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Genetic analysis of non-return and conception rate of Jersey crossbred cattle

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Reproductive performance of animals is extremely important for the dairy industry, as it exerts considerable impact on the economic efficiency of dairy production (Jansen 1985). Among different fertility traits, non-return rate (NRR), a direct measure of fertility, allows for a fast evaluation of reproductive performance, without the need of waiting for the subsequent calving (Tiezzi *et al.* 2011). Besides, per cent conception per first insemination (PC/FI) is also a potential measure of reproductive performance which encompasses puberty and ability to conceive in immediate first service by AI, gestate and deliver a calf. Decrease percentage of PC/FI shows decrease in reproductive performance, and decrease in genetic gain by increasing the generation interval. Both NRR and PC/FI are generally affected by genetic and non-genetic factors. Identification of the important factors affecting the non-return rates and per cent conception after first insemination of animals would help in making important decisions regarding herd management. The present study was carried out to investigate the factors affecting the NRR at 56 days and per cent conception per first insemination in Jersey crossbred cows and to estimate their genetic control.

Data on fertility traits, viz. non-return rates at 56 days (NRR56) and per cent conception per first insemination (PC/FI) of Jersey crossbred animals, maintained at the Eastern Regional Station of National Dairy Research Institute, Kalyani, West Bengal, over a period of 36 years (1980–2015) were utilized for the study. The cows with incomplete records due to sickness or abortions were excluded from the study. Entire duration was divided into 6 periods; each period of 5 years. Based on prevalent climatic conditions of the area, year of calving was divided into 3 seasons- winter (November to February), summer (March to June) and rainy (July to October). The parities of animals were classified in to 7 groups. All animals were grouped in to 7 groups based on age groups of animals at calving. These animals were progenies of 42 sires and sires having 3 or more progenies were considered in the study. The data were distributed into 10 genetic groups based on the exotic inheritance level of animals. Least-squares analysis of variance (Harvey 1990) was applied to identify the significance of important genetic factors, viz. sire and non-genetic factors like period of service/insemination, season of service/insemination, age group at service, genetic group of animal and parity of animal affecting these fertility traits of animals. The differences among the sub-groups means were tested by Duncan Multiple Range Test (DMRT) as described by Kramer (1957). The heritability of these traits was estimated by paternal half-sib method.

The least-squares means for non-return rates at 56 days (NRR56) and per cent conception per first insemination of animals are presented in Table 1. The average for NRR-56 days (57.61±3.53 days) in the present study was well in agreement with the findings of Habib *et al.* (2013). The mean value for per cent conception per first insemination of crossbred animals was 57.30±3.52% in this study and the findings were well comparable with the findings of Abeygunawardena *et al.* (2001) in Sri Lanka who reported the value of 50.4%. However, Naha *et al.* (2015) reported lower conception rate per first insemination in Jersey crosses (45%) and Sahiwal bulls (45.9%), respectively. The present study revealed that the sire had significant ($P<0.01$) influence on NRR56 and PC/FI of crossbred cattle. Similarly, significant effect of sire on non-return rates (Fouz *et al.* 2011) and conception rate per first insemination (Buckley *et al.* 2003, Potdar *et al.* 2016) were observed in dairy cattle. In this study, the significant influence of sire on NRR-56 days suggests that this trait can be genetically improved by selection of superior sires in the herd. The non-significant ($P>0.05$) effects of period of service/insemination and season of service/insemination on NRR-56 and PC/FI of animals were noticed in this study (Table 1). Further, both these fertility traits were significantly ($P<0.01$) affected by parity of animals. Similarly, Alphonsus *et al.* (2014) and Potdar *et al.* (2016) found significant effect of parity on NRR56 and PC/FI of animals, respectively.

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Animals in first parity had highest NRR56 and PC/FI than animals of later parities in this study. The lowest non-return rates at 56 days and per cent conception after first insemination was achieved in first calvers animals (Table 1). Similar findings of higher non-return rates in animals of first parity and lowest in first calvers were also noticed by Rautala (1991) in dairy cattle. Age of the animals at insemination didn't have any significant (P>0.05) influence on NRR-56 and PC/FI of Jersey crossbred cows (Table 1). Similar non-significant result for non-return rates was also obtained by Mekonnen *et al*. (2010). Significant (P<0.05) variations for NRR-56 and per cent conception per first insemination existed among the Jersey crossbred animals having different genetic groups in this study (Table 1). On perusal of Table 1, it is revealed that the animals having genetic combination of ½ Jersey × ½ Tharparkar had higher rate of non-return at 56 days and higher per cent conception after first insemination as compared to animals having other genetic combinations. Similar significant effects of genetic groups on NRR-56 days (Nasrin *et al.* 2008) and PC/FI (Khatun *et al.* 2014) were reported in different crossbred cattle.

