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To assess the effect of dry period on subsequent production and reproduction performance ofHoldeo (Holstein Friesian x Deoni) straightbreds

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Abstract
The present study was undertaken to evaluate the effect of non genetic factors on production and reproduction performance in Holdeo (HF x Deoni). It involves investigations of productive and reproductive characteristics viz., Lactation milk yield, Peak milk yield, Days to reach peak milk yield, Lactation period, Dry period, Service period, Gestation period and Inter calving period. The study included 20 years data (1976-1995) on total number of animals 223 Holdeo straightbred cows. The overall least squares means were recorded for LMY (1491.58 ±21.62 kg), PMY (7.12 ±0.02 kg), DRPMY (35.82 ±0.16 days), LP (288.58 ±2.14 days), DP (141.24 ±1.52days), SP (156.96 ±2.49 days), (273.77 ±0.06 days) and ICP (429.43 ±2.44 days). The LMY, PMY,LP, DP, SP, GP and ICP in Holdeo cow was not significantly affected by period of calving, season of calving and lactation order and dry period. The DRPMY was significantly affected by lactation order and dry period (P < 0.05) in Holdeo straightbred cows. However, period of calving and season of calving had non-significant effect on DRPMY. Overall least squares means of DP in Holdeo cow was 141.24 ± 1.52 days. The effect of period of calving on GP was significant (P<0.01), however, season of calving lactation order and dry period was non significant effect on GP. Overall least squares means for GP in Holdeo cows was 273.77 ± 0.05 days. Only period of calving had significant (P < 0.01) effect on GP.
Key words. *Holdeo, productive and reproductive characteristics.*

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I. Introduction

India is the world's largest producer and consumer of milk with a global share of about 22 per cent. Another factor that makes India leading producer in milk is the technology, which enables it to increase productivity. India has largest livestock population in the world 535.78 millions. The cattle population is 192.49 millions, out of which 142.11 millions indigenous and 50.42 millions crossbred. The total buffaloes in the country is 109.85 Million. The overall contribution of livestock sector in total GDP is 4.11per cent and 25.6 % of total Agriculture GDP . In our country, the average milk productivity of crossbred cows, indigenous cows and buffaloes is about 7-8, 2.4-3 and 6.8 kg/day, respectively (20th Livestock Census). Holstein Friesian is the exotic elite milch purpose breed. It was originated in two Northern most provinces of Netherlands i.e. Western Friesland and North-Holland. Later on it has spread almost all over the European countries as well as over the world. The main stay of dairy industries in countries like U.S.A., Australia, New Zealand is the Friesian breed. With the introduction of exotic inheritance in indigenous cattle, improved attributes like high milk yield, age at first calving, early sexual maturity, efficient feed conversion efficiency and higher butter fat percentage has been observed.

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In India, crossbreeding of Zebu cattle with exotic germplasm is considered as a national policy, both on the organized farm as well as in field condition. Crossbreeding of Indian cows with exotic dairy breeds has been started in our country under cattle developing programme from 3rd five year plan. Crossbreeding programme in India has made significant impact on milk production in the country. The greatest advantage of crossbreeding is attributed to faster growth rate eventually leading better reproduction and production. Vasantrao Naik

Marathwada Krishi Vidyapeeth, Parbhani (MS), has taken a project for improvement of Deoni cattle breed by crossbreeding with elite exotic breed, named as Holstein Friesian. The effect of variation in dry period on subsequent lactation production and reproduction, for modern day dairy cattle is largely unknown and warrants re-evaluation. Therefore, this investigation was planed to study "Effect of Dry Period on the Subsequent Productive and Reproductive Performance in Holdeo (Holstein Friesian x Deoni) Straightbreds".

II. Materials and Methods

Earlier the CCBP use to maintain Friesian x Deoni cattle. The data accumulated on production characters of Holdeo straightbred was considered in the present study. The information on characters namely lactation milk yield (LMY) , Peak milk Yield (PMY), Days to reach peak milk yield (DRPMY), Lactation period (LP), Dry period (DP), Service period (SP), Gestation period (GP) and Intercalving period (ICP) were taken from the pedigree sheets, daily milk yield record and breeding records maintained at the farm. In all records of Holdeo straightbred dams with lactations over a period of 20 years (1976 to 1995) were included in the study. The data were analysed for linear model. Duncan Multiple Range Test (DMRT) was employed to test and locate means that significantly differed from each other (Kramer, 1957).

