REPRODUCTIVE PERFORMANCE OF TWO AND THREE WAY CROSSED COWS

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ABSTRACT

Reproductive performance of Bos indicus breeds is lower than that of Bos taurus breeds. This low Performance could be improved through crossbreeding and maintaining heterosis. Two and three ways crossbreeding (Boran, Friesian and Jersey) study was carried out at Holeta Research Center. Data on 150 primiparous and 287 multiparous cows were used to evaluate reproductive performances. There was no significant difference ($p>0.05$) in age at first calving and number of services per conception between two and three breed crosses in primiparous and multiparous cows. Age at first calving and services per conception significantly ($p<0.05$) varied between exotic blood levels in two breed crosses. Reproductive performances of three ways crosses were similar to two way crosses, indicating that there will be no loss in reproductive performances while using three ways crossing to maintain productivity heterosis achieved in the two ways crossings.

Key words: - crossbreed reproduction, two ways, three ways

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INTRODUCTION

Reproductive performance is one of the important aspects, which contribute to dairy cattle productivity. Female cattle with high fertility rate, short calving interval, and younger age at first calving are important for productive dairy herd. More than 90% of cows used for dairy purpose in Ethiopia are Zebu types, *Bos indicus* (C.S.A., 2009). However, reproductive performances of these cattle are low. They have longer age at first calving and calving intervals than *Bos taurus* cattle. Age at first calving, and calving interval for zebu cows were reported 44 and 26.6 months, respectively (Mukassa Mugerwa, 1989). On the average, zebu heifers reach puberty 6-12 months later than that of Bos *taurus* (Warnick, 1965; Wiltbank et al 1969). Zebu cows also have silent heat, which prolongs age at first calving and calving interval. Crossing these low performing Zebus with high performing exotic breeds was widely accepted idea in the tropics to improve their performance.

McDowell (1985) found that crosses of Zebu with European breeds calved earlier than local herd mates, gave more milk per lactation and had slightly shorter calving interval. Therefore, a long term crossbreeding study was initiated employing pure local Borans, exotic Friesians and Jerseys. From the initial two breeds crossing study productive and reproductive performance of 50% crosses was substantially improved. However, it was understood that the supply of 50% crosses for smallholder farmers for production purpose demands continuous process. Otherwise backcrossing these 50% cross heifers would result in a drop in dairy performance. Therefore, to maintain heterosis obtained in these heifers three ways crossing was proposed as an alternative solution. It has been also indicated that in three breed rotational crossing scheme heterosis coefficient stabilize fairly rapidly (Hohenboken, 1985). Information on reproductive

performance of three breed crossing is lacking in Ethiopia. The objective of this paper is to evaluate reproductive performance of three-breed-crosses relative to their contemporary two-breed crosses.

MATERIALS AND METHODS

Location

This study was conducted at Holeta Agricultural Research Center, which is located in the cool central highlands of Ethiopia with 2400m altitude above sea level. It has annual mean minimum and maximum temperature ranging from 18-24 ^{0}C and annual rainfall ranging from 800-1200 mm.

Animals

Crossbreeding activities were carried out during 1990-1997. Data from 150 primiparous and 287 multiparous cows at Holetta Research Center were used to evaluate age at first calving, calving intervals, days open and services per conception.

Mating plan

Mating plan was designed to produce two and three way crosses of different exotic blood levels for contemporary comparison as follows.

In the two way crossing (Fg.1) Boran local cattle were used as foundation dam breeds to be crosses with either Friesian or Jersey breed to produce first (F_1) generations (50% exotic, 50% local) Friesian cross Boran or Jersey cross Boran off-springs during first phase. During second phase, the first generation off-springs were mated to be upgraded to produce either 75% F 25%Bo or 75%J 25%Bo blood levels. The other groups were selfed to produce either F_2 Friesian cross Boran or F_2 Jersey cross Boran genotypes. During third phase, F_2 crosses were again selfed to produce either F_3 Friesian cross Boran or F_3 Jersey cross Boran third generations.

The high grades obtained during second phase (75%F 25% Bo and 75% J 25% Bo) were mated to either F_1 Friesian cross Borans or F_1 Jersey cross Borans to produce 62.5% F 37.5%Bo, or 62.5% J 37.5%Bo blood levels, respectively.

