Journal of Animal Research: v.6 n.5, p. 885-889. October 2016
DOI: 10.5958/2277-940X.2016.00114.5

Comparison of Two Methods of Calculating Breeding Efficiency of Crossbred Cattle and Murrah Buffaloes

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Received: 08 July, 2016 **Accepted:** 06 September, 2016

ABSTRACT

A total of 1474 and 1935 production and reproduction records of crossbred cattle and Murrah buffaloes from the year 1992 to 2012 were utilized in the present study to investigate breeding efficiency (BE) at Gadvasu Dairy farm. Breeding efficiency was calculated using Wilcox (1957) and Tomar (1965) methods and then Least squares of Harvey (1990) model was used to study the effects of various non-genetic factors (period, season) on breeding efficiency. Average breeding efficiency of Crossbred Cattle was 82.31 ± 0.97% ranging from 75% to 85% by Wilcox method and 98.14 ± 1.09% ranging from 95% to 99% by Tomar method. Breeding efficiency of Buffaloes was 78.03 ± 1.01% ranging from 69% to 84% by Wilcox method (1957) and 78.39 ± 0.39% ranging from 74% to 80% by Tomar method under the present management and production conditions. The little differences in two methods may be attributed to different methods of calculation as well as large variation in the no. of calvings, calving interval and age at first calving across 20 years. Hence it may further be concluded that the two methods were equally useful in the calculation of reproductive efficiency in dairy animals.

Keywords : Breeding efficiency, methods, no. of calvings, calving interval, age at first calving

Cattle and Buffaloes occupy an important place in the dairy set up of the country. The success of dairy industry much depends on level of production and reproduction traits of the animals. Breeding efficiency is one of most important trait. 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). The breeding efficiency is a complex phenomenon controlled by both genetic and non-genetic factors, the non- genetic factors being climate, nutrition, and level of management. The breeding efficiency varies not only between species and breeds but also among the animals within the same breed. Even the best feeding and management cannot coax performance beyond the genetic limit of an inferior animal. Improving the genetic merits of livestock populations is important at all levels of management. A sound breeding programme is a necessary part of the total animal production system. The diversity of the breeding stock and the variation available in economic traits of cattle and buffaloes in the country offer greater challenge and scope for their improvement for the animal breeder.

The initial formula for working out the breeding efficiency of dairy cows was given by Wilcox *et al.* (1957) and was based on a calving interval of 365 days. Since the buffaloes have a gestation period of 310 days the calving interval is increased to 400 days. Thus the formula for working out the reproductive efficiency has been modified by many workers (Tomar, 1965). The objective of this study was to determine the Breeding efficiency of Crossbred Cattle and Murrah buffaloes maintained at Gadvasu dairy farm by different methods and to compare their effectiveness for calculating Breeding efficiency.

MATERIALS AND METHODS

A total of 1474 and 1935 production and reproduction records of crossbred cattle and Murrah buffaloes from the year 1992 to 2012 were utilized in the present study to investigate breeding efficiency (BE) and its various contributors in Crossbred cattle and Murrah buffaloes respectively maintained at Gadvasu dairy farm. Data of abnormal lactation like abortion, mastitis and below 150 days milk yield were excluded from the study. The years were divided into five periods; of each having four years while the months were divided into five seasons viz. Spring (16^{th} Feb. –15^{th} April), summer (16^{th} April – 15^{th} June), rainy (16^{th} June – 15^{th} August), autumn (16^{th} Aug. – 15^{th} Nov.), winter (16^{th} Nov. – 15^{th} Feb.).

Breeding efiiciency was calculated using the following two methods reported by different workers:

$$\text{Breeding efficiency} = \frac{365 \times (n-1)}{D} \times 100$$

Where,

N = total no. of parturitions
D = days from first to last parturition Wilcox *et al.* (1957)

The second method for estimation of breeding efficiency in cattle and buffalo, this formula takes into account both calving interval and age at first calving.

(a) Breeding Efficiency for cows

$$\text{BE (cows)} = \frac{(365N + 1020)}{(AFC + \sum CI)} \times 100$$

(b) Breeding efficiency for Buffaloes

$$\text{BE (buffaloes)} = \frac{(365N + 1040)}{(AFC + \sum CI)} \times 100$$

Where,

N = Total no. of calving intervals
AFC = Age at first calving
CI = Calving interval
$\sum$ = Summation of calving intervals Tomar (1965)

The Least-squares of Harvey (1990) model was used to study the effects of various non-genetic factors on different traits:

The following model was used for least squares analysis,

$$Y_{ijk} = \mu + S_i + P_j + b\,(X_k - \overline{X}) + e_{ijkl}$$

Where,

Y_{ijk} = Observation on the k^{th} individual recorded in the j^{th} period and i^{th} season.

