



Genetic improvement of cattle through field progeny testing programme: An evaluation of achievement

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ABSTRACT

Evaluation of bulls through progeny testing and their extensive use has been a major source of genetic improvement in dairy animals. Adequate numbers of progeny tested bulls are not available in India and whatever small numbers of bulls are progeny tested, they have low repeatability as the progeny tests are based on a small number of daughters mostly reared at the institutional farms. Since the facilities available with the institutional farms are limited, it is necessary that the progeny testing programmes are extended to the farmers' herds where large number of daughters per bull can be produced and recorded. A mega field progeny testing (FPT) program in mid-eighties was initiated at the Project Directorate on Cattle (PDC), presently upgraded as ICAR- Central Institute for Research on Cattle, Meerut, Uttar Pradesh in collaboration with Agricultural Universities and Non-Government Organization at different agro-climatic regions of the country. This article reviews the detailed progress of the FPT Program executed at ICAR- Central Institute for Research on Cattle since inception.

Key words: Age at first calving, Cattle, Field progeny testing, First lactation milk yield, Frieswal

Selection based on a number of criteria has been the tool for achieving improvement in livestock throughout the world. In India, selection of sires based on the breed characteristics and pedigree information whenever available was followed during the pre-independence period. The evaluation of sires was generally based on body size, conformation and high production potential of dam. Recent investigations have however, revealed that young bulls must be tested based on their daughters performance, before extensive use in artificial insemination program. Use of crossbred bulls with known genetic merit and exotic blood may sustain the genetic progress in the crossbred herds, maintain level of exotic inheritance and improve non-descript animals. There is a great demand of crossbred bulls with high genetic merit in cattle genetic improvement programs. Population size further needs to be increased by including many organized/farmers' herds to make the progeny testing program successful.

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History and background of the project

An ad-hoc research project by ICAR on 'Progeny testing of crossbred bulls under village conditions' was first started in the year 1985-86 at BAIF Development Research Foundation, Uruli-Kanchan (Maharashtra) and two Agricultural Universities at Ludhiana (Punjab) and Mannuthy (Kerala) for standardization of the performance recording systems at farmers' herds and to develop progeny testing procedures under field conditions.

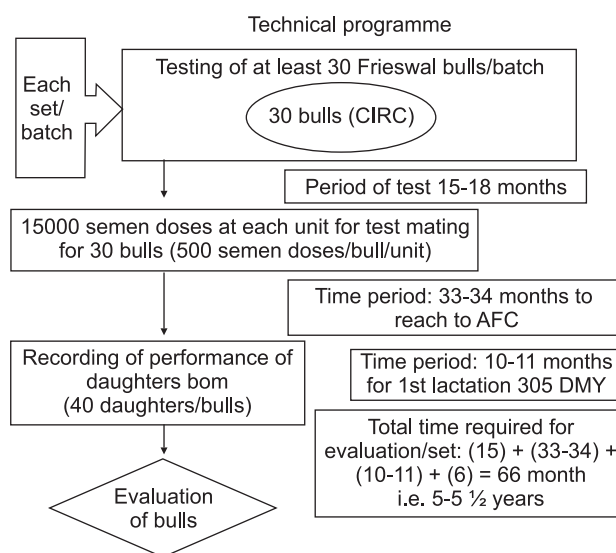
The technical program envisaged testing of 10 crossbred (50 to 75% exotic inheritance) bulls in each batch with performance records on minimum of 30 daughters per test bull. After the establishment of Project Directorate on Cattle in 1987, this ad- hoc Field Progeny testing program, after little modifications in the technical program, is now being coordinated as a regular part of its mandate, aiming at evaluation of crossbred bulls on a large scale using farmers' cows in the field since January 1994. At present, the project is running at four different units, i.e. Kerala Veterinary and Animal Sciences University (KVASU), Mannuthy, Thrissur; Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana; BAIF Development Research Foundation, Central Research Station, Uruli-Kanchan, Pune and G. B. Pant University of Agriculture and Technology (GBPUAT), Pantnagar.

