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Development of Prediction Equations for 300 Days Milk Yield from Part Yields, Cumulative part and Sequential monthly Records in Sahiwal Cows

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ABSTRACT

The present study was planned to develop the prediction equations for 300 days milk yield on the basis of part, cumulative part and sequential monthly records of Sahiwal cows. Among the monthly part yields the 3rd, 5th and 7th months were best for 300 days prediction for first lactation records, while 6th, 7th and 4th months were best for second lactation records. For third lactation records 2nd, 6th and 5th months were best months for prediction. On cumulative monthly basis, first-3, first-4 and first-5 months were best for 300 days prediction for first, second and third lactation records.

Key Words: Prediction; Part yields; Cumulative yields; Sahiwal cows

INTRODUCTION

The selection of dairy cattle at an early age on the basis of part yields is beneficial to the dairy farmer as it cuts down the cost of rearing the animals and also helps is progeny testing. Part yields (monthly milk yield) or cumulative monthly records have been shown to have a very high genetic and phenotypic relationship with full records (Koul, 1973). The ability to predict the complete lactation period of a cow from its part yields would determine the successes of dairy herd culling programmes. In dairy cattle, high rate of genetic improvement is only possible through early culling of low producing cows. This can be achieved by selecting cows and bulls on the basis of their part records provided that full lactation yield can be accurately predicted from part yields. Predicting total lactation yield on the basis of part lactation records has practical utility. The present study was, therefore, undertaken to develop the prediction equations for 300 days milk yields on the basis of monthly yields, cumulative monthly yields and sequential monthly records for Sahiwal cows.

MATERIALS AND METHODS

The data for present investigation were taken from the pedigree cum performance records and daily milk records of Sahiwal cows maintained at "Government Cattle Breeding Farm, Anjora, Durg, Chhattissgarh. For the present study, the monthly milk yield data of about 131 lactations were collected for the period 1992-2003.The complete lactation milk records (131) of Sahiwal cows were recorded (1st lactation to 3rd lactation) from pedigree-cum-performance sheet. The records with less than 180 days lactation length, with the history of abortion, stillbirth and records not complete were eliminated from the study. Data collected for 300 days milk yield, monthly milk yield and cumulative monthly milk yield were subjected to analysis prediction equations for 300 days milk yield on the basis of part yields and cumulative part yields 1st to 3rd lactation records. The general formula used for the prediction equations for predicting 300 days milk yields from part monthly yields was as follows.

$$\hat{Y} = a + b_j * x_i$$

Where $\hat{Y}$ is expected value of Y, 'a' is intercept, x_i is record of i^{th} month of lactation and b_i is the regression coefficient. Regression factors estimating 300 days milk yield from cumulative monthly records was as follows:

$$\hat{Y} = a + b_j \Sigma x_i$$

Where apart from other factors b_j is the regression coefficient with first j^{th} months of cumulative yields

Multiple regressions. Regression factors estimating 300 days milk yield from sequential monthly records was as follows

$$\hat{Y} = a + b_1X_1 + b_2X_2 + \text{-----} + b_nX_n$$

Where

$\hat{Y}$ is expected lactation yield for 300 days; a is the intercept;X_1,X_2,X_3---X_n are milk production during particular period. The significance of regression coefficients of $\hat{Y}$ on X was tested by using 't' test (Snedecor & Cochran, 1967).

RESULTS AND DISCUSSION

Prediction of 300 Days Milk Yields from Part and Cumulative Milk Yields

First lactation. The regression factors for estimating 300 days milk yields for different monthly and cumulative monthly yields are presented in Table I and II. The critical appraisal of tables revealed that regression coefficients were highly significant ($p<0.01$) for all single monthly and cumulative monthly records suggesting the dependence of 300 days milk yield on monthly and cumulative monthly milk yields.

Among the single monthly milk yields used for prediction, the highest R^2 (58.41%) value (%) was obtained for 3rd month followed by 5th (57.97%) and 4th (50.80%) months. The prediction equations based on 3rd , 4th and 5th month yields were $\hat{Y}$ =584.02+6.318X; $\hat{Y}$ =494.02+6.84X and $\hat{Y}$ =611.98+6.38 X, respectively; where $\hat{Y}$ is the predicted 300 days milk yield (kg) and X is the monthly milk yield (kg). Among the cumulative monthly records used for prediction of 300 days milk yield, the R^2 values for first-2 months cumulative yield were 38.76%; it increased up to 75% for first-7 months cumulative yield. Since the R^2 values were reasonably high for early cumulative yields so first-4 (60.6%) months, first-5 (65.6%) and (70.6%) for first –6 months cumulative yields were best for 300 days prediction. Prediction on early part as well as cumulative milk yield would cut down the time for selection on complete records basis. So, first-4, first-5 and first-6 months were best for prediction of (300 days) total milk yield. The results obtained for first lactation records for the prediction of 300 days milk yields were in close agreement with the findings of Roy and Katpatal (1989) and Khoda and Trivedi (1987) for Jersey cattle. They found that 3rd, 4th and 5th months of lactation were best for prediction on the basis of monthly yields while first-3, first-4 and first-5 cumulative yields were best months on the cumulative milk yield basis. Similar findings were also reported by Shrivastava and Khan (1989) for Sahiwal cows; while, Tahir *et al.* (1983) reported that 5th month yield and 4th to 10th cumulative months were best for prediction of first lactation milk yield in Niliravi buffaloes.

