# Genetic and Non-Genetic Factors Affecting Efficiency of Milk Production of Cattle in and Around Biharsharif of Nalanda District (Bihar)

THESIS

SUBMITTED TO THE

RAJENDRA AGRICULTURAL UNIVERSITY

(FACULTY OF VETERINARY AND ANIMAL SCIENCES)

PUSA (SAMASTIPUR) BIHAR


*By*

*Dr. Shrutikesh Kumar*

Registration No. - M/ABG/66/2003-2004


**In the partial fulfilment of the requirements**

**FOR THE DEGREE OF**

**Master of Veterinary Science**

**(ANIMAL BREEDING & GENETICS)**


**POST GRADUATE DEPARTMENT OF ANIMAL BREEDING & GENETICS**

**BIHAR VETERINARY COLLEGE**

**PATNA - 800 014**


**2006**

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**2006**

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**DEPARTMENT OF ANIMAL BREEDING & GENETICS**
**BIHAR VETERINARY COLLEGE, PATNA-14**
**RAJENDRA AGRICULTURAL UNIVERSITY, PUSA**
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# CERTIFICATE-I

This is to certify that the thesis entitled ***"Genetic and non-genetic factors affecting efficiency of milk production of cattle in and around Biharsharif of Nalanda District (Bihar)"*** submitted in partial fulfillment of the requirements for the Degree of Master of Veterinary Science **(Animal Breeding & Genetics)** of the faculty of post-graduate studies, Rajendra Agricultural University, PUSA, Samastipur, Bihar is the record of bonafide research work carried out by **Dr. Shrutikesh Kumar, Registration No. M/ABG/66/2003-04,** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

It is further certified that the assistance and help received during the course of this investigation and preparation of the thesis have been fully acknowledged.

***Endorsed***

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Chairman of the Department

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**DEPARTMENT OF ANIMAL BREEDING & GENETICS**
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# CERTIFICATE –II

We the undersigned members of the Advisory Committee of **Dr. Shrutikesh Kumar**, **Registration No.- M/ABG/66/2003-2004**, a candidate for the Degree of Master of **Veterinary Science** with Major in **Animal Breeding and Genetics** have gone through the manuscript of the thesis and agree that the thesis entitled ***"Genetic and non-genetic factors affecting efficiency of milk production of cattle in and around Biharsharif of Nalanda District (Bihar)"*** may be submitted by **Dr. Shrutikesh Kumar** in partial fulfillment of the requirements for the degree.

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# CERTIFICATE-III

This is to certify that the thesis entitled ***"Genetic and non-genetic factors affecting efficiency of milk production of cattle in and around Biharsharif of Nalanda District (Bihar)"*** submitted by **Dr. Shrutikesh Kumar**, **Registration No. M/ABG/66/2003-04** in partial fulfillment of the requirements for the Degree of Master of Veterinary Science **(Animal Breeding & Genetics)** of the Faculty of Post-Graduate Studies, Rajendra Agricultural University, PUSA, Samastipur, Bihar was examined and approved on ..13../..3../2006.

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*Dedicated to*

*benevolent adorable*

*Parents*

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Shrutikesh Kumar

Date : 13.03.06 ***(Shrutikesh Kumar)***

Place : B.V.C, Patna.

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# CHAPTER - I

# INTRODUCTION

# INTRODUCTION

Bestowed with only 2.4% of the world's land area, India has 199 million cattle population which has led her to have the distinction of being the largest milk producer in the world producing 86.7 million tonnes of milk per annum (India, 2005) . The highest level has been attained through various breeding strategies employed in cattle breeding for milk production in the country. Although the per capita availability of milk is estimated to have increased to 230g per day, yet there is a big gap between availability and requirement of milk mainly because of steep rise in the human population of the country which has already crossed the mark of 100 crores in 2001 itself. Thus, intensive efforts are being made to increase milk production through scientific breeding, balanced feeding, health care and better management of milch animals.

Milk production in Bihar is predominantly a domain of small and marginal households. The dairy farmers maintain the small dairy units popularly known as ' Khatals' consisting of Desi and crossbred cows mainly crosses of Holstein Friesian and Jersey in different herd sizes and herd constitution managed under sub-optimal feeding and managemental systems with the sole objective of profitable milk production. But these units produce about 65% of the total milk production which is almost double in quantity produced by organized farms which are very few in number.

After truncation of the State in 2000, the remaining Bihar has become too much deficient in industries, minerals and forest resources as major portion of these sectors have gone to Jharkhand. The remaining Bihar is left over only with agriculture and animal husbandry for its economic resources. It is well known fact that every year North Bihar has to bear a

great economic loss due to flood. Apart from these, there are poor irrigation facilities because of poor generation of electricity and insufficient canal facilities. Thus animal husbandry in general and dairying in particular, remains as the only tool for alleviation of poverty in the State.

The four NARP (National Agricultural Research Project) zones (I, II, III A and III B) differ from one another with respect to physical features, climate, geographical area, density of human and livestock population, feeds and fodder resources, system of livestock management and socio-economic status of the farmers. Thus, there is need to formulate and recommend area-specific suitable breeding strategies for improvement of livestock in order to maximize milk production.

Biharsharif, the district headquarter of Nalanda, is only about 8 kms away from the World famous Nalanda University, about 16 kms. away from Rajgir famous for Brahmkund and Budha Shanti Stup and about 80 kms away from the State capital, Patna. Apart from these, Biharsharif is now famous for producing cash crops especially potato, onion and other green vegetables. But the farmers show keen interest in dairy farming as well and produce large quantity of milk which cater the needs of the people of Biharsharif and supply the surplus milk to Patna Dairy Project (PDP) which has opened many milk collection centres in the district.

The milk producing efficiency of cows is dependent upon various genetic and non-genetic factors. Besides, the dairy farmers perceive many constraints in maintaining the dairy units in different agro-climatic-socio-economic zones. Although there are some information available on milk production efficiency of cows in organized farms, yet the information on cows maintained under un-organized farms is very few (Kalra *et al. 1995;* Chandra and Agarwal 2000, Srivastava and Singh,2000) necessitating the study of various factors

influencing milk efficiency in un-organized herds of agro-climatic region of Biharsharif (Nalanda). Therefore, the present study has been planned with the following objectives:

(i) To estimate the phenotypic parameters of some of the milk production efficiency measures of Desi and crossbred cows in un-organized farms in and around Biharsharif of Nalanda district (Bihar).

(ii) To estimate the nature and magnitude of variation in various measures of milk production efficiency under consideration due to genetic and non-genetic factors in cows in and around Biharsharif.

(iii) To study the different constraints perceived by the dairy farmers in and around Biharsharif in rearing high yielding cows.

(iv) To provide suggestions for suitable dairy practices for economic milk production to the dairy farmers in and around Biharsharif, Nalanda (Bihar).

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# CHAPTER - II

# REVIEW OF LITERATURE

# REVIEW OF LITERATURE

## LACTATION MILK YIELD :

**AVERAGE** : The finding of various authors on average lactation yield (Kg) are summarised in Table – 1.

**Table – 1 : Average Lactation Yield of various genetic groups :**

| Genetic Group | Lactation/300 days or less | Milk Yield (kg) | Author |
|---|---|---|---|
| HFX Hariana | 300 days or less | 2609.82 ± 20.92 kg | Panda and Sadhu |
| Jersey x Hariana | Do | 2143.94 ± 17.15 kg | (1983) |
| Hariana | 305 days | 1150.70 ± 44.65 kg | Duc and Taneja (1984) |
| HFX H | Do | 2001.97 ± 54.55 kg | |
| Jersey x Hariana | Do | 1588.24 ± 50.78 kg | |
| Hariana | Lactation milk | 1066.28 kg | Raj Kumar (1985) |
| JX H | yield | 2110.58 kg | |
| Hariana | 305 days | 693.2 ± 67.8 kg | Parmar *et al.* (1986) |
| Hariana x Holstein Friesian | Do | 1933.2 ± 42.1 kg | |
| Friesian crossbreds ≥ 50% | Lactation milk | 3556.2 ± 83.6 kg | Singh *et al.* (19 86[a]) |
| 50 % | yield | 3655.1 ± 125.6 kg | |
| ≤ 50% | | 2288.8 ± 158.5 kg | |
| Friesian crossbreds | Do | 3166.7 ± 74.4 kg | Singh *et al.* (1986[b]) |
| Jersey x Kankrej ($F_1$) | Lactation milk yield | 2681.11 ± 83.6 kg | Patel and Trivedi (1989) |
| 1/2 Holstein Friesian x 1/2 Hariana | Do | 2647.3 ± 55.5 kg | Chopra (1990) |
| 1/2 Jersey x 1/2 Hariana | Do | 1968.9 ± 68.2 kg | |

| | | | |
|---|---|---|---|
| 1/2 Jersey<br>1/2 Friesian<br>3/4 Jersey<br>3/4 Friesian | Do<br>Do<br>Do<br>Do | 1971.03 ± 13.72 kg<br>2357.23 ± 16.00 kg<br>1951.17 ± 25.60 kg<br>2358.96 ± 23.64 kg | Hayatnagarkar *et al.* (1990) |
| Holstein Friesian x Sahiwal | Do | 2494.70 ± 50.43 kg | Jadhav *et al.* (1991) |
| Tharparkar | Do | 1935.61 ± 51.31kg | Vij *et al.* (1992) |
| Hariana | Do | 1426.53 ± 18.11 kg | Yadav and Rathi (1992) |
| Sahiwal | Do | 1695.88 ± 20.55 kg | Yadav *et al.* (1992) |
| Sahiwal<br>Jersey x Sahiwal<br>Red Dane x Sahiwal | Do<br>Do<br>Do | 1508.32 ± 77.8 kg<br>2581.08 ± 77.8 kg<br>2769.30 ± 77.8 kg | Singh *et al.* (1993) |
| Jersey crossbreds | Do | 1954.53 ± 68.99 kg | Deshmukh *et al.* (1995) |
| Friesian crossbreds | Do | 2370.8 ± 66.0 kg | Singh (1995) |
| Friesian x Hariana | Do | 2432 ± 33.6 kg | Raheja (1997) |
| Hariana | 300 days | 1132.0 ± 19.5 kg | Pundir and Raheja (1997) |
| Friesian crossbreds | Lactation milk yield | 2716.03 ± 7.89 kg | Shrivastava *et al.* (1998) |
| 1/2 Jersey x 1/2 Hariana<br>> 1/2 Jersey x < 1/2 Hariana | 300 day or 1st Lactation<br>Do | 1258.3 ± 46.31 kg<br>1256.8± 67.9 kg | Thakur *et al.* (1999) |
| Jersey crossbreds<br>HF crossbreds | Lactation milk Yield | 2355.42 ± 56.29 kg<br>3021.73 ± 40.53 kg | Singh *et al.* (2000) |
| Jersey crossbreds | 300 day | 1652.2 ± 129.4 kg<br>2044.55 ± 55.5 kg | Thakur *et al.* (1999) |
| Jersey crossbreds | Lactation milk yield | 1899.81 ± 47.6 lit. | Rao *et al.* (2000) |
| Hariana | 300 day or less | 1081.0 ± 14.21 kg | Dalal *et al.* (2002) |

| | | | |
|---|---|---|---|
| Tharparkar<br><br>Tharparkar x HF ($F_1$)<br>($F_2$) | Lactation milk yield<br>Do<br>Do | 1525.06 ± 58.75 kg<br><br>2753.16 ± 67.15 kg<br>1747.99 ± 169.65 kg | Bhattacharya *et al.* (1999) |
| 1/2 Jersey x 1/2 Sahiwal | Do | 2662.67 ± 132.9 kg | Kumar and Kumar (2003) |
| Hf Cross | Lactation yield (kg) | 3299.89 ± 79.02 kg | Shiv Prasad (2003) |
| HF Cross | Do | 2264.45 ± 42.49 kg | Akhter *et al.* (2003) |
| Jersey cross | 1st lactation milk yield | 1614.0 ± 32.38 kg | Varade *et al.* (2004) |
| Desi<br><br>HFX<br>JX | Lactation milk yield<br>Do<br>Do | 1005.19 ± 43.83<br><br>2800.2 ± 34.32<br>2169.30 ± 40.25 | Kumar (2005) |
| HF > 50 %<br>HF 50 %<br>HF < 50 %<br>Hariana Pure | Lactation yield | 1703.83 ± 89.42<br>2233.81 ± 64.36<br>1204.51 ± 106.92<br>837.99 ± 132.61 | Sharan (2005) |

**GENETIC AND NON-GENETIC ACTORS AFFECTING LACTATION YIELD :**

**EFFECT OF GENETIC GROUP :**

Panda and Sadhu (1983) reported significant ($P<0.01$) effect of genetic group on lactation yield and observed the overall lactation yield to be highest in Hariana x HF followed by Desi Bengal x HF, Hariana x Jersey and Desi Bengal x Jersey.

Raj Kumar (1985) observed nearly double higher milk yield in Jersey x Hariana ($F_1$) than Hariana cows.

Singh *et al.* (1986[b]) studied the effect of genetic and non-genetic factors in Friesian crossbred cows maintained in small dairy belonging to private sectors in and around Ranchi and

observed significant effect of genetic grades of cows on the lactation yield.

Hayatnagarkar *et al.* (1990) conducted experiments in different genetic groups of cows and reported highly significant ($P<0.01$) effect of genetic group on lactation yield in rural crossbred cows. They found that the lactation milk yield was highest in 3/4 Friesian followed by 1/2 Friesian, 1/2 Jersey and 3/4 Jersey inheritance.

Jadhav *et al.* (1991) reported significant ($P<0.01$) effect of genetic group on 300-day lactation yield and found that 1/2 grades had the highest performance for 300-day milk yield followed by 7/8 and 5/8 grades.

Singh *et al.* (1993) observed significant ($P<0.01$) effect of genetic group on 1st lactation milk yield in Sahiwal, Jersey x Sahiwal and Red Dane x Sahiwal and reported that the highest 1st lactation milk was yielded by Red Dane x Sahiwal followed by Jersey x Sahiwal and Sahiwal.

Thakur *et al.* (1999) reported significant ($P<0.01$) effect of genetic group on 1st lactation 300 days or less milk yield in nine genetic groups of Jersey x Zebu crossbreds.

Bhattacharya *et al.* (2002) conducted an experiment to study the dairy performance of Tharparkar and Holstein Friesian and their crosses and reported that the lactation milk yields of $F_1$ crossbreds of Holstein Friesian were better than Indian born Holstein Friesian and also $F_2$ crossbreds of HFX Tharparkar.

Priya Raj (2002) reported that genetic group significantly ($P<0.01$) influenced the lactation milk yield under farmers' managemental condition in Patna and observed that HF crossbreds had significantly ($P<0.01$) higher lactation milk yield than Jersey crossbreds.

Akhter *et al.* (2003) compared the performance of two and three bred cross progenies of three exotic breeds viz. Holstein

Friesian (F), Jersey (J), Red Dane (RD) with three Zebu breeds viz. Sahiwal (S), Hariana (H) and Red Sindhi (RS) and reported significant effect of genetic group on 1st lactation milk yield. They observed that 5/8 F x 3/8 S and J (F x S) crossbreds produced highest and lowest milk yield respectively in their 1st lactations.

Bhadauria and Katpatal (2003) reported that different genetic grades of Friesian and Sahiwal crosses had significant (P<0.01) effect on 300 days milk yield of 1st lactation. They observed that 300 days milk yield significantly (P<0.01) increased from 3/8th Friesian level upto 5/8th level but beyond that there was a gradual decline in the milk production.

Kumar[1] (2004) studied the effect of genetic group on lactation yield in Hariana and its crosses with HF and Jersey in hot humid climate of North-Bihar. He observed that 1/2 HF 1/2 H genetic group was most suitable and produced highest milk followed by 1/2 J 1/2 H genetic group.

Kumar[2] (2004) reported that 1/2 HF 1/2 H genetic group had highest lactation yield among the six genetic groups of cows and had more than double 300 days or less milk yield than Hariana and HF 62.5% groups. The 1/2 J 1/2 H group yielded 2nd highest lactation milk yield which was significantly (P<0.01) higher than Hariana pure, HF < 50%, HF 62.5% and HF 75% genetic groups.

Kumar (2005) conducted an experiment to study the effect of genetic group on lactation milk yield in Desi, HFX and JX cows under farmers' managemental condition in and around Patna (Bihar). He reported that HF crossbreds had significantly (P<0.01) 1795.01 kg and 630.9 kg more milk yield than Desi and Jersey crossbred cows respectively. He further observd that HFX and JX had nearly 3 times and more than double lactation yields respectively than Desi cows.

Sharan (2005) reported significant (P<0.01) effect of genetic group on lactation yield. The 1/2 HF 1/2 H group yielded highest quantity of milk which was significantly (P<0.05) higher by 529.983 and 1029.294 kg than HF>50% and HF<50% genetic groups respectively. He further observed that Hariana yielded lowest quantity of milk and 1/2 HF 1/2 H genetic group had more than double lactation yield than Hariana.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

Singh *et al.* (1986[b]) reported significant (P<0.01) influence of location of herd on lactation yield in local based Friesian crossbred cows of private sector in and around Ranchi.

Hayatnagarkar *et al.* (1990) studied the effect of location of herd on total milk yield and observed that location of herd significantly (P<0.01) affected the total milk yield in the crossbreds consisting of 1/2 J (Jersey) 1/2 non-descript (ND), 1/2 Friesian (F) 1/2 ND, 3/4 J 1/4 ND and 3/4 F 1/4 ND.

Jadhav *et al.* (1991) reported significant (P<0.01) effect of farm on 1st lactation 300 days milk yield in various Holstein x Sahiwal grades.

Priya Raj (2002) reported that different zones in and around Patna did not influence lactation milk yield of crossbred cows under farmers' managemental condition.

Bhadauria and Katpatal (2003) observed that farm did not influence 1st lactation 300 days milk yield significantly in Friesian x Sahiwal crosses.

Kumar[1] (2004) reported that location of herd in and around Darbhanga had no significant effect on lactation milk yield of cattle.

Kumar (2005) reported significant (P<0.05) effect of location of herd on lactation milk yield in cattle in and around Patna under farmers' managemental condition.

**HERD SIZE :**

Shrivastava *et al.* (1998) reported significant (P<0.05) effect of herd size on lactation yield in Friesian crossbred cows of un-organized herd.

Priya Raj (2002) observed that herd size did not influence lactation milk yield significantly in crossbred cows under farmers' managemental condition in and around Patna.

Kumar[1] (2004) reported significant (P<0.05) effect of herd size on lactation milk yield in cattle in and around Darbhanga (Bihar). He further observed that animals maintained in a herd of 11-14 had the highest average lactation milk yield followed by those in the herd size of 7-10, 3-6 and 15 & more cows.

Kumar (2005) studied the genetic and non-genetic factors affecting milk production efficiency of cattle in and around Patna and reported significant (P<0.05) effect of herd size on lactation milk yield. He reported that the Khatals maintaining 7 & above cows had significantly (P<0.05) 95.56 kg more lactation yield than those maintaining 3-6 cows.

**HERD CONSTITUTION :**

Kumar[1] (2004) reported that herd constitution did not influence the lactation milk yield significantly in cattle and buffalo in and around Darbhanga (Bihar). However, he found that the average lactation milk yield was highest for the milch animals maintained in the Khatals having only cows and the lowest for the animals in the units having only buffaloes.

Kumar (2005) reported non-significant effect of herd constitution on lactation yield under farmers' managemental condition in and around Patna. However, the average lactation milk yield was found to be the highest in the Khatals which

maintained Desi along with HFX followed by Desi and Jersey crossbred cows.

**SEASON OF CALVING :**

Jadhav *et al.* (1991) reported that season of calving did not influence lactation milk yield in six grades of Holstein x Sahiwal cows.

Yadav and Rathi (1992) observed that season of calving had no significant effect on 1st three lactations of Hariana breeds extending over a period of twelve years between 1975-1986.

Singh *et al.* (1993) reported that season of calving did not influence 1st lactation milk yield in Sahiwal and its crosses with Jersey and Red Dane. However, they observed that the highest lactation milk was yielded during June-August followed by March-May, December-February and September-Novemebr.

Raheja (1997) reported non-significant effect of season of calving on first lactation milk yield in half breds of Hariana and Sahiwal with Holstein Friesian.

Shettar and Govindaiah (1999) reported significant ($P<0.05$) effect of the season of calving on 305 days and total lactation milk yields in crossbred cows.

Thakur *et al.* (1999) reported non-significant effect of season of calving on 1st lactation 300 days or less milk yield in nine genetic groups of Jersey x Zebu crossbreds.

Singh *et al.* (2000) studied the effect of season of calving on lactation yield in crosses of Holstein Friesian, Brown Swiss and Jersey with Hariana and observed that the season of calving did not influence the lactation yield significantly.

Priya Raj (2002) reported that the different seasons of calving did not influence lactation milk yield significantly of crossbred cows under farmers' managemental condition in and around Patna (Bihar).

Shiv Prasad (2003) could not find significant effect of season of calving on lactation milk yield in 7/8 Holstein Friesian cows. However, he observed the yield to be highest during summer followed by winter and rainy seasons.

Akhter *et al.* (2003) reported that season played significant role on 1st lactation milk yield in two and three breed cross progenies of three exotic breeds viz. Holstein Friesian, Jersey and Red Dane with Zebu breeds constituting twelve genetic groups.

Bhadauria and Katpatal (2003) reported non-significant effect of season of calving on the 300 days milk yield of 1st lactation in Friesian x Sahiwal crosses.

Kumar[1] (2004) reported that season of calving had significant ($P<0.01$) influence on lactation milk yield in cattle and buffalo under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar[2] (2004) reported non-significant effect of season of calving on 300 days or less milk yield in six genetic grades of Hariana and its crosses with Holstein Friesian and Jersey.

Kumar (2005) studied the effect of genetic and non-genetic factors affecting milk production efficiency of cattle under farmers' managemental condition in and around Patna (Bihar) and reported that season of calving played significant ($P<0.01$) influence on lactation milk yield. He observed that the lactation yield was the highest in the cows calved during rainy season followed by summer and winter. However, the lactation yield of cows calved during summer and rainy seasons did not differ significantly.

Sharan (2005) observed significant ($P<0.01$) effect of season of calving on lactation yield in Hariana and its crosses with Holstein Friesian. He further reported that the highest milk yield was produced by winter calvers which was significantly ($P<0.05$) higher by 332.92 kg than rainy calvers.

However, the lactation yields of winter and summer calvers did not differ significantly.

**LACTATION ORDER :**

Raj Kumar (1985) reported significant (P<0.01) effect of sequence of lactation on milk yield on Hariana and its crosses with HF. He observed that there was gradual increase in milk yield upto the 3rd lactation after which it tended to decline.

Priya Raj (2002) reported significant (P<0.01) effect of parity of lactation on lactation yield in crossbred cows under farmers' managemental condition in Patna (Bihar). She observed the highest lactation milk yield to be in 3rd lactation after which it started to decline.

Shiv Prasad (2003) reported that the lactation milk yield significantly (P<0.01) increased with the increase of sequence of lactation in 7/8 Holstein Friesian cows and observed the highest milk yield to be in 3rd lactation.

Kulkarni *et al.* (2003) observed significant effect of sequence of lactation on total lactation milk yield in crosses of Jersey, Holstein Friesian and Gir in varying inheritance and their interse. They reported that the lactation yield increased with the increase of sequence of lactation which attained its maximum in 3rd lactation.

Kumar[2] (2004) studied the influence of genetic and non-genetic factors on some economic traits in Hariana and its crosses. He reported non-significant effect of parity of lactation on lactation yield in Hariana and its crosses with HF and Jersey.

Kumar (2005) found significant (P<0.01) effect of parity of lactation on lactation yield in Desi, HFX and JX cows under farmers' managemental condition in and around Patna. He reported that although the lactation yield increased gradually from 1st to 4th parity of lactation, yet it did not differ

significantly upto 4th lactation after which there was significant decline.

Sharan (2005) observed that parity of lactation had no significant effect on lactation milk yield in Hariana and its crosses with Holstein Friesian.

**FARMING SYSTEM :**

Kumar[1] (2004) studied the effect of system of farming on average lactation milk yield in cattle and buffalo in and around Darbhanga (Bihar) and reported non-significant effect of farming system on the lactation milk yield. However, he observed that the animals maintained in the units involving dairying alone had higher average lactation milk yield than those maintained in the dairy units integrated with agriculture farming.

Kumar (2005) reported significant ($P<0.01$) influence of farming system on lactation yield in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna (Bihar). He observed that the cows maintained in the dairy units integrated with agriculture farming yielded significantly ($P<0.01$) 224.15 kg more milk than those which were maintained in the units involving dairying alone.

**LACTATION LENGTH :**

**AVERAGE :** The economics of dairy farming is directly dependent on lactation length. The averages of lactation length (days) of cows of different genetic groups as reported by various authors are tabulated as below:

**Table – 2 : Average Lactation length (days) of various genetic groups :**

| Genetic Group | Lactation length days | Author |
|---|---|---|
| Hariana | 385.3 ± 16.3 | Parmar *et al.* (1986) |
| Hariana x HF ($F_1$) | 432.7 ± 10.4 | |

| | | |
|---|---|---|
| HF ≥ 50%<br>50%<br>≤ 50% | 310.2 ± 1.6<br>305.3 ± 2.4<br>292.8 ± 3.0 | Singh *et al.* (1986[a]) |
| HF crossbred | 302.8 ± 1.4 | Singh *et al.* (1986[b]) |
| 1/2 HF 1/2 Hariana<br>1/2 Jersey 1/2 Hariana | 344.4 ± 5.3<br>328.3 ± 6.5 | Chopra (1990) |
| HFX Sahiwal | 295.70 ± 3.93 | Jadhav *et al.* (1991) |
| Hariana | 268.28 ± 1.91 | Yadav and Rathi (1992) |
| Sahiwal | 280.40 ± 2.38 | Yadav *et al.* (1992) |
| Sahiwal<br>Sahiwal x Jersey<br>Sahiwal x Red Dane | 286.38 ± 7.31<br>306.08 ± 7.31<br>303.04 ± 7.31 | Singh *et al.* (1993) |
| Jersey crossbreds | 309.87 ± 3.56 | Deshmukh *et al.* (1995) |
| HF crossbreds | 324.7 ± 6.4 | Singh (1995) |
| Hariana | 336 ± 4.3 | Pundir and Raheja (1997) |
| Friesian crossbreds | 298.73 ± 0.48 | Shrivastava *et al.* (1998) |
| 1/2 JX 1/2 H<br>> 1/2 JX < 1/2 H | 314.7 ± 9.9<br>356.1 ± 14.5 | Thakur *et al.* (1999) |
| Sahiwal | 269.45 ± 2.41 | Sethi *et al.* (2000) |
| Tharparkar<br>Tharparkar x HF ($F_1$)<br>($F_2$) | 279 ± 9.99<br>312.20 ± 6.49<br>247.87 ± 18.58 | Bhattacharya *et al.* (2002) |
| 1/2 Jersey x 1/2 Sahiwal | 312.32 ± 14.34 | Kumar *et al.* (2003) |
| HF cross | 307.57 ± 0.58 | Akhter *et al.* (2003) |
| Desi<br>HFX<br>JX | 293.29 ± 1.71<br>334.64 ± 1.99<br>333.43 ± 2.02 | Kumar[1] (2004) |
| Hariana<br>HF < 50%<br>HF 50%<br>HF 625%<br>HF 75%<br>J 50% | 325.38 ± 13.96<br>390.74 ± 18.30<br>334.85 ± 18.39<br>341.47 ± 31.36<br>406.98 ± 18.17<br>462.69 ± 15.44 | Kumar[2] (2004) |
| Desi<br>HFX<br>JX | 360.70 ± 4.38<br>349.01 ± 3.43<br>358.44 ± 40.3 | Kumar (2005) |

| | | |
|---|---|---|
| HF > 50% | 400.69 ± 15.32 | Sharan, (2005) |
| HF 50% | 423.41 ± 11.03 | |
| HF < 50% | 391.88 ± 18.34 | |
| Hariana Pure | 328.58 ± 22.72 | |

**EFFECT OF GENETIC GROUP :**

Jadhav *et al.* (1991) studied the effect of different grades of Holstein and Sahiwal on lactation length. They reported that 1/2 , 5/8, 3/4 and 7/8 grades of Holstein and Sahiwal had significantly (P<0.05) longer lactation lengths than 1/4 and 3/8 grades.

Thakur *et al.* (1999) reported significant (P<0.01) effect of genetic group on 1st lactation length among Jersey x Zebu crossbreds.

Bhattacharya *et al.* (2002) reported longest (312.20 days) lactation length in $F_1$ cross of Holstein Friesian x Tharparkar followed by Holstein Friesian, Tharparkar and $F_2$ cross.

Priya Raj (2002) studied the effect of genetic group on lactation length in Desi and crossbred cows under farmers' managemental condition of Patna and reported that the Jersey crossbreds had significantly (P<0.01) longer lactation length than HF crossbreds.

