



## Genetic improvement programme in Gir cattle for enhancing milk productivity

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### ABSTRACT

The All India Co-ordinated Research Project (AICRP) on Cattle is implemented in the home tract of Gir cattle for their conservation, propagation and genetic improvement. The involvement of Gir animal owners under the programme has helped to create awareness among the farmers on the importance of this valuable breed. The production of frozen semen doses of genetically superior young bulls and the availability of AI facility at the doorsteps of the farmer has increased the conception rate to a large extent. All lactation production performance of Gir animals maintained in the GP unit revealed better performance than the first lactation production traits. The overall total lactation milk yield, 305-days yield, lactation length, peak yield and dry period were estimated as 3801.0 kg, 2868.30 kg, 457.2 days, 14.80 kg and 68.50 days, respectively. The mean all lactation service period and calving interval were 216.50 and 498.50 days, respectively. The production and reproduction performance of Gir cattle has improved over the years due to the implementation of the project and continuous efforts will be made to propagate this valuable germplasm to the needy people of the country.

**Key words:** AI, Cattle, Conception rate, EBV, Genetic improvement, Gir

Indian subcontinent is a paradise of cattle biodiversity as it harbours 40 recognized native cattle breeds classified according to their utility as milch (04), dual (08) and draft (28). The history of evolution of cattle breeds in the country reflects the cultural and social differences prevailing among the Indian population. Traditionally, the cattle breeding was practiced based on regional necessity and farmer preferences and constant interbreeding among the animals of a region resulted in the formation of animal populations with some specific similar characters leading to the development of new cattle breeds. Further, the movement of animal owners from one region to another for their livelihood also made the movement of their cattle and their crossing with the native cattle breed of new location resulted in the formation of new breeds having slight morphological differences from the parent breeds.

The majority of rural farmers of the country use cattle predominantly for agricultural operations and hence significant size of the cattle population is in the hands of marginal, small and landless farmers. Cattle in India have been raised over centuries primarily for agricultural operations and not for milk production, thus are often classified as draft animals. The country possesses only four defined milch breeds, viz. Gir, Sahiwal, Red Sindhi and

Rathi while the other important breeds such as Kankrej, Tharparkar, Hariana, Deoni, Ongole etc. are classified as dual purpose breeds and the rest of the breeds are described as draft cattle. The country is proud possessor of excellent draft breeds like Hariana, Nagori, Khillar, Kangayam, Amritmahal etc. Per animal milk production of important milch breeds of the country is much lower than the productivity of the exotic milch breeds such as Holstein-Friesian, Jersey etc. In order to increase the milk production, the crossbreeding of indigenous cattle with high yielding temperate cattle breeds was taken up extensively during 70s and 80s. This is now often criticized as it eroded the genetic base of native cattle breeds and increased the incidence of disease and heat stress and reproductive problems in the crossbred progenies. There were no comparable large scale breeding programmes for the improvement of milch/dual purpose/draft breeds of the country for enhancing their productivity. Further, the recent acceptance of the effect of A1-A2 beta casein milk on human health also favours the production of milk from indigenous cattle breeds which are essentially A2. Thus, it becomes highly essential to take up a breed improvement programme for increasing the milk production of our native cattle breeds.

### AICRP on Cattle

Considering the above facts, the Indian Council of Agricultural Research under the aegis of All India Co-ordinated Research Programme on Cattle (AICRP on Cattle) started the Indigenous Breeds Project (IBP) for the

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genetic improvement of important indigenous breeds of cattle from 11<sup>th</sup> five-year plan period. The project is being operated by Central Institute for Research on Cattle, Meerut in the native breeding tracts of three indigenous cattle breeds, viz. Gir, Kankrej and Sahiwal in collaboration with various State Veterinary /Agricultural Universities and ICAR institutes, State Government Farms, NGOs and Gaushalas. The project is primarily aimed to conserve, improve and propagate the genetic potential of these three important indigenous cattle milch breeds involving the local farmers.

#### Objectives

1. To study the genetic and phenotypic variances in milk and covariance among milk and associated economic characteristics such as growth, reproduction and survival with a view to develop suitable selection criteria for improving milk production.
2. To undertake progeny testing and selection of bulls for bringing genetic improvement in population involved and provides superior Germplasm for utilization in development programme for improving milk production.

