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To study the effect of non-genetic factors on production and reproduction performance of Holdeo (Holstein Friesian x Deoni) interse

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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). The data representing HF X Deoni interse cattle from Cattle Cross Breeding Project, VNMKV, Parbhani with 960 total records of lactation over a 25 years period (1991-2015) were analyzed to determine the effect of period of calving and season of calving on production and reproduction performance of Holdeo. The overall least squares means were LMY for (1495.45 ± 123.74 kg), PMY (7.35 kg), DRPMY (35.36 ± 0.15 days), LP (275.58 ± 2.63 days), DP (124.83 ± 5.76 days), SP (126.36 ± 5.63 days) and ICP (402.85 ± 5.58 days). The LMY and DRPMY in Holdeo interse cow was not significantly affected by period of calving and season of calving. However, The PMY, LP, DP, GP and ICP was significantly affected by period of calving ($P < 0.01$) in Holdeo interse cows. However, season of calving had non-significant effect on PMY and DP.

Keywords: Holdeo, Non-genetic factors, production and reproduction performance

Introduction

Indian dairying is an emerging industry, so to make it profitable and sustainable we should have not only produce high producer animals but also develop an economic and profitable production system. Overall, economic return from individual animals depends upon various productive and reproductive performance besides milk production. The decade-wise rate of growth in milk production in India (4.00 per cent) is substantially higher than the world average of 1.50 per cent. Despite of holding the number one position in milk production in the world for over a decade, the milk productivity in the country remains one of the lowest as compared to the many leading country of the world border areas of Andhra Pradesh and Karnataka state. 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. Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani has taken a project for improvement of Deoni cattle by crossbreeding with elite exotic breed Holstein Friesian. The crossbred is named as Holdeo. Deoni is one of the important dual purpose cattle breed of Marathwada region of Maharashtra state and adjoining areas of Maharashtra *i.e.* Andhra Pradesh and Karnataka states (Singh *et al.* 2002) [49].

Materials and Methods

Data representing HF × Deoni interse cattle from CCBP with 960 total records of lactation over a 25 years period (1991-2015) were analyzed to determine the effect of period of calving and season of calving on production and reproduction performance of holdeo cattle. The complete years was divided into 3 seasons and 5 periods having 5 years each. The three seasons namely winter (October-January), summer (February-May) and monsoon (June-September) were coded as S₁, S₂ and S₃. The period of calving were coded as P₁ (1991-1995), P₂ (1996-2000), P₃ (2001-2005), P₄ (2006-2010) and P₅ (2011-2015). The data were statistically analysed for linear model (SAS, 2002) [43]. Duncan Multiple Range Test (DMRT)

was employed to test and locate means that significantly differed from each other (Kramar, 1957). The following statistical model was employed to analyse the data.

$$y_{ijk} = \mu + S_i + P_j + e_{ijk}$$

y_{ijk} - 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_{ijk} - Random error associated with NID (6^2e)

Results and Discussion

Lactation milk yield

The least squares means of LMY and analysis of variance showing effect of period of calving and season of calving on lactation milk yield in Holdeo interse crossbred cattle are presented in Table 1 and 2. The overall least squares means for LMY of Holdeo interse crossbred cattle was 1495.45 ± 123.74 kg. These results were close to Taneja and Sikka (1981) [52], Rao *et al.* (1984) [40], Yadav and Rathi (1992) [60] and Bhutkar *et al.* (2015) [9] in Holstein Friesian x Deoni halfbred. The effect of period of calving on LMY was non-significant in Holdeo interse cattle (Table 2). The mean LMY (kg) was higher in period P_4 (1963.33 ± 254.42) followed by P_5 (1491.15 ± 289.83), P_3 (1367.83 ± 266.08), P_1 (1350.60 ± 216.78) and lowest in P_2 (1304.33 ± 265.98). The results were supported with the findings of Kaul *et al.* (1985) [24] in Haryana x Friesian and Haryana x Brown Swiss, Mudgal *et al.* (1990) [33] in Holstein Friesian x Sahiwal. Thombre (1991) [55] and Thombre (1996) [56] in Holstein Friesian x Deoni halfbred. The effect due to season of calving on LMY of Holdeo interse cattle was non-significant (Table 2). The LSM of LMY (Kg) was higher in cows calved during season S_2 (1609.96 ± 185.56) followed by S_3 (1482.72 ± 220.69) and lowest in S_1 (1393.67 ± 201.10). The results revealed that seasonal changes do not influence on the variation on LMY in crossbred cattle including Holdeo and get comfortable. Similar results reported by Patel *et al.* (1989) [37] in Jersey x Kankrej, Mudgal *et al.* (1990) [33] in Holstein Friesian x Sahiwal, Thombre (1991) [55] in Holstein Friesian x Deoni halfbred and Rao *et al.* (1984) [40] in Ongole, Tharparkar and Malvi breeds of cattle.