μ = Population mean

S_i = Effect of i^{th} season, i = 1 ……5 (season)

P_j = Effect of j^{th} period, j = 1………5 (period)

b = Regression of Y_{ijk} on age at first calving

X_k = Age at first calving of the k^{th} individual

$\overline{X}$ = Average age at first calving

e_{ijkl} = Random error, NID (0, σ^2e)

Genetic and phenotypic correlation between different traits age at first calving, weight at calving and lactation length was estimated by using Mixed model least square and maximum likelihood computer programme (Harvey, 1990).

RESULTS AND DISCUSSION

Breeding efficiency as calculated by two different methods reported by Wilcox *et al.* (1957) and Tomar, (1965). The least square means of breeding efficiency of crossbred Cattle was 82.31 ± 0.97% ranging from 75% to 85% by Wilcox method and 98.14 ± 1.09% ranging from 95% to 99% by Tomar method as shown in Table 2 and 3. Breeding efficiency showed an inconsistent trend across various periods for crossbred cattle. While for different seasons it showed an increasing trend. M.A. Habib *et al.* (2013) reported breeding Efficiency of crossbreds in Bangladesh by Wilcox and Tomar methods as 79% and 82% respectively. Kiwuwa *et al.* (1983) estimated higher breeding efficiency on crossbred cattle in ethopia as 95%. Similar results were obtained in Egypt by Hammoud *et al*. (2010) on HF crossbreds.

Similarly for Murrah buffaloes breeding efficiency was 78.03 ± 1.01% ranging from 69% to 84% by Wilcox method (1957) and 78.39 ±0.39% ranging from 74% to 80% by Tomar method as shown in Table 4 and 5. For, Murrah buffaloes continuous increasing trend was noticed for different periods. While for different seasons inconsistent trend was there. Bashir *et al.* (2007) reported an average breeding efficiency of 64.0 % in Nili-Ravi buffaloes. Ahmad *et al*. (1987) reported low breeding efficiency in Nili-Ravi buffaloes than the present findings while maximum (84 percent) average was reported by Baghdasar and Juma, (1998).

Breeding efficiency as calculated by two different methods in crossbred cattle and Murrah buffaloes are presented in Table 1. The breeding efficiency calculated by both methods in Murrah buffaloes is similar, whereas for crossbred cattle it is higher by Tomar method. The differences in the reproductive efficiency by these workers may be attributed to the differences in number of calvings as the number of calvings varied from 2 to 10. It was seen when no. of calvings increased from 2 to 6 breeding efficiency increased and there was decrease in coefficient of variation. In Tomar method (1965) also because of variation in age at first calving breeding effficiency varied. Similar, variation in breeding efficiency estimates have been reported by Khan *et al.* (1990) where he compared three methods of calculating breeding efficiency.

Basu (1985) pointed out that the method of Wilcox *et al.* (1957) does not take into account the first reproductive cycle of each cow because of excessive environmental Influences. This is further substantiated by the comparison of the method of Wilcox *et al.* (1957) and Sharma *et al.* (1980). where it was stated that reproductive efficiency in 581 Murrah buffaloes sired by 75 bulls was 83.1 and 82.8%. respectively (Sharma and Kumar, 1984; Wilcox *et al.*, 1957) also excluded the reproductive cycles after the sixth parturition in the estimation of reproductive efficiency because of suspected bias caused by special managemental practices in favour of the proven older cows. The differences in Wilcox *et al.* (1957) and Tomar (1965) methods may be attributed to different methods of calculation as well as large variation in the calving interval and age at first calving across 20 years. Khan (1990) reported values of reproductive efficiency calculated on the basis of calvings were quite consistent by the two different methods.

Thus, the estimated breeding efficiency below the expected level exists in the present study might be due to variation in no. of calvings, age at first calving and calving interval (caused by prolonged post partum estrous period and days open). The variation of magnitude among different workers might be resulted due to environment, sample size, management or different formula used for estimation by different workers.