This project helped with recording of performance data on large number of daughters and their use in ranking of test sires so as to increase the efficiency and accuracy of

Progeny Testing Program. The genotype environment interaction is kept to the lowest by simultaneously using the semen of all test bulls in 4 agro-ecologically different geographical locations of the country and introducing exotic genes from Friesian for higher production into the progeny of non-descript cows so as to improve upon their genetic makeup (Gaur 2007).

Objectives and technical program

The modified field progeny testing program envisages testing of 30 Frieswal (HF × Sahiwal) bulls in each batch having 62.5% exotic inheritance and dam's minimum mature equivalent milk yield of 4,500 kg. The bull - dams should be of good conformation. This project covers about 32,000 test females in the field conditions at 4 different locations. Each time a new batch of 30 Frieswal young crossbred bulls has to be introduced into the cycle at 15-18 months interval.



The target is to record first lactation milk performance of at least 40 daughters per bull spread over KVASU, GADVASU, BAIF and GBPUAT. This will involve inseminating at least 300 cows/bull at each unit, thus a population of about 9,000 cows at each unit will be required for test mating with 30 bulls. Information on animal identification, its age, sire, dam, date of insemination, pregnancy result, date of calving, data on milk production and reason for loss of data are to be generated. Data are also to be recorded on farmer's socio-economic status, herd size, land holding, feeding and housing and herd management practices. The milk recording was carried out by trained milk recorders on contractual basis. Milk supervisors and senior officers of the project make regular checks to ensure accurate milk production and performance recording.

Salient achievements in the project

Bulls of 5th and 6th set were evaluated independently in the three field centres. A total of 24, 9 and 9 bulls were

evaluated in the 5th set in BAIF, GADUVASU and KVASU, respectively, whereas it was 22, 13 and 13 bulls in the 6th set. The overall least squares mean of first lactation milk yield in BAIF, GADUVASU and KVASU were 2985.75±203.12, 2941.06±115.25 and 2288.29±114.12 kg respectively in the 5th set, whereas the corresponding values in the 6th set were 3073.50±139.93, 3165.59± 75.47 and 2494.67±119.99 kg respectively. The breeding values ranged from 2807.51 to 2985.75, 2856.62 to 3011.97 and 2174.65 to 2394.87 in the 5th set in BAIF, GADUVASU and KVASU respectively. The breeding values of bulls in the 6th set ranged from 2921.66 to 3137.71 in BAIF, 3039.18± 82.06 to 3262.09 in GADUVASU and 2340.70 to 2760.75 in KVASU. The number of bulls exceeding the herd average in breeding value for first lactation milk yield in 5th set in BAIF, GADUVASU and KVASU were 18, 3 and 5 respectively; whereas the same in the 6th set were 10, 6 and 8 in the same order. The per cent of genetic superiority in the top ranking bull in the BAIF, GADUVASU and KVASU was 4.70, 2.41 and 4.66 in the 5th set and 2.09, 3.05 and 10.67 in the 6th set respectively. Almost similar trends were also reported earlier by Gaur *et al.* 2006, 2008.

Kerala Veterinary and Animal Sciences University, Mannuthy, Thrissur: Field progeny testing program at this unit is running through seven field units and six artificial insemination centers along with three livestock farms of KVASU. Crossbreeding is the accepted breeding policy of cattle in Kerala since 1950s. The consistence improvement in productivity of cattle in the project areas of the Field Progeny Testing Programme is evident throughout the period. This is due to providing superior crossbred germplasm generated through effective selection of male calves and provided to the farmers of the state. As a result, production from progenies of the project are always 2 to 2.5 kg more than that of their contemporaries on daily average basis, thus providing additional income to each farmer to the tune of ₹ 13,000 to 15,000 per year per animal.

The first set of bull at KVASU was executed in January 1992. Subsequently 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th and 14th sets were implemented in 1994, 1995, 1998, 2001, 2003, 2005, 2006, 2008, 2009, 2011, 2012, 2014 and 2015, respectively. A total of 268 bulls in fourteen different sets have so far been inducted in the program. Up to 12th batch bulls from three different sources, i.e. from GADVASU, Ludhiana; BAIF, Pune and PDC, Meerut were pooled together and put under test but from batch 13th onwards only ICAR-CIRC bulls are used for Field Progeny Testing Programme. A total 112,052 Artificial Inseminations have so far been done out of which more than 2,094 breedable female progenies have been produced through the use of semen of the test bulls (Table 1).