Table 1: Lactation milk yield (kg) in Holdeo interse

Source	Code	N	LSM \pm SE
Mean	μ	959	1495.45 ± 123.74
Period of calving	P_1	271	1350.60 ± 216.77
	P_2	175	1304.33 ± 265.98
	P_3	172	1367.83 ± 266.08
	P_4	192	1963.33 ± 254.42
	P_5	150	1491.15 ± 289.83
Season of calving	S_1	312	1393.67 ± 201.10
	S_2	390	1609.96 ± 185.56
	S_3	258	1482.72 ± 220.69

Table 2: Analysis of variance for LMY

Source	DF	SS	MSS	F value calculated
Period of calving	4	56757872.11	14189468.03	1.19 ^{NS}
Season of calving	2	8174449.99	4087224.99	0.34 ^{NS}

Peak milk yield (PMY)

The least squares means of PMY and analysis of variance showing effect of period of calving and season of calving on

peak milk yield in Holdeo interse cattle are presented in table 3 and 4. The overall least squares means for PMY of Holdeo interse crossbred cattle was 7.34 ± 0.02 kg. These results were similar to Dutta and Bhushan (2001) [19] in Brown Swiss x Haryana crossbred cattle, Bhopale (2008) [5] in Holstein Friesian x Deoni interse crossbred cattle, Anarase (2011) [1] in Holdeo (HF x Deoni) crossbred cattle, Kumar *et al.* (2014) [28] in Holstein Friesian crossbred cows. The analysis of variance revealed significant ($p < 0.01$) effect of period of calving on PMY in Holdeo interse cattle (Table 4). The DMRT indicated that mean PMY (Kg) for cows calved in P_4 (7.48 ± 0.05) was significantly higher than P_3 (7.40 ± 0.05), P_5 (7.35 ± 0.05), P_2 (7.26 ± 0.05) and P_1 (7.25 ± 0.04). Similar results reported by Sharma and Singh (1999) [45], Lakshmi *et al.* (2009) [30] in Friesian x Sahiwal, Kumar *et al.* (2014) [28] in Hosten Friesian cow, Rafiulla (2014) [39] in HF x Deoni interse crossbred cattle. The effect due to season of calving on PMY was non-significant. This revealed that the season of calving not very influencing the variation on PMY in Holdeo interse cow (Table 4). The LSM for PMY (Kg) was higher in S_2 (7.39 ± 0.03) followed by S_1 (7.36 ± 0.04) and lowest in S_3 (7.29 ± 0.04). These result were collaborated with Bhutkar *et al.* (2015) [9] in HF x Deoni crossbred cows.

