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Prediction of 305 days first lactation milk yield from fortnightly test and part yields

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ABSTRACT

Data on 453 Surti buffaloes maintained at "Network Project on Surti buffaloes'' Livestock Research Station, Vallabhnagar, Udaipur were used to predict 305 days first lactation milk yield (305 FLMY) from fortnightly test day milk yield (systematic and stratified random sampling) and part yields. The 10^{th} and 11^{th} fortnight gave the highest accuracies of fitting when fortnightly systematic and stratified random sampling using single test record were used. The 10^{th} fortnight part yield also gave the highest accuracy (62.10%) of prediction of 305 days first lactation by regression method. When two fortnightly test records and part yields were taken, the best multiple regression equations were found to be those utilizing 4^{th} and 10^{th} fortnightly test records under systematic sampling, 4^{th} and 11^{th} fortnightly test records under stratified random sampling and 6^{th} and 10^{th} fortnightly part yield; the accuracy of prediction being 69.70, 69.70 and 75.50% respectively. When 3 tests and part records were considered, the best equations involved 4^{th},10^{th} and 14^{th} fortnightly test records under systematic sampling, 4^{th}, 11^{th} and 14^{th} fortnightly test records under stratified and 6^{th},10^{th} and 14^{th} fortnightly part yield; their accuracy of prediction being 77.50, 77.20 and 85.50% respectively. When more number of test and part records were considered as independent variable there was increase in accuracy of prediction but with slow rate.

Key words: Step-wise regression, Prediction, Systematic sample, Stratified random sample, Test day milk yield

Selection of sires to be used for breeding under field conditions in India has been practiced to a limited extent on small number of bulls tested under progeny testing programmes in the organized farm conditions and to some extent in farmers' herd. However, to make the selection of breeding bulls more effective and efficient, it is essential to conduct progeny testing of as many numbers of bulls as possible and that too by involving large buffalo population in rural areas. The main obstacle is that the daily milk recording system is neither economically nor physically feasible because of a large number of buffaloes required to be recorded. It is, therefore, important to explore the possibility of designing an appropriate test-day recording system applicable under prevailing field conditions in India without sacrificing the reliability of results. Therefore, an attempt was made for predictability of 305 days first lactation milk yield (305FLMY) from fortnightly test as well as part yields by regression method.

MATERIALS AND METHODS

Data on 453 Surti buffaloes maintained at "Network Project on Surti buffaloes'' Livestock Research Station, Vallabhnagar, Udaipur over a period of 29 years (1976–2004) were utilized for the present study. The 305FLMY was predicted from fortnightly test day milk yield and part yields. Two sampling schemes, viz. systematic and stratified random sampling, were used for test day recording. A systematic sampling scheme was applied by selecting first test record (one-day milk yield) at random from first fortnight and subsequent samples at test records were selected at exact interval of 15 days from preceding date of test record till 210 days of lactation ($F_{15}S_1$– $F_{15}S_{14}$). In stratified random sampling scheme the lactation period of 210 days was divided in to 14 strata at fortnightly intervals. Then independent random sampling of test records (one day milk yield) was drawn from each stratum during first, second and so on up to 14 fortnightly strata ($R_{15}S_1$– $R_{15}S_{14}$). The fortnightly part milk yield was taken by adding of observed daily milk yield during each fortnight up to 210 days lactation (FNY_1- FNY_{14}). The milk yield for every part of lactation under both the above sampling schemes was estimated as under:

$$\text{PMY (Predicted)} = \sum_{i=1}^{N} (15 \times \text{milk yield of sampled day}) + [\{(\text{actual lactation length}) - (\text{space of sampling schemes} \times \text{number of samples})\} \times \text{milk yield of last sample yield}]$$

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The lactation less than 100 days was not considered and culling in the middle of lactation, abortion, stillbirth or any other physiological causes which affect the milk yield were considered as abnormalities and thus, such records were not taken for the study. A simple linear regression analysis with only one independent variable at a time and step-wise forward multiple linear regression analysis was used to predict 305FLMY.

