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Abhishek Joshi
College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Gujarat, India

MM Pawar
College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Gujarat, India

BK Ashwar
College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Gujarat, India

AK Srivastava
College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Gujarat, India

JK Patel
College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Gujarat, India

JB Patel
College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Gujarat, India

Corresponding Author:
Abhishek Joshi
College of Veterinary Science and Animal Husbandry, Sardarkrushinagar Dantiwada Agricultural University, Gujarat, India

Analysis of factors that affect the longevity trait in Kankrej cattle at an organised farm

Abhishek Joshi, MM Pawar, BK Ashwar, AK Srivastava, JK Patel and JB Patel

Abstract
The longevity is an important factor, which affects the total productivity, economy and the rate of genetic gain. There is very little information available in the literature about these traits in Kankrej cattle. As a breed-improvement tool, longevity in dairy cattle can be viewed both from an economic perspective as well as from a breed-improvement standpoint ((34)). This analysis was done on 251 calving records of Kankrej cows collected at Livestock Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat over 15 years i.e. from 2001 to 2015, under identical feeding and managemental circumstances. The mean for longevity of cow was 2568.72±1092.87 days, C.V. being 42.5 percent. The least-square mean for longevity was 2592.56±115.02 days. The Longevity was significantly affected by period of first calving and first lactation milk yield in Kankrej cattle. Non-significant effect of age at first calving and season of first calving were observed on Longevity in Kankerj Cattle.

Keywords: Longevity, Kankrej, calf production, age at first calving

Introduction
Livestock has a great role in the economy of rural households in India. Most of the households in rural area possess some kind of livestock and three-quarters of these household in the rural area belongs to small and marginal farmers. During the last two decades India has emerged as World's top most nation in the dairy sector and has witnessed rapid development in the milk production but it is not sufficient for the large population of the country. Cattle occupy an important place in the agricultural economy of India because of their adaptability to harsh climatic conditions, tolerance to tropical diseases and survival under poor feeding and management practices. Kankrej plays an important role in the milk production of the state. The temperature in summer goes up to 40 °C and in winter it is as low as 9-10 °C. Rainfall is uncertain. Soil in these areas is sandy alluvial and porous, which in the southern parts merges into the black cotton soil. Longevity is a trait of increasing importance in animal's breeding scheme. Much research has been done and is still being done, on estimation of genetic parameters that are needed in order to incorporate longevity into a breeding program.

Material and Methods
The relevant data for the present investigation generated over a period of 15 years (2001-2015) were collected from the history sheets and pedigree sheets maintained at Livestock Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat which was initially set up to evaluate production potential of Kankrej cattle, a native breed of Gujarat state.
Least square mean for the above traits were estimated across different period of first calving, season of first calving, age at first calving groups and first lactation milk yield groups. The data were classified into five periods of three year each according to the year of first calving, as P1, P2, P3, P4 and P5. Season of calving was classified as S1 (March-June), S2 (July-October) and S3 (November-February). Age at first calving was classified into five groups with the class interval of 150 days, A1 (Less than 1001days), A2 (1001 to 1150days), A3 (1151 to 1300 days), A4 (1301 to 1450 days) and A5 (Above 1451). First lactation milk yield was classified into seven groups on the basis of first lactation 305 days milk yield as follows L1(Less than 1001 kg), L2 (1001 to 1400 kg), L3 (1401 to 1800 kg), L4 (1801 to 2200 kg), L5 (2201 to 2600 kg), L6 (2601 to 3000 kg) and L7 (Above 3000 kg).

Longevity
It is defined as number of days from the date of birth to date of disposal of cows from herd either due to culling or death.

Results

1. **Longevity:** The mean for longevity of cow was 2568.72±1092.87 days, C.V. being 42.5 percent (Table 1).
2. **Least square mean and significance of fixed effect for longevity:** The least square mean for longevity across the different non-genetic factors and analysis of variance are presented in Table 2 and 3, respectively. The least-square mean for longevity was 2592.56±115.02 days.