A total of 1,658 daughters from first twelve sets have completed their first lactation. The first lactation 305 days milk yield showed an increasing trend among the progenies of different sets and the average first lactation 305 days milk yield was 1,958 kg in 1st set and 2,836 kg in 12th set indicating an increase of 878 kg milk production (44%)

Table 1. Information regarding different sets (KVASU)

Set No.	Date of Start	Total bulls used	Total inseminations	Total AIs followed	Pregnancies confirmed	Conception rate (%)	Followed for calving	Female calves	
								Born	Reached AFC
1	01-01-1992	12	23351	6722	2420	36	1902	956	319
2	01-04-1994	11	12817	4800	1680	35	1300	603	240
3	01-09-1995	11	9331	3942	1324	33.6	1065	757	89
4	01-11-1998	15	11750	3753	1501	39.9	1489	676	178
5	09-11-2001	19	3437	3261	1136	34.8	847	401	139
6	24-06-2003	20	8173	7683	2582	33.6	1689	746	216
7	16-03-2005	24	5759	5211	2281	43.7	1298	597	180
8	30-08-2006	22	5703	5514	2472	44.8	1538	768	160
9	05-02-2008	16	3393	3131	1181	37.7	801	394	81
10	01-07-2009	24	5781	5612	2124	37.8	1324	664	162
11	25-05-2011	21	4820	4401	2006	45.6	1280	659	219
12	10-10-2012	28	6045	5531	2357	42.61	1302	642	111
13	14-03-2014	15	5211	4850	2063	41.97	1114	545	0
14	22-07-2015	30	6481	5101	2186	42.85	689	336	0
Total		268	112052	69512	27313	549.93	17638	8744	2094

Annual Report 2015-16, ICAR-CIRC.

per lactation in the daughters of bulls under test. A trend of decreasing age at first calving was also observed in subsequent sets of bulls. The Age at First Calving of progenies was recorded as 1,136 days in progenies of first set of Bulls (1992) and which has reduced upto 896 days in current set (2016) which indicated a sharp decrease of 240 days in Age at First Calving (Fig. 1). The average age at first calving of progenies of the test bulls and contemporaries calved during report period was 896 and 1250 days respectively. The progeny born from test bulls of the scheme is producing about 500 litres more milk per lactation than the other cow in the area and farmers are getting additional income of ₹ 16000 per year per cow. The contribution of the project to the state is the production of more than 10,000 female progenies of high genetic merit is very substantial.

Inseminations of 13th set and 14th set of bulls have been

completed. Recording of first lactation milk yield of cows of 10th set of bulls were completed till the end of 2016. The average conception rate of 14th batch used was 46.22%. Predicted average birth weight of female calves in the project was 30.85±0.30 kg. Average fat content of morning milk during the period was 3.50, 3.77, and 3.84%, respectively, of 2nd, 5th and 8th month of lactation respectively. The loss of data during the project was 1.81% for 10th set, 1.82% for 11th set, 3.89% for 12th set and 9.72% for 13th set of bulls. The data on cow's owner revealed that around 72% of the cow owners were farmers and the rest were engaged in other activities. Among the dairy farmers, 68.4% had at least upper primary level of education and only 4.1% were illiterate. More than 50% cattle owners had less than one acre of land. It was observed that majority (42.1%) of the dairy farmers had only one cow.