Akhter *et al.* (2003) reported the highest and lowest 1st lactation periods in 1/2 HF 1/2 Sahiwal and >75% exotic inheritance genetic groups among two and three breed crosses involving HF, Jersey, Red Dane, Sahiwal, Hariana and Red Sindhi breeds.

Kumar[1] (2004) studied the effect of genetic group on lactation length in Desi, HFX and Jersey crossbred cows and reported that HF crossbreds had the longest average lactation length followed by Jersey crossbreds and Desi cows.

Kumar[2] (2004) observed the significant (P<0.05) influence of genetic group on lactation length and reported the highest

and lowest lactation length (days) to be in 1/2 J 1/2 H and Hariana pure genetic groups respectively.

Kumar (2005) studied the effect of genetic and non-genetic factors affecting milk production efficiency of cattle under farmers' managemental condition in and around Patna and reported that genetic group did not influence lactation length significantly.

Sharan (2005) reported significant (P<0.01) effect of genetic group on lactation length. He observed the highest and lowest lactation lengths (days) to be in HF > 50% and Hariana pure groups respectively. However, the average lactation lengths of HF > 50%, HF 50% and HF < 50% genetic groups did not differ significantly.

**EFFECT OF NON-GENETIC FACTORS :**

**DIFFERENT ZONES IN AND AROUND BIHAR SHARIF :**

Jadhav *et al.* (1991) reported significant (P<0.01) effect of farm on lactation length in different grades of Holstein Friesian with Sahiwal.

Priya Raj (2002) could not find significant influence of zone on lactation length in different crossbred cows under farmers' managemental condition in and around Patna.

Kumar[1] (2004) studied the effect of different zones on lactation length in different genetic groups under farmers' managemental condition in and around Darbhanga. He observed that the zones had no significant effect on lactation length.

Kumar (2005) observed that different zones in and around Patna under farmers' managemental condition did not affect the lactation length of Desi, HFX and Jersey crossbred cows significantly.

**HERD SIZE :**

Priya Raj (2002) studied the effect of size of the herd on lactation length of crossbred cows under farmers'

managemental condition in and around Patna and reported that the herd size did not influence the lactation length significantly.

Kumar[1] (2004) observed that the effect of herd size on lactation length in different genetic groups of cattle and buffalo in and around Darbhanga (Bihar) was statistically non-significant.

Kumar (2005) reported that the size of the herd had no significant effect on lactation length in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna.

**HERD CONSTITUION :**

Kumar[1] (2004) observed that the herd constitution had no significant effect on lactation length in different genetic groups of cattle and buffalo in and around Darbhanga (Bihar).

Kumar (2005) reported significant ($P<0.05$) effect of herd constitution on lactation length. The highest (362.69 days) and the lowest (345.85 days) lactation lengths were observed to be in Khatals maintaining Jersey along with HFX and Desi along with Jersey crossbred cows respectively.

**SEASON OF CALVING :**

Jadhav *et al.* (1991) reported that summer and spring calvers had significantly longer lactation lengths than those calved during other seasons in different grades of Holstein Friesian and Sahiwal.

Vij *et al.* (1992) reported the highest lactation length to be during December-February followed by March-April, May-August and Spetember-November in Tharparkar cows.

Yadav *et al.* (1992) reported that the season of calving had no significant influence on lactation length in Sahiwal cows.

Yadav and Rathi (1992) could not find significant effect of season of calving on lactation length in Hariana.

Singh *et al.* (1993) observed that season of calving had no significant effect on 1st lactation length in Sahiwal and its crosses with Jersey and Red Dane.

Shettar and Govindaiah (1999) reported non-significant effect of season of calving on lactation length in different genetic groups of cows involving crosses of Holstein Friesian, Jersey and Red Dane with Red Sindhi, Hallikar and Amritmahal.

Thakur *et al.* (1999) could not find significant influence of different seasons of calving on 1st lactation length in nine genetic groups of Jersey x Zebu crossbreds.

Singh *et al.* (2000) reported non-significant effect of season of calving on half breds and three-fourth bred cows involving Friesian, Brown-Swiss, Jersey and Hariana breeds.

Priya Raj (2002) reported that the season of calving played significant ($P<0.01$) role on lactation length of HFX and Jersey cross-bred cows under farmers' managemental condition in and around Patna. She observed that the cows calved during November-February had the longest lactation length followed by July-August and March-June.

Akhter *et al.* (2003) observed that season of calving had no significant effect on 1st lactation length in crossbred cows involving three exotic and three Zebu breeds.

Kumar[1] (2004) did not find significant effect of season of calving on lactation length in different genetic groups of cattle and graded buffalo under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar[2] (2004) reported non-significant effect of season of calving on lactation length in Hariana and its crosses with HF and Jersey.

Kumar (2005) observed significant ($P<0.01$) influence of season of calving on lactation length in Desi, HFX and Jersey

crossbred cows. He reported that summer calvers had longer lactation length than winter and rainy calvers.

Sharan (2005) reported non-significant effect of season of calving on lactation length in Hariana and its crosses with Holstein Friesian.

**LACTATION ORDER :**

Vij *et al.* (1992) reported significant ($P<0.05$) effect of parity of lactation on lactation length in Tharparkar cows. However, they could not find any definite trend over different lactations.

Yadav and Rathi (1992) observed that sequence of lactation had significant ($P<0.05$) effect on lactation length in Hariana cows.

Yadav *et al.* (1992) found significantly ($P<0.05$) longer length of 1st lactation than 3rd in Sahiwal cows.

Singh and Nagarcenkar (1997) observed significant ($P<0.05$) influence of parity of lactation on lactation length in Sahiwal cows.

Sethi *et al.* (2000) reported that parity of lactation had significant ($P<0.05$) effect on pooled lactation period in Sahiwal cows.

Singh *et al.* (2000) studied the effect of sequence of lactation on lactation length in seven genetic groups of crossbreds involving Holstein Friesian, Brown Swiss, Jersey and Hariana. They observed that the parity of lactation significantly ($P<0.01$) influenced the lactation length.

Priya Raj (2002) reported significant ($P<0.01$) role of sequence of lactation on lactation length in the crossbred cows under farmers' managemental condition in and around Patna. She observed the longest and shortest duration of lactation lengths to be in 2nd and 5th parity of lactations.

Kumar[1] (2004) observed significant (P<0.01) effect of parity of lactation on lactation length in different genetic groups of cattle and buffalo.

Kumar[2] (2004) reported that the sequence of lactation had no significant effect on lactation length in Hariana and its crosses with HF and Jersey.

Kumar (2005) did not find significant effect of sequence of lactation on lactation length in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna.

Sharan (2005) studied the effect of genetic and non-genetic factors on lactation length in Hariana and its crosses with HF and reported that parity of lactation did not influence lactation length significantly.

**FARMING SYSTEM :**

Kumar[1] (2004) reported the effect of farming system on lactation length to be non-significant in various genetic groups of cattle and buffalo under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) observed significant (P<0.01) effect of farming system on lactation length in Desi and crossbred cows maintained in the Khatals located in and around Patna. He reported that the cows maintained in the dairy units integrated with agriculture farming had significantly (P<0.01) 16.45 days longer lactation length than those maintaining dairying alone.

**PEAK YIELD :**

**AVERAGE :** The means of peak yield of various genetic groups of cows as reported by different authors are tabulated as below :

**Table – 3 : Average peak yield (kg) of various genetic groups :**

| Genetic group | Peak yield (kg) | Author |
|---|---|---|
| Hariana | 5.95 ± 0.13 | Raheja (1982) |
| 1/2 HF + 1/2 Hariana | 14.39 ± 0.27 | |
| 1/2 Jersey + 1/2 Hariana | 12.02 ± 0.44 | |
| Hariana | 5.95 | Raheja and Balaine (1982) |
| 1/2 HF + 1/2 H | 14.39 | |
| 1/2 J + 1/2 H | 12.02 | |
| HF ≥ 50% | 14.4 ± 0.3 | Singh *et al.* (1986[b]) |
| 50% | 16 ± 0.3 | |
| ≤ 50% | 13.6 ± 0.5 | |
| HFX Sahiwal | 11.89 ± 0.20 | Jadhav *et al.* (1991) |
| Hariana | 8.11 ± 0.08 | Yadav and Rathi (1992) |
| Sahiwal | 9.22 ± 0.18 | Yadav *et al.* (1992) |
| Sahiwal | 8.65 ± 0.38 | Singh *et al.* (1993) |
| Sahiwal x Jersey | 13.27 ± 0.38 | |
| Sahiwal x Red Dane | 14.92 ± 0.38 | |
| HF cross | 13.3 ± 0.3 | Singh (1995) |
| Friesian crossbreds | 13.52 ± 0.04 | Shrivastava *et al.* (1998) |
| Friesian crossbreds | 8.51 | Tomar *et al.* (1998) |
| 7/8 HF | 16.19 ± 0.34 | Shiv Prasad (2003) |
| FH | 10.40 ± 0.17 | Singh *et al.* (2004) |
| BH | 8.87 ± 0.24 | |
| JH | 8.82 ± 0.25 | |
| Hariana Pure | 5.36 ± 0.22 | Kumar[2] (2004) |
| HF < 50% | 6.37 ± 0.19 | |
| HF 50% | 11.02 ± 0.52 | |
| HF 62.5 % | 5.32 ± 0.46 | |
| HF 75 % | 8.89 ± 0.52 | |
| J 50% | 8.56 ± 0.22 | |

| | | |
|---|---|---|
| Desi | 4.21 ± 0.30 | |
| HFX | 12.19 ± 0.23 | Kumar (2005) |
| JX | 7.96 ± 0.27 | |

**EFFECT OF GENETIC GROUP :**

Jadhav *et al.* (1991) studied the effect of genetic group on peak yield in six Holstein x Sahiwal grades and reported that the half grades had the highest performance for peak yield in 1st lactation followed by 7/8 and 5/8 grades.

Nayak and Raheja (1996) observed that grades of Hariana and its crosses with exotic dairy breeds had significant effect on peak yield.

Dutt and Bhusan (2001) studied the effect of genetic grade on peak yield and reported its significant effect on peak yield in half breds of HF, BS and Jersey with Hariana. However, they observed non-significant effect of three breed grades on peak yield.

Priya Raj (2002) observed that the average peak yield of Friesian crossbred cows was significantly ($P<0.01$) higher than those of Jersey crossbreds under farmers' managemental condition in and around Patna.

Kumar[2] (2004) studied the effect of different genetic groups involving Hariana, HFX and Jersey crossbred cows and reported the highest peak yield to be in HF 50% followed by HF 75%, Jersey 50% and HF < 50% groups.

Singh *et al.* (2004) studied the effect of genetic groups viz. 1/2 HF 1/2 H, 1/2 BS 1/2 H and 1/2 J 1/2 H on peak yield in 1st three lactations. They reported the peak yield to be significantly ($P<0.05$) higher in 1/2 HF 1/2 H group in all the lactations. However, there was no significant difference between the average peak yields of 1/2 BS 1/2 H and 1/2 J 1/2 H genetic groups.

Kumar (2005) studied the effect of genetic groups on peak yield under farmers' managemental condition in and around

Patna. He observed significant effect of genotypes on peak yield. The highest peak yield (12.19 kg) was observed to be in HF crossbreds followed by Jersey crossbred and Desi cows.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

Jadhav *et al.* (1991) reported the effect of farm on peak yield to be significant ($P<0.01$) in 1st lactation of various Holstein x Sahiwal grades.

Priya Raj (2002) reported that the different zones under farmers' managemental condition in and around Patna did not influence peak milk yield in HF and Jersey crossbred cows.

Kumar[1] (2004) reported that the cows maintained in different zones under farmers' managemental condition in and around Darbhanga (Bihar) had no significant effect on peak yield.

Kumar (2005) reported non-significant effect of location of herd on peak yield in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna.

**HERD SIZE :**

Priya Raj (2002) reported that the size of herd had no significant effect on average peak yield in crossbred cows maintained in the Khatals located in and around Patna.

Kumar[1] (2004) reported that the size of herd did not influence peak yield significantly in different genetic groups of cattle and buffalo under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) reported non-significant effect of size of herd on peak yield in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna.

**HERD CONSTITUTION :**

Kumar[1] (2004) reported non-significant effect of herd constitution on peak milk yield in cattle and buffalo in and around Darbhanga.

Kumar (2005) studied the effect of genetic and non-genetic factors affecting milk production efficiency of cattle. He observed that herd constitution had no significant role on average peak yield in Desi and crossbred cows under farmers' managemental condition in and around Patna.

**SEASON OF CALVING :**

Jadhav *et al.* (1991) observed that the season of calving had significant ($P<0.01$) effect in 1st lactation period of Holstein x Sahiwal grades. They reported the highest and lowest peak milk yields to be in winter and rainy seasons of calving respectively.

Singh *et al.* (1993) reported that season of calving had no significant effect on the 1st lactation peak yield in Sahiwal and its crossbreds with Jersey and Red Dane.

Singh *et al.* (2000) studied the effect of season of calving in seven genetic groups involving HF, BS and Jersey crosses with Hariana cows and reported that season of calving did not influence peak yield significantly.

Dutt and Bhusan (2001) studied the effect of season of calving in half breds and three breed grades of HF, BS and Jersey with Hariana. They reported that season of calving had no significant effect on peak yield among half breds but it was a significant source of variation in three breed grades.

Priya Raj (2002) studied the effect of season of calving on peak yield in HFX and Jersey crossbred cows and reported that crossbreds calved during November-February had the highest mean peak yield followed by those calved during July-October and March-June under farmers' managemental condition of Patna (Bihar).

Kumar[2] (2004) reported the non-significant effect of season of calving on peak yield in Hariana and its crosses with HF and Jersey.

Singh *et al.* (2004) observed the effect of season of calving on peak yield to be significant in 2nd and 3rd lactations in crosses of Hariana with Friesian, Brown Swiss and Jersey.

Kumar (2005) observed that the season of calving did not influence significantly ($P<0.05$) the peak yield in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna (Bihar).

**LACTATION ORDER :**

Yadav *et al.* (1992) reported non-significant influence of sequence of lactation on peak milk yield in Sahiwal cows.

Yadav and Rathi (1992) observed that lactation order had significant ($P<0.01$) effect on peak milk yield in Hariana cows on the basis of 1st three lactation records extended over a period of twelve years.

Bhattacharya *et al.* (1999) observed that sequence of lactation did not influence the peak yield significantly in Hariana cows.

Singh *et al.* (2000) observed significant ($P<0.01$) effect of parity of lactation on peak yield in crossbred cows of Holstein Fiesian, Brown Swiss and Jersey with Hariana breeds upto 3 lactations. They reported the peak yield to be lowest (11.85kg) in 1st lactation which increased with the increase of lactation order and it was observed to be highest (15.40 kg) in 3rd lactation.

Priya Raj (2002) observed that sequence of calving had highly significant ($P<0.01$) effect on peak yield in HFX and Jersey crossbred cows maintained under farmers' managemental condition in and around Patna. She reported that the peak milk yield increased with the increase of the lactation order upto 3rd lactation after which it tended to decline gradually.

Kumar[2] (2004) could not find significant role of sequence of lactation on peak yield in different genetic groups of Hariana and its crosses with HF and Jersey.

Singh *et al.* (2004) studied the effect of season of calving on peak yield in 1st three lactations of 1/2 Friesian 1/2 Hariana, 1/2 Brown Swiss 1/2 Hariana and 1/2 Jersey 1/2 Hariana and reported the significant ($P<0.01$) effect of season of calving in 2nd and 3rd lactations. They further observed that the rainy and autumn calvers had lower peak yields than winter, spring and summer.

Kumar (2005) could not find significant effect of parity of lactation on peak milk yield in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna.

**FARMING SYSTEM :**

Kumar[1] (2004) reported that the farming system did not play significant role on peak milk yield in cattle and buffalo in and around Darbhanga (Bihar) under farmers' managemental condition.

Kumar (2005) studied the role of non-genetic factors affecting milk production efficiency of cattle under farmers' managemental condition in and around Patna (Bihar). He observed that animal husbandary along with agriculture had siginificantly ($p<0.05$) higher peak yield than those practising Animal husbandry alone.

**DAYS TO ATTAIN PEAK MILK YIELD: (DAPY)**

**AVERAGE:** The average values of DAPY as mentioned in the literature are tabulated as below:-

**Table-4 : Average Days to attain peak yield of various genetic groups :**

| Genetic group | Days to attain peak yield (days) | Author |
|---|---|---|
| HF x Hariana | 54.25 | Rathi (1975 |

| | | |
|---|---|---|
| HF cross | 41.6 ± 1.60 | Raheja (1982) |
| Hariana<br>1/2 HF 1/2 H<br>1/2 J 1/2 H<br>1/2 BS 1/2 H<br>1/2 Red Dane 1/2 H | 42.31<br>38.64<br>36.5<br>36.3<br>37.41 | Raheja and Balaine (1982) |
| Sahiwal<br>Sahiwal x Jersey<br>Sahiwal x Red Dane | 42.86 ± 1.70<br>38.65 ± 1.70<br>42.87 ± 1.70 | Singh *et al.* (1993) |
| Hariana | 51.83 ± 2.48 | Bhattacharya *et al.* (1999) |
| 7/8 HF | 34.00 ± 2.30 | Shiv Prasad (2003) |
| FH<br>BH<br>JH | 41.72 ± 3.87<br>40.96 ± 5.13<br>56.60 ± 5.47 | Singh *et al.* (2004) |
| Hariana<br>HF < 50%<br>HF 50%<br>HF 62.5%<br>HF 75%<br>J 50% | 39.72 ± 2.32<br>26.80 ± 1.40<br>30.35 ± 3.41<br>28.12 ± 1.41<br>33.80 ± 2.60<br>35.35 ± 1.78 | Kumar[2] (2004) |
| Desi<br>HFX<br>JX | 59.94 ± 0.86<br>46.39 ± 0.67<br>50.12 ± 0.79 | Kumar (2005) |

**DAYS TO ATTAIN PEAK MILK YIELD : (DAPY)**

**EFFECT OF GENETIC GROUP :**

Singh *et al.* (1993) studied the genetic and non-genetic factors affecting milk production efficiency traits in Sahiwal and its crosses with jersey and Red Dane and reported non-significant role of genetic group on DAPY.

Kumar[1] (2004) observed significant effect of genetic group on DAPY and reported that Desi cows significantly ($P<0.01$)

attained peak milk yield earlier than Jersey crossbreds and HFX under farmers' managemental conditions.

Kumar[2] (2004) observed significant (P<0.01) effect of genetic group on DAPY in Hariana and its different grades with HF and Jersey in organized farm. He reported the longest and shortest DAPY in HF <50% and Hariana pure genetic groups respectively.

Singh *et al.* (2004) studied the effect of genetic group on DAPY in 1st three lactations of 1/2 Friesian 1/2 Hariana, 1/2 Brown Swiss 1/2 Hariana and 1/2 Jersey 1/2 Hariana. They reported significant (P<0.01) effect of genetic group on DAPY in 1st two lactations and observed that 1/2 J 1/2 H genetic group had significantly (P<0.01) longer DAPY than 1/2 HF 1/2 H and 1/2 BS 1/2 H.

Kumar (2005) reported significant (P<0.01) effect of genetic group on DAPY. He observed that HF crossbreds had significantly (P<0.05) shorter DAPY than Jersey crossbreds and Desi cows. He further reported that Jersey crossbred cows had significantly (P<0.05) 9.82 days shorter DAPY than Desi.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

Kumar[1] (2004) reported non-significant effect of zones on DAPY under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) reported significant (P<0.05) influence of location of herd on DAPY in Desi, HFX and Jersey crossbred cows in the Khatals located in and around Patna.

**HERD SIZE :**

Kumar[1] (2004) observed that the size of herd had no significant influence on DAPY under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) reported non-significant effect of the size of herd on DAPY in Desi and crossbred cows of HF and Jersey

under farmers' managemental condition in an around Patna, (Bihar).

**HERD CONSTITUTION :**

Kumar[1] (2004) reported non-significant influence of herd constitution on DAPY in Desi and crossbred cows of HF and Jersey in and around Darbhanga (Bihar).

Kumar (2005) observed significant ($P<0.05$) influence of herd constitution on DAPY in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna (Bihar).

**SEASON OF CALVING :**

Singh *et al.* (1993) studied the effect of season of calving on milk production efficiency traits in Sahiwal and its crosses with Jersey and Red Dane and reported its non-significant effect on DAPY.

Singh *et al.* (2004) reported significant ($P<0.05$) influence of season of calving on DAPY in half-breds of Hariana with HF, Jersey and Brown Swiss. They reported that the days required to attain peak yield were lowest in summer calvers and highest in autumn calvers.

Kumar[1] (2004) studied the effect of season of calving on DAPY in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Darbhanga (Bihar). He observed the average DAPY of March-June calvers to be significantly ($P<0.05$) higher than those calved during November-February.

Kumar[2] (2004) reported significant ($P<0.05$) effect of season of calving on DAPY. He observed that the average DAPY to be highest and lowest during winter and summer seasons of calving respectively in Hariana and its crosses with HF and Jersey. However, there were no significant differences in the average DAPY of summer, rainy and spring calvers.

Kumar (2005) reported significant (P<0.01) effect of season of calving on DAPY in Desi. HFX and JX cows in and around Patna. He observed that winter and summer calvers required significantly (P<0.05) more days to attain peak yield than rainy calvers.

**LACTATION ORDER :**

Kumar[1] (2004) reported significant (P<0.01) increase in average DAPY from 1st to 3rd sequences of lactation after which it tended to decline gradually in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar[2] (2004) reported non-significant effect of sequence of lactation on DAPY in Hariana and its crosses with HF and Jersey in organized farm.

Kumar (2005) observed that parity of lactation had significant (P<0.05) effect on DAPY in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna (Bihar). He observed that the DAPY tended to decrease from 1st & 2nd lactations (pooled together) to 3rd lactation, where it was the minimum, after which it tended to increase in subsequent lactations.

**FARMING SYSTEM :**

Kumar[1] (2004) reported non-significant effect of farming system on DAPY in Desi and crossbred cows in and around Darbhanga (Bihar). However, he observed that the cows managed in the units involved in the dairying alone had longer DAPY than those maintained in the dairy units integrated with agriculture.

Kumar (2005) reported non-significant effect of farming system on DAPY in Desi, HFX and Jersey crossbred cows under farmers' managemental condition. He, however, observed that the average DAPY to be shorter among the cows managed in units involved in dairying alone in comparison to

those maintained in the units integrated with agriculture farming.

**MILK YIELD PER DAY OF LACTATION LENGTH (MY/day LL) :**

**AVERAGES :** The averages of MY/day LL (kg) as reported by various authors are tabulated below :

**Table - 5 : Average milk yield per day of lactation length (MY/day LL) of various genetic groups :**

| Genetic group | Milk yield (kg) per day of lactation length (day) | Author |
|---|---|---|
| HF crossbred | 7.929 ± 0.216 | Singh *et al.* (1989) |
| 1/2 J<br>1/2 HF<br>3/4 J<br>3/4 HF | 6.05 ± 0.04<br>7.01 ± 0.04<br>5.94 ± 0.07<br>7.13 ± 0.06 | Hayatnagarkar *et al.* (1990) |
| HFX Sahiwal | 8.41 ± 0.13 | Jadhav *et al.* (1991) |
| Hariana | 5.29 ± 0.05 | Yadav and Rathi (1992) |
| Sahiwal | 6.02 ± 0.05 | Yadav *et al.* (1992) |
| Tharparkar | 6.54 ± 0.16 | Vij *et al.* (1992) |
| Sahiwal<br>Sahiwal x Jersey<br>Sahiwal x Red Dane | 5.78 ± 0.16<br>7.11 ± 0.16<br>9.15 ± 0.16 | Singh *et al.* (1993) |
| Frisian crossbred | 6.75 | Tomar *et al.* (1998) |
| Frisian crossbred | 9.09 ± 0.03 | Shrivastava and Singh (2000) |
| FH<br>BH<br>JH<br>FBH<br>BFH<br>FJH<br>JFH | 8.95 ± 0.15<br>8.43 ± 0.21<br>7.30 ± 0.20<br>8.43 ± 0.23<br>7.84 ± 0.27<br>8.28 ± 0.26<br>7.89 ± 0.27 | Singh *et al.* (2000) |

| | | |
|---|---|---|
| Tharparkar<br>Tharparkar x HF ($F_1$)<br>($F_2$) | 5.47 ± 0.12<br>8.71 ± 0.13<br>6.65 ± 0.39 | Bhattacharya *et al.* (2002) |
| Hariana<br>HF <50%<br>HF 50%<br>HF 62.5%<br>HF 75%<br>J 50% | 2.75 ± 0.13<br>3.46 ± 0.17<br>6.05 ± 0.20<br>2.82 ± 0.24<br>4.84 ± 0.29<br>5.03 ± 0.14 | Kumar[2] (2004) |
| Desi<br>HFX<br>JX | 2.98 ± 0.19<br>8.05 ± 0.15<br>6.06 ± 0.17 | Kumar (2005) |
| HF >50%<br>HF 50%<br>HF <50%<br>Hariana Pure | 4.37 ± 0.19<br>5.32 ± 0.14<br>4.18 ± 0.23<br>2.64 ± 0.28 | Sharan (2005) |

**MILK YIELD PER DAY OF LACTATION LENGTH (MY/day LL) :**

**EFFECT OF GENETIC GROUP :**

Hayatnagarkar *et al.* (1990) reported that 1/2 HF 1/2 ND cows had significantly (P<0.01) more MY/day LL than 1/2 J 1/2 ND cows.

Jadhav *et al.* (1991) studied the performance of various Holstein x Sahiwal grades for 1st lactation reproduction and production traits. They reported significant (P<0.01) effect of genetic group on MY/day LL. They further observed that there was increase in the production traits upto 1/2 grade after which they declined gradually.

Singh *et al.* (1993) studied the milk production efficiency traits in Sahiwal and its crosses with Jersey and Red Dane. They reported significantly (P<0.01) higher 1st lactation

MY/day LL in Red Dane x Sahiwal than Jersey x Sahiwal and Sahiwal pure.

Thakur *et al.* (1999) studied the different levels of Jersey inheritance in nine genetic groups involving Jersey and four indigenous breeds viz. Red Sindhi, Sahiwal, Tharparkar and Hariana on average daily milk yield per lactation length and reported significant ($P<0.05$) effect of genetic group on it. They observed the highest and lowest MY/day LL to be in 1/2 Jx 1/2 T and 1/2 JX 1/2 H genetic groups respectively.

Shrivastava and Singh (2000) reported significant ($P<0.05$) effect of different grades of Friesian x Zebu crossbred on MY/day LL in un-organized herds. They observed that the cows possessing 50% and more Friesian inheritance had significantly ($P<0.05$) higher MY/day LL than those having less than 50% inheritance of Friesian.

Singh *et al.* (2000) reported significant ($P<0.01$) effect of genetic group on MY/day LL to be in crossbred cows of HF, Jersey and BS with Hariana. They observed the highest and lowest average milk yields in FH and JH genetic groups respectively.

Bhattacharya *et al.* (2002) studied the dairy performance of Tharparkar, HF and their crosses and reported the highest MY/day LL to be in $F_1$ of HFX Tharparkar followed by Indian born HF, $F_2$ of HFX Tharparkar and Tharparkar pure.

Priya Raj (2002) reported significantly ($P<0.01$) higher MY/day LL in HF crossbreds than Jersey crossbreds under farmers' managemental condition in and around Patna (Bihar).

Akhter *et al.* (2003) studied the effect of genetic grades of crossbred cattle involving three exotic breeds viz. HF, Jersey and Red Dane and three Zebu breeds viz. Sahiwal, Hariana and Red Sindhi on average daily milk yield of 1st lactation period. They observed that the cows having 62.5% exotic inheritance from Friesian and Jersey and 37.5% from Sahiwal

had significantly (P<0.05) higher 1st lactation milk yield per day of 1st lactation period (FLY/DLP) than their own halfbreds and all the three breed crosses. Besides, they also reported the Friesian crosses to be superior to all Jersey crossbreds.

Kumar[1] (2004) reported significant (P<0.01) effect of genetic group on MY/day LL. He observed that HFX and Jersey crossbreds had significantly (P<0.05) more than double MY/day LL than Desi cows in un-organised herd in and around Darbhanga (Bihar)

Kumar[2] (2004) reported significant (P<0.05) effect of genetic group on average daily milk yield per lactation length. He reported 1/2 HF 1/2 H had significantly higher MY/day LL than all the genetic groups viz. Hariana pure, HF < 50%, HF 62.5%, HF 75% and J 50%. He further noted that 1/2 J 1/2 H had more than double and 1/2 J 1/2 H had almost double MY/day LL than pure Hariana.

