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Relationship Among Various Production and Reproduction Contributors of Breeding Efficiency in Dairy Buffaloes of Pakistan

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Abstract.- The performance of dairy buffaloes kept at three state farms were studied. A total of 5033 reproductive and productive records from the year 1985 through 2004 were utilized in the present study to investigate breeding efficiency (BE) and its various contributors in dairy buffaloes. General linear model, Pearson's correlation and regression procedure were used to study the effect of herd, period, season of calving, birth weight (BW), age at puberty (AAP), lactation yield (LY) and calving interval (CI) on breeding efficiency. Average breeding efficiency of dairy buffaloes was 72.75 ± 10.58 %. Age at puberty, age at first calving (AFC) and calving interval being indicators of breeding efficiency averaged 951.09, 1339.29 and 558.36 days, respectively. The effect of year and season(different from results) of calving, lactation yield, calving interval, age at first calving and birth weight was found significant (P<0.001) on breeding efficiency, while the effect of herd was non significant. BE correlated positively with BW and LY and negatively with AAP, AFC and CI (r = 0.45, 0.30, -0.42, -0.49 and -0.07; P<0.001). Breeding efficiency increased with the increasing AFC up to 1400 days, remained high up to day 1500 and then decreased. An increase in lactation yield rapidly increased BE up to 1750 liters per lactation but further increase was associated with a sluggish upward trend in BE. Across the years the BE showed a persistent declining trend which was also associated with a declining BW and increasing AAP. The spring calvers showed the highest BE followed by winter, summer and autumn calvers. It may be concluded that birth weight was the most significant contributor of breeding efficiency in dairy buffaloes and it also influenced age at puberty, age at first calving and lactation yield.

Key words: Breeding efficiency, dairy buffaloes, birth weight.

INTRODUCTION

The economic returns from dairy animals are not only based on milk production alone but also on their reproductive efficiency (Khan, 2002). Everett *et al*. (1966) reported that breeding efficiency and production were essentially interdependent. Reproductive efficiency is proposed as a measure of the net biological accomplishment of all reproductive activities and phenotypic expression of the interplay of genetic and environmental factors (McDowell, 1985). Indicators of reproductive efficiency are service period affecting in turn, the calving interval. However, the breeding efficiency in addition to accommodating the number of calvings also takes care of age at first calving and total number of days from first to last lactation.

In buffaloes the breeding efficiency has been reported to be 64.0±0.6% (Bashir *et al*., 2007). These authors utilized the data generated on Nili-Ravi buffaloes from the four government herds in Punjab for a period of twenty years. At government farms culling in buffalo were done periodically on the basis of reproductive disorder, low production, age factor and reproductive disorders.

Reproductive efficiency represents the overall performance of the herd with respect to age and reproductive traits. Heifers attaining mature body weight earlier, on the average would have smaller age at first calving and would be expected to calve more frequently than slow growing heifers (Syed *et al*., 1994). Breeding efficiency, being a composite trait was estimated using various equations (Wilcox *et al*., 1957; Sharma *et al*., 1980). Average values of breeding efficiency according to these methods among Murrah buffaloes were 83.18±0.51 and 92.88±1.41 %, respectively. Sharma and Chaudhry (1986) reported mean breeding efficiency as 82.98±1.41%. Strategic culling of the less fertile cows is mandatory for improving reproductive efficiency. The present paper provides informations on these lines which will also be useful for devising proper weightage to be given to various relevant contributors.

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MATERIALS AND METHODS

Records of dairy buffaloes from three large sized state farms, namely Okara, Peshawar and Kohat from the year 1985 through 2004 were utilized for the present study. The temperature in the study areas rises up to 45 °C with high humidity in summer, while in winter it often falls below freezing point at night. At these farms the buffaloes are kept in covered sheds. In winter and spring seasons they are in zero grazing systems, and are fed fresh green fodder such as Egyptian clover, oats, barley and lucern. In summer and autumn in the morning times, the buffaloes are taken out to the grazing fields for 2 to 3 hours. They are offered fresh green cuts fodders such as chopped maize, millet and sorghum etc. At these farms no special selection scheme is practiced. High producing buffaloes are kept as bull mothers and given special attention.

Data collection

Data were collected on animal's identity, date of birth, date of service, date of calving, date of drying and sire numbers. The derived variables were age at puberty, age at first calving, calving interval, lactation yield and breeding efficiency. Breeding efficiency for each buffalo cow was worked out using the equation given by Sharma *et al*. (1980). The equation was modified as:

$$\text{Breeding efficiency (\%)} = \frac{[900 + (n-1)\ 400]*100}{AFC + Z} \quad (1)$$

Where 900 was considered as the standard age in days at first calving, n is number of calvings, AFC is actual age at first calving (in days) and Z is the total number of days from first to last lactation.

