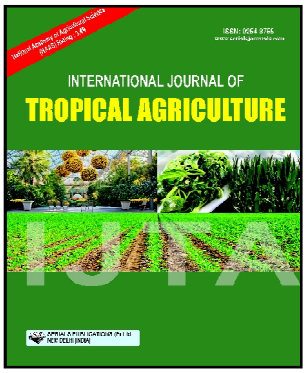

INTERNATIONAL JOURNAL OF TROPICAL AGRICULTURE

ISSN : 0254-8755

available at http: www.serialsjournal.com

Volume 35 • Number 3 • 2017

Genetic and Environmental Causes of Variation in Gestation Length of Dairy Cattle

Vinod V Potdar[1], N. L. Phadke[2] and J. R. Khadse[3]

[1] Associate Research Programme Manager
E-mail: vinod231068@gmail.com
[2,] I.T. Manager, [3] Research Director, Central Research Station, BAIF Development Research Foundation
Pune, India 431402

Abstract: The objective of this study was to investigate the effect of genetic and non-genetic factors and estimate the genetic parameter for gestation length (GL) of cattle.The data included the 12607 parturition records on dairy cattle breeds including Holstein Friesian Cross,JerseyCross,Sahiwal&Non Descript Cattle from field condition from Bihar state during period 2010 to 2015. The data were analyzed applying mixed model least square technique considering the fixed effects of cattle breed, season of calving, period of calving, parity of animal and sex of calf born from animal was considered for study.Gestation length in Holstein Friesian Cross gestation period was 279.5±0.06, in Jersey Cross280.03±0.02. Non Descript cattle279.30±0.05 & in Sahiwal cross was 279.32±0.24 days.Gestation length was ranges from 262 to 295 days. Haq et al. (1993) reported similar findings in HolsteinFriesian cows. Dutta et al. (1989) reported longer gestation period (281.9 ± 1.5 days) in Jersey cows in India. But Juneja et al. (1991) reported shorter gestation period (266 ± 47.7 days) in Friesian cows in India. Sire breed, calvingseason, body score condition, sex of calf, year of insemination & calving year were found to be a significant source of variation in the GL in Holstein Friesian Cross. In Jersey Cross only body score condition was found significant effect over gestation length. In non descript cattle sire breed, lactationnumber, year of insemination were found to be significant effect. In sahiwal cattle only sire breed was found significant effect.It can be concluded that significant effect of all factors found in Holstein Friesian cattle breed than in other breeds accurate prediction ofcalving date will help in better management and health care of pregnant animals.

Keywords: crossbred cattle, genetic and environmental factors, gestation length

INTRODUCTION

Gestation length (GL) is one the most importanttraits in cow-calf operations and significantly affectscattle breeding and production.

It is the period extending from the date of conception to that of delivery. At optimum service period, gestation period was shown to keep the regularity of inter–calving period, hence the economical and breeding efficiency of dairy cow.

Gestation length is shorter in heifers than in older cows (Przysucha and Grodzki, 2009). High temperatures in the summer speed up calving and shorten gestation length (McClintock *et al.,* 2003). High milk yield prolongs gestation, as suggested by a positive genetic correlation between GL and milk production levels (Silva *et al.* 1992). Both longer and shorter gestation periods contribute to a higher number of stillbirths (Norman *et al.,* 2009).

Dairy farmers give least importance to GL has so far a comprehensivestudy regarding variation in GL with environmentand level of exotic inheritance in cattle of India is limited therefore, the objective of this study was todetermine the various genetic and non-genetic factorsinfluencing gestation length and the estimation of the geneticparameter in crossbred & Indigenous dairy cattle from field condition.

MATERIAL AND METHODS

The data consisted of 12607 gestation recordsat cattle development centres from BAIFfrom Bihar state were considered for study. The period covered was fromJune 2010 to December 2015. The available data wereclassified on the basis of lactation order, sex of calf, animal breed, body score condition of cattle, insemination year and season of calving.

Gestation length (GL) was determined as the number of days between effective fertilization until calving. The animals were divided into four breeds as Holstein Friesian cross, Jersey Cross, Sahiwal & Non descript cattle.

