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ANIMAL MODEL ESTIMATES OF REPEATABILITY FOR VARIOUS PERFORMANCE TRAITS OF NILI-RAVI BUFFALOES

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Pedigree and performance records (N=3197) of a purebred herd of 1322 Nili-Ravi buffaloes maintained at the Livestock Experiment Station, Bahadumagar, Okara, Pakistan were utilized for the estimation of repeatability of 305-day lactation milk yield, total lactation milk yield, lactation length, dry period, service period, gestation period and calving interval. The repeatability values were estimated by using restricted maximum likelihood procedure fitting an individual animal model. The derivative-free restricted maximum likelihood set of computer programmes was used in this analysis. The repeatability estimates were computed to be 0.21±0.02 for 305-day lactation milk yield, 0.18±0.02 for total lactation milk yield, 0.20±0.03 for lactation length, 0.09±0.03 for dry period, 0.09±0.03 for service period, 0.07±0.02 for gestation period and 0.05±0.02 for calving interval. The low estimates of repeatability for all of the performance traits suggested that most of the observed variation in these traits was due to temporary environmental conditions and culling buffaloes on the basis of early performance records would be of little value. Thus multiple records of buffaloes need to be considered while making culling decisions.

Key words: animal model, Nili-Ravi buffaloes, performance traits, repeatability estimates

INTRODUCTION

Nili-Ravi buffaloes of Pakistan are considered to be one of the best milch buffaloes in the world. They also possess outstanding beef and draft qualities. These animals are well adapted to hot and humid climatic conditions of the country and have resistance to several prevalent diseases. They are also efficient converters of low quality roughage. Being the main dairy animal, they supply about 75 % of the milk produced in the country. The buffalo milk is relished and fetches better price than cow's milk due to its higher butterfat content. This has led to an increase in the buffalo population. Their number has increased from II million to 22 million in the last 20 years. The buffalo has not improved much in productivity and is blamed for late age at first calving, long calving intervals and low milk production on lifetime basis. Improper nutrition, lack of scientific breeding and poor management have curtailed the role of buffalo as the specialized dairy animal. In the past the genetic improvement in production and reproduction traits has been very slow due to limited breeding programmes and lack of effective selection criteria. This situation indicates a need for the improvement of genetic merit of the buffaloes in Pakistan. The estimates of genetic parameters namely repeatability, heritability and genetic correlations are needed for the formulation of effective breeding plans. These parameters are characteristic of the population in which they are estimated and they may change over time due to selection and managemental decisions. Salah-ud-Din (1989), Hussain et al.(1993) and Khan et al.(1996) calculated repeatability estimates of different performance traits of Nili-Ravi buffaloes in Pakistan but the methodology used in these earlier studies is out-dated now. The present study was thus planned to compute repeatability estimates of different performance traits using the latest available analytical procedure.

MATERIALS AND METHODS

Pedigree and performance records (N=3197) of a purebred herd of 1322 Nili-Ravi buffaloes maintained at the Livestock Experiment Station, Bahadurnagar, Okara, Pakistan were utilized for the estimation of repeatability of 305-day lactation milk yield, total lactation milk yield, lactation length, dry period, service period, gestation period and calving interval. Only normal and complete records of the buffaloes were used for this study. Lactation records of less than 150 days duration were not considered in the analyses . All the buffaloes which had at least two records were included in the study.

The repeatability values were estimated by using restricted maximum likelihood procedure as outlined by Patterson and Thompson (1971) fitting an individual animal model. The derivative-free restricted maximum likelihood (DFREML) set of computer programmes (Meyer, 19.97) was used for the analysis. All of the available pedigree information was included in the analysis in an attempt to minimise the bias due to selection and non-random matings. The convergence criterion (variance of function values -2 10r likelihood) for various genetic parameters was Ix 10' . The repeatability estimates were computed by assuming the following mixed model:

$$Y_{ijk} = \mu + B_i + F_j + e_{ijk}$$

where,

Y_{ijk} = measurement of a particular trait;
μ = population mean;
B_i = the random effect of ith buffalo;
F_j = fixed effects observed to be significant from the earlier analyses; and
e_{ijk} = random error with mean zero and variance σ^2_E.

The various fixed effects observed to be significant sources of variation for different performance traits were fitted in

the above mixed model for the estimation of repeatability. These included year of calving, lactation number and lactation length for 305-day lactation milk yield and total lactation' milk yield, year and season of calving and lactation number for lactation length, year of calving for dry period, year and season of service and lactation number for service period , season of service for gestation period and year and season of calving and lactation number for calving interval.. Keeping in view the climatic data, the year of calving / service was divided into following seasons: Winter, December to January; Spring, February to April; Hot dry, May to June; Hot humid, July to September; Autumn, October to November. .

