

Original Research Article

Comparative Lifetime Fertility and Productivity Performance of Gir Halfbred and Triple Crosses

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ABSTRACT

The data on lifetime performance traits of Gir halfbred and triple crosses maintained at the MPKV, Rahuri, Maharashtra from 1972 to 2012 were used to determine the lifetime performance up to six lactation. The effect of period of birth, season of birth and age at first calving group on average lifetime pregnancy rate (ALTPR) was non-significant in all genetic groups under study. The period of birth had significant effect on LTLMY and LT300DMY in FG and IFJG group. The age at first calving group had significant effect on LTLMY and LT300DMY in FJG group. The comparative lifetime performance of Gir halfbred and triple crosses has shown that performance of the F₁ animals are the best with respect to all reproduction and production traits.

Keywords

Gir halfbred,
Gir triple
crosses,
ALTPR,
LTLMY,
LT300DMY

Introduction

The major goal of any dairy herd is to increase the amount of milk sold per cow per lactation. In order to achieve this goal one should recognize the factors that influence and contribute to milk sales. These factors include udder health, nutrition, peak milk yield, persistency of milk yield, and reproductive status of cows. Herd reproductive performance and efficiency have great impact on milk yield per lactation, overall lifetime production and therefore the overall profitability of the farm.

The RCDP on Cattle is the extended project of AICRP's on Cattle. This project

developed Gir halfbred (FG) and triple cross cows (Phule Triveni synthetic cows *i.e.* FJG) consists of 50% Holstein Friesian + 25% Jersey + 25% Gir inheritance also they had been bred *inter-se* followed by selective breeding, and their performances were tested. Various factors affects milk production such as breed, fixed environmental factors, managerial practices, period/season of birth and age at first calving.

Therefore, an attempt was made to investigate the lifetime performance of population over the various non-genetic factors and corresponding generations.

Materials and Methods

The data on reproduction and production traits of 221 Gir halfbred and 184 triple cross cows spread over a period of 41 years (1972-2012), maintained at Research cum Development Project on Cattle, Mahatma Phule Krishi Vidyapeeth, Rahuri were analysed to study the comparative lifetime performance. Lifetime fertility (the ability of cow to conceive every 21 days after calving) up to 6th lactation. Lifetime milk production and productivity is considered as the average milk production up to 6th lactation. Data of reproduction and production traits were standardized and normalized.

The pregnancy rates of cows in each lactation were calculated as suggested by USDA (2003).

$DPR = 21 / (\text{service period} - \text{voluntary waiting period} + 11)$

The constant factors 11 centralize the measure of possible conception within each 21 days' time period.

The voluntary waiting period (VWP) varies in the range of 70-90 days. However, to have the precise estimates, standard voluntary waiting period of 63 days was considered to estimate the pregnancy rate.

The data of total 41 years from 1972-2012 were collected and grouped in periods as: for FG genetic group P₁ (1972-1973), P₂ (1974-1975) and P₃ (1976-1977), IFG genetic group P₁ (1980-85), P₂ (1986-91), P₃ (1992-97), P₄ (1998-2003) and P₅ (2004 and above), for FJG genetic group P₁ (1975-77) and P₂ (1978-80) and for IFJG genetic group P₁ (1977-82), P₂ (1983-88), P₃ (1989-94), P₄ (1995-2000), P₅ (2001-06) and P₆ (2007 and above). Each year was divided into three seasons namely Rainy (June-September), Winter (October-January) and Summer

(February-May). The effect of age at first calving group on lifetime traits was studied by dividing AFC into six groups i.e. A₁ (<800 days), A₂ (801-850 days), A₃ (851-900 days), A₄ (901-950 days), A₅ (951-1000 days) and A₆ (>1000 days).

The collected data were analyzed by linear models of least-squares means (SAS, 2011). When the analysis of variance indicated the existence of significant within class, Duncan's Multiple Range Test (DMRT) was employed to test and locate means that are significantly differed from the rest.

