Selection of Young Dairy Bulls for Future Use in Artificial Insemination

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ABSTRACT : Relationships of breeding values of sires for first lactation milk yield with pedigree information or indices were examined to identify the optimal criteria of selecting young dairy bulls for future use in artificial insemination (AI). Records of performance data on 1087 crossbred daughters (Holstein-Friesian, Jersey and Brown Swiss with Hariana) of 147 sires, generated at Livestock Production Research (Cattle and Buffaloes) Farm, IVRI, Izatnagar, U.P., during 1972-1995 were used to obtain the estimates of sire's breeding values (EBV) using the Best Linear Unbiased Prediction Procedures. The correlations between young bull's EBV and the dam's first lactation milk yield was non-significantly different from zero. However, the young bull's EBV was negatively and significantly related ($r = -0.275$; $p < 0.05$) to the dam's best lactation milk yield, suggesting that the selection of young dairy bulls from high yielding elite dams is not a suitable criteria for genetic improvement. The correlations of sire's and paternal grandsire's EBV's with young bull's EBV were high and positive (0.532, 0.844; $p < 0.01$). The maternal grandsire's EBV was positively but non-significantly related to grandson's EBV. The pedigree index incorporating dam's milk records and sire's EBV's showed a negative and non-significant correlation with young bull's EBV. However, the correlation of a pedigree index (I_3) combining information on sire's and paternal grand-sire's EBV's with young bull's EBV's was considerably high and positive (0.797; $p < 0.01$). The regression coefficients of young bull's EBV on pedigree index I_3, was higher than those on other pedigree information. These results revealed that there was no advantage in basing selection on dam's performance or maternal grand-sire's EBV and that sire's and paternal grandsire's EBV's were reliable pedigree information for selection of young dairy bulls for future use in AI.

(**Key Words**: Cattle, Crossbreds, Young Bulls, Selection, Pedigree, Breeding Values)

INTRODUCTION

Selection of young dairy bulls of outstanding genetic merit is crucial for genetic improvement in AI breeding system. Selection of bulls entering into AI services accounts for approximately 74% of the annual genetic gain (Van Vleck, 1977). Pedigree evaluation is the most used method of selecting young dairy bulls for future use in AI.

Bulls are chosen first on a pedigree proof then used in limited AI service for a second proof on progeny test before being selected for extensive use. Many cattle breeders traditionally select the young dairy bulls for future use in AI on the basis of dam's milk production. In MOET nucleus breeding schemes, young bulls are selected on the basis of their dam's first lactation record or on an index using sib and dam's performance (Nicolas, 1979). The correlations of the breeding values of sons with the dam's milk yield were either low or negative (Vinson and Freeman, 1972; Dutt et al., 1996). There is a need to study the use of various relatives for evaluation of young dairy bulls in AI by pedigree.

The objective of the present study was to examine the relationships of the breeding values of sons for first lactation milk yield with various pedigree information or indices in order to identify the optimal criteria of selecting young dairy bulls for future use in AI.

MATERIALS AND METHODS

The data on 1087 crossbred cows of Holstein-Friesian, Jersey and Brown Swiss with Hariana maintained at Livestock Production Research (Cattle and Buffaloes) Farm, IVRI, Izatnagar, U. P., during 1972-1995 were analysed. These cows were progenies of 147 sires and sire progeny group size ranged between 3 and 64. Cows with abnormal and incomplete records due to sickness or