(a) Period of first calving
The longevity was 3222.72±169.15, 2729.86±153.44, 2773.07±165.31, 2151.25±164.65 and 2085.88±175.85 days in P1, P2, P3, and P4 periods, respectively. Period had Significant effect on longevity, contributing 12.57 percent to total variability (Table 2). Longevity was highest in P1 period (2001-2003) followed by P3, P2, P4, and P5 periods. The difference between P2 and P3 on the one hand and P4 and P5 on other hand was non-significant.

(b) Season of first calving
The least-square mean for longevity was longest at 2696.02±133.67 days for cow calving in S3 season, then 2560.99±170.16 days in S2 season and shortest at 2520.64±133.19 days for cow calving in S1 season. The difference between seasons was being non-significant.

(c) Age at first calving
The least square mean for longevity for different age at first group ranged between 2438.24±161.83 days for A2 group to 2819.26±367.27 days for A1 group (Table 2). The age at first calving group had non-significant effect on longevity contributing 0.63 percent to total variability (Table 3).

Table 1: Mean, standard deviation and C.V. (%) of Longevity

Sr. No.	Traits	No. of Observations	Mean	S.E.	S.D.	C.V. (%)
1	Longevity (days)	251	2568.72	68.98	1092.87	42.5

(d) First lactation milk yield
The least-square mean for longevity on the basis of first lactation milk yield group were 1679.50±164.93, 1965.62±175.85, 2536.62±132.66, 2873.75±135.15, 3280.93±203.17, 2582.53±358.11 and 3228.91±472.64 days in L1, L2, L3, L4, L5, L6 and L7, respectively. The longevity of cow belonging to first lactation milk yield group L5 was significantly higher than L1, L2, L3, L4, L6 and L7 groups. First lactation milk yield group was significantly contributing 20.15 percent to the total variability (Table 2).

Table 2: Least square mean and standard error for productive herd life (days) across different non genetic factors

Sr. No.	Parameter	No. of Observations	Mean±S.E. (days)
1	Total	251	1351.99±114.55
2	PFC	**	
2.1	P1 (2001-2003)	59	1988.57^{c}±168.45
2.2	P2 (2004-2006)	67	1491.15^{a}±152.81
2.3	P3 (2007-2009)	49	1536.54^{a}±164.62
2.4	P4 (2010-2012)	48	903.40^{b}±163.97
2.5	P5 (2013-2015)	28	840.27^{b}±199.68
3	SFC	Non-significant	
3.1	S1 (Summer) March to June	109	1281.49±132.64
3.2	S2 (Rainy) July to October	47	1302.38±169.46
3.3	S3 (Winter) November to February	95	1472.10±133.12
4	AFC	Non-significant	
1.1	A1 (< 1001 days)	7	1874.37±365.75
4.2	A2 (1001-1150 days)	43	1351.19±161.16
4.3	A3 (1151-1300 days)	79	1341.03±128.50
4.4	A4 (1301-1450 days)	69	1281.88±140.52
4.5	A5 (> 1450 days)	53	911.47±158.25
5	FLMY	**	
5.1	L1 (< 1001 kg)	38	443.24^{d}±164.25
5.2	L2 (1001-1400 kg)	34	721.15^{cd}±175.12
5.3	L3 (1401-1800 kg)	66	1290.97^{bc}±132.11
5.4	L4 (1801-2200 kg)	75	1634.06^{ab}±134.60
5.5	L5 (2201-2600 kg)	27	2029.80^{a}±202.33
5.6	L6 (2601-3000 kg)	7	1341.18^{abc}±356.63
5.7	L7 (> 3000 kg)	4	2000.51^{ab}±470.69

Table 3: Least square analysis for productive herd life

Source of Variation	d.f.	MS	R^2
PFC	4	9531050**	12.64
SFC	2	704098	0.58
AFC	4	875654	2.75
FLMY	6	9868937**	19.63

**Significant at $p<0.01$

Discussion
Longevity: The least square mean value for longevity of Kankrej cow was found to be 2592.56±115.02 days in the present study.
Higher estimates for longevity than the present findings were, however, reported by Kohli and Suri (1957) [21] in Hariana (136.3 months), Singh and Sinha (1960) [45] in Tharparkar

