannavaram, Andhra Pradesh and 12 females and 2 males pertaining to 2 sire lines from Government Bacon Factory, Harringhata, West Bengal were procured. Subsequently, in Sixth Workshop on AICRP on Pigs held at College of Veterinary Science, APAU, Tirupati in 1980, the technical programme of the project was modified. One of the main objective of the revised programme was to conduct the research work on indigenous pigs under optimum managemental conditions and to produce crossbred pigs by crossing indigenous gilts with exotic boars. Comparative performance of these genotypes in respect of efficiency of feed conversion, production and reproduction was assessed. For implementation of the programme, 78 indigenous pigs (25 males and 53 females) of about 3-4 months of age were purchased from local area by the end of October, 1983.

The Izatnagar centre (IVRI) is located at an altitude of 564' above the mean sea level, at latitude of 28°N and longitude of 79°E. The climate of this place touches both the extremes of cold and hot weather experienced in the country and the relative humidity ranges between 15 and 85 percent.

Crossbred group of animals having 50% exotic inheritance was maintained for 5 generations. The piglets were housed in Pakka system. Sufficient space was provided to each individual according to age. Piglets were injected 1 ml iron dextran on 4th and 14th day of birth. Creep ration rich in protein (Protein 21%, Lysine 0.89% and ME 3.36 Mcal/kg) was started from 3rd week onward and was continued upto weaning age (8 weeks of age). Weaned piglets were given *ad lib* concentrate, thereafter. The ration consisted of 20% protein, 0.78% lysine and 3.17 Mcal/kg ME. Female piglets were housed in a group of 5-7 upto the age of 32 weeks. Piglets were vaccinated for foot and mouth disease and swine fever, both.

Data consisted of 891 crossbred piglets, progeny of 29 boars. The piglets were born in 132 parities of 72 sows between 8 years from 1987 to 1994. Records on weight at birth, at 2 weeks interval upto 8 weeks of age (W1, W2 ······ W8) and at 16th week (W16) were used in this investigation. Inbreeding coefficient of each piglet was estimated by pedigree procedure as given by Wright (1921). Each year of birth was divided into 4 seasons based on agroclimatic conditions of the locality i.e. December to Februdary, March to May, June to August, September to November. Data were analyzed using Least Squares and Maximum Likelihood Computer Programme (Harvey, 1990) using following model.

$$Y_{ijklmnop} = \mu + G_i + S_{ij} + SE_k + P_l + LS_m + SX_n + INB_o + b_{ijklmnop} + e_{ijklmnop}$$

where, $Y_{ijklmnop}$ = observations on pth progeny of jth sire belonging to ith generation; μ = overall mean, G_i = fixed effect of ith generation, S_{ij} = random effect of jth sire within ith generation, SE_k = fixed effect of kth season of farrowing, P_l = fixed effect of lth parity, LS_m = fixed effect of mth litter size group, SX_n = fixed effect of nth sex, INB_O = fixed effect of oth inbreeding group, $b_{ijklmnop}$ = linear regression of observation on age of dam at farrowing and $e_{ijklmnop}$ = random error.

Sires were categorized into 5 groups based on generation number in which their first litter was born. BLUP estimates of the sires were computed using specified option in the above package and prior values of heritabilities. Breeding value of each sire was estimated as twice of sire and sire group solutions. Phenotypic trend was estimated as regression of weight performance on year. Genetic trend was computed by estimating regression of breeding value of sires on time (Southwood and Kennedy, 1991). Average breeding value of sires in a year was in fact weighted average taking number of progeny of sires in that year into account.

RESULTS AND DISCUSSION

Table 1 shows the averages, standard deviations and heritabilities of the growth at different ages. Average body weights ranged from 0.92 kg (W1) to 18.95 kg (W16) and showed a continuous increase over age. The average values were similar to the findings of Sharda and Yadav (1988) and Chhabra et al. (1994). However, Kudrjawzew et al. (1964), Young et al. (1978) and Milagres et al. (1983) reported higher body weights at birth and weaning as compared to those in our study. Variability in growth increased over the period (0.22 to 5.26 kg). However, weight at 6th week had higher standard deviation than that of 8th week. Heritabilities of the weight at 4th and 6th week were medium and low (0.29 and 0.14). Rest of the weight were highly heritable. Their estimates ranged from 0.32 to 0.58. The standard errors of the heritabilities were reasonably low. The higher estimates of heritability in present investigation were contrary to the findings of Belic et al. (1968). Popescu-Vifor (1977) and Lian and Wu (1980). Smaller number of observations may be the cause of this phenomena.

Table 1. Means (kg), standard deviations (kg) and heritabilities of weights at different ages

Trait	Average	Standard deviation	Heritability
W 1	0.92	0.22	0.538 ± 0.156
W 2	2.86	0.77	0.318 ± 0.123
W 4	5.08	1.35	0.298 ± 0.094
W 6	7.57	2.77	0.144 ± 0.043
W 8	10.10	2.49	0.428 ± 0.121
W16	18.95	5.26	0.581 ± 0.132

Total number of progeny per sire varied from 5 to 47. Breeding value of sires for W16 ranged from −17.74 (sire No. 102) to 9.89 kg (sire No. 480). In general, sires whose progeny were born in 1991, 1992 and 1994 had higher breeding values than those which produced their progeny in other years. Average breeding value of the sires for this weight increased at a steady trend from 1987 (−6.88 kg) to 1991 (6.32 kg). Thereafter, it declined but remained at higher level. The results were similar to the findings of Lea (1985) who observed an increase in average breeding value of sires estimated by BLUP procedure over period in 3 production groups. Rank of sires were almost similar for W6 and W16.