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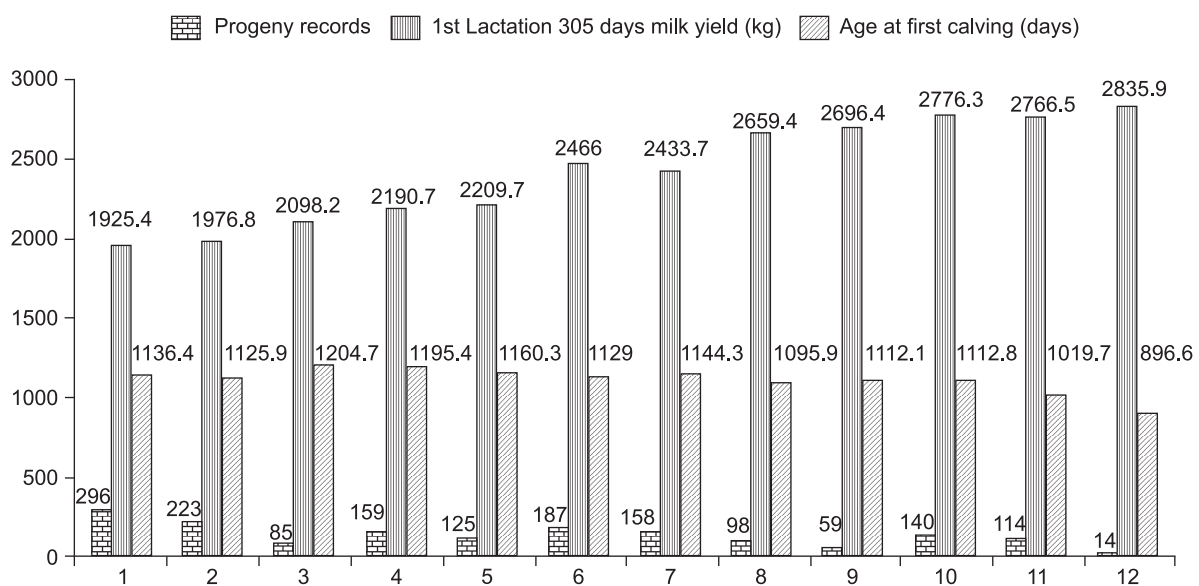


Fig. 1. Set wise progeny performance (milk yield and age at first calving) at KVASU

University, Ludhiana: The artificial insemination work of the Field Progeny Testing project is undertaken through 30 AI centres covering 276 villages in Ludhiana district. A total 10,337 farmers have so far been registered and benefited through this project. The First set of bull at GADVASU was executed in April 1995. Subsequently, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th and 13th sets were implemented in 1997, 1999, 2001, 2003, 2005, 2006, 2008, 2009, 2011, 2012, 2014 and 2015 respectively. A total of 284 bulls in thirteen different sets have so far been inducted in the program. Up to 11th batch bulls from three different sources, i.e. from GADVASU, Ludhiana; BAIF, Pune and PDC, Meerut were pooled together and put under test but from batch 12th onwards, only ICAR-CIRC bulls were used for Field Progeny Testing Programme. A total 139,170 Artificial Inseminations have so far been done out of which more than 5,181 female progenies (breedable females) have been produced through the use of semen of these bulls (Table 2).

About 3,549 daughters from first ten batches of bulls have completed their 1st lactation 305 days milk yield. There

is a trend of gradual increase in 1st lactation 305 days milk yield of daughters from first set of bulls which was recorded as 2697.8 kg and in eleventh set of bull it was recorded as 3841.0 kg which indicates a sharp increase of 1,143 kg milk per lactation (42.3%) in progenies of bulls under test. A trend of decreasing age at first calving was also observed in subsequent sets of bulls. The Age at First Calving of progenies was recorded as 1,192 days in progenies of first set of Bulls (1995) and which has reduced upto 768 days in 11th set (2016) which indicate a sharp decrease of 64% in Age at First Calving (Fig. 2).

The average fat percentage of milk of the daughters of ninth, tenth and eleventh set of bulls was 3.7 ± 0.003 , 3.7 ± 0.004 and 3.7 ± 0.013 respectively. The average first lactation 305 days milk yields of the crossbred progenies in the adopted villages was 2449.7 ± 57.0 , 2965.5 ± 35.3 and 3133.8 ± 38.0 kg in the year 1993, 2006 and 2011, respectively. This is a result of supply of high quality semen of test bulls and has increased to 3743.3 ± 25.6 kg in the year 2016. Some progressive dairy farmers after getting training and superior germplasm from the project have

Table 2. Information regarding different sets (GADVASU)