The common environmental parameter estimated (c^2) represented the proportion of cr^2p attributable to an irnal' s permanent environmental effects (cr^2_{pE}) and was calculated as cr^2_{pE} / cr^2_p. Repeatability of the concerned trait was estimated as $cr^2_A + cr^2_{pE} / cr^2_p$. The model included animal's permanent environmental effect in addition to the animal's additive genetic effect and the residual effect assuming that it is uncorrelated to the other random effects i.e. additive genetic and the residual effects. In this case animal's permanent environmental effect as fitted as an additional random effect..

RESUL TS AND DISCUSSION

The repeatability estimates along with the number of observations, the number of animals, phenotypic variance and c^2 term (permanent environmental effects as a proportion of the phenotypic variance) for different production and reproduction traits are given in Table I and are discussed below under separate headings:

I) 30S-Day Lactation Milk Yield: The repeatability estimate for 305-day lactation milk yield in the present study was 0.21±0.02 which was based on 3141 lactation records of 1308 buffaloes (Table 1). The c^2 value i.e. the proportion of phenotypic variance which is due to permanent environmental effects was found to be 0.186. The estimate of repeatability as observed in the present study was in agreement with the value of repeatability (0.19) reported by Singh et al. (1988) from the analysis of the data of Nili-Ravi buffaloes from India. However, repeatability for milk yield as reported by many workers (Saxena and Tornar, 1988, Vij and Tiwana, 1989; Mourad et al., 1991;PillaandMoioli, 1992; Juma et al., 1994; Khan et al., 1996; Patel and Tripathi, 1997) was much higher than that obtained in the present study. These workers reported repeatability for milk yield ranging from 0.30 to 0.68 in different breeds of buffaloes. The estimate of repeatability for milk yield in Nili-Ravi buffaloes from Pakistan was reported to be 0.52±0.07 (Syed et al., 1996). The estimates of repeatability for milk yield from Egyptian, Italian and crossbred buffaloes (Murrah x Jaffarabadi x Mediterranean) was fairly high and ranged from 0.40 - 0.47 (Mourad et al., 1991; Marques et al., 1991; Pilla and Moioli, 1992). The repeatability estimate of milk yield for Mehsana buffaloes was reported to be 0.30 ± 0.10 (Ranjan and Siddiquee, 1985). Khalil et al. (1992) studied the milk production records for Egyptian buffalo herds using 2739 lactations of 696 buffaloes representing 67 sires during 1970-85. It was reported that the repeatability estimates were moderate and ranged from 0.29-0.40 for all lactation traits.

The repeatability estimate for total lactation milk yield in the present study was 0.18±0.02. This is slightly lower than the repeatability estimate for 305-day lactation milk yield (0.21±0.02). The estimate of c^2 for total lactation milk yield was 0.159 which is also lower than the corresponding value for 305-day lactation milk yield (0.186). This value was lower than the estimate (0.28±0.03) reported by Patel and Tripathi (1997). Soliman et al. (1994) studied data from 1983-87 for different productive and reproductive traits in Egyptian buffaloes raised under desert conditions. It was reported that the repeatability estimate was moderate (0.30±0.03) for total lactation milk yield. In contrast, Juma et al.,(1994) reported a higher estimate of repeatability (0.50) for this trait in Egyptian buffaloes. Vij and Tiwana (1989) reported a very high estimate of repeatability (0.59±0.12) compared to that of the present study (0.18±0.02).

2) Lactation Length: The repeatability estimate of lactation length as obtained in the present investigation was 0.20±0.03 which was based on 3197 records of 1322 buffaloes (Table I). The c^2 value for this trait was found to be 0.134. The estimate of repeatability for lactation length in the present study was in agreement with those of some other workers who reported the repeatability estimate for this trait as 0.22 ± 0.01 in Nili-Ravi buffaloes (Khan et al., 1996), 0.23 in Murrah buffaloes (Saxena and Tornar, 1988), 0.21 in Egyptian buffaloes (Ashrnawy, 1991) and 0.21 in Iraqi buffaloes (Juma et al., 1994). Contrarily, Hatwar and Chawla (1988) and Syed et al. (1996) reported slightly lower estimates (0.14 - 0.17) of repeatability for length of lactation as compared to the present study, while the corresponding values of repeatability as reported by Pate I and Tripathi (1997) and Jawarkar and Johar (1975) were much higher than the present estimate and ranged from 0.27±0.03 in Surti buffaloes to 0.45±0.03 in Murrah buffaloes.