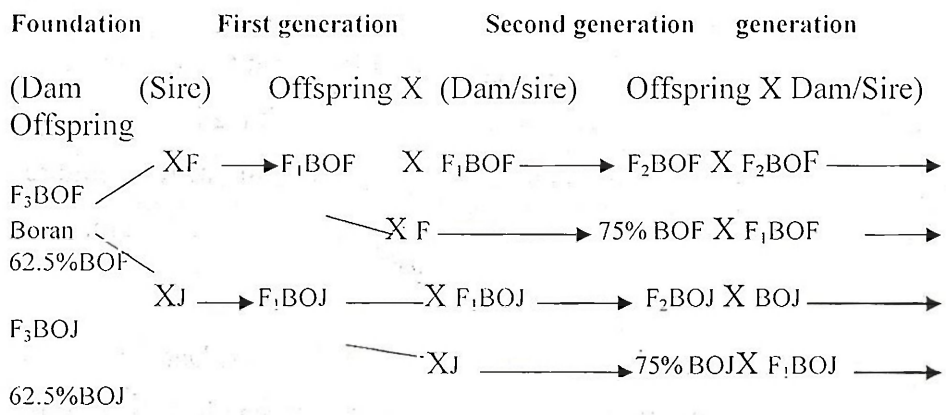

Fig.1. Breeding plan for two breeds crossing[†]

In the three ways crossing (Fig 2), local Boran cattle were used as foundation dam breeds, which were crossed either with pure Friesian or pure Jersey exotic cattle breeds using artificial insemination (AI). During first phase, F_1 generations of either Friesian cross Boran (50%J 50%Bo) or Jersey cross Boran (50%J, 50%Bo) were obtained. During second phase, the first generation (F_1) female crosses of Friesian cross Borans were mated to three groups of sires. They were F_1 Friesian cross Borans, Pure Friesians, and F_1 Jersey cross Boran sires to produce F_2 Friesian cross

[†] *BOF =Boran Friesian*
BOJ =Boran Jersey
BOF (62.5%) =Boran Friesian
BOJ (62.5%) =Boran Jersey
BOF (75%) =Boran Friesian
BOJ (75%) =Boran Jersey

Boran, 75%F 25%Boran and F_2 Friesian cross Boran Jersey (three breed) crosses, respectively. Similarly, during this second phase, the first generation (F_1) female crosses of Jersey cross Borans were mated to three groups of sires. They were F_1 Jersey cross Borans, Pure Jersey, and F_1 Friesian cross Boran bulls to produce F_2 Friesian cross Boran, 75% J 25% Bo and F_2 Jersey cross Boran Friesian (three breed) crosses, respectively. During third phase, F_2 Friesian cross Borans were selfed to produce F_3 Friesian cross Boran genotypes. The high grade Friesian cross Boran, (75%F 25% Bo), were crossed with F_1 Jersey cross Boran, (50%J 50%Bo), using natural mating, to produce three breed 62.5% Friesian cross Boran Jersey (31.25% F, 31.25% J, 37.5% Bo,). Similarly, during third phase, F_2 Jersey cross Borans were selfed to produce F_3 Jersey cross Boran genotypes. The high grade Jersey cross Borans (75%J 25% Bo), were crossed with F_1 Friesian cross Borans (50%Fan 50%Bo), using natural mating, to produce three breed 62.5% Jersey cross Boran Friesian (.31.25.5% J, 31.25% F, 37.5% Bo).

