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Prediction of 305-day first lactation milk yield by ratio method

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ABSTRACT

First lactation milk records from 1976 to 2004 on 453 buffaloes, sired by 51 bulls, maintained at Network Project on Buffalo, Livestock Research Station, Vallabhnagar were utilized for prediction of 305-day first lactation milk yield (305 FLMY). The milk production levels were predicted from records in progress (fortnightly, monthly and bimonthly test as well as part yields) using ratio method. Sampling schemes, viz. systematic and stratified random sampling schemes were used. The maximum R^2 was obtained during 10^{th} and 11^{th} fortnight and minimum during the first fortnight when lactation milk yield was predicted on the basis of fortnightly systematic and stratified random sampled test records as well as part yields. Similarly, accuracy was the maximum when test sample was taken during sixth month and minimum when test sample was taken during first month. The accuracy of prediction of lactation yield on the basis of monthly part yields showed that maximum (62.25%) accuracy was obtained for fifth month and minimum (29.27%) during first month, which is higher than accuracies obtained under both systematic and stratified random sampling schemes. The maximum (47.20 and 46.38% respectively) accuracy for prediction was obtained when test sample was taken during third bimonth and minimum (35.76 and 29.59% respectively) during first bimonth. The prediction based on bimonthly part yields revealed that maximum (66.42%) accuracy was obtained during third bimonth and minimum (51.70%) accuracy during first bimonth. Looking at the cost of recording under field conditions and computational difficulties, a single test record could be taken during 10^{th} fortnight and sixth month by systematic and 11^{th} fortnight by stratified random sampling schemes gave predictability more than 50% for prediction of 305 days first lactation milk yield by ratio method.

Key words: Bimonthly milk yield, Milk production, Monthly milk yield, Prediction

In USA, Denmark, Israel, the Netherlands, Norway and Sweden, more than 50% of the total dairy cattle population is recorded, while in most of the developing countries production figure of individual animals are usually available for only a tiny proportion of total cattle population (McDowell 1972). Nevertheless, importance of herd recording has been keenly felt in developing countries and serious efforts are underway to implement it. It is now well recognized that as long as individual farmer remains unconvinced of the gains of herd recording system, its development would remain a difficult proposition in spite of much needed efforts of the Government agencies and other organizations. This calls for need of devising a recording system which is simple, involves least cost on account of evaluation of production ability of cows/ buffaloes of the herd and provide unbiased and efficient estimate of breeding value of branding bulls. Therefore, an attempt was made for predictability of 305-day first lactation milk yield (305FLMY) from fortnightly, monthly and bimonthly test as well as part yields by ratio method.

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MATERIALS AND METHODS

First lactation milk records from 1976 to 2004 of 453 buffaloes, sired by 51 bulls, maintained at Network Project on Buffalo, Livestock Research Station, Vallabhnagar were utilized. The milk production levels were predicted from records in progress (fortnightly, monthly and bimonthly test as well as part yields) using ratio method. Two sampling schemes viz., systematic and stratified random sampling schemes were used. The milk yield for every part of lactation under both the above sampling schemes was estimated as under:

$$PMY = \sum_{i=1}^{N}$$

= (space of sampling × milk yield of sampled day) + [{(actual lactation length) – (space of sampling schemes × number of samples)} × milk yield of last sample yield]

where, space of systematic and stratified random sampling schemes was 15, 30 and 60 days. The ratio of 305-day lactation milk yield to part yield was calculated as under:

$$Rj \frac{\sum_{i=1}^{N} Y_i}{\sum_{i=1}^{N} X_{ij}}$$

where, R_j, ratio for extending j^{th} part record; Y_i, actual

lactation yield of i^{th} animal and X_{ij}, J^{th} part record of the i^{th} animal.

The estimated lactation yield of i^{th} animal from j^{th} part record:

$$Y_{ij} = R_j X_{ij}$$

$X_{ij,}$ j^{th} part record of i^{th} animal.

RESULTS AND DISCUSION

Prediction of 305-FLMY on the basis of fortnightly records: Prediction of first lactation milk yield on the basis of fortnightly systematic sampled test records reveals that maximum (52.27%) accuracy of prediction was obtained during 10^{th} fortnight and minimum accuracy (12.89%) during first fortnight. In the similar way, when lactation milk yield was predicted on the basis of fortnightly stratified random sampled test records then the maximum (51.98%) accuracy of prediction was obtained with test records taken during 11^{th} fortnight and minimum (14.21%) accuracy during first fortnight. The results of prediction of lactation yield on the basis of fortnightly part yields indicated that maximum (62.09%) accuracy was obtained for 10^{th} fortnight and minimum (15.21%) accuracy at first fortnight (Table 1).

The accuracies of prediction based on fortnightly systematic and stratified random sampled records also showed almost equal accuracies of prediction from fourth fortnight to 14^{th} fortnight except seventh and eighth fortnight. On the other hand, the accuracies of prediction based on fortnightly part yield indicated almost similar accuracies from fourth part yield to 14^{th} part yield except 12^{th} part yield (Table 1). The results also indicated that accuracies were low during early stage of lactation.