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abortions were excluded from the study. The data were distributed into seven genetic grades viz., 1/2 Friesian + 1/2 Hariana, 1/2 Brown Swiss + 1/2 Hariana, 1/2 Jersey + 1/2 Hariana, 1/2 Friesian + 1/4 Brown Swiss + 1/4 Hariana, 1/2 Friesian + 1/4 Jersey + 1/4 Hariana, 1/2 Brown Swiss + 1/4 Friesian + 1/4 Hariana and 1/2 Jersey + 1/4 Friesian + 1/4 Hariana. Data on the entire duration was divided into 5 periods, comprised of 5 years each, where differences would be sizable enough to be detected. The year was delineated into 5 seasons based on prevalent climatic conditions viz., winter (December, January), spring (February, March), summer (April, May), rainy (June - September) and autumn (October, November). The estimates of sire's EBV's for first lactation milk yield were computed by the Best Linear Unbiased Prediction (BLUP) procedures. The model for BLUP included the genetic grade and season and period of calving as fixed effects and sire/genetic grade as a random effect, with age at first calving as linear covariable.

Estimates of sire and residual variance components required for BLUP analysis were obtained from the same data sets using Henderson Method 3 (Henderson, 1953) by a model containing genetic grade and season and year of calving as fixed effects and sire/genetic grade as a random effect, with age at first calving as linear covariable using the least-squares and maximum likelihood computer programme of Harvey (1990).

The pedigree information chosen for selection of young dairy bulls for future use in AI were dam's first or the best lactation milk yield and sire's, paternal grandsire's and maternal grandsire's EBV's. The pedigree indices combining the information from different relatives were constructed by selection index techniques (Lin, 1978) to predict young bull's breeding values. The pedigree indices were constructed, for which the weights (b) were calculated using the basic principles of genetic and phenotypic co-variances among different relatives.

Let the D_f be the dam's first lactation yield, D_b the dam's best lactation milk yield, S the sire's EBV and F the paternal grandsire's EBV and the variance be denoted by V and covariance by Cov. The selection index (I) and aggregate genotype (H) were defined

$$I = X'b \quad \text{and} \quad H = g'a$$

where X'was a row vector of m known measured variables of relatives viz., D, S and F, g'was a row vector of p unknown genetic variables, a was a column vector of p known genetic variables, b was a column vector of m unknown index coefficients, V(X) = P, V(g) = C and Cov (X, g) = G. Then the V(I) = b'Pb, V(H) = a'Ca and Cov (I, H) = b'Ga. Maximizing the correlation between I and H gives index equations Pb = Ga with solutions $b = P^{-1}Ga$. The following pediegree index were constructed:

$$I_1 = b_1D_f + b_2S$$
$$I_2 = b_1D_b + b_2S$$
$$I_3 = b_1S + b_2F$$

Relationships of dam's milk yield and sire's, paternal grandsire's and maternal grandsire's EBV's and pedigree indices with young bull's EBV's were estimated in order to identify the optimal criteria of selecting young dairy bulls for future use in AI.

RESULTS AND DISCUSSION

Relationships of young bull's EBV's for milk yield with various pedigree information for selecting young dairy bulls in AI are presented in table 1. The correlation between young bull's EBV and the dam's first lactation milk yield was non-significantly different from zero. However, the young bull's EBV was negatively and significantly related to the dam's best lactation milk yield ($r = -0.275$; $p < 0.05$). This might be due to the fact that cow's own records are not reasonably accurate indicator of breeding values. The higher milk yield of dams may be because of either their genetic superiorty or better feeding, management and preferential treatments. This might results in negative and positive covariances of young bull's EBV's with dam's milk yield which turns out the correlations to be very small or negative. These results suggested that the selection of young dairy bulls based on dam's milk production for future use in AI is not a suitable criteria for genetic improvement in the herd. Low correlations (0.10 - 0.21) of dam's first, second and third lactation records with young bull's predicted difference (PD) were also obtained by Butcher (1973). Vinson and Freeman (1972) showed a correlation of 0.11 between dam's milk yield and young bull's PD. Low correlations between young bull's EBV's for first lactation traits and the dam's milk yield were observed in a study on the performance records of Murrah buffaloes (Dutt et al., 1996).