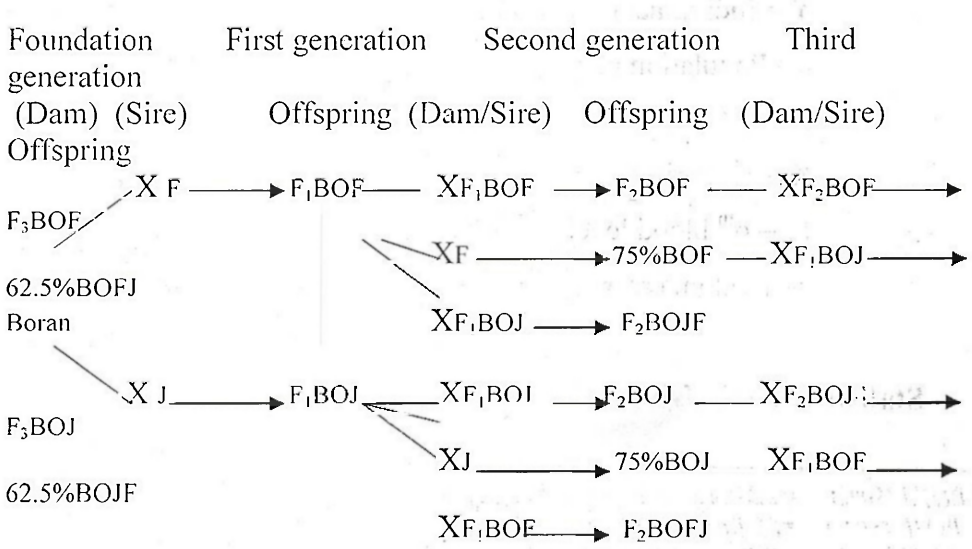

Fig 2. Breeding plan for three breeds crossing‡.

Traits

Age at first calving, number of services per conception, calving intervals and days open were important reproductive traits considered in this study.

Data grouping

Number of cows available from each cross and each exotic blood level were not equal as preplanned due to a number of factors. Data were grouped based on type of crosses (two ways versus three ways), parity, and exotic blood level. These groupings were included in the mathematical model as independent variables.

Mathematical model to compare two crosses (two and three way) using GLM procedure for Nested Design was used as follows:

Model $Yi = \mu + J_m + K_n (J_m) + L_o (J_m K_n) + e$

Where,

Yi= individual observation

μ= Population mean

$J_i = i^{th}$ cross

$K_n = n^{th}$ parity;

$L_o = o^{th}$ blood level

e= random error

Statistical analysis

‡ *BOFJ (50%)* =Boran Friesian Jersey
BOJF (50%) =Boran Jersey Friesian
BOJF (62.5%) = Boran Jersey Friesian
BOFJ (62.5%) = Boran Friesian Jersey

Data was analyzed using least square means of GLM procedure for Nested Design (SAS, 1999). Duncan's multiple range tests was used to separate means for test of significance.

RESULTS

Least square mean and standard error of age at first calving and number of services per conception for primiparous cows are presented in Table 1. There was no significant difference in age at first calving between crosses ($p>0.05$). However, age at first calving was slightly higher for two breed crosses than three breed crosses. Age at first calving was affected by exotic blood level ($p<0.05$). Friesian crosses with 62.5% Friesian and 37.5% Bo blood level had markedly longer age at first calving than 50%F 50%Bo, 62.5%J

37.5% Bo and 25%J 25%F 50% Bo crosses ($p<0.05$).

Table 1. Reproductive performances of primiparous cows

Variables	*Number*	*Age at First Calving (months)*	*Number of Services Per Conception*
Overall means	150	47.00	1.43
Types of crosses			
Two ways	61	47.78±1.12	1.46±0.12
Three ways	89	47.10±1.11	1.39±0.12
Blood levels within Two way crosses			
50%F 50%Bo*	25	46.65±1.90[b]	1.40±0.16
50%J* 50%Bo	34	45.72±1.63[b]	1.32±0.14
62.5%F* 37.5%Bo	20	52.73±2.12[a]	1.45±0.18
62.5%J 37.5%Bo	10	46.03+3.00b	1.40±0.25
Blood levels within Three way crosses			
25%F25%J 50%Bo	37	44.98±1.56	1.57±0.13[b]
37.5%F25%J 37.5%Bo	13	45.49±2.63	1.08±0.23[b]
37.5%J25%F 37.5%Bo	11	50.83±2.86	1.73±0.24[a]
R^2		0.08	0.04
CV		20.20	55.99

Means with different Superscripts within columns are significantly different (P<0.05)
* [F]=Friesian [J]=Jersey [Bo]=Boran

Number of services required for conception in primiparous cows didn't vary between crosses (p>0.05). However, two breed crosses required slightly higher number of services per conception than three breed crosses. There was pronounced difference in number of services required per conception due to exotic blood level (p<0.05). Cows with 37.5%F 25%J 37.5%Bo blood level required the highest number of services per conception than 25%J 37.5%F 37.5%Bo and 37.5%J 25%F 37.5%Bo (p<0.05). Number of services required per conception for 50%F 50%Bo, 50%J 50%Bo, 62.5%F 37.5%Bo and 62.5%J 37.5%Bo were intermediate

between the two extremes. Generally number of services per conception was declining as level

of Jersey exotic blood was increasing and level of Friesian blood was decreasing.