$\mathbf{y_{ijkl} = \mu + S_i + P_j + e_{ijkl}}$

$\mathbf{y_{ijkl}}$ - Observation for $_i^{th}$ season and $_j^{th}$ period of calving

μ - The overall mean

S_i - The effect of $_i^{th}$ season of calving

P_j - The effect of $_j^{th}$ period of calving

e_{ijkl} - Random error associated with NID ($\delta^2 e$)

III. Results and Discussion

Lactation Milk Yield

The least squares means of LMY and analysis of variance showing effect of period of calving, season of calving, lactation order and dry period on lactation milk yield in Holdeo straightbred cattle are presented in Table 1 and 2. The overall least squares means for LMY of Holdeo crossbred cattle was 1491.58 $\pm$ 21.62 kg. These results were close to Sing and Dave (1989), Thombre (1991) and Bhutkar (2015) in Holstein Friesian x Deoni halfbred.The effect of period of calving on LMY was non significant in Holdeo straigtbred cattle (Table 8). The mean LMY (Kg) was higher in period P_3 (1552.02 $\pm$ 33.87) followed by P_1 (1546.67 $\pm$54.61), P_2 (1467.16 $\pm$36.21) and lowest in P_4 (1400.46 $\pm$ 38.85). The results were supported with the findings of Taneja and Sikka (1981) in Red Sindhi, Thombre (1991) in HF x Deoni halfbred, Bhopale(2008) in Holstein Friesian x Deoni and Zewdu *et al.* (2013) in Hilstein Friesian x Deoni crossbred cattle.The variation due to season of calving in LMY of Holdeo straightbred cattle was non significant (Table 8). The LSM of LMY (Kg) was higher in cows calved during season S_1 (1565.72 $\pm$32.35) followed by S_2 (1473.24 $\pm$32.90) and lowest in S_3 (1435.78 $\pm$ 37.98). Similar results reported by Sing and Dave(1989) in Friesian x Tharparkar, Thombre (1991) in Holstein Friesian x Deoni crossbred and Bhutkar *et al.* (2015) in Holstein Friesian x Deoni.

Table 1 Peak Milk Yield (PMY) in Holdeo Straightbreds

Source	Code	N	LSM$\pm$SE
Mean	μ	860	1491.58 $\pm$21.62
Period of calving	P_1	99	1546.67 $\pm$54.61
	P_2	276	1467.16 $\pm$36.21
	P_3	280	1552.02 $\pm$33.87
	P_4	205	1400.46 $\pm$38.85
Season of calving	S_1	335	1565.72 $\pm$32.35
	S_2	308	1473.24 $\pm$32.90
	S_3	217	1435.78 $\pm$37.98

Table2 Analysis of variance for LMY in Holdeo Straightbreds

Sources	DF	SS	MSS	F value calculated
Period of calving	3	3.09	1.03	0.35^{NS}
Season of calving	2	2.44	1.22	0.41^{NS}

Peak Milk Yield (PMY)

The least squares means of PMY and analysis of variance showing effect of period of calving, season of calving, lactation order and dry period on peak milk yield in Holdeo straightbred cattle are presented in table 3 and 4. The effect due to season of calving on PMY was non significant (Table 4). This revealed that the season of calving not very influencing the variation on PMY in Holdeo straightbred cows (Table 9). The LSM for PMY (Kg) was higher in S_3 (7.19 $\pm$0.04) followed by S_1 (7.11 $\pm$0.04) and lowest in S_2 (7.07 $\pm$0.04). These result

support that Rathi and Sharma (1990) in Jersey x Sahiwal crossbreds, Kumar *et al*. (2014) and Bhutkar *et al*.(2015) in Holstein Friesian × Deoni.