The following statistical model was employed to analyse the data.

$$Y_{ijklm} = \mu + P_i + S_j + AG_k + G_l + e_{ijklm}$$

Where,

Y_{ijklm} = Observations on production traits of the nth animal belonging to ith period of birth, jth season of birth, kth age group and lth generation

μ = Overall mean

P_i = Effect of ith period of birth (i = 1, 2....6)

S_j = Effect of jth season of birth (j = 1, 2 and 3)

AG_k = Effect of kth age at first calving group (k = 1, 2 and 3)

G_l = Effect of lth generation (l = 1, 2....8)

e_{ijklm} = Random error associated with NID (0, σ^2e)

Results and Discussion

The results pertaining to the analysis of variance and least-squares means for ALTPR, LTLMY, LT300DMY in Gir

halfbred and triple crosses are presented in Table 1 to 4.

Average lifetime pregnancy rate (ALTPR)

In the present study the average lifetime pregnancy rate were estimated as 0.35 ± 0.02 , 0.29 ± 0.01 , 0.31 ± 0.03 and 0.27 ± 0.01 per cent in FG, IFG, FJG and IFJG groups, respectively.

The influence of period of birth, season of birth and age at first calving group were non-significant on average lifetime pregnancy rate. The literature reviewing the

average lifetime pregnancy rate was not available for crossbred cows.

Life time total lactation milk yield (LTLMY)

The lifetime total lactation milk yield is based on sum of lactation milk yield of cows completed six lactations. The lifetime milk yield in FG, IFG, FJG and IFJG group were 18281.08 ± 582.48 , 14381.57 ± 329.01 , 17482.73 ± 596.91 and 15102.62 ± 301.28 kg, respectively. These results were in close agreement with Abbas and Sachdeva (2008) reported in Sahiwal and Markad (2012) in 5/8 Gir crossbreds.

Table.1 ANOVA for factors affecting on ALTPR, LTLMY and LT300DMY in Gir halfbred and triple crosses

Trait	ALTPR							
Source of variation	Genetic group							
	FG		IFG		FJG		IFJG	
	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S.
POB	2	0.013	4	0.021	1	0.011	5	0.028
SOB	2	0.230	2	0.035	2	0.038	2	0.044
AFCG	5	0.098	5	0.005	4	0.013	5	0.033
Error	86	0.0770	104	0.0294	30	0.0410	130	0.032
Trait	LTLMY							
Source of variation	Genetic group							
	FG		IFG		FJG		IFJG	
	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S.
POB	2	114744628.45*	4	26125077.91	1	19541943.60	5	36610906.88*
SOB	2	13837075.64	2	7738050.52	2	10346102.82	2	6912922.04
AFCG	5	58510150.93	5	11041495.94	4	41631557.75*	5	20626198.31
Error	87	28938737.43	112	13121006.21	32	10596497.10	131	12263493.24
Trait	LT300DMY							
Source of variation	Genetic group							
	FG		IFG		FJG		IFJG	
	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S.
POB	2	106684250.80*	4	25366379.13	1	22828445.63	5	34562994.73**
SOB	2	11812665.34	2	3617092.85	2	993869845	2	16177966.93
AFCG	5	53342719.14	5	6462649.98	4	3482234.58*	5	17588225.54
Error	87	25375108.23	112	11178993.24	32	9754806.12	131	9725042.51

** : P < 0.01

* : P < 0.05

Table.2 Least squares means for ALTPR (per cent) in halfbred and three breed crosses of Gir