Least square mean and standard error of services per conception, calving interval, and days open for multiparous cows are presented in Table 2. Type of cross, didn't affect services per conception, calving interval and days open ($p>0.05$). However, two breed crosses had numerically higher services per conception, and longer calving interval and days open than three breed crosses. Parity had no marked effect on services per conception, calving interval and days open of two breed cows. However, two breed cows in third parity had numerically higher services per conception, longer calving interval and days open than cows in third and fourth parities. Days open was significantly longer during 2^{nd} parity in three breed cows ($p<0.05$).

Table 2. Reproductive performances of multiparous cows

Variables	*Number*	*Number of Services Per Conception*	*Calving Interval (days)*	*Days Open*
Overall mean	286	1.60	482.80	221.16
Types of crosses				
Two ways	179	1.67 ±0.09	497.07 ±14.40	236.67 ±14.12
Three ways	107	1.58 ±0.14	462.87 ±21.81	193.41 ±21.42
Parity within two ways crosses				
2nd	79	1.47 ±0.13	489.73 ±19.92	227.52± 19.57
3rd	59	1.77 ±0.15	516.90 ±22.93	247.40 ±22.52
4th	41	1.75 ±0.20	484.57 ±30.62	235.07 ±30.08
Parity within three ways crosses				
2nd	50	1.71 ±0.13	506.18 ±27.42	257.26
3rd	36	1.51 ±0.15	479.73± 35.17	±26.93[a]
4th	21	1.52 ±0.19	402.71 ±47.88	204.31 ±34.55[abc]
				118.67± 47.03[b]
R2		0.06	0.09	0.11
CV%		64.57	33.0	70.8

Means with different supersecripts within columns are significantly different (P<0.05)

Reproductive performances of exotic blood levels within crosses are presented in Table 3. In two breed crosses, services per conception, calving interval and days open were markedly affected by blood level ($p<0.05$). Friesian crosses with 62.5% 37.5%Bo ,50%F 50%Bo and Jersey cross with 50%J50%Bo had similar number of services per conception, which was higher than 50%J50%Bo crosses ($P<0.05$). Crosses of 62.5%J37.5%Bo and 50%J 50%Bo had shortest calving interval and days open ($p<0.05$). But 50%F 50%Bo cows had relatively medium calving intervals. Generally,

calving interval had a decreasing trend as blood level of Jersey cattle was increasing and Friesian blood was decreasing (Fig 3.).

Table 3. Reproductive performances of multiparous cows within crosses

Variables	*Number*	*Number of Services Per Conception*	*Calving Interval (days)*	*Days Open*
Overall means	286	1.60	482.80	221.16
Blood levels within two way crosses				
50%F 50%Bo	44	1.95 ±0.15^{ab}	514.86	248.70±
50%J 50%Bo	78	1.38 ±0.12^{c}	±24.04^{abc}	23.89^{abc}
62.5%F 37.5%Bo	37	1.54 ±0.17^{abc}	458.17	197.27±
62.5%J 37.5%Bo	20	1.60 ±0.23^{abc}	±18.05^{c}	17.94^{c}
			544.70	295.65
			±26.21^{ab}	±26.05^{ab}
			471.88 ±35.65	199.0
			^{ab}	0±35.43^{c}
Blood levels within two way crosses				
25%F25%J 50%Boran	74	1.64 ±0.12	460.51± 18.41	199.43 ±18.30
37.5%F25%J 37.5%Bo	15	1.40 ±0.26	463.93 ±41.17	191.73± 40.92
37.5%J25%F 37.5%Bo	18	1.83± 0.24	504.67 ±37.58	244.00 ±37.35
R^2		0.04	0.04	0.05
CV%		63.84	33.03	71.65

Means with different Superscripts within columns are significantly different ($P<0.05$) [F] [F]=Friesian [J]=Jersey [Bo]=Boran