Genetic progress from selection of sires depends upon the accuracy of estimates of breeding value of sires. Accuracy of estimated breeding value for W6 was highest (0.67) for sire No. 439 with 47 daughters. The accuracy of estimated breeding value of sire for W16 ranged from 0.53 to 0.85. The accuracy of breeding value of sires depended upon the number of daughters and did not differ for W6 and W16. The accuracy of estimate of breeding value of sire for W16 was always higher than previous weights. Sire evaluation for W16 with 6 daughters had same accuracy as evaluation for W6 with 9 offsprings (Sire No. 114). The results indicated that additional number of offsprings are required to have accuracy of sire proof based on W6 similar to accuracy of W16. Increase in accuracy of breeding value of sires with increase in number of daughters has also been shown by Narain (1978) and Gaur and Raheja (1996).

The product moment and ranks correlations among estimates of sire's breeding values have been shown in table 2. Product moment correlations were, in general, higher than corresponding rank correlation. W8 had highest product moment correlation (0.71) with W16, but rank correlation between them was medium (0.55). The product moment and rank, both correlations were high between W6 and W16 (0.68 and 0.70). This shows that sire selection for W6 can be successfully implemented in order to achieve sufficient genetic improvement in growth. This will not only reduce the investment on keeping of poor piglets, but will also minimize generation interval leading to higher genetic gain per year. The investigations on this aspect in pigs are not available in literature. But some workers (Tandon and Harvey, 1984; Gaur and Raheja, 1996) have used this approach in cattle for early selection of bulls for milk yield on the basis of part records.

Table 2. Product moment (above diagonal) and rank (below diagonal) correlations among estimates of sire's breeding value for weights at different ages

	W1	W2	W4	W6	W8	W16
W 1	–	0.42	0.32	0.21	0.11	0.37
W 2	0.33	–	0.83	0.79	0.79	0.63
W 4	0.21	0.83	–	0.85	0.90	0.70
W 6	0.08	0.79	0.83	–	0.89	0.68
W 8	0.18	0.70	0.82	0.84	–	0.71
W16	0.32	0.64	0.67	0.70	0.55	–

Table 3 shows the genetic and phenotypic trend in body weights at different ages. Phenotypic trend was positive at all ages. The phenotypic regression coefficient ranged from 0.02 kg in birth to 0.40 kg in 16 weeks. Standard errors of the coefficients were low. All the regression coefficients were significant except for W1. This shows that growth has improved reasonably in this herd over time. Weight at 8th and 16th week has increased by 301 and 398 g per year, respectively. Genetic trend was also positive. The regression coefficients of average breeding value of sires on time showed a range of 1.471

kg (0.021 to 1.492 kg). These coefficients were significant and higher than their corresponding phenotypic regression coefficient. This shows that environmental components had negative trend over time. But due to continuous genetic improvement in growth, phenotypic performance could not be lowered down. Genetic improvement in this herd is the result of selection in F1 and further generations. Weight at 16th weeks had received sufficient genetic improvement showing 1.49 kg/year.

Table 3. Genetic and phenotypic trend in body weights at different ages

Trait	Phenotypic Trend		Genetic trend	
	Regression Coefficient	Standard Error	Regression Coefficient	Standard Error
W 1	0.021	0.003	0.021**	0.011
W 2	0.077**	0.014	0.029**	0.024
W 4	0.154**	0.024	0.281**	0.044
W 6	0.173**	0.051	0.415**	0.054
W 8	0.301**	0.044	0.718**	0.107
W16	0.398**	0.097	1.492**	0.331

** significant $p < 0.01$, * significant $p < 0.05$

Investigations on genetic and phenotypic trend for relevant growth (W1-W16) are scanty in pigs. Buchanan and Luce (1992) observed a regular increase in average daily gain over period (1971 to 90) in a herd of Chester White, Duroc, Hampshire, Spot and Yorkshires. In Durocs, age at 105 kg decreased by 7.4 days over a 5 year period (Nibe et al., 1992). Bejar et al. (1993) reported genetic trends for weaning weight as small and consistent with positive selection differentials and low selection intensity. Environmental trends also reflected a change to worse management conditions in this herd during later half of the study period. Genetic trend in a closed seed populations of Large White and Landrace pigs was 5.91 g per year for daily gain (Ferraz and Johnson, 1993). Reco and Menchaca (1993) also obesrved genetic trend in Large White and Hampshire populations. Both breeds showed a significant annual genetic gain in average daily gain (2.7 and 2.7 g, respctively). Southwood and Kennedy (1991) observed genetic and environmental trends for litter size in Yorkshire and Landraces. The environmental trends were positive for all traits in both breeds but were significant only for total number born in Landrace. Genetic trends were very small. Significant estimates of genetic trends were observed for Yorkshire breed ranging from −0.012 to 0.004 pigs/year.

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