Table 3: Peak milk yield (kg) in Holdeo interse

Source	Code	N	LSM \pm SE
Mean	μ	959	7.34 ± 0.02
Period of calving	P_1	271	$7.25^a \pm 0.04$
	P_2	175	$7.26^a \pm 0.05$
	P_3	172	$7.40^{bc} \pm 0.05$
	P_4	192	$7.48^{b\pm} 0.05$
	P_5	150	$7.35^a \pm 0.04$
Season of calving	S_1	312	7.36 ± 0.04
	S_2	390	7.39 ± 0.03
	S_3	258	7.29 ± 0.04

Table 4: Analysis of variance for LMY

Source	DF	SS	MSS	F value calculated
Period of calving	4	7.35	1.84	4.74 ^{**}
Season of calving	2	1.57	0.78	2.02 ^{NS}

Days to reach peak milk yield (DRPMY)

The least squares means of DRPMY and analysis of variance showing effect of period of calving and season of calving on days to reach peak milk yield in Holdeo interse cattle are presented in Table 5 and 6. The overall least squares means for DRPMY of Holdeo interse crossbred cattle was 35.36 ± 0.15 days. These results were close to Maizi *et al.* (2007) [31] in Friesian x Local, Bhopale (2008) [5] and Anarase (2011) [1] in Holstein Friesian x Deoni crossbred cattle. The DMRT indicated that mean DRPMY (Kg) for cows calved in P_4 (34.99 ± 0.32) was significantly higher than P_2 (35.86 ± 0.33), P_3 (35.40 ± 0.33), P_1 (35.38 ± 0.27), P_5 (35.17 ± 0.36) and lowest in P_4 (34.99 ± 0.32). Similar results reported by Garacha *et al.* (1989) [20], Sharma and Singh (1999) [45], Kulkarni (2001) [27] in Red Sindhi cattle, Lakshmi *et al.* (2009) [30] in Friesian x Sahiwal. The effect due to season of calving on DRPMY was non-significant (Table 6). The LSM for DRPMY (days) was higher in cows calved during S_3 (35.61 ± 0.28) followed by S_2 (35.35 ± 0.23) and lowest in S_1 (35.12 ± 0.25). This has indicated that irrespective of any season of calving the cows for their DRPMY remains unchanged and do not get significantly deviated. These results were in agreement with Pathak and Dhingara (1989) [38] in Gir cattle.

Table 5: Days to reach peak milk yield in Holdeo interse

Source	Code	N	LSM ± SE
Mean	μ	959	35.36 ± 0.15
Period of calving	P ₁	271	35.38 ± 0.27
	P ₂	175	35.86 ± 0.33
	P ₃	172	35.40 ± 0.33
	P ₄	192	34.99 ± 0.32
	P ₅	150	35.17 ± 0.36
Season of calving	S ₁	312	35.12 ± 0.25
	S ₂	390	35.35 ± 0.23
	S ₃	258	35.61 ± 0.28

Table 6: Analysis of variance for DRPMY

Source	DF	SS	MSS	F value calculated
Period of calving	4	75.52	18.88	1.02 ^{NS}
Season of calving	2	32.98	16.49	0.89 ^{NS}

Lactation period (LP)

The least squares means of lactation period and analysis of variance showing effect of period of calving and season of calving on lactation period in Holdeo interse cattle and presented in Table 7 and 8. The overall least squares means for LP of Holdeo interse cattle was 275.58 ± 2.63 days. These results were close to Singh and Tomar (1991) [50] in Karan Fries, Bhattacharya (2002) [3] in Friesian x Tharparkar F₁ and F₂ crossbred, Komatwar *et al.* (2010) [25] in Holstein Friesian x Sahiwal crossbred cattle. The analysis of variance indicated that effect due to period of calving on LP was significant ($P < 0.01$) (Table 8). The LSM for LP (days) was higher in cows calved in P₃ (290.79 ± 5.67) followed by P₁ (284.21 ± 4.62), P₄ (275.68 ± 5.39), P₂ (273.70 ± 5.66) and lowest in P₅ (253.54 ± 6.14). This that period of calving not interfering on LP. Similar results were reported, Thombre (1991) [55] in Holstein Friesian x Deoni crossbred cattle, Jat *et al.* (1996) [23] in Rathi cattle, Bhuktare *et al.* (1998) in Holstein Friesian x Sahiwal. The effect due to season of calving on LP was significant ($P < 0.01$) (Table 8). The LSM of LP (Days) was higher in cows calved during S₃ (293.45 ± 4.68) followed by S₁ (270.47 ± 4.29) and lowest in S₂ (262.83 ± 3.93). The present results indicated that in Holdeo interse seasonal changes had significantly effect on lactation period. These results were in agreement with Rehman and Rehman (2006) [41] and Zewdu *et al.* (2013) [61] in HF x Deoni crossbred cattle.