Based on the age factor cows were divided into Heifer group &lactation group (1-3). Three calving seasons were identifiedRainy (July, August, September, October),Winter (November, December, January, February), Summer (March, April, May, June). Animals were divided in to four groups under body score condition (no ribs visible, one rib visible, two rib visible & three rib visible). Insemination year was divided in year 2010, 2011, 2012, 2013, 2014 & 2015.

To evaluatethe effect of various genetic and non-genetic factorson GL, the data were grouped into different classes tobe used as fixed effects. The data were classified asshown in Table 1. The GL of heifers was assigned firstparity in this study. Only those gestations whichterminated in single births of normal calves were consideredin the study. Animals with abortion,stillbirth, or premature birth records were not includedin the present study.

Statistical Analysis

The effects of genetic and non-genetic factorson reproductive traits were carried out by least squareanalysis of variance using the technique described by Harvey. Duncan's multiple range test as modifiedby Kramer was used for testing the differencesbetween least squares means between sub-classes.Genetic parameters were estimated using Model 2 of Mixed Model Least square and Maximum Likelihood, PC-2 Version Computer Program. The effect of GL on CE was evaluated using dbstat version 1.0

RESULTS AND DISCUSSION

It was obvious from the frequency distribution of thegestation length (Figure 1-4) that the raw data could haveincluded errors - the curve is skewed towards a length ofgestation of over 279 days.Overall in Holstein Friesian Cross gestation period was 279.5±0.06, in Jersey Cross 280.03±0.02. Non Descript cattle 279.30±0.05 & in Sahiwal cross was

Table 1
Classification of data for genetic and environmental factors

Animal breeds (4 classes)
• Holstein Friesian Cross
• Jersey Cross
• Non Descript cattle
• Sahiwal
Season of calving (3 classes)
• Winter (November-February)
• Summer (March-June)
• Rainy (July-October)
Period of calving (5 classes)
• 2011
• 2012
• 2013
• 2014
• 2015
Parity
• Heifer
• 1
• 2
• 3
Body condition score (4 class)
• No ribs
• One rib exposed
• Two rib exposed
• Three rib exposed
Sex of calf born (2 classes)
• Male
• Female

279.32±0.24 days.Gestation length was ranges from 262 to 295 days. Haq *et al.* (1993) reported similar findings in HolsteinFriesian cows. Dutta *et al.* (1989) reported longer gestation period (281.9 ± 1.5 days) in Jersey cows in India. But Juneja *et al.* (1991) reported shorter gestation period (266 ± 47.7 days) in Friesian cows in India.

The average gestation length in Holstein Friesian Cross cattle was 279.5±0.06 days was shorter than determined for Holstein cattle by Nadarajah *et al.* (1989) 281.3 days, Silva *et al.* (1992) 280 days, and Norman *et al.* (2009) 281.6 days.

Jersey crossbred cattle was 280.03±0.02 days (Table 4), with a range of 262-295 days.It is in agreement with the other reports in Jersey crossbred cattle.Normanet al. also reported similar results for GL withmean value of 280 days for Jersey cattle. However,the mean GL of animals in this study was higher thanthe finding of Bhutkar et al., Mondal et al. and Varaprasad et al. who obtained the values of 274.93, 275, and 276.89 days, respectively, in crossbredcattle of India.

In present study gestation length in Non-Descript cattle was 279.30±0.05 days & in Sahiwal cross was 279.32±0.24 days. M.K.Uddinet al.reportedgestation length was shorter in case of Sahiwal cross (277.64±1.99 days) and it varies within Friesian and Sindhi cross in a short range (278.77±1.38 to 279.31±1.00 days). Nahar et el., reported that theaverage gestation period of Sindhi, Sahiwal, Jersey and Holstein crossbred cows were 280.55, 279.81,279.76 and 279.91 days respectively. Similar result was found by Mondal (1998).Difference in gestation period might be attributed by genetic factor.

Effect of sire

Sire had highly significant ($p<0.01$) effect on length of gestation of Holstein Friesian crossbred &Non-descript cattle while there was no sire effect in Jersey Cross & Sahiwal cattle in the present study.

