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Evaluation of pooled lactation production and reproduction traits in Sahiwal cattle

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ABSTRACT

The pooled lactation records of Sahiwal cows maintained at 3 different farms over a period of 40 years were analysed to evaluate the production and reproduction performance.The overall least squares means of lactation traits for pooled data over the herds and lactations were: 1708.10±11.32 kg for 305DMY, 1793.09±12.63 kg for LMY, 286.32±1.52 days for LL, 155.33±2.15 days for SP, 148.61±1.97 days for DP and 445.92±2.38 days for CI. The effect of herd was significant on all production and reproduction traits. The season was highly significantly influencing 305DMY and LL, whereas it had no significant effect of LMY. The season of calving had significant effect on SP and CI; while it had no significant effect on DP. The effect of period was significant on all production and reproduction traits. The effect of parity was highly significant on all production and reproduction traits. It was observed that first lactation reproduction traits were comparatively of longer duration than the later lactations indicating better reproductive efficiency in later lactations/age of cows.

Key words: Calving interval, Herd, Lactation milk yield, Parity, Sahiwal

The Sahiwal breed of dairy cattle is being utilized widely for improvement of local stock or for initial crossbreeding of indigenous stock with European breeds in many warm humid countries of the world because of its well-known resistance to tropical diseases, endurance to hot climate of tropics, low cost of maintenance and higher milk constituents. Sahiwal blood has been used to produce different synthetic strains like Jamaica Hope, Australian Milking Zebu (AMZ), Australian Friesian Sahiwal (AFS), Mpwapwa and Pabna crosses. In India, Karan Swiss and Frieswal have been developed by crossing Sahiwal breed with exotic breeds like Brown Swiss and Holstein-Friesian. Literature available on various pooled lactation economic traits is scanty in Sahiwal cattle. In present Investigation an attempt was made to evaluate the productive and reproductive performance of Sahiwal cows maintained at 3 different farms of India and to compare our estimate with earlier published reports (Gandhi *et al.* 1995, Javed 1999, Rehman 2006, Ilatsia *et al.* 2007, Bajwa *et al.* 2008) of pooled lactation performances.

MATERIALS AND METHODS

The data on Sahiwal cows for present investigation were collected from herds namely National Dairy Research Institute (NDRI), Karnal, Government Livestock Farm, Lucknow and Government Cattle Breeding Farm, Anjora, Durg.The performance records on all lactation of Sahiwal cattle for last 40 years (1966–2005) were collected. The production traits were 305 days or less milk yield (305DMY), lactation milk yield (LMY) and lactation length (LL), whereas reproduction traits included service period (SP), dry period (DP) and calving interval (CI), respectively.

The influence of non genetic factors on different traits was studied by least squares analysis of variance for unequal and non orthogonal data as prescribed by Harvey (1990). The following statistical model was used for different traits under investigation:

$$Y_{ijkl} = m + H_i + S_j + P_k + L_l + (HS)_{ik} + (HP)_{ik} + (HL)_{il} + e_{ijklm}$$

where, Y_{ijklm}, trait under study, viz. Pooled lactation 305 days or less milk yield, lactation total milk yield, lactation length, service period, calving interval etc.;m, overall population mean; H_i, effect of ith herd; S_j, effect of jth season; P_k , effect of kth period; L_l, effect of lth lactation number; and $(HS)_{ik}$, $(HP)_{ik}$ and $(HL)_{il}$, interaction of herd with season, period and lactation number, respectively; e_{ijklm}, random error, assumed to be normally independently distributed with mean zero and constant variance i.e. NID (0, σ_e^2).

RESULTS AND DISCUSSION

Evaluation of pooled lactation production traits: The least

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squares analyses of variance for 305DMY, LMY and LL for pooled data over herds are presented in Table 1. Most of the non-genetic factors had a significant influence on all the production traits (Table 2). Estimates of LMY were comparable with the results reported by Yadav *et al.* (1992) and Gandhi *et al.* (1995) in Sahiwal cattle. Gandhi *et al.* (1995) reported 1659.72±31.60 kg 305DMY and a shorter LL of 278.31±3.33 days in Sahiwal cows. Bajwa *et al.* (2008) reported a lower estimate of lactation milk yield of1475±651 kg for an average lactation length of 248±67 days in Sahiwal cows at Pakistan. Rehman (2006) reported a lower estimate of lactation milk yield (1550 liters), lactation length (235 days) in Sahiwal cows of Pakistan. Ilatsia *et al.* (2007) reported lower estimates for lactation milk yield (1368 kg) and lactation length (282 days) in Sahiwal cows in Kenya.