(119.06 months), Sharma and Singh (1974) [43] in Red Sindhi (7.66 years) and Sahiwal (7.28 years), Gill (1981) [14] in Sahiwal (3163 days) and Holstein Friesian x Sahiwal (3394 days), Matharu and Gill (1981) [29] in Holstein Friesian x Sahiwal (3200 days), Patel *et al.* (1982) [31] in Kankrej at Anand farm (7.28 years) and Chharodi farm (9.1 years), Basu *et al.* (1983) [5] in Tharparkar (7.77 years), Tanida *et al.* (1988) [50] in Angus and Hereford (7.4 years), El-Arain and Tripathi (1988) [11] in Murrah buffalo at farm one (2893.23 days) and farm two (3531.29 days), Roy and Tripathi (1990)[40] in Holstein Friesian x Sahiwal/Tharparkar (2725.31 days), Sahota and Gill (1990) [42] in Sahiwal (3202 days), Bailey *et al.* (1991) [4] in American Angus x Hereford (7.17 years), Brahman x Angus (7.5 years) and Brahman x Hereford (7.81 years), Rehout *et al.* (1992) [39] in Cows (10.23 years), Rao (1993) [37] in Jersey x Desi at organised farm (7.9 years) and village (9.4 years), Mahdy (1994a) [27] in Egyptian buffalo (86.52 months), Kaushik *et al.* (1994) [20] in Hariana farm one (8.94 years) and two (11.79 years), Petkove and Boichev (1995) [33] in Holstein Friesian (8.3 years), Rao and Rao (1996) [38] in Murrah buffalo (8.69 years), Kumar (1997) [22] in crossbred cattle (3615.23 days), Singh *et al.* (1997) [44] in Rathi (3329 days) and Red Dane x Rathi (3858.48 days), Chaudhari and Fulsoundar (1999) [7] in Kankrej (3392.58 days), Bhattacharjya *et al.* (2000) [6] in Tharparkar (3609.62 days), Gahlot *et al.* (2001) [13] in Tharparkar (9.7 years), Ram and Goswami (2005) [36] in Tharparkar (8.6 years), Kumar (2007) [23] in Hariana (9.12 years), Kumar *et al.* (2009) [25] in Hariana (9.12 years), Jakhar *et al.* (2010) [19] in Hariana (8.52 years), Singh *et al.* (2011) [49] in Sahiwal (8.76 years), Goshu *et al.* (2014) [15] in Holstein Friesian (7.84 years), Upadhyay *et al.* (2015) [51] in Sahiwal (2751.47 days).

Lower estimates for longevity than the present findings were reported by Asker *et al.* (1954) [2] in Egyptian cattle (3.5 years) and Egyptian buffalo (2.45 years), Youssef and Asker (1959) [52] in Egyptian buffalo (5.1 years), Evans *et al.* (1964) [12] in Holstein Friesian (2527 days), Singh *et al.* (1964) [47] in Hariana (79.5 months), Hibner and Krzywda (1981) [17] in Poland Black and White Lowland cattle (74.5 months), Croak-Brossman (1983) [8] in Angus (5.65 years) and crossbred (5.8 years) and Milking Shorthorn (4.58 years), Hegade and Bhatnagar (1985) [16] in Brown Swiss (2563.78 days), Panella *et al.* (1987) [30] in Marchigiana (72.1 months), Ponce de Leon and Guzman (1988) [35] Holstein Friesian (75.6 months), Bailey *et al.* (1991) [4] in Red Poll x Hereford (6.98 years), in Angus x Charolias (6.55 years), Red Poll cattle (6.5 years), Hereford (6.08 years) and Hereford x Red Poll (5.82 years), Singh and Tomar (1991) [46] in Karan Fries (2.87 years), Ibeawuchi (1993) [18] in Wadara (Shuwa) (5.1 years), Chaudhari and Fulsoundar (1999) [7] in Jersey x Kankrej (2492.98 days), Dalal *et al.* (2002) [9] in Hariana (4.7 years), Singh *et al.*(2002) [48] in Holstein Friesian (6.62 years), Atrey *et al.* (2005) [3] in Frieswal (6.2 years), Dubey and Singh (2005) [10] in Sahiwal crossbred (1921.61 days), Abbas and Sachdeva (2008) [1] in Sahiwal (6.98 years), Saha *et al.* (2010) [41] in Karan Fries (1809.80 days), Kumar *et al.* (2014) [24] in Frieswal (6.43 years).