Effect of season of calving

The influence of season of calving was significant ($p<0.01$) in Holstein Friesian Cross breed only there was no influence of season of calving in other cattle breeds. In Holstein Friesian CrossGestation length was shorter in winter 279.22±0.11 than in summer 280.73±0.11 & rainy season279.57±0.12.

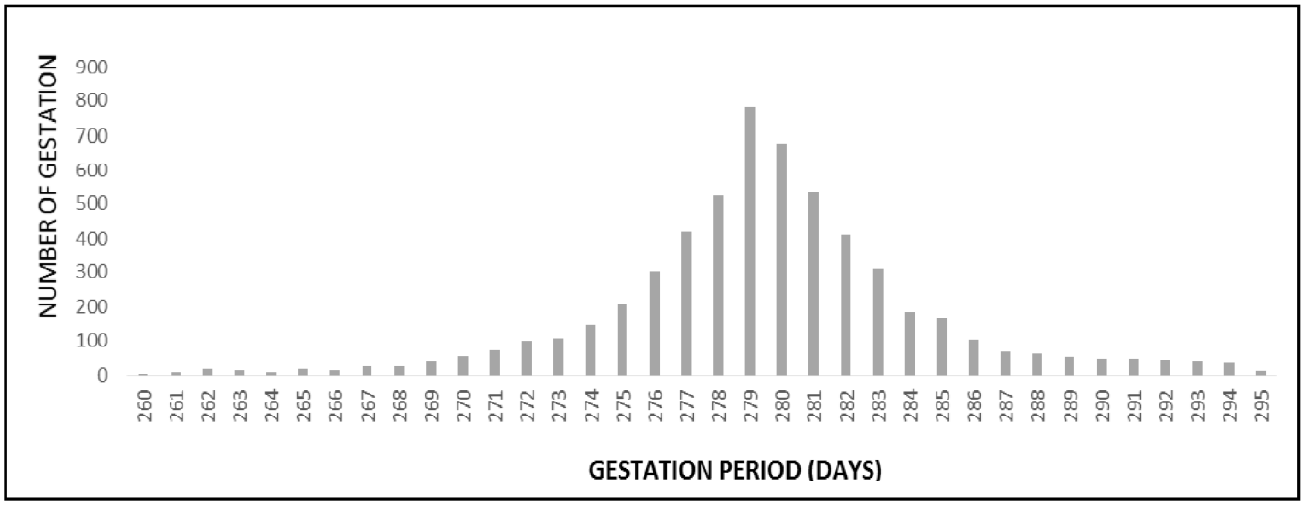

Figure 1: Frequency distribution of gestation length in Holstein Friesian Cross cow