Second lactation. Prediction equations for single monthly yields and cumulative monthly yield are presented in Table III and IV. The tables revealed that regression coefficients were highly significant ($p<0.01$) for single monthly and cumulative monthly records and suggested that 300 days milk yield were highly dependent on monthly and cumulative monthly yields. R^2 values for single monthly yield was significant for 6th month (57.41%) closely followed by 4th (45.71%) and 5th month (42.97%). The prediction equations for second lactation based on 4th, 5th and 6th months were $\hat{Y}$ = 910.29+4.17 X; $\hat{Y}$ =933.61+4.46 X and $\hat{Y}$ =803.81+5.24 X, respectively, Where $\hat{Y}$ is the predicted 300 days milk yield (kg) and X is the monthly milk yield for second lactation records. Among cumulative monthly yields the R^2 values for first-2 months cumulative yield was (50.69%) and it increased up to (84.68%) for first-7 months cumulative yield. Since the R^2 values for early cumulative months were reasonably high, so first-3 (63.6%) months, first-4 (71.7%) and first –5 (79.8%) months cumulative yields were best for 300 days prediction for second lactation records. Tahir *et al.* (1983)

Table I. Regression factors for estimating 300 days milk yield from different monthly yields for first lactation

Months	Intercept	Regression Coefficient	S.E.(b)	t cal	R^2
First	1142.75	3.92**	1.213	3.23	0.1467
Second	644.60	5.73**	0.786	7.29	0.4661
Third	584.02	6.31**	0.682	9.25	0.5841
Fourth	494.02	6.84**	0.861	7.93	0.5080
Fifth	611.98	6.38**	0.696	7.17	0.5797
Sixth	557.79	6.71**	0.905	7.41	0.4742
Seventh	748.46	6.01**	0.773	7.77	0.4976
Eight	641.69	7.11**	0.778	9.14	0.5780
Ninth	605.57	8.18**	1.021	7.98	0.5112

**Significant at 1% level of significance

Table II. Regression factors for estimating 300 days milk yield from different cumulative monthly yields for first lactation

Months	Intercept	Regression Coefficient	S.E.(b)	t cal	R^2
First-2	621.23	3.26**	0.526	6.21	0.3876
First-3	352.07	2.64**	0.301	8.77	0.5581
First-4	237.56	2.12**	0.219	9.69	0.6066
First-5	199.64	1.74**	0.161	10.78	0.6561
First-6	065.57	1.58**	0.130	12.12	0.7066
First-7	-6.94	1.42**	0.103	13.75	0.7563

**Significant at 1% level of significance

Table III. Regression factors for estimating 300 days milk yield from different monthly yields for second lactation

Months	Intercept	Regression Coefficient	S.E.(b)	t cal	R^2
First	1067.67	4.23**	0.834	5.08	0.3813
Second	1033.33	3.47**	0.650	5.33	0.4044
Third	1085.31	3.16**	0.600	5.27	0.3982
Fourth	910.29	4.17**	0.707	5.89	0.4527
Fifth	933.61	4.46**	0.794	5.62	0.4294
Sixth	803.81	5.24**	0.696	7.52	0.5741
Seventh	982.23	4.72**	0.757	6.23	0.4805
Eight	1073.49	4.44**	0.913	4.86	0.3606
Ninth	985.69	5.56**	1.139	4.88	0.3625

**Significant at 1% level of significance

Table IV. Regression factors for estimating 300 days milk yield from different cumulative monthly yields for second lactation

Months	Intercept	Regression Coefficient	S.E.(b)	t cal	R^2
First-2	838.69	2.55**	0.373	6.57	0.5069
First-3	745.90	1.71**	0.230	7.45	0.5697
First-4	607.53	1.44**	0.168	8.57	0.6366
First-5	440.72	1.33**	0.129	10.33	0.7179
First-6	312.08	1.23**	0.095	12.90	0.7986
First-7	244.40	1.13**	0.074	15.21	0.8464

**Significant at 1% level of significance

Table V. Regression factors for estimating 300 days milk yield from different monthly yields for third lactation

