



Lifetime calf production distribution and effect of genetic and non-genetic factors on total herd life in Phule Triveni crossbred cattle

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There is sharp increase in the demand of milk and milk products like ghee, cheese, khoa etc. with increase in human population. To fulfill this requirement, crossbreeding of indigenous cattle with superior exotic breeds of cattle has emerged as a successful and suitable strategy to increase milk production of indigenous cattle. Crossbreeding and selective breeding or selections of superior animals are main tools to increase the milk production potential of indigenous cattle. Cattle population of India is 190.9 million, of which indigenous cattle comprise of 151.17 million and crossbred or exotic cattle comprise of 39.73 million. The contribution of indigenous cattle to total milk production is 21% and crossbred or exotic contributes 24% to the total milk production of India (BAHS 2014). Genetic contribution of cattle in form of living progeny to the next generation is called as selective value and it is associated with herd life and calf production. Genetic contribution to the next generation of cattle depends upon herd life, total female calves born, selective value, total calves born and total normal calves born (Atrey *et al.* 2005, Kumar *et al.* 2009). Herd life or longevity is one of the most important efficient or economic traits in dairy cattle populations. Herd life evaluates the genetic ability of cattle to stay in the herd and make cattle more profitable and sustainable. Longer herd life improves milk production as well as total lifetime calf which in turn increases selection intensity.

Keeping all this in view, the present study was undertaken to analyze the importance of effect of various genetic and non-genetic factors on longevity and to determine distribution of life time calf production which could be used for selecting elite or superior Phule triveni crossbred cattle for life time production traits.

Data on Phule Triveni crossbred cattle maintained at

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Research-Cum-Development Project on Cattle at Mahatma Phule Krishi Vidyapeeth Rahuri, spread over a period of 39 years from 1976 to 2014 were analyzed in the study. Thirty nine years span for which data collected was divided into 6 periods and each period comprised of 6 years. Year of calving was divided into 3 seasons- winter (October to January), summer (February to May) and rainy (June to September). Age at first calving (AFC) of animals was divided into 4 groups. First lactation milk yield data was divided into 7 groups. Sires having 3 or more progenies were considered in the present study. The data were classified into 9 sub-classes based on genetic groups. Data were analyzed using mixed model least-squares analysis for fitting constants (Harvey 1990) due to non-orthogonal and disproportionate sub-class frequencies. The following model was used to adjust significant effect of genetic and non-genetic factors on longevity trait:-

$$Y_{ijklmno} = \bar{i} + S_i + (\text{Sea})_j + (P)_k + (\text{AFC})_l + (\text{GG})_m + (\text{FLMYG})_n + e_{ijklmno}$$

where, $Y_{ijklmno}$ is observation of o^{th} trait of crossbred cattle which is progeny of i^{th} sire, calved in j^{th} season, k^{th} period, l^{th} age at first calving, m^{th} genetic group and o^{th} first lactation milk yield group of the animal; \bar{i} is overall mean, S_i is random effect of i^{th} sire, Sea_j is fixed effect of j^{th} season of calving, P_k is fixed effect of k^{th} period of calving, AFC_l is effect of l^{th} age at first calving, GG_m is effect of m^{th} genetic group, FLMYG_n is fixed effect of n^{th} milk yield group and $e_{ijklmno}$ is random error associated with each observation assumed to be NID (0, σ_e^2). Duncan's multiple range test (DMRT) as modified by Kramer (1957) was used for testing the significant differences of means between subclasses of periods, seasons, age at first calving and genetic groups.

The overall least squares mean for longevity (total herd life) was 2330 ± 60.12 days (6.4 ± 0.16 years) in Phule Triveni cows (Table 1). Similar results were reported by Kumar *et al.* (2014) in Frieswal cattle (6.43 ± 0.09 years) but Tomar and Basu (1981) observed lower value of longevity as compared to present findings in Murrah buffaloes (4.54 ± 0.26). However, higher longevity (total herd life) was noticed by Jakhar *et al.* (2010) in Haryana cattle (8.50 ± 0.20 years), Lemma *et al.* (2010) in Jersey cattle (2983.74 ± 67.98

days) and Goshu *et al.* (2014) in Holstein Friesian cattle (2864±63 days).

Effect of period of birth: The influence of period of birth on total herd life (longevity) was found to be non-significant in Phule Triveni cows. Similar effect of period of birth on longevity was also noticed by Singh *et al.* (2002) in Holstein Friesian cattle. However, significant effect of period of birth on longevity was observed by Goshu (2005) in Friesian-Boran crossbred cattle and Lemma *et al.* (2010) in Jersey cow. In Phule Triveni cows, the longevity of cows calved during period P5 (2603.11±179.21 days) was found to be highest followed by cows calved in P3 (2399.33±94.09) and lowest was seen in period P2 (2082.05±91.88) as evident from Table 1. The variation in total normal (alive) calves produced during different periods might be attributed to culling of animals, influence of environmental factors and various diseases.