Table 3. Peak Milk Yield (PMY) in Holdeo Straightbreds

Sources	Code	**N**	LSM ±SE
Mean	μ	860	7.12 ±0.02
Period of calving	P_1	99	7.13 ± 0.06
	P_2	276	6.96 ±0.04
	P_3	280	7.11 ±0.04
	P_4	205	7.30 ±0.04
Season of calving	S_1	335	7.11 ±0.04
	S_2	308	7.07 ±0.04
	S_3	217	7.19 ±0.04

Table 4 Analysis of variance for PMY in Holdeo Straightbreds

Sources	DF	SS	MSS	Fvalue calculated
Period of calving	3	11.82	3.94	1.08^{NS}
Season of calving	2	15.74	7.87	2.16^{NS}

Days to Reach Peak Milk Yield (DRPMY)

The least squares means of DRPMY and analysis of variance showing effect of period of calving, season of calving, lactation order and dry period on days to reach peak milk yield in Holdeo straightbred cattle are presented in Table 5 and 6. The analysis of variance revealed non significant effect of period of calving on DRPMY in Holdeo straightbred cattle (Table 6). The effect due to season of calving on DRPMY was non significant (Table 12). The LSM for DRPMY (Days) was same in cows calved during S_1 (35.95 ±0.24) and S_3 (35.81 ±0.28) and lowest in S_2 (35.71 ±0.24). This has indicated that irrespective of any season of calving the cows for their DRPMY remains unchanged. These results were in agreement with Anarase (2011) in Holstein Friesian x Deoni crossbred cattle and Rafiullah (2014) in Holstein Friesian x Deoni crossbred cattle.

Table 5 Days to reach peak milk yield in Holdeo Straightbreds

Sources	Code	N	LSM ±SE
Mean	μ	860	35.82 ±0.16
Period of calving	P_1	99	35.87 ±0.40
	P_2	276	35.94 ±0.27
	P_3	280	35.85 ± 0.25
	P_4	205	35.64 ±0.29
Season of calving	S_1	335	35.95 ±0.24
	S_2	308	35.71 ±0.24
	S_3	217	35.81 ±0.28

Table 6 Analysis of variance for DRPMY in Holdeo Straightbreds

Sources	DF	SS	MSS	F value calculated
Period of calving	3	10.26	3.42	2.16^{NS}
Season of calving	2	9.00	4.50	2.85^{NS}

Lactation Period (LP)

The least squares means of lactation period and analysis of variance showing effect of period of calving, season of calving, lactation order and dry period on lactation period in Holdeo straightbreds and presented in Table 7 and 8. The overall least squares means for LP of Holdeo straightbred cattle was 288.58 ±2.14 days. These results were close to Hassan and Khan (2013), Kumar *et al.* (2014) and Bhutkar *et al.* (2015) in Holstein Friesian x Sahiwal crossbred cattle.The analysis of variance indicated that effect due to period of calving on LP was non significant (Table 14). The LSM for LP was higher in cows calved in P_3 (294.49 ±3.36) followed by P_1 (293.99 ±5.41), P_2 (288.80 ±3.59) and lowest in P_4 (277.06 ± 3.85). Similar results were reported by Auradhkar and Sakhare (1984), Yadav and Rathi (1992) in Sahiwal and Dhale (2003) in Deoni cattle and Kumar *et al* (2014) in HF crossbred cattle.The effect due to season of calving on LP was non significant(Table 8). The LSM of LP was higher in cows calved during S_1 (295.91 ± 3.21) followed by S_2 (291.10 ±3.26) and lowest in S_3 (278.73 ±3.76). These results were in agreement with Yadav and Rathi(1992), Joshi *et al*.(2005) in Deoni and Ongole cattle.