Months	Intercept	Regression Coefficient	S.E.(b)	t cal	R^2
First	1022.45	4.72**	1.677	2.82	0.2840
Second	1233.51	2.75**	0.744	3.69	0.4062
Third	1194.60	2.68**	0.853	3.14	0.3306
Fourth	1156.97	3.02**	0.873	3.46	0.3745
Fifth	644.18	5.98**	1.310	4.56	0.5102
Sixth	855.88	5.29**	1.112	4.76	0.5313
Seventh	1015.50	4.74**	1.403	3.37	0.3632
Eight	932.79	5.51**	1.490	3.70	0.4064
Ninth	1198.97	4.53**	1.505	3.01	0.3119

**Significant at 1% level of significance

Table VI. Regression factors for estimating 300 days milk yield from different cumulative monthly yields for third lactation

Months	Intercept	Regression Coefficient	S.E.(b)	t cal	R^2
First-2	974.84	2.182**	0.535	4.07	0.4530
First-3	1004.58	1.307**	0.334	3.90	0.4326
First-4	1010.80	0.956**	0.243	3.92	0.4353
First-5	755.48	1.011**	0.206	4.90	0.5462
First-6	526.98	1.038**	0.164	6.30	0.6651
First-7	348.71	1.032**	0.136	7.55	0.7406

**Significant at 1% level of significance

reported the similar results that 4th cumulative monthly yield was best for the prediction of 284 days milk yields in Niliravi buffaloes. Sharma *et al.* (1980) also reported the similar findings for all lactation records in Hariana cows.

Third lactation. The regression factors for estimating 300 days milk yields for different single monthly and cumulative monthly yields are presented in Table V and VI, respectively. The critical appraisal of both the tables revealed that the regression coefficients were highly significant ($p<0.01$) for both monthly as well as cumulative monthly. It clearly suggested that both single monthly yields and cumulative monthly yields were very much dependent on predicted values of 300 days milk yields. Among single monthly milk yields used for prediction, the highest R^2 value was obtained for 6th (53.13%) followed by 5th (51.02%) and 2nd (40.62%) months, respectively. In case of cumulative yields, R^2 values ranges from 45.03% (for first 2 months) to 74.06% (for first 7 months). Since the R^2 values for early cumulative months were reasonably high, so first-3 (43.53%) months, first-4 (54.62%) and for first –5 (66.51%) months cumulative yields were best for 300 days prediction for third lactation records. Gokhle and Nagarsanker (1979) for monthly as well as cumulative monthly milk yields reported the similar findings for early prediction of 300 days milk yields; while, Sharma *et al.* (1983) reported hat 4th to 6th month yields were best for the prediction of 305 days milk yields in Hariana cattle.

Predicting 300 days milk yields from sequential combination of monthly milk yields. The regression factors obtained from multiple regression analysis of 300 days milk yield are shown in Table VII for first lactation records. It was revealed that there was an increasing trend for R^2 as the subsequent months were added in the equation. Among the equations, those involving the first three, first four, first five and first six months had R^2 values 62.80, 65.10, 70.20 and 75.20. In these equations, last months were highly significant ($p<0.01$) except for first month in 3rd equation, 1st and 2nd in 4th and 5th equations. Prediction in early months could save 3 to 6 months against the use of 8th and 9th equation where the R^2 values were highest. In view of R^2 values, the equations 3 onwards could compromise on efficiency and economy and could struck out by using equations 3rd, 4th, 5th or 6th instead of others. For 2nd and 3rd lactation records, multiple regression analysis of 300 days milk yield are shown in Table VIII and IX. First four, first five and first six months had R^2 values 66.40, 75.20 and 85.50 for second lactation while 53.90, 76.50 and 84.80 for third lactation records .In these equations, last months were highly significant ($p<0.01$). As prediction in early months could save 3 to 6 months against the use of 8th and 9th equation where the R^2 values were highest. In view of R^2 values the equations 4 onwards could compromise on efficiency and economy and could struck out by using equations 4th, 5th or 6th instead of others. The results of the present investigation are in close agreement with those of Roy and Katpatal (1989) for Jersey cows, Roy (1980) for Ongole and Gore (1981) for Sahiwal X HF crosses.

CONCLUSION

From the results obtained in the present study, it can be concluded that 3rd, 4th and 5th months were the best months for prediction of 300 days milk yields, while first-3, first-4 and first-5 cumulative months were best for prediction on the basis of cumulative milk yields. Among the various multiple regression equations, those involving the first three, first four, first five and first six months could be used with higher accuracy for predicting 300 days milk yields.