The variations observed by various workers in longevity may be due to variations in voluntary and involuntary culling by individual farmers or research stations. Higher estimates for longevity than the present findings showed that disposal based on low milk production of milch animal was good and disposal based on other traits like physical defects, dry period and service period etc. was also good. Lower estimates for longevity than the present findings showed that the most of the adult cows left the herd, due to teat and udder and reproductive problems.

(a) Effect of period of first calving on longevity

The statistical analysis of data indicated that the longevity of Kankrej cow was significantly affected ($p \leq 0.01$) by period of first calving with a similar trend observed in productive herd life. The reason attributed to this effect may be the same as mentioned earlier for productive herd life. Thus decrease in average longevity from P1 to P5 showed that the improvement in herd due to selection/culling and also may be due to improvement in management practices over the period.

Significant effect of period of first calving on longevity was also reported by Hegade and Bhatnagar (1985) [16] in Brown Swiss x Zebu, Ponce de Leon and Guzman (1988) [35] Holstein Friesian, Singh and Tomar (1989) [46] in Karan Fries, Kaushik *et al.* (1994) [20] in Hariana farm one, Mahdy (1994a) [27] in Egyptian buffaloes, Singh *et al.* (1997) [44] in Red Dane x Rathi, Gahlot *et al.* (2001) [13] in Tharparkar, Atrey *et al.* (2005) [3] in Frieswal, Dubey and Singh (2005) [10] in Sahiwal and crossbred, Ram and Goswami (2005) [36] in Tharparkar, Kumar (2007) [23] in Hariana, Kumar *et al.* (2009) [25] in Hariana, Jakhar *et al.* (2010) [19] in Hariana, Saha *et al.* (2010) [41] in Karan Fries, Singh *et al.*(2011) [49] in Sahiwal, Kumar *et al.* (2014) [24] in Frieswal, Upadhyay *et al.* (2015) [51] in Sahiwal.

Non-significant effect of period of first calving on longevity was also reported by Kumar (1997) [22] in crossbred cattle, Singh *et al.* (1997) [44] in Rathi, Abbas and Sachdeva (2008) [1] in Sahiwal.

(b) Effect of season of first calving on longevity

In the present study a non-significant effect of season of first calving on longevity of Kankrej cow was observed. The main reason for this is that Kankrej breed is more adaptable to semi-arid climatic condition of north Gujarat. Similar results were reported by Youssef and Asker (1959) [52] in Egyptian buffaloes, Hegade and Bhatnagar (1985) [16] in Brown Swiss x Zebu, Kumar and Reddy (1989) [26] in Karan Swiss, Ibeawuchi (1993) [18] in Wadara (Shuwa), Kaushik *et al.* (1994) [20] in Hariana farm one, Kumar (1997) [22] in crossbred, Pathodiya (1999) [32] in Surti buffalo, Atrey *et al.* (2005) [3] in Frieswal, Dubey and Singh (2005)[10] in Sahiwal and crossbred, Ram and Goswami (2005) [36] in Tharparkar, Saha *et al.* (2010) [41] in Karan Fries, Singh *et al.* (2011) [49] in Sahiwal, Goshu *et al.* (2014) [15] in Holstein Friesian.

On the other hand, significant effect of season of first calving on longevity was reported by Mahdy (1994a) [27] in Egyptian buffalo, Gahlot *et al.* (2001) [53] in Tharparkar, Upadhyay *et al.* (2015) [51] in Sahiwal.