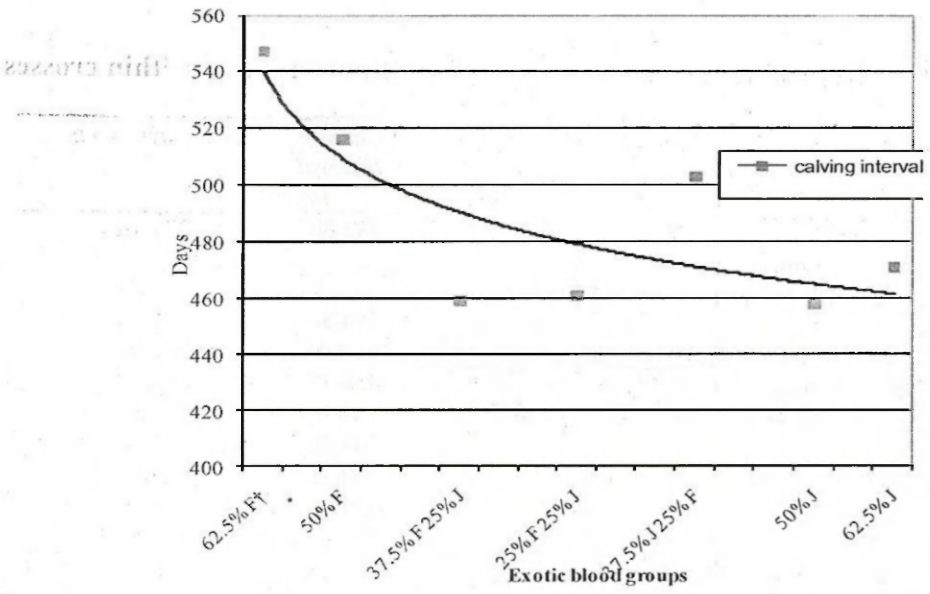

Fig 3. Calving interval of different exotic blood groups

In three breed crosses services per conception, calving interval and days open from calving to conception was not affected by blood level ($p>0.05$). However, 37.5%J 25%F 37.5%Bo three breed crosses had numerically higher services per conception, longer calving interval and days open than their counterparts.

Discussion

The difference in age at first calving between two and three breed crosses is only 20 days. However, both crosses had higher age at first calving than earlier reports. Boran cross Friesian (50%) was reported 890±20.4 (Goshu, 1987) and 975 days (Moges and Baars, 1998) which was much lower than our report. This could be due to nutritional factors as suggested by Eduveic and Dawada (1986), or failure in estrus management. Age at first calving for 62.5% Friesian was exceptionally the longest, which might be due to

low reproductive management. On the other hand, age at first calving has also been reported to vary due to blood level (Chhikara et al, 1979). Ideal age at first calving was reported to be 24 months (Moges and Baars, 1998). Number of services required to conceive was only slightly higher for two breed crosses than three breed crosses. It was also higher for multiparous cows than primiparous cows. Similarly, Sharma and Bhatangar (1978) found a significant effect of parity on number of services per conception in Sahiwal, Red Sindhi and Tharparkar cattle. The number of services per conception was highest at the fourth lactation for F_1 crosses with Brown Swiss (Busch and Furstenburg, 1984). Inseminators, as suggested by Busch and Furstenburg (1984), also influenced number of services per conception. All cows in our report had lower than two services per conception irrespective of type of cross, parity, exotic blood level and calving season which is considered good as reported earlier (Mukassa-Mugerwa, 1989).

Calving interval was found to differ due to exotic blood level. Crosses with blood level of 62.5%F and 37.5%Bo had the longest calving interval; while crosses of 50% F 50%Bo blood level had the shortest. Calving interval was slightly longer for two-way crosses and for cows with 2^{nd} parity than for three way crosses and cows with advanced parities, respectively. However, all calving intervals in this report were found longer than reported (Azage, 1981, Goshu, 1983: Moges and Baars, 1998; Syrstad, 1996). Borsotti et al. (1976) observed that genotype had a significant effect on the calving interval of Brahman cows in Venezuela.

The slight differences in days open between two and three breed crosses might be due to genetic difference. Days open for F_1 Friesian cows was found higher than earlier reports (Goshu, 1987; Tesfu, 1990). This variation may be attributed to nutrition (Wiltbank et al, 1962), season, milk yield and parity (Buck et al, 1975). The days open period should not

exceed 80-85 days if a calving interval of 12 months is to be achieved (Peters, 1984). However, all day's open periods were higher than this recommendation.

Conclusion

Reproductive performances of three ways crosses were similar to two ways crosses. This indicates that there will be no loss in reproductive performances when striving to maintain heteroses, achieved in productivity in the two ways crossing, through employing three ways crossing.

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