Kumar (2005) reported that HF crossbreds had significantly (P<0.05) higher MY/day LL than Jersey crossbreds and Desi cows of un-organised herd in and around Patna. He further observed that HFX and Jersey crossbreds cows had significantly (P<0.05) more than double MY/day LL than Desi cows. Besides, he also reported that HF crossbreds had significantly (P<0.05) 1.99 kg more MY/day LL than Jersey crossbred cows.

Sharan (2005) reported significant (P<0.05) effect of genetic group on average daily milk yield in Hariana and its crosses with HF. He reported that 1/2 HF 1/2 H had the highest ADMY which was significantly (P<0.05) higher by 0.979 kg, 1.134 kg and 2.671 kg than HF > 50%, HF <50% and Hariana pure genetic groups respectively.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

Jadhav *et al.* (1991) observed significant (P<0.01) effect of farms on 1st lactation MY/day LL in six grades of Holstein x Sahiwal crosses on the basis of level of Holstein inheritance.

Shrivastava and Singh (2000) observed that different zones in and around Ranchi (Jharkhand) had significant (P<0.05) effect on MY/day LL in un-organized herd of Friesian x Zebu crossbreds.

Priya Raj (2002) could not find significant effect of zone on average daily milk yield/LL in un-organized herd of crossbreds of HF and Jersey in and around Patna.

Kumar[1] (2004) reported non-significant effect of zones on average daily milk yield/LL in Desi, HFX and Jersey corssbred cows in and around Darbhanga (Bihar).

Kumar (2005) reported significant (P<0.05) effect of location of herd on MY/day LL in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna (Bihar).

**HERD SIZE :**

Shrivastava and Singh (2000) reported that the herd size upto five cows had significantly (P<0.05) higher average daily milk yield/LL than the herd sizes of 6-8, 9-11 and 12 & above in Friesian x Zebu crossbreds of un-organized herd in and around Ranchi (Jharkhand).

Priya Raj (2002) could not find significant role of herd size on average daily milk yield/LL in crossbred cows under farmers' managemental condition in and around Patna (Bihar).

Kumar[1] (2004) reported the effect of herd size on average daily milk yield/LL to be significant (P<0.05) in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) compared the effect of 3-6 and 6 & above herd sizes on MY/day LL in Desi and crossbred cows of HF and Jersey under farmers' managemental condition in and around Patna but could not find any significant difference between the herd sizes with respect to MY/day LL.

**HERD CONSTITUTION :**

Kumar[1] (2004) reported non-significant effect of herd constitution on average daily milk yield/LL in different genetic groups of cows including buffalo of un-organized herd in and around Darbhanga (Bihar).

Kumar (2005) reported that herd constitution had no-significant effect on MY/day LL in Desi and crossbred cows of HF and Jersey under farmers' managemental condition in and around Patna (Bihar).

**SEASON OF CALVING :**

Jadhav *et al.* (1991) studied the 1st lactation production performance of six Holstein x Sahiwal grades of cows on the basis of level of Holstein inheritance and reported that winter calvers had significantly ($P<0.01$) higher MY/day LL than rainy and spring calvers.

Yadav and Rathi (1992) observed non-significant effect of season of calving on average daily milk yield/LL in Hariana cows.

Yadav *et al.* (1992) reported non-significant effect of season of calving on average daily milk yield/LL in Sahiwal cows.

Singh *et al.* (1993) studied the effect of season of calving on 1st lactation records of three genetic groups viz. Sahiwal, Jersey x Sahiwal and Red Dane x Sahiwal and reported its non-significant effect of it on average daily milk yield/LL.

Thakur *et al.* (1999) studied the effect of season of calving on 1st lactation MY/day LL in Jersey and its crosses with four indigenous breeds viz. Red Sindhi, Sahiwal, Tharparkar and

Hariana. They reported that season of calving had non-significant role on MY/day LL.

Shrivastava and Singh (2000) reported the effect of season of calving on average daily milk yield/day LL to be non-significant in Friesian x Zebu crossbreds of un-organised herd in and around Ranchi (Jharkhand). However, they reported the highest and lowest MY/day LL to be during winter and summer seasons of calving respectively.

Singh *et al.* (2000) reported the effect of season of calving on average milk yield per day lactation length to be non-significant in seven genetic group of cows involving HF, BS and Jersey crosses with Hariana maintained at CCS Haryana Agriculture University Farm, Hissar.

Priya Raj (2002) reported the effect of season of calving on average milk yield per day LL to be non-significant in crossbred cows of HF and Jersey under farmers' managemental condition in and around Patna. However, she observed the MY/day LL to be the highest by winter calvers followed by rainy and summer.

Akhter *et al.* (2003) observed the effect of season of calving on FL/DLP to be non-significant in crossbred cows involving three exotic breeds viz. FH, J and RD and three Zebu breeds viz. Hariana, Sahiwal and Red Sindhi. However, they reported that winter and rainy calvers produced more FL/DLP than spring and summer calvers.

Kumar[1] (2004) observed the effect of season of calving on average milk yield per day of LL to be significant ($P<0.01$) in Desi, HFX and JX cows under farmers' managemental condition in and around Darbhanga. He observed that November-February calvers yielded significantly ($P<0.01$) higher average milk yield per day of lactation length than the cows calved during other seasons.

Kumar[2] (2004) observed the effect of season of calving on average MY/day LL to be non-significant in Hariana and its crosses with HF and Jersey.

Kumar (2005) reported non-significant effect of season of calving on MY/day LL in Desi, HFX and JX cows in and around Patna. However, he observed that the winter calvers had maximum MY/day LL followed by rainy and summer calvers.

**LACTATION ORDER :**

Yadav and Rathi (1992) observed that the average MY/day LL of 2nd and 3rd lactations did not differ significantly ($P<0.05$) in Hariana cows. However, both these lactations had significantly higher MY/day LL than 1st lactation.

Yadav *et al.* (1992) observed the effect of lactation number on MY/day LL to be significant in Sahiwal cows. However, the average lactation yield per day of 2nd and 3rd lactations did not differ significantly.

Shrivastava and Singh (2000) reported the effect of sequence of lactation on MY/day LL to be significant ($P<0.05$) in Zebu cows crossed with Friesian under farmers' managemental condition in and around Ranchi (Jharkhand). The MY/day LL increased significantly upto 3rd lactation but there were no-significant differences in the MY/day LL of 3rd to 5th lactations.

Singh *et al.* (2000) observed significant ($P<0.05$) effect of parity of lactation in crossbred cows of HF, Jersey and Brown Swiss with Hariana maintained at CCS Agriculture University farm from 1970-87. They further reported that the 3rd lactation average MY/day LL was significantly higher than 1st and 2nd lactations.

Priya Raj (2002) reported that the MY/day LL significantly ($P<0.01$) increased upto 3rd lactation after which it

tended to decline in the crossbred cows under farmers' managemental condition in and around Patna.

Kumar[1] (2004) reported that the MY/day LL increased significantly ($P<0.01$) up to 4th lactation after which it tended to decline in different genetic groups of cows and buffalo under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar[2] (2004) reported the effect of sequence of lactation on MY/day LL to be non-significant in Hariana and its different grades with HF and Jersey inheritance.

Kumar (2005) reported the effect of parity of lactation on MY/day LL to be significant ($P<0.05$). However, he observed that the average MY/day LL from 1st to 4th lactations did not differ significantly after which it declined in 5th and 6th lactations in Desi, HFX and JX cows under farmers' managemental condition in and around Patna.

**FARMING SYSTEM :**

Kumar[1] (2004) observed that the system of farming had no significant influence on MY/day LL of Desi and crossbred cows under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2003) observed that the cows managed in dairy units integrated with agriculture farming had significantly ($P<0.01$) 0.59 kg more average MY/day LL than those units maintaining dairying alone in Desi, HFX and JX cows under farmers' managemental condition in and around Patna.

**CALVING INTERVAL :**

**AVERAGE :** The mean calving intervals (days) of different genetic groups as reported in literature have been depicted in table-6.

**Table 6 : Average Calving interval of various genetic groups :**

| Genetic group | Calving internal (days) | Author |
|---|---|---|
| Hariana | 416.57 ± 3.88 | Yadav and Rathi (1992) |
| Sahiwal | 486.75 ± 6.43 | Yadav *et al.* (1992) |
| Jersey<br>Sahiwal<br>Jersey x Sahiwal | 422.71 ± 28.50<br>447.07 ± 21.19<br>451.70 ± 7.76 | Chaudhari *et al.* (1995) |
| Friesian crossbreds | 384.48 ± 1.40 | Shrivastava *et al.* (1996) |
| Friesian crossbreds | 403.72 | Tomar *et al.* (1998) |
| FH<br>BH<br>JH<br>FBH<br>BFH<br>FJH<br>JFH | 429.47 ± 40.53<br>423.11 ± 8.17<br>405.94 ± 8.17<br>456.05 ± 9.14<br>479.38 ± 10.75<br>455.35 ± 10.42<br>444.94 ± 10.96 | Singh *et al.* (2000) |
| 1/2 JX 1/2 Sahiwal | 440.34 ± 15.92 | Kumar *et al.* (2003) |
| 5/8 F x 3/8 S<br>1/2 F x 1/2 S<br>1/2 R x 1/2 S<br>5/8 JX 3/8 S<br>1/2 F x 1/2 S<br>1/2 F x 1/2 H | 386.62 ± 2.59<br>378.7 ± 2.59<br>380.64 ± 2.59<br>396.87 ± 2.59<br>390.87 ± 2.59<br>380.2 ± 2.59 | Akhter *et al.* (2003) |
| HF crossbreds | 382.37 ± 0.93 | Akhter *et al.* (2003) |
| Desi<br>HFX<br>JX | 470.56 ± 5.05<br>427.09 ± 3.96<br>430.07 ± 4.04 | Kumar (2005) |
| HF > 50%<br>HF 50%<br>HF < 50%<br>Hariana Pure | 538.97 ± 24.06<br>528.70 ± 16.75<br>570.70 ± 34.22 | Sharan (2005) |

**EFFECT OF GENETIC GROUP :**

Jadhav *et al.* (1991) reported significant (P<0.01) effect of various genetic grades of Holstein x Sahiwal inheritance ranging from 1/4 to 7/8 exotic inheritance on calving interval. The lowest and highest calving interval days were obtained in 1/2 and 7/8 genetic grades respectively.

Singh *et al.* (2000) reported significant (P<0.01) effect of genetic group on calving interval in 1/2 (one exotic breed) and 3/4 (two exotic breeds) inheritance involving HF, BS and Jersey crosses with Hariana cows. They observed the lowest (405.94 ± 8.17 days) and the highest (479.38 ± 10.75 days) CI to be in JH and BFH genetic groups respectively.

Priya Raj (2002) reported significant (P<0.01) effect of genetic group on calving interval in HF and Jersey crossbred cows under farmers' managemental condition in and around Patna. She observed that HF crossbred cows had significantly (P<0.01) lower calving interval days than the crossbred cows of Jersey.

Akhter *et al.* (2003) reported non-significant effect of various genetic grades of crossbred cows involving HF, Jersey and Red Dane with Sahiwal, Hariana and Red Sindhi on 1st lactation calving interval. They reported the lowest and highest FCI days to be in 1/2 F x 1/2 S and 75% exotic inheritance genetic groups respectively.

Kumar (2005) observed that both HFX and Jersey crossbred cows had significantly (P<0.05) lower calving interval by 43.47 days and 40.49 days than Desi cows respectively under farmers' managemental condition in and around Patna (Bihar). However, the mean days of calving interval of HFX and Jersey crossbred cows did not differ significantly.

Sharan (2005) observed significant (P<0.05) effect of inter-calving period ranging from 528.70 days in HF 50% to

572.19 days in HF<50% genetic groups in crosses of HF with Hariana.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

Jadhav *et al.* (1991) studied the effect of different military farms located at Ambala, Deharadun and Jalandhar on calving interval days in various Holstein x Sahiwal grades for 1st lactation and reported significant (P<0.01) effect of farm on it.

Priya Raj (2002) could not find significant effect of different zones on calving interval in crossbred cows of Holstein Friesian and Jersey in the Khatals situated in and around Patna.

Kumar[1] (2004) observed non-significant effect of different zones on calving interval in Desi and crossbred cows under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) reported that location of herd did not influence the calving interval significantly in Desi and crossbred cows of Holstein Friesian and Jersey under farmers' managemental condition in and around Patna (Bihar).

**HERD SIZE :**

Priya Raj (2002) reported the effect of herd size on calving interval to be non-significant in crossbred cows under farmers' managemental condition in and around Patna.

Kumar[1] (2004) observed non-significant effect of herd size on calving interval in different genetic groups of cows and buffalo in and around Darbhanga (Bihar).

Kumar (2005) reported non-significant effect of size of herd on CI in Desi and crossbred cows under farmers' managemental condition in and around Patna. However, he observed that the cows maintained in the herd size of 3-6 had lower CI than those maintained in the herd size of 7 & above.

**HERD CONSTITUTION :**

Kumar[1] (2004) did not find significant effect of herd constitution on calving interval in Desi, crossbred cows and buffalo under farmers' managemental condition.

Kumar (2005) reported that the herd constitution did not play significant role on CI in Desi and crossbred cows of HF and Jersey in the Khatals located in and around Patna (Bihar).

**SEASON OF CALVING :**

Jadhav *et al.* (1991) reported that autumn, rainy and winter calvers had significantly ($P<0.01$) lower days of calving interval than summer and spring calvers in 1st lactation of various Holstein x Sahiwal grades.

Yadav *et al.* (1992) observed non-significant effect of season of calving on CI in Sahiwal cows.

Yadav and Rathi (1992) reported the effect of season of calving on CI (days) to be non-significant in Hariana cows.

Singh *et al.* (2000) reported non-significant effect of season of calving on CI in seven genetic groups of crossbred cows involving HS, BS and Jersey with Hariana.

Priya Raj (2002) observed the influence of months of calving on CI (days) to be non-significant in crossbred cows of HF and Jersey under farmers' managemental condition in and around Patna (Bihar).

Akhter *et al.* (2003) reported that season of calving had significant ($P<0.05$) effect on CI in 12 two and three breed crosses involving three exotic breeds viz. HF, J and Red Dane with three Zebu breeds viz. Sahiwal, Hariana and Red Sindhi.

Kumar (2005) observed that season of calving had significant ($P<0.01$) effect on CI in Desi, HFX and Jersey crossbred cows under farmers' managemental condition in and around Patna. He further reported that winter calvers had lowest CI which was significantly ($P<0.05$) 75.35 days and 49.21 days lower than summer and rainy calvers respectively.

Besides, rainy calvers had also significantly (P<0.05) 26.14 days less CI than the cows calved during summer.

**LACTATION ORDER :**

Yadav *et al.* (1992) reported significant (P<0.01) decrease in CI (days) with the advancement of lactation order in Sahiwal cows.

Yadav and Rathi (1992) observed significant (P<0.01) decrease in CI (days) with the increase of parity of lactation in Hariana cows.

Singh *et al.* (2000) reported significant (P<0.05) decrease in CI (days) with the increase of sequence of lactation in crossbred cows involving HF, BS and Jersey with Hariana. The longest (456.23 ± 5.92) and the shortest (427.65 ± 6.02) days of CI were observed to be in 1st and 3rd lactations respectively.

Priya Raj (2002) reported significant (P<0.05) effect of sequence of calving on CI (days) in crossbred cows under farmers' managemental condition in and around Patna. However, she could not find any definite trend for the effect of parity of lactation on this trait.

Kumar[1] (2004) reported significant (P<0.01) effect of sequence of lactation of CI (days) in Desi, crossbred cows and buffalo under farmers' managemental condition in and around Darbhanga (Bihar). However, he also did not report any definite trend.

Kumar (2005) reported that parity of lactation significantly (P<0.01) affected CI (days) in Desi, HFX and J crossbred cows in the Khatals located in and around Patna. However, he could not observe any definite trend for this trait.

Sharan (2005) reported non-significant effect of parity of lactation on CI (days) in Hariana and its crosses.

**FARMING SYSTEM :**

Kumar[1] (2004) reported non-significant effect of farming system on CI (days) in Desi, HFX, JX and buffalo under

farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) observed significant (P<0.01) effect of system of farming on CI (days). He reported that cows managed in the units involved in the dairying alone had significantly (P<0.01) 28.17 days less CI in comparison to those maintained in the units integrated with agriculture farming.

**MILK YIELD PER DAY OF CALVING INTERVAL (MY/day of CI):**

The average milk yield per day of CI as reported in literature has been shown in the table-7.

**Table-7 : Average Milk yield per day of calving interval of various genetic groups :**

| Genetic group | Milk yield per day of calving interval (kg) | Author |
|---|---|---|
| HF ≥ 50%<br>50%<br>≤50% | 8.9 ± 0.2<br>9.4 ± 0.3<br>5.7 ± 0.4 | Singh *et al.* (1986[b]) |
| HF crossbred | 5.92 ± 0.42 | Singh *et al.* (1989) |
| 1/2 J<br>1/2 H<br>3/4 J<br>3/4 HF | 4.60 ± 0.03<br>5.34 ± 0.04<br>4.53 ± 0.06<br>5.41 ± 0.05 | Hayatnagarkar *et al.* (1990) |
| HFX Sahiwal | 6.10 ± 0.12 | Jadhav *et al.* (1991) |
| Hariana | 3.49 ± 0.04 | Yadav and Rathi (1992) |
| Sahiwal | 3.60 ± 0.05 | Yadav *et al.* (1992) |
| Tharparkar | 4.90 ± 0.14 | Vij *et al.* (1992) |
| Friesian crossbred | 4.18 | Tomar *et al.* (1998) |
| Friesian crossbred | 7.11 ± 0.03 | Shrivastava *et al.* (2000) |

| | | |
|---|---|---|
| 5/8 F x 3/8 S | 7.82 ± 0.08 | Akhter *et al.* (2003) |
| 1/2 F x 1/2 S | 6.86 ± 0.08 | |
| 1/2 R x 1/2 S | 6.3 ± 0.08 | |
| 5/8 JX 3/8 S | 6.52 ± 0.08 | |
| 1/2 F x 1/2 S | 6.20 ± 0.08 | |
| 1/2 F x 1/2 H | 6.29 ± 0.08 | |
| Desi | 2.34 ± 0.15 | Kumar (2005) |
| HFX | 6.57 ± 0.12 | |
| JX | 5.04 ± 0.14 | |
| HF > 50% | 3.19 ± 0.19 | Sharan (2005) |
| HF 50% | 3.67 ± 0.12 | |
| HF < 50% | 2.95 ± 0.28 | |
| Hariana Pure | 1.65 ± 0.27 | |

**GENETIC GROUP :**

Jadhav *et al.* (1991) studied the effect of six grades of Holstein x Sahiwal crosses, classified on the basis of level of Holstein inheritance, on MY/day CI in the cows maintained at military farms located at Ambala, Deharadun and Jalandhar. They observed significant (P<0.05) effect of genetic group on MY/day CI and reported the highest (6.87 ± 0.18 kg) and lowest (4.89 ± 0.16 kg) MY/day CI to be in 1/2 HF 1/2 S and 1/4 HF 3/4 S genetic grades respectively.

Shrivastava and Singh (2000) reported significant (P<0.05) effect of genetic group on MY/day CI of un-organised herd located in and around Ranchi, (Jharkhand). They reported MY/day CI to be highest (7.45 ± 0.05 kg) and the lowest (6.49 ± 0.07 kg) in 1/2 Friesian 1/2 Zebu and < 50% Friesian inheritance genetic groups respectively. They further observed that MY/day CI of 50% and >50% exotic inheritance groups did not differ significantly.

Singh *et al.* (2000) reported significant (P<0.05) effect of genetic group on MY/day CI in 407 crossbred cows of HF, BS and Jersey with Hariana maintained over a period of 18 years.

The highest (7.17 ± 0.16kg) and the lowest (5.88 + 0.23 kg) MY/day CI were observed to be in HFX H cows and JX H cows respectively.

Priya Raj (2002) observed significantly (P<0.01) higher MY/day CI in HF crossbred cows than Jersey crossbreds under farmers' managemental condition in and around Patna.

Akhter *et al.* (2003) reported significant (P<0.05) effect of genetic group on 1st lactation MY/day CI in twelve genetic groups involving three exotic breeds viz. HF, J and RD with 3 Zebu breeds viz. Sahiwal(S), Hariana (H) and Red Sindhi (RS). They reported the highest and lowest FLY/DCI kg per day to be in 5/8 HFX 3/8 S and 1/2 HFX 1/2 S genetic groups respectively.

Kumar[1] (2004) reported that crossbreds of HF and Jersey with Desi cows had significantly (P<0.01) more than double MY/day CI than those of Desi cows under farmers' managemental condition in and around Darbhanga (Bihar). He also observed higher MY/day CI in HF crossbreds than Jersey crossbreds.

Kumar (2005) also reported that HF and Jersey crossbred cows with Hariana had significantly (P<0.01) more than double MY/day CI than Desi cows under farmers' managemental condition in and around Patna. He reported the highest MY/day CI (6.57 ± 0.12kg) to be in HF crossbreds followed by Jersey crossbreds (5.04 ± 0.14 kg) and Desi cows (2.34 ± 0.15 kg).

Sharan (2005) observed significant (P<0.01) effect of genetic group on MY/day CI in Hariana and its crosses with Holstein Friesian. He observed that HF 50% had significantly (P<0.01) higher MY/day CI than HF>50%, HF < 50% and Hariana Pure genetic groups. The MY/day CI of both HF>50 and HF<50% genetic groups had significantly (P<0.05) higher MY/day CI than Hariana Pure.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

Jadhav *et al.* (1991) reported significant (P<0.01) effect of farms on MY/day CI in cows grouped into six grades viz. 1/4, 3/8, 1/2 , 5/8, 3/4 and 7/8 in Holstein x Sahiwal crosses on the basis of level of Holstein inheritance.

Shrivastava and Singh (2000) reported significant (P<0.05) effect of zones on MY/day CI in Friesian x Zebu crossbred cows under farmers' managemental condition in and around Ranchi (Jharkhand).

Priya Raj (2002) observed non-significant effect of location of herd on MY/day CI in HFX and JX cows maintained in the Khatals situated in and around Patna.

Kumar[1] (2004) reported that different zones in and around Darbhanga (Bihar) did not influence the MY/day CI significantly in Desi and crossbred cows and buffaloes.

Kumar (2005) reported significant (P<0.01) effect of location of herd on MY/day CI in Desi, HFX and JX cows under farmers' managemental condition in and around Patna.

**HERD SIZE :**

Shrivastava and Singh (2000) reported significant (P<0.05) effect of herd size on MY/day CI in three different genetic grades of Friesian x Zebu cows of un-organized herd in and around Ranchi (Jharkhand). They observed that there was consistent decrease in MY/day CI with the increase in herd size.

Priya Raj (2002) reported non-significant influence of the size of the herd on MY/day CI in HFX and JX cows under farmers' managemental condition in and around Patna.

Kumar[1] (2004) Observed that the size of the herd did not influence MY/day CI significantly. However, he reported that a herd of 11-14 milch animals had the highest average MY/day

CI followed by herd sizes of 7-10, 15 & above and 3-6 cows in the Khatals situated in and around Darbhanga (Bihar).

Kumar (2005) reported non-significant effect of herd size on MY/day CI in Desi, HFX and JX cows under farmers' managemental condition in and around Patna.

**HERD CONSTITUTION :**

Kumar[1] (2004) observed non-significant effect of herd constitution on MY/day CI in milch cows and buffaloes under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) did not find significant effect of herd constitution on MY/day CI in Desi and crossbred cows of HF and Jersey with Desi cows in the Khatals located in and around Patna.

**SEASON OF CALVING :**

Jadhav *et al.* (1991) reported significant ($P<0.01$) influence of season of calving in six genetic grades of HFX Sahiwal crosses. They reported that winter and rainy calvers had significantly ($P<0.01$) higher MY/day CI than spring calvers.

Yadav *et al.* (1992) did not find significant influence of season of calving on MY/day CI in Sahiwal cows. However, they observed the highest MY/day CI by winter calvers followed by summer and rainy calvers.

Yadav and Rathi (1992) could not find significant effect of season of calving on MY/day CI in Hariana cows.

Shrivastava and Singh (2000) reported that season of calving did not influence the MY/day CI significantly in HFX Zebu crossbred cows under farmers' managemental condition in and around Ranchi. However, they observed the highest MY/day CI by winter calvers followed by monsoon and summer calvers.

Singh *et al.* (2000) reported non-significant effect of season of calving on MY/day CI in crossbred cows involving HF, BS and Jersey with Hariana.

Priya Raj (2002) could not find significant effect of months of calving on MY/day CI in HFX and JX cows under farmers' managemental condition in and around Patna (Bihar).

Akhter *et al.* (2003) reported that season of calving did not influence 1st lactation MY/day CI significantly in twelve genetic groups of crossbred cows involving three exotic breeds viz. HF, J and RD with three zebu breeds viz. Sahiwal, Hariana and Red Sindhi. However, they observed that the winter calvers produced highest MY/day CI followed by rainy, spring and summer calvers.

Kumar[1] (2004) observed significant ($P<0.01$) effect of season of calving on MY/day CI in Desi, crossbred cows and buffaloes under farmers' managemental condition in and around Darbhanga (Bihar). They reported that winter calvers had significantly higher MY/day CI than rainy and summer calvers.

Kumar (2005) reported that season of calving did not influence MY/day CI significantly in Desi and crossbred cows maintained in the Khatals located in and around Patna (Bihar).

**LACTATION ORDER :**

Vij *et al.* (1992) reported the effect of sequence of lactation on MY/day CI to be significant ($P<0.01$) in Tharparkar cows. However, they could not observe any definite trend for the effect of parity of lactation on it.

Yadav and Rathi (1992) reported the effect of parity of lactation on MY/day CI to be significant ($P<0.05$) in Hariana cows. They observed that MY/day CI increased consistently upto 3rd lactation.

Yadav *et al.* (1992) observed that the average milk yield per day of CI increased significantly (P<0.01) upto 3rd lactation in Sahiwal cows.

Shrivastava and Singh (2000) found that parity of lactation had significant (P<0.05) effect on MY/day CI in three genetic grades of Holstein Friesian crosses with Zebu under farmers' managemental condition in and around Ranchi (Jharkhand). They observed that the MY/day CI increased significantly (P<0.05) upto 3rd lactation but there were no significant differences among MY/day CI of 3rd, 4th and 5th lactations.

Singh *et al.* (2000) observed the effect of sequence of lactation on MY/day CI to be significant (P<0.01) in seven genetic groups of crossbred cows of HF, BS and J with Hariana. They reported that MY/day CI significantly (P<0.05) increased by 0.84 kg from 1st to 2nd lactation. However, the mean My/day CI of 2nd and 3rd lactations did not differ significantly.

Priya Raj (2002) observed the effect of sequence of lactation on MY/day CI to be significant (P<0.05) in crossbred cows of HF and Jersey with Desi under farmers' managemental condition in and around Patna. She found that MY/day CI increased upto 3rd lactation after which it tended to decline.

Kumar[1] (2004) reported the effect of sequence of lactation on MY/day CI to be significant (P<0.01) in cattle and buffalo under farmers' managemental condition in and around Darbhanga. He observed that the MY/day CI increased upto 3rd lactation after which it declined.

Kumar (2005) reported significant (P<0.01) effect of parity of lactation on MY/day CI in Desi, HFX and JX cows in the Khatals located in and around Patna. He observed that MY/day CI increased upto 3rd sequence of lactation, tended to

decline in 4th lactation and significantly (P<0.05) decreased in 5th and 6th lactations.

**FARMING SYSTEM :**

Kumar[1] (2004) could not find the effect of farming system on MY/day CI to be significant in cows and buffaloes under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) reported non-significant effect of farming system on MY/day CI in Desi, HFX and JX cows in the Khatals located in and around Patna. However, he observed that the cows managed in the dairy units integrated with agriculture farming had higher MY/day CI in comparison to those maintained in the units involved in dairying alone.

Sharan (2005) reported that parity of lactation did not influence MY/day CI significantly in Hariana cows and its crosses with Holstein Friesian.

**DRY PERIOD :**

The average dry periods as mentioned by various authors are summarised as below in table : 8.