Statistical analysis

The data were analyzed using general linear model (GLM) to study the effect of different class variables on breeding efficiency:

$$Y_{ijklmnop} = \mu + HD_i + PD_j + SN_k + BW_l + AAP_m + LY_n + CI_o + \epsilon_{ijklmnop} \quad (2)$$

Where Yijklmnop is The p-th breeding efficiency of each buffalo cow; μ, population constant; HD_i, ith herd, I = Okara, Peshawar and Kohat; PD_j, jth period of calving, j = 1, …, 7; SN_k, kth season of calving, k = 1,2, …, 4; BW_l, lth birth weight, l = 1,2,…,5; AAP_m, mth age at puberty, m = 1,2,…,5; LY_n, nth lactation yield, n = 1, 2,…,5; CI_o, oth calving interval, o = 1,2,…,5; $\epsilon_{ijklmnop}$ is random residuals.

The year of calvings were grouped into seven periods, each period comprising two consecutive years, while the season of birth were classified into four groups as winter, spring, summer and autumn. The production parameters affecting BE were grouped into five classes; indicating very low, low, medium, high and very high. Analysis were performed using computer package SAS (1997).

RESULTS

Average breeding efficiency of dairy buffaloes was 72.74±10.58% ranging from 43.95% to 96.88% under the present management and production conditions. Average birth weight, age at puberty, age at first calving and calving interval being components of breeding efficiency was found to be 34.69 kg, 951.09, 1339.29 and 558.36 days, respectively while mean lactation yield was 2076 kg.

Among the management parameters the effect of year was significant on the breeding efficiency while the effect of herd and season were non-significant (Table I). Birth weight, age at puberty, lactation yield and calving interval affected breeding efficiency. Across the years the breeding efficiency showed a persistently downward trend which was

Table I.- Analysis of variance for effect of management and production parameters on breeding efficiency in dairy buffaloes.

Source	DF	MS	P
Management			
Herd	2	127.54	0.1742
Period	6	1152.02	0.0001
Season	3	155.88	0.0935
Production			
Birth weight	4	1615.69	0.0001
Age at puberty	4	1701.60	0.0001
Lactation yield	4	411.54	0.0002
Calving interval	4	304.16	0.0023

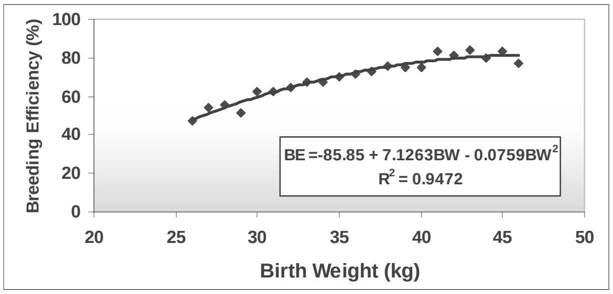

Fig. 1. Breeding efficiency in relation to birth weight

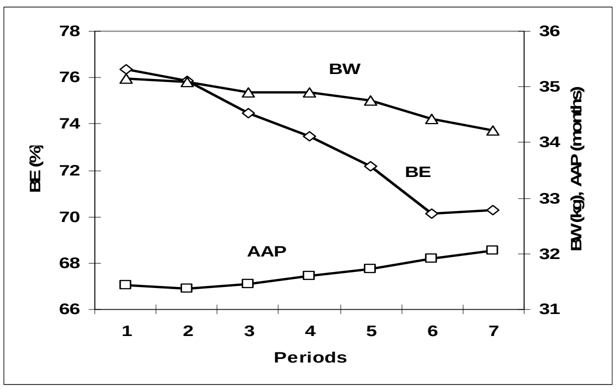

Fig. 2. Changes in BE (Breeding Efficiency %), BW (Birth weight) and AAP (age at puberty) with the advancing periods (P1=1991-92, up to P7 = 2003-04).
The BE correlated with BW and AAP (r = 0.46 and - 0.42, P<0.001)