The technical programme of the project envisages the establishment of germplasm (GP) and data recording units (DR) for each breed by registering the animals maintained under farm and field conditions. The young bulls born out of nominated mating of elite cows with high genetic merit bulls maintained at the germplasm units are progeny tested using animal and farm facilities existing at the Data Recording Units/ associated herds.

**Germplasm unit:** About 75 elite females are mated with 4 to 5 genetically superior/proven bulls of the breed for production of young bulls. These males are reared at the germplasm centre, out of which about 8 to 10 bulls on attaining maturity are selected as future bulls based on their expected breeding values. These bulls are trained and used for semen collection and freezing of about 3000 doses of semen from each bull. About 1000 doses of frozen semen are utilized for sire evaluation at the data recording units and 1000 doses each will be maintained at the germplasm centre and gene pool laboratory of ICAR-Central Institute for Research on Cattle.

**Data recording units:** The progeny testing of young bulls born out of the nominated mating of elite cows at the germplasm centre is carried out using the animal and farm facilities existing at the Data Recording Units/associated herds. To carry out this program, about 750 breedable females are identified at about 5 data recording units (herds) for that breed as far as possible near the germplasm centre. Each bull is mated with a minimum of 60 to 70 females in order to provide first lactation milk production records on at least 20 progenies per bull. Information on growth, reproduction, milk production and survivability are collected for genetic analysis.

Gir is one of the important indigenous milch breeds of cattle, originated in Gujarat state of India. The home tract

of the breed is the Gir forests and hills of Kathiawar region covering Junagadh, Rajkot, Amreli and Bhavnagar districts. Desan, Kathiawari, Gujarati, Bhodali, Surti and Sorthi are some of the synonyms of this breed (Gaur *et al.* 2003). These animals are known for their heat tolerance and resistance to most of the tropical diseases. Due to their superiority, the Gir germplasm had been imported by many countries such as Brazil, USA, Mexico, Venezuela etc. for breeding with their native cattle breeds. Considering the potential of this breed, it has been included under the AICRP project for genetic improvement.

#### Topography and climate of the breeding tract

The native tract of the Gir cattle lies between 20°5' and 22°6' north latitude and 70° and 72° east latitudes. The altitude of the tract ranges from 125 to 600 m above the mean sea level. The region experiences tropical climate with the temperature range of 11° (January) to 40°C (May) with the relative humidity range of 60–80% during rainy seasons.

#### Project study area

The Germplasm unit of Gir cattle is located at Cattle Breeding Farm, Junagadh Agricultural University, Junagadh (Gujarat). The DR units of the breed are located in villages in the region involving 11 farmer herds and three associated herds. The detailed list of farmer herds and associated are given below:

Germplasm unit	Data Recording (DR) units (Farmer herds – in 11 villages in the tract)	Data Recording (DR) units (Associated herds – 3 Nos)
Cattle Breeding Farm (CBF), Junagadh Agricultural University (JAU), Junagadh, Gujarat	Shedhaya, Pipli, Loej, Movana, Surva, Sherdi, Hadmadiya, Mandlikpur, Khorasa, Kodadnar, Chanchakvad	Cattle Breeding Farm, JAU, Junagadh, Gujarat; Bhutnath Gaushala, Khorasa Swami Narayan Gaushala, Gondal

**Germplasm unit:** The CBF, JAU is identified as the GP unit of the project as it maintains the elite Gir germplasm. The total herd strength of the Gir Germplasm unit was 163 in March 2017 which included 19 female calves up to 12 months, 44 heifers (up to 2 ½ years), 37 milking and 24 dry cows. The total number of male animals was 39 consisting of 15 male calves up to 12 months and 24 young bulls.

In the project, 24 Gir bulls in three sets (six in first set, nine each in second and third sets) have been put under semen collection, out of which, 19 bulls (six in first, nine in second and four in third set) have been used for breeding so far. The young bulls are selected on the basis of their pedigree and dam's yield and trained for semen collection. The fresh and frozen semen doses collected from the bulls are tested for quality parameters before distribution

Table 1. Set wise information on breeding bulls (Since inception)

Particular	Set-1	Set-2	Set-3	Total
Year of induction of set	2009-10	2012-13	2015-16	-
No. of bulls inducted/used	6	9	9	24
No. of semen doses frozen	31688	88956	38919 (Contd.)	159563
No. of semen doses utilized	18328	16658	2729 (Contd.)	37715
No. of semen doses discarded	-	-	-	-
No. of cows covered	12186	8266	1374 (Contd.)	21826
No. of female calves born	3114	1428	81 (Contd.)	4623
No. of female reached AFC	450	0	0	450
No. of daughters completed 1 <sup>st</sup> lactation	147	0	0	147
Frozen semen doses available	13360	72298	36190	121848