The correlations of sire's and paternal grandsire's EBV's with young bull's EBV were high and positive, the values being 0.532 ($p < 0.01$) and 0.844 ($p < 0.01$), respectively. The maternal grandsire's EBV was positively but non-significantly related to grandyoung bull's EBV, suggesting that the sire's and paternal grandsire's EBV's should be given more emphasis than the maternal grandsire's EBV's for selecting young bulls. These

Table 1. Relationships of young bull's breeding values for first lactation milk yield with pedigree information for selecting young dairy bulls for future use in AI

Pedigree information	Number of bulls in data subset	Correlation coefficient of young bull's EBV with pedigree information	Regression coefficient of young bull's EBV on pedigree information
Dam's 1st lactation milk yield (P_1)	53	0.012	0.003 (0.040)
Dam's best lactation milk yield (P_2)	53	−0.275	−0.048* (0.024)
Sire's EBV (P_3)	41	0.532**	0.660** (0.168)
Paternal grandsire's EBV (P_4)	16	0.844**	1.254** (0.213)
Maternal grandsire's EBV (P_5)	35	0.155	0.262 (0.290)
Pedigree indices: I_1: P_1, P_3	36	−0.130	−0.505 (0.660)
I_2: P_2, P_3	36	−0.287	−0.355 (0.203)
I_3: P_3, P_4	16	0.797**	8.380** (1.690)

Figures in parenthesis are standard errors of regression coefficients. * $p < 0.05$; ** $p < 0.01$.

findings were consistent with those of Butcher (1973) who observed higher correlations between young bull's and sire's PD (0.24 - 0.43) than those of young bull's and maternal grandsire's PD (0.12 - 0.24). Walton and Wagner (1970), discussing results from American Breeders Service Selection Programme, showed a consistently positive trend between young bull's and sire's PD for milk production over the total range of data while the maternal grandsire's PD positively but not consistently related to young bull's PD.

The pedigree indices incorporating dam's first or the best lactation milk yield and sire's EBV's had a negative but non-significant relationships with young bull's EBV. The negative and non-significant relationships were due to the facts that the correlations of dam's first or the best lactation milk yield with young bull's EBV were low or negative. The correlation of a pedigree index I_3, incorporating sire's and paternal grandsire's EBV's with young bull's EBV, was considerably high and positive (0.797; $p < 0.01$). These results, therefore, suggested that the information on the estimates of sire's and paternal grandsire's breeding values should be used for selecting young dairy bulls for future use in AI.

Regression coefficients of young bull's EBV on dam's milk yields were low. However, regressions of young bull's EBV on sire's and paternal grandsire's EBV's and pedigree index I_3, were positive and significant. Regressions were: young bull's EBV on sire's EBV, 0.66 ± 0.168; young bull's EBV on paternal grandsire's EBV, 1.254 ± 0.213 and young bull's EBV on index I_3, 8.380 ± 1.69. These findings were consistent with those of Chauhan et al. (1994) who observed the regression of young bull's EBV on dam's first lactation or the best lactation milk yield were low and non-significant but that on sire's EBV were considerably high and positive (0.734; $p < 0.01$). Vinson and Freeman (1972) observed the regression of young bull's proof on sire's proof and young bull's proof on dam's milk production as 0.4 ± 0.11 and 0.43 ± 0.26, respectively. Similar analysis of New York data showed the regressions of young bull's proof on sire's proof, young bull's proof on dam's milk production and young bull's proof on maternal grandsire's proof were 0.22 ± 0.13, 0.07 ± 0.04 and −0.09 ± 0.20, respectively while on Ontario data, the regression of young bull's proof on sire's proof was 0.34 ± 0.09 (Freeman, 1970).

In conclusion, according to data from the sample studied, selection of young dairy bulls for milk production from high yielding elite dams is not a suitable selection criteria for genetic improvement in the herd. The estimates of sire's and paternal grandsire's breeding values were reliable pedigree information for selecting young dairy bulls for future use in artificial insemination.

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