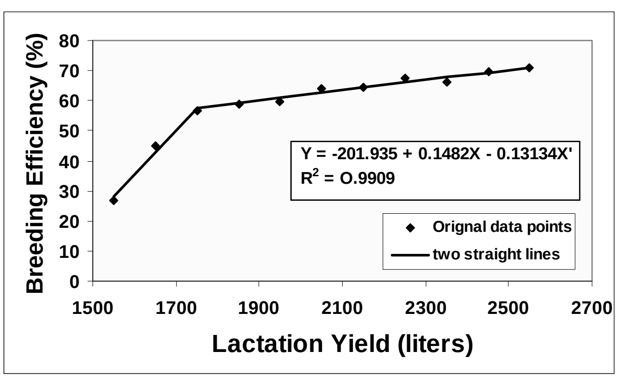

Fig. 3. Relationship between breeding efficiency and lactation yield, two straight-lines with a joining point at 1750 liters per lactation

also associated with a declining BW and increasing AAP. The BE increased linearly with the increase in birth weights. The BE decreased with increase in age at puberty and calving interval, while it increased with increase in lactation yield. Birth weight and age at puberty was negatively and significantly correlated (r = -0.69, P<0.001). Similarly relationship between birth weight and age at first calving was significant but negative (r = -0.52, P<0.001). Positive and significant correlation was found between birth weight and breeding efficiency (r=0.45, P<0.001). Correlation coefficient between birth weight and lactation yield was also positive and significant (r = 0.41, P<0.001). Perfect positive and significant correlation (r = 0.79, P<0.001) existed between age at puberty and age at first calving. Negative and significant (P<0.001) correlation was observed between age at puberty and lactation yield. Correlation coefficient was found to be positive and significant (P<0.001) between lactation yield and breeding efficiency, while calving interval and breeding efficiency was significantly (P<0.001) and negatively correlated with each other.

A positive trend was observed indicating an increase in BW with % BE. The R^2 for the fitted model was 94.72%. Breeding efficiency increased with increase in age at first calving and later on it decreased with progression in age at first calving. It was suggested that a relatively higher value of age at first calving favors breeding efficiency. An inverse trend was observed between BE and CI. Breeding efficiency increased from 25% to a critical level of 55% with increase in lactation yield from 1550 to 1750 liters rapidly as depicted in Figure 3, while further increase in breeding efficiency was found slower and gradual up till 2600 liters milk produced.

DISCUSSION

The presently reported BE (72.24%) seems to be sufficient under the management condition of large sized state farms. However, this trait showed a persistent downward trend over the year (78.20 to 71.38%) during the period from 1991-92 to 2003-04. Birth weight was found to be the most significant contributor to BE associated with an increasing AAP, AFC and LY. This may have occurred due to the inbreeding affect or a deteriorating management conditions at these farms.

This relationship indicated an increase in birth weight with an increase in breeding efficiency of the animal. Higher birth weight may have lead to an improved postpartum performance of the calf leading to development and maturity of organs to better reproductive cycle. Khan (2002) reported an average breeding efficiency in Nili-Ravi buffaloes to be 72.55 %, which is exactly the same as reported in the present findings.

Bashir *et al*. (2007) reported an average breeding efficiency of 64.0 % in Nili-Ravi buffaloes. Herd and year were found as important source of variation for breeding efficiency while season of calving or age at first calving had no effect in the reported study. This indicated that all the herds used in the present study were better managed in terms of reproduction and the animals were fed properly. The difference in the breeding efficiency found in the present study and the reported studies may be due to different parities, method of estimation and reproductive management (Bashir *et al*., 2007). Calving interval has great economic bearing on the life production and reproductive efficiency of dairy animals. The findings of the present study indicated that % BE was decreased with increase in calving interval. Ashfaq and Mason (1954) in support of the present study, reported that for enhancing calf crop during life time span of dairy animals, reduction in the length of calving interval is important.

Role of AAP and BE

The results showed that optimum age at first calving favors breeding efficiency because the reproductive organs and neuro-endocrine system develop sufficiently to support optimum reproductive cycle and conception. Further increase in age at first calving may be the effect of aging leading to a lower reproductive performance. In a previous study Khan (2007) reported that the decline in milk yield with the onset of pregnancy was prevented by an increase in maturity of dairy buffaloes. It can be concluded that the increasing maturity up to some extent results in maintenance of better reproductive performance.

The breeding efficiency of the dairy buffaloes was decreased with increase in calving interval. Prolonged calving interval being a negative indicator of reproductive efficiency results in delayed breeding which is commonly practiced in urban and the peri-urban dairy farming system in the country, in order to avoid loss in milk yield due to pregnancy (Qureshi *et al*., 2007).

LY and BE

Increase in BE is associated with an increase in lactation yield. It confirmed the earlier findings of Qureshi *et al*. (2007). The authors reported that high yielding buffaloes were also efficient in fertility. However, after a certain level BE was reduced with further increase in production, indicating high priority of nutrients partitioning towards production than reproduction.

CONCLUSIONS

Based on the findings of this study it may be concluded that birth weight was the most significant contributor of breeding efficiency in dairy buffaloes and it also influenced age at puberty, age at first calving and lactation yield.

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