Table 2. Details of insemination carried out, conception rate and daughters born

Set	No. of bulls	AI done	Conception	Daughters born	Daughters completed 1 <sup>st</sup> lactation milk yield
1	6	12186	6207 (50.94)	3114	147
2	9	8266	4054 (49.04)	1428	-
3	9	1374	353 (25.69)	81	-
Total	24	21826	10614 (48.63)	4623	147

Figures in parentheses indicate the conception rate in percentage

to the artificial insemination (AI) centres. The details on the set wise information of breeding bulls inducted in the project and semen doses available are given in Table-1. A total of 159563 frozen semen doses were produced under the project and as on 1<sup>st</sup> January 2017, 121848 doses of frozen semen are available for future breeding. Moreover, 21826 adult females were registered and inseminated under the programme. The semen doses of Gir cattle were also made available at the Co-ordinating unit of ICAR-CIRC, Meerut to supply to the needy farmers of the state.

The details of insemination carried out, number of animals conceived and the daughters born are given in Table 2. In the first set of bulls, 12186 animals were covered using AI, out of which 6207 animals conceived and 3114 daughters were born. Around 8266 animals were inseminated with the frozen semen of second set of bulls, 4054 animals were confirmed pregnant and 1428 female calves born. In the third set, out of nine bulls, four were inducted for AI and the rest five bulls are ready for breeding. A total of 1374 females have so far been covered by AI, 353 confirmed pregnant and 81 daughters born. The conception rates obtained based on confirmed pregnancy for the first, second and third set of bulls were 50.94, 49.04 and 25.69%, respectively. Since the third set of bulls was inducted during the last year, most of the animals inseminated are yet to be tested for pregnancy and because of this reason, the conception rate is very low (25.69%) as compared to the first two set of bulls. Out of 3114 daughters born to the first set of bulls, 450 have reached their first

calving and 147 daughters completed their first lactation. The evaluation of first set of bulls based on the first lactation milk yield of their daughters is under progress as some of the daughters are yet to complete their lactation.

The first and all lactation production and reproduction performance of Gir cows maintained in the GP unit and all lactation performance of Gir cows at DR unit during the year 2016 are presented in Table 3. The average estimates of AFC of animals maintained in GP and DR units were 44.8 and 46.62 months, respectively. The AFC estimates observed in the present project was similar to the average of 3.74 years reported by Mathur and Khosla (1994) in Gir cows. However, Singh *et al.* (2016), Ulmek (1990) and Dangar *et al.* (2014) reported average AFCs higher than the present study. The average estimates for first lactation production traits viz., lactation milk yield, lactation 305-days yield, lactation length, peak yield and dry period were

Table 3. Production and reproduction performance of Gir animals at Germplasm unit during the year 2016

Trait	GP unit
Age at first calving (days)	1343.5±43.7 (17)
	44.6 months
First lactation total milk yield (FLMY in kg)	3650.6±643.9 (10)
First lactation 305-days or less milk yield (FL305DMY in kg)	2392.1±239.3 (10)
First lactation length (FLL in days)	499.1±65.3 (10)
First peak yield (FPY in kg)	13.7±0.8 (10)
First dry period (FDP in days)	95.0±46.5 (03)
First service period (FSP in days)	331.3±42.7 (03)
First calving interval (FCI in days)	610.3±40.3 (03)
All lactation total milk yield (kg)	3801.0±221.7 (38)
All lactation 305-days or less milk yield (kg)	2868.3±93.8 (38)
All lactation length (FLL in days)	457.2±25.6 (38)
All lactation peak yield (FPY in kg)	14.8±0.3 (38)
All lactation dry period (FDP in days)	68.5±11.7 (25)
All lactation service period (FSP in days)	216.5±22.4 (25)
All lactation calving interval (FCI in days)	498.5±22.4 (25)
Wet average (kg)	8.9±0.3 (31)
Herd average (kg)	5.2±0.3 (54)

Figures in parentheses indicate number of observations

3650.60 kg, 2392.10 kg, 499.10 days, 13.70 kg and 95 days, respectively. The first lactation milk yield obtained in the present study was higher than the estimates reported by Mathur and Khosla (1994) and Singh *et al.* (2016) in Gir cattle; Albuquerque *et al.* (1990) and Bhoite and Kale (1996) in crossbred Gir cows. The averages for first lactation service period and inter-calving interval were 331.3 and 610.30 days, respectively. Mathur and Khosla (1994) reported a lower calving interval of 434.25 days.