Source of variation	Halfbred							Three breed crosses of Gir							
	FG				IFG				FJG				IFJG		
	N	Mean	SE		N	Mean	SE		N	Mean	SE		N	Mean	SE
μ	96	0.35	0.02	μ	116	0.29	0.01	μ	38	0.31	0.03	μ	143	0.27	0.01
Period of birth															
1972-73	36	0.34	0.04	1980-85	16	0.27	0.04	1975-77	28	0.31	0.04	1977-82	38	0.27	0.03
1974-75	35	0.34	0.05	1986-91	22	0.31	0.05	1978-80	10	0.31	0.07	1983-88	43	0.31	0.03
1976-77	25	0.36	0.06	1992-97	34	0.30	0.03		-	-	-	1989-94	37	0.24	0.02
	-	-	-	1998-03	28	0.26	0.02		-	-	-	1995-00	16	0.18	0.02
	-	-	-	> 2004	16	0.33	0.05		-	-	-	2001-06	8	0.29	0.08
	-	-	-		-	-	-		-	-	-	> 2007	1	0.21	0.05
Season of birth															
Rainy	33	0.40	0.06	Rainy	42	0.27	0.02	Rainy	9	0.34	0.08	Rainy	49	0.24	0.02
Winter	39	0.36	0.05	Winter	32	0.32	0.03	Winter	15	0.25	0.04	Winter	47	0.29	0.03
Summer	24	0.25	0.03	Summer	42	0.29	0.02	Summer	14	0.35	0.05	Summer	47	0.28	0.03
Age at first calving group															
< 800	44	0.34	0.04	< 800	7	0.26	0.04	< 800	24	0.29	0.04	< 800	29	0.34	0.04
801-850	30	0.36	0.06	801-850	9	0.31	0.07	801-850	6	0.30	0.07	801-850	19	0.28	0.05
851-900	8	0.26	0.04	851-900	7	0.29	0.07	851-900	4	0.41	0.15	851-900	19	0.21	0.03
901-950	7	0.30	0.06	901-950	15	0.27	0.05	901-950	3	0.35	0.14	901-950	28	0.27	0.03
951-1000	1	0.10	0.01	951-1000	18	0.31	0.06	951-1000	1	0.26	0.09	951-1000	10	0.22	0.03
>1000	6	0.55	0.20	>1000	60	0.29	0.02	>1000	-	-	-	>1000	38	0.24	0.03

Table.3 Least squares means for LTLMY (kg) in halfbred and three breed crosses of Gir

Source of variation	Halfbred							Three breed crosses of Gir							
	FG				IFG				FJG				IFJG		
	N	Mean	SE		N	Mean	SE		N	Mean	SE		N	Mean	SE
μ	97	18281.08	582.48	μ	124	14381.57	329.01	μ	40	17482.73	596.91	μ	144	15102.62	301.28
Period of birth															
1972-73	36	20675.12 ^a	964.69	1980-85	15	16676.97	1096.67	1975-77	28	17950.12	734.14	1977-82	37	16633.47 ^a	581.29
1974-75	35	16925.23 ^b	931.73	1986-91	24	13517.72	644.12	1978-80	12	16393.23	984.78	1983-88	43	14846.25 ^a	460.00
1976-77	26	16793.21 ^b	980.96	1992-97	37	14017.87	552.73		-	-	-	1989-94	41	14651.36 ^a	551.75
	-	-	-	1998-03	30	14749.53	674.72		-	-	-	1995-00	14	13292.43 ^a	1239.64
	-	-	-	> 2004	18	13749.01	756.60		-	-	-	2001-06	8	14871.63 ^a	1425.45
	-	-	-		-	-	-		-	-	-	> 2007	1	15271.56 ^a	4244.45
Season of birth															
Rainy	34	17873.07	899.87	Rainy	42	14328.45	598.34	Rainy	9	16069.14	967.36	Rainy	50	15628.20	478.08
Winter	40	18539.11	879.36	Winter	38	14059.97	604.08	Winter	17	17609.17	818.80	Winter	50	14930.41	538.59
Summer	23	18436.21	1430.65	Summer	44	14710.11	520.56	Summer	14	18239.43	1239.95	Summer	44	14701.12	551.80
Age at first calving group															
< 800	44	17131.09	885.74	< 800	8	15684.91	1950.54	< 800	24	18112.12 ^b	755.63	< 800	29	15121.72	525.21
801-850	31	18445.23	946.34	801-850	8	15102.97	1082.49	801-850	7	14616.21 ^b	1000.52	801-850	17	13767.97	913.72
851-900	8	24026.02	1795.27	851-900	7	15326.11	1435.44	851-900	5	15233.40 ^b	531.68	851-900	18	15072.88	964.21
901-950	7	17257.32	2164.14	901-950	17	15217.18	870.12	901-950	3	20338.26 ^{ab}	1715.58	901-950	29	15954.54	580.00
951-1000	1	26167.27	5837.08	951-1000	19	13240.33	668.59	951-1000	1	25132.24 ^a	4650.90	951-1000	11	13090.04	1016.17
>1000	6	18089.18	1550.59	>1000	65	14146.42	455.42	>1000	-	-	-	>1000	40	15607.55	640.87

