VARIATION IN FERTILITY IN BOS INDICUS CROSS BULLS

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SUMMARY

There were significant differences between bulls in the pregnancy rate of cows to which they were mated and these were partially repeatable from year to year. There were no significant effects on pregnancy rate of bull age and cow: bull ratio. Scrotal circumference increased with age but semen quality reached a plateau at 3 to 4 years of age. Semen quality but not scrotal circumference was correlated with pregnancy rate, and a bull's fertility was correlated with that of his female relatives.

INTRODUCTION

The low calving rate of Brahman cross herds is due in part to poor bull fertility (Seifert et al. 1980). Whilst variations in fertility between Bos indicus cross bulls are recognised (Seebeck 1973) there is limited information on the extent and causes of this variation, and on how bulls of low fertility may be identified. In this paper we investigate 2 measures of bull fertility - the pregnancy rate of cows to which the bull is mated, and the results of a clinical examination of the reproductive tract and semen - and report on the repeatability of individual differences, the effect of age and the ability of the clinical examination to predict pregnancy rates. We also report on the correlation between a bull's own fertility and that of his female relatives.

MATERIALS AND METHODS

The data on pregnancy rates were obtained from the records for 1965 to 1982 of the Droughtmaster herd maintained at the CSIRO 'Lansdown' Pasture Research Station situated 50 km south of Townsville. Mating is for 3 months from late January, calves are weaned at 5-7 months and pregnancy diagnosis is performed in June/July. Both multiple-sire and single-sire mating groups are used. The analysis used the data from 7425 cow-years of records.

Prior to the 1980 and 1981 matings the bulls were examined twice 6 weeks apart. Data recorded included details of any clinical abnormalities of the reproductive tract, scrotal circumference, and motility and percentage of abnormal cells in ejaculates. A breeding soundness score (BSS) based on the latter three measurements (Anon. 1978; Freer 1979) was determined at each examination.

The data on pregnancy rates were analysed by least squares methods in two stages. In the first stage, the data for single years were analysed separately and the model fitted included the effects of cow age and lactation status and bull. For each analysis the between-bull variance component was estimated. This is the variation between bulls at a single mating and includes the effects of short term fluctuations in a bull's fertility, and possibly variation between paddocks, since bull effects are necessarily confounded with paddock effects when using natural mating. The least-squares means for the bulls in single-sire mating groups from these year by year analyses formed the data for the second stage of the analysis. This data file contained records on 92 bulls with an average of two observations per bull. In the second stage, the model fitted

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included the effects of year, bull, bull age and cow:bull ratio. From this analysis the between-bull variance component which represents the variation between bulls in life-time fertility, was estimated. The fixed effects of year, bull age and cow:bull ratio were estimated by fitting a mixed model with bull as a random effect with an assumed repeatability of 0.28. From this model an estimate of the life-time fertility of each bull was calculated.

The data from physical examination of the bulls for the 1980 and 1981 matings was analysed by bull age. The correlations between examination results and pregnancy rate in the following mating were calculated. In addition, the correlations between the average of the two examinations and the bull's life-time fertility were determined. In another analysis of pregnancy rates in this herd (to be reported elsewhere), the breeding value of each bull for female fertility was estimated based on the pregnancy rates of his female relatives. This estimate was also included in the second set of correlations.

RESULTS

The year by year analyses of pregnancy data provided 18 estimates of the between-bull variance and the mean and standard error of these were 0.0179 ± 0.0047.

Over the 18 years the difference in pregnancy rate between multiple-sire and single-sire mating groups was only 0.01 ($P>0.05$). All further analyses were based on bulls used in single-sire groups only. Neither bull age nor cow:bull ratio had a significant effect (Table 1). The between-bull variation in life-time fertility was significant ($P>0.05$) and the variance component was 0.0066.

TABLE 1 Least-squares means for pregnancy rate

	Bull age (yr)				Cow:Bull ratio		
	2	3	4	>5	10-19	20-29	30-39
Mean	.64	.64	.63	.66	.64	.70	.67
(s.e.)	(.04)	(.03)	(.03)	(.03)	(.03)	(.03)	(.04)

The correlation between BSS scores for bulls examined twice before the 1980 or 1981 mating was 0.68 and in subsequent analyses only the average of these 2 scores was used. Age significantly affected scrotal circumference BSS, and body weight, weight and scrotal circumference increasing steadily with age (Table 2). In 1980, 2 year old bulls had a lower BSS than older bulls and this difference remained although reduced in 1981 when the bulls were all one year older. Although the 2 year old bulls grew during 1980, they were still considerably lighter in 1981 than the same age group the previous year. Scrotal circumference actually declined in all but the youngest bulls between 1980 and 1981, and when corrected for body weight was significantly less in 1981 than in 1980. The BSS showed little change between years except that the youngest age group was closer to the older bulls in 1981 than in 1980. The within age repeatabilities of the variables are given in Table 3. The within-age correlations between weight and scrotal circumference ($r=.14$) and BSS ($r=.03$) were non-significant.

