SUMMARY AND CONCLUSIONS

The data on first lactation record of Tharparkar cows comprising of 1502 progeny of 155 sires (799 progeny of 95 sires at Government Cattle Farm, Patna for the period 1947-76 and also on 703 cows progeny of 60 sires at NDAL, Karnal for the period 1951-76) were analysed by least squares technique to study the effect of farm, period, season and age at first calving. By adjusting the data for significant environmental effects, prediction of 300 days lactation milk yield from monthly and the cumulative partial yields was made.

The farm, period and season effects were highly significant for monthly, cumulative partial as well as 300 days first lactation milk yield. The estimates of regression of these traits on age at first calving were also highly significant.

The least squares means of ten monthly (part) milk yields of first lactation were 183.69 ±1.37,
200.23 ±1.85, 186.75 ±1.80, 172.15 ±1.68, 162.44 ±1.61,
154.79 ±1.56, 147.90 ±1.49, 140.46 ±1.50, 134.01 ±1.49 and
130.71 ±1.50 kg respectively while for cumulative partial lactation milk yields of 30, 60, 90, 120, 150, 180, 210, 240,
270 and 300 days these were 183.69 ±1.87, 383.92 ±3.60,
575.66 ±5.26, 748.18 ±6.78, 917.50 ±8.21, 1086.17 ±9.47,
1251.89 ±10.83, 1410.41 ±12.57, 1569.87 ±14.01 and
1743.95 ±16.25 kg respectively. The least squares mean of
300 days or less lactation yield was \(1500.00 \pm 15.73\) kg. The overall least squares means for monthly (part) yields was highest in the second month and then there was a steady decline.

The data after adjusting for significant effects were utilized to predict 300 days first lactation yield from monthly and also with cumulative partial yields by linear regression and ratio methods. The phenotypic correlation between various monthly and 300 days yield increased up to 5th month and ranged from 0.781 to 0.908. The predicted value \(\left(\hat{a}^2\right)\) increased up to 5th monthly yield, range being from 61.05 to 82.47%. The predicted value for cumulative partial yields also increased from 30 days yield (61.06%) to 240 days yield (92.33%). This value increased rapidly up to 150 days and thereafter the increase was slow up to 240 days. It appeared that yield beyond 150 days did not enhance the accuracy of prediction to the extent of much practical importance.

The ratio of 300 days yield and monthly yields ranged from 7.99 (2nd month) to 13.31 (10th month) while for cumulative partial yields it decreased rapidly with the increase in the period.

The average percentage error ranged from -0.58 to 3.97 in regression method and from -1.01 to 4.36 in ratio method. The absolute error percentage ranged from 7.34 to 13.14 for regression estimates and from 7.62 to 17.24 for ratio method estimates for different partial
records. The regression and ratio methods when applied to the cumulative partial lactation yields indicated that all the parameters decreased with the increase in duration for first six cumulative partial records.

Regression method for predicting 300 days lactation can be used with advantage where computational facilities exist but under field conditions in developing countries ratio method being more simple, is recommended for adoption.

The heritability estimates by paternal half-sib method using Harvey's LAM-76 mixed model for first ten monthly part lactation yields beginning with first 30 days yield were 0.229 ± 0.077, 0.218 ± 0.076, 0.276 ± 0.030, 0.202 ± 0.074, 0.236 ± 0.079, 0.241 ± 0.081, 0.207 ± 0.081, 0.109 ± 0.075 and 0.218 ± 0.113 respectively, while the estimates for cumulative partial lactation yields up to 300 days at an interval of 30 days each beginning with 60 days production were 0.233 ± 0.077, 0.253 ± 0.073, 0.250 ± 0.073, 0.260 ± 0.079, 0.273 ± 0.083, 0.284 ± 0.081, 0.291 ± 0.081, 0.288 ± 0.081 and 0.284 ± 0.081 respectively. Consistent uniformity of estimates of heritability for cumulative partial lactation yields was noted. The estimate of heritability for first lactation milk yield of 300 days or lower duration was 0.230 ± 0.081.

Phenotypic correlation of monthly and cumulative partial lactation milk yields among themselves and with lactation of 300 days or lower duration were positive and
highly significant. The correlation of the monthly lactation yields with 300 days (or lower complete) lactation production reached maximum at 5th/6th month, i.e., $0.924 \pm 0.011$. The genetic correlation estimates among monthly and the cumulative partial yields were also positive and high. The values for both genetic and phenotypic correlations were high for adjacent months than for extreme months of the first lactation while considering monthly and the cumulative partial yields. The correlation estimates of cumulative partial lactation yields increased with 300 days (or lower complete) lactation yield as lactation advanced. The phenotypic correlations of 300 days (or lower complete) lactation yield were essentially smaller than the genetic correlations.

Early selection on the basis of cumulative partial lactation yields could be useful in culling of the cows at an early stage for faster genetic progress and high milk production.

The estimates of selection efficiency ranged from 43.3% (9th month) to 92.2% (3rd month), values being high for 3rd, 5th and 6th monthly records. The cumulative 180 days yield was 96% as effective as that of 300 days (or lower complete) lactation yield. It could be said that 3rd monthly yield and the first 180 days cumulative partial yield in Tharparker breed would help in effective selection of cows.