**Table – 8 : Average Dry period of various genetic groups :**

| Genetic group | Dry period (days) | Author |
|---|---|---|
| Tharparkar | 114.75 ± 6.57 | Vij *et al.* (1992) |
| Sahiwal | 164.70 ± 8.74 | Singh *et al.* (1993) |
| Jersey x Sahiwal | 106.15 ± 8.74 | |
| Red Dane x Sahiwal | 89.15 ± 8.74 | |
| Jersey crossbreds | 141.18 ± 6.02 | Deshmukh *et al.* (1995) |
| Friesian cross | 85.98 ± 1.36 | Shrivastava *et al.* (1996) |
| Hariana | 228 ± 5.4 | Pundir and Raheja (1997) |
| Friesian crossbreds | 167.07 | Tomar *et al.* (1998) |

| | | |
|---|---|---|
| 1/2 JX 1/2 H<br>> 1/2 JX < 1/2 H | 166.8 ± 13.3<br>158.3 ± 19.9 | Thakur *et al.* (1999) |
| Heriana | 210 ± 3.36 | Dalal *et al.* (2002) |
| HF crossbreds | 72.82 ± 0.65 | Akhter *et al.* (2003) |
| Hariana Pure<br>HF < 50%<br>HF 50%<br>HF 62.5%<br>HF 75%<br>Jersey 50% | 201.10 ± 20.83<br>153.06 ± 9.55<br>121.25 ± 19.76<br>264.44 ± 34.70<br>113.40 ± 11.87<br>126.97 ± 9.47 | Kumar (2004) |
| Desi<br>HFX<br>JX | 115.38 ± 5.49<br>77.25 ± 4.30<br>70.44 ± 5.05 | Kumar (2005) |

**EFFECT OF GENETIC GROUP :**

Singh *et al.* (1993) observed the effect of genetic group on 1st dry period to be non-significant in Sahiwal and its crosses with Jersey and Red Dane maintained in the Livestock Research Centre of G.B. Pant University of Agriculture and Technology Pantnagar, Nainital.

Thakur *et al.* (1999) reported the effect of genetic group on 1st dry period to be significant ($P<0.01$) in nine genetic groups of different levels of Jersey inheritance in Jersey crosses with Red Sindhi, Sahiwal, Tharparkar and Hariana.

Priya Raj (2002) observed the effect of genetic group on dry period to be non-significant in HFX and JX cows under farmers' managemental condition in and around Patna.

Akhter *et al.* (2003) reported the effect of genetic group consisting of crossbred cows of three exotic breeds viz. HF, J and RD with three Zebu breeds viz. Sahiwal, Hariana and Red Sindhi on dry period to be significant ($P<0.05$). They observed that the cows with 62.5% exotic inheritance from Friesian or

Jersey and 37.5% from Sahiwal had shorter 1st dry period than their own halfbreds and all the three breed crosses.

Kumar[1] (2004) observed the effect of genetic group on dry period to be significant (P<0.01) in Desi, HFX and JX cows and buffaloes. He reported significantly (P<0.01) longer dry period in Desi cows than HFX and Jersey crossbred cows.

Kumar[2] (2004) reported significant (P<0.01) effect of genetic group on dry period in Hariana and its crosses with HF and Jersey. He observed that 1/2 HF, 1/2 H and 1/2 HF 1/2 J genetic groups had nearly half of the dry period in comparison to Hariana Pure.

Kumar (2005) reported that crossbreds of HF and Jersey with Zebu had significantly (P<0.01) shorter dry period by 38.13 days and 44.94 days respectively than Desi cows.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

Priya Raj (2002) observed the effect of different zones on dry period to be non-significant in HFX and JX cows in the Khatals located in and around Patna.

Kumar[1] (2004) reported the effect of different zones on dry period to be non-significant in Desi, crossbred cows and graded buffaloes under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) reported the effect of different locations on dry period to be non-significant in Desi and crossbred cows under farmers managemental condition in and around Patna.

**HERD SIZE :**

Priya Raj (2002) reported that the size of herd did not influence dry period significantly in HFX and JX cows under farmers' managemental condition in and around Patna (Bihar).

Kumar[1] (2004) reported the effect of herd size on dry period to be non-significant in Desi, crossbred cows and graded buffaloes in and around Darbhanga (Bihar).

Kumar (2005) did not find the effect of the size of the herd on dry period to be significant in Desi and crossbred cows of HF and Jersey with Desi under farmers' managemental condition in and around Patna (Bihar)

**HERD CONSTITUTION :**

Kumar[1] (2004) could not find the effect of herd constitution on dry period to be significant in Desi, crossbred cows and buffaloes under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) reported the effect of herd constitution on dry period to be non-significant in Desi, HFX and JX cows in the Khatals located in and around Patna (Bihar).

**SEASON OF CALVING :**

Vij *et al.* (1992) reported that season of calving had significant ($P<0.05$) effect on dry period in Tharparkar cows. They observed that December-February calvers had shorter dry period as compared to March-April, May-August and September-November calvers.

Singh *et al.* (1993) observed that the season of calving had no significant role on 1st dry period in Sahiwal and its crosses with Jersey and Red Dane.

Thakur *et al.* (1999) observed the effect of season of calving on dry period to be non-significant in nine genetic groups of Jersey x Zebu crossbred cows.

Priya Raj (2002) observed the effect of month of calving on dry period to be non-significant in HFX and JX cows under farmers' managemental condition in and around Patna (Bihar).

Akhter *et al.* (2003) reported the effect of season of calving on 1st dry period to be significant ($P<0.05$) in crosses involving three exotic breeds viz. FH, J and RD with three Zebu breeds viz. Sahiwal, Red Sindhi and Hariana. They reported that rainy calvers had the shortest dry period followed by spring, winter and summer.

Kumar[1] (2004) observed non-significant effect of dry period in Desi, crossbred cows and graded buffaloes under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar[2] (2004) did not find significant effect of season of calving on dry period in Hariana and its crosses with HF and Jersey.

Kumar (2005) reported the effect of season of calving on dry period to be non-significant in Desi, HFX and JX crossbred cows in the Khatals situated in and around Patna. However, he observed that winter calvers had the lowest dry period followed by rainy and summer calvers.

**LACTATION ORDER :**

Vij *et al.* (1992) observed the effect of parity of lactation on dry period to be significant ($P<0.01$) in Tharparkar cows. Although they did not find any definite trend, yet the dry period decreased after 2nd lactation and again increased in 4th and 5th lactations.

Priya Raj (2002) observed that the dry period preceding to 2nd lactation was significantly ($P<0.05$) higher than other lactations in crossbred cows of HF and Jersey with Zebu under farmers' managemental condition in and around Patna (Bihar).

Kumar[1] (2004) reported non-significant effect of sequence of lactation on dry period in Desi and crossbred cows under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar[2] (2004) reported that sequence of lactation had no significant role on dry period in Hariana and its crosses with HF and Jersey in the organized farm.

Kumar (2005) reported non-significant effect of sequence of lactation on dry period in Desi, HFX and JX cows under farmers' managemental condition in and around Patna (Bihar).

**FARMING SYSTEM :**

Kumar[1] (2004) observed the effect of farming system on dry period to be non-significant in Desi and crossbred cows and graded buffaloes in and around Darbhanga (Bihar).

Kumar (2005) reported the effect of farming system on dry period to be significant ($P<0.01$). He observed that the cows maintained in the units involved in dairying alone had significantly ($P<0.01$) shorter dry period than those maintained in the units integrated with agriculture farming.

**NET COST :**

**GENETIC GROUP :**

Priya Raj (2002) reported the average net cost of per kg milk production of HF crossbred cows to be significantly ($P<0.05$) lower than Jersey crossbred cows in the Khatals located in and around Patna.

Kumar[1] (2004) observed significant ($P<0.01$) effect of genetic group on net cost of milk production. He observed the lowest and highest net cost per kg of milk production to be in HF crossbred and Desi cows respectively.

Kumar (2005) observed significant ($P<0.01$) effect on average net cost of per kg of milk production in Desi, HFX and JX cows maintained under farmers' managemental condition in and around Patna. He reported that HF crossbreds had the lowest cost of per kg milk production and they proved to be most economical. The average net cost per kg of milk produced by HF crossbreds was significantly ($P<0.01$) lower by Rs. 1.04 and Rs. 1.68 than Jersey crossbred and Desi cows respectively. Besides, he also observed that the net cost per kg of milk produced by Jersey crossbreds to be significantly ($P<0.01$) Re 0.64 lower than produced by Desi cows.

**LOCATION OF HERD :**

Singh (1984) reported non-significant effect of location of herd on cost of milk production in Friesian x Zebu cows maintained in and around Ranchi (Jharkhand).

Priya Raj (2002) observed the variation in cost of per kg milk production due to differences in location of Khatals in and around Patna to be non-significant.

Kumar[1] (2004) found the effect of zones on net cost of milk production to be significant ($P<0.01$) in milch cows and buffaloes in and around Darbhanga (Bihar).

Kumar (2005) reported significant ($P<0.01$) effect of location of herd on net cost per kg of milk production in Desi and crossbred cows of HF and Jersey maintained in the Khatals situated in and around Patna. He further observed that the average net cost of per kg milk in Eastern zone was significantly ($P<0.05$) 63 paise and 60 paise lower than N-W and S-W zones respectively.

**HERD SIZE :**

Singh (1984) observed the effect of the size of the herd on cost of milk production to be significant ($P<0.05$) in Friesian x Zebu cows maintained in and around Ranchi (Jharkhand).

Priya Raj (2002) reported significantly ($P<0.05$) higher net cost of milk production in the Khatals maintaining 3-7 crossbred cows than those maintaining 8-12 and 13-17 crossbred cows in and around Patna.

Kumar[1] (2004) reported significant ($P<0.01$) effect of herd size on net cost per kg of milk production in Desi, HFX , JX and buffaloes under farmers' managemental condition in and around Darbhanga (Bihar). He observed the herd size of 11-14 milch animals to be optimum for relatively cheaper milk production.

Kumar (2005) reported that the size of the herd significantly ($P<0.01$) influenced net cost per kg of milk

production. He observed that the average net cost per kg of milk production in the size of 7 & above milch cows to be significantly (P<0.01) 48 paise lower than the herd size of 3-6 cows.

**HERD CONSTITUTION :**

Kumar[1] (2004) observed the influence of herd constitution on net cost of milk production to be significant (P<0.01) in Desi, cross bred cows and graded buffaloes under farmers' managemental condition in and around Darbhanga (Bihar). He reported the average net cost of milk production to be significantly (P<0.05) higher in Khatals having only buffaloes followed by those having only cows and both cows and buffaloes.

Kumar (2005) reported the effect of herd constitution on net cost per kg of milk production to be significant (P<0.01) in Desi and crossbred cows maintained in the herds located in and around Patna. He observed that the dairy units having Desi along with Jersey crossbreds had the lowest net cost per kg of milk production than other herd constitution groups.

**SEASON OF CALVING :**

Singh (1984) observed that the season of calving influenced the cost of milk production significantly (P<0.05) in Friesian x Zebu crosses in and around Ranchi (Jharkhand).

Priya Raj (2002) reported the effect of month of calving of HFX and JX cows on the net cost of per kg milk production to be non-significant.

Kumar[1] (2004) reported significant (P<0.01) influence of season of calving on net cost per kg of milk production in Desi, HFX and JX and graded buffaloes in and around Darbhanga (Bihar).

Kumar (2005) reported the effect of season of calving on net cost per kg of milk production to be non-significant in Desi

and crossbred cows of HF and Jersey under farmers' managemental condition in and around Patna (Bihar).

**LACTATION ORDER :**

Singh (1984) observed the effect of parity of lactation on cost of milk production to be significant ($P<0.05$) in Friesian x Zebu cows of private sector maintained in and around Ranchi (Jharkhand).

Priya Raj (2002) studied the effect of lactation order on cost of per kg milk production in HFX and JX cows under farmers' managemental condition in and around Patna. She reported that the 3rd parity out of the five sequences of lactation had significantly ($P<0.01$) lower net cost of per kg milk production.

Kumar[1] (2004) observed that the net cost of per kg milk production during 3rd lactation was significantly ($P<0.05$) lower than all the sequences of lactation upto 5th parity in milch cows and graded buffaloes in and around Darbhanga (Bihar).

Kumar (2005) reported that parity of lactation significantly ($P<0.05$) influenced the net cost per kg of milk production in Desi and crossbred cows under farmers' managemental condition in and around Patna. He observed that the average net cost/kg of milk production significantly ($P<0.05$), decreased from 1st & 2nd to 3rd lactation and thereby it tended to increase in the subsequent lactations.

**FARMING SYSTEM :**

Kumar[1] (2004) reported that the milch animals managed in the dairy units alone had significantly ($P<0.01$) higher net cost / kg of milk production as compared to those maintained in the units integrated with agriculture farming under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) could not find significant effect of farming system on net cost/kg milk production. However, he observed that the units involved in dairying alone had 18 paise higher

net cost as compared to the units maintaining dairy integrated with agriculture farming.

**ECONOMICS OF MILK PRODUCTION:**

Singh *et al.* (1986[a]) reported that HF crossbreds were "Breed of choice" because of their higher average daily milk yield, docile nature, black coat colour, lower fat percentage etc. in and around Ranchi (Jharkhand). However, they found the Jersey crossbred cows to be more economical milk producer, more adaptable and more resistant to stress conditions.

Kalra *et al.* (1995) observed that feeds and fodder contributed the maximum amount of the variable cost item in rural areas of Haryana. The feeds and fodder cost in buffalo, crossbreds and local cows were found to be 58.08%, 56.22% and 63.64% respectively, whereas the corresponding percentages for the labour cost were obtained as 18.18, 19.45 and 16.95.

Badal and Dhaka (1998) also reported that among the various cost items of milk production, feed cost shared maximum followed by labour cost, interest of fixed assets, depreciation of animal and veterinary and miscellaneous expenditure in different breeds of bovines of Gopalganj district in Bihar. They reported the overall net cost of milk production per litre to be Rs. 5.67, Rs. 5.88 and Rs.7.10 in crossbred cows, buffaloes and local cows respectively.

Chandra and Agarwal (2000) observed that among the variable cost items, feeds and fodder contributed 69.8% and 68.2% of the gross cost of maintenance in crossbred cows and buffaloes respectively. They reported the labour cost to be 21.5% and 21.9% in cows and buffaloes respectively. They obtained the net cost of per litre of milk production as Rs. 6.83 and Rs. 7.58 in crossbred cows and buffaloes respectively.

Priya Raj (2002) reported that feeds and fodders contributed 63.43% and 65.41% in HFX and JX cows

respectively under farmers' managemental condition in and around Patna.

Kumar[1] (2004) reported the feed cost to be 66.64%, 66.03% and 66.71% of the gross cost per kg of milk production in Desi, and HFX cows respectively under farmers' managemental condition in and around Darbhanga (Bihar).

Kumar (2005) reported that among the variable cost items, feed cost contributed 69.95%, 71.70% and 69.88% in Desi, HFX and JX cows respectively under farmers' managemental condition in and around Patna (Bihar). He observed the respective percentages of labour cost to be 12.79, 14.89 and 17.19.

**CONSTRAINTS IN LIVESTOCK FARMING :**

Rajendran and Prabhaharan (1993) studied the constraints encountered in the management of crossbred cows in Tamil Nadu. They reported the main constraints to be higher incidence of repeat breeding followed by high capital investment, high frequency of illness of animals, costly feed and costly treatments of the animals.

Savarkar *et al.* (2001) suggested the employment of more veterinary extension efforts for changing the attitude of large number of dairy owners who were still following natural insemination process for breeding dairy cows.

Priya Raj (2002) studied the constraints perceived by the dairy owners in the Khatals located in and around Patna in rearing crossbred cows of HF and Jersey inheritance. She reported the main constraints to be high cost of crossbred cows followed by lack of proper housing, non-availability of green fodder and good dairy animals throughout the years, repeat breeding, costly feed and fodders, high cost of veterinary medicines, unsatisfactory results of A.I., adulteration in cattle feed, cumbersome and tedious procedures in insurance and certification of crossbred cows,

insufficient finance and credit facilities, low value of crossbred male cows and non-remunerative price of milk.

Mishra and Pal (2003) observed the main constraints in dairy sectors perceived by the respondents to be inadequate technical knowledge, poor organizational support and lack of financial support. They observed the major technical constraints to be repeat breeding of cows, low conception rate through A.I, calf mortality and poor knowledge of heat detection. They reported the economic constraints to be lack of credit facilities, high cost of veterinary services and non-availability of green fodder. The major organizational constraints included distant location of A.I. centre, lack of motivation by extension workers and non-availability of A.I. facility. Besides, illiteracy, lack of support from elders and social dogma were the main social constraints perceived by the dairy farmers.

Kumar[1] (2004) studied the major constraints perceived by the dairy owners under farmers' managemental condition in and around Darbhanga (Bihar). He observed the constraints to be costly crossbred cows, repeat breeding problems, costly feed and feed supplements, non-availability of green fodder throughout the year, high cost of veterinary medicines and services, non-availability of genetically improved dairy animals in the locality, poor A.I. results, improper housing, costly land, lack of finance and credit facilities, very less price of crossbred male calves and non-remunerative price of milk.

Kumar (2005) studied the major constraints perceived by the dairy farmers' in the Khatals located in and around Patna in rearing Desi, HFX and JX cows. He observed the major constraints to be high cost of crossbred cows, lack of proper housing due to costly land, non-availability of good dairy animals in the locality, high incidence of repeat breeding, non-availability of green fodder throughout the year, high cost of

feeds, fodders and feed supplements, high cost of veterinary medicines, poor results of A.I., lack of finance/credit facilities, uneconomical crossbred male calves and non-remunerative price of milk.

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# CHAPTER - III

# MATERIALS AND METHODS

# MATERIALS AND METHODS

**Source of Data :**

The present research study was conducted on Desi and HFX and Jersey crossbred cows maintained in private dairy units located in a radius of about 15 km. in and around Biharsharif (Nalanda).

**Area of Experimentation :**

The whole area under study was divided into four distinct zones which are tabulated below :

**Table - 9 : Zone-wise villages/Mohalla of area of experimentation.**

| Sl. No. | Zone No. | Major Area | Villages/Mohalla |
|---|---|---|---|
| 1 | I | Biharsharif proper | Ramchandrapur, Bharawpar, Patelnagar, Pulpar, Khandakpar, Kagji Mohala, Amberchowk, Bhaisasur, Sohsarai, Naisarai, Bari Pahari, Asha Nagar, Teachers Colony etc. |
| 2. | II | Noorsarai Block | Noorsarai proper, Chandasi, Jalalpur, Bridgepur, Godiha, Salepur, Khemibigha, Bheria, Barakhrud, Muzzafarpur, Kathauli, Juhichaker etc. |
| 3. | III | Rahui Block | Dekpura, Itasan, Rahui Proper, Moratalab, Bhaganbigha, Kutubpura, Ganjpar, Gobaria, Rahimpur, Supasan, Patasan etc. |
| 4. | IV | North West Biharsharif | Maghra, Dahpar, Kebai, Nalanda, Silaw, Dayalubigha, Mamurabad, Kakaila, Pawapuri, etc. |

**Primary Survey :**

The primary survey was conducted in the private dairy units popularly known as 'Khatals' located in a radius of 15 km. in and around Biharsharif (Nalanda). 'Khatals' consisting of at least 3 or more Desi or crossbred cows either alone or in combination were enumerated through a "door to door survey" method in this study. The sole aim of dairy Khatal owners was profitable production. However, the animals were fed poor quality of roughages and there was deficiency of greens in the feed. This study did not include the dairy units which were managed with exceptional superiority and which also consisted of buffaloes. A total of 910 cows consisting of 210 Desi, 406 HFX and 294 JX cows were enumerated from 97 dairy units located in and around Biharsharif (Nalanda). The details of zone-wise distribution of cows are tabulated below :

**Table – 10 : Zone wise distribution of enumerated dairy units of cows of different genetic groups.**

| Zones | Dairy units enumerated | Genetic groups | | | |
|---|---|---|---|---|---|
| | | Desi | HFX | Jersey x | Total |
| I | 27 | 58 | 110 | 82 | 250 |
| II | 20 | 41 | 94 | 65 | 200 |
| III | 22 | 46 | 96 | 67 | 209 |
| IV | 28 | 65 | 106 | 80 | 251 |
| **Total** | **97** | **210** | **406** | **294** | **910** |

**General managerials practices of dairy units :**

The study revealed that there were no uniform managerial practices in the Khatals. The cows, in general, were stallfed with individual feeding. Cows were provided the

concentrates depending upon their physical and physiological status such as size of the body, milk production, stage and sequence of lactations, dry period etc.

Generally home made concentrate mixtures were fed to the animals with few exceptions too. The most common items of dry fodder consisted of wheat bhoosa and choffed paddy. The main source of the green fodders included seasonal cultivated and un-cultivated grasses. Besides, there was general practice to add mineral mixture, vitamins and common salt to balance the ration. Although majority of the dairy units did not follow the scientific schedule of vaccination completely, yet they considerably took prophylactic and curative measures against various diseases. Besides, A.I. was also in common practice for breeding the cows in the dairy units.

The housing pattern in the dairy units was not as per the scientific norms. The cows were maintained in four types of houses such as Kachcha, 1/2 and 3/4 pacca and also full pucca houses. The different types of houses are classified as follow.

Type A – Full kachcha house

Type B – Half kachcha house (only wall pucca without plaster)

Type C – 3/4$^{th}$ pucca house (walls, floors and feeding trough pucca)

Type D – Full pucca house (roof of CA/CI sheets).

**Respondent Units :**

Out of 97 enumerated units, only 76 units provided relevant informations. Such units were defined as respondent units and data obtained from them were considered for further investigation. These respondent units consisted of 759 cows which included 186 Desi, 332 HFX and 241 JX cows. The

zone-wise distribution of the respondent units along with cows of different genetic groups are depicted in table – 11.

**Table – 11 : Zone-wise distribution of dairy units and cows of different genetic groups in respondent units.**

| Zones | Respondent dairy units | Crossbred cows | | | |
|---|---|---|---|---|---|
| | | Desi | HFX | Jersey x | Total |
| I | 22 | 53 | 90 | 66 | 209 |
| II | 16 | 37 | 79 | 56 | 172 |
| III | 18 | 38 | 80 | 57 | 175 |
| IV | 20 | 58 | 83 | 62 | 203 |
| **Total** | **76** | **186** | **332** | **241** | **759** |

**Sampling of respondent units :**

Out of the total 76 units, 50% i.e. 38 dairy units consisting of 580 cows of different genetic groups were randomly selected utilizing procedures of stratified random sampling with proportional allocation" (Snedecor and Cochran 1967). The zone-wise distribution of selected respondent units along with the number of Desi and crossbred cows and also the number of discarded cows have been depicted table-12.

A total 253 cows were discarded due to their non-identified genetic architecture and/or non-completion of one calving-interval during the period of this study.

**Table – 12 : Zone wise distribution of cows of different genetic groups in selected respondent units.**

| Particulars/Genetic group | Zones | | | | Total |
|---|---|---|---|---|---|
| | I | II | III | IV | |
| **No. of units selected** | **11** | **8** | **9** | **10** | **38** |
| No of cows studied | | | | | |
| Desi | 21 | 20 | 21 | 22 | 84 |
| HFX | 36 | 33 | 33 | 34 | 136 |
| JX | 27 | 26 | 26 | 28 | 107 |
| **Sub total (A)** | **84** | **79** | **80** | **84** | **327** |
| Discarded Cows | | | | | |
| Desi | 19 | 12 | 11 | 22 | 64 |
| HFX | 30 | 28 | 27 | 21 | 106 |
| JX | 22 | 20 | 20 | 21 | 83 |
| **Sub total (B)** | **71** | **60** | **58** | **64** | **253** |
| Total (A + B) | | | | | |
| Desi | 40 | 32 | 32 | 44 | 148 |
| HFX | 66 | 61 | 60 | 55 | 242 |
| JX | 49 | 46 | 46 | 49 | 190 |
| **Grand Total** | **155** | **139** | **138** | **148** | **580** |

**Collection of data :**

Data were recorded from the cows of defined genetic groups and which also completed at least one calving-interval.

The information consisting of zone, herd size, herd constitution, farming system, genetic architecture, measures of

production, reproduction and economic efficiencies were noted. The details are as below :

**Information of the unit :**

(a) Zonal location

(b) Herd-size

(c) Herd-constitution

(d) Farming system

**Information on the cows :**

**A) General**

(a) Genetic architecture :

(i) Desi cows consisting of local and indigenous breeds of cows.

(ii) HF crossbred cows

(iii) Jersey crossbred cows

(b) Season of calving

(c) Lactation order

**B) Measures of production efficiency :**

(a) Lactation milk yield (kg)

(b) Lactation length (days)

(c) Peak yield (kg)

(d) Days to attain peak yield (days)

(e) Milk yield per day of lactation length (Kg) (MY/day LL)

(f) Milk yield per day of calving interval (Kg) (MY/day Cl)

**C) Measures of Reproduction efficiency :**

(a) Dry period (days)

(b) Calving interval (days)

**D) Measure of Economic efficiency :**

(a) Cost of milk production

**The distribution of Desi, and crossbred cows with the details of herd size, herd constitution season of calving farming system and parity of lactation are depicted in table – 13.**

The selected respondent units were provided the schedule and questionnaires to record the information as per the objective of the present investigation. The selected respondent units were approached frequently for collection, monitoring and recording the data. Apart from these, the owners were also interviewed and information obtained from them was also included in this investigation.

Milk yield was recorded weakly upto the attainment of peak milk yield after which it was recorded fort-nightly.

The bi-weakly records during the lactation were averaged to find out the mean daily milk yield.

The lactation yield was obtained by multiplying the average daily milk yield with number of days the cow remained in milk. The directly observed economic traits like lactation length (LL), peak yield (PY), days to attain peak yield (DAPY), dry period (DP) and calving interval (CI) were recorded in the schedules.

**Table – 13 : Distribution of cows of different genetic groups on the basis of various non-genetic factors.**

| Parity | No. of cows | Herd size | No. of cows | Herd Constitution | No. of cows | Season of Calving | No. of cows | Farming System | No. of cows |
|---|---|---|---|---|---|---|---|---|---|
| 1st | 76 | 3 – 4 | 46 | D | 19 | Winter | 88 | Agriculture + Dairying | 123 |
| 2nd | 91 | 5- 6 | 79 | HF X | 31 | Summer | 118 | Only Dairying | 204 |
| 3rd & 4th | 106 | 7- 8 | 92 | J X | 24 | Rainy | 121 | | |
| 5th & above | 54 | 9 & above | 110 | D + JX | 37 | | | | |
| | | | | D+ HF X | 51 | | | | |
| | | | | J+ HF X | 76 | | | | |
| | | | | D+ JX+ HF X | 89 | | | | |
| **Total** | **327** | | **327** | | **327** | | **327** | | **327** |

**Cost of milk production :**

The measure of cost of milk production of a cow was taken as the "net cost of maintenance of a cows for each kg of milk she produced of an inter-calving period". Thus, it was obtained as the ratio of average daily maintenance cost of a cow during an inter calving period and average daily milk she produced during the inter-calving period i.e.

$$\text{Cost of per kg milk of a cow} = \frac{\text{Average maintenance cost (Rs.) of cow during an inter calving period (days)}}{\text{Value of average milk yield (Rs.)/per day of the inter calving period (days)}}$$

The various expenditure items on maintenance of a cow were broadly categorized into

(a) Fixed cost items

(b) Variable cost items

(c) Miscellaneous cost items

**(A) Fixed cost item :**

**(i) Depreciation on animals :**

It was based on the market value of milch cows during the period of study. A general prediction formulae to estimate approximate market value of a lactating cow of Nalanda could be derived on the basis of exact purchase cost of 100 cows, their milk yield and lactation order at the time of purchase which is tabulated as below :

**Table –14: Prediction formula to estimate the approximate market value of lactating cows.**

| Lactation No. | Rate of calculating price (Rs.) cows |
|---|---|
| 1. | Milk yield (kg) x 1500 = 00 |
| 2. | Milk yield (kg) x 1400 = 00 |
| 3. | Milk yield (kg) x 1100 = 00 |
| 4. | Milk yield (kg) x 900 = 00 |
| 5. | Milk yield (kg) x 600 = 00 |

Animals beyond 5th lactation were excluded from this study. A sum of Rs. 800 = 00 and Rs. 500 = 00 was added to the cost of a Friesian and Jersey crossbred cows respectively. Considering the productive life of a cow to be of five lactations, the depreciation was calculated @ 12% of the estimated cost per calving interval assuming that 40% of the cow's cost could be refundable even after completion of its fifth lactation as "salvage value". Per day depreciation value of a cow was obtained as the "ratio of 12% of the estimated cost of the cows and number of days in inter-calving period.

**Depreciation on building/sheds :**

It was based on categories of the houses built in and around Biharsharif (Nalanda). The following approximate rates were derived to estimate the cost of houses built up and utilized to run the Khatals in and around Biharsharif (Nalanda).