The within-age correlations between variables derived from physical examination of the bulls and their observed fertility are given in Table 3. The BSS has some ability to predict bull fertility both in the following mating and over the bull's life-time, but the prediction is farfromperfect, while scrotal circumference has little value. Surprisingly a bull's own fertility was correlated with his breeding value for female fertility.

TABLE 2 Age and year effects on body weight (BW), scrotal circumference (SC) and Breeding Soudness Score (BSS)

Age (yr)	1980 n	BW (kg)	SC (cm)	BSS	1981 n	BW (kg)	SC (cm)	BSS
2	15	296	31.6	60				
3	5	516	36.2	74	14	403	31.9	66
4	6	578	36.1	77	3	591	33.5	76
5	5	607	39.7	63	5	601	34.0	78
6	8	620	40.8	78	1	618	37.5	60
7					6	649	38.3	78

TABLE 3: Correlations between physical examination criteria and fertility

	Repeatability	Pregnancy rate same year	Life-time pregnancy rate	Breeding value for female fertility
Scrotal circumference	.89** (27)	.15 (26)	-.10 (30)	-.25 (27)
BSS	.67** (28)	.36 (26)	.47* (30)	.26 (27)
Body weight	.78** (28)	.14 (26)	.16 (30)	.03 (27)
Life-time pregnancy rate				.33* (75)

* P<.05 ** P<.01 Number of observations in parentheses

DISCUSSION

Our estimates of the differences in pregnancy rate between multiple- and single-sire mating groups and the effects of bull age and cow:bull ratio are subject to some error. The data came from general herd records and so are not optimally designed to measure these effects, and may be subject to some bias due to confounding (e.g. with stocking rate) and due to culling (e.g. of young bulls that were not well grown). Nevertheless our finding that none of these factors signifiicantly influence pregnancy rate is consistent with the findings of Wiltbank et al. (1961), Rupp et al. (1977) and Neville et al. (1979). The results provide cautious support for the policies of using young bulls and moderately high cow:bull ratios in single-sire mating groups, both of which would help to increase the rate of genetic progress.

Scrotal circumference increases with weight as bulls mature but BSS seems to reach a plateau at 3 to 4 years of age. The plateau occurred at a later age in 1981 than 1980 probably because late 1980 was a very poor season and bulls 3 years old in 1981 were not as well grown as similar aged bulls in 1980. Severe dry season conditions in late 1980 appeared to affect scrotal circumference and hence testis size which is more sensitive to nutritional conditions than body weight (Ndama et al. 1983).

The variance components estimated here imply large variation between individual bulls in fertility. For life-time fertility the variance of 0.0066 is equivalent to a standard deviation of .08 or 8%. The variation between bulls in a single year is larger than this due to temporary effects on a bull's fertility (e.g. disease) and/or due to differences between paddocks.

Unfortunately it is difficult to accurately measure a bull's fertility when he is mated to only 20-30 cows. The correlation between a bull's pregnancy rate after a mating with 25 cows and his life-time fertility should be about 0.5. Thus culling bulls who achieve a very poor pregnancy rate is worthwhile but will not eliminate all bad bulls.

Ideally we would like to have a premating prediction of a bull's fertility. It was hoped that the breeding soundness examination would allow this. Our results are limited by the small amount of data available on single-sire mated bulls, and by the fact that no bulls with gross abnormalities were used. However, it seems that the BSS based on scrotal circumference and semen quality has some ability to predict fertility but the prediction is not completely accurate for individual bulls. Perhaps the prediction would be improved if a measure of sexual behaviour or libido was included. Scrotal circumference increased with age but fertility did not, and within an age group scrotal circumference and fertility were not significantly correlated. In contrast in another Bos indicus cross herd a significant correlation between scrotal circumference and fertility has been observed (Holroyd and Entwistle, unpublished data). Under conditions where mating pressure is low, as it is in most herds in northern Australia, Bos indicus cross bulls with a scrotal circumference as low as 30 cm may achieve a good pregnancy rate. Our results provide preliminary evidence that selection to improve male fertility could, as a side-effect, improve female fertility.

ACKNOWLEDGEMENTS

We wish to thank Mr. R. Dixon and the staff of 'Lansdown' for their help and co-operation.

REFERENCES

ANON (1978). Soc. Theriogenology Journal 7 (2nd ed).

FREER, R.E. (1979). Proc. Inaug. Conf. Aust. Assoc. Anim. Breed and Genet. Armidale, p.174.

NDAMA, P., ENTWISTLE, K.W. and LINDSAY, J.A. (1983). Theriogenology (in press).

NEVILLE, W.E., SMITH, J.B. and McCORMICK, W.C. (1979). J. Anim. Sci. 48: 1020.

RUPP, G.P., BALL, L., SHOOP, M.C. and CHENOWETH, P.J. (1977). J. Am. Vet. Med. Ass. 171: 639.

SEEBECK, R.M. (1973). J. agric. Sci., Camb. 81: 253.

SIEFERT, G.W., BEAN, K.G. and CHRISTENSEN, H.R. (1980). Proc. Aust. Soc. Anim. Prod. 13: 162.

WILTBANK, J.W., WARWICK, E.J., VERNON, E.H. and PRIODE, B.M. (1961). J. Anim. Sci. 20: 409.