Table 7: Lactation period (days) in Holdeo interse

Source	Code	N	LSM ± SE
Mean	μ	959	275.58 ± 2.63
Period of calving	P ₁	271	284.21 ^a ± 4.62
	P ₂	175	273.70 ^b ± 5.66
	P ₃	172	290.79 ^a ± 5.67
	P ₄	192	275.68 ^a ± 5.39
	P ₅	150	253.54 ^{bc} ± 6.14
Season of calving	S ₁	312	270.47 ^b ± 4.29
	S ₂	390	262.83 ^b ± 3.93
	S ₃	258	293.45 ^a ± 4.68

Table 8: Analysis of variance for LP

Source	DF	SS	MSS	F value calculated
Period of calving	4	129837.64	32459.41	6.07 ^{**}
Season of calving	2	147589.17	73794.59	13.79 ^{**}

Dry period (DP)

The least squares means of DP and analysis of variance showing effects of period of calving and season of calving on dry period in Holdeo cows are presented in Table 9 and 10.

The overall least squares means for DP of Holdeo cows was 124.83 ± 5.76 days. The results were close to Singh *et al.* (1980) [53] in Friesian x Local, Jersey x Local and other crosses, Jadhav *et al.* (1991) [22] in HF x Sahiwal, Dubey and Singh (2005) [18] in Jersey x Sahiwal. The effect of period of calving on DP was significant ($P < 0.01$) in Holdeo cows (Table 10). The mean DP (days) was higher in period P₅ (147.57 ± 13.90) followed by P₂ (139.44 ± 12.67), P₃ (129.88 ± 11.68), P₁ (108.31 ± 9.95) and lowest in P₄ (98.94 ± 11.67). These results were supported with the findings of Bonde *et al.* (1983) [11] in HF x Deoni crossbred cattle and Jadhav *et al.* (1991) [22] in HF x Sahiwal. The variation due to season of calving in DP was non-significant (Table 10). The LSM of DP (days) was higher in cows calved during S₃ (129.05 ± 9.95) followed by S₁ (128.03 ± 9.44) and lowest in S₂ (117.40 ± 8.67). The present results indicated that in particular season of calving the DP in Holdeo interse crossbred was not deviated and showed the slightly differences among the seasons. More or less similar results were reported by Tivari *et al.* (1995) in Jersey x Sahiwal crossbred, Holstein Friesian x Sahiwal crossbred, Komatwar (2010) [25] in Holstein Friesian x Deoni crossbred cow and Bhutkar *et al.* (2015) [9] in Holstein Friesian x Deoni crossbred cattle.

Table 9: Dry period in Holdeo interse

Source	Code	N	LSM ± SE
Mean	μ	730	124.83 ± 5.76
Period of calving	P ₁	211	108.31 ^b ± 9.95
	P ₂	124	139.44 ^a ± 12.67
	P ₃	144	129.88 ± 11.68
	P ₄	147	98.94 ^b ± 11.68
	P ₅	104	147.57 ^a ± 13.90
Season of calving	S ₁	232	128.03 ± 9.44
	S ₂	292	117.40 ± 8.67
	S ₃	206	129.05 ± 9.95

Table 10: Analysis of variance for DP

Source	DF	SS	MSS	F value calculated
Period of calving	4	230647.08	57661.77	3.01 ^{**}
Season of calving	2	21244.83	10622.41	0.56 ^{NS}

Service period (SP)

