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SHORT COMMUNICATION

Evolution of Generation-Wise Comparative Reproduction Performance of Halfbred and Three Breed Crosses of Gir

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ABSTRACT
The data on reproduction traits of halfbred (523) and three breed crosses (522) of Gir maintained at MPKV, Rahuri, Maharashtra from 1972 to 2012 (41 years) were used to investigate the generation-wise comparative reproduction performance. Pedigree of each animal born during this period was traced back up to foundation stock. The cows up to 8th generation from maternal side in halfbred and three breed crosses of Gir were observed. The result indicated that the generation had significant effect on age at first calving (AFC) in FG group, Waiting period (WP) in FJG group, service period (SP) in IFG and IFJG group, and non-significant effect on pregnancy rate (PR) in all given groups. The first generation of FG halfbred and three breed crosses of Gir showed significantly higher performance over their interbred because of hybrid vigour, subsequent decline in further generations which may be partly due to the differences in the breeding values of the sires used for producing further generations. Therefore, it indicated to restrict the Inter-se mating and adopt suitable breeding system to retain hybrid vigour like possibly selective rotational crossing. Also, essential to use only proven crossbred bulls for producing further generations to minimize this decline.
Keywords: *Generation, AFC, Waiting Period, Service Period, Pregnancy Rate*

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INTRODUCTION
Research on crossbreeding in tropical countries has shown that performance of the F_1 animals are the best with respect to various reproduction as well as productive traits [3]. But it is practically not feasible to maintain pure F_1 population for a milking herd. *Inter-se* mating of animals with 50% exotic inheritance however is the usual practice. It was found that there was decline in performance from F_1 to F_2 crossbreds. The present breeding policy for improvement of synthetic crossbred population is through *inter-se* mating followed by selection with the maintenance of desired level of exotic inheritance. But exotic inheritance is not found to be the only key factor in determining the performance of the synthetic population. In Maharashtra, one of the projects was started at MPKV, Rahuri. The ICAR terminated this programme in 1986 [4]. Later on, the AICRP on Cattle is designated as RCDP on Cattle. This project evolved halfbred (FG) and three breed cross (FJG) also, they had been bred *inter-se* followed by rigorous selection and their performances were tested. Therefore, an attempt was made to investigate the reproduction performance over the generations.

MATERIAL AND METHODS
The data on reproduction and production traits of 523 Girhalfbred and 522 triple cross cows spread over a period of 41 years (1972-2012), maintained at Research cum Development Project on Cattle, Mahatma PhuleKrishi Vidyapeeth, Rahuri were analysed to study the comparative reproduction performance.
Data of reproduction traits were standardized and normalized.
The pregnancy rates of cows in each lactation were calculated as suggested by USDA [7].

DPR = 21 / (service period – voluntary waiting period + 11)
The constant factor 11 centralize the measure of possible conception within each 21 days' time period. The voluntary waiting period (VEP) varies in the ranges of 70-90 days. However, to have the precise estimates of standard voluntary waiting period of 63 days was considered to estimate the pregnancy rate. The collected data were analysed by [6] linear models of least-squares means.
The following statistical model was used to estimate the effect of genetic group and generation on reproduction traits as follows:

$$Y_{ijk} = \mu + A_i \text{ or } B_j + e_{ijk}$$

Where,
Y_{ijk}= Performance record of i^{th} genetic group of j^{th} generation
μ = Overall mean
Ai = Effect of i^{th} genetic group
Bj= Effect of j^{th} generation
eijk = Random error associated with NID (0, σ^2e)

RESULTS AND DISCUSSION

The results pertaining to the analysis of variance, least square means for AFC, WP, SP and PR in halfbred and three breed crosses of Gir are presented in Table 1, 2 and 3 respectively.

Age at First Calving (AFC)

The analysis of variance indicated that the generation had significant ($P<0.01$) effect on AFC in FG halfbred and three breed cross of Gir. The overall mean AFC as affected by generations was 944.79 ± 7.54 days in FG and 914.19 ± 6.55 days in FJG. Similar results were reported by Bhoite (1996) in IFG, IFJG, IJFG and IBFG and Bhagat *et al*. [1] in crossbred cattle.
The DMRT revealed that in FG the 1st generation heifers had significantly shorter AFC (793.63 ± 6.23 days) than the cows of other generations. However, 6th generation had longest AFC (1068.52 ± 28.16 days) which were at par with 4th, 5th and 8th generations. The DMRT indicated that in FJG the 1st generation heifers had shortest AFC (800.84 ± 6.36 days). However, the heifers of 6th generation had the longest AFC of (1075.34 ± 27.42 days).
This might be due to the highest heterotic effect in first generation and due to the loss of heterosis in next generations AFC tends to slightly increase in each generation. It was noticed from Table 2 that the generation-wise genetic group differences compared with 't' test were significant for overall age at first calving. However, the cows from G_2, G_3, G_4 and G_8 had significant differences in FG and FJG group.