Table 7 Lactation period in Holdeo Straightbreds

Sources	Code	N	LSM ± SE
Mean	μ	860	288.58 ± 2.14

Period of calving	P_1	99	293.99 ± 5.41
	P_2	276	288.80 ± 3.59
	P_3	280	294.49 ± 3.36
	P_4	205	277.06 ± 3.85
Season of calving	S_1	335	295.91 ± 3.21
	S_2	308	291.10 ± 3.26
	S_3	217	278.73 ± 3.76

Table 8 Analysis of variance for LP in Holdeo Straightbreds

Sources	DF	SS	MSS	Fvalue calculated
Period of calving	3	3.87	1.29	0.44^{NS}
Season of calving	2	3.86	1.93	0.67^{NS}

Dry Period (DP)

The least squares means of DP and analysis of variance showing effects of season of calving, period of calving, lactation order and dry period on dry period in Holdeo cows are presented in Table 9 and 10. The effect of period of calving on DP was non significant in Holdeo cows (Table 16). The mean DP (Days) was higher in period P_3 (144.92 ± 2.38) followed by P_2 (143.14 ± 2.55), P_4 (140.53 ± 2.73) lowest in P_1 (136.35 ± 3.84). These results were supported with the findings of Jadhav *et al.* (1991) Thombre *et al.*(2000) in Friesian x Deoni and Soleimani *et al.* (2010) in HF cows and Zadeh and Mohit (2013) in Holstein cows. The variation due to season of calving in DP was non significant (Table 16). The LSM of DP (Days) was higher in cows calved during S_3 (143.70 ± 2.67) followed by S_2 (140.00 ± 2.32) and lowest in S_1 (140.00 ± 2.78). More or less similar results were reported by Singh *et al.* Friesian x Sahiwal crossbreds, Siddiqui (1984) in Friesian x Sahiwal halfbred and Thalkari (1984) in Jersey x Deoni, Friesian x Deoni cattle, Soleimani *et al.* (2010) in HF cows and Zadeh and Mohit (2013) in Holstein cows.

Table 9 Dry period in Holdeo Straightbreds

Sources	Code	N	LSM ± SE
Mean	μ	860	141.24 ± 1.52
Period of calving	P_1	99	136.35 ± 3.84
	P_2	276	143.14 ±2.55
	P_3	280	144.92 ±2.38
	P_4	205	140.53 ± 2.73
Season of calving	S_1	335	140.00 ±2.78
	S_2	308	140.00 ±2.32
	S_3	217	143.70 ±2.67

Table 10 Analysis of variance for DP in Holdeo Straightbreds

Sources	DF	SS	MSS	Fvalue calculated	
Period of calving	3	6.09	2.03	1.4^{NS}	
Season of calving	2	2.18	1.09	0.75^{NS}	

Service Period (SP)

The least squares means of SP and analysis of variance showing effects of period of calving, season of calving, lactation order and dry period on service period in Holdeo cows are presented in Table 11 and 12. The effect of period of calving on SP was non significant in Holdeo cows (Table 18). The DMRT revealed that the SP of Holdeo cows calved during P_3 (166.29 ± 3.91) was higher than cows calved in P_1 (161.13 ± 6.30), P_2 (158.36 ± 4.18), P_4 (142.07 ± 4.48). The results are supported with the findings of Patil (1983) in F x D halfbred, Sharma *et al.* (1988) in Friesian x Ongole, Chaudhari *et al.* (2013), Bhutkar *et al.* (2014a) in Holstein Friesian x Deoni cows.The variation due to season of calving on SP in Holdeo cows was non significant (Table 12). The LSM of SP was higher in cows calved during season S_1 (162.98 ± 3.73) followed by S_2 (160.15 ± 3.80), S_3 (147.75 ± 4.38). More or less similar results were reported by Singh and Gurnani (2004) in Karan Fries and Karan Swiss, Chewale (2008) in HF X Deoni interse crossbred, Komatwar *et al.* (2010) in Friesian x Sahiwal cattle and Bhutkar *et al.* (2014a) in Holstein Friesian x Deoni.