Table 1: Comparison of estimates of breeding efficiency in crossbred cattle and murrah buffaloes as calculated by Wilcox and Tomar method

	Breeding Efficiency	Av. Breeding Efficiency	Std. Deviation	Coefficient of variation
Cattle	Wilcox B.E	82.31 ± 0.97	19.33	23.27 %
	Tomar B.E	98.14 ± 1.09	22.12	22.51 %
Buffalo	Wilcox B.E	78.03 ± 1.01	27.75	35.65 %
	Tomar B.E	78.39 ± 0.39	11.92	15.13 %

Table 2: Least squares means (±SE) for breeding efficiency (%) over different periods for Crossbred cattle

Period	1992-95	1996-99	2000-03	2004-07	2008-12
N (455)	117	111	85	72	70
$B.E_W$ 82.31±0.97)	85.20^{ab}± 1.83	84.39^{ab} ±1.83	87.23^{b} ± 2.09	79.03^{bc}± 2.34	75.70^{c} ± 2.36
$B.E_T$ (98.14±1.09)	96.15^{a} ± 2.06	97.96^{ab}± 2.07	100.69^{c}± 2.36	97.91^{bc}± 2.65	95.97^{bca}± 2.66

Table 3: Least squares means (±SE) for breeding efficiency (%) by season effects for Crossbred cattle

Season	Spring	Summer	Rainy	Autumn	Winter
N (455)	70	58	81	86	160
$B.E_W$ (82.31 ±.97)	79.82^{a} ± 2.31	81.88^{a} ±2.54	82.54^{a} ±2.11	85.57^{a} ± 2.05	81.74^{a} ±1.50
$B.E_T$ (98.14 ± 1.09)	100.54^{a} ±2.60	97.11^{a} ±2.87	97.75^{a} ±2.38	96.95^{a} ± 2.32	98.34^{a} ±1.70

^{a,b,c}Within variable groups means followed by different subscripts differ significantly (P<0.05). * = P<0.05; ** =P<0.01, $B.E_W$ = Breeding efficiency by Wilcox method, $B.E_T$ = Breeding efficiency by tomar method

Table 4: Least squares means (±SE) for breeding efficiency (%) over different periods for Murrah buffaloes

Period	1992-95	1996-99	2000-03	2004-07	2008-12
N (519)	141	111	88	70	109
$B.E_W$ (78.03±1.01)	69.54^a ± 1.80	77.68^b ± 2.02	79.74^{bc}± 2.26	84.80^c ± 2.51	78.38^{bc}± 2.08
$B.E_T$ (78.39± 0.39)	74.27^a ± .70	78.09^b ± .78	80.12^c ± .88	79.66^c ± .97	79.82^c ± .81

Table 5: Least squares means (±SE) for breeding efficiency (%) by season effects for Murrah buffaloes

Season	Spring	Summer	Rainy	Autumn	Winter
N (519)	71	54	121	97	176
$B.E_W$ (78.03±1.01)	74.31^a±2.47	77.56^{ab}±2.83	81.51^b±1.90	80.40^{ab}±2.13	77.27^a±0.61
$B.E_T$ (78.39± 0.39)	76.78^a±0.96	78.95^{ab}±1.10	80.11^{ab}±0.74	78.85^b±0.83	77.54^a±2.52

^{a,b,c}Within variable groups means followed by different subscripts differ significantly (P<0.05). * = P<0.05; ** =P<0.01, $B.E_W$ = Breeding efficiency by Wilcox method, $B.E_T$ = Breeding efficiency by tomar method

CONCLUSION

This study revealed that the values of breeding efficiency calculated on the basis of more no. of

calvings (4 to 6) were quite consistent by the two different methods and hence it may further be concluded that both methods were equally useful in the calculation of breeding efficiency in dairy animals. Thus, the reproductive management system should be maintained carefully in consideration with the month in which the most reproductive behaviors take place. In addition, the lower breeding efficiency in this study compared to expected level (100%) indicates the requirements for the better breeding management in the herd. Significant effect of period of calving indicating that some changes might have occurred in the climate and management of the herd over the years.

Since, temporary environmental factors play a major role on these reproductive traits, better breeding management like accurate detection of heat and managemental interventions could enhance the breeding efficiency.

ACKNOWLEDGEMENTS

This study was carried out with the support of GADVASU Ludhiana. The authors acknowledge the partial support and facilities provided by the other departments of institution also.

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