Set No.	Date of start	Total bulls used	Total inseminations	Total A.I.'s followed	Pregnancies confirmed	Conception rate (%)	Followed for calving	Females calves	
								Born	Reached AFC
I	1.04.95	18	7595	7355	3065	41.7	3000	855	227
II	1.01.97	10	5150	4865	2132	43.8	2000	789	210
III	1.01.99	23	18006	17159	8258	48.1	8000	1844	562
IV	16.12.01	30	12548	11504	5720	49.7	5720	1368	490
V	1.04.03	22	10409	10154	4362	43.0	4362	1497	478
VI	1.2.05	25	8265	8105	3476	42.9	3476	1181	359
VII	1.8.06	22	9710	9710	3999	41.1	3999	1120	448
VIII	1.1.08	16	9611	9611	3898	40.6	3898	1186	461
XI	1.8.12	28	15662	15662	7008	44.7	7008	2500	407
XII	1.2.14	15	6662	6662	3039	45.6	3039	1321	8
XIII	1.8.15	30	8000	6107	2831	46.4	1409	589	0
	Total	284	139170	134446	59071	43.9	57194	17993	5181

(Annual Report 2014-15, ICAR-CIRC)

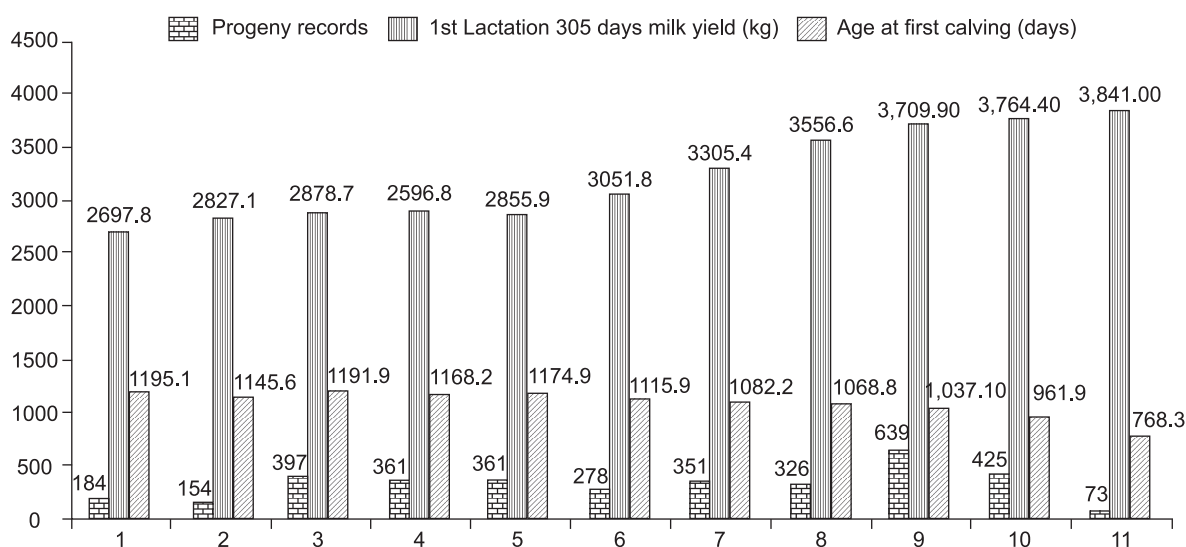


Fig. 2. Set wise progeny performance (milk yield and age at first calving) at GADVASU.

established outstanding crossbred herds with lactation milk yield of more than 6,500 litres and peak yield of more than 40 litres a day (Kumar *et al.* 2016).

Village level group meetings were regularly organized to make the dairy farmers aware about the importance of the field progeny testing programme and were advised for scientific breeding, feeding, management and health care practices for improving the production performance of their animals. As high as 33.7% of the data was lost due to different causes largely the sale of the animals. The production performance of the animals according to different categories of farmers showed that the cows predominantly maintained on green fodders had significantly higher milk yield than those maintained without fodder. Crossbred cows maintained by farmers having adequate green fodder produced 2,849 kg milk during 1st lactation against 2,106 kg with little or no green fodder supply. Educated farmers have more awareness and practiced dairying on scientific lines for getting higher productivity. Majority of the farmers (89.6%) possessed permanent cattle sheds and only a very few (10.4%) housed

their animals in temporary sheds. About 98% animals were maintained on stall feeding.