The least squares means of SP and analysis of variance showing effects of period of calving and season of calving on service period in Holdeo cows are presented in Table 11 and 12, respectively. The overall least squares means for SP of Holdeo cows was 126.36 ± 5.63 days. The results were close to Siddiqui (1984) [46] in Friesian x Sahiwa lhalfbred and Thombre *et al.* (2001) [58] in Holstein Friesian x Deoni halfbred. The effect of period of calving on SP was non-significant in Holdeo cows (Table 12). The DMRT revealed that the SP of Holdeo cows calved during P₃ (149.03 ± 11.45) was higher than cows calved in P₁ (133.41 ± 9.67), P₂ (125.05 ± 12.37), P₅ (122.85 ± 13.63) and lowest in P₄ (101.48 ± 11.40). The results are supported with the findings of Nagare and Kulkarni (2000) [35] in Holstein Friesian, Jersey, Brown Swiss, Chaudhary (2013) in Holstein Friesian and Bhutkar *et al.* (2014) [7] 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 (days) was higher in cows calved during season S₃ (144.52 ± 9.69) followed by S₁ (126.46 ± 9.24) and S₂ (108.11 ± 8.47). More or less similar results were reported by Nagarcenkar and Rao (1982) [34] in Friesian x Tharparkar, Brown Swiss x

Tharparkar and Jersey x Tharparkar cattle and Komatwar *et al.* (2010)^[25] in Friesian x Sahiwal cattle and Bhutkar *et al.* (2014)^[7] in Holstein Friesian x Deoni cows.

Table 11: Service period in Holdeo interse

Source	Code	N	LSM ± SE
Mean	μ	730	126.36 ± 5.63
Period of calving	P ₁	213	133.41 ± 9.67
	P ₂	124	125.05 ± 12.37
	P ₃	143	149.03 ± 11.45
	P ₄	147	101.48 ± 11.40
	P ₅	103	122.85 ± 13.63
Season of calving	S ₁	231	126.46 ^a ± 9.24
	S ₂	292	108.11 ^b ± 8.47
	S ₃	207	144.52 ^a ± 9.69

Table 12: Analysis of variance for SP

Source	DF	SS	MSS	F value calculated
Period of calving	4	174189.67	43547.42	2.39 ^{NS}
Season of calving	2	158916.39	79458.19	4.35 ^{**}

Gestation period (GP)

The least squares means of GP and analysis of variance showing effects of period of calving and season of calving on gestation period in Holdeo cow are presented in Table 13 and 14, respectively. The overall least squares means for GP of Holdeo cows was 278.24 ± 0.19 days. The results were more or less similar to Mondal *et al.* (2005)^[32] in Jersey cross x Sahiwal crossbred cattle, Saut *et al.* (2007)^[44] in crossbred cattle and Rokonzaman *et al.* (2009) in crossbred cattle. The effect of period of calving on GP was significant in Holdeo cows. The DMRT revealed that the GP of Holdeo cows calved during higher than P₄ (280.33 ± 0.39) was significantly higher than P₃ (279.83 ± 0.39), P₅ (277.93 ± 0.46), P₂ (276.63 ± 0.42) and lowest in P₁ (276.48 ± 0.33). The results are supported with the findings of Corbet *et al.* (1997), Sultana *et al.* (2001)^[51] in Friesian cross, Jersey cross, Sahiwal cross, Sindhi cross and Bhutkar *et al.* (2014)^[7] in Holstein Friesian x Deoni cows. The variation due to season of calving on GP in Holdeo cow was significant (Table 14). The LSM of GP was higher in cows calved during S₂ (278.87 ± 0.29) followed by S₁ (278.37 ± 0.31), S₃ (277.47 ± 0.33). 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 Blotner *et al.* (2011)^[10] in Brown Swiss x Hostein crossbred and Bhutkar *et al.* (2014)^[7] in Holstein Friesian x Deoni cows.