The investigations revealed that breeding value of a sire can be predicted safely at the earliest on the basis of 3rd monthly yield of 12 of his daughters. Ranking of sires with adequate accuracy was possible on 150 days
cumulative partial lactation yield of their first 12 daughters. By increasing the number of daughters per sire, the accuracy improved but was not commensurate with the efforts, time and cost involved to obtain complete lactation yield information on large number of daughters beyond 12 per sire.

Genetic and the financial consequences were studied for 5 different populations and for various alternatives within each population by increasing the selection intensity among young bulls which indicated progeny testing did not appear to be an economic proposition in a herd of 300 cows when semen was processed for use in the herd. Small herds can, therefore, join to form a grid of associated herds to increase population size and have a viable program. The genetic gain could, however, be maximised when 50 percent of the cows were mated to the selected proven sires.

The genetic gain (4 of mean) per year (0.906) with maximum discounted returns ($1.01530/+) and positive relative efficiency (0.06) for 2nd alternative where 30 percent of population were mated to 3 young bulls with 1.4 as selection rate was found to be the best amongst the 8 alternative breeding plans simulated while considering the multi-herd population with 1700 cows.

Three hypothetical populations of varying sizes comprising of organized herds and farmers (breeders) herds
together constituting population size of: (i) 4700, (ii) 5700, (iii) 11,700, of which 60 percent was assumed to be milk recorded, were considered for different breeding plans. It was observed that the genetic gain per annum (2 of mean) was maximum in all of these three populations when 70 percent of the population was mated to selected elite (proven) sires.

The discounted returns were maximum when 80 percent of the population was mated to elite (proven) sires and the gross efficiency was highest when 85 percent of the population was mated to such elite sires. The relative efficiency was also positive in all of these three populations being 0.39, 0.60 and 0.85 respectively when 80 percent of the population was mated to selected elite proven sires.

Genetic gain per annum (2 of mean) increased with the increase in the size of the population. Genetic gain increased if up to 30 percent of the population were mated to young bulls when multi-herd (Organised farms) and farmers (breeders) herds were combined together and in single and the multi-herd population the said proportion had to be 40 percent. However, not much difference in the genetic gain in multi-herd population could be observed when either 30 or 40 percent of the population was mated to young bulls.

The number of young bulls for evaluation, when 30 percent of the population of 11,700 milk recorded cows were mated to them, could be increased by reducing the progeny group size, resulting thereby in increased genetic gain but with a decreasing rate due to lower accuracy.
However, the cost of progeny testing increased proportionately with the increase in the number of young bulls taken for progeny testing. The gross efficiency decreased as more and more bulls were brought in the testing programme. Testing of small number of bulls with large number of daughters per bull was likely to prove profitable than larger annual intake of young bulls for evaluation. The rate of increase in genetic gain was high up to a level of 20 young bulls tested and the rate of increase in genetic gain reduced thereafter. Cost considerations suggested that the optimum number of young bulls under test should be around 12 to 20. On testing larger number of bulls, cost increased exponentially while genetic gain increased very slowly comparatively. A selection rate of 1 in 4 was optimum and beyond that the increase in discounted monetary returns diminished with the increase in number of bulls tested.

In the same population if 20 young bulls were tested keeping the progeny group constant (37 daughter/sire), the genetic gain per annum (5 of mean) increased from 1.053 (selection rate 1:14) to 1.454 (selection rate 1:10). The discounted returns increased linearly with the increased genetic gain per annum (5 of mean). Gross efficiency was 4.23 being maximum while selection rate was 1:14. The relative efficiency was positive and also maximum when the selection intensity was 1:400.

Utilization of top ranked sires due to higher rate of selection increased the cost of testing because of
large number of breeding doses per bull required to be stored for future use. The increased genetic progress per year resulted mostly from greater selection intensity. The discounted monetary returns though enhanced by more intensive use of improved bulls, the economic benefits were nullified because of the increased cost of testing and particularly the cost on storage of large number of breeding doses (frozen semen). The genetic gain per annum (€ of mean), discounted returns, gross efficiency and relative efficiency were almost same though relatively low when 300 days lactation yield was predicted based only on 5th monthly yield and/or 150 days cumulative partial lactation yield compared to 300 days (or lower complete) lactation yield in all the alternative breeding plans in the three different sizes of hypothetical populations considered (N = 1700, 4020, 7020). It was considered worthwhile to use 5th month's yield for estimating 300 days' lactation yield without losing much accuracy for evaluation of a sire's genetic merit and its ranking five months in advance, thus giving an opportunity for faster turnover rate within the same physical facilities.

It was also observed that in A.I. organization to be economically beneficial, the surplus semen of the bulls must be sold for profit to add to monetary gains in addition to the genetic advancement a breeder wishes to introduce in the herds.

In conclusion, it could be surmised that in all the methods considered, breeding programme leading to
the maximum profit was a sub-optimal programme than for the maximum genetic progress. Large population was needed in sire evaluation through progeny testing so that greater proportion of the population might be made available for breeding with highly selected elite (proven) sires.

The cost of progeny testing was directly proportional to the number of young bulls taken in the programme. It was observed that under conditions as prevailing in developing countries like India, it was more profitable to test 12 to 20 bulls with an average of 12 daughters per sire and selection rate of 1:4 among sires. The surplus semen of bulls could then be disposed of for profit to offset the cost on progeny testing.