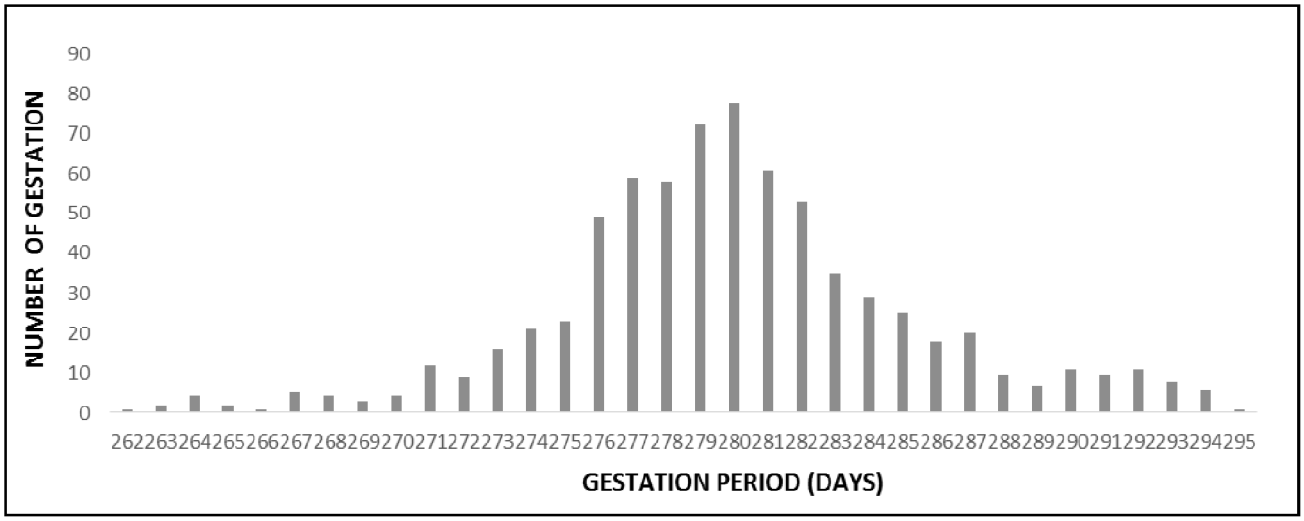

Figure 2: Frequency distribution of gestation length in Jersey Cross cow

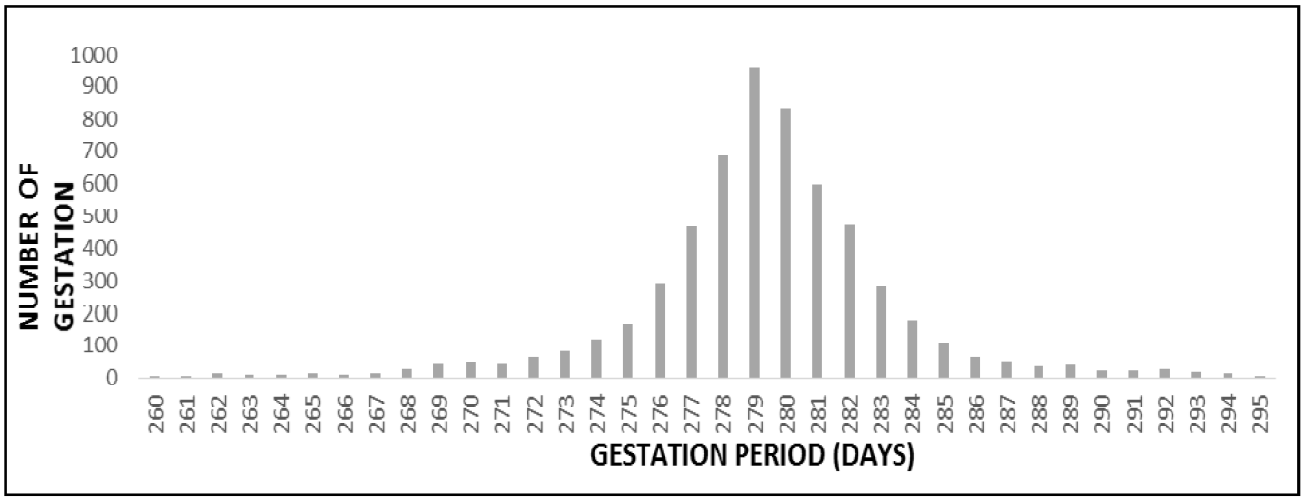

Figure 3: Frequency distribution of gestation length in Non Descript cow

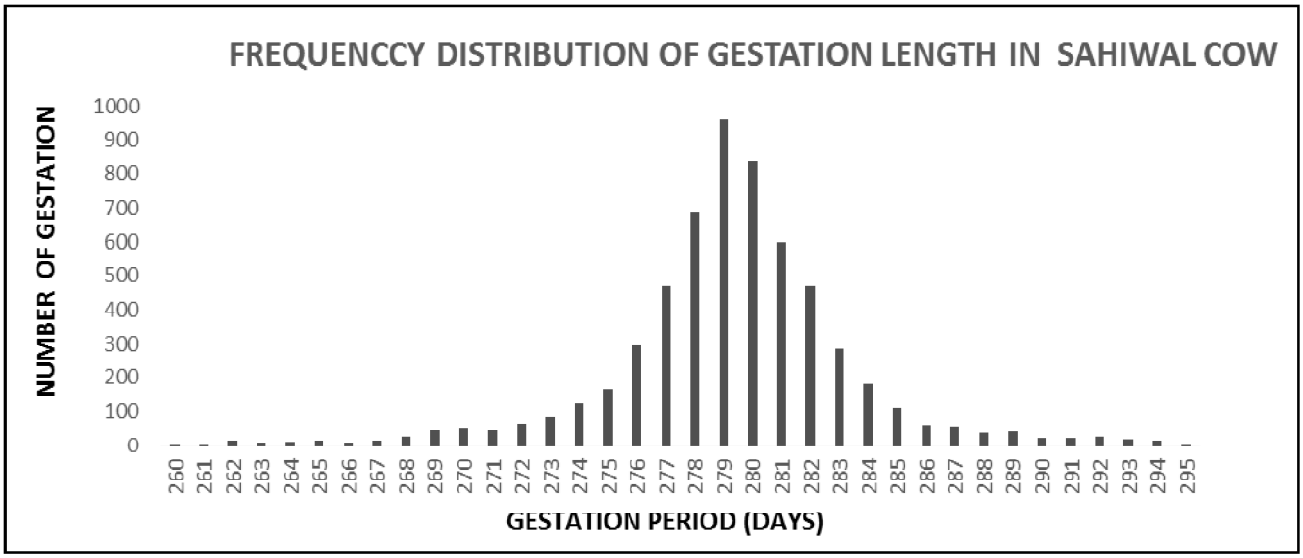

Figure 4: Frequency distribution of gestation length in Sahiwal cow

Table 2
Degrees of freedom, mean squares, F valuesand significance of sources of variation affecting gestationlength in Holstein Friesian Cross cattle.

Source of variation	*Degrees of freedom*	*Mean square*	*F value*	*p*
Sire Breed	4	87.82	3.5	0.0069
Calving Season	2	134.57	5.41	0.005
Lactation No	3	28.87	1.16	0.357
Calf Sex	1	361.64	14.55	0.003
Body Condition	3	126.70	5.092	0.0016
Calving year	4	56.45	2.26	0.059
Year of AI	4	164.0467	6.6013	0.0001

Table 3
Degrees of freedom, mean squares, F valuesand significance of sources of variation affecting gestationlength in Jersey Cross dairy cattle

Source of variation	*Degrees of freedom*	*Mean square*	*F value*	*p*
Sire breed	4	9.62	0.32	0.85
Calving Season	2	16.06	0.546	0.57