BAIF Development Research Foundation, Uruli-Kanchan, Pune: The artificial insemination work of the Field Progeny Testing project is undertaken through 25 Artificial Insemination centres covering 86 villages in BAIF, Urlikanchan, Pune unit. A total of 3,678 local farmers have so far been registered and benefited through this project. The first set of bull at BAIF was executed in July 1995. Subsequently, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th and 12th sets were implemented in 1998, 2001, 2003, 2005, 2006, 2008, 2009, 2011, 2012, 2014 and 2015 respectively. A total of 260 bulls from twelve different sets have so far been used for insemination. A total of 108,312 Artificial Inseminations have so far been done; out of which 100,415 AI followed and 45,490 progenies were confirmed leading to a conception rate of 45.3%. More than 4,658 female progenies (breedable females) have so far reached AFC through the use of semen of these bulls (Table 3).

A total of 3,366 daughters from first ten sets of bulls have completed their first lactation records. The first

Table 3. Information regarding different set of bulls in BAIF unit

Set No	Bull Batch Starting date	Total bulls used	Total A.I. done	Total A.I. followed	Pregnancies Confirmed	Conception rate	Followed for Calving	Female calves	
								Born	Reached AFC
I	Jul-95	20	16118	15063	7001	46.48%	4868	2344	1563
II	Jul-98	19	21321	17239	7673	44.51%	3815	1756	514
III	Jul-01	20	7461	7380	3398	46.04%	2626	1201	364
IV	Jul-03	20	5249	5162	2162	41.88%	1493	731	289
V	Feb-05	25	6806	6638	2989	45.03%	1969	856	394
VI	Sep-06	22	6533	6327	2899	45.82%	1993	885	371
VII	Feb-08	16	4902	4902	2169	44.25%	1561	733	313
VIII	Aug-09	24	6893	6867	2987	43.50%	1997	878	391
IX	Apr-11	21	6364	6364	3109	48.85%	2270	1010	388
X	Aug-12	28	9270	9030	4190	46.40%	2509	1182	71
XI	Mar-14	15	7139	7139	3221	45.12%	2536	1163	0
XII	Aug-15	30	10256	8304	3692	44.46%	472	190	0
Total		260	108312	100415	45490	45.30%	28109	12929	4658

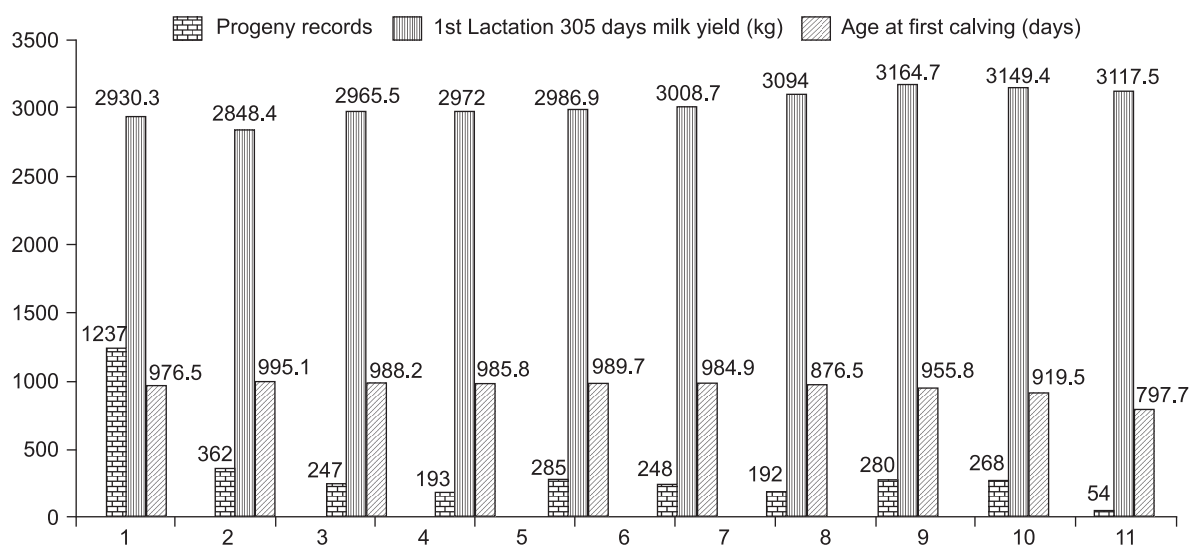


Fig. 3. Set wise progeny performance (milk yield and age at first calving) at BAIF unit.