Table VII. Regression factors along with standard errors for estimating 300 days milk yield from sequential combination of different monthly milk yields for first lactation

S.No.		Milk Yields (Month)									R^2
	Intercept	1	2	3	4	5	6	7	8	9	
1	1142.75	3.93**									14.70
		(1.21)									
2	633.28	0.172	5.66**								46.60
		(1.15)	(0.94)								
3	410.18	0.204	2.36*	4.63**							62.80
		(0.97)	(1.02)	(0.91)							
4	309.93	0.0389	1.97	3.43**	2.30*						65.10
		(0.953)	(1.02)	(1.09)	(1.20)						
5	311.45	0.0060	0.932	3.18**	0.59	3.17**					70.20
		(0.887)	(1.00)	(1.02)	(1.24)	(1.00)					
6	123.06	-0.017	1.09	2.85**	0.067	2.15*	2.82**				75.20
		(0.816)	(0.93)	(0.94)	(1.15)	(0.97)	(0.84)				
7	68.19	0.310	1.11	2.49**	0.63	1.32	1.17	2.43**			78.50
		(0.776)	(0.87)	(0.89)	(1.10)	(0.96)	(0.97)	(0.84)			
8	28.43	0.723	1.23	1.59	0.54	1.68	0.24	0.68	3.11**		81.80
		(0.731)	(0.81)	(0.87)	(1.02)	(0.90)	(0.95)	(0.95)	(1.07)		
9	-141.52	0.722	1.82*	1.46	-0.13	1.45	1.10	0.0001	1.37	3.75**	85.70
		(0.656)	(0.74)	(0.74)	(0.93)	(0.81)	(0.88)	(0.87)	(1.10)	(0.99)	

*, **Significant at 1% and 5% level of significance

Table VIII. Regression factors along with standard errors for estimating 300 days milk yield from sequential combination of different monthly milk yields for second lactation

S.No.		Milk Yields (Month)									R^2
	Intercept	1	2	3	4	5	6	7	8	9	
1	1067.23	4.24**									38.10
		(0.83)									
2	837.23	2.63**	2.32**								50.70
		(0.90)	(0.76)								
3	729.23	2.42**	1.22	1.72							57.80
		(0.84)	(0.79)	(0.66)							
4	532.91	1.97*	1.43	0.39	2.49**						66.40
		(0.77)	(0.71)	(0.73)	(0.78)						
5	348.87	1.33	1.35	0.38	1.84	2.33*					75.20
		(0.70)	(0.62)	(0.61)	(0.70)	(0.63)					
6	251.08	1.21	1.13	0.58	1.55	-1.78	3.54**				85.50
		(0.54)	(0.48)	(0.49)	(0.55)	(0.69)	(0.69)				
7	217.13	0.91	1.10	0.65	1.65	-0.57	2.58**	1.82			88.70
		(0.49)	(0.43)	(0.44)	(0.49)	(0.63)	(0.69)	(0.57)			
8	108.48	1.23	1.38	0.56	1.40	0.35	1.74	0.067	2.17*		90.30
		(0.48)	(0.42)	(0.42)	(0.47)	(0.70)	(0.73)	(0.89)	(0.88)		
9	8.12	0.85	1.10	0.82	1.10	0.57	1.63	1.14	-0.33	3.02**	94.60
		(0.37)	(0.32)	(0.32)	(0.36)	(0.54)	(0.55)	(0.710	(0.83)	(0.58)	

*, **Significant at 1% and 5% level of significance

Table IX. Regression factors along with standard errors for estimating 300 days milk yield from sequential combination of different monthly milk yields for third lactation

S.No.		Milk Yields (Month)									R^2
	Intercept	1	2	3	4	5	6	7	8	9	
1	1022.44	4.72**									28.40
		(1.67)									
2	964.54	2.30	2.13								45.30
		(1.80)	(0.87)								
3	929.54	2.42	1.75	0.39							45.40
		(1.97)	(2.39)	(2.36)							
4	576.19	4.37*	-0.53	-2.47	5.32**						53.90
		(2.17)	(2.60)	(2.75)	(3.0)						
5	377.68	-0.92	2.41	-0.67	0.70	5.39**					76.50
		(2.09)	(2.06)	(2.08)	(2.50)	(1.37)					
6	500.77	-1.76	2.92	0.25	-0.41	0.21	5.24**				84.80
		(1.76)	(1.72)	(1.75)	(2.11)	(2.13)	(1.82)				
7	465.96	-1.62	2.75	0.31	-0.23	-0.067	4.77**	0.76			85.00
		(1.85)	(1.83)	(1.81)	(2.23)	(2.33)	(2.28)	(2.11)			
8	-11.66	-0.46	0.28	-0.13	2.82	2.81	1.63	-5.14*	7.69**		92.40
		(1.41)	(1.51)	(1.34)	(1.86)	(1.90)	(1.89)	(2.27)	(2.15)		
9	84.27	-0.65	1.96	0.87	0.15	1.55	2.80	-2.61	1.86	3.34**	95.80
		(1.09)	(1.29)	(1.09)	(1.67)	(1.52)	(1.51)	(1.93)	(2.50)	(1.07)	

*, **Significant at 1% and 5% level of significance

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