RESULTS AND DISCUSSION

The regression equations for predicting 305FLMY from single records are given in Tables 1–3. The R^2 of equation comprising test day milk recording at fourth to sixth, 10th to 14th fortnight by systematic sampling and 6, 9 to 14th by stratified random sampling schemes were within a narrow range for prediction of 305 days first lactation milk yield. However, 10th fortnight gave the highest accuracies at 52.30% of fitting when fortnightly systematic sampled test record was used. While in case of stratified random sampled test records, 11th fortnightly test record gave the highest accuracy at 51.90%, which was slightly lower than R^2 obtained by systematic sampling scheme. The 10th fortnight part yield also gave the highest accuracy (62.10%) of prediction of 305 days first lactation by regression method. The results of R^2 indicated that accuracy of prediction was almost similar under both the sampling schemes while about 10% lower than the accuracy of prediction obtained using fortnightly part records.

Amble *et al*. (1959) and Amble and Rajagopalan (1960) estimated the lactation milk yield from test yield recorded at different intervals by simple random sampling and systematic sampling in cattle and buffaloes in India. They observed that systematic sampling was better than simple random sampling method for estimation of lactation yield from test day records which are in consonance with the present results. Agarwala (1962) reported that recording of milk production after every 10 days for predicting the lactation yields was found to be the most reliable. Murthy *et al.* (1984) reported that prediction of lactation milk yield based on test records taken at fixed days or at random from 25 to 35 and 40 to 50 days of lactation was highly reliable with the accuracy of prediction of 97 and 91%, respectively, which is considerably higher than accuracies obtained in the present study.

Low R^2 values were found when fortnightly test and part yields were taken during initial phase of lactation (first and second fortnight) and seventh to ninth fortnight, indicating that this part of lactation explained least of total variation as compared to rest part of lactation. This could be due to the effect of temporary environment that was higher as parturition

Table 1. Regression equations for prediction of 305FLMY from single fortnightly systematic sampled test yield

Dependent variable (Y)	Independent variable (X)	Intercept constant 'a'	b ± SE	R^2 (%)
305 FLMY	$F_{15}S_1$	749.865	5.022±0.614**	12.90
	$F_{15}S_2$	534.759	7.221±0.567**	26.50
	$F_{15}S_3$	486.005	7.654±0.430**	41.30
	$F_{15}S_4$	424.135	8.333±0.403**	48.60
	$F_{15}S_5$	457.869	7.981±0.403**	46.50
	$F_{15}S_6$	447.101	8.045±0.392**	48.30
	$F_{15}S_7$	672.717	6.338±0.411**	34.50
	$F_{15}S_8$	610.089	8.477±0.499**	39.00
	$F_{15}S_9$	548.732	9.737±0.531**	42.70
	$F_{15}S_{10}$	506.615	10.983±0.494**	52.30
	$F_{15}S_{11}$	525.299	10.840±0.522**	48.90
	$F_{15}S_{12}$	559.486	10.732±0.520**	48.60
	$F_{15}S_{13}$	607.322	10.117±0.528**	45.90
	$F_{15}S_{14}$	598.160	10.951±0.570**	45.00

** = P≤ 0.01.

Table 2. Regression equations for prediction of 305FLMY from single fortnightly stratified random sampled test yield

Dependent variable (Y)	Independent variable (X)	Intercept constant 'a'	b ± SE	R^2 (%)
305 FLMY	$R_{15}S_1$	712.743	5.488±0.635**	14.20
	$R_{15}S_2$	568.115	6.672±0.557**	24.20
	$R_{15}S_3$	509.842	7.395±0.446**	37.90
	$R_{15}S_4$	450.702	8.033±0.428**	43.90
	$R_{15}S_5$	511.393	7.341±0.409**	41.60
	$R_{15}S_6$	439.815	8.112±0.398**	48.00
	$R_{15}S_7$	655.819	6.611±0.416**	35.90
	$R_{15}S_8$	596.660	8.572±0.493**	40.10
	$R_{15}S_9$	539.375	9.786±0.495**	46.50
	$R_{15}S_{10}$	533.543	10.389±0.532**	45.90
	$R_{15}S_{11}$	531.187	10.761±0.488**	51.90
	$R_{15}S_{12}$	553.580	10.730±0.531**	47.50
	$R_{15}S_{13}$	600.548	10.392±0.528**	46.20
	$R_{15}S_{14}$	625.176	10.476±0.555**	44.10