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**Table – 15 : Cost of different types of housing.**

| Type of housing | Rate to build up per sft. covered area (Rs.) | Cost of troughs etc. (Rs.) | Total cost of housing/animal (Rs.) |
|---|---|---|---|
| Type A | 30 = 00 | 100 = 00 | 1300 = 00 |
| Type B | 50 = 00 | 200 = 00 | 2200 = 00 |
| Type C | 90 = 00 | 500 = 00 | 4100 = 00 |
| Type D | 120 = 00 | 500 = 00 | 5300 = 00 |

The basic assumptions behind fixation of housing cost were to provide 40 sft. covered area to each cow. The construction cost of trough etc. varied according to the type of construction. The total life of (A) and (D) type houses were accounted to be 10 and 40 years respectively, whereas for (B) and (C) types it was 25 yrs. Depreciation on housing was calculated as the ratio of "cost of housing per animal and the estimated life of that house in days". Depreciation per kg of milk produced by an animal was calculated as :

$$\text{Depreciation per kg of milk produced by an animal} = \frac{\text{Housing cost for an animal}}{\text{Estimated life of that house (in days) x A.V. daily milk produced by that animal for the calving interval.}}$$

**Depreciation on farm utensils, machineries, equipments and other assets except animals and housing :**

The total cost of utensils, equipments, machineries and other assets of daily use such as chaff cutter, buckets, milk pots, electric motor etc. with each and every selected respondent unit was estimated. The depreciation was

calculated @ 10% of the total cost per annum. The depreciation per kg of milk produced at the Khatals was reckoned as the ratio of "10 percent of the total cost of utensils, equipments, machineries etc. at a Khatal and 365 x average milk yield (Kg)/day of calving interval for that Khatal, keeping in mind that utensils, equipments, machineries etc. of a Khatal were equally used for every animal at that Khatal irrespective of its level of milk production. Therefore, this cost item was considered as fixed for every cow.

**Interest on fixed capital :**

Fixed capital included all the assets of a respondent unit including cost of animal, housing, utensils, machineries etc. in this study. The interest on the fixed capital was worked out @ 8% per annum.

**Variable cost item :**

**(a) Cost of feeds and fodders :** Average quantity of fodder fed per cow was obtained by dividing the total quantity of fodder supplied by the number of cows fed. The prevailing market rate including transportation cost was taken as the purchase price for various green and dry fodders. For calculating the expenditure on concentrates, the rates of purchase of concentrate ration or its ingredient along with its transportation cost was taken into account. The seasonal variation in the market rates of different feed and fodders were also taken into account. In this way, the average daily expenditure for feed and fodders was worked out for each cow under investigation.

**(b) Labour cost :** The total labour cost of milk production was considered as the sum of paid (hired) and unpaid (family labourer). For family labourers the actual time spent daily on looking after the animals and other farm operations by each of the family members including

women were recorded and apportioned for each animal. The wage paid to the hired labourer as well as family labourer was calculated @ Rs. 60=00/day (8 hr.).

**(c) Cost of A.I. and Veterinary aids :** Cost of items for A.I. and veterinary aids included cost of medicines, vaccines, semen and other sanitary items as well as the remuneration paid to the veterinarians, inseminators etc. Since majority of the respondent units could not provide individual records of its expenditure on this cost item, the line of proposition of Tripathi *et al.* (1978) for veterinary and A.I. costs was utilized in this study.

**(d) Miscellaneous cost item :** The miscellaneous cost item consisted of electric and water tariff, the revenue of the land, cost of repair of building, utensils/machinery etc. as well as unforeseen minor contingent expenditures.

In the present study it was kept fixed @ Rs. 500.00/cow/calving interval. Finally, the cost on account of this component of expenditure was apportioned for each kg of milk produced by a cow as :

$$\text{Miscellaneous cost/kg milk} = \frac{500 = 00}{\text{Inter-calving period (days) of a cow x Average milk yield per day of calving interval of that cow.}}$$

**Gross cost of maintenance :**

The gross cost of maintenance of cow consisted of expenditure on all cost components viz. depreciation on animal, building/shed, equipment, machinery, farm utensils etc, interest on fixed capital, cost of feed and fodders, labour cost, cost of veterinary aids and A.I. as well as miscellaneous expenditures.

**Income :**

Farm yard manure (FYM) consisting of dung and other animal excreta and empty concentrate's bags were the only

source of income other than milk but it could not be possible to have précised record of income from individual cow on account of dung or FYM produced by Khatals. Therefore, assuming that an adult cow excretes on an average 20 kg wet dung (Reddy *et al.*, 1972) and current market rate of wet dung in and around Biharsharif (Nalanda) being an average of Rs. 10/quintal, it was kept as a fixed income @ Rs. 2.00 per animal/day.

**Net cost of maintenance :**

It was obtained by deducting income from dung from the gross cost of maintenance. The net cost of maintenance per kg of milk produced per day of calving interval by particular cow was termed as "The cost of per kg milk production" for that cow.

**Classification of data :**

The data were classified on the basis of genetic group of the cows, location of herd (zones), herd size, herd constitution, season of calving, lactation order and farming system for studying the effect of various genetic and non-genetic factors on the economic traits. The various factors affecting the traits under study were classified below :

**(1) Genetic group :**

The experimental units under study were classified under 3 genetic groups such as :

(i) Desi cows (ii) Friesian crossbred cows and (iii) Jersey crossbred cows.

**(2) Location of herd (zones) :**

**Zone I : Biharsharif proper**

**Zone II : Noorsarai Block**

**Zone III : Rahui Block**

**Zone IV : North West Biharsharif**

The details have been mentioned in "area of experimentation".

**(3) Herd size :**

Dairy units were classified into 4 groups of herd sizes.

(i) Units having 3-4 cows.

(ii) Units having 5-6 cows.

(iii) Units having 7-8 cows.

(iv) Units having 9 & above cows.

**(4) Herd constitution :**

The cows were grouped into seven categories of herd constitution as mentioned below :

(i) Desi alone.

(ii) HFX alone.

(iii) JerseyX alone

(iv) Desi + JerseyX

(v) Desi + HFX

(vi) JerseyX + HFX

(vii) Desi + Jersey X + HFX

**(5) Season of calving :**

The year was classified into 3 as mentioned below :

i) Winter : November – February

ii) Summer : March- June

iii) Rainy : July – October

**(6) Lactation order :**

Performance records of the cows were classified into four groups on the basis of sequences of lactation.

i) 1st parity

ii) 2nd parity

iii) 3rd & 4th parity

iv) 5th parity and above

**(7) Farming system :**

The enumerated dairy units were classified according to the system of farming adopted by the farmers which are mentioned as below :

i) Mixed farming (Animal husbandry integrated with agriculture).

ii) Only animal husbandry.

**STATISTICAL METHODS :**

Data were subjected to statistical analysis through computer in ARIS (Agricultural Research Information System) cell of Indian Veterinary Research Institute, Izatnagar, Bareilly (U.P.).

Means and standard errors were calculated using the formulae given by Snedecor and Cochran (1967).

**Stratified random sampling with proportional allocation :**

Assuming that the population of size N is divided into K Strata (zones) of sizes $N_1$, $N_2$, $N_3$ ..... $N_k$ such that,

$$\sum_{i=1}^{K} N_i = N$$

Let sample of sizes $n_1$, $n_2$, $n_3$ ..... nk be drawn from these strata respectively so that,

$$\sum_{i=1}^{K} n_i = N$$

Let $n_i \alpha N_i$

Or $n_1 = C N_i$ ..... (1)

Where,

C is the constant of proportionality.

After taking summation on both the sides, we get.

$$\sum_{i=1}^{K} n_i = C \sum_{i=1}^{K} n_i$$

Or, n = CN

Hence, n/N = C (constant)

After substituting the value of C in the equation (1), we get :

$$n_i = \frac{(n)\, N_i}{(N)} \qquad (i = 1,2,3, \ldots\ldots\ldots\ldots, K)$$

Let $Y_{ij}$ be the value of $j^{th}$ unit in the $i^{th}$ strata of population (i = 1,2,3, ....., K and j = 1,2,3, .....$N_i$ and $y_{ij}$ be the corresponding sample observation (i = 1,2,3, .....K and j = 1,2,3, .....$n_i$), then population mean $\bar{Y}$ given by:

$$\bar{Y}_{ij} = 1/N \sum_{i=1}^{K} \sum_{i=1}^{N_i} \bar{y}_{ij}$$

$$= 1/N \sum_{i=1}^{K} N_i \bar{y}_i$$

Where,

$\bar{Y}_i = 1/N_i \sum_{j=1}^{N_i} y_{ij}$, which is the mean of the $i^{th}$ strata of the population.

The population variance

$$V(\bar{y}) = \sum_{i=1}^{Ni} \frac{(Ni)^2}{N} (1/n_i - 1/N_i)s_i^2$$

$$= \sum_{i=1}^{Ni} w_i^2 \; (1/n_i - 1/N_i)s_i^2$$

Where, $w_i = ni/N$ and $s_i^2 = 1/(Ni-1) \sum_{j=1}^{N_i} (y_{ij} - \bar{Y}_i)^2$

Similarly, the sample mean can be defined as :

$$\bar{y}_i = 1/n_i \sum_{j=1}^{n_i} \bar{y}_i ,$$

Where,

$y_1 = 1/k \sum_{i=1}^{K} y_{ij}$ i.e. the sample mean of the $i^{th}$ strata and

$$V(\bar{y}) = \sum_{i=1}^{N_i} w_i^2 (1/n_i - 1/N_i) s_i^2$$

Since, $[E (S)^2 = S^2]$

$$s_i^2 = 1/n_i - 1 \sum_{j=1}^{n_i} (Y_{ij} - y_i)^2$$

**Least squares analysis :**

To study the effect of various genetic and non-genetic factors on milk production efficiency traits, data were subjected to least squares analysis (Harvey, 1966) for which the following mathematical model was utilized.

$$Y_{ijklmnop} = \mu + G_i + HL_j + HS_k + HC_1 + L_m + S_n + Z_0 + e_{ijklmnop}$$

Where,

$Y_{ijklmnop}$ = The value of $p^{th}$ individual under $i^{th}$ genetic group, $j^{th}$ herd location, $k^{th}$ herd size, $I^{th}$ herd constitution, $m^{th}$ lactation order, $n^{th}$ season of calving and $o^{th}$ farming system.

$\mu$ = Overall general mean

$G_i$ = The effect of $i^{th}$ genetic group (i = 1,2,3)

$HL_j$ = The effect of location of herd (j = 1,2,3,4)

$HS_k$ = The effect of herd size (k = 1,2,3,4)

$HC_l$ = The effect of herd constitution (1 = 1,2,3,4,5,6,7)

$L_m$ = The effect of lactation order (m = 1,2,3,4,)

$S_n$ = The effect of season of calving (n = 1,2,3,)

$Z_o$ = The effect of farming system (0 = 1,2)

$e_{ijklmnop}$ = The random error which is distributed normally and independently with mean 0 and variance $\sigma^2_e$

Duncan's Multiple Range (DMR) test as modified by Kramer, 1957 was utilized for pair-wise comparison of the least squares means at 5% level of probability.

**Constraints in dairy farming :**

The respondents provided the important technological and managemental problems perceived by them, in maintaining the dairy units in and around Biharsharif (Nalanda). Garett's ranking technique was used to rank the problems. The order of merit, thus given by the respondents, were converted into ranks by using the following formulae (Garett & Woodworth, 1969).

$$\text{Percent position} = \frac{100\ (R_{ij} - 0.5)}{N_j}$$

Where $R_{ij}$ = Rank given for $i^{th}$ constraints by the $j^{th}$ individual

$N_j$ = Number of factors ranked by $j^{th}$ individual.

The percent position of each rank was converted into scores by referring Garett's ranking table. Then for each factor the scores of individual respondents were added. The mean scores for all the factors were arranged in descending order and ranked.

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# CHAPTER - IV

# RESULTS AND DISCUSSION

# RESULTS AND DISCUSSION

**Lactation Milk Yield :**

Least squares means ± SE of lactation milk yield (LMY) of cows under genetic and various non-genetic factors have been presented in table - 17.

**Average Lactation Yield :**

The average LMY (Kg) of Desi, HFX and JX were obtained as 1030.15 ± 39.40, 2705.13 ± 32.99 and 2137.48 ± 36.31 respectively (Table-17) which fall in the ranges of 693.2 kg (Parmar *et al.*, 1986) to 1935.61 kg (Vij *et al.*, 1992) for Desi, 1933.2 kg (Parmar *et al.*, 1986) to 3655.1 kg (Singh *et al.*, 1986[a]) for HFX and 1256.8 kg (Thakur *et al.*, 1999) to 2681.11 kg (Patel and Trivedi, 1989) for JX as reported in the literature (Table-1). Managemental and environmental variations, differences in breeds of indigenous cows and levels of exotic inheritance for crossbreds might be responsible for variations in average lactation milk yield.

**EFFECT OF GENETIC FACTOR :**

Least squares analysis of variance (Table-16) reflected significant ($P<0.01$) effect of genetic group on lactation yield. The lowest LMY (1030.15 kg) and the highest LMY (2705.13kg) were obtained in Desi and HFX cows respectively. Duncan's Multiple Range Test (DMRT) revealed significantly ($P<0.05$) 1674.98 kg and 567.65 kg higher milk yield in HFX than Desi and JX cows respectively. Besides, JX had also significantly ($P<0.05$) 1107.33 kg more milk yield than Desi cows. Thus, the analysis revealed that HFX and JX had more than double LMY than Desi cows. The critical

**Table - 16 : Least squares analysis of variance showing the effect of different genetic & non-genetic factors on Lactation Yield(kg) and Lactation Length (days).**

| Source of variation | D.F. | Lactation Yield | | Lactation Length | |
|---|---|---|---|---|---|
| | | MSS | F | MSS | F |
| Zone | 3 | 264053.2 | 3.124* | 2527.554 | 1.713$^{NS}$ |
| Genetic Group | 2 | 43921410.0 | 519.565** | 6703.203 | 4.544* |
| Herd Size | 3 | 1871858.0 | 22.146** | 6974.326 | 4.728** |
| Herd Constitution | 6 | 201010.6 | 2.378* | 2642.024 | 1.791$^{NS}$ |
| Season of Calving | 2 | 1929432.0 | 22.828** | 18238.74 | 12.364** |
| Lactation Order | 3 | 120757.0 | 1.428$^{NS}$ | 5344.080 | 3.622* |
| Farming System | 1 | 894472.5 | 10.582** | 13160.13 | 8.921** |
| **Error** | **306** | **84520.16** | | **1475.072** | |

*** Significant (P<0.05)**
**** Significant (P<0.01)**
**NS : Non-significant**

analysis reflected that both HFX and JX are well adapted in the agroclimatic region prevalent in and around Biharsharif (Nalanda) with respect to LMY. Apart from these, it also proved the superiority of HF crossbred cows over JX cows for milk yield suggesting the more use of HF than Jersey for crossbreeding in and around Biharsharif (Bihar). Panda and Sadhu (1983) and Kumar (2005) also reported superiority of HF crossbreds over Jersey crossbreds. Kumar (2005) reported

**Table-17 : Least squares means of Lactation Milk Yield & Lactation Length under different genetic and non-genetic factors.**

| Genetic & Non-genetic factors | LACTATION MILK YIELD (kg) MEAN ± SE | LACTATION LENGTH (Days) MEAN ± SE |
|---|---|---|
| **Genetic factors :-** | | |
| **Desi** | $1030.15^{a} \pm 39.40$ | $352.18^{a} \pm 5.20$ |
| **HF Crossbred** | $2705.13^{b} \pm 32.99$ | $331.78^{b} \pm 4.35$ |
| **Jersey Crossbred** | $2137.48^{c} \pm 36.31$ | $342.77^{b} \pm 4.79$ |
| **Non-genetic factor:-** | | |
| **Location of herd :** | | |
| **I** | $1899.88^{a} \pm 36.95$ | $334.95 \pm 4.88$ |
| **II** | $2021.61^{b} \pm 39.57$ | $345.61 \pm 5.22$ |
| **III** | $2005.12^{b} \pm 37.67$ | $348.88 \pm 4.97$ |
| **IV** | $1903.76^{a} \pm 36.73$ | $339.54 \pm 4.85$ |
| **Herd Size :-** | | |
| **3-4** | $1869.52^{a} \pm 48.28$ | $342.08^{ab} \pm 6.37$ |
| **5-6** | $1778.19^{a} \pm 37.68$ | $328.28^{a} \pm 4.97$ |
| **7-8** | $2049.61^{b} \pm 34.56$ | $350.52^{b} \pm 4.56$ |
| **9 & above** | $2133.04^{b} \pm 31.47$ | $348.11^{b} \pm 4.15$ |
| **Herd Constitution:-** | | |
| **D** | $1937.94^{abcd} \pm 75.02$ | $334.54 \pm 9.91$ |
| **HFX** | $1905.05^{abd} \pm 61.42$ | $332.68 \pm 8.11$ |
| **JX** | $1856.73^{b} \pm 68.20$ | $344.08 \pm 9.01$ |
| **D + JX** | $1932.75^{abcd} \pm 54.83$ | $333.84 \pm 7.24$ |
| **D + HFX** | $2084.76^{ce} \pm 40.37$ | $354.17 \pm 6.12$ |
| **JX + HFX** | $1957.01^{abcd} \pm 44.36$ | $350.23 \pm 5.86$ |
| **D + JX + HFX** | $2028.90^{de} \pm 36.27$ | $346.16 \pm 4.79$ |
| **Season of Calving :-** | | |
| **Winter** | $1955.47^{a} \pm 35.38$ | $325.66^{a} \pm 4.67$ |
| **Summer** | $1824.02^{b} \pm 29.50$ | $348.77^{b} \pm 3.89$ |
| **Rainy** | $2093.29^{c} \pm 30.07$ | $352.30^{b} \pm 3.97$ |
| **Lactation Order :-** | | |
| **1st** | $2007.72 \pm 36.15$ | $336.07^{a} \pm 4.77$ |
| **2nd** | $1909.74 \pm 33.36$ | $348.16^{bc} \pm 4.40$ |
| **3rd & 4th** | $1946.59 \pm 32.30$ | $333.86^{a} \pm 4.26$ |
| **5th & above** | $1966.31 \pm 42.38$ | $350.90^{b} \pm 5.60$ |
| **Farming System :-** | | |
| **Agriculture + Dairying** | $2021.72^{a} \pm 31.36$ | $350.02^{a} \pm 4.14$ |
| **Dairying alone** | $1893.46^{b} \pm 24.97$ | $334.47^{b} \pm 3.30$ |

**Column - wise means bearing different superscripts differ significantly ($P<0.05$).**

more than double LMY in HFX and JX cows than Desi. Raj Kumar (1985) also observed nearly double higher LMY in JerseyX than Hariana cows. Various authors like - Hyatnagarkar *et al.* (1990), Jadhav *et al.* (1991), Singh *et al.* (1993), Thakur *et al.* (1999), Bhattacharya *et al.* (2002), Priya Raj (2002), Akhter *et al.* (2003), Bhadauria and Katpatal (2003), Kumar[1] (2004), Kumar[2] (2004), Kumar (2005) and Sharan (2005) have also reported significant ($P<0.01$) effect of genetic group on LMY. The findings of the present study are in conformity with the reports of various authors mentioned above.

**EFFECT OF NON GENETIC FACTORS :**

**Location of herd (zones) :**

Least squares of analysis of variance (Table-16) presented significant ($P<0.05$) effect of zone on LMY. The lowest (1899.88 kg) and the highest (2021.61kg) LMY were observed in zones I and II respectively. Zone II had significantly ($P<0.05$) 121.73 kg and 117.85 kg more LMY than zones I and IV respectively. Zone III had significantly ($P<0.05$) 105.24 kg and 101.36 kg more LMY than zones I and IV respectively in this study. Although Zone II had 16.49 kg more LMY than zone III, Yet it did not differ significantly. Besides, there was no significant difference between the LMY of zones I and IV Singh *et al.* (1986[b]), Hyatnagarkar *et al.* (1990), Jadhav *et al.* (1991) and Kumar (2005) also reported significant effect of zones on LMY which are similar to the findings of the present investigation. However, Priya Raj (2002), Bhadauria and Katpatal (2003) and Kumar[1] (2004) could not find significant effect of farms/zones on LMY. The variations in LMY in different zones might be attributed to differences in managemental practices prevalent in different zones in and around Biharsharif (Nalanda).

**Herd size :**

Least squares analysis of variance presented in Table - 16 revealed significant (P<0.01) effect of herd size on LMY. It was observed that the herd sizes of 7-8 and 9 & above had significantly (P<0.05) higher LMY than the sizes of 3-4 and 5-6. The herd size 9 & above had significantly (P<0.05) 263.52 kg and 354.85 kg more LMY than the herd sizes of 3-4 and 5-6 respectively. Similarly, the herd size of 7-8 had significantly (P<0.05) 180.09 kg and 271.42 kg moreLMY than the herd sizes of 3-4 and 5-6 respectively. However, the herd sizes of 3-4 and 5-6 as well as 7-8 and 9 & above did not differ significantly. Kumar[1] (2004) and Kumar (2005) observed significant (P<0.05) effect of herd size on LMY which are in agreement with the findings of the present investigation. The finding of the present study was suggestive of the fact that the managemental practices prevailing in the Khatals/dairy units in and around Biharsharif (Nalanda) were able to sustain 7 and above cows in a herd for higher LMY.

**Herd Constitution :**

Herd constitution played significant (P<0.05) role on LMY (Table-16). The highest LMY was obtained in the Khatals maintaining Desi along with HFX cows which is similar to the finding of Kumar (2005). However, Kumar[1] (2004) and Kumar (2005) reported non-significant effect of herd constitution on LMY.

**SEASON OF CALVING :**

Least squares analysis of variance presented significant (P<0.01) effect of season of calving on LMY (Table-16). The LMY was observed to be highest in the cows calved during rainy season. It was significantly (P<0.05) higher by 137.82 kg and 269.27 kg than winter and summer seasons of calving respectively. Besides, the cows calved during winter season had significantly (P<0.05) 131.45 kg more LMY than

those calved during summer. Higher LMY in rainy season might be attributed to the availability of more green fodders. Shettar and Govindaiah (1999), Akhter *et al.* (2003), Kumar[1] (2004), Kumar (2005) and Sharan (2005) also reported significant effect of season of calving on LMY. However, various authors such as Jadhav *et al.* (1991), Yadav and Rathi (1992), Singh *et al.* (1993), Raheja (1997). Singh *et al.* (2000), Priya Raj (2002), Shiv Prasad (2002), Bhadauria and Katpatal (2003) and Kumar[2] (2004) did not find the effect of season of calving on LMY to be significant.

**LACTATION ORDER :**

Least squares analysis of variance presented non-significant effect of parity of lactation on LMY (Table-16). However, the LMY increased by 36.85 kg in 3rd & 4th lactations from 2nd parity and by 19.72 kg in 5th & above lactations from 3rd & 4th but the differences in mean LMY were observed to be non-significant. Bhatnagar *et al.* (1979) reported non-significant effect of dam's parity on 1st lactation total yield in Sahiwal and its crosses with Brownswiss. Kumar[2] (2004) observed that the parity of lactation did not play any significant role on 300 days or less milk yield in Hariana and its crosses with Holstein Friesian and Jersey. Sharan (2005) also observed non-significant effect of parity of lactation on LMY in Hariana and its crosses with Holstein Friesian. However, contrary to the finding of the present study, Singh *et al.* (1986[b]), Priya Raj (2002), Shiv Prasad (2002), Kulkarni *et al.* (2003) and Kumar (2005) reported significant effect of parity of lactation on LMY.

**FARMING SYSTEM :**

Duncan's Multiple Range Test (DMRT) revealed that cows maintained in the units integrated with agriculture farming yielded significantly ($P<0.01$) 128.26 kg more LMY than those which were maintained in the units involving

effect of genetic group on LL (days) have also been reported by Jadhav *et al.* (1991), Thakur *et al.* (1999), Priya Raj (2002), Kumar[2] (2004) and Sharan (2005) in different genetic groups of cows. Kumar (2005) also obtained highest LL (days) in Desi cows followed by HFX and JX under farmers' managemental condition, the trend of which is very similar to the finding of the present investigation. Priya Raj (2002) also observed longer LL (days) of JX than HFX which is in close agreement with the finding of the present study. However, contrary to the present finding, Raj Kumar (1985) in J x H ($F_1$), Singh *et al.* (1993) in Sahiwal and its crosses with Jersey and Red Dane, Shettar and Govindaiah (1999) in different levels of HF, J and Red Dane inheritance with indigenous cows and Kumar (2005) in Desi, HFX and JX reported that genetic group did not influence lactation length significantly.

**EFFECT OF NON-GENETIC FACTORS :**

**EFFECT OF ZONES :**

Least squares means reflected non-significant effect of zones on LL (days) (Table-16). The mean LL (days) ranged from 334.95 in zone I, to 348.88 in zone III. Priya Raj (2002) in HFX and JX cows and Kumar[1] (2004) in Desi and crossbred cows and Kumar (2005) in Desi, HFX and JX cows also reported non-significant effect of zones on LL (days) under farmers' managemental condition which are in conformity with the finding of the present study. It is worth mentioning here that the present study was carried out in a radius of 15 km. only in and around Biharsharif (Nalanda) which was divided into 4 zones and therefore there was no much variation in the agroclimatic conditions of different locations of herd. However, Jadhav *et al.* (1991) observed significant ($P<0.01$) effect of farm on LL (days ) in different grades of HF with Sahiwal which might be, possibly, due to the study conducted in the farms

maintained at Ambala, Dehradun and Jalandhar having agro-climatic differences leading to variations in lactation length.

**HERD SIZE :**

Table-16 presented significant (P<0.01) effect of herd size on LL (days) in this study. It was observed that the cows maintained in the herd sizes of 7-8 and 9 & above had significantly (P<0.05) 22.24 days and 19.83 days longer LL than the herd having the size of 5-6 respectively. However, the average LL (days) of the herd sizes 7-8 and 9 & above did not differ significantly suggesting longer LL in a herd size of 7and above. Kumar (2005) also observed longer but non-significant LL (days) in the herd size of 7 and above than 3-6, the trend of which is similar to the finding obtained in the present investigation. Contrary to this, Priya Raj (2002) and Kumar[1] (2004) reported that herd size did not influence LL significantly.

**HERD CONSTITUTION :**

Least squares analysis of variance (Table-16) presented non-significant effect of herd constitution on LL (days). Kumar[1] (2004) also reported non-significant effect of herd constitution on LL in different genetic groups of cattle under farmers' managemental conditions, the trend of which is similar to the finding obtained in the present investigation. However, Kumar (2005) observed significant (P<0.05) effect of herd constitution on this trait.

**SEASON OF CALVING :**

Season of calving played significant (P<0.01) role on lactation length in Desi, HFX and JX cows in this study (Table-16) . It was observed that rainy calvers had the longest LL (days ) followed by summer and winter calvers. Rainy calvers had significantly (P<0.05) 26.64 days longer LL (days) than winter calvers. Besides summer calvers had also significantly (P<0.05) 23.11 longer LL (days) than winter calvers. However,

dairying alone in the Khatals in and around Biharsharif (Nalanda). Kumar (2005) also reported significantly (P<0.01) higher LMY of the cows managed in the dairy units along with agriculture farming than those units maintaining dairying alone in and around Patna (Bihar). The trend obtained in the present investigation is similar to the findings of Kumar (2005). It might be possible that the farmers might have grown the quality feeds and green fodders in time which were fed to the animals leading to increase in LMY. However, Kumar[1] (2004), contrary to the findings of the present study, reported non-significant effect of farming system on LMY under farmers' managemental condition in and around Darbhanga (Bihar).

**LACTATION LENGTH : (LL)**

The least squares means of lactation length (days) of Desi, HFX and JX cows were obtained as 352.18 ± 5.20, 331.78 ± 4.35 and 342.77 ± 4.79 respectively (Table-17). The ranges of LL as mentioned in the literature varied from 268.28 days (Yadav and Rathi, 1992) to 385.3 days (Parmar *et al.*, 1986) for indigenous cows, 247.87 days (Bhattacharya *et al.*, 2002) to 432.7 days (Parmar *et al.*, 1986) for HFX and 306.08 days (Singh *et al.*, 1993) to 462.69 days (Kumar[2], 2004) for JX cows. The findings of the present study for all the three genetic groups of cows fall in the ranges mentioned above. Besides, the averages of LL (days) obtained in the present investigation are very close to the findings of Kumar (2005) for Desi, Kumar[1] (2004) and Kumar[2] (2004) for HFX and Thakur *et al.* (1999) and Kumar[1] (2004) for JX cows.

**EFFECT OF GENETIC FACTOR :**

DMRT revealed that Desi cows had significantly (P<0.05) 20.40 days and 9.41 days longer LL (days) than HFX and JX respectively in this study (Table-17). Although the average LL (days) of HFX and JX did not differ significantly, yet JX cows had 10.99 days longer LL than HFX cows. Significant

the mean LL (days) of summer and rainy calvers did not differ significantly. Priya Raj (2002) also reported longer LL (days ) of rainy calvers than summer. Jadhav *et al.*( 1991) observed that summer and spring calvers had significantly (P<0.01) longer LL (days) than those calved in other seasons. Kumar (2005) also found that summer calvers had longer LL than winter in Desi, HFX and JX cows. The trend of longer LL in summer calvers than winter obtained in this study is similar to the findings of Jadhav *et al.*( 1991) and Kumar (2005). However, Yadav *et al.* (1992) in Sahiwal cows, Yadav and Rathi (1992) in Hariana, Singh *et al.* (1993) in Sahiwal and its crosses with Jersey and Red Dane, Thakur *et al.*( 1991) in different genetic groups of Jersey x Zebu, Kumar[1] (2004) in different genetic groups of cattle, Kumar[2] (2004) in Hariana and its crosses with HF and Jersey and Sharan (2005) in Hariana and its crosses with HF reported non-significant effect of season of calving on lactation length.