(c) Effect of age at first calving on longevity

In the present study a non-significant effect of age at first calving on longevity of Kankrej cow was observed. Similar results were reported by Asker *et al.* (1954) [2] in Egyptian cattle and Egyptian buffalo, Singh and Sinha (1960) [45] in Tharparkar, Ibeawuchi (1993) [18] in Wadara (Shuwa), Bhattacharjya *et al.* (2000) [6] in Tharparkar, Abbas and Sachdeva (2008) [1] in Sahiwal, Kumar *et al.* (2009) [25] in Hariana, Jakhar *et al.* (2010) [19] in Hariana, Goshu *et al.* (2014) [15] in Holstein Friesian, Upadhyay *et al.* (2015) [51] in Sahiwal.

On the other hand, significant effect of age at first calving on longevity was reported by Hibner and Krzywda (1981) [17] in Poland Black and White Lowland Cattle, Ponce de Leon and Guzman (1988) [35] Holstein Friesian, Mahdy (1994a) [27] in Egyptian buffaloes, Gahlot *et al.* (2001) [13] in Tharparkar, Ram and Goswami (2005) [36] in Tharparkar, Kumar (2007) [23] in Hariana, Kumar *et al*. (2014) [24] in Frieswal.

(d) Effect of First lactation milk yield on longevity

In the present study a significant effect of first lactation milk yield on longevity of Kankrej cow was observed. Similar results were reported by Ibeawuchi (1993) [18] in Wadara (Shuwa), Mahdy (1994b) [28] in Holstein Friesian, Atrey *et al.* (2005) [3] in Frieswal, Ram and Goswami (2005) [36] in Tharparkar, Kumar (2007) [23] in Hariana, Abbas and Sachdeva (2008) [1] in Sahiwal, Kumar *et al.* (2009) [25] in Hariana, Goshu *et al.* (2014) [15] in Holstein Friesian, Upadhyay *et al*. (2015) [51] in Sahiwal.

On the other hand, non-significant effect of age at first calving on longevity was reported by Mahdy (1994a) [27] in Egyptian buffalo.

The main cause of lower milk production in the first lactation was the culling of cows from the herd. It was therefore concluded that higher milk production in the first lactation was associated with more longevity.

Conclusion

The Longevity was significantly affected by period of first calving and first lactation milk yield in Kankrej cattle.

Non significant effect of age at first calving and season of first calving were observed on Longevity in Kankerj Cattle.

Finally, longer-living animals can provide greater genetic gain, allowing for a more diverse gene pool, which can lead to stronger and healthier animals in the future.