** = P ≤ 0.01.

Table 3. Regression equations for prediction of 305FLMY from single fortnightly part milk yield

Dependent variable (Y)	Independent variable (X)	Intercept constant 'a'	b ± SE	R^2 (%)
305 FLMY	FNY_1	781.036	4.490±0.499**	39.00
	FNY_2	840.964**	3.295±0.296**	21.50
	FNY_3	397.913**	8.634±0.430**	47.20
	FNY_4	371.749	8.934±0.398**	52.80
	FNY_5	382.780	8.803±0.399**	51.90
	FNY_6	368.044	9.025±0.388**	54.60
	FNY_7	481.142	9.009±0.404**	52.50
	FNY_8	495.295	10.295±0.495**	48.90
	FNY_9	415.146	11.974±0.506**	55.40
	FNY_{10}	362.832	13.301±0.489**	62.10
	FNY_{11}	487.413	11.441±0.511**	52.60
	FNY_{12}	611.372	9.512±0.528**	41.90
	FNY_{13}	432.722	13.555±0.519**	60.20
	FNY_{14}	456.596	13.904±0.524**	61.00

** = P ≤ 0.01.

stress during early and post-partum heat and early pregnancy stress during 3 ½ to 4 ½ months of lactation.

The result of prediction of first 305 days lactation milk yield on the basis of fortnightly systematic sampled and stratified random sampled test records by regression method reveled that a single test record could be drawn by both sampling schemes during 10th or 11th fortnight to predict 305 days first lactation yield with fairly high accuracies. One major reason for 10th or 11th test and part yield being the best predictor of 305FLMY among single fortnightly records is because it is placed in the stabilized phase of lactation curve where the stress due to pregnancy, parturition and peak production are minimum on the animal.

The prediction equation derived through step-wise procedure for prediction of 305FLMY from test and part yields are given in Tables 4–6 . From the tables it is evident that 10th and 11th fortnightly test records under systematic and stratified random sampling gave highest accuracy of prediction at 52.30 and 51.90% respectively. The 10th fortnightly part yield also gave the highest accuracy at 62.10% as observed in single fortnightly test and part yields (Tables 1–3). When 2 fortnightly test records and part yields were taken, the best multiple regression equations were found to be those utilizing 4th and 10th fortnightly test records under systematic sampling, 4th and 11th fortnightly test records under stratified random sampling and 6th and 10th fortnightly part yield; the accuracy of prediction being 69.70, 69.70 and 75.50% respectively. When 3 tests and part records were considered, the best equations involved 4th,10th and 14th fortnightly test records under systematic sampling, 4th, 11th and 14th fortnightly test records under stratified and 6th,10th and 14th fortnightly part yield; their accuracy of prediction

Table 4. Step-wise regression equations for prediction of 305FLMY from fortnightly test day sampled by systematic sampling scheme

Steps	Variable	a	b	SE (b)	F	EMS	R^2 (%)
I	$F_{15}S_{10}$	506.615	10.983	0.494	494.936	19746082.201	52.30
II	$F_{15}S_{10}$	219.817	7.801	0.441	517.908	13154714.206	69.70
	$F_{15}S_{4}$		5.576	0.347			
III	$F_{15}S_{10}$	142.304	5.587	0.421	514.064	9743116.874	77.50
	$F_{15}S_{4}$		4.918	0.304			
	$F_{15}S_{14}$		5.389	0.434			
IV	$F_{15}S_{10}$	105.021	5.024	0.405	443.769	7533493.230	79.70
	$F_{15}S_{4}$		3.163	0.375			
	$F_{15}S_{14}$		5.204	0.412			
	$F_{15}S_{6}$		2.681	0.367			
V	$F_{15}S_{10}$	85.798	4.124	0.407	401.990	6174657.393	81.60
	$F_{15}S_{4}$		3.176	0.357			
	$F_{15}S_{14}$		3.391	0.471			
	$F_{15}S_{6}$		2.648	0.349			
	$F_{15}S_{13}$		3.111	0.448			

Table 5. Step-wise regression equations for prediction of 305FLMY from fortnightly test day sampled by stratified random sampling scheme