**LACTATION ORDER :**

Least squares analysis of variance (Table-16) revealed significant (P<0.05) effect of parity of lactation on LL (days) in this study. The LL (days) significantly (P<0.05) increased by 12.09 days in 2nd lactation from 1st, after which it declined in 3rd & 4th lactation and then again increased giving irregular trend in this study. Viz *et al.*( 1992) also reported significant effect of parity of lactation on LL but they also could not find any definite trend over different lactations, the finding of which is similar to the trend obtained in the present study. Significant effect of sequence of lactation on LL has also been observed by Yadav and Rathi (1992) in Hariana cows, Yadav *et al.* (1992) in Sahiwal cows, Singh and Nagarcenkar (1997) in Sahiwal cows, Shethi *et al.*(2000) in Sahiwal cows, Singh *et al.* (2000) in different genetic groups of crossbreds, Priya Raj (2002) in crossbred cows and Kumar[1] (2004) in different

genetic groups in cattle. However, Kumar[2] (2004), Kumar (2005) and Sharan (2005) did not find significant role of sequence of lactation on lactation length in Zebu and crossbred cows.

**FARMING SYSTEM :**

Least squares analysis of variance (Table-16) revealed significant effect of farming system on LL (days). Least squares means of LL (days) of the cows maintained in the dairy units integrated with agriculture farming was significantly 15.55 days longer than those maintained in the dairying alone. It is to be mentioned here that the LMY of cows maintained in agriculture + dairying units was also significantly higher than those cows maintained in dairying alone. It appears that the farmers might have produced quality feeds and green fodder in time for feeding their dairy animals, which might be responsible for significant increase in both LMY and LL. Kumar (2005) also reported similar trend in Desi, HFX and JX cows under farmers' managemental condition.

**PEAK YIELD :**

Least squares means of peak yield (kg) were observed to be 4.49 ± 0.25, 11.86 ± 0.21 and 8.24 ± 0.23 for Desi, HFX and JX respectively in this study (Table-19) which fall in the ranges of 4.21 (Kumar, 2005) to 9.22 kg (Yadav *et al.* 1992) for Desi, 6.37 kg (Kumar[2], 2004) to 16.19 kg (Shiv Prasad, 2003) for HFX and 7.96 kg (Kumar, 2005) to 13.27 kg (Singh *et al.* 1993) for JX cows (Table-3). Variations in peak yield might be attributed to the differences in managemental and environmental practices, breeds of indigenous cows breeds of exotic bulls used and levels of exotic inheritance for crossbreds.

**EFFECT OF GENETIC FACTOR :**

Least squares analysis of variance (Table-18) presented significant ($P<0.01$) effect of genetic group on peak

yield in this study. It was observed that HFX had significantly (P<0.05) 7.37 kg and 3.62 kg higher peak yields than Desi and JX cows. Besides, JX had also significantly (P<0.05) 3.75 kg higher PY than Desi cows. Priya Raj (2002) also observed significantly (P<0.01) higher PY in HFX than JX. Kumar (2005) also reported highest peak yield (12.19 kg) in HFX followed by JX (7.96 kg) and Desi (4.21 kg), the trend of which is in conformity with the findings of the present study. Besides, Jadhav *et al.*( 1991), Nayak and Raheja (1996), Dutt and Bhusan (2001), Kumar[2] (2004) and Singh *et al.* (2004) also

**Table – 18 : Least squares analysis of variance showing the effect of different genetic & non-genetic factors on Peak yield and Days to attain peak yield DAPY).**

| Source of variation | D.F. | Peak Yield | | DAPY | |
|---|---|---|---|---|---|
| | | MSS | F | MSS | F |
| Zone | 3 | 18.513 | 5.150** | 469.082 | 15.946** |
| Genetic Group | 2 | 860.469 | 239.365** | 1286.570 | 43.736** |
| Herd Size | 3 | 14.823 | 4.123** | 6.564 | 0.223$^{NS}$ |
| Herd Constitution | 6 | 4.702 | 1.308$^{NS}$ | 76.625 | 2.604* |
| Season of Calving | 2 | 15.713 | 4.371* | 82.541 | 2.805* |
| Lactation Order | 3 | 6.883 | 1.914$^{NS}$ | 127.732 | 4.342** |
| Farming System | 1 | 91.806 | 25.538** | 5.442 | 0.185$^{NS}$ |
| **Error** | **306** | **3.594** | | **29.416** | |

*** Significant (P<0.05)**

**** Significant (P<0.01)**

**NS : Non-significant**

reported significant effect of genetic group on peak yield which are in agreement with the finding of the present study.

**Table-19 : Least squares means of Peak yield (PY) & Days to attain peak yield (DAPY) under various genetic and non-genetic factors.**

| Genetic & Non-genetic factors | Peak yield (kg) MEAN ± SE | Days to attain Peak yield (DAPY) MEAN ± SE |
|---|---|---|
| **Genetic factors :-** | | |
| **Desi** | $4.49^{a} \pm 0.25$ | $55.70^{a} \pm 0.73$ |
| **HF Crossbred** | $11.86^{b} \pm 0.21$ | $46.67^{b} \pm 0.61$ |
| **Jersey Crossbred** | $8.24^{c} \pm 0.23$ | $49.38^{c} \pm 0.67$ |
| **Non-genetic factor:-** | | |
| **Location of herd :** | | |
| **I** | $7.17^{a} \pm 0.24$ | $47.64^{a} \pm 0.68$ |
| **II** | $8.82^{b} \pm 0.25$ | $49.40^{a} \pm 0.73$ |
| **III** | $7.72^{a} \pm 0.24$ | $53.68^{b} \pm 0.70$ |
| **IV** | $8.55^{b} \pm 0.24$ | $51.59^{c} \pm 0.68$ |
| **Herd Size :-** | | |
| **3-4** | $7.65^{a} \pm 0.31$ | $50.02 \pm 0.90$ |
| **5-6** | $7.97^{a} \pm 0.24$ | $50.82 \pm 0.70$ |
| **7-8** | $8.41^{ab} \pm 0.22$ | $50.89 \pm 0.64$ |
| **9 & above** | $8.77^{b} \pm 0.20$ | $50.59 \pm 0.58$ |
| **Herd Constitution:-** | | |
| **D** | $7.49 \pm 0.48$ | $49.54^{abc} \pm 1.40$ |
| **HFX** | $8.49 \pm 0.40$ | $48.67^{ac} \pm 1.14$ |
| **JX** | $8.09 \pm 0.44$ | $50.22^{abc} \pm 1.27$ |
| **D + JX** | $8.39 \pm 0.35$ | $50.85^{abc} \pm 1.02$ |
| **D + HFX** | $8.48 \pm 0.30$ | $52.71^{b} \pm 0.86$ |
| **JX + HFX** | $8.64 \pm 0.28$ | $50.07^{cd} \pm 0.82$ |
| **D + JX + HFX** | $7.82 \pm 0.28$ | $51.75^{bd} \pm 0.67$ |
| **Season of Calving :-** | | |
| **Winter** | $8.06^{a} \pm 0.23$ | $50.30^{ab} \pm 0.66$ |
| **Summer** | $7.90^{a} \pm 0.19$ | $51.58^{a} \pm 0.55$ |
| **Rainy** | $8.63^{b} \pm 0.19$ | $49.86^{b} \pm 0.56$ |
| **Lactation Order :-** | | |
| **1st** | $8.45 \pm 0.23$ | $51.28^{a} \pm 0.67$ |
| **2nd** | $7.87 \pm 0.21$ | $51.38^{a} \pm 0.62$ |
| **3rd & 4th** | $8.45 \pm 0.21$ | $48.85^{b} \pm 0.60$ |
| **5th & above** | $8.02 \pm 0.27$ | $50.81^{a} \pm 0.79$ |
| **Farming System :-** | | |
| **Agriculture + Dairying** | $8.85^{a} \pm 0.20$ | $50.42 \pm 0.58$ |
| **Dairying alone** | $7.55^{b} \pm 0.16$ | $50.74 \pm 0.46$ |

**Column - wise means bearing different superscripts differ significantly ($P<0.05$).**

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD:**

Table-18 revealed significant (P<0.01) effect of zones on peak yield in this study. The highest peak yield was observed in zone II followed by zones IV, III and I. Zone II had significantly (P<0.05) 1.65 kg and 1.10 kg higher PY than zones I and III respectively. Similarly, zone IV had significantly (P<0.05) 1.38 kg and 0.83 kg higher PY than zones I and III respectively. However, the mean PY of zones II and IV as well as I and III did not differ significantly. The differences in the average PY in various zones might be attributed to the managemental factors practised in various zones.

Jadhav *et al.* (1991) also reported the significant (P<0.01) effect of farm on PY in various HF x Sahiwal grades, the trend of which is similar to the finding of the present study.

**HERD SIZE :**

Least squares analysis of variance depicted in table-18 presented that the size of the herd significantly (P<0.01) affected the PY in this study. The cows maintained in the herd size of 9 & above had significantly (P<0.05) 1.12 kg and 0.80 kg higher PY than those maintained in the herd sizes of 3-4 and 5-6. However, the mean PY of the herd size of 9 & above did not differ significantly with those of 7-8, a similar trend obtained for PY in this study. It may be mentioned here that the cows maintained in the herd size of 9 & above had also the highest lactation milk yield followed by the cows maintained in the herd size of 7-8. However, contrary to the finding of the present study, Priya Raj (2002), Kumar[1] (2004) and Kumar (2005) reported non-significant effect of herd size on peak yield.

**HERD CONSTITUTION :**

Least squares analysis of variance (table-18) revealed non-significant effect of herd constitution on peak yield. However, it was observed that the herd having JX and HFX cows had the highest (8.64 kg) peak yield (table-19) in and around Biharsharif (Nalanda). Kumar[1] (2004) in cattle and buffalo and Kumar (2005) in Desi and crossbred cows under farmers' managemental condition also reported non-significant effect of herd constitution on peak yield which are in agreement with the finding of the present study.

**SEASON OF CALVING :**

Least squares analysis of variance (table-18) presented significant ($P<0.05$) effect of season of calving on peak yield in this study. The cows calved during rainy season had significantly ($P<0.05$) 0.57 kg and 0.73 kg higher peak yields than winter and summer calvers. However, there was no significant difference between average peak yields of winter and summer calvers. It is worth mentioning here that rainy calvers had significantly ($P<0.05$) higher lactation milk yield than winter and summer calvers in this study. Jadhav *et al.* (1991) in HF x Sahiwal grades, Priya Raj (2002) in HFX and JX cows and Singh *et al.* ( 2004) in crosses of Hariana with Friesian, Brown Swiss and Jersey also reported significant effect of season of calving on peak yield. Higher peak yield during rainy season might be, possibly, due to availability of more green fodders during rainy season. However, contrary to the finding of the present study, Singh *et al.*( 1993) in Sahiwal and its crosses with Jersey and Red Dane, Singh *et al.* (2000) in crosses of Hariana with HF, BS and Jersey, Dutt and Bhusan (2001) in half breds and three breed grades of HF, BS, Jersey with Hariana, Kumar[2] (2004) in Hariana and its crosses with HF and Jersey and Kumar (2005) in Desi, HFX and JX

cows did not find significant effect of season of calving on peak yield.

**LACTATION ORDER :**

As depicted in least squares analysis of variance (table-18), lactation order did not influence peak yield significantly in this study. However, it was observed that 3rd & 4th parity of lactations, (pooled together) had the highest (8.45 ± 0.21 kg) peak yield which tended to decline in subsequent lactations (table-19). Yadav *et al.* (1992) in Sahiwal cows, Bhattacharya *et al.* (1999) in Hariana cows, Kumar[2] (2004) in different genetic groups of Hariana and its crosses with HF and Jersey and Kumar (2005) in Desi, HFX and JX cows under farmers' managemental condition also reported non-significant effect of lactation order on peak yield which are in conformity with the finding of the present study. However, contrary to the finding of the present study, Yadav and Rathi (1992) in Hariana cows, Singh *et al.* (2000) in crossbred cows of Hariana with HF, BS and Jersey and Priya Raj (2002) in HFX and JX observed significant ($P<0.05$) effect of sequence of lactation on peak yield, but they also reported highest peak yield in 3rd lactation after which it tended to decline.

**FARMING SYSTEM:**

Least squares analysis of variance (table-18) presented significant ($P<0.01$) effect of farming system on peak milk yield in this study. An appraisal of (table-19) revealed that the dairy units integrated with agriculture had significantly ($P<0.05$) 1.30 kg more peak yield than those maintaining dairying alone. It is worth mentioning here that the dairy units along with agriculture had also significantly ($P<0.05$) higher lactation milk yield and lactation length than those maintaining dairying alone in this study. Timely cultivation of quality feed and green fodders might be responsible for higher PY by the dairy units integrated with agriculture. Kumar

(2005) also reported significantly (P<0.05) higher PY by the dairy units integrated with agriculture under farmers' managemental condition in and around Patna, which is similar to the finding of the present study. However, Kumar[1] (2004) did not find significant influence of system of farming on peak milk yield in cattle and buffalo under farmers' managemental condition in and around Darbhanga (Bihar).

**DAYS TO ATTAIN PEAK MILK YIELD (DAPY) :**

Days to attain peak yield (DAPY) has very high economic importance in dairy enterprises. Economical cows are those who attain peak yield shortly after calving and having its higher persistency.

**AVERAGE DAPY :**

Least squares means (table-19) revealed the average DAPY in Desi, HFX and JX to be 55.70 ± 0.73, 46.67 ± 0.61 and 49.38 ± 0.67 days respectively. The ranges of DAPY (days) as mentioned in literature were obtained as 39.72 (Kumar[2],2004) to 59.94 ( Kumar, 2005) for Desi, 26.80 (Kumar[2], 2004) to 54.25 (Rathi, 1975) for HF crossbreds and 35.35 (Kumar[2], 2004) to 56.60 (Singh *et al.* 2004) for Jersey crossbred cows. The results obtained in the present study for all the three genetic groups fall in the ranges mentioned above. However, the average DAPY of Desi was on the upper limit of the range which might be possibly due to the fact that Desi cows, in general, consisted of mainly non-descript type local animals having higher DAPY than those of established indigenous breeds.

**GENETIC FACTORS :**

Least squares analysis of variance (table-18) presented significant (P<0.01) effect of genetic group on DAPY. An appraisal of (table-19) revealed that HF crossbred cows had significantly (P<0.05) 9.03 days and 2.71 days lower DAPY than Desi and Jersey crossbred cows. Besides, JX cows had

also significantly (P<0.05) 6.32 days lower DAPY than Desi cows. Kumar[2] (2004) observed that HFX and JX with Hariana had significantly (P<0.05) lower DAPY than Hariana and also HF corssbreds had lower DAPY than Jersey crossbreds. Singh *et al.*(2004) observed that 1/2 J 1/2 H genetic group had significantly (P<0.01) longer DAPY than 1/2 HF 1/2 H genetic group. Kumar (2005) reported that HF crossbreds had significantly (P<0.05) shorter DAPY than Jersey crossbreds and Desi cows and also Jersey crossbred cows had significantly (P<0.05) 9.82 days shorter DAPY than Desi. The trend obtained in the present study is in close agreement with the findings of the above mentioned authors. However, Singh *et al.* (1993) observed non-significant effect of genetic group on DAPY and also Kumar[1] (2004) reported lower DAPY in Desi cows than JX and HFX cows.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

Table-18 presented significant (P<0.01) effect of zones on DAPY in this study. Least squares means of DAPY depicted in (table-19) revealed that zone I had the lowest DAPY followed by zones II, IV and III. However, the average DAPY of zones I and II did not differ significantly. Zone I had significantly (P<0.05) 6.04 and 3.95 days lower DAPY than zones III and IV respectively. Besides, zone II had significantly 4.28 days and 2.19 days lower DAPY than zones III and IV respectively. Apart from these zone IV had also significantly (P<0.05) 2.09 days lower DAPY than zone IV. Kumar (2005) also reported significant (P<0.01) effect of location of herd on DAPY in Desi, HFX and JX cows under farmers' managemental condition in and around Patna. The finding of the present study is in close agreement with the finding of Kumar (2005). Managemental factors practised in different zones might be,

possibly, responsible for the variations in the average DAPY in different zones.

**HERD SIZE :**

Least squares analysis of variance (table-18) revealed non-significant effect of herd size on DAPY in Desi and crossbred cows in and around Biharsharif, Nalanda in his study. However, the average DAPY which ranged from 50.02 days to 50.89 days, was found to be lowest in the herd size of 3-4. Kumar[1] (2004) in cattle and buffalo under farmers' managemental condition in and around Darbhanga (Bihar) and Kumar (2005) in Desi, HFX and JX also under farmers' managemental condition in and around Patna (Bihar) reported non-significant effect of herd size on DAPY which are in conformity with the finding of the present study. Besides, Kumar (2005) also observed lower DAPY in the herd size of 3-5, the trend of which is similar to the finding of the present study.

**HERD CONSTITUTION :**

Least squares analysis of variance as presented in table-18), reflected significant ($P<0.05$) effect of herd constitution on DAPY. The average DAPY ranged from 48.67 days to 52.71 days in this study, a difference of only 4.04 days. The lowest average DAPY was observed to be in HFX cows which, however, did not differ significantly with the average DAPY of Desi, JX and Desi + JX combinations. Kumar 2005) also reported significant ($P<0.05$) influence of herd constitution on DAPY in Desi and crossbred cows of HF and Jersey which is similar to the finding of the present study. However, Kumar[1] (2004) observed non-significant effect of herd constitution on DAPY.

**SEASON OF CALVING :**

As revealed by least squares analysis of variance table-18), season of calving had significant ($P<0.05$) effect on

DAPY in this study. The lowest average DAPY was observed by rainy calvers which was significantly (P<0.05) lower by 1.72 days than summer calvers. However, there was no significant difference between the average DAPY of rainy and winter calvers (table-19) . It may be pointed out here that highest lactation milk yield, longest lactation length and maximum peak yield were obtained by rainy calvers in the present study which might be attributed to the availability of more green fodders during rainy season in and around Biharsharif (Nalanda). Significant influences of season of calving on DAPY have also been reported by Singh *et al.* (2004), Kumar[1](2004), Kumar[2] (2004) and Kumar (2005). Kumar (2005) also observed lowest DAPY by rainy calvers followed by winter and summer calvers in Desi, HFX and JX cows under farmers' managemental condition in and around Patna which is in close agreement with the finding of the present study.

**LACTATION ORDER :**

Least squares analysis of variance (table-18) reflected significant (P<0.05) influence of season of calving on DAPY in this study. The average DAPY which ranged from 48.85 days to 51.38 days, was found to be lowest in 3rd & 4th lactations. The average DAPY of 3rd & 4th sequence of lactation was significantly (P<0.05) lower by 2.43 days, 2.53 days and 1.96 days than 1st, 2nd and 5th & above lactations respectively in this study (table-19). The mean DAPY increased from 1st lactation to 2nd, there after decreased in 3rd & 4th lactations (pooled together) and after which it again increased in 5th & above lactations. Kumar (2005) also reported significant (P<0.05) effect of parity of lactation on DAPY in Desi, HFX and JX cows under farmers' managemental condition in and around Patna and he also observed that average DAPY was minimum in 3rd lactation after which it tended to increase. The trend of DAPY obtained in the present investigation is similar

the finding of Kumar (2005). However, contrary to the result btained in this study, Kumar[2] (2004) did not find significant ffect of parity of lactation on DAPY.

**ARMING SYSTEM :**

The system of farming did not play significant role n average DAPY (table-18) in this study. However, it was oted that the cows maintained in the dairy units along with griculture had lower average DAPY than those involved in airying alone. Kumar[1] (2004) in Desi and crossbred cows and umar (2005) in Desi, HFX and JX cows both under farmers' anagemental condition also reported non-significant nfluence of farming system on DAPY which are in agreement ith finding of the present study.

**ILK YIELD PER DAY LACTATION LENGTH (MY/day LL) :**

**VERAGE MY/day LL :**

The mean MY/day LL (kg) of Desi, HFX and JX cows ere obtained as 3.78 ± 0.69, 8.45 ± 0.58 and 6.66 ± 0.64 espectively which fall in the ranges of 2.64 kg (Sharan, 2005) o 6.02 kg (Yadav *et al.* 1992) for Desi, 2.82 (Kumar, 2004) to .09 (Shrivastava *et al.*, 2000) for HF crossbred cows and 5.03 g (Kumar[2], 2004) to 8.28 kg (Singh *et al.* 2000) for Jersey rossbred cows as mentioned in the literature. Differences in he breeds of indigenous cows and exotic bulls, levels of exotic nheritance for crossbreds and managemental and nvironmental variations might be attributed to the variations n MY/day LL.

**FFECT OF GENETIC FACTOR :**

Least squares analysis of variance (table-20) evealed significant ($P<0.01$) effect of genetic group on MY/day

**Table - 20 : Least squares analysis of variance showing the effect of different genetic & non-genetic factors on MY/day LL and CI.**

| Source of variation | D.F. | MY/day LL | | CI | |
|---|---|---|---|---|---|
| | | MSS | F | MSS | F |
| Zone | 3 | 27.891 | 1.053$^{NS}$ | 10619.84 | 6.577* |
| Genetic Group | 2 | 339.328 | 12.811** | 60758.54 | 37.630** |
| Herd Size | 3 | 32.018 | 1.208$^{NS}$ | 9340.700 | 5.785** |
| Herd Constitution | 6 | 37.592 | 1.419$^{NS}$ | 3869.367 | 2.396* |
| Season of calving | 2 | 70.120 | 2.647$^{NS}$ | 33286.52 | 20.615** |
| Lactation Order | 3 | 39.673 | 1.497$^{NS}$ | 8482.345 | 5.253** |
| Farming System | 1 | 61.365 | 2.316$^{NS}$ | 38376.88 | 23.768** |
| **Error** | **306** | **26.486** | | **1614.627** | |

*** Significant (P<0.05)**

**** Significant (P<0.01)**

**NS : Non-significant**

LL. Least squares means (table-21) presented the highest MY/day LL in HF crossbred cows which was significantly (P<0.05) higher by 4.67 kg and 1.79 kg than Desi and Jersey crossbred cows respectively. Besides, Jersey crossbred cows had also significantly (P<0.05) 2.88 kg higher MY/day LL than Desi cows in this study. An appraisal of table-21, reflected that HF crossbreds had more than double and Jersey crossbreds had nearly double MY/day LL than Desi cows. It requires to be mentioned here that HFX and JX had also more than double

**Table - 20 : Least squares analysis of variance showing the effect of different genetic & non-genetic factors on MY/day LL and CI.**

| Source of variation | D.F. | MY/day LL | | CI | |
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LL. Least squares means (table-21) presented the highest MY/day LL in HF crossbred cows which was significantly (P<0.05) higher by 4.67 kg and 1.79 kg than Desi and Jersey crossbred cows respectively. Besides, Jersey crossbred cows had also significantly (P<0.05) 2.88 kg higher MY/day LL than Desi cows in this study. An appraisal of table-21, reflected that HF crossbreds had more than double and Jersey crossbreds had nearly double MY/day LL than Desi cows. It requires to be mentioned here that HFX and JX had also more than double

**Table-21 : Least squares means of Milk yield (kg) per day of lactation length (MY/day LL) & Calving interval (CI) under various genetic and non-genetic factors.**

| Genetic & Non-genetic factors | MY/day LL (kg) MEAN ± SE | CI (days) MEAN ± SE |
|---|---|---|
| **Genetic factors :-** | | |
| **Desi** | $3.78^{a} \pm 0.69$ | $466.18^{a} \pm 5.44$ |
| **HF Crossbred** | $8.45^{b} \pm 0.58$ | $405.63^{b} \pm 4.56$ |
| **Jersey Crossbred** | $6.66^{c} \pm 0.64$ | $416.03^{b} \pm 5.02$ |
| **Non-genetic factor:-** | | |
| **Location of herd :** | | |
| **I** | $7.25 \pm 0.65$ | $421.82^{ac} \pm 5.10$ |
| **II** | $6.14 \pm 0.70$ | $432.28^{ab} \pm 5.47$ |
| **III** | $5.98 \pm 0.66$ | $445.82^{b} \pm 5.20$ |
| **IV** | $5.80 \pm 0.65$ | $417.20^{c} \pm 5.07$ |
| **Herd Size :-** | | |
| **3-4** | $5.76 \pm 0.85$ | $431.48^{c} \pm 6.67$ |
| **5-6** | $5.69 \pm 0.66$ | $412.37^{b} \pm 5.20$ |
| **7-8** | $7.16 \pm 0.61$ | $438.57^{c} \pm 4.77$ |
| **9 & above** | $6.57 \pm 0.55$ | $434.70^{c} \pm 4.35$ |
| **Herd Constitution:-** | | |
| **D** | $5.16 \pm 1.32$ | $420.54^{ab} \pm 10.36$ |
| **HFX** | $5.97 \pm 1.08$ | $419.83^{a} \pm 8.49$ |
| **JX** | $6.47 \pm 1.20$ | $426.15^{ab} \pm 9.42$ |
| **D + JX** | $6.23 \pm 0.97$ | $418.87^{a} \pm 7.57$ |
| **D + HFX** | $5.53 \pm 0.82$ | $443.33^{b} \pm 6.41$ |
| **JX + HFX** | $5.95 \pm 0.78$ | $437.21^{ab} \pm 6.13$ |
| **D + JX + HFX** | $5.75 \pm 0.64$ | $439.02^{ab} \pm 5.01$ |
| **Season of Calving :-** | | |
| **Winter** | $6.65 \pm 0.26$ | $407.83^{a} \pm 4.89$ |
| **Summer** | $5.35 \pm 0.52$ | $434.76^{b} \pm 4.07$ |
| **Rainy** | $6.89 \pm 0.53$ | $445.25^{b} \pm 4.15$ |
| **Lactation Order :-** | | |
| **1st** | $5.98 \pm 0.64$ | $427.51^{ab} \pm 4.99$ |
| **2nd** | $5.97 \pm 0.59$ | $432.06^{a} \pm 4.61$ |
| **3rd & 4th** | $7.29 \pm 0.57$ | $416.09^{b} \pm 4.46$ |
| **5th & above** | $5.94 \pm 0.75$ | $441.46^{a} \pm 5.85$ |
| **Farming System :-** | | |
| **Agriculture + Dairying** | $6.83 \pm 0.55$ | $442.56^{a} \pm 4.33$ |
| **Dairying alone** | $5.76 \pm 0.44$ | $416.06^{b} \pm 3.45$ |

**Column - wise means bearing different superscripts differ significantly ($P<0.05$).**

lactation milk yield than Desi cows and also HFX had higher LMY than Jersey crossbred cows in this study. Significant effects of genetic group on MY/day LL have also been reported by various authors (Hayatnagarkar *et al.* 1990; Jadhav *et al.* 1991; Singh *et al.* 1993; Thakur *et al.* 1999, Shrivastava and Singh 2000; Singh *et al.* 2000; Bhattacharya *et al.* 2002; Priya Raj 2002; Akther *et al.* 2003; Kumar[1] 2004; Kumar[2] 2004; Kumar 2005; and Sharan, 2005) which are in agreement with the finding of the result obtained in this study. Priya Raj (2002); Akhter *et al.* (2003), and Kumar (2005) also reported the superiority of Holstein Friesian crossbreds over Jersey crossbreds with respect to average MY/day LL which are in conformity with the finding of the present study.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

As depicted in (table-20), least squares analysis of variance revealed non-significant effect of zones on MY/day LL. Least squares means (table-21) presented the range of MY/day LL to be 5.80 kg in zone IV to 7.25 kg in zone I in this study. Priya Raj (2002) and Kumar[1] (2004) also did not obtain significant effect of zone on average daily milk yield/day LL under farmers' managemental condition which are in agreement with the finding of the present study. The non-significant effect of location of herd might be possibly due to the fact that all the four zones under study were located in the radius of 15 K.M in and around Biharsharif, Nalanda having similar ecological and managemental practices. However, Shrivastava and Singh (2000) and Kumar (2005) reported, contrary to the finding of present study, significant effect of location of herd on average MY/day LL under farmers' managemental condition.