Table 4. Information regarding different set of bulls in GBPAU&T, Pantnagar unit

Set No	Date of start	Bulls used	Total AI	AI followed	Pregnancy confirmed	Followed for calving	Female calves	
							Born	Reached AFC
I	20.01.2010	10	1,784	1,750	1,030	997	340	201
II	16.03.2011	6	2,303	2,258	1,546	1529	542	261
III	25.07.2012 04.09.2013	9	2,473	2,243	1,405	1382	573	65
IV	05.02.2014	15	5,205	4,115	2,934	2904	1058	0
V-1	22.07.2015	15	4,809	3,324	2,391	1482	597	0
V-2	17.06.2016	15	1,776	620	419	0	0	0
	Sum	70	18,350	14,310	9,725	8,294	3,110	527

lactation 305 days milk yield showed an increasing trend among the progenies of different sets and the average first lactation 305 days milk yield was 2,930 kg in 1st set and 3,117 kg in 10th set indicating an increase of 187 kg milk production in the daughters of bulls under test. A trend of decreasing age at first calving was also observed in subsequent sets of bulls. The Age at First Calving of progenies was recorded as 976 days in progenies of first set of Bulls (1992) and which has reduced upto 797 days in 10th set (2016) which indicate a sharp decrease of 179 days in Age at First Calving (Fig. 3).

The progeny performance of bull batches introduced during July 1995, February 1998, July 2001, July 2003, February 2005, September 2006, February 2008 and August 2009 have completed their first lactation. Total eight sets of bull batches completed progeny performance while progeny from bull batches introduced during April 2011 (9th set) and August 2012 (10th set) are under milk recording. The 11th bull batch is in calving stage and 12th bull batch which was introduced during August 2015 is under insemination and pregnancy diagnosis stage.

Regarding socio-economic status of farmers under the project, it was noticed that out of total 1,480 farmers, 40.41% farmers had education upto primary level, 37.09% upto secondary, 8.51% higher secondary and 4.59% graduate and above. The proportion of illiterate cow owner was 9.39%. The average herd size in field progeny testing area was 6.04. In milking animals, 35.46% were of first to third lactations, 18.24% animals were of 4th to 6th lactations and 1.69% animals were in 7th lactation and above. Majority of herd owners (48.79%) had permanent or semi-permanent cattle sheds for their animals, 20.13% owners had temporary type and 31.08% thatched type of housing to their animals. None of the animal was kept without shelter. As high as 90.95% of cattle owners were agriculturists and almost all (95.74%) owned land. Nearly 60% farmers had land up to 5 acres and the percentage of farmers having land more than 10 acres was 10.74%.

G. B. Pant University of Agriculture & Technology (GBPUA&T), Pantnagar: The project was initiated in 2009 and it is being implemented from 16.09.2009 at GBPUA&T, Pantnagar and presently running through 7 AI centres covering 292 villages of U.S.Nagar and Nainital districts of Uttarakhand. A total 6,524 farmers were registered under

this project. A total of 32,364 frozen semen doses from 70 bulls (3,000 FSD from 10 bulls of I set; 2,906 FSD from 6 bulls of II set, 4,410 FSD from 9 bulls of III set, 7,350 FSD from 15 bulls of IV set; 7,350 FSD from 15 bulls of V-1 set and 7,348 FSD from 15 bulls of V-2 set) were used for AI. A total of 18,350 AIs have been done so far out of which AI followed was 14,310 and pregnancy confirmed was 9,725 leading to overall conception rate of 67.9% (Table 4).

A total of 151 daughters (7 of I set, 87 of II set and 57 of III set) completed first lactation. An overall First Lactation Milk Yield was recorded as 2758.6±189.6 kg. While first 300 days milk yield of progenies of first set of bull was 2459.6±61.7 kg, for second set it was 2670.3±46.2 kg and for third set it was 3181.0±128.5 kg which indicates that there is an improvement of 722 kg milk per lactation among the daughters from first set of bull to third set of bulls. Similarly, age at first calving in the progenies of first set of bull was recorded as 1149 days, in second set of bull it was 1098 days and in third set of bull it was recorded as 885 days which indicates that there is a gradual decrease of 264 days in age at first calving among the daughters from first set of bull to third set of bulls (Fig. 4).