Means under each class in the same column with different superscripts differed significantly

Table.4 Least squares means for LT300DMY (kg) in halfbred and three breed crosses of Gir

Source of variation	Halfbred							Three breed crosses of Gir							
	FG				IFG				FJG				IFJG		
	N	Mean	SE		N	Mean	SE		N	Mean	SE		N	Mean	SE
μ	97	17472.46	549.76	μ	124	13483.68	302.75	μ	40	16701.46	569.89	μ	144	13940.90	275.64
Period of birth															
1972-73	36	19815.20 ^a	905.44	1980-85	15	15499.29	971.43	1975-77	28	17253.76	717.77	1977-82	37	15508.99 ^a	514.17
1974-75	35	16332.23 ^b	894.86	1986-91	24	12531.74	558.91	1978-80	12	15414.14	820.00	1983-88	43	13726.13 ^a	462.19
1976-77	26	15763.36 ^b	885.36	1992-97	37	13037.47	512.46		-	-	-	1989-94	41	13392.22 ^a	480.64
	-	-	-	1998-03	30	14101.18	674.72		-	-	-	1995-00	14	11924.25 ^a	1038.77
	-	-	-	> 2004	18	12963.20	756.60		-	-	-	2001-06	8	14277.71 ^a	1252.72
	-	-	-		-	-	-		-	-	-	> 2007	1	13241.94 ^a	3902.72
Season of birth															
Rainy	34	17063.21	861.15	Rainy	42	13343.29	534.00	Rainy	9	15246.20	846.74	Rainy	50	14628.79	435.42
Winter	40	17801.20	826.00	Winter	38	13341.31	568.51	Winter	17	17002.14	851.06	Winter	50	13536.02	464.16
Summer	23	17507.34	1339.61	Summer	44	13740.74	486.64	Summer	14	17272.02	1131.16	Summer	44	13619.40	532.19
Age at first calving group															
< 800	44	16218.64	828.40	< 800	8	14529.83	1672.64	< 800	24	17374.34 ^{ab}	719.89	< 800	29	13999.94	497.78
801-850	31	17682.34	887.80	801-850	8	13937.63	866.14	801-850	7	13925.21 ^b	945.65	801-850	17	12627.84	819.83
851-900	8	23031.21	1712.32	851-900	7	14001.80	1349.49	851-900	5	14456.32 ^b	295.41	851-900	18	14073.42	800.26
901-950	7	16982.28	2118.81	901-950	17	14031.19	840.19	901-950	3	19555.67 ^{ab}	2287.58	901-950	29	14789.87	577.28
951-1000	1	25220.76	5559.37	951-1000	19	12415.72	563.88	951-1000	1	22653.56 ^a	4227.94	951-1000	11	12085.63	948.17
>1000	6	17457.31	1302.44	>1000	65	13413.87	433.77	>1000	-	-	-	>1000	40	14291.49	578.31

Means under each class in the same column with different superscripts differed significantly

The analysis of variance showed that effect of period of birth was significant ($P < 0.05$) on LTLMY in FG and IFJG while it was non-significant in IFG and FJG groups. The non-significant results were reported by Abbas and Sachdeva (2008) and Singh *et al.*, (2011) in Sahiwal cows and Reddy *et al.*, (2011) in Ongole cattle. The DMRT revealed that cows born during 1972-73 had highest LTLMY (20675.12 ± 964.69 kg) than other periods in FG (Table 3). In IFJG, cows born during 1977-82 had highest LTLMY (16633.47 ± 581.29 kg) which was at par with 1983-88 (14846.25 ± 460.00 kg), 1989-94 (14651.36 ± 551.75 kg), 1995-00 (13292.43 ± 1239.64 kg), 2001-06 (14871.63 ± 1425.45 kg) and >2007 (15271.56 ± 4244.45 kg).