Table 11 Service period in Holdeo Straightbreds

Sources	Code	N	LSM ±SE
Mean	μ	860	156.96 ±2.49
Period of calving	P_1	99	161.13 ±6.30
	P_2	276	158.36 ±4.18
	P_3	280	166.29 ± 3.91
	P_4	205	142.07 ±4.48
Season of calving	S_1	335	162.98 ±3.73

	S_2	308	160.15 ±3.80
	S_3	217	147.75 ±4.38

Table 12 Analysis of variance for SP in Holdeo Straightbreds

Sources	DF	SS	MSS	Fvalue calculated
Period of calving	3	6.96	2.32	0.60^{NS}
Season of calving	2	3.18	1.59	0.41^{NS}

Gestation Period (GP)

The least squares means of GP and analysis of variance showing effects of period of calving, season of calving, lactation order and dry period on gestation period in Holdeo cow are presented in Table 13 and 14. The effect of period of calving on GP was non significant (P<0.05) in Holdeo cows (Table 14). The DMRT revealed that the GP of Holdeo cows calved during period P_4 (276.31 ±0.10) was significantly higher than P_3 (273.58 ±0.09), P_1 (272.92 ± 0.15) and P_2 (272.27 ±0.10). The results are supported with the findings of Hassan (1995) indegenous, Jersey cross, Sindhi cross, Sahiwal cross and Tariq (2000) in HF x Sahiwal crossbred cattle, Diack *et al*. (2004), Holstein cross and Bhutkar *et al*. (2014b) in Holstein Friesian x Deoni cows.The variation due to season of calving on GP in Holdeo cow was non significant (Table 14). The LSM of GP (Days) was higher in cows calved during S_2 (273.90 ±0.08) followed by S_1 (273.77 ± 0.08), S_3 (273.64 ± 0.10). The results revealed that seasonal changes did not influence on the variation on GP in Holdeo cow. More or less similar results were reported by Mondal *et al.* (2005) in Jersey cross, Sahiwal cross and Sindhi crossbreds and Bhutkar *et al*. (2014b) in Holstein Friesian x Deoni cows.

Table 13. Gestation period in Holdeo Straightbreds

Sources	Code	N	LSM ±SE
Mean	μ	860	273.77 ±0.06
Period of calving	P_1	99	272.92 ±0.15
	P_2	276	272.27 ±0.10
	P_3	280	273.58 ±0.09
	P_4	205	276.31 ±0.10
Season of calving	S_1	335	273.77 ±0.08
	S_2	308	273.90 ±0.08
	S_3	217	273.64 ±0.10

Table 14 Analysis of variance for GP in Holdeo Straightbreds

Sources	DF	SS	MSS	Fvalue calculated
Period of calving	3	18.42	6.14	2.94*
Season of calving	2	8.26	4.13	1.98^{NS}

Inter Calving Period (ICP)

The least squares means of ICP and analysis of variance showing effects of period of calving, season of calving and lactation order and dry period on gestation period in Holdeo cows are presented in Table 15 and 16. The effect of period of calving on ICP was non significant in Holdeo cow (Table 16). The mean ICP (Days) was higher in period P_3 (436.73 ± 3.81) followed by P_1 (433.77 ±6.15), P_2 (429.75 ±4.07) and lowest in P_4 (417.46 ±4.38). The results are supported with the findings of Bhoite *et al*. (1998) in Friesian x Jersey x Gir, Jersey x Friesian x Gir and Brown Swiss x Friesian x Gir crossbred, Bhutkar *et al*. (2014b) in Holstein Friesian x Deoni cows.The results revealed that Holdeo crossbred genotype possess shorter ICP and well adopted to the season of tract as such there will not be significant deviation in the expression of character. Results of Thombre *et al*.(2001) in Holstein Friesian x Deoni halfbred, Dubey and Singh (2005) in Sahiwal x Holstein Friesian, Sahiwal x Jersey and Sahiwal x Rathi x Holstein Friesian,

Table 15 Inter calving period in Holdeo Straightbreds

Sources	Code	N	LSM ±SE
Mean	μ	860	429.43 ±2.44
Period of calving	P_1	99	433.77 ±6.15
	P_2	276	429.75 ± 4.07
	P_3	280	436.73 ±3.81
	P_4	205	417.46 ±4.38
Season of calving	S_1	335	437.75 ±3.64
	S_2	308	431.68 ± 3.70
	S_3	217	418.85 ± 4.28

Table 16 Analysis of variance for inter ICP in Holdeo Straightbreds

Sources	DF	SS	MSS	Fvalue calculated
Period of calving	3	4.5	1.50	0.40^{NS}
Season of calving	2	4.62	2.31	0.62^{NS}

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