Steps	Variable	a	b	SE (b)	F	EMS	R^2 (%)
I	$R_{15}S_{11}$	531.187	10.761	0.488	487.115	19596089.560	51.90
II	$R_{15}S_{11}$	212.838	8.194	0.418	518.041	13155735.336	69.70
	$R_{15}S_{4}$		5.523	0.340			
III	$R_{15}S_{11}$	138.422	5.528	0.424	507.014	9712664.644	77.20
	$R_{15}S_{4}$		5.194	0.296			
	$R_{15}S_{14}$		5.257	0.433			
IV	$R_{15}S_{11}$	96.689	4.910	0.405	448.593	7549856.234	80.00
	$R_{15}S_{4}$		3.430	0.356			
	$R_{15}S_{14}$		4.943	0.408			
	$R_{15}S_{6}$		2.833	0.357			
V	$R_{15}S_{11}$	69.788	3.520	0.437	404.586	6181872.237	81.90
	$R_{15}S_{4}$		3.314	0.339			
	$R_{15}S_{14}$		3.867	0.419			
	$R_{15}S_{6}$		2.804	0.340			
	$R_{15}S_{12}$		3.145	0.461			

Table 6. Step-wise regression equations for prediction of 305FLMY from fortnightly part yield

Steps	Variable	a	b	SE (b)	F	EMS	R^2 (%)
I	FNY_{10}	362.832	13.301	0.489	740.274	23451723.369	62.10
II	FNY_{10}	149.522	9.238	0.471	693.571	14247612.131	75.50
	FNY_6		5.346	0.341			
III	FNY_{10}	75.307	5.089	0.432	885.570	10760973.985	85.50
	FNY_6		4.820	0.264			
	FNY_{14}		7.435	0.421			
IV	FNY_{10}	29.063	4.908	0.375	920.226	8411114.983	89.10
	FNY_6		4.226	0.234			
	FNY_{14}		7.148	0.366			
	FNY_2		1.426	0.177			
V	FNY_{10}	–0.717	4.660	0.363	805.034	6793440.486	90.00
	FNY_6		3.194	0.280			
	FNY_{14}		7.137	0.352			
	FNY_2		1.206	0.118			
	FNY_3		1.783	0.288			

being 77.50, 77.20 and 85.50% respectively. The per cent variability accounted for by the equation increased at each step with the increase in multiplicity of equation, but after an equation with three variables, the increase in per cent variability accounted for was less than three per cent in all the three part and test sampling schemes.

Saigaonkar *et al.* (1981) found that the 2 records during sixth and eighth fortnight gave highest accuracy (76%) of prediction of 26 fortnights' milk yield. Nagarcenkar and Basavaiah (1981) reported that a single part record during 11th fortnight was best predictor for lactation milk yield in Murrah buffaloes.

It may be concluded on the basis of present results that in order to estimate first lactation 305 days milk yield, 2 records taken randomly during 4th fortnight and 10th or 11th fortnight or 3 records taken during 4th, 10th or 11th and 14th fortnight would be adequate for prediction of first lactation yield in field condition.

REFERENCES

Agarwala O P. 1962. Estimation of lactation yield in buffaloes from production for short intervals in a lactation. *Indian Veterinary Journal* **39**: 69–72.

Amble V N and Rajagopalan M. 1960. Further studies in sampling daily milk yields. *Indian journal of Veterinary Science* **30**: 272–86.

Amble V N, Rajagopalan M and Gill BS. 1959. Sampling of daily milk records for estimating lactation yield of cows. *Indian Journal of Animal Sciences* **29**: 13–26.

Murthy G M K, Chennarayudu, Rao, L S P, Jairam B T, Ratnarao T V and Jayaramprishna V. 1984. Prediction of lactation milk yield by test recording. *Livestock Advisor* **9**: 10–11.

Nagarcenkar R and Basavaiah P. 1981. Testing intervals and part lactations in evaluation of Murrah buffalo bulls. *World Review Animal Production* **17**: 7–10.

Saigaonkar P B, Deshmukh S N, Thatte V and Desai R. 1981. Prediction of total lactation milk yield in Sahiwal cattle. *Indian Journal of Animal Research* **15**: 87–92.