Waiting Period (WP)

Waiting period or days required to first service after calving is one of the important reproduction trait in cows.
The results revealed that generation had significant ($P<0.01$) effect on waiting period in FJG and non-significant in FG group (Table 15). The overall mean waiting period as affected by generations was 74.54 ± 0.85 and 88.85 ± 1.28 days in FG and FJG group, respectively (Table 16). The lowest waiting period was observed in 6th generation (70.76 ± 3.05 days) in FG and 7th generation (77.72 ± 4.60 days) in FJG group. The literature reviewing the effect of generation on waiting period was not available for crossbred cows.
It was observed from Table 2 that the generation-wise genetic group differences compared by 't' test were significant ($P<0.01$) in waiting period. It indicated that the genetic groups of *interse* progeny had much variation in waiting period.

Service Period (SP)

The service period is an important economic trait in dairy cows. As a component of calving interval, it influences reproductive efficiency and thus has a bearing on lifetime production of dairy animals.
The overall mean of service period as affected by generation was 146.51 ± 2.37 and 157.39 ± 2.63 days in FG and FJG group, respectively. The significant ($P<0.01$) effect of generation on service period was observed in FJG group. In FJG group, DMRT indicated that the significant lowest service period (141.68 ± 4.98 days) was found in 1st generation which was at par with other generations under study while the highest service period (187.45 ± 15.06 days) was found in 6th generation. The effect of generation was found to be non-significant in FG halfbred, which were in consonance with Bhoite [2] in Gir halfbred and triple crosses, Bhagat *et al.* [1] in Gir crossbred cows and Singh *et al.* [4] in Hariana crossbred cows.
It was observed from Table 3 that the generation-wise genetic group differences compared with 't' test were found significant ($P<0.01$) in overall mean service period. However, the difference in service period among cows from G_2, G_3, G_5 and G_6 was significant while it was the non-significant in G_1, G_4, G_7 and G_8. It indicated that there was no specific trend in *interse* progenies of halfbred and three breed crosses of Gir.

Pregnancy Rate (PR)

Pregnancy rate is defined as the percentage of non-pregnant cows that become pregnant during each 21 days period, because each estrus cycle represents one chance for a cow to become pregnant.

The result revealed that the generation had non-significant effect on pregnancy rate in halfbred and three breed crosses of Gir. The overall least-squares mean for pregnancy rate in FG and in FJG was 0.33 ± 0.07 and 0.29 ± 0.07 per cent. The literature reviewing the effect of generation on pregnancy rate was not available for crossbred cows.

It was noticed from Table 3 that the generation-wise genetic group differences as compared with 't' test found significant ($P<0.01$) in overall mean pregnancy rate. However, the differences in PR among cows from G_1, G_2, G_3, G_5 and G_6 were significant while it was the non-significant in cows from G_4, G_7 and G_8. It indicated that the genetic groups of *interse* progeny had much variation in pregnancy rate.

Table 1. ANOVA of AFC, WP, SP and PR in halfbred and three breed crosses of Gir as affected by generation

Traits	AFC				WP			
Source of variation	Genetic group				Genetic group			
	FG		FJG		FG		FJG	
	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S.	d.f.	M.S.S.
Generation	7	911751.30**	7	470268.08**	7	296.23	7	8510.79**
Error	491	15781.76	489	14952.99	1141	847.31	973	1581.82
Traits	**SP**				**PR**			
Source of variation	**Genetic group**				**Genetic group**			
	FG		**FJG**		**FG**		**FJG**	
	d.f.	**M.S.S.**	**d.f.**	**M.S.S.**	**d.f.**	**M.S.S.**	**d.f.**	**M.S.S.**
Generation	7	2602.36	7	17824.47**	7	0.065517	7	0.071398
Error	922	5268.08	896	6194.02	847	0.048133	800	0.044421

*: $P < 0.05$ **: $P <0.01$

Table 2. Least-squares means for AFC and WP in halfbred and three breed crosses of Gir as affected by generation