VanVleck and Henderson (1961) reported that the best period for drawing single test record for estimating complete lactation yield was 8th to 12^{th} fortnight of lactation in Holstein cows. Singh and Gurnani (2004) also reported that single test record could be taken during a fortnight around mid-lactation to predict lactation yield with fairly accuracy, which is in consonance to the present results. Nagarcenkar and Basavaiah (1981) found that the prediction of lactation milk yield on the basis of 11^{th} fortnight gave highest accuracy (68.89%), which is slightly higher than accuracy obtained in the present study.

Prediction of 305-FLMY on the basis of monthly records: The prediction of lactation milk yield on the basis of monthly systematic and stratified random sampled test records reveals that maximum accuracy for prediction was obtained during 6^{th} month and minimum accuracy for first month. The accuracies of prediction on the basis of stratified random sampled test records were slightly lower than systematic sampled test records (Table 2). The accuracy of prediction of lactation yield on the basis of monthly part yields showed that maximum (62.25%) accuracy was obtained for 5^{th} month and minimum (29.27%) during first month, which is higher than accuracies obtained under both systematic and stratified random sampling schemes (Table 2). VanVleck and Henderson (1961) reported that the best single month for estimating lactation milk yield by ratio method was fourth, fifth and sixth month, which is in agreement with the present results.

Table 1. Ratio factor and their accuracies for prediction of 305-FLMY under fortnightly test and part yields

Duration of sample	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}	7^{th}	8^{th}	9^{th}	10^{th}	11^{th}	12^{th}	13^{th}	14^{th}
Systematic test record yields														
Multiplicative ratio factor	15.28	13.85	13.55	13.43	13.52	13.41	15.93	18.68	19.14	20.10	20.46	21.50	22.17	23.58
Accuracy (%)	12.89	26.42	41.22	48.58	46.51	48.30	34.46	39.06	42.77	52.27	48.86	48.58	44.89	45.02
Stratified random test record yields														
Multiplicative ratio factor	15.16	13.58	13.60	13.47	13.54	13.38	16.01	18.40	18.92	19.89	20.52	21.27	22.47	23.79
Accuracy (%)	14.21	24.11	37.82	43.96	41.60	48.02	35.88	40.07	46.51	45.83	51.98	47.47	46.10	44.09
Part yields														
Multiplicative ratio factor	14.92	13.34	13.41	13.39	13.39	13.46	15.82	18.50	19.06	19.70	20.30	21.01	22.13	23.52
Accuracy (%)	15.21	21.53	47.20	52.85	51.84	54.61	52.41	48.86	55.35	62.09	52.56	41.86	60.21	61.00

Table 2. Ratio factor and their accuracies for prediction of 305-FLMY under monthly test and part yields

Months	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}	7^{th}
Systematic test record yields							
Multiplicative ratio factor	7.24	6.81	6.74	8.43	9.73	10.35	11.39
Accuracy (%)	19.54	47.77	51.84	34.93	41.09	52.56	46.65
Stratified random test record yields							
Multiplicative ratio factor	7.25	6.77	6.74	8.56	9.74	10.47	11.35
Accuracy (%)	16.81	44.22	46.92	39.94	43.43	47.20	45.29
Part yields							
Multiplicative ratio factor	7.04	6.70	6.71	8.53	9.69	10.32	11.40
Accuracy (%)	29.27	53.87	55.80	57.00	62.25	55.95	64.48

Table 3. Ratio factor and their accuracies for prediction of 305-FLMY under bimonthly test and part yields

Bimonths	1st	2nd	3rd
Systematic test record yields			
Multiplicative ratio factor	3.42	3.84	5.04
Accuracy (%)	35.76	36.36	47.20
Stratified random test record yields			
Multiplicative ratio factor	3.47	3.78	5.01
Accuracy (%)	29.59	35.05	46.38
Part yields			
Multiplicative ratio factor	3.43	3.76	5.00
Accuracy (%)	51.70	65.77	66.42

Prediction of 305-FLMY on the basis of bimonthly record: The prediction of lactation milk yield on the basis of bimonthly systematic and stratified random sampled test records (Table 3) revealed that maximum (47.20 and 46.38% respectively) accuracy for prediction was obtained during third bimonth and minimum (35.76 and 29.59% respectively) during first bimonth. The prediction based on bimonthly part yields reveals that maximum (66.42%) accuracy was obtained during third bimonth and minimum (51.70%) accuracy for first bimonth (Table 3). Dass (1991) studied the efficacy of prediction of lactation yield in Murrah buffaloes based on bimonthly milk recording under systematic and stratified random sampling schemes using ratio method. He reported that stratified random sampling scheme was more efficient than systematic sampling scheme, which is in contradiction to the present results.

Looking to the cost of recording under field conditions and computational difficulties, a single test record could be taken during 10th fortnight and sixth month by systematic and 11th fortnight by stratified random sampling schemes gave predictability more than 50% for prediction of 305-day first lactation milk yield by ratio method.

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