Table 1. Least squares means (±S.E.) for non-return rate at 56 days (NRR56) and per cent conception per first insemination (PC/FI) of Jersey crossbred cattle

Parameter	No. of observation	NRR56 (%)	PC/FI (%)
Overall mean	1457	57.61±3.53	57.30±3.52
Period of service/insemination			
POS 1 (1980–84)	47	62.42±13.92	62.05±13.93
POS 2 (1985–89)	145	60.61±9.11	59.90±9.11
POS 3 (1990–94)	187	57.57±6.71	55.98±6.70
POS 4 (1995–99)	243	48.84±5.65	48.10±5.64
POS 5 (2000–04)	234	51.38±6.36	51.18±6.36
POS 6 (2005–09)	281	60.42±8.43	60.42±8.43
POS 7 (2010–15)	320	62.06±11.02	63.51±11.02
Season of service/insemination			
SOS 1 (Winter)	532	59.69±3.89	59.91±3.89
SOS 2 (Summer)	469	55.81±4.09	55.71±4.08
SOS 3 (Rainy)	465	57.34±4.02	56.30±4.01
Parity of animals			
P 1	393	69.34^{a}±6.09	68.01^{a}±6.09
P 2	325	49.86^{c}±5.14	49.54^{b}±5.14
P 3	248	53.05^{bc}±4.90	58.58^{ab}±4.89
P 4	173	55.84^{abc}±5.49	56.23^{ab}±5.48
P 5	124	57.92^{abc}±6.93	57.97^{ab}±6.93
P 6	85	66.94^{ab}±8.80	65.61^{ab}±8.80
P 7 (7 or more)	109	50.36^{bc}±9.15	50.20^{b}±9.15
Age of animals at insemination			
AG- 1 (≥1 to <2 yr)	173	52.61±8.24	55.06±8.24
AG- 2 (≥2 to <3 yr)	303	52.02±6.90	51.72±6.90
AG- 3 (≥3 to <4 yr)	236	61.23±6.90	61.02±6.90
AG- 4 (≥4 to <5 yr)	203	63.50±5.73	62.23±5.78
AG- 5 (≥5 to < 6 yr)	174	60.08±5.52	59.03±5.52
AG- 6 (≥6 to < 7 yr)	125	58.31±6.20	57.56±6.20
AG- 7 (≥ 7 yr)	243	55.55±6.82	54.53±6.81
Genetic groups of animals			
GG-1 (½ J × ½ RS)	112	61.90^{b}±5.84	62.8^{bc}±5.84
GG-2 (½ J × ½ T)	283	81.11^{a}±7.34	$81.42^{a\pm}$7.34
GG-3 (≥ 50% to 62.5% J)	310	44.83^{c}±4.80	44.91^{d}±4.79
GG-4 (1/2 J×1/4 RS ×1/4 T)	219	55.28^{b}±5.28	58.83^{bc}±5.28
GG-5 (1/2 J × 1/4 RS × 1/8T × 1/8 D)	141	63.78^{b}±5.68	63.59^{bc}±5.68
GG-6 (½ J×3/8 RS×1/8 T)	85	53.48^{bc}±6.87	53.35^{bcd}±6.86
GG-7 (Misc. 50% J)	93	48.62^{c}±7.25	48.32^{cd}±7.25
GG-8 (≤50% J)	49	46.70^{c}±9.54	46.52^{cd}±9.54
GG-9 (>62.5 to75% J)	86	67.93^{a}±6.56	66.93^{a}±6.56
GG-10 (>75% J)	79	52.53^{bc}±7.63	51.30^{bcd}±7.63

Means with different superscripts differ significantly (P<0.05) from each other. J, Jersey; RS, Red sindhi; T, Tharparkar; D, Desi.

The heritability estimates of non-return rate-56 days (NRR56) and per cent conception per first insemination (PC/FI) of Jersey crossbred cattle were 0.06±0.04 and 0.06±0.04, respectively using paternal half-sib method. Similarly, low heritability (0.01 to 0.03) estimates for NRR56 (Sewalem *et al.* 2010, Liu *et al.* 2017) and for PC/FI (Castillo-Juarez *et al.* 2000, Bormann *et al.* 2006) were reported in dairy cattle. In the present study, the low heritability estimates of these fertility traits indicate slow genetic progress possible by selection under the prevalent management conditions and fertility performance of animals could be improved by better management practices rather than selection.

SUMMARY

Data pertaining to non-return and conception rate of Jersey crossbred cattle, maintained at the Eastern Regional Station, ICAR-NDRI, Kalyani, were collected/generated for a period of 36 years (1980 through 2015) to determine the effects of important environmental factors affecting these traits and to estimate their genetic parameters. The present study revealed that the sire had significant influence on NRR-56 days and PC/FI of animals. The parity and genetic groups of animals showed significant (P<0.05) effect on NRR-56 days and PC/FI of animals. However, the period and season of service/ insemination and age group of animals didn't have any significant impact on all the traits in this study. Animals having genetic group of ½ Jersey × ½ Tharparkar and more than 50–75% Jersey performed better as compared to animals of other genetic groups. The heritability estimates for non-return rate-56 days (NRR-56 days) and per cent conception per first insemination (PC/FI) was low (0.06±0.04) in magnitude for the present set of data.

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