Effect of herd on production traits: The effect of herd was highly significant (P<0.01) on all of the pooled lactation production traits (Table 1). The 305DMY and LMY were highest with their value 2016.94±18.89 and 2098.63±21.07 kg, in NDRI herd; whereas their estimates were lowest (1405.93±20.34 and 1523.37±22.69 kg) in Lucknow herd (Table 2). The least squares mean for LL was highest in Lucknow herd (290.73±2.73 days), whereas the lactation length was shortest (279.69±2.63 days) in Anjora herd. Reddy (1983) and Gandhi *et al.* (1995) reported significant effect of herd on 305DMY, LMY and LL. They reported that maximum LMY and 305DMY in NDRI, herd.

Effect of season of calving on production traits: The season of calving was significantly affecting 305DMY and LL; whereas it had no significant effect of LMY (Table1). The cows calving during autumn season had highest 305DMY of 1748.26±21.16 kg, whereas cows calving during summer season had lowest 305DMY of 1678.35±17.36 kg. In case of LL, the summer calvers were having longest LL of 281.51±2.84 days. On the contrary, most of the workers (Narayankhedkar *et al.* 1975, Mishra *et al.* 1979, Chawla and Mishra 1982, Reddy 1983, Yadav *et al.* 1992) reported that the effect of season was not significant on LL. However, Gandhi *et al.* (1995) and Bajwa *et al.* (2008) reported significant effect of the season of calving on LL and 305DMY in Sahiwal cattle.

Effect of period of calving on production traits: The effect of period was highly significant (P<0.01) on all of the pooled lactation production traits (Table 1). The cows calved during period 1976–78 had highest 305DMY and LMY (1853.41±27.51 and 2013.18±30.70 kg, respectively); whereas cows calved during 2003–05 had lowest least squares mean (1411.77±31.31 and 1375.45±34.94 kg, respectively) for 305DMY and LMY (Table 2). The LL was longest (309.23±4.05 days) for the cows calving during 1982–84, whereas the LL was shortest (261.01±4.20 days) for the cows calving during 2003–05. Similar to these findings, Reddy (1983), Yadav *et al.* (1992) and Gandhi *et al.* (1995) observed the significant effect of period on 305DMY, LMY and LL.

Effect of parity on production traits: The parity was significantly (P<0.01) affecting all the pooled lactation production traits (Table 1). The least squares mean for 305DMY and LMY were maximum (1839.88±25.00 and 1949.71±27.89 kg, respectively) in the fifth parity (Table 2). The LL was longest (306.81±2.18 days) in first parity whereas it was shortest (267.99±5.90 days) in ninth and above parities. Reddy (1983) and Gandhi *et al. (1995)* also revealed that the effect of lactation number was significant on LMY, 305 DMY and LL. The LMY was lowest in first lactation and gradually increased up to third to fifth lactation. In agreement with present findings, Javed (1999) reported increase in milk yield towards 5th parity and declined thereafter to 12th parity. A contradictory report that parity had no significant effect on milk yield (Dhumal *et al.* 1989) is also available in the

Table 1. Least squares analysis of variance (mean squares only) for production and reproduction traits pooled over herds and lactations in Sahiwal cattle

Traits	Herd	Season	Period	Parity	Herd* season	Herd* period	Herd* parity	Error	R^2 value (%)
305DMY	97394769.5** (2)	1499615.5** (3)	10173798.0** (12)	9797290.3** (8)	1658147.0** (6)	8150290.5** (24)	1575380.4** (16)	400447 (8359)	23.00
LMY	87960557.2** (2)	1311301.3 (3)	15372343.2** (12)	7145472.6** (8)	2041998.6** (6)	10434548** (24)	1249394.9** (16)	498564 (8359)	20.43
LL	35213.6** (2)	23523.4* (3)	88767.7** (12)	87964.4** (8)	6264.3 (6)	84604.9** (24)	12425.1* (16)	7223.6 (8359)	09.80
SP	671776.2** (2)	23350.3* (3)	20142.6* (12)	216728.6** (8)	11584.3 (6)	88258.3** (24)	21200.9* (16)	8242.9 (6005)	16.56
DP	914906.4** (2)	8957.3 (3)	84934.1** (12)	88482.4** (8)	19317.4* (6)	109611.5** (24)	9989.1 (16)	6930.4 (6005)	22.43
CI	683991.2** (2)	29964.3* (3)	30588.4** (12)	264187.0** (8)	20465.7 (6)	104855.0** (24)	23479.5** (16)	10127.5 (6005)	16.26