The influence of season of birth was non-significant on lifetime total lactation milk yield in all genetic groups under study. Similar results were reported by Rao and Rao (1996) in Jersey cows and Singh *et al.*, (2011) in Sahiwal cattle.

The variation due to age at first calving group was significant ($P < 0.05$) on LTLMY in FJG and non-significant effect in FG, IFG and IFJG groups. The significant results were reported by Odedra *et al.*, (1977) in Gir cattle and Markad (2012) in 5/8 Gir crossbred cows. Whereas, non-significant result was reported by Abbas and Sachdeva (2008) in Sahiwal cows. In FJG, the DMRT revealed that cows of A₅ (951-1000) group had highest lifetime total lactation milk yield (25132.24 ± 4650.90 kg) than other age groups.

Lifetime 300 days or less milk yield (LT300DMY)

The lifetime 300 days or less milk yield is based on sum of 300 days or less milk yield of cows completed six lactations. The

lifetime 300 days or less milk yield was 19721.43 ± 1086.28 , 14559.92 ± 415.22 , 18245.77 ± 1081.23 and 14587.74 ± 673.56 kg in FG, IFG, FJG and IFJG groups, respectively.

The analysis of variance showed that effect of period of birth was significant on LT300DMY in FG ($P < 0.05$) and in IFJG ($P < 0.01$), however, non-significant in IFG and FJG groups. The DMRT revealed that cows born during (1972-73) had higher LT300DMY (19815.20 ± 905.44 kg) than other periods in FG.

In IFJG, cows born during (1977-82) had higher LT300DMY (15508.99 ± 514.17 kg) than other periods but it was at par with 1983-88 (13726.13 ± 462.19 kg), 1989-94 (13392.22 ± 480.64 kg), 1995-2000 (11924.25 ± 1038.77 kg), 2001-06 (14277.71 ± 1252.72 kg) and >2007 (13241.94 ± 3902.72 kg) periods.

The results showed that effect of season of birth had non-significant influence on lifetime 300 days or less milk yield in all the genetic groups under study.

The influence of age at first calving group was significant ($P < 0.05$) on LT300DMY in FJG and non-significant in FG, IFG and IFJG groups. The DMRT revealed that in FJG, A₅ (951-1000) group had highest LT300DMY (22653.56 ± 4227.94 kg) and A₁ (<800) group had lowest LT300DMY (17374.34 ± 719.89 kg).

Lifetime performance traits of Gir halfbred and triple crosses are studied. The overall mean for ALTPR, LTLMY and LT300DMY in FG group were 0.35 ± 0.02 per cent, 18281.08 ± 582.48 kg and 17472.46 ± 549.76 kg, respectively. However, in IFG group, the overall mean for ALTPR, LTLMY and LT300DMY were 0.29 ± 0.01

per cent, 14381.57 ± 329.01 kg and 13483.68 ± 302.75 kg, respectively. The overall mean for ALTPR, LTLMY and LT300DMY, in FJG group were 0.31 ± 0.03 per cent, 17482.73 ± 596.91 kg and 16701.46 ± 569.89 kg, respectively. However, in IFJG group, the overall mean for ALTPR, LTLMY and LT300DMY were 0.27 ± 0.01 per cent, 15102.62 ± 301.28 kg and 13940.90 ± 275.64 kg, respectively. The comparative lifetime performance of Gir halfbred and triple crosses has shown that performance of the F₁ animals are the best with respect to all reproduction and production traits.

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