Lactation No	3	17.98	0.61	0.60
Calf Sex	1	0.41	0.014	0.90
Body Condition	3	91.45	3.15	0.024
Calving year	4	20.88	0.72	0.57
Year of AI	4	8.7272	0.3009	0.87

Table 4
Degrees of freedom, mean squares, F valuesand significance of sources of variation affecting gestationlength in Non descript cattle

Source of variation	*Degrees of freedom*	*Mean square*	*F value*	*p*
Sire breed	4	66.62	3.94	0.0034
Calving Season	2	14.03	0.831	0.43
Lactation No	3	84.87	5.03	0.001
Calf Sex	1	5.73	0.33	0.56
Body Condition	3	33.58	1.98	0.11
Calving year	4	10.30	0.60	0.65
Year of AI	4	39.3139	2.3237	0.05

Table 5
Degrees of freedom, mean squares, F valuesand significance of sources of variation affecting gestationlength in Sahiwal cattle

Source of variation	*Degrees of freedom*	*Mean square*	*F value*	*p*
Sire breed	4	48.67	2.47	0.04
Calving Season	2	2.45	0.12	0.88
Calf Sex	1	0.04	0.02	0.96
Lactation No	2	3.57	0.17	0.83
Body Condition	3	46.0788	2.2761	0.07
Calving year	4	13.6940	0.6764	0.60
Year of AI	4	25.2780	1.2611	0.28

Table 6
Least squares means (±SE) for Gestation Length (GL)