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References

1. Abbas M, Sachdeva GK. Effect of genetic and non-genetic factors on productive herd life and longevity in a herd of Sahiwal cows. Indian Journal of Animal Sciences. 2008;42(2):136-138.
2. Asker AA, Ragab MT, Hilmy SA. Longevity in Egyptian cattle and buffaloes. Indian Journal of Dairy Science. Cited by Youssef and Asker. 1954;7:135-138..
3. Atrey RK, Singh H, Sharma RK. Factors affecting the productive herd life, longevity and lifetime calf production traits in Frieswal cattle. Indian Journal of Animal Sciences. 2005;75(10):1172-1175.
4. Bailey CM. Life Span of beef type of Bos-Taurus and *Bos-indicus* x *Bos taurus* breed type in a dry temperate climate. Journal of Animal Science. 1991;69(6):2379-2386.
5. Basu SB, Bhatnagar DS, Taneja VK. Genetic and phenotypic parameters of lifetime traits in Tharparkar cows. Indian Journal of Dairy Science. 1983;36(2):207-210.
6. Bhattacharjya TK, Kumar P, Joshi JD. Lifetime traits in Tharparkar cattle. Indian Journal of Animal Sciences. 2000;70(5):535-536.
7. Chaudhari PR, Fulsoundar AB. Lifetime performance of Kankrej and Jersey x Kankrej crossbred cows under organized herd. Indian Journal of Animal Production and Management. 1999;15(3):94-96.
8. Croak-Brossman SJ. Lifetime productivity of purebred and crossbred cows of Angus and milking shorthorn parentage. In: Bull 44, Dissertation Abstracts International, B. (Science and Engineering); c1983. p. 1715-1716.
9. Dalal DS, Rathi SS, Raheja KL. Estimates of genetic and phenotypic parameters for first lactation and lifetime performance traits in Hariana cattle. Indian Journal of Animal Sciences. 2002;72(5):398-401.
10. Dubey PP, Singh CV. Estimates of genetic and phenotypic parameters considering first lactation and lifetime performance traits in Sahiwal and crossbred cattle. Indian Journal of Animal Sciences. 2005;75(11):1289-1294.
11. El-Arain MN, Tripathi VN. Studies on herd life and productive life of Murrah buffaloes. Buffalo Journal. 1988;4(2):225-229.
12. Evans DL, Branton C, Farthing BR. Heritability estimates and interrelationship among production per day of productive life, longevity, breeding efficiency and type in a herd of Holstein cows. Journal of Dairy Science. 1964;47:699-700.
13. Gahlot GC, Pant KP, Barahat NK. Longevity and lifetime performance of Tharparkar cows. Indian Journal of Animal Sciences. 2001;71(4):391-393.
14. Gill GS. Implication of genotype x environmental interaction in sire evaluation in dairy cattle. Indian Journal of Dairy Science. 1981;34:1-7.
15. Goshu G, Singh H, Petersson KJ. Effect of non-genetic factors on herd life, selective value and its components in Holstein Friesian cows. Indian Journal of Animal Sciences. 2014;84(1):50-53.
16. Hegade ME, Bhatnagar DS. Lifetime performance of different genetic groups of Swiss crossbred cow. Indian Journal of Dairy Science. 1985;38(4):321-326.
17. Hibner A, Krzywda J. The effect of age at first calving on the fertility and longevity of cows. Medycyna Weterynaryjna. 1981;37(1):31-34.
18. Ibeawuchi IA. Longevity and milk production efficiency of Wadara (Zebu) cattle in the semi-arid region of Nigeria. East African Agricultural and Forestry Journal. 1993;59(1):11-17.
19. Jakhar GS, Singh R, Malik CP, Rajkumar. Factors affecting productive herd life, longevity and lifetime calf production traits in Hariana cattle. Indian Journal of Animal Sciences. 2010;80(12):1251-1253.
20. Kaushik SN, Agarwal SC, Garg RC. Life-time traits in Hariana cattle. Indian Journal of Animal Sciences. 1994;64(10):1104-1107.
21. Kohli ML, Suri KR. Longevity and reproductively in Hariana cattle. Indian Journal of Animal Sciences. 1957;27(3):105-110.
22. Kumar A. Evaluation of crossbred cattle for selective value. M.Sc. (Agri.) Thesis (Unpublished). Rajasthan Agricultural University, Bikaner, Rajasthan; c1997.
23. Kumar A. Longevity and productive herd life of Hariana cattle. Indian Veterinary Journal. 2007;84(1):51-53.
24. Kumar A, Kumar S, Singh U, Beniwal BK. Factors affecting herd life and total calf production in Frieswal cows. Indian Journal of Animal Research. 2014;48(2):159-161.