Traits	AFC				't' Test	WP				't' Test
Source of variation	Genetic group					Genetic group				
	FG		FJG			FG		FJG		
	N	Mean ± S.E.	N	Mean ± S.E.		N	Mean ± S.E.	N	Mean ± S.E.	
μ	**499**	**944.79± 7.54**	**497**	**914.19± 6.55**	**4.33****	**1149**	**74.54± 0.85**	**981**	**88.65± 1.28**	**13.37****
G_1	167	793.63^{d} ± 6.23	117	800.84^{e}± 6.36	1.14	469	74.51± 1.18	231	80.77^{bc} ± 2.05	4.11**
G_2	73	986.30b^{c}± 17.04	118	897.52^{d}± 10.55	6.62**	128	74.89± 2.86	244	84.60^{bc} ± 2.61	3.59**
G_3	58	951.40^{c}± 16.00	95	916.21^{d}± 16.12	2.18*	118	75.90 ± 2.88	193	92.51^{abc} ± 3.17	5.42**
G_4	64	1060.47^{a}± 17.59	67	955.61^{cd}± 15.96	6.25**	150	75.25± 2.58	117	103.77^{a} ± 3.97	8.74**
G_5	60	1060.50^{a} ± 17.09	49	1043.73^{ab}± 18.06	0.95	110	73.94± 3.01	112	96.51^{ab} ± 3.99	6.37**
G_6	31	1068.52^{a} ± 28.16	26	1075.34^{a}± 27.42	0.24	92	70.76± 3.05	41	90.04^{abc} ± 6.67	4.29**
G_7	29	1010.79^{ab} ± 31.14	18	1002.28^{bc}± 36.54	0.25	61	74.90 ± 4.05	29	77.72^{c} ± 4.60	0.66
G_8	17	1046.94^{a} ± 42.23	7	934.43cd± 52.32	2.47*	21	78.90 ± 6.55	14	$79.^{bc}$ ± 14.42	0.05

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

*: $P < 0.05$ **: $P < 0.01$

Table 3. Least-squares means for SP and PR in halfbred and three breed crosses of Gir as affected by generation

Traits	SP				't' Test	PR				't' Test
Source of variation	Genetic group					Genetic group				
	FG		FJG			FG		FJG		
	N	Mean ± S.E.	N	Mean ± S.E.		N	Mean ± S.E.	N	Mean ± S.E.	
μ	**930**	**146.51± 2.37**	**904**	**157.39±2.63**	**4.34****	**855**	**0.33± 0.007**	**808**	**0.29± 0.007**	**5.71****
G_1	337	147.78 ± 3.79	197	$141.68^{b}\pm 4.98$	1.42	337	0.35± 0.01	172	0.32 ± 0.02	2.11*
G_2	112	140.30 ± 6.76	230	$154.91^{ab}\pm 5.10$	2.56**	98	0.32 ± 0.02	201	0.28 ± 0.01	2.84**
G_3	108	141.19 ± 6.97	173	$159.71^{ab}\pm 5.94$	2.91**	94	0.33± 0.02	154	0.28 ± 0.02	2.50**
G_4	125	153.37 ± 7.19	113	$156.97^{ab}\pm 6.94$	0.50	110	0.30 ± 0.02	107	0.30 ± 0.02	0.00
G_5	102	147.18 ± 7.37	111	$174.69^{ab}\pm 8.77$	3.38**	87	0.30± 0.02	100	0.25 ± 0.02	2.50**
G_6	81	143.22 ± 7.51	40	$187.45^{a}\pm 15.06$	4.16**	76	0.32± 0.02	38	0.24 ± 0.03	3.36**
G_7	45	144.96 ± 10.91	31	$157.71^{ab}\pm 14.81$	1.00	36	0.27± 0.03	28	0.28 ± 0.04	0.28
G_8	20	159.55 ± 19.40	9	$178.89^{ab}\pm 30.41$	0.82	17	0.29 ± 0.06	8	0.22 ± 0.06	1.16

Means under each class in the same column with different superscripts differed significantly
*: $P < 0.05$ **: $P < 0.01$

CONCLUSIONS

From the results it could be concluded that the first generation of FG halfbred and three breed crosses of Gir showed significantly higher performance over their interbred because of hybrid vigour, subsequent decline in further generations which may be partly due to the differences in the breeding values of the sires used for producing further generations. Therefore, it indicated to restrict the *Inter-se* mating and adopt suitable breeding system to retain hybrid vigour like possibly selective rotational crossing. Also, essential to use only proven crossbred bulls and maintaining the suitable breed inheritance from generations, for producing further generations to minimize this decline.

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