	Holstein Friesian Cross cattle.		*Jersey cross cattle*		*Non Descript cattle*		*Sahiwal cattle*	
Parameters	*N*	*GL (days)*	*N*	*GL (days)*	*N*	*GL (days)*	*N*	*GL (days)*
Overall mean	5698	279.50±0.06	728	280.03±0.02	5851	279.30±0.05	330	279.32±0.24
Season								
Winter (November-February)	2002	279.22±0.11	250	279.84±0.33	2355	279.25±0.08	116	279.09±0.46
Summer (March-June)	2062	280.73±0.11	312	280.29±0.31	1933	279.43 ±0.09	149	279.50±0.36
Rainy (July-October)	1634	279.57±0.12	166	279.81±0.41	1563	279.22±0.10	65	279.31±0.46
Parity								
heifer	3604	279.54±0.084	511	279.91±0.23	3689	279.38±0.06	237	279.41±0.27
1	1530	279.54±0.131	154	280.39±0.47	1335	279.31±0.11	75	280.25±0.61
2	502	279.27±0.2	54	280.31±0.71	700	279.16±0.15	18	278.50±0.90
3	62	278.61±0.62	9	278.67±0.71	127	277.90±0.40	-	-

contd. table 6

Parameters	*Holstein Friesian Cross cattle.*		*Jersey cross cattle*		*Non Descript cattle*		*Sahiwal cattle*	
	N	*GL (days)*	*N*	*GL (days)*	*N*	*GL (days)*	*N*	*GL (days)*
Sex of calf								
Male	2797	279.76±0.09	361	280.04±0.29	2946	279.34 ±0.07	148	279.34±0.41
Female	2901	279.26±0.09	367	280.01±0.27	2905	279.26 ±0.07	182	279.30±0.30
Body score								
No rib	792	279.32±0.14	111	279.80±0.41	1061	279.57±0.11	65	279.66±0.42
One rib	1351	279.84±0.14	266	280.08±0.36	1282	279.38±0.12	63	279.90±0.50
Two rib	2519	279.56±0.10	263	280.56±0.34	1641	279.17±0.11	120	279.61±0.44
Three rib	1056	279.09±0.13	88	278.57±0.43	1867	279.22±0.08	82	278.18±0.54
Year of Artificial Insemination								
2010	107	280.61±0.49	14	281.50±1.50	106	280.24±0.36	3	283.67±2.18
2011	1015	279.95±0.16	195	280.16±0.38	1268	279.53±0.12	58	279.45±0.59
2012	2311	279.59±0.10	264	279.85±0.31	1932	279.25±0.08	137	279.37±0.39
2013	1831	279.21±0.11	187	280.18±0.39	2010	279.21±0.09	123	279.27±0.39
2014	434	278.99±0.23	38	279.45±0.97	535	279.12±0.21	9	277.00±1.42

In Jersey Cross GL was shortest in rainy season 279.81±0.41 than in winter 279.84±0.33 & summer season 280.29±0.31. In Non-Descript cattle gestation length was shortest in rainy season 279.22±0.10 than in winter 279.25±0.08 & summer season 279.43 ±0.09.In Sahiwal GL was shortest in winter season 279.09±0.46 than in rainy 279.31±0.46 & summer season 279.50±0.36.

For the European breed, Younis (1976) showed that the mean gestation length of Frisian herd at Kuwait was 272.3±0.92 days, source of cows, year of calving, gestation period, and age at first calving had no significance on the trait, but the period and month of calving had significant ($p<0.05$) effect on gestation period. Costa et al.(1982) obtained mean gestation period of Holstein-Frisian in Brazil as 276.1±0.73 days and was significant ($p<0.05$) affected by season and sex of calf.