25. Kumar A, Singh U, Khanna AS, Singh RP. Genetic and non-genetic variability in selective value of Hariana cows. Indian Journal of Animal Sciences. 2009;79(4):388-391.
26. Kumar S, Reddy KM. Herd life and productive life among Karan Swiss and Karan Fries cattle. Indian Journal of Dairy Science. 1989;42(2):277-279.
27. Mahdy AE. Lifetime performance in Egyptian buffalo. Alexandria Journal of Agricultural Research. 1994a;39(3):69-82.
28. Mahdy AE. Studies on lifetime milk production and longevity traits in Friesian cows. Alexandria Journal of Agricultural Research. 1994b;39(3):83-91.
29. Matharu RS, Gill GS. Evaluation of different grades of Holstein Friesian x Sahiwal crosses on the basis of lifetime production and reproductive efficiency. Indian Journal of Dairy Science. 1981;34:16-20.
30. Panella F, Renieri C, Cervigni G, Giordani R. Genetic and phenotypic effects on longevity in Marchigiana cattle. *Annali della* Facolta di Agraria, Universita degli Studi di Perugia. 1987;41:537-545.
31. Patel JP, Patel JM, Patel UG, Dave AD. Age at disposal and productive life of Kankrej cows. Indian Journal of Dairy Science. 1982;35(1):101-102.
32. Pathodiya OP, Jain LS, Tailor SP. Age at first calving and its correlation with economic traits in Surti buffaloes. Indian Veterinary Journal. 1999;76(10):902-905.
33. Petkov P, Boichev G. Lifetime milk yield and productive longevity of cows with different genotypes for the casein system. Zhivotnov' dni Nauki. 1995;32(5):191-193.
34. Plowman RD, Gaalaas RF. Heritability estimates of longevity in Holstein Friesian cattle. Journal of Dairy Science. 1960;43(6):877-878.
35. Ponce de Leon R, Guzman M. Genetics and environmental factors Effecting Long Term production and longevity in Holstein breed. Cuban Journal of Agricultural Sciences. 1988;22(1):9-15.
36. Ram P, Goswami SC. Effect of age at first calving on productive herd life, longevity & life time calf production in Tharparkar cattle. Indian Journal of Dairy Science. 2005;58(6):439-441.
37. Rao AVN. Lifetime performance of Jersey x Desi half bred cows under farm and village management in Andhra Pradesh. Livestock Adviser. 1993;18(5):24-25.
38. Rao AVN, Ram Mohan Rao AH. Longevity, lactation efficiency and culling pattern of Murrah buffaloes in Andhra Pradesh. Indian Veterinary Journal. 1996;73(11):1196-1197.
39. Rehout V, Hajic F, Kosvanec K, Citek J, Slipka J. A genetic view of longevity in cows. Sbornik Jihoceska Univerzita, Zemedelska Fakulta, Ceske Budejovice, Zootechnicka Rada. 1992;9:117-118.
40. Roy PK, Tripathi VN. Factors effecting lifetime performance in Holstein x Zebu crosses. Indian Veterinary Journal. 1990;67(1):29-33.
41. Saha S, Joshi BK, Singh A. Generation-wise genetic evaluation of various first lactation traits and herd life in Karan Fries cattle. Indian Journal of Animal Sciences. 2010;80(5):451-456
42. Sahota RS, Gill GS. Relative life-time performance for economic efficiency in different grades of dairy cattle. Indian Journal of Dairy Science. 1990;43(4):512-514.
43. Sharma KNS, Singh S. Estimation of average productive life of cattle on a modern dairy farm. Indian Journal of Animal Sciences. 1974;44(3):145-149.
44. Singh B, Gahlot GC, Gahlot RS. Lifetime performance of Rathi cows in closed herd. Indian Journal of Dairy Science. 1997;50(6):439-442.
45. Singh ON, Sinha NC. Effect of AFC on milk production, reproduction and longevity of Tharparkar cattle. Indian Journal of Dairy Science. 1960;13:163-169.
46. Singh RB, Tomar SS. Genetic analysis of Herd Life in Karan Fries cattle. Indian Journal of Dairy Science. 1989;42(3):431-433.
47. Singh SB, Singh SP, Desai RN. Effect of age at first calving and first lactation milk production on longevity and lifetime milk production in Hariana cattle. Indian Journal of Veterinary Science Animal Husbandry. 1964;34(4):202-213.
48. Singh S, Khanna AS, Singh RP. Replacement and lifetime production traits: effect of non-genetic factors and sire evaluation. Asian Australasian Journal of Animal Sciences. 2002;15(1):11-15.
49. Singh U, Kumar A, Kumar, Sushil, Beniwal BK. Evaluation of Sahiwal cattle for lifetime traits in an organized herd. Indian Journal of Animal Sciences. 2011;81(7):708-710.
50. Tanida H, Hohenboken ND, Denise SK. Genetic aspects of longevity in Angus and Hereford cows. Journal of Animal Science. 1988;66(3):640-647.
51. Upadhyay A, Sadana DK, Gupta AK, Singh A, Shivahre PR. Effect of genetic and phenotypic parameters on lifetime performance traits in Sahiwal cattle. Indian Veterinary Journal. 2015;92(1):58-61.
52. Youssef AA, Asker AA. Breeding efficiency, longevity and age at first calving in the Egyptian buffaloes. Indian Journal of Dairy Science. 1959;12(1):1-9.