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**HERD SIZE :**

Least squares analysis of variance (table-20) presented non-significant effect of size of herd on MY/day LL in this study. However, the average MY/day LL ranged from 5.69 kg in the size of 5-6 to 7.16 kg in the herd size of 7-8. Priya Raj (2002) and Kumar (2005) also reported non-significant effect of herd size on average daily milk yield per day LL under farmers' managemental condition which are in conformity with the finding of the present study. However, Shrivastava and Singh (2000) and Kumar[1] (2004) observed significant effect of herd size on average MY/day LL.

**HERD CONSTITUTION :**

Least squares analysis of variance (table-20) presented that the herd constitution did not play significant role on MY/day LL in this study. Kumar[1](2004) in different genetic groups of cows including buffalo and Kumar (2005) in Desi, HFX and JX cows under farmers' managemental condition also reported non-significant effect of herd constitution on average MY/day LL which are in agreement with the finding of the present study.

**SEASON OF CALVING :**

Least squares analysis of variance (table-20) reflected non-significant effect of season of calving on MY/day LL. However, least squares means of MY/day LL (table-21) revealed the highest MY/day LL in rainy followed by winter and summer calvers.

Yadav and Rathi (1992); Yadav *et al.* (1992); Singh *et al.* (1993); Thakur *et al.* (1999), Shrivastava and Singh (2000), Singh *et al.* (2000), Priya Raj (2002), Akhter *et al.* (2003), Kumar[2] (2004) and Kumar (2005) also recroded non-significant effect of season of calving on MY/day LL which are in conformity with the finding of the present study. However, in the present study rainy and winter calvers had 1.54 kg and

1.30 kg more average MY/day LL than summer calvers. Jadhav *et al.* (1991) and Kumar[1](2004) reported significant effect of season of calving on MY/day LL but they have also observed that the winter calvers had more average MY/day LL than the cows calved during other seasons, the trend of which is similar to the finding of the present study. The congenial climatic condition for the crossbreds just after calving during winter and rainy seasons together with availability of good quality fodders might have favoured increase in average MY/day LL whereas the stress of heat during summer might have lowered the performance of this trait.

**LACTATION ORDER :**

As evident from least squares analysis of variance (table-20), lactation order did not influence the average MY/day LL significantly. Yadav and Rathi (1992) and Kumar[2] (2004) also observed non-significant effect of sequence of lactation on average MY/day LL. The table-21 of least squares means of milk yield per day of lactation length revealed that although the parity of lactation had non-significant effect on average MY/day LL, yet the 3rd & 4th lactation orders (pooled together) had 1.31 kg and 1.32 kg more average MY/day LL than 1st and 2nd sequences of lactation respectively, after which it tended to decline in subsequent lactations.

Shrivastava and Singh (2000), Singh *et al.* (2000), Priya Raj (2002) and Kumar[1](2004), however, reported significant increase in average MY/day LL upto 3-4 lactations after which it tended to decline, the trend of which is similar to the trend obtained in this study.

**FARMING SYSTEM :**

Least squares analysis of variance (table-20) presented non-significant influence of farming system on average MY/day LL in this study. Kumar[1](2004) also reported non-significant effect of farming system on average MY/day LL

in Desi and crossbred cows under farmers' managemental condition which are in conformity with the finding of the present study. However, Kumar (2005) reported that cows managed in dairy units integrated with agriculture farming had significantly 0.59 kg more average MY/day LL than those units maintaining dairying alone. In the present study also, the dairy units integrated with agriculture farming had higher but non-significant average MY/day LL than those maintaining dairying alone.

**CALVING INTERVAL (CI):**

Calving interval is one of the important economic indicators of dairy enterprises. Besides, it also indicates healthy and sound reproductive status of the cows. An ideal calving interval which consists of about 12-13 months is economical to the dairy farmers.

**AVERAGE CALVING INTERVAL :**

Least squares means of calving interval (days) for various genetic and non-genetic factors have been presented in table-21. The least squares means for Desi, HFX and Jersey crossbred cows were found to be 466.18 ± 5.44, 405.63 ± 4.56 and 416.03 ± 5.02 days respectively. The literature revealed ranges of average CI (days) to be 416.57 (Yadav and Rathi, 1992) to 570.70 (Sharan, 2005) for Desi cows, 378.7 (Akhter *et al.*, 2003) to 572.19 (Sharan, 2005) for HFX and 396.87 (Akhter *et al.* 2003) to 455.35 (Singh *et al.* 2000) for Jersey crossbred cows. The least squares means obtained in the present investigation for all the three genetic groups fall in their respective ranges as mentioned above. Variations in genetic constitution, nutritional, managemental, environmental and reproductive status of the cows might be responsible for differences in calving interval.

**EFFECT OF GENETIC FACTOR :**

As depicted in table-20, least squares analysis of variance revealed significant (P<0.01) effect of genetic group on average days of calving interval in this study. An appraisal of table-21 presented the lowest days of calving interval to be in HF crossbreds followed by Jersey crossbreds and Desi cows. HF crossbreds and JX cows had significantly (P<0.05) 60.55 days and 50.15 days lower average CI than Desi cows. Although HFX had 10.40 days lower average CI than JX crossbreds, yet the means of both the crossbreds did not differ significantly. Thus, it may be concluded that both the crossbreds are superior to Desi cows with respect to calving interval.

Jadhav *et al.* (1991) in various genetic grades of Holstein x Sahiwal, Singh *et al.* (2000) in crossbreds of HF, BS and Jersey with Hariana cows, Priya Raj (2002) in HFX and JX, Kumar (2005) in Desi, HFX and JX and Sharan (2005) in different grades of HF with Hariana reported significant (P<0.05) effect of genetic group on CI which are in conformity with the finding of the present study. However, Akhter *et al.* (2003) reported the effect of various genetic grades of crossbred cows involving HF, Jersey and Red Dane with Sahiwal, Hariana and Red Sindhi to be non-significant.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

As depicted in table-20 of least squares analysis of variance, the different zones played significant (P<0.05) role on calving interval in this study. It was observed that zone IV had the lowest (417.20) average calving interval days which was significantly (P<0.05) lower by 15.08 days and 24.00 days than the average CI of zones II and III respectively. However, the average least squares means of CI of zones I and II, zones II and III as well as zones I and IV did not differ significantly

(table-21). Jadhav *et al.* (1991) also reported significant effect of farms on CI (days) in various Holstein x Sahiwal grades. However, Priya Raj (2002), Kumar[1] (2004) and Kumar (2005) did not find significant role of location of herd on calving interval. Variations in nutritional, environmental and reproductive status of the cows might be responsible for differences in CI of the cows maintained in different zones.

**HERD SIZE :**

As observed through analysis of variance (table-20), the herd size significantly ($P<0.01$) affected the calving interval in this study. The cows maintained in the herd size of 5-6 had significantly ($P<0.05$) 19.11, 26.20 and 22.33 days lower CI than the cows maintained in the herd sizes of 3-4, 7-8 and 9 & above respectively. However, the cows maintained in the herd sizes, of 3-4, 7-8 and 9 & above did not differ significantly with respect to CI. Priya Raj (2002) in crossbred cows, Kumar[1] (2004) in different genetic groups of cow and Kumar (2005) in Desi and crossbred cows under farmers' managemental conditions reported non-significant effect of herd size on CI. But Kumar (2005) observed that cows maintained in the size of 3-6 had lower CI than those maintained in the herd size of 7 & above, the trend of which is similar to the finding of the present study.

**HERD CONSTITUTION :**

Least squares analysis of variance (table-20) presented significant ($P<0.05$) effect of herd constitution on CI in this study. The days of CI ranged from 418.87 in D+JX to 443.33 in D + HFX days. However, all the herd constitutions except D + HFX group did not differ significantly among themselves with respect to CI days in this study. Kumar[1] (2004) and Kumar (2005) also reported non-significant effect of herd constitution on CI under farmers' managemental condition.

**SEASON OF CALVING :**

Least squares analysis of variance (table-20) presented significant (P<0.01) effect of season of calving on CI in this study. An appraisal of table-21 revealed that winter calvers had lowest days of CI which was significantly (P<0.05) lower by 26.93 and 37.42 days than summer and rainy calvers respectively. However, the average CI (days) of summer and rainy calvers did not differ significantly. Jadhav *et al.* (1991) in various Holstein X Sahiwal grades also observed lower CI days by winter calvers than summer and spring calvers. Kumar (2005) also reported significantly (P<0.05) lower CI days by winter calvers than summer and rainy in Desi, HFX and JX cows. The finding of the present investigation is in close agreement with the findings of the above authors. However, Yadav *et al.* (1992), Yadav and Rathi (1992), Singh *et al.* (2000) and Priya Raj (2002) did not find significant effect of season of calving on CI days.

**PARITY OF LACTATION :**

Least squares analysis of variance (table-20) reflected significant (P<0.01) influence of parity of lactation on days of CI in the present study. Least squares means (table - 21) revealed that 3rd & 4th lactation order (pooled together) had significantly (P<0.05) 15.97 and 25.37 days lower CI than 2nd and 5th & above lactations. Although it did not differ significantly with 1st lactation, yet it has 11.42 days lower CI than 1st lactation order. It is pertinent to note that 3rd & 4th parity of lactation had highest peak yield, lowest days to attain peak yield and highest MY/day LL in this study. However, no definite trend could be obtained in this study. Significant effect of lactation order on CI days have also been reported by various authors Yadav *et al.* (1992), Yadav and Rathi (1992), Singh *et al.* (2000), Priya Raj (2002), Kuma1 (2004) and Kumar (2005) which are in agreement with the finding of the present

study. Further, Priya Raj (2002), Kumar[1] (2004) and Kumar (2005) also recorded significant effect but without any definite trend, of sequence of lactation on days of CI which are in conformity with the finding of the present study.

**FARMING SYSTEM :**

As presented in (table-20) of least squares analysis of variance, the system of farming played significant ($P<0.01$) effect on CI days in this study. It was observed through least squares means (table-21) that the cows maintained in the units involved in the dairying alone had significantly ($P<0.05$) 26.50 days lower CI than those dairy units integrated with agriculture farming. Kumar (2005) also recorded lower days of CI in the units involved in dairying alone than those integrated with agriculture farming which is in close agreement with the finding of the present study. However, Kumar[1] (2004) did not find significant effect of farming system on CI days.

**MILK YIELD PER DAY CALVING INTERVAL (MY/day CI) :**

**AVERAGE MY/day CI :**

Milk yield/ day of calving interval is one of the most important criteria for milk production efficiency. The average milk yield/day CI (kg) of Desi, HFX and JX were obtained as 2.19 ± 0.09 kg, 6.63 ± 0.07 kg and 5.12 ± 0.08kg respectively in this study (table-23). Literature revealed the ranges of 1.65kg (Sharan, 2005) to 4.90 kg (Vij *et al.*, 1992) for Desi cows, 2.95 kg (Sharan, 2005) to 9.4 kg (Singh *et al.*, 1986) for HF crossbred cows and 4.53 kg (Hayatnagarkar *et al.*, 1990) to 6.52 kg (Akhter *et al.*, 2003) for Jersey crossbred cows. The mean milk yield per day of CI of all the cows under three genetic groups fall in the ranges as mentioned in the literature. Differences in breeds of indigenous cows and exotic bulls, levels of exotic inheritance for crossbreds and managemental

**Table – 22 : Least squares analysis of variance showing the effect of different genetic & non-genetic factors on MY/day CI and DP.**

| Source of variation | D.F. | MY/day CI | | DP | |
|---|---|---|---|---|---|
| | | MSS | F | MSS | F |
| Zone | 3 | 0.840 | 1.778$^{NS}$ | 5044.739 | 16.733** |
| Genetic Group | 2 | 308.573 | 652.730** | 31421.89 | 104.226** |
| Herd Size | 3 | 6.982 | 14.769** | 390.951 | 1.296$^{NS}$ |
| Herd Constitution | 6 | 0.525 | 1.111$^{NS}$ | 550.507 | 1.826$^{NS}$ |
| Season of calving | 2 | 7.213 | 15.258** | 2233.094 | 7.407** |
| Lactation Order | 3 | 2.241 | 4.740** | 1177.898 | 3.907** |
| Farming System | 1 | 7.361 | 0.155$^{NS}$ | 8327.874 | 27.623** |
| **Error** | **306** | **0.472** | | **301.476** | |

*** Significant (P<0.05)**

**** Significant (P<0.01)**

**NS : Non-significant**

and environmental variations might be attributed to the differences in MY/day CI.

**EFFECT OF GENETIC FACTOR :**

Least squares analysis of variance as depicted in table-22 revealed significant (P<0.01) effect of genetic factor on MY/day CI. Duncan's Multiple Range Test presented that HF crossbreds had highest MY/day CI which was significantly (P<0.05) higher by 4.44 kg and 1.51kg than Desi and JX cows respectively. Besides, Jersey crossbred cows had also significantly (P<0.05) 2.93 kg higher average MY/day CI than Desi cows. An appraisal of least squares means of MY/day CI

**Table-23 : Least squares means of Milk yield per day of calving interval (MY/day CI) & Dry period (DP) under various genetic and non-genetic factors.**

| Genetic & Non-genetic factors | MY/day CI (kg) MEAN ± SE | DP (days) MEAN ± SE |
|---|---|---|
| Genetic factors :- | | |
| Desi | $2.19^{a} \pm 0.09$ | $114.96^{a} \pm 2.35$ |
| HF Crossbred | $6.63^{b} \pm 0.07$ | $74.99^{b} \pm 1.97$ |
| Jersey Crossbred | $5.12^{c} \pm 0.08$ | $72.85^{b} \pm 2.16$ |
| Non-genetic factor:- | | |
| Location of herd : | | |
| I | $4.61 \pm 0.08$ | $87.62^{a} \pm 2.20$ |
| II | $4.78 \pm 0.09$ | $86.54^{a} \pm 2.36$ |
| III | $4.50 \pm 0.08$ | $98.95^{b} \pm 2.25$ |
| IV | $4.71 \pm 0.08$ | $77.29^{c} \pm 2.19$ |
| Herd Size :- | | |
| 3-4 | $4.34^{a} \pm 0.11$ | $90.40 \pm 2.88$ |
| 5-6 | $4.43^{a} \pm 0.08$ | $84.06 \pm 2.25$ |
| 7-8 | $4.80^{b} \pm 0.08$ | $88.65 \pm 2.06$ |
| 9 & above | $5.04^{c} \pm 0.07$ | $87.28 \pm 1.88$ |
| Herd Constitution:- | | |
| D | $4.76 \pm 0.17$ | $86.46 \pm 4.48$ |
| HFX | $4.59 \pm 0.14$ | $86.25 \pm 3.66$ |
| JX | $4.40 \pm 0.16$ | $83.15 \pm 4.07$ |
| D + JX | $4.75 \pm 0.13$ | $86.06 \pm 3.27$ |
| D + HFX | $4.79 \pm 0.11$ | $89.00 \pm 2.77$ |
| JX + HFX | $4.55 \pm 0.10$ | $87.83 \pm 2.64$ |
| D + JX + HFX | $4.71 \pm 0.08$ | $94.45 \pm 2.16$ |
| Season of Calving :- | | |
| Winter | $4.93^{a} \pm 0.08$ | $83.09^{a} \pm 2.11$ |
| Summer | $4.36^{b} \pm 0.07$ | $87.04^{a} \pm 1.76$ |
| Rainy | $4.66^{c} \pm 0.07$ | $97.67^{b} \pm 1.79$ |
| Lactation Order :- | | |
| 1st | $4.80^{a} \pm 0.08$ | $91.40^{a} \pm 2.15$ |
| 2nd | $4.51^{b} \pm 0.07$ | $84.53^{bc} \pm 1.99$ |
| 3rd & 4th | $4.81^{a} \pm 0.07$ | $83.85^{b} \pm 1.92$ |
| 5th & above | $4.49^{b} \pm 0.10$ | $90.62^{ac} \pm 2.53$ |
| Farming System :- | | |
| Agriculture + Dairying | $4.63 \pm 0.07$ | $93.79^{a} \pm 1.87$ |
| Dairying alone | $4.67 \pm 0.05$ | $81.41^{b} \pm 1.49$ |

**Column - wise means bearing different superscripts differ significantly ($P<0.05$).**

under different genetic groups (table-23) revealed that HF crossbred cows had more than triple average MY/day CI than Desi cows. Besides, Jersey crossbred cows had also more than double average MY/day CI than Desi cows. Apart from these, HF crossbred cows had superiority of 1.51 kg over JX cows with respect to MY/day CI. It may be pointed out here that both HFX and Jersey crossbred cows had nearly triple and more than double LMY respectively than Desi cows suggesting that both HFX and JX cows are well adapted in the agro-climatic region of Biharsharif (Nalanda) with respect to MY/day CI. Besides, HF crossbreds had superiority over JX cows for MY/day CI supporting more use of HF than Jersey for crossbreeding in an around Biharsharif (Nalanda). Significant effect of genetic groups on MY/day CI have also been reported by Jadhav *et al.* (1991), Sharivastava and Singh (2000), Singh *et al.* (2000); Priya Raj (2002); Akhter *et al.* (2003); Kumar[1] (2004); Kumar (2005) and Sharan (2005) which are in agreement with the finding of the present study. Kumar[1] (2004) and Kumar (2005) have also recorded significantly ($P<0.01$) more than double MY/day CI of HFX and JX cows than those of Desi cows under farmers' managemental condition which are in close agreement with the result obtained in this study. Besides, Hayatnagarkar *et al.* (1990) Singh *et al.* (2000), Priya Raj (2002) and Kumar (2005) have also reported superiority of HF crossbreds over Jersey crossbred cows which are in conformity with the finding of the present study.

**EFFECT OF NON GENETIC FACTORS;**

**LOCATION OF HERD:**

As depicted in least squares analysis of variance table -22, location of herd had no significant effect on MY/day CI in the present study. The average MY/day CI ranged from 4.50 kg in zone III to 4.78 kg in zone II. Priya Raj (2002) in

HFX and JX cows and Kumar[1] (2004) in Desi and crossbred cows under farmers' managemental conditions also recorded non-significant effect of zones on MY/day CI which are in conformity with the finding of the present study. It may be noted here that all the four zones under study were located in a radius of 15 Km. in and around Biharsharif (Nalanda) having similar environmental and managemental conditions which might be responsible for non-significant effect of zones on this trait. However, Jadhav *et al.* (1991), Shrivastava and Singh (2000) and Kumar (2005) reported significant effect of location of herd on MY/day CI.

**HERD SIZE :**

Least squares analysis of variance (table-22) reflected significant ($P<0.01$) effect of herd size on MY/day CI. The least squares means (table-23) presented the range of 4.34 kg in herd size of 3-4 to 5.04 kg in the herd size of 9 & above. The cows maintained in the herd size of 7 and above had significantly ($P<0.05$) MY/day of CI than the cows maintained in lower sizes. However, Priya Raj (2002), Kumar[1] (2004) and Kumar (2005) did not find significant influence of herd size on MY/day CI. Besides, contrary to the finding of the present study, Shrivastava and Singh (2000) observed consistent decrease in MY/day CI with the increase in herd size.

**HERD CONSTITUTION :**

Least squares analysis of variance depicted in table-22, reflected non-significant effect of herd constitution on average MY/day CI. Least squares means, as mentioned in table-23, presented the range to be 4.40 kg to 4.79 kg. Kumar[1] (2004) in Desi and crossbred cows and Kumar (2005) in Desi, HFX and JX cows under farmers' managemental conditions also reported non-significant effect of herd constitution which are in agreement with the finding of the present study.

**SEASON OF CALVING :**

Least squares analysis of variance (table-22) presented significant (P<0.01) influence of season of calving on MY/day CI. An appraisal of least squares means as presented in table-23, reflected that winter calvers had significantly 0.27 kg and 0.57 kg more average MY/day CI than rainy and summer calvers. Besides, rainy calvers had also 0.30 kg higher MY/day CI than summer calvers. Jadhav *et al.* (1991) and Kumar[1] (2004) also reported significantly higher MY/day CI by winter and rainy calvers than those calved during other seasons which are in close agreement with the finding of the present study. Besides, Shrivastava and Singh (2000) and Akhter *et al.* (2003), although reported non-significant effect of season of calving on MY/day CI, yet they observed the average MY/day CI to be the highest by the winter calvers followed by rainy and summer calvers. Higher MY/day CI by rainy and winter calvers than summer might be attributed to the availability of more green fodders. However, Singh *et al.* (2000), Priya Raj (2002) and Kumar (2005) reported non-significant effect of season of calving on MY/day CI.

**LACTATION ORDER :**

As evident from least squares analysis of variance table-22, the lactation order had significant (P<0.01) influence on average MY/day CI in this study. The least squares means as presented in table-23, reflected that the average MY/day CI decreased in 2nd lactation by 0.29 kg but increased in 3rd & 4th lactations (pooled together) after which it significantly (P<0.05) declined by 0.32 kg. An appraisal of table-23 reflected that although there was no any definite trend, yet the MY/day CI significantly (P<0.05) declined after 3rd & 4th lactations. Vij *et al.* (1992) also reported significant effect of lactation order on MY/day CI but they also could not find any definite trend which are in agreement with the finding of the present study.

Besides, Priya Raj (2002), Kumar[1] (2004) and Kumar (2005) also observed decrease in MY/day CI after 3rd lactation, a trend, in general, similar to the trend obtained in this study.

**FARMING SYSTEM :**

As evident from least squares analysis of variance table-22, the system of farming did not play significant role on MY/day CI. However, the cows maintained in the units involved in dairying alone had 0.04 kg more average MY/day CI than those maintaining dairying integrated with agriculture. Kumar[1] (2004) in cows and buffaloes, Kumar (2005) in Desi, HFX and JX cows, both under farmers' managemental conditions and Sharan (2005) in Hariana and its crosses with HF also reported non-significant effect of farming system on MY/day CI which are in close agreement with the finding of the present study.

**DRY PERIOD :**

Dry period is one of the most important factors affecting the economy of dairy enterprises. Longer the dry period more uneconomical is the milk production. Genetic and various non-genetic factors significantly influence this trait.

**AVERAGE DRY PERIOD :**

The least squares means of average dry period under different genetic groups have been depicted in table-23. The average dry period (days) in Desi, HFX and JX cows were found to be 114.96 ± 2.35, 74.99 ± 1.97 and 72.85 ± 2.16 respectively. As per the information obtained from literature, dry period ranged from 114.75 days (Vij *et al.*, 1992) to 228 days (Pundir and Raheja, 1997) for Desi cows, 72.82 days (Akhter *et al.*, 2003) to 264.44 days (Kumar[2], 2004) for HFX and 70.44 days (Kumar, 2005) to 166.8 days (Thakur *et al.*, 1999) for JX cows. The least squares means for all the three genetic groups obtained in this study fall in the ranges mentioned above. Besides, it was also noted that the average

dry period for all the three genetic groups obtained in this study are very close to the minimum values of the ranges mentioned in the literature. Variations in indigenous breeds of cows, levels of exotic inheritance of different breeds used, differences in managemental practices and environmental variations might be responsible for large fluctuations for dry period.

**EFFECT OF GENETIC FACTOR :**

Table - 22 of least squares analysis of variance revealed significant ($P<0.01$) effect of genetic group on dry period (days). It was observed that the Jersey crossbred cows had the shortest (72.85 days) and the Desi cows had the longest (114.96 days) dry period in this study. HF crossbred cows and JX cows had significantly ($P<0.05$) 39.97 days and 42.11 days shorter dry periods than Desi cows. However, the average dry period of HFX and JX cows did not differ significantly. Significant effect of genetic group on dry period (days) have also been reported by Thakur *et al.* (1999), Akhter *et al.* (2003), Kumar[1] (2004), Kumar[2] (2004) and Kumar (2005) which are in agreement with the finding of the present study. Kumar[1] (2004) and Kumar (2005) also reported significantly longer dry period in Desi cows than HFX and Jersey crossbred cows which are in close agreement with the finding of the present study. Priya Raj (2002) reported non-significant differences between average dry periods of HFX and JX cows under farmers' managemental condition which are in conformity with the finding of the present study.

**EFFECT OF NON-GENETIC FACTORS :**

**LOCATION OF HERD :**

Least squares analysis of variance (table-22) reflected significant ($P<0.01$) effect of location of herd on dry period (days). It was observed that zone IV had the shortest dry period days which was significantly ($P<0.05$) shorter by 10.33

days, 9.25 days and 21.61 days than zones I, II and III respectively. Besides, zones I and II had also significantly 11.33 days and 12.41 days shorter DP than zone III. However, Priya Raj (2002) in HFX and JX cows, Kumar[1] (2004) in Desi crossbred cows and graded buffaloes and Kumar (2005) in Desi and crossbred cows, all under farmers' managemental condition reported non-significant effect of location of herd on crossbred cows. Variations in nutritional and reproductive status of the cows maintained under different zones as well as other managemental conditions might be attributed to the differences in dry period (days).

**HERD SIZE :**

Least squares analysis of variance depicted in table-22 presented non-significant effect of herd size on dry period (days). However, it was found to be shortest in the herd size of 5-6 cows in this study. Priya Raj (2002), Kumar[1] (2004) and Kumar (2005), all under farmers' managemental conditions, also reported non-significant effect of herd size on dry period which are in conformity with the finding of the present study. However, Shrivastava *et al.* (1996) reported the effect of zones to be significant in Zebu x Friesian cows which might be due to variations in the management of the herd under study.

**HERD CONSTITUTION :**

Table-22 of least squares analysis of variance presented that the herd constitution did not play significant role on dry period (days). The dry period (days) under different herd constitution groups ranged from 83.15 to 94.45 days in this study. Kumar[1] (2004) in Desi, crossbred cows and graded buffaloes in and around Darbhanga and Kumar (2005) in Desi, HFX and JX in and around Patna, both under farmers' managemental conditions reported non-significant effect of herd constitution on dry period (days) which are in agreement with the finding of the present study.

**SEASON OF CALVING :**

Analysis of variance (table-22) presented that season of calving had significant (P<0.01) effect on dry period. The shortest DP (83.09 days) was observed by winter calvers which was significantly (P<0.05) 14.57 days shorter than rainy calvers (table-23). Although winter calvers had also 3.95 days shorter days of dry period than summer calvers, yet it did not differ significantly in this study. Vij *et al.* (1992) also reported significant (P<0.05) effect of season of calving on DP in Tharparkar cows and observed that December- February clavers had shorter dry period than calvers of other seasons which is in close agreement with the finding of the present study. However, Singh *et al.* (1993), Thakur *et al.* (1999), Priya Raj (2002), Kumar[1] (2004), Kumar[2] (2004) and Kumar (2005) did not find significant effect of season of calving on dry period.

**LACTATION ORDER :**

As per analysis of variance depicted in table-22, the sequence of lactation had significant (P<0.01) effect on dry period. Least squares means (table-23) presented that the days of dry period preceding to 1st lactation tended to decrease upto 3rd & 4th lactations after which it tended to increase. The days of dry period preceding to 2nd lactation was observed to be the shortest in 3rd & 4th lactations which was significantly shorter by 7.55 days and 6.77 days than 1st and 5th & above lactations respectively. Vij *et al.* (1992) also reported significant effect of lactation order on dry period and observed that days of dry period decreased after 2nd lactations and again increased after 4th & 5th lactations which are in close agreement with the finding of the present study. However, Kumar[1] (2004), Kumar[2] (2004) and Kumar (2005) reported non-significant effect of sequence of lactation on dry period under farmers' managemental conditions.

**FARMING SYSTEM :**

Analysis of variance (table-22) revealed significant ($P<0.01$) effect of farming system on dry period. The cows maintained in dairying alone had significantly ($P<0.05$) 12.38 days shorter dry period than those maintaining dairy units integrated with agriculture farming in this study. Kumar (2005) also reported that the cows maintained in the units in dairying alone had significantly ($P<0.01$) shorter dry period than those maintained in the units integrated with agriculture farming which is in close agreement with the finding of the present study. However, Kumar[1] (2004) did not find any significant role of system of farming on dry period (days) in Desi, crossbred cows and graded buffaloes under farmers' managemental conditions.

**NET COST**

**AVERAGE :**

The overall mean for net cost per kg of milk was obtained as Rs. 9.067 in this study. Priya Raj (2002), Kumar[1] (2004) and Kumar (2005) reported the overall net cost per kg milk to be Rs. 8.78, Rs.9.22 and Rs. 8.94 respectively. Priya Raj did not take into account Desi cows in her study as well as her result was based on prices of items prevailed during 2002 or before which might be responsible for lower cost of milk production. Kumar[1] (2004) took into account buffaloes also in his study along with Desi and crossbred cows which might be responsible for a little elevated net cost for milk production. Kumar (2005) considered Desi, HFX and Jersey crossbred cows under farmers' managemental conditions in and around Patna and the net cost per kg of milk production accounted by him is in close agreement with the finding of this study. However, variations in managemental conditions, year of calculation and cost of different components due to place might be attributed as important factors for price variation.

**Table – 24 : Least squares analysis of variance showing the effect of different genetic & non-genetic factors on Net cost.**

| Source of variation | d.f. | Net Cost | |
|---|---|---|---|
| | | MSS | F |
| Zone | 3 | 4.365 | 2.957* |
| Genetic Group | 2 | 37.754 | 25.578** |
| Herd Size | 3 | 12.933 | 8.800** |
| Herd Constitution | 6 | 1.741 | 1.179$^{NS}$ |
| Season of calving | 2 | 12.571 | 8.517** |
| Lactation order | 3 | 3.513 | 2.380$^{NS}$ |
| Farming System | 1 | 1.380 | 0.935$^{NS}$ |
| **Error** | **306** | | **1.476** |

*** Significant (P<0.05)**

**** Significant (P<0.01)**

**NS : Non-significant**

**EFFECT OF GENETIC FACTOR :**

Least squares analysis of variance (table-24) presented significant (P<0.01) effect of genetic group on net cost per kg of milk production in this study. Least squares means (table-25) revealed HF crossbreds to be most economical with respect to net cost per kg of milk production. The HFX cows had lowest net cost/ kg of milk production followed by JX and Desi in this study. HF crossbreds had significantly (P<0.05) Rs. 1.54 and Re. 0.81 lower net cost/kg of milk production than Desi and JX cows respectively. Besides, JX cows had also significantly (P<0.05) Re. 0.73 lower net cost/ kg of milk production than Desi cows. Priya Raj (2002) observed the net cost/kg of milk production of HFX to be significantly lower than JX cows under farmers' managemental condition. Kumar[1] (2004) also reported the lowest and highest net cost/kg of milk production to be in HFX

**Table-25 : Least squares means of Net cost of per kg milk production under various genetic & non-genetic factors.**

| Genetic & Non-genetic factors | Net cost/kg of milk (Rs.) production MEAN ± SE |
|---|---|
| **Genetic factors :-** | |
| **Desi** | $10.14^{a} \pm 0.16$ |
| **HF Crossbred** | $8.60^{b} \pm 0.13$ |
| **Jersey Crossbred** | $9.33^{c} \pm 0.15$ |
| **Non-genetic factor:-** | |
| **Location of herd :** | |
| **I** | $9.42^{a} \pm 0.15$ |
| **II** | $8.96^{b} \pm 0.16$ |
| **III** | $9.49^{a} \pm 0.15$ |
| **IV** | $9.56^{a} \pm 0.15$ |
| **Herd Size :-** | |
| **3-4** | $9.76^{a} \pm 0.20$ |
| **5-6** | $9.73^{a} \pm 0.15$ |
| **7-8** | $9.01^{b} \pm 0.14$ |
| **9 & above** | $8.93^{b} \pm 0.13$ |
| **Herd Constitution:-** | |
| **D** | 9.77 ± 0.31 |
| **HFX** | 9.21 ± 0.25 |
| **JX** | 9.75 ± 0.28 |
| **D + JX** | 9.19 ± 0.22 |
| **D + HFX** | 9.08 ± 0.19 |
| **JX + HFX** | 9.15 ± 0.18 |
| **D + JX + HFX** | 9.33 ± 0.15 |
| **Season of Calving :-** | |
| **Winter** | $9.01^{a} \pm 0.14$ |
| **Summer** | $9.75^{b} \pm 0.12$ |
| **Rainy** | $9.30^{a} \pm 0.12$ |
| **Lactation Order :-** | |
| **1st** | 9.20 ± 0.15 |
| **2nd** | 9.59 ± 0.13 |
| **3rd & 4th** | 9.16 ± 0.13 |
| **5th & above** | 9.48 ± 0.17 |
| **Farming System :-** | |
| **Agriculture + Dairying** | 9.44 ± 0.13 |
| **Dairying alone** | 9.28 ± 0.10 |

**Column - wise means bearing different superscripts differ significantly (P<0.05).**

and Desi cows respectively under farmers' managemental conditions. Kumar (2005) found the lowest average net cost/ kg of milk production to be in HFX followed by JX and Desi cows under farmers' managemental conditions in and around Patna. The trend obtained in the present study is in close agreement with the trend obtained by the above mentioned authors.

**EFFECT OF NON-GENETIC FACTORS:**

**LOCATION OF HERD :**

Least squares analysis of variance depicted in table-24 presented significant ($P<0.05$) effect of zones on average net cost per kg of milk production in this study. It was observed that zone II had significantly ($P<0.05$) lower net cost/kg of milk production by Re. 0.46, Re. 0.53 and Re.0.60 than zones I, III and IV respectively. However, zones I, III and IV did not differ significantly with respect to net cost/kg of milk production. Kumar[1] (2004) and Kumar (2005) also reported significant effect of location of herd on net cost/kg of milk production in their studies which are in close agreement with the finding of the present study. Comparatively cheaper feeds and fodders and hired labours as well as better managemental conditions in zone II might be, possibly, responsible for lower cost. However, Singh *et al.* (1986) in Friesian x zebu cows and Priya Raj (2002) in HFX and JX under farmers' managemental conditions reported non-significant effect of zones on net cost/kg of milk production.

**HERD SIZE :**

Table-24 of least squares analysis of variance revealed significant ($P<0.01$) effect of herd size on net cost/kg of milk production in this study. An appraisal of least squares means presented in table-25, revealed that the cows maintained in the herd size of 7 & above had significantly ($P<0.05$) lower net cost/kg of milk production than the cows

maintained in the herd sizes of 3-4 and 5-6. The cows maintained in the herd size of 7-8 had significantly Re.0.75 and Re. 0.72 lower net cost/kg of milk than the cows maintained in the herd sizes of 3-4 and 5-6 respectively. Similarly, the cows maintained in the herd size of 9 & above had significantly ($P<0.05$) Re. 0.78 and Re. 0.75 less net cost/kg of milk production than the cows maintained in the herd sizes 3-4 and 5-6 respectively. However, the herd sizes of 7-8 and 9 & above did not differ significantly with respect tonet cost/kg of milk production reflecting that the herd size of 7 & above are more economical than the lower herd sizes. Priya Raj (2002) and Kumar (2005) observed that the crossbred cows maintained in herd sizes of 7 & above under farmers' managemental condition had significantly ($P<0.05$) lower net cost/kg of milk production Kumar[1] (2004) also observed the herd size of 11-14 to be optimum for relatively cheaper milk production. The findings of the present study are similar to the results obtained by the above mentioned authors.

**HERD CONSITUTION :**

Least squares analysis of variance (table-24) reflected non-significant effect of herd constitution on net cost/kg of milk production in this study. However, it was observed to be the lowest (Rs. 9.08) in the group having Desi along with HFX and the highest (Rs. 9.77) in the group maintaining only Desi cows. However, Kumar[1] (2004) and Kumar (2005) reported significant effect of herd constitution on net cost/kg of milk production.

**SEASON OF CALVING :**

As evident from least squares analysis of variance (table-24), season of calving significantly ($P<0.01$) influenced the net cost/kg of milk production. An appraisal of least squares means depicted in table-25 reflected that winter and rainy calvers had significantly ($P<0.05$) Re. 0.74 and Re. 0.45

lower net cost/kg of milk production than summer calvers. It is worth mentioning here that winter and rainy calver had higher lactation milk yield, MY/day of calving, MY/day LL and peak yield than summer calvers in this study. Singh (1984) and Kumar[1] (2004) also reported significant effect of season of calving on net cost/kg of milk production. Availability of more green fodders during rainy and winter seasons might be responsible for lower net cost/kg of milk production than summer calvers. However, Priya Raj (2002) in HFX and JX cows and Kumar (2005) in Desi, HFX and JX cows under farmers' managemental condition reported the effect of season of calving on net cost/kg of milk production to be non-significant. Such variations in the findings might be, possibly, due to the variations in experimental areas as well as agro-eco-socio conditions prevalent in those areas.

**LACTATION ORDER :**

Although least squares analysis of variance lable-24 revealed that parity of lactation did not influence the net cost/kg of milk production, yet it was found to decrease in 3rd & 4th lactations from 1st and 2nd lactations and thereby, it tended to increase in subsequent lactations (Table-25). It is to be mentioned here that lactation order also did not influence, MY/day LL and peak yield in this study, yet these were highest in 3rd & 4th lactations after which they tended to decline in subsequent lactations. Although Priya Raj (2002), Kumar[1] (2004) and Kumar (2005) reported significant effect of lactation order on net cost/ kg of milk production, yet they also obtained lower net cost in 3rd sequence of lactation and thereby increase in subsequent lactations, a similar trend obtained in the present study.

**FARMING SYSTEM :**

As evident from least squares analysis of variance depicted in table-24, it was observed that farming system did

not influence net cost/kg of milk production in this study. However, it was found (table-25) that the units maintaining dairying alone had Re. 0.16 lower net cost/kg of milk production than the units maintaining dairy integrated with agriculture farming. Kumar (2005) also observed non-significant effect of farming system on net cost/kg of milk production which is in agreement with the finding of the present study.

**ECONOMICS OF MILK PRODUCTION**

**COST COMPONENTS:**

The various cost components and their relative contributions to the gross cost of milk production in Desi, HFX and JX cows obtained in the present study have been depicted in table-26. Further, the data analysed through 'least squares analysis of variance' (Harvey, 1966) revealed the net cost per kg of milk production in Desi, HFX and JX to be Rs. 10.14, Rs. 8.60 and Rs. 9.33 respectively in this study (table-25).

The average gross cost of milk production in Desi, HFX and JX cows were observed to be Rs. 10.48, Rs.8.67 and Rs. 9.42 respectively. Among the various variable cost items, feed cost was observed to be the major cost component contributing 70.13, 71.74 and 71.12 percentages of their respective gross cost in Desi, HFX and JX cows respectively. Labour cost appeared to be the 2$^{nd}$ major cost component contributing 12.88, 14.87 and 16.34 percentages of their respective gross cost in Desi, HFX and JX cows respectively.

Depreciation on fixed assets like depreciation on housing, equipments, machinery and animals were taken together as one cost item under the heading " Depreciation" which were found to be 4.86, 4.95 and 4.24 percentages of their respective gross cost in Desi, HFX and JX cows respectively.

**Table-26: Average of different cost components and their relative contribution to the gross cost of milk production in cows of different genetic groups in the area of investigation.**

| Cost Item | Mean (Rs.) per kg of milk production | | | Overall |
|---|---|---|---|---|
| | Desi | HFX | JX | |
| Feed cost | 7.35 (70.13) | 6.22 (71.74) | 6.70 (71.12) | 6.48 (71.12) |
| Labour cost | 1.35 (12.88) | 1.29 (14.87) | 1.54 (16.34) | 1.39 (14.67) |
| Depreciation | 0.51 (4.86) | 0.43 (4.95) | 0.40 (4.24) | 0.44 (4.63) |
| Vaterinary and A.I. cost | 0.30 (2.86) | 0.15 (1.73) | 0.14 (1.48) | 0.19 (2.00) |
| Interest on fixed capital | 0.55 (5.24) | 0.43 (4.95) | 0.45 (4.77) | 0.47 (4.95) |
| Miscellaneous cost | 0.42 (4.00) | 0.15 (1.73) | 0.19 (2.01) | 0.25 (2.63) |
| Gross cost of milk production (A) | 10.48 | 8.67 | 9.42 | 9.22 |
| Income from dung (B) | 0.34 (3.24) | 0.06 (0.69) | 0.09 (0.95) | 0.16 (1.68) |
| Net cost of milk production (A-B) | 10.14 | 8.60 | 9.33 | 9.06 |

**Figures in parentheses indicate percentages of respective gross cost.**

The veterinary and A.I cost contributed 2.86, 1.73 and 1.48 percentages of their respective gross cost of milk production in Desi, HFX and JX cows respectively. The respective values for the contribution of interest were obtained as 5.24, 4.95 and 4.77 whereas for miscellaneous cost items, the respective values were found to be 4.00, 1.73 and 2.01 percentages.

The dung was the only source of income other than milk to the dairy farmers. The income obtained from sale of dung was deducted from the gross cost of milk production in order to get the estimate of net cost of per kg of milk production. Income from dung was estimated as 3.24, 0.69 and 0.95 percentages of their respective gross costs in Desi, HFX and JX cows respectively.

The estimate of contribution of different cost items found in the present study were, in general, in conformity with the findings of Badal and Dhaka (1998), Priya Raj (2002), Kumar[1] (2004) and Kumar (2005). However, Kalra *et al.* (1995) reported lower percentages of contribution in feed cost and Chandra and Agarwal (2000) observed higher contribution of labour cost percentages than obtained in this study.

Variations in the estimate of contribution of different cost items to the gorss cost of per kg milk production might be attributed to the variable managemental practices in different dairy units, variable feeds and fodders used in different ecological conditions, variations in degree of demand from place to place influencing price of milk, variable sample size and different degree of sampling, studies made in different agro-ecological regions of the country, inflation rate etc.

## CONSTRAINTS PERCEIVED BY THE OWNERS OF DAIRY UNITS :

**Table – 27: Constraints perceived by the owners of dairy units in and around Biharsharif (Nalanda) in rearing Desi, HF and Jersey crossbred cows.**

| Sl.No. | Constraints | Rank |
|---|---|---|
| 1. | High cost of crossbred cows | 1 |
| 2. | Non-availability of good dairy animals in the locality | II |
| 3. | High incidences of repeat breeding | III |
| 4. | High cost of feeds, fodders and feed supplements | IV |
| 5. | High cost of veterinary medicines | V |
| 6. | Poor results of A.I. | VI |
| 7. | Lack of proper housing | VII |
| 8. | Non-availability of green fodder throughout the year | VIII |
| 9. | Lack of finance/credit facility. | IX |
| 10. | Uneconomical crossbred male calves. | X |
| 11. | Non-remunerative price of milk | XI |

The owners of the different dairy units in and around Biharsharif (Nalanda) were interviewed to enumerate the constraints related to breeding, feeding, management, disease control and availability of animals of superior genetic architecture etc. in order of priority which varied from one dairy unit to another depending upon location of the units, types of breed used in the Khatals, herd size, herd constitution and farming system. The common constraints, as perceived and reported by the owners of the different dairy units were identified and ranked on the basis of frequency of the dairy unit owners expressing the same which have been depicted in table-27.

It was observed that the high cost of crossbred cows ranked 1st in the constraint perceived by the various Khatal owners in and around Biharsharif which is mainly because of non-availability of good dairy animals in the locality which has also been ranked as 2nd constraint in this study. It is worth mentioning here that after partition of Bihar into Bihar and Jharkhand, the rest of Bihar has very thin population of HFX and JX cows. Besides, the Khatal owners had to bring high producing crossbred cows of superior genetic make-up from outside the state mostly from Haryana and Punjab resulting into increase in the price of high milk yielders.

The 3rd constraint obtained in this study was found to be "High incidences of repeat breeding" which might be, due to deficiency of optimum quantity of essential minerals and trace elements required necessarily to maintain the sexual health of the cows and also non-availability of timely A.I. facilities with high quality semen.

High cost of feed, fodders and feed supplements and high cost of veterinary medicines ranked 4th and 5th respectively in this study. The small dairy unit owners were not able to purchase quality feeds and fodders and costly veterinary medicines resulting into high incidences of deficiency diseases, in general, and repeat breeding in particular in the dairy units.

Poor results of A.I. ranked as 6th major constraint in this study which might be attributed to the lapses in timely detection of heat and timely insemination with quality semen by trained personnels. This requires improvement with better managerial practices.

Lack of proper housing ranked as 7th major constraint in this study. The owners of the different Khatals located in the urban area could not provide the prescribed surface area according to the scientific norms because of the

cost of land whereas the Khatal owners in the rural areas had mostly kachcha houses without proper drainage and sanitation facilities resulting into improper and unhygienic housing for the animals.

The 8th major constraint was noted as "non-availability of green fodder throughout the year" which is directly correlated with high incidences of repeat breeding of the cows.

Lack of financial/ credit facilities ranked as 9th major constraint in this investigation. Although there are many nationalized commercial Banks including Kshetriya Gramin Bank located in and around Biharsharif which are able to provide financial and credit facilities to the owners of the dairy units, yet the dairy farmers of the area could not take advantages of such facilities mainly because of complexity in the procedures of financing.

The crossbred male calves were reported to be unfit for farm operations. Thus, the dairy farmers perceived them to be un-economical and ranked them as 10th major constraint in this study. It was observed that the Khatal owners used to sale the crossbred male calves before the age of castration on non-remunerative prices.

'Non- remunerative price of milk' was observed to be 11th major constraint in this study. However, Patna dairy project is in operation in and around Biharsharif (Nalanda) which collects the milk through different Milk Producers Co-operative Socities.

Since the constraints vary from place to place, time to time, dairy units to dairy units and also in genetic architecture of the cows as well as availability of feeds, fodders and feed supplements etc., the results obtained in this study were not quite comparable with similar studies conducted

elsewhere in the country resulting into variations in the ranks of constraints perceived by different dairy units.

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# CHAPTER - V

# SUMMARY AND CONCLUSION

# SUMMARY AND CONCLUSIONS

The present experiment was conducted on 38 randomly selected dairy units consisting of 84 Desi, 136 HFX and 107 Jersey crossbred cows utilizing the procedures of "stratified random sampling with proportional allocation" (Snedecor and Cochran, 1967), in an around Biharsharif, Nalanda (Bihar). The aim of this investigation was to study the effect of genetic and various non-genetic factors on milk production efficiency traits. Besides, the various constraints perceived by the dairy farmers were also taken into account and ranked to suggest a suitable package of dairy practices for economic milk production.

The milk production efficiency traits included in this study were lactation milk yield (LMY, kg), lactation length (LL, days), peak yield (PY, kg), days to attain peak yield (DAPY, days), milk yield per day of lactation length (MY/day LL, kg) and milk yield per day of calving interval (MY/day CI). The traits for reproduction efficiency under study were dry period (DP, days) and calving interval (CI, days), whereas the economic efficiency trait investigated was 'cost of milk production'.

The genetic factors consisted of Desi, HFX and JX cows, whereas the non-genetic factors included location of herd, herd size, herd constitution, season of calving, sequence of lactation and system of farming.

The experiment was planned with the following main objectives :

(i) To estimate the phenotypic parameters of some of the milk production efficiency measures of Desi and

crossbred cows in un-organized farms in and around Biharsharif of Nalanda district (Bihar).

(ii) To estimate the nature and magnitude of variation in various measures of milk production efficiency under consideration due to genetic and non-genetic factors in cows in and around Biharsharif.

(iii) To study the different constraints perceived by the dairy farmers in and around Biharsharif in rearing high yielding cows.

(iv) To provide suggestions for suitable dairy practices for economic milk production to the dairy farmers in and around Biharsharif.

Data were subjected to statistical analysis through computer in ARIS (Agricultural Research Information System) cell of Indian Veterinary Research Institute, Izzatnagar, Barielly (U.P.). Least squares analysis (Harvey, 1966) was utilized to study the genetic and various non-genetic factors on all the milk production efficiency traits, whereas Duncan's Multiple Range test (DMRT) as modified by Kramer, 1957 was used for pair-wise comparison of the least squares means at 0.05 level of probability.

The average lactation milk yield (kg) of Desi, HFX and JX cows were found to be 1030.15 ± 39.40, 2705.13 ± 32.99 and 2137.48 ± 36.31 respectively. HFX had almost thrice and JX had more than double average lactation milk yields respectively than Desi cows. Besides, there was superiority of HFX over JX cows for LMY suggesting the more use of HF than Jersey for crossbreeding in and around Biharsharif (Nalanda).

Location of farm, herd size, herd constitution, season of calving and farming system had significant ($P<0.05$) effect on LMY, whereas lactation order did not influence this trait significantly. The highest and lowest milk yields were observed

to be in zones II and I respectively. The cows in the herd size of 7 & above had significantly ($P<0.05$) higher LMY than sizes of 6 and below. The highest LMY was obtained in the Khatals maintaining Desi along with HFX cow. The highest LMY was observed to be in the cows calved during rainy season followed by winter and summer. The cows maintained in the units integrated with agriculture farming yielded 128.26 kg more LMY than those maintained in the units involving dairying alone.

The least squares means of lactation length (days) of Desi, HFX and JX cows were obtained as 352.18 ± 5.20, 331.78 ± 4.35 and 342.77 ± 4.79 respectively.

Genetic group, herd size, season of calving, lactation order and farming system had significant ($P<0.05$) effect on LL (days), whereas zone and herd constitution did not play significantly on it. Desi cows had significantly 20.40 days and 9.41 days longer LL than HFX and JX cows respectively. Although the average LL (days) of HFX and JX cows did not differ significantly, yet JX cows had 10.99 days longer LL than HFX cows. The cows maintained in the herd size of 7 & above had longer LL (days) than lower herd sizes in this study. Rainy calvers had the longest (352.30 ± 3.97) LL (days) followed by summer and winter calvers. The sequence of lactation, however, had irregular trend on LL (days). The cows maintained in the dairy units + agriculture had 15.55 longer LL (days) than those maintained in the dairying alone.

The average peak yield (kg) in Desi, HFX and JX cows were obtained as 4.49 ± 0.25, 11.86 ± 0.21 and 8.24 ± 0.23 respectively.

HFX cows had significantly ($P<0.05$) 7.37 kg and 3.62 kg higher PY than Desi and JX cows respectively. Besides, JX had also significantly ($P<0.05$) 3.75 kg higher PY than Desi cows. The highest peak yield was observed to be in zone II followed

by zones IV, III and I. Zone II had significantly (P<0.05) 1.65 kg and 1.10 kg higher PY than zones I and III respectively. The cows maintained in the herd size of 9 & above had significantly (P<0.05) 1.12 kg and 0.30 kg higher PY than those maintained in the herd sizes of 3-4 and 5-6. However, the mean PY of 9 & above herd size did not differ significantly with those of 7-8. The cows calved during rainy season had significantly (P<0.05) 0.57 kg and 0.73 kg higher PY than winter and summer calvers. The dairy units integrated with agriculture had significantly (P<0.05) 1.30 kg more PY than those maintaining only dairying. Herd constitution and lactation order, however, did not influence PY significantly.

Least squares means of DAPY in Desi, HFX and JX cows were found to be 55.70 ± 0.73, 46.67 ± 0.61 and 49.38 ± 0.67 days respectively.

Genetic factor, location of herd, herd constitution, season of calving and lactation order had significant (P<0.05) role on DAPY. HF crossbred cows had significantly (P<0.05) 9.03 days and 2.71 days lower DAPY than Desi and Jersey crossbred cows respectively. Besides, JX had also significantly (P<0.05) 6.32 days lower DAPY than Desi cows. Zone I had the lowest DAPY followed by zones II, IV and III. Zone I had significantly (P<0.05) 6.04 and 3.95 days lower DAPY than zones III and IV respectively. The lowest average DAPY was observed to be in HFX cows which, however, did not differ significantly with the average DAPY of Desi, JX and Desi + JX combination. The lowest average DAPY was observed by rainy calvers followed by winter and summer. The average DAPY was found to be the lowest in 3$^{rd}$ & 4$^{th}$ (pooled together) lactations which was significantly (P<0.05) lower by 2.43 days, 2.53 days and 1.96 days than 1$^{st}$, 2$^{nd}$ and 5$^{th}$ & above lactations respectively. Herd size and farming system did not influence DAPY significantly.

The average MY/day LL in Desi, HFX and JX cows were observed to be 3.78 ± 0.69, 8.45 ± 0.58 and 6.66 ± 0.64 kg respectively.

Genetic group had significant (P<0.01) effect on MY/day LL. HF crossbred cows had more than double and JX cows had nearly double MY/day LL than Desi cows. Besides, HFX had also significantly (P<0.05) 1.79 kg more MY/day LL than JX cows. However, location of herd, herd size, herd constitution, season of calving, lactation order and farming system did not play significant roles on MY/day LL in this study.

The least squares means of calving interval (CI, days) were obtained as 466.18 ± 5.44, 405.63 ± 4.56 and 416.03 ± 5.02 days respectively.

HF crossbreds and JX cows had significantly (P<0.05) 60.55 days and 50.15 days lower average CI than Desi cows.

Zone IV had the lowest (417.20 days) of CI which was significantly (P<0.05) lower by 15.08 days and 24.00 days than the average CI of zones II and III respectively. The cows maintained in the herd size of 5-6 had significantly (P<0.05) 19.11, 26.20 and 22.33 days lower CI than the cows maintained in the herd sizes of 3-4, 7-8 and 9 & above respectively. The days of CI was observed to be the lowest (418.87 days) in D + JX. However, all the herd constitution groups except D + HFX group did not differ significantly among themselves with respect to CI (days). Winter calvers had the lowest days of CI which was significantly (P<0.05) lower by 26.93 and 37.42 days than summer and rainy calvers respectively. Although parity of lactation had significant (P<0.01) effect on CI (days), yet no definite trend could be obtained for this trait. Cows maintained in the dairy units involved in the dairying alone had significantly (P<0.05) 26.50 days lower CI than those integrated with agriculture farming.

Desi, HFX and JX cows yielded 2.19 ± 0.09 kg, 6.63 ± 0.07 kg and 5.12 ± 0.08 kg milk yield per day of CI respectively.

HF crossbreds had significantly (P<0.05) higher MY/day of CI by 4.44 kg and 1.51 kg than Desi and JX cows respectively. Besides, JX cows had also significantly (P<0.05) 2.93 kg higher average MY/day CI than Desi cows. Herd size had significant (P<0.01) effect on MY/day CI. The cows maintained in the herd size of 7 and above had significantly (P<0.05) higher MY/day of CI than the cows maintained in the lower sizes. Season of calving played significant (P<0.01) role on MY/day CI. Winter calvers had the highest MY/day CI (4.93 kg) followed by rainy (4.66 kg) and summer (4.36kg) calvers. Sequence of lactation had significant (P<0.05) effect on MY/day CI. Although there was no any definite trend, the MY/day CI significantly (P<0.05) declined after 3rd & 4th lactations (pooled together). Location of herd, herd constitution and farming system, however, had no significant effect on MY/day CI.

The average dry period (days) in Desi, HFX and JX cows were found to be 114.96 ± 2.35, 74.99 ± 1.97 and 72.85 ± 2.16 respectively. HF crossbreds and JX cows had significantly (P<0.05) 39.97 and 42.11 days shorter dry periods than Desi, cows. However, the average DP of HFX and JX cows did not differ significantly.

The zone IV had the shortest dry period (days) which was significantly (P<0.01) shorter by 10.33, 9.25 and 21.61 days than zones I, II and III respectively. Herd size and herd constitution did not play significant role on DP in this study. The shortest DP (83.09 days) was observed by winter calvers which was significantly (P<0.05) 14.57 days shorter than rainy calvers. The days of DP was observed to be the shortest in 3rd & 4th lactations (pooled together) after which it tended to

increase. The cows maintained in dairying alone had significantly ($P<0.05$) 12.38 days shorter DP than those maintaining dairy units + agriculture farming.

The average net cost/kg of milk production was observed to be Rs. 10.14 ± 0.16, Rs. 8.60 ± 0.13 and Rs. 9.33 ± 0.15 in Desi, HFX and JX cows respectively.

HF crossbreds had significantly ($P<0.05$) Rs. 1.54 and Re. 0.81 lower net cost/kg of milk production than desi and JX cows respectively. Besides, JX cows had also significantly ($P<0.05$) Re. 0.73 lower net cost/kg of milk production than Desi cows.

Zone II had significantly ($P<0.05$) lower net cost/kg of milk production by Re. 0.46, Re. 0.53 and Re 0.60 than zones I, III and IV respectively. The cows maintained in the herd size of 7 and above had significantly ($P<0.05$) lower net cost/kg of milk production than the cows maintained in the lower sizes. Winter and rainy calvers had significantly ($P<0.05$) Re. 0.74 and Re. 0.45 lower net cost/kg of milk production than summer calvers. However, herd constitution, lactation order and farming system had no significant effect on net cost/kg of milk production.

Among the various variable cost items, feed cost was observed to be the major cost component contributing 70.13, 71.74 and 71.72 percentages of their respective gross cost in Desi, HFX and JX cows respectively, whereas labour cost appeared to be the 2$^{nd}$ major cost component contributing 12.88, 14.87 and 16.34 percentages of their respective gross cost.

The farmers of the dairy units located in and around Biharsharif, Nalanda recorded eleven constraints perceived by them of which high cost of crossbred cows ranked 1$^{st}$ followed by non-availability of good dairy animals, high incidences of repeat breeding, high cost of feeds, fodders and feed

supplements, high cost of veterinary medicines, poor performance of A.I., improper housing, shortage of green fodder through out the year, lack of finance/credit facility, uneconomical crossbred male calves and non-remunerative price of milk which require proper attention on priority basis.

**RECOMMENDATIONS :**

On the basis of the findings of the present study, HF crossbreds should be preferred to Jersey crossbred cows for LMY, PY, DAPY, MY/day LL, CI, MY/day CI and net cost/kg of milk production in and around Biharsharif, Nalanda (Bihar). Besides, a herd size of 7 and above cows upto 4$^{th}$ lactations would be the optimum for relatively economic milk production in this area.

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