Johanson and Berger (2010) reported average GL values in American HF cattle at 277.9 days. The gestation length of Guernsey, Holstein and Jersey cows in several Florida-based farms increased by four days on average over a period of 50 years. According to the authors Silva et al. (1992), this increase could be attributed to a steep rise in production levels. Shorter gestation was noted in the summer months, and these findings are consistent with the results of previous research which validated the effect of higher temperature and dietary changes on shorter GL (Hansen et al., 2004; Przysucha and Grodzki, 2009). In this study, a longer gestation period was observed in respect of older cows the shorter GL inparticular season in the present study may beattributable to dietary changes and local environmental factors. On other hand, Swensson et al. (1981) reviewed the reproductive performance of Arussi Zebu breed of Ethiopia. They found that gestation period were 276.2±6.1 and 276.1±6.7 days for Gobe and Asella Station respectively, while mean gestation period of Jersey and Frisian x Arussi heifers were 275.3±6.1 and 275 .2±6.5 days respectively at Asella Station

Effect of parity

In the present study parity had no significant effect on the GL except in Non descript cattle breed. These

findings weresimilar to those of Obese et al. (24) in Sanga cattle in Ghana.

In Holstein Friesian Cross parity wise GL was lowest in 3rd parity & highest in heifer& first parity cattle.In Jersey Cross GL was lowest in 3rd lactation while it was highest in 1st parity.In Non descript cattle parity wise GL was shortest in 3rd lactation while it was highest in heifers. In Sahiwal cattle parity wise gestation length was shortest in 2nd lactation highest gestation length was observed in 1st lactation.Berglund and Philipsson (1987) reported that breed, parity, and sex of the calf were significant ($p<0.001$) in their influence on gestation period of Swedish Frisian

Effect of sex of calf

The present study revealed the significant effect of sex of calf on GL of the Holstein Friesian Cross only. Overall study show shorter gestation period in males than in females.

In Holstein Friesian Cross calf sex wise GL was shorter in female 279.26±0.09 than in males 279.76±0.09. In Jersey cross calf sex wise GL was shorter in female 280.01±0.27 than in males 280.04±0.29.nd. In non-descript cattle calf sex wise GL was shorter in female 279.26 ±0.07 than in males 279.34 ±0.07.In Sahiwal calf sex wise GLwas shorter in female 279.30±0.05 than in males 279.57±0.05 .

In this study, GL values were significantly affected by the sex of the fetus, and they were s longer time for male fetuses. According to Silva et al. (1992) and Hansen et al. (2004), GL was 1.1 days longer for male calves. Abdel Aziz (1994) stated that male conceiving cows was significantly ($p<0.01$) longer by 2.7 days than female conceiving cows. Patel et al. (1983) estimated mean gestation period of Jersey x Kunkrej cows in India be 282.29 and 279.20 days for male and female delivery, and that of Holstein–Frisian x Kankrej were 281.90 and 278.27 days for males and females respectively. They also found that the effect of sex was significant ($p<0.05$) in both groups.

Body score condition was significant in Holstein Friesian Cross,Jersey Cross only how ever there was no effect of body score condition in Non-descript & Sahiwal cattle. Animal with body score condition showing three ribs were having shorter GL than others in all cattle breeds.

As research indicates, monitoring cow condition impacts the GL in Holstein Friesian & Jersey Cross. Keeping cows in adequate condition throughout the production cycle can improve reproductive performance and positively impact the economics of the operation.

Calving year was significant in Holstein Friesian Cross only there was no significant difference in other breeds.Year of artificial insemination was significant in Holstein Friesian Cross & Non-descript cattle breed.

CONCLUSIONS

Sire breed, calving season, body score condition, sex of calf, year of insemination & calving year were found to be asignificant source of variation in the GL in Holstein Friesian Cross. In Jersey Cross only body score condition was found significant effect over gestation length. In non descript cattle sire breed, lactation number, year of insemination were found to be significant effect. In sahiwal cattle only sire breed was found significant effect.

Rainy & summer season ,age, male fetuses are factors contributed to prolonged gestation length. Optimal gestation length was determined in the range offrom 262 to 295 days in all breeds.

ACKNOWLEDGMENTS

The authors are indebted to the Vice President and Research Director BAIF for providing the required help to carry out the study. The authors would also wish to acknowledge the incharge of the cattle development centre, Area & state office team for management and recording of animals over the years.

REFERENCES

Abdal Aziz (1994), Factors Affecting Reproductive and Productive Performance of Crossbred Dairy Cattle in Sudan. M.Sc. Thesis University of Khartoum, Sudan.