Table 13: Gestation period in Holdeo interse

Source	Code	N	LSM ± SE
Mean	μ	730	278.24 ^{bc} ± 0.19
Period of calving	P ₁	213	276.48 ^{bc} ± 0.33
	P ₂	124	276.63 ^{bc} ± 0.42
	P ₃	143	279.83 ^a ± 0.39
	P ₄	147	280.33 ^a ± 0.39
	P ₅	103	277.93 ^b ± 0.46
Season of calving	S ₁	231	278.37 ^a ± 0.31
	S ₂	292	278.87 ^a ± 0.29
	S ₃	207	277.47 ^b ± 0.33

Table 14: Analysis of variance for GP

Source	DF	SS	MSS	F calculated
Period of calving	4	1976.72	494.18	23.76 ^{**}
Season of calving	2	234.27	117.13	5.63 ^{**}

Inter calving period (ICP)

The least squares means of ICP and analysis of variance showing effects of period of calving and season of calving on inter calving period in Holdeo cows are presented in Table 15 and 16, respectively. The overall least squares means for ICP of Holdeo cows was 402.85 ± 5.58 days. The results are close to Deshapande and Bonde (1983)^[16] in Friesian x Sahiwal cattle, Thalkari (1984)^[54] in Friesian x Deoni cattle, Dalal *et al.* (1991)^[15] in Brown Swiss x Hariana cattle and Thombre *et al.* (2002)^[57] in Holstein Friesian x Deoni halfbred. The effect of period of calving on ICP was significant in Holdeo cow (Table 16). The mean ICP (days) was higher in period P₃ (428.98 ± 11.38) followed by P₁ (403.67 ± 9.60), P₂ (403.63 ± 12.28) and lowest in P₅ (400.57 ± 13.48) and P₄ (377.40 ± 11.30). The results are supported with the findings of Deshpande and Ingole (1986)^[17] in Friesian x Sahiwal crossbred, Bhoite *et al.* (1998)^[4] in Friesian x Jersey x Gir, Jersey x Friesian x Gir and Brown Swiss x Friesian x Gir crossbred, Ghatcharle (2003)^[21] and Chewale (2008)^[12] in Holstein Friesian x Deoni interse crossbred cattle and Bhutkar *et al.* (2014)^[7] in Holstein Friesian x Deoni cows.

The variation due to season of calving on ICP in Holdeo cows was significant (Table 16). The LSM of ICP (days) was higher in cows calved during S₃ (418.68 ± 9.65) followed by S₁ (400.71 ± 9.13) and lowest in S₂ (389.16 ± 8.39). The results revealed that Holdeo crossbred genotype possess shorter ICP and well adopted to the season of tract as such there will be significant deviation in the expression of character. Results of Deshpande and Bonde (1983)^[16] in Friesian x Sahiwal crossbred, Bhatnagar *et al.* (1986)^[2] in Karan Fries and Karan Swiss cattle, Thakur and Singh (2001)^[53] in Jersey x Hariana crossbred and Ghatcharle (2003)^[21] in Holstein Friesian x Deoni interse crossbred, Zewdu *et al.* (2015)^[62] and Bhutkar *et al.* (2014)^[7] in Holstein Friesian x Deoni cows supportive to present trends on ICP.

Table 15: Inter calving period in Holdeo interse

Source	Code	N	LSM ± SE
Mean	μ	725	402.85 ± 5.58
Period of calving	P ₁	212	403.67 ^a ± 9.60
	P ₂	123	403.63 ^a ± 12.28
	P ₃	141	428.98 ^a ± 11.38
	P ₄	146	377.40 ^b ± 11.30
	P ₅	103	400.57 ^a ± 13.48
Season of calving	S ₁	231	400.71 ^a ± 9.13
	S ₂	290	389.16 ^b ± 8.39
	S ₃	204	418.68 ^a ± 9.65

Table 16: Analysis of variance for ICP

Source	DF	SS	MSS	F value calculated
Period of calving	4	188910.50	47227.62	2.65 [*]
Season of calving	2	102462.27	51231.14	2.87 [*]

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