Effect of season of birth: The analysis of variance revealed that season of birth had non-significant effect on longevity in Phule Triveni cows. These results corroborated with Singh *et al.* (2002) and Goshu *et al.* (2014) in Holstein Friesian cattle while, contradictory result as compared to present result was reported by Lemma *et al.* (2010) in Jersey cattle. In Phule Triveni cows, the highest longevity (2452.89±85.34 days) was observed during rainy season followed by summer season (2289.73±84.14 days) and least value for longevity (2248.65±78.01 days) was noticed in winter season (Table 1).

Effect of age at first calving: The analysis of variance showed that age at first calving had non-significant effect on longevity in Phule Triveni cow. Similar results were obtained by Atrey *et al.* (2005) in Frieswal cattle and Jakhar *et al.* (2010) in Haryana cattle whereas different results were reported by Gahlot *et al.* (2000) in Tharparkar cattle. In Phule Triveni cows, least squares analysis revealed that the highest longevity was observed in cows of A2 group (2509.38±125.31 days) followed by A4 (2339.73±74.08 days) and the lowest value of longevity was found in A1 AFC group (2221.14±79.43 days) (Table 1).

Effect of first lactation milk yield: Longevity was highly significantly ($P<0.01$) affected by first lactation milk yield in Phule Triveni cows. These findings corroborated with the results of Atrey *et al.* (2005) and Gowane and Tomar (2007) in Frieswal cattle. Although Goshu *et al.* (2014) in Holstein Friesian cattle reported nonsignificant effect of first lactation milk yield on longevity. In Phule Triveni cows, DMRT indicated that longevity of L6 group (2808.39±139.87 days) was significantly higher than L1 (1652.50±112.45 days), L2 (2121.40±119.66 days), L3 (2245.39±97.95 days), L4 (2278.76±97.07 days) and was at par with L7 (2632.44±160.57 days) and L5 (2574.07±110.57 days) FLMY group (Table 1). There was an increasing trend for longevity with the increase in FLMY. Higher milk producing cows had high longevity as compared to low milk producing cows. This varied from 1652.50±112.45 days for low milk producers (<1500 kg) to 2808.39±139.87 days for high producers (>3500 kg). This

Table 1. Least squares means for longevity as affected by various factors in Phule Triveni cattle

| Effect | N | Longevity (Days) | |
|--|-----|------------------|--------|
| | | Mean | SE |
| μ | 611 | 2330.42 | 60.12 |
| <i>Period of birth</i> | | | |
| P1 (1976-81) | 216 | 2282.29 | 78.97 |
| P2 (1982-87) | 136 | 2082.05 | 91.88 |
| P3 (1988-93) | 129 | 2399.33 | 94.09 |
| P4 (1994-99) | 65 | 2359.55 | 134.96 |
| P5 (2000-05) | 32 | 2603.11 | 179.21 |
| P6 (2006- above) | 33 | 2256.21 | 173.59 |
| <i>Age at first calving (days)</i> | | | |
| A1 (<900) | 273 | 2221.14 | 79.43 |
| A2 (901-950) | 69 | 2509.38 | 125.31 |
| A3 (951-1000) | 63 | 2251.44 | 128.79 |
| A4 (>1000) | 206 | 2339.73 | 74.08 |
| <i>First lactation milk yield (kg)</i> | | | |
| L1 (<1500) | 88 | 1652.50e | 112.45 |
| L2 (1500-2000) | 77 | 2121.40cd | 119.66 |
| L3 (2000-2500) | 128 | 2245.39d | 97.95 |
| L4 (2500-3000) | 127 | 2278.76bc | 97.07 |
| L5 (3000-3500) | 94 | 2574.07a | 110.57 |
| L6 (3500-4000) | 55 | 2808.39a | 139.87 |
| L7 (>4000) | 42 | 2632.44b | 160.57 |
| <i>Season of birth</i> | | | |
| S1 (Winter) | 233 | 2248.65 | 78.01 |
| S2 (Summer) | 197 | 2289.73 | 84.44 |
| S3 (Rainy) | 181 | 2452.89 | 85.34 |

might be due to the fact that best available cows might have been maintained as long as they were reproducing at the farm.

Effect of generation: Variation due to generation in longevity (was nonsignificant in Phule Triveni cows. These findings were in accordance with the results obtained by Saha *et al.* (2012) in Karan Swiss cattle, but these results were contradictory with findings of Hedage and Bhatnagar (1985) in Brown Swiss cattle and Effa *et al.* (2013) in Jersey cattle. In Phule Triveni cows, highest longevity (2660.64±482.90 day) was recorded in G9 generation

Table 2. Least squares means for longevity as affected by generation in Phule Triveni cattle

| Effect | N | Longevity (Days) | |
|-------------------|-----|------------------|--------|
| | | Mean | SE |
| μ | 611 | 2324.81 | 73.34 |
| <i>Generation</i> | | | |
| G1 | 121 | 2348.27 | 87.80 |
| G2 | 152 | 2332.10 | 78.33 |
| G3 | 107 | 2353.30 | 93.36 |
| G4 | 85 | 2257.44 | 104.75 |
| G5 | 56 | 2467.64 | 129.06 |
| G6 | 41 | 2285.24 | 150.83 |
| G7 | 36 | 2263.01 | 160.96 |
| G8 | 9 | 1955.70 | 321.93 |
| G9 | 4 | 2660.64 | 482.90 |