LMY, Lactation total milk yield; 305DMY, 305 days or less milk yield; LL, Lactation length; DP, Dry period; SP, Service period; CI, Calving interval;**significant at 1% level;* Significant at 5% level;figures in parentheses are the degrees of freedom.

Table 2. Least squares means of production and reproduction traits pooled over herds and lactations in Sahiwal cattle

Effects	Production traits				Reproduction traits			
	N	305DMY (kg)	LMY (kg)	LL (days)	N	SP (days)	DP (days)	CI (days)
Overall	8431	1708.10±11.32	1793.09±12.63	286.32±1.52	6077	155.33±2.15	148.61±1.97	445.92±2.38
Farm								
Karnal	2234	2016.94^{a}±18.89	2098.63^{a}±21.07	288.55^{a}±2.53	1638	117.80^{a}±3.62	104.01^{a}±3.32	407.66^{a}±4.01
Lucknow	4239	1405.93^{b}±20.34	1523.37^{b}±22.69	290.73^{a}±2.73	3026	179.68^{b}±3.66	167.40^{b}±3.36	468.61^{b}±4.02
Anjora	1957	1701.43 ^{c}±19.57	1757.29^{c}±21.83	279.69^{b}±2.63	1413	168.50^{b}±3.88	174.42^{b}±3.55	461.50^{b}±4.30
Season								
Winter	3662	1721.00^{a}±14.32	1821.31±15.97	286.78^{ab}±1.92	2608	156.36^{a}±2.62	150.15±2.41	448.99^{a}±2.90
Summer	1933	1678.35^{b}±17.36	1790.94±19.37	291.58^{a}±2.33	1383	159.02^{a}±3.07	146.61±2.82	448.78^{a}±3.41
Rainy	1665	1684.78^{b}±18.07	1759.06±20.16	285.42^{ab}±2.42	1205	158.17^{a}±3.20	151.88±2.93	448.65^{a}±3.55
Autumn	1170	1748.26^{a}±21.16	1801.08±23.61	281.51^{b}±2.84	881	147.75^{b}±3.68	145.80±3.37	437.28^{b}±4.08
Period								
1.1966 – 69	472	1779.91^{a}±64.95	1861.19^{a}±72.47	287.31^{a}±8.72	425	144.53^{a}±10.25	141.64^{a}±9.39	432.80^{a}±11.36
2.1970 – 72	605	1827.79^{ab}±28.91	1909.22^{ab}±32.26	289.55^{a}±3.88	485	152.30^{a}±4.71	138.91^{a}±4.32	438.10^{ab}±5.22
3.1973 – 75	659	1821.91^{ab}±26.65	1920.30^{ab}±29.72	297.83^{b}±3.58	478	162.11^{b}±4.51	135.92^{ab}±4.13	447.48^{b}±5.00
4.1976 – 78	670	1853.41^{b}±27.51	2013.18^{b}±30.70	301.17^{bc}±3.70	529	146.43^{a}±4.66	120.10^{b}±4.28	435.13^{a}±5.17
5.1979 – 81	675	1764.96^{ab}±31.00	1914.47^{ab}±34.59	299.24^{b}±4.16	493	145.49^{a}±5.38	124.87^{b}±4.93	433.88^{a}±5.96
6.1982 – 84	660	1720.41^{ab}±30.16	1901.31^{ab}±33.65	309.23^{c}±4.05	475	170.31^{b}±5.13	143.41^{a}±4.70	465.82^{c}±5.68
7.1985 – 87	793	1805.45^{a}±28.22	1897.42^{a}±31.48	288.46^{a}±3.78	578	157.39^{ab}±5.11	145.27^{a}±4.69	449.89^{b}±5.67
8.1988 – 90	827	1662.69 ^{c}±31.03	1720.40^{c}±34.63	279.47^{ad}±4.16	569	168.11^{b}±5.64	166.80^{cd}±5.17	462.02^{c}±6.26
9.1991 – 93	725	1751.59 ^{ac}±31.29	1776.06^{ac}±34.92	274.18^{d}±4.20	513	160.08^{b}±5.48	161.15^{c}±5.02	450.90^{b}±6.07
10.1994 – 96	602	1724.44^{a}±32.94	1780.75^{ac}±36.75	284.95^{ad}±4.42	433	159.47^{ab}±5.31	155.34^{ac}±4.87	451.84^{b}±5.88
11.1997 – 99	597	1641.08 ^{c}±27.40	1700.55^{c}±30.57	278.73^{ad}±3.67	460	155.89^{ab}±4.50	162.07^{c}±4.12	448.67^{b}±4.98
12.2000 – 02	674	1440.29^{d}±25.36	1539.95^{d}±28.30	271.07^{de}±3.41	485	151.42^{a}±4.41	163.93^{c}±4.04	442.98^{ab}±4.89
13.2003–05	471	1411.77^{e}±31.31	1375.45^{e}±34.94	261.01^{e}±4.20	154	145.73^{a}±8.04	172.54^{d}±7.38	437.91^{ab}±8.92
Parity Effects	Production traits				Reproduction traits			
	N	305DMY (kg)	LMY (kg)	LL (days)	N	SP (days)	DP (days)	CI (days)
1	2141	1551.87^{a}±16.22	1714.58^{a}±18.09	306.81^{a}±2.18	1655	195.38^{a}±2.68	172.90^{a}±2.45	489.83^{a}±2.97
2	1724	1682.89^{b}±17.39	1796.99^{b}±19.40	290.45 ^{b}±2.33	1264	164.77^{b}±2.95	154.57^{b}±2.70	457.44^{b}±3.27
3	1301	1789.48^{c}±19.27	1896.43^{c}±22.05	291.40^{b}±2.65	995	157.31^{b}±3.28	147.21^{bc}±3.00	446.18^{b}±3.64
4	1040	1786.17^{c}±22.03	1872.17^{c}±24.49	284.08^{c}±2.96	772	156.57^{b}±3.68	153.84^{b}±3.37	447.05^{b}±4.08
5	793	1839.88^{d}±25.00	1949.71^{d}±27.89	295.11^{ab}±3.35	542	157.08^{b}±4.27	146.95^{bc}±3.91	450.63^{b}±4.73
6	560	1769.97^{bc}±29.04	1852.60^{bc}±32.40	284.58^{c}±3.90	384	143.90$^{c±}$4.94	137.84^{c}±4.53	433.45^{c}±5.48
7	393	1679.69^{ab}±33.88	1759.98^{ab}±37.80	277.55^{cd}±4.55	239	144.41^{c}±6.16	138.26^{c}±5.65	431.92^{c}±6.83
8	247	1749.67^{bc}±42.02	1718.78^{a}±46.89	278.92^{cd}±5.64	133	148.30^{bc}±8.12	146.54^{bc}±7.44	438.50^{bc}±9.00
9^{+}	231	1523.28^{e}±43.93	1576.62^{e}±49.02	267.99^{d}±5.90	93	130.20^{d}±10.17	139.38^{c}±9.32	418.32^{d}±11.27

