MEDWELL PUBLISHING
Research Journal of Animal Sciences 3 (1): 6-9, 2009
ISSN: 1993-5269

Evaluation of Age at First Calving and Number of Services per Conception Traits on Milk Yield Potentials of Holstein Friesian x Bunaji Crossbred Cows

[1]E.M. Ngodigha, [2]E. Etokeren and [2]O. Mgbere
[1]Department of Fisheries/Livestock Production Technology, University of Niger Delta, Wilberforce Island, P.M.B. 071, Yenagoa, Bayelsa State, Nigeria
[2]Department of Animal Science, Rivers State University of Science and Technology, P.M.B. 5080, Port Harcourt, Rivers State, Nigeria

Abstract: The objective of the study, was to determine the optimum Holstein Friesian (HF) inheritance for a shorter Age at First Calving (AFC) and Number of Services per Conception (NSC) on milk yield potentials of HF x Bunaji (BJ) crossbred cows. Data of HF and BJ dairy cows with 75, 87.5 and 100% HF inheritance kept at the West African Milk Company (WAMCO) farm in Vom, Plateau State, Nigeria, between 1998 and 2004 were used for the study. The independent variables considered included genotype, birth year, birth season and service season, while AFC and NSC were the dependent variables. The data were analyzed with the General Linear Model (GLM) and where differences were observed, the least square mean obtained for the effects were compared using the Probability of Difference (PDIFF) procedure of Statistical Analysis System (SAS). Results showed that calf birth year significantly ($p<0.05$) influenced AFC and NSC, while genotype was significantly ($p<0.05$) expressed in NSC only. With good management, the 87.5% HF crossbreed cows exhibited superior genetic potential (AFC and NSC). Breeding of the crossbreeds can be done in early wet season, when NSC is low and fertility is high.

Key words: Age at first calving, bunaji, holstein friesian, number of services per conception

INTRODUCTION

The increasing demand for milk and dairy products in Nigeria occasioned by increasing population and improved standard of living may worsen if the bulk of milk production is still based on the use of multi-purpose indigenous cows with genetically low reproductive potentials. This is because milk production depends largely on reproductive efficiency with the best cows being those that calf at an early age, with little number of services per conception and with minimum calving intervals thereafter (Ibeawuchi, 1988).

To improve the reproductive efficiency of the indigenous cow, the best option is to combine the hardiness of *Bos indicus* with the genetically high reproductive and milk yield potentials of the *Bos taurus* through crossbreeding (Cunningham and Syrstad, 1987). The resulting heterosis in the crossbreeds is exhibited through superior reproductive performance and high milk yield. To utilize this genetical advantage, many decades ago, Nigeria imported several Holstein Friesian (HF) bulls for crossbreeding with the local dairy breeds, especially Bunaji (BJ) cows. This effort resulted in considerable reproductive improvement on Age at First Calving (AFC) and Number of Services per Conception (NSC) (Knudsen and Sohael, 1970; Mbap and Ngere, 1988). Since, then there has been increasing interest in the use of pure Friesian or their imported frozen semen to upgrade the indigenous dairy cows. However, knowledge of the effects of upgrading indigenous dairy cows, using various proportions of HF inheritance is still not fully known. This study was therefore, carried out to evaluate the optimum HF inheritance for a shorter AFC and NSC on milk yield potentials of crossbreeds with 75, 87.5 and 100% HF inheritance.

MATERIALS AND METHODS

Study area: The research was carried out using data from West African Milk Company (WAMCO) farm, a privately owned integrated commercial dairy enterprise producing a wide variety of dairy products. The first set of animals used in the farm were imported from Holland in 1988 and comprised 76 pregnant pure bred HF cows and a few

Corresponding Author: E.M. Ngodigha, Department of Fisheries/Livestock Production Technology, Niger Delta University, Wilberforce Island, P.M.B. 071, Yenagoa, Bayelsa State, Nigeria

bulls, while the BJ heifers were sourced locally. The farm is located at about 1280 m above sea level and lies between longitude 08°45'E and latitude 09°43'N. It occupies 500 ha of land in the Guinea Savannah belt of Nigeria. The total rainfall recorded in the farm during the period of this study (1998-2004), ranged from 1010.75-1479.77 mm with a mean annual rainfall of 12350.88 mm. Based on the pattern of rainfall distribution, two major seasons (wet and dry) were identified and each of these seasons was sub-divided into early and late season. The wet season ranged from late March to early September with the peak period being between July and August and the dry season ranged from late September to early March. Maximum temperature during the period of study was 20.7°C and relative humidity taken at 10:00 am synoptic hours was 50.45%. The vegetative cover was a mixed-planted pasture sown with *Chloris guayana*.

Animal management/breeding programme: Calves were allowed to suckle their dams for 4 days after which they were separated and bucket-fed with whole milk in the morning and evening at the rate of 10% of their body weight. At 4 weeks, calf ration containing 23.9% crude protein, hay and maize silage was fed *ad libitum.* They were weaned at 10 weeks after a live weight of between 70 and 75 kg. The heifers were fed with young-stock stable concentrate containing maize silage and whey.

Heifers were bred after they attained a body weight of 375 kg through Artificial Insemination (AI) using frozen semen of HF bulls. Natural mating was however, used after any 3 consecutive unsuccessful inseminations. Estrous was monitored in the mornings and evenings and animals showing signs of heat were mated within 12 h. Pregnancy was first checked at 30 days and confirmed 60 days after breeding.