Table 3. Least squares means for longevity as affected by only 10 top ranked Sire in Phule Triveni cows

| Effect | N | Longevity (Days) | |
|-------------|-----|------------------|--------|
| | | Mean | SE |
| μ | 611 | 2337.28 | 65.77 |
| <i>Sire</i> | | | |
| R92 | 40 | 2319.60 | 150.49 |
| R29 | 31 | 2660.37 | 170.95 |
| R81 | 29 | 2376.07 | 176.75 |
| R65 | 23 | 2414.94 | 198.47 |
| R36 | 22 | 2149.89 | 202.93 |
| R24 | 21 | 2252.57 | 207.70 |
| R68 | 20 | 2279.63 | 212.83 |
| R40 | 19 | 2310.17 | 218.36 |
| R67 | 18 | 2343.38 | 224.35 |
| R90 | 18 | 2127.81 | 224.35 |

Total alive (normal) calves born: The per cent distribution of cows according to total alive calves produced in their lifetime indicated that 2.0% of total cows left the herd without leaving any live calf. The percentage of cows which left the herd after giving 1, 2, 3, 4 and 5 alive calves was 27.2, 24.7, 15.5, 9.7 and 10.0, respectively. One per cent cows left the herd after giving 10 and more alive calves (Table 4).

Total female calves born: The per cent distribution of cows indicated that 30.1% cows in the herd could not produce any female calf, 33.6% cows left the herd after producing only 1 female calf, only 4.3% cows produced more than 5 female calves. A maximum number of 8 female calves were produced by only 0.2 % cows (Table 4).

Total female calves reached to milking herd: It was found that about 47% cows left the herd without giving any replacement heifer, whereas 32.4% of total cows left only

Table 4. Per cent distribution of cows according to their life time calf production traits

| Lifetime calf production | Value of traits | | | | | | | | | | | | |
|----------------------------------|-----------------|---------------|---------------|--------------|-------------|--------------|--------------|-------------|--------------|------------|------------|------------|------------|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Total calves born | | 28.6 (175) | 24.7 (151) | 15.7 (96) | 9.7 (59) | 10.0 (61) | 6.4 (39) | 2.3 (14) | 0.8 (5) | 0.8 (5) | 0.7 (4) | 0.2 (1) | 0.2 (1) |
| Alive calves born | 2.0 (12) | 27.2 (166) | 24.7 (149) | 15.5 (95) | 9.7 (59) | 10.0 (61) | 3.9 (6.4) | 2.3 (14) | (0.8) (5) | 0.8 (5) | 0.8 (5) | 0.2 (1) | |
| Female calves born | 30.1 (184) | 33.6 (205) | 18.5 (113) | 11.6 (71) | 3.6 (22) | 2.0 (12) | 0.2 (1) | 0.3 (2) | 0.2 (1) | | | | |
| Female calves reached to milking | 47.1 (288) | 32.4 (198) | 12.3 (75) | 6.4 (39) | 1.1 (7) | 0.5 (3) | 0 (0) | 0.2 (1) | | | | | |

(*Figures in parenthesis are the number of cows)

followed by G5 generation (6467.64±129.06 days) and lowest longevity (1955.70±321.93 days) was recorded in G4 generation (Table 2).

Effect of sire: The random effect of sire had nonsignificant effect on longevity in Phule Triveni cows. These results were in close agreement with the estimates reported by Gowane and Tomar (2007) in Murrah buffalo whereas significant effect of sire was reported by Atrey *et al.* (2005) in Frieswal cattle. In Phule Triveni cows, the least squares analysis revealed that the highest longevity (2660.37±170.95 days) was observed for sire R29 followed by sire R65 (2414.94±198.47 days) and lowest longevity was observed (2127.81±224.35 days) for sire R90 (Table 3).

Distribution of cow according to lifetime calf production

Total calves born: The highest number of total calves produced was 12 which was only 0.2% of total cows and about 55% cows left the herd after producing 3 or less calves in their life time. Percentage of cows which left the herd after giving only one calf was 28.6 but the percentage of cows producing 2 through 8 calves was 24.7, 15.7, 9.7, 10.0, 6.4, 2.3 and 0.8, respectively. Only 1.1% cows produced 10 or more calves (Table 4).

one, 12.3 and 6.4% left 2 and 3 replacements, respectively, and rest 5.0% cows left 4 or more replacement daughters with maximum of 7 replacement daughters by only 0.2% cows (Table 4).

SUMMARY

The overall least squares mean for longevity or total herd life was found to be 2330±60.12 days (6.4±0.16 years) in the present study. Fixed effect of first lactation milk yield group significantly affected longevity of Phule Triveni cattle. Therefore, adjustment of longevity data for significant effect of first lactation milk yield is important for accurate and unbiased estimates of genetic parameters. Further, there is scope for the improvement in management of Phule Triveni crossbred cattle to get high longevity or total herd life of crossbred cattle.

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