The least squares means within a column, bearing same superscripts do not differ significantly.

literature. Similar to these findings, the LL was reported to be longest in first lactation by Reddy (1983) and Yadav *et al*. (1992).

Interaction effect of herd with other non-genetic factors on production traits: The effect of herd×season interaction was highly significant (P<0.01) on LMY and 305DMY, whereas it had no significant effect on LL (Table 1). The effect of herd×period interaction was highly significant (P<0.01) on all the pooled lactation production traits studied. The effect of herd×parity was highly significant (P<0.01) on LMY and 305DMY, whereas it had significant effect (P<0.05) effect on LL.

Evaluation of pooled lactation reproduction traits: The least squares analyses of variance for SP, DP and CI for pooled data over herds is presented in Table 1. Most of the non-genetic factors had a significant influence on all the reproduction traits (Table 2). Similar to our results, Reddy (1983) observed the pooled SP of 148.0 days, but Chaudhary *et al.* (1995) reported higher estimate of SP of 167.77±21.05 days. Similarly, Reddy (1983) found pooled DP as 153.8 days in Sahiwal cows whereas, Gehlon and Malik (1967) reported longer DP of 183.46 days. Closer to the present findings, Basu *et al.* (1979), Reddy (1983) and Gandhi *et al.* (1995) observed pooled CI of 412, 434.0 and 433.88 days, respectively. On the contrary, Yadav *et al.* (1992) obtained longer CI of 486.75 days, in Sahiwal cattle. Rehman (2006) reported similar SP of (155 days) and CI (440 days) whereas he reported a higher estimate of DP (205 days) in Sahiwal

cows in Pakistan.

