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Genetic and phenotypic correlations among reproductive traits in crossbred pigs

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Abstract
Records on various reproductive traits belonging to a total of 541 crossbred pigs out of which 308 were half-bred *inter se* (½ Hampshire × ½ Local) pigs and 233 were graded *inter se* (¾ Hampshire × ¼ Local) pigs from the year 2002 to 2013 constituted the material for study. Pigs were born, maintained and bred at ICAR- Mega Seed Project (MSP) and All India Coordinated Research Project (AICRP) on pigs, Assam Agricultural University, Khanapara, Guwahati- 781022, Assam, India. Phenotypic and genetic correlation coefficients among the reproductive traits were estimated from the data by paternal half sib method (Becker 1975) [1]. The phenotypic correlation coefficient in both the genetic group was found to be positive for all reproductive traits and highly significant in among some traits. The genetic correlation coefficient among reproductive traits are positive and ranged from low to high and in desired direction in most of the case for both the genetic groups.

Keywords: Halfbred *inter se*, graded *inter se*, genetic correlation, phenotypic correlation, crossbred pigs

1. Introduction
Pig rearing is very popular in the north eastern states of India and pig act as a major source of meat. The indigenous pigs of this region are low producers and hence the demand of the meat cannot be fulfilled. On the other hand, exotic pig breeds are superior in production potentiality but they do have adaptability problem in the low input management system adopted by farmers and under the high humid environment of the region. In this region 'crossbred' are gaining popularity because they have more production potential than indigenous pigs and more adaptable than the pure exotic breeds of pig. Realizing the necessity to stabilize and consolidate characters, *inter se* mating of crossbreds for generations was practiced in the population under study. For further genetic improvement of such population it is imperative to estimate genetic and phenotypic correlation among the reproductive traits. In a highly prolific animal like pig, importance of traits of reproduction bears special significance. Profitability of a swine enterprise depend on reproductive traits. Hence, the present study was carried out to estimate genetic and phenotypic correlation among the reproductive traits in crossbred pigs with 50 and 75 percent Hampshire inheritance.

2. Materials and methods
The data analyzed in the investigation were collected from the performance records of 308 halfbred *inter se* (½ Hampshire × ½ Indigenous) pigs ; 233 graded *inter se* (¾ Hampshire × ¼ Indigenous) pigs maintained and bred at ICAR-MSP and AICRP on Pigs, Assam Agricultural University, Khanapara, Guwahati-781022, Assam, India. The data were collected and compiled from progenies of 59 sires and 541 dams maintained over a period of 12 years ranging from 2002 to 2013. The genetic and phenotypic correlations for various reproductive traits were estimated following the paternal half-sib correlation method described by Becker (1975) [1]. For this analysis, the data on only those animals whose sires had three or more progeny were used for all these traits. The estimates were obtained from data corrected for significant effect of various factors by use of least-square constants. Standard errors of genotypic and phenotypic correlations were estimated as per the method described by Robertson (1959) [2] and Panse and Sukhatme (1967) [3].

3. Results and discussion

3.1 Phenotypic correlation

3.1.1 Half bred *inter se* pigs

In half bred *inter se* pig, age at sexual maturity was found to have highly significant ($P<0.01$) phenotypic correlation coefficients with age at first conception and age at first farrowing and significant ($P<0.05$) phenotypic correlation coefficients with litter size at weaning. The coefficients of phenotypic correlation ranged from 0.022±0.090 with litter weight at weaning to 0.993±0.001 with age at first conception. The positive and significant correlation coefficients of age at sexual maturity with other traits was comparable with the findings of Bhowal (1997) [4] and Ferdoci (2003) [5].

The coefficients of phenotypic correlation of age at first conception was found to be positive and highly significant with age at first farrowing and significant with litter size at weaning and litter weight at birth. The estimates of phenotypic correlation coefficients of age at first conception ranged from 0.021±0.090 with litter weight at weaning to 0.979±0.003 with age at first farrowing. Bhowal (1997) [4] and Ferdoci (2003) [5] also reported a positive and significant correlation coefficients of age at first conception with other traits.

Age at first farrowing had positive phenotypic correlation coefficients with gestation length and litter traits. The coefficients of phenotypic correlation were ranging from 0.003±0.090 between age at first farrowing and litter weight at weaning to 0.150±0.0874 between age at first farrowing with litter weight at birth. The positive correlation coefficients of age at first farrowing with all other traits was similar with the findings of Kalita (1995) [6], Bhowal (1997) [4] and Ferdoci (2003) [5].

The `phenotypic correlation coefficients of gestation length observed to be positive and highly significant with litter size at weaning and significant with litter size at birth. The coefficients of phenotypic correlations of gestation length ranged from 0.007±0.057 with litter weight at birth to 0.147±0.056 with litter size at weaning. Similar reports were observed by Kalita (1995) [6], Bhowal (1997) [4] and Ferdoci (2003) [5].

The coefficients of phenotypic correlations among litter traits were found to be positive and highly significant. The estimates of phenotypic correlation coefficient were ranging from 0.123±0.057 between litter size at birth and litter weight at weaning to 0.809±0.020 between litter size at birth and litter size at weaning. The positive and significant correlation coefficients of among the litter traits could be compared with the findings of Kalita (1995) [6], Bhowal (1997) [4] and Ferdoci (2003) [5], Phookan *et al*. (2013) [7]. High and positive phenotypic correlations obtained in the present study indicated that piglets having larger litter size at birth and weaning also have higher and larger litter weight at birth and weaning. So it could favour the selection for larger litter size at weaning and higher litter weight at weaning on the merit of litter size of the piglets.

3.1.2 Graded *inter se* pigs

In Graded *inter se* the phenotypic correlation coefficients of age at sexual maturity with other reproductive traits were positive and highly significant ($P<0.01$) with age at first conception and age at first farrowing. The coefficients of phenotypic correlation ranged from 0.005±0.113 with litter weight at weaning to 0.990±0.002 with age at first conception. Kalita (1995) [6], Bhowal (1997) [4] and Ferdoci (2003) [5] reported a comparable findings.

The coefficient of phenotypic correlations of age at first conception were found to be positive and highly significant with age at first farrowing. The estimates of phenotypic correlation coefficients of age at first conception ranged from 0.001±0.113 with litter weight at weaning to 0.998±0.0003 with age at first farrowing. The positive and significant correlation coefficients of age at first conception with other traits was in good agreement with the findings of Kalita (1995) [6], Bhowal (1997) [4] and Ferdoci (2003) [5].

Age at first farrowing had positive phenotypic correlation coefficients with gestation length and litter traits. The coefficients of phenotypic correlation were ranging from 0.003±0.113 between age at first farrowing and litter weight at weaning to 0.100±0.110 between age at first farrowing with litter size at birth. The positive correlation coefficients of age at first farrowing with all other traits was also reported by Kalita (1995) [6], Bhowal (1997) [4] and Ferdoci (2003) [5].

The phenotypic correlation coefficients of gestation length observed to be positive with litter traits. The coefficients of phenotypic correlations of gestation length ranged from 0.012±0.065 with litter weight at birth to 0.052±0.068 with litter size at weaning. A similar observation was reported by Kalita (1995) [6], Bhowal (1997) [4] and Ferdoci (2003) [5].

The coefficients of phenotypic correlations among litter traits were found to be positive and highly significant in litter size at birth with litter size at weaning and litter weight at birth with litter weight at weaning. The estimates of phenotypic correlation coefficient were ranging from 0.015±0.068 between litter size at weaning and litter weight at birth to 0.664±0.038 between litter weight at birth and litter weight at weaning. The positive and significant correlation coefficients of among the litter traits could be compared with the findings of Kalita (1995) [6], Bhowal (1997) [4] and Ferdoci (2003) [5], Phookan *et al*. (2013) [7]. High and positive phenotypic correlations obtained in the present study indicated that piglets having larger litter size at birth and weaning also have higher and larger litter weight at birth and weaning. So it could favour the selection for larger litter size at weaning and higher litter weight at weaning on the merit of litter size of the piglets

3.2 Genetic correlation

3.2.1 Half bred *inter se* pigs

In Half bred *inter se* the genetic correlation coefficients of age at sexual maturity with age at first conception, age at first farrowing, gestation length, litter size at birth and weaning, litter weight at birth and weaning were positive and relatively high ranging from 0.050±0.113 between age at sexual maturity and age at first conception to 1.444±2.402 between age at sexual maturity and litter weight at weaning. Similar genetic correlation coefficients of age at sexual maturity with other traits were reported by Deka (2000) [8] and Ferdoci (2003) [5].

Age at first conception had positive and relatively low to high genetic correlation coefficients with age at first farrowing, gestation length, litter size at birth and weaning, litter weight at birth and weaning. The estimates were ranging from 0.052±0.269 between age at first conception and litter weight at birth to 1.431±0.825 between age at first conception and gestation length. Comparable findings were reported by Deka (2000) [8] and Ferdoci (2003) [5]. However, Bhowal (1997) [4] observed higher genetic correlation of age at first conception with age at first farrowing.

Age at first farrowing maintained positive and relatively high genetic correlation coefficients with gestation length (1.189±0.288), litter size at birth (0.833±0.320), litter size at weaning (0.516±0.567), litter weight at birth (0.121±0.105) and litter weight at weaning (0.579±0.231). Similar genetic correlation coefficients of age at sexual maturity with other subsequent traits were reported by Kalita (1995) [6], Deka (2000) [8] and Ferdoci (2003) [5]. Pandey and Singh (2010) [9] observed negative genetic correlation among age at first farrowing with litter traits.

The genetic correlation coefficients of gestation length with litter size at birth and at weaning and litter weight at birth and at weaning were found to be positive and medium in magnitude. The estimates were ranging from 0.014±0.422 between gestation length and litter size at birth to 0.655±0.199 between gestation length and litter size at weaning. Similar genetic correlation coefficients of gestation length with other traits were reported by Kalita (1995) [6], Deka (2000) [8] and Ferdoci (2003) [5].

The coefficients of genetic correlations among litter traits were found to be positive and low to high in magnitude. The genetic correlation coefficients were ranging from 0.120±0.452 between litter size at weaning and litter weight at birth to 1.0003±0.001 between litter size at birth and litter size at weaning. Similar genetic correlation coefficients of age at sexual maturity with other traits were reported by Kalita (1995) [6], Deka (2000) [8], Ferdoci (2003) [5] and Phookan *et al*. (2013) [7]. High and positive genetic correlation coefficients obtained in the present study indicated that piglets having larger litter size at birth and weaning also have higher and larger litter weight at birth and weaning. So it could be in favour the selection for larger litter size at weaning and higher litter weight at weaning on the merit of litter size of the piglets.

3.2.2 Graded *inter se* pigs

In Graded *inter se* the genetic correlation coefficients of age at sexual maturity with age at first conception, age at first farrowing, gestation length, litter size at birth and weaning, litter weight at birth and weaning were positive and relatively high ranging from 0.084±0.322 between age at sexual maturity and litter weight at weaning to 1.327±0.614 between age at sexual maturity and litter size at weaning. The observation was in good agreement with the reports of Deka (2000) [8] and Ferdoci (2003) [5].

Age at first conception had positive and relatively low to high genetic correlation coefficients with age at first farrowing, gestation length, litter size at birth and weaning, litter weight at birth and weaning. The estimates were ranging from 0.085±0.297 between age at first conception and litter weight at weaning to 1.341±0.595 between age at first conception and litter size at weaning. Similar genetic correlation coefficients of age at first conception with other traits were reported by Deka (2000) [8] and Ferdoci (2003) [5]. However, Bhowal (1997) [4] observed higher genetic correlation of age at first conception with age at first farrowing.

Age at first farrowing maintained positive and relatively high genetic correlation coefficients with gestation length (0.600±0.236), litter size at birth (0.520±0.395), litter size at weaning (1.294±0.498), litter weight at birth (0.080±0.346) and litter weight at weaning (0.034±0.296). Similar genetic correlation coefficients of age at sexual maturity with other subsequent traits were reported by Kalita (1995) [6], Deka (2000) [8] and Ferdoci (2003) [5]. Pandey and Singh (2010) [9] observed negative genetic correlation among age at first farrowing with litter traits.

The genetic correlation coefficients of gestation length with litter size at birth and at weaning and litter weight at birth and at weaning were found to be positive and medium in magnitude. The estimates were ranging from 0.020±0.968 between gestation length and litter size at birth to 0.353±0.369 between gestation length and litter weight at weaning. Kalita (1995) [6], Deka (2000) [8] and Ferdoci (2003) [5]. Reported similar genetic correlation coefficients of gestation length with other traits.

The coefficients of genetic correlations among litter traits were found to be positive and high in magnitude. The genetic correlation coefficients were ranging from 0.596±0.276 between litter weight at birth and litter weight at weaning to 1.481±0.679 between litter size at weaning and litter weight at weaning. Comparable genetic correlation coefficients of age at sexual maturity with other traits were reported by Kalita (1995) [6], Deka (2000) [8], Ferdoci (2003) [5] and Phookan *et al*. (2013) [7]. High and positive genetic correlation coefficients obtained in the present study indicated that piglets having larger litter size at birth and weaning also have higher and larger litter weight at birth and weaning. So it could be in favour the selection for larger litter size at weaning and higher litter weight at weaning on the merit of litter size of the piglets.

4. Summary and Conclusion

The phenotypic correlation coefficient and genetic correlation coefficients was found to be positive for all reproductive traits, highly significant in some traits, ranged from low to high and in desired direction in most of the cases for both the genetic groups. Moreover, the genetic correlation coefficients of age at sexual maturity with litter size at weaning and litter weight at weaning, age at first conception and farrowing with gestation length, litter size at birth with litter size at weaning were more than unity (>1.00) for half bred *inter se* pigs. Age at sexual maturity with age at first conception, age at first farrowing and litter size at weaning; age at first conception and farrowing with litter size at weaning; litter size at birth with litter size at weaning and litter size at weaning with litter weight at birth were more than unity (> 1.00) for graded inter se pigs.

High, positive and significant phenotypic and genetic correlations among different reproductive traits obtained in the present study can be utilized for genetic improvement of the crossbred pigs through selection.

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