3) Dry Period: The repeatability estimate for dry period in the present study was 0.09±0.03 with a c^2 value of 0.025. This estimate was calculated from 1972 lactation records of 895 buffaloes (Table 1). The estimate of repeatability in the present study was in agreement with those of several earlier studies (Gurnani et al., 1976; Basu and Ghai, 1981; Khatkar et al.,1996 and Patel and Tripathi,1997). The repeatability estimates for dry period as found from these studies ranged from 0.08 to 0.11 ±0.04 in different breeds of buffaloes. However, Juma et al. (1994) reported a lower estimate of repeatability for dry period (0.0 I) in Iraqi buffaloes than the present study. Contrarily, several workers (Khishin et al., 1968; Vij and Tiwana, 1989; Salah-ud-Din, 1989; Ashmawy, 1991; Metry et al., 1994 and Harned, 1994) reported higher estimates (0.20-0.30) of repeatability for dry period.

4) Service Period: The repeatability estimate for service period in the present study was computed to be 0.09±0.03 (Table 1). The c^2 value for service period was 0.068. The present estimate of repeatability was in line with the

Table 1. Reveatability estimates for various per formance traits of Nili-Ravibu rraloes

Traits	Number of records	Number of animals	σ^2_p	c-'	Repeatability estimate ± S.E.
305-day lactation milk yield (kg)	3141	1308	368177.45	0.186	0.21±0.02
Total lactation milk yield (kg)	3141	1308	420210.18	0.159	0.18±0.02
Lactation length (days)	3t97	1322	6366.75	0.134	0.20±0.03
Dry period (days)	1972	895	13295.28	0.025	0.09±0.03
Service period (days)	2239	1034	17008.74	0.068	0.09±0.03
Gestation period (days)	2923	1677	64.70	0.009	0.07±0.02
Calving interval (days)	1797	829	12765.60	0.016	0.05±0.02

σ^2_p is the phenotypic variance; c" is the proportion of phenotypic variance, which is due to permanent environmental effects; S.E. is the standard error..

findings ofYij and Tiwana (1989); Umrikar et al. (1993) ; Hussain et al.(1993) and Pate I and Tripathi (1997), who reported repeatability estimates ranging from 0.06 to 0.13 in different breeds of buffaloes. Hussain et al.(1993) analysed 2068 records of 583 Nili-Ravi buffaloes by intra-class correlation technique and found that the estimate of repeatability for service period was 0.10.

5) Gestation Period: The repeatability estimate for gestation period was found to be 0.07±0.02 (Table I). The c" value for gestation period was calculated to be 0.009 which is the smallest value among all the results obtained. It was in agreement with that reported by Basu et al. (1978) (cited by Basu, 1985) in Indian buffaloes.

6) Calving Interval: The repeatability estimate for calving interval based on 1797 calving records of 829 buffaloes was 0.05±0.02 (Table 1). The calving interval was found to have a c" value of 0.0 16. The repeatability value from the present study was in line with findings of Hatwar and Chawla (1988); Metry et al.(1994) and Hamed (1994) who reported the repeatability estimate for calving interval ranging from 0.0 I to 0.08. The estimates of repeatability for calving interval obtained by Singh et al. (1988), Yij and Tiwana (1989), Hussain et al. (1993), Kandasamy et al.(1993), Khatkar et al. (1996), Khan et al.,(1996), Syed et al.(1996) and Patel and Tripathi (1997) were higher as compared to that obtained in the present study. The repeatability estimates reported by the above workers ranged from 0.10 to 0.19 in different breeds of buffaloes. In the earlier studies on Nili-Ravi buffaloes, relatively higher estimates of repeatability had been obtained (Singh et aI., 1988; Salah-ud-Din, 1989; Hussain et al., 1993; Syed et al., 1996 and Khan et al., 1996). These estimates ranged from 0.12 to 0.23. The estimate of repeatability for calving interval as obtained in the present study was very low as compared to those of Chantalakhana et al. (1982), Juma et al.(1991), Juma et al. (1994) and Tonhati and Vasconcellos (1997). These workers reported repeatability estimates varying from 0.39 to 0.67 in various breeds of buffaloes.

The estimates of repeatability for various production and reproduction traits in the present study ranged from 0.05 to 0.21. The lowest value was obtained for calving interval and the highest for 305-day lactation milk yield. Although all of the repeatability estimates are low but tend to be within the range of values reported in the literature. The differences between the estimates obtained in the present study and those reported from other studies may be attributed to differences in temporary environmental conditions prevailing in different areas and differences due to breeds. The low estimates of repeatability for various performance traits indicated that the traits were almost entirely under the control of temporary environment.. For example for calving interval with a repeatability estimate of 0.05. it may stated that it was almost entirely under the control of management because it had been reduced from 20 months to less than 13 months during 5 years period under good management conditions (Ashfaq and Mason, 1954), which showed that it had a little or no genetic component.. Thus. in any selection programme for short calving interval, emphasis should be given to the repeated records of the individuals rather than a single record.

Repeatability estimates as low as obtained in the present study indicated that culling buffaloes on the basis of early records for productive and reproductive performance would be of little value. Future performance can not be predicted accurately from early records when the repeatability estimates are as low as those found in the present study.

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