Effect of herd on reproduction traits: The effect of herd was highly significant (P<0.01) on all reproduction traits for pooled data over herd (Table 1). Cows calving at NDRI farm had shortest SP, DP and CI with their values being 117.80±3.62, 104.01±3.32 and 407.66±4.01 days, respectively. The longest least squares means for SP, and CI were of 179.68±3.66 and 468.61±4.02 days at Lucknow herd. The cow calved at Anjora farm had longest DP of 174.42±3.55 days (Table 2). Similar to these findings, Reddy (1983) reported effect of farm was highly significant (P<0.01) on SP, DP and CI.

Effect of season of calving on reproduction traits: The season of calving had highly significant (P<0.01) impact on SP and CI, whereas it had not significant effect on DP (Table 1). The cows calving during summer months had longest SP of 159.02±3.07 days, whereas autumn calvers had shortest SP of 147.75±3.68 days (Table 2). The shortest CI was in autumn season whereas the CI did not differ significantly for the cows calving in summer, winter and rainy season. Similar to our findings, Yadav *et al.* (1992) reported season of calving had significant effect on CI. On the contrary, Reddy (1983) reported that effect of season was not significant on SP, DP and CI. Chaudhary *et al.* (1995) and Gandhi *et al*. (1995) also observed a non significant effect of season of calving on CI.

Effect of period of calving on reproduction traits: The effect of period of calving was highly significant (P<0.01) on DP and CI (Table 1). The cows calving during 2003–05 had longest least squares mean of 172.54±7.38 days for DP. The CI was longest of 465.82±5.68 days for cows calving during 1982–84. The shortest DP was of 120.104.28 days for the cows calving during 1976–78, whereas shortest CI was of 432.80±11.36 days was observed during 1966–69 (Table 2). The effect of period of calving was significant (P<0.05) on SP. The longest SP was of 162.11±4.51 days for the cows calved during 1973–75; whereas the cows calved during 1966–69 had shortest SP of 144.53±10.25 days. Similar to these findings, Reddy (1983) observed that effect of period was highly significant (P<0.01) on SP, DP and CI.

Effect of parity on reproduction traits: The parity had highly significant (P<0.01) effect on all of the pooled lactation reproduction traits (Table 1). The longest least squares mean for DP, SP and CI was found to be in the cows of first parity with their values being 172.90±2.45, 195.38±2.68 and 489.83±2.97 days, respectively (Table 2). The shortest SP and CI were in the cows in 9th lactation with their means of 130.20±10.17 and 418.32±11.27 days. The shortest DP was of 137.84±4.53 days in 6th parity. Similar to these findings, Malik and Sindhu (1968) and Reddy (1983) reported that the effect of parity was highly significant (P<0.01) on SP, DP and CI. Yadav *et al*. (1992) and Gandhi *et al.* (1995) indicated significant effect of lactation number on CI where the longest CI was found during first lactation.

Interaction effect of herd with other non-genetic factors on reproduction traits: The effect of herd×season interaction was significant (P<0.05) on DP, whereas it had no significant effect on SP and CI (Table 1). The effect of herd×period interaction was highly significant (P<0.01) on all the reproduction traits. The effect of herd×parity interaction was not significant on DP whereas it was significant (P<0.05) on SP and highly significant on CI (P<0.01).

It is inferred from the above findings that first lactation reproduction traits were of longer durations; whereas later lactation reproduction traits were of shorter durations indicating better reproductive efficiency in later lactations/ age of cows. The better estimates of desirable pooled lactation production and reproduction traits at NDRI herd as compared to Lucknow and Anjora herds could be due to better breeding, feeding and managemental practices followed at NDRI. The milk production of Sahiwal cows increased gradually from first to fifth lactation and thereafter a decline in production was noticed. Hence, it may be recommended that after attaining the fifth lactation the cows may be replaced by new heifers.

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