Bhutkar S.S, Thombre B.M, Bainwad D.V. Studies on effect of non–genetic factors on reproduction traits in Holstein friesian x deoni cows. IOSR. J. Agric. Vet. Sci. 2014; 7(12): 15–19.

Mondal S.C, Alam M.M, Rashid M.M, Ali M.Y, Hossain M.M. Comparative study on the productive and reproductive performance of different dairy genotypes reared in Bangladesh Agricultural University Dairy Farm. Pak. J. Nutr. 2005;4(4):222–225.

Dutta, J. C., K. C. Deka, C. K. Rajkonwar and B. N. Borgohain, (1989), Gestation length of exotic cattle under hot-humid climate. Livestock Adviser, 14: 14-15.

Juneja, I. J., N. S .R. Sastry and B. L. Yadav, (1991), Performance of purebred herd of Jersey and Holstein-Friesian cows in the semi-arid region. Indian J. Anim. Prod. Management, 7: 240-241.

Haq, A. U., R. A. Chaudhry, T. Rahil, N. Ahmad and R. A. Jabbar, 1993. Reproductive efficiency of Holstein Friesian and Jersey cows maintained at Livestock Experiment Station, Bhunikey (Pattoki), Punjab. Annual report, Res. Inst. Physiol. Anim. Reprod., Bhunikey (Pattoki), Distt. Kasur, Pakistan, pp: 24-34.

McClintock, K. Beard A. Gilmour and Goddard. (2003), Relationships between calving traits in heifers and mature cows in Australia. Interbull Bulletin 31:102-106.

Nadarajah K, Burnside E.B, Schaeffer L.R. Factors affecting gestation length in Ontario Holsteins. Can. J. Anim. Sci. 1989; 69(4): 1083–1086.

Hansen, M., M. S. Lund, J. Pedersen and L. G. Christensen. (2004), Gestation length in Danish Holsteins has weak genetic associations with stillbirth, calving difficulty, and calf size. Livest. Prod. Sci. 91: 23-33.

Przysucha, T. and H. Grodzki. (2009), The influence of selected factors on beef breed cows pregnancy length (in Polish). Rocz. Nauk. Pol. Tow. Zoot. 5:65-72.

Silva H.M, Wilcox C.J, Thatcher W.W, Becker R.B, Morse D. Factors affecting days open, gestation length, and calving interval in Florida dairy cattle. J. Dairy Sci. 1992; 75(1): 288–293. [PubMed]

Norman H.D, Wright J.R, Kuhn M.T, Hubbard S.M, Cole J.B, Van Raden P.M. Genetic and environmental factors that affect gestation length in dairy cattle. J. Dairy. Sci. 2009; 92(5): 2259–2269. [PubMed]

Nahar T.N, Islam M, Hashath M.A. A comparative study on the performance of F1 crossbred cows under rural conditions. Asian. Aust. J. Anim. 1992; 5: 435–338.

Johanson, J. M., P. J. Berger, S. Tsuruta and I. Misztal. (2011), Bayesian threshold-linear model evaluation of perinatal mortality, dystocia, birth weight, and gestation length in a Holstein herd. J. Dairy Sci. 94:450-460.

Varaprasad A.R, Raghunandan T, Kumar M.K, Prakash M.G. Studies on the reproductive performance of Jersey x Sahiwal cows in chittoor district of Andhra pradesh. Int. J. Agric. Sci. Vet. Med. 2013; 1(1): 52–57.

Swensson, C., Schaar, J., Brannang, E. and Meskel, L. B. (1981), Breeding 62 activities of the Ethio- Swedish performance of Zebu and crossbred cattle. Wld. Anim . Rev., 38.31-36.

Younis, A. A., Abolu-Naga, A., Kotby, S. and Salman, A. A. (1976), A study of some reproductive in a Friesian herd kept under Kuwait condition.Indian J. Anim. Sci., 46 (11):576-579.

M. K. Uddin, A. Wadud , D. Begum , M. S. R. Siddiki2 and M. H. Rashid Productive and reproductive performance of indigenous and crossbred cattle in comilla district Bang. J. Anim. Sci. 2008, 37 (1) : 39 - 43.