Data collection, preparation and statistical analysis: Data used in this study were extracted from records kept for heifers bred in WAMCO farm from 1998-2004. Calving interval for pregnant cows whose pregnancy was confirmed was estimated at 280 days. The data were initially coded and entered into a computer file using dBase V programme. It was later crosschecked for completeness and conformity manually and later by cross tabulation. Data with incomplete information were deleted thus, leaving a total record of 84 for AFC and 63 for NSC. The independent variables considered in the study included genotype, birth year, birth season and service season, while the dependent variables were AFC and NSC. The final analysis of the data was carried out using the General Linear Model (GLM) procedure of SAS (1999).

Where, differences were observed, the least square mean obtained for the effects was compared using the Probability of Difference (PDIFF) procedure of SAS (1999).

The final statistical model used for the analysis is stated:

$$Y_{ijklm} = \mu + B_i + S_j + C_k + G_l + E_{ijklm}$$

where:

Y_{ikl}	=	Single observation on AFC and NSC
μ	=	Overall mean
B_i	=	Effects due to ith birth year (i = 1998-2004)
S_j	=	Effects due to jth birth season
C_k	=	Effects due to kth service season
G_l	=	Effects due to 1th genotype (l = 1…3)
E_{ijklm}	=	random error associated with the measurement, which is assumed to be normally, identically and independently distributed with a zero mean and common error variance i.e., iind (0. $ó^2$e).

RESULTS AND DISCUSSION

The overall least square mean of 30.7±2.5 months obtained for AFC in this study (Table 1) is about 8 months lower than those reported in different grades of *Bos taurus* x *Bos indicus* crossbred (Negussie *et al*., 1999) and within the range of 36.59 and 28.7 months reported for imported Friesian and their purebred offspring in Nigeria (Mbap and Ngere, 1989). However, Ibeawuchi (1987) in his study of the production characteristics of F_1 Friesian x Bunaji heifers, observed a younger AFC of 1.6 months than those obtained in this study.

The mean squares from least square analysis of variance presented in Table 2 showed that of all the factors tested, only birth year had a highly significant ($p<0.001$) effect on AFC. This is in agreement with the findings of Rajan and Dave (1981), Galina and Arthur (1989) and Negussie *et al.* (1999). A yearly linear increase in AFC from 30.8±1.33-38.2±1.77 in the first 3 years later decreased significantly to 25.7±1.60 months (Table 1). The increase corresponded with the period of reorganization in the farm occasioned by poor management. This later led to a complete change of ownership of the farm in 2004. Poor management, especially feeding, could have a very devastating effect on the reproductive life of cows. For instance, poor nutrition could significantly delay puberty and consequently AFC in both Zebu and Taurine breeds (Oyedipe *et al*., 1982; Bedrak *et al*., 1969; Short and Bellows, 1971). It also, stops ovarian activities in cows that were already cycling (Bond *et al*., 1958; Tarqui *et al*., 1982). The reorganization must have brought about the

Table 1: Least Square Mean (LSM) and Standard Error (SE) of effects of genetic and non genetic factors on Age at First Calving (AFC) and Number of Services per Conception (NSC)

	AFC (months)		NSC	
Effects	N	LSM±SE	N	LSM±SE
Overall mean	84	30.7±2.5	63	2.0±1.0
Birth year				
1998	4	30.8 ± 1.33^b	-	
1999	17	31.0 ± 0.66^b	-	3.6 ± 0.50^a
2002	5	38.2 ± 1.77^a	5	2.1 ± 0.16^b
2003	55	30.2 ± 0.38^b	55	1.7 ± 0.69^c
2004	3	25.7 ± 1.60^c	3	
Birth season				
Early dry (Sept-Nov)	28	30.2±0.65	17	2.0±0.38
Late dry (Dec-Feb)	16	31.6±0.68	13	2.9±0.35
Early wet (Mar-May)	15	31.0±0.80	9	2.7±0.44
Late wet (June-Aug)	25	31.9±0.73	24	2.2±0.38
Genotype				
75% HF x 25% BJ	27	31.5±0.64	13	3.0 ± 0.41^a
87.5% HF x 12.5% BJ	19	30.0±0.75	16	2.1 ± 0.37^b
100% HF	38	31.2±0.58	34	2.3 ± 0.30^b
Season of service				
Early dry (Sept.-Nov)			7	2.96±1.2
Late dry (Dec.-Feb)			13	2.36±0.31
Early wet (Mar.-May)			26	2.16±0.39
Late wet (June-Aug)			17	2.46±0.39

^{a,b,c}Means in the same column for a given factor with different superscripts are significantly different (p<0.05); HF = Holstein Friesian; BJ = Bunaji; N = Number of records with complete information

Table 2: Mean squares from least square analysis of variance for Age at First Calving (AFC) and Number of Services per Conception (NSC) of Holstein Friesian x Bunaji cows

Source of variation	Df	AFC (months)	f-value	Df	NSC	f-value
Birth year	4	76.83	12.54***	2	4.92	4.47**
Birth season	3	10.99	1.79^{ns}	3	2.20	1.96^{ns}
Genotype	2	2.33	0.38^{ns}	2	3.31	3.01*
Error	74	6.13		55	1.10	
Total	83			62		

* = p<0.05; ** = p<0.01; *** = p<0.001; ns = not significant (p>0.05)

significant reduction in AFC from 38.2±1.77 in 2002 to 25.7±1.60 in 2004. This shows that AFC and subsequent productivity of cows could be improved through good farm management as demonstrated by Meaker *et al.* (1980) who reported that despite low conