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Genetic and Phenotypic Trends of Fertility Traits in Iranian Holstein Cows

Research Article

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ABSTRACT

A total of 72124 fertility records was used to estimate the genetic and phenotypic trend of fertility traits in Iranian Holstein cow from 1981 to 2007. Fertility traits in this study were: days from calving to first service (DFS), number of insemination per conception (INS), days open (DO), interval between first and last insemination (IFL), calving interval (CI) and success to first insemination (SF). The overall genetic trend in fertility traits was as desired and statistically significant. Mean breeding value of SF increase by 0.00067 percent per year. The annual genetic trends for INS, DFS, IFL, CI and DO were -0.0029 number/year, -0.062 days/year, -0.041 days/year, -0.23 days/year and -0.24 days/year, respectively. Phenotypes trends for fertility traits were unfavorable except for DFS and DO. Phenotypic trends in IFL, INS and SF were as undesirable positive. Phenotypically DO and CI did not change over the time period. Phenotypically IFL has increased 1.6 days/year and DFS has decreased 1.6 days/year. The annual phenotypic trends for INS and SF were 0.04 and -0.018, respectively.

KEY WORDS fertility traits, genetic trends, Iranian Holstein cows, phenotypic trend.

INTRODUCTION

The effectiveness of any animal breeding program is measured by the obtained genetic progress. Estimating genetic and environmental trends in a population allows the assessment of the effectiveness of the selection procedure and gives the opportunity for monitoring management conditions. It also supplies the animal breeder with essential information to develop more successful programs in the future (Hallowell *et al.* 1998). Fertility is one of the most economically important traits in dairy cattle industry. Before the 1990 most attention of dairy cattle breeding programs were focused on milk production. Since the negative genetic relationship exist between milk production and fertility this caused decline in fertility performance of Holstein dairy cow (Rauw, 1998). This decline in female fertility performance can increase inseminations cost, veterinary cost and culling rate. Therefore, in current decades in many breeding programs fertility traits have been included. But the heritabilities of fertility traits are low, ranging from 0.01 to 0.1, that leads to slow improvement in fertility performance (González-Recio *et al.* 2005; Ghiasi *et al.* 2011). The dairy cattle population in Iran has undergone a strong selection for milk production. Iranian Holstein breeders have been using semen from dairy bulls sourced mainly from north American Holstein sire, especially USA and Canada. This strategy has caused a considerable increase in milk yield, for example, Razmkabir *et al.* (2006) reported in Iranian Holstein population from 1987 to 2004, genetic trend in milk yield was 33.84 ± 2.10 kg, for fat yield 0.64 ± 0.05 kg and for protein yield it was 1.00 ± 0.08 kg. Ansari-Lari *et al.* (2010) reported that by increasing 100 kg in milk yield, days open will increase about 0.3 days. Therefore fertility can be decreased by increasing in milk yield. Mohammadi (2009), reported that the average annual culling rate in Iranian Holstein cow in Neyshabur area was 13.1% and most important reason for culling in these populations (out of all 34.9% of disposals) was due to poor fertility performance. The objectives of the current study were to estimate the genetic and phenotypic trend of female fertility traits in Iranian Holstein cows.

MATERIALS AND METHODS

A total of 72124 records of parities 1 to 6 of 27113 cows collected from 1981 to 2007 in 15 large Iranian Holstein herds were used to estimate the genetic trends for female fertility. These herds were distributed in different part of Iran from arid or semiarid to subtropical. Traits in later parities were treated as repeated measurement. The fertility records were: days from calving to first service (DFS), number of insemination per conception (INS), days open (DO), interval between first and last insemination (IFL), calving interval (CI) and success to first insemination (SF). The following statistical model was applied to estimate breeding value of traits using REML method with the AS-REML software (Gilmour *et al*. 2009):

$$y = Xb + Zu + Wp + e$$

Where:
y: trait of interest.
b: fixed effects of parity and age at previous calving for all traits, herd-year-season of calving for DO, CI, INS, IFL and SF, herd-year of calving for DFS, months of first insemination for DO, INS, IFL, and SF, and previous month of calving for DFS.
u: additive genetic effect.
p: cow permanent environmental effect for all traits.
e: residual term.
X, Z and W: incidence matrices relating data to the corresponding effect.

Estimated breeding values and phenotypic record were averaged within birth year and then trends were estimated by regression of breeding values or phenotypic records on the year of birth for the period from 1981 to 2007 by using the R package (R Development Core Team. 2011).

RESULTS AND DISCUSSION

Genetic trends

The genetic trends for fertility traits from 1981 to 2007 are shown in Figure 1.

The overall genetic trend in fertility traits was as desired and statistically significant (P<0.001). Indicating a genetic improvement in fertility performance of Iranian Holstein cows overtime. These genetic improvement could be due to the use of imported semen of the sires.

Mean breeding value for SF increased by 0.00067 percent per year, indicating more cows had been pregnant in first insemination. The mean breeding value of SF has increased from -0.0097 in 1981 to 0.0076 in 2007. Genetic trends in INS, IFL, DO, CI and DFS were as desired negative and statistically significant (P<0.001). The regression estimated genetic trends for INS, DFS, IFL, CI and DO were -0.0029, -0.062 days/year, -0.041 days/year, -0.23 days/year and -0.24 days/year, respectively. Desirable genetic trend obtained for INS could lead to favorable decreasing in IFL, CI and DO over time that is consistent with result obtained in the current study. Amimo *et al*. (2006) reported that the genetic trend in Kenyan Ayrshire herds from 1980 to 2005 for CI was -0.6 days/year. Faraji arough *et al*. (2011) reported that genetic trends for first and second calving interval in Iranian Holstein cow from 1983 to 2007 were 0.004 ± 0.02, -0.02 ± 0.01 day(s) per year and phonotypic trend for these traits were -1.13 ± 0.39, -0.28 ± 0.23 day(s) per year, respectively. VanRaden *et al*. (2004) reported that the genetic trend of daughter pregnancy rate in USA was different among cow breeds. Milking Shorthorn, Jersey and Ayrshire breeds had smaller losses of daughter pregnancy rate across time, whereas Guernsey, Brown Swiss and Holstein had larger losses of daughter pregnancy rate. These researchers reported that after 1994 genetic trend for daughter pregnancy rate nearly was flat perhaps because of selection for increased production life. De Jong (2005) reported undesirable genetic trends for non-return within 56 days, DFS and CI from 1982 to 1998 in Netherlands Holstein cows. In USA and England Holstein, cow conception rate at first insemination has decreased by 0.45% and 1% per year, respectively (Butler, 1989; Royal *et al*. 2000).

Phenotypic trends

Phenotypic trends for fertility traits are shown in Figure 2. Against the genetic trend, corresponding phenotypic trends for fertility traits were unfavourable, except for DFS, DO and CI. The undesirable phenotypic trends might be attributed to the adverse environmental factors. As favourable genetic trends obtained for DFS, phenotypic trends for DFS also was favourable. The phenotypic trends for DFS was calculated as -1.6 days and statistically was significant (P<0.001); indicating phenotypic mean for DFS decrease by -1.6 days per year, this shows that ability of cow to recycle after calving is improved ovretime.

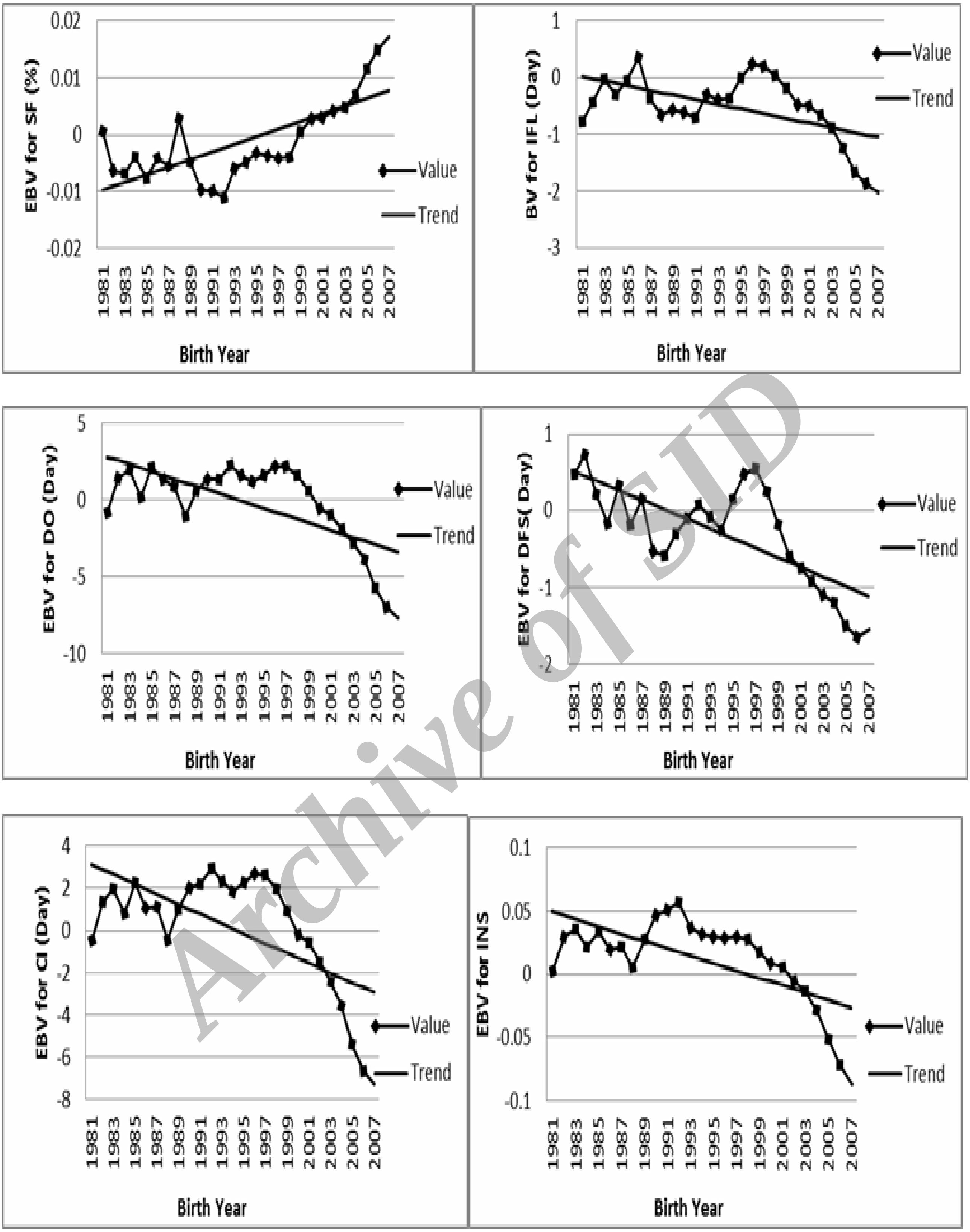

Figure 1 Genetic trends of fertility traits
EBV: estimaited breeding value; INS: number of insemination per conception; CI: calving interval; DFS: days from calving to first service; IFL: interval between first and last insemination; DO: days open and SF: success to first insemination

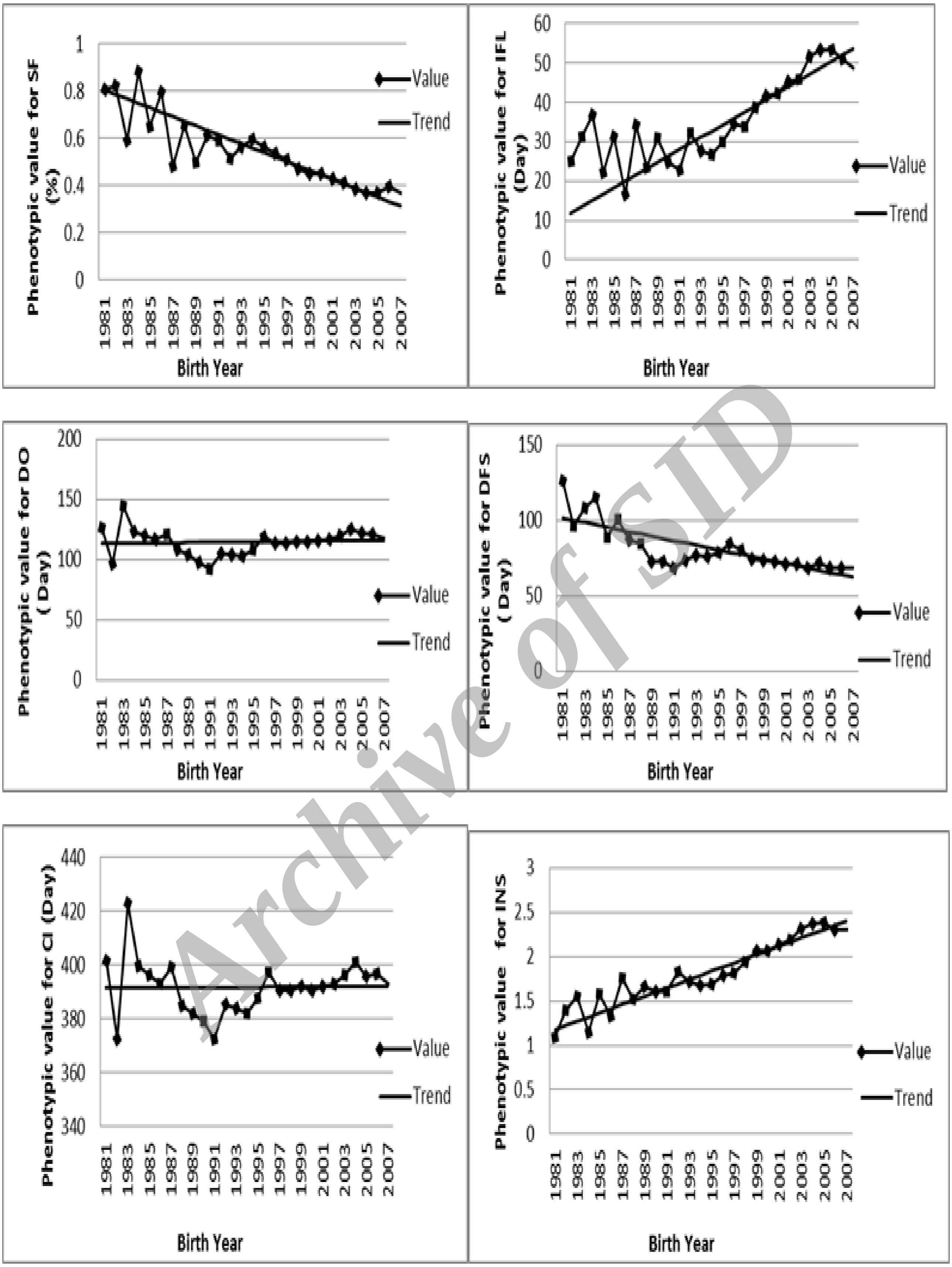

Figure 2 Phenotypic trends of fertility traits
INS: number of insemination to conception; CI: calving interval; DFS: days from calving to first service; IFL: interval between first and last insemination; DO: days open and SF: success to first insemination

There was a significant (P<0.001) undesirable positiv phenotypic trend in IFL with an overall rate of 1.6 days/year.

This means that the mean phenotypic value of IFL has increased by 1.6 days/year from 1981 to 2007. IFL has increased 1.6 days/year and DFS has decreased 1.6 days/year. Since DO is equal to the sum of IFL and DFS, therefore it can be expected phonetically that DO will be constant over the time.

Regression coefficients of mean phenotypic valueon the year of birth for DO was 0.1 and statistically was not significant, indicating phonetically DO was not changed over the time from 1981 to 2007.

The sum of the mean of the gestation period with DO is equal the mean of CI. As the results showed DO phenotypically was not changed over the time, therefore it can be expected that CI will be constant over the time. The phenotypic trend for CI was not significant, indicating that phonetically CI was not changed over the time from 1981 to 2007. Amimo *et al.* (2006), reported that the phenotypic trend in Kenyan Ayrshire herds from 1980 to 2005 for CI was not significant (P<0.001). Phenotypic trends in INS and SF were undesirable. Regression coefficients of mean phenotypic valueon the year of birth for INS and SF were 0.04 and -0.018, respectively and statistically was significant (P<0.001).

These unfavourable phenotypic trends had caused the mean phenotypic value of the INS increasing from 1.17 to 2.39 and mean phenotypic value of SF decreasing from 0.8 to 0.31 during the time period of 1981 to 2007. Phenotypic trend for the success rate at first insemination in the Netherlands dairy cow were undesirable and went down from 55.5% to 45.5% in 10 years (Jorritsma *et al.* 2000). Average annual pregnancy rate in USA Holstein cow from 1977 to 1979 was 21.6% and decreased to an average of 12% from 2000 to 2002 (De Vries *et al.* 2005). A survey by Mackey *et al.* (2007) of 19 Irish Holstein-Friesian dairy herds showed that fertility performance was generally poor with the interval to first service being 84.4 ± 35.4 days and the first insemination success rate 40.6 ± 0.7%. (De Vries *et al.* 2005) reported that the DFS for Holstein cows in Florida and Georgia increased from 84 in 1983 to 104 days in 2001. As results obtained by Washburn *et al.* (2002), DO increased from about 126 days in 1976 to 169 days in 1999 for 532 Holstein and 29 Jersey herds in 10 South-eastern states of the United States.

In USA Holstein cows INS were increased from 1.76 to 3 over a period of 20 years (Lucy, 2001), in Ireland INS increased from 1.54 to 1.75 between 1990 and 2000 (Mee *et al.* 2004).

Jamrozik *et al.* (2005) found that INS for first parity and older Holstein cows in Canada was 1.64 ± 1.09 and 2.14 ± 1.50, respectively.

CONCLUSION

Although favourable positive genetic trends obtained for fertility traits in Iranian Holstein cows, this could not lead to improvement in the fertility performance because phenotypic trends were undesirable.

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