Regarding socio-economic status of farmers under the project, it was noticed that about 19.5% farmers were having more than 10 acres of land, 11.5% farmers having less than one to 2 acres of land and about 20.3% farmers were landless. The educational status of owners of the progenies was analysed. Owners of animals with an educational qualification of higher secondary were 15.6%. Illiterate

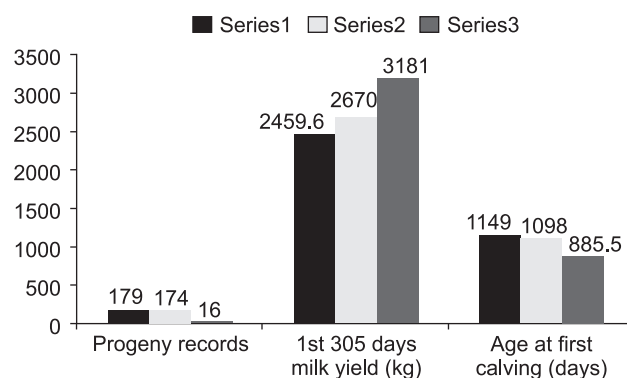


Fig. 4. Set wise progeny performance at GBPUA&T, Pantnagar unit.

owners were 10.4% and 41.7% of the owners were having an educational qualification of matriculation and 14% of the owners were having college qualifications whereas 2% animal owners had PG education.

CONCLUSION

A mega project on Field Progeny Testing taking most of the constraints into account was initiated during mid-eighties by the Project Directorate on Cattle, Meerut, Uttar Pradesh in collaboration with Non-Governmental Organization and Agricultural Universities at different agro-climatic conditions of the country. The project is being implemented under the technical guidance of ICAR-Central Institute for Research on Cattle, Meerut. About 284 young HF crossbred bulls (Frieswal Bull) have been put under the test mating in different sets at four units. Daughters born in first seven sets have completed their 1st lactation. Their average 305 days milk yield ranged from 1,958 to 2,835 kg at KAU, Mannuthy; from 2,698 to 3,841 kg at GADVASU, Ludhiana; from 2,930 to 3,117 kg at BAIF, Pune and from 2,459 to 3,181 kg at GBPUA&T, Pantnagar in different sets. The recording of milk yield of daughters in subsequent sets is in the pipeline. A large number of cows are being inseminated in the program so that records of sufficient daughters are achieved for sire evaluation despite significant data loss (Kumar *et al.* 2015). Bulls of 5th and 6th set were evaluated independently in the three field centres. A total of 24, 9 and 9 bulls were evaluated in the 5th set in BAIF, GADUVASU and KVASU respectively whereas it is 22, 13 and 13 bulls in the 6th set. The overall least squares mean of first lactation milk yield in BAIF, GADUVASU and KVASU were 2985.75±203.12, 2941.06±115.25 and 2288.29±114.12 kg respectively in the 5th set, whereas the same in the 6th set were 3073.50±139.93, 3165.59±75.47 and 2494.67±119.99 kg in the same order. The breeding value ranged from 2807.51 to 2985.75, 2856.62 to 3011.97 and 2174.65 to 2394.87 in the 5th set in BAIF, GADUVASU and KVASU respectively. The breeding value in the 6th set ranged from 2921.66 to 3137.71 in BAIF, 3039.18± 82.06 to 3262.09 in GADUVASU and 2340.70 to 2760.75 in KVASU.

The results of the program are encouraging and are

comparable with the performance of Holstein-Friesian crosses maintained under farm conditions (Singh Simran *et al.* 2014). The top ranked bulls are used in nominating mating for production of male calves for induction in the new sets. The program is not only restricted to produce and test the superior crossbred male calves in the field but is consistently improving genetic potential of the cows available in the operational area of the program leading to consistent increase in milk production. The association between Field Progeny Testing staff and farmers is being improved by frequent visits, motivation to farmers and some provision of incentives. Manpower engaged in artificial insemination and data recording has been trained and is being monitored so that the farmer's faith is not lost and accuracy of the program is maintained. Excellent germplasm unit with modern facilities has been developed at ICAR-CIRC and its Bull Rearing Units.

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