The study on all lactation production performance of Gir animals maintained in the GP units revealed better performance than the first lactation production traits. The overall total lactation milk yield, 305-days yield, lactation length, peak yield and dry period were estimated as 3801.0 kg, 2868.30 kg, 457.2 days, 14.80 kg and 68.50 days, respectively. The mean all lactation service period and intercalving interval were 216.50 and 498.50 days, respectively. The mature lactation milk yields were higher than first lactation milk yield also with lowered lactation length. This indicates that the average daily milk yield in first lactation was comparatively lower than the subsequent lactations. This is also supported by the increased average peak yield of 14.80 kg in the later lactations while it was 13.70 kg in the first lactation. Moreover, the reduction in the service period and intercalving interval observed in the subsequent lactations as compared to the first lactation also indicates the improvement in the performance of animals as their age advances. However, contrary to present findings, Mathur and Khosla (1994) reported comparatively higher milk yield of 2215.64 kg in the first lactation which did not increase much in the second (2195.02 kg), third (2200.64 kg), fourth (2128.04) and fifth (2194.90 kg) lactations.

The results on the performance of Gir cows maintained in the DR units are presented in Table 3. The overall performance of animals in DR units was lower than the GP unit, but was comparable with the performance of Gir animals reported by earlier workers. Since the GP unit of the project is the nuclear herd and maintains the genetically superior elite Gir animals, their performance will obviously be superior to the DR animals. The overall average all lactation total milk yield and 305-days milk yield were 1833.40 and 1786.60 kg, respectively. The lowered lactation length (273.50 days) had resulted in higher dry period of 172.50 days. However, the service period (182.30 days) and intercalving interval (466.20 days) were lower than the GP unit.

#### *Expected breeding values (EBVs) of Gir bulls and their rankings*

Six Gir bulls of first set were evaluated on the basis of first lactation milk yield of their daughters by Best Linear Unbiased Prediction (BLUP) method and the result is given in Table 4. The overall breeding value was estimated as 2699.05 kg. Among the six bulls inducted, two bulls viz., Pankaj and Raj had breeding values higher than the overall average with the genetic superiority of 3.71 and 2.78%, respectively. The most inferior bull had the genetic inferiority of 3.26%.

Table 4. Expected Breeding Values of Gir bulls estimated by BLUP method

Sires	Factors	No.	LS Mean $\pm$ SE (Kg)	EBV (Kg)	Ranking
	Overall	145	2699.05 $\pm$ 168.67		
1	Bhavik	50	2644.82 $\pm$ 151.80	-54.23	5
2	Bholo	03	2684.31 $\pm$ 227.01	-14.74	3
3	Murari	37	2611.11 $\pm$ 165.36	-87.95	6
4	Pankaj	21	2799.24 $\pm$ 184.12	+ 100.19	1
5	Raj	03	2774.03 $\pm$ 224.86	+74.98	2
6	Rupak	31	2680.81 $\pm$ 165.65	-18.25	4

The outcome of project was as follows:

1. A sizable number of Gir cattle reared in the breeding tract were registered under the project, bringing the farmers under one umbrella functioning like a breed society.
2. Under this project, a large number of semen doses were collected, frozen and made available for use to enable germplasm conservation and propagation.
3. Through associated herd progeny testing programme, farmers were supplied with semen of genetically superior young bulls born to elite females for AI at free of cost.
4. The project also helped to supply the progeny tested high ranking bull semen for AI of the Gir animals, thus bringing genetic improvement of the existing Gir population at a faster rate.
5. The farmers were also supplied with the mineral mixture, medicines for deworming and vaccination of animals at regular intervals.
6. The programme also help to upgrade the non-descript or diluted Gir cattle into defined breed so as to increase the population size for conservation of this elite cattle germplasm.
7. The farmers are regularly enriched with the knowledge on scientific dairy cattle production through seminars, animal welfare camps, training programme, scientists-farmer interactions etc. for improving the production.
8. Creates awareness among the farmers on the importance of Gir cattle for milk production and to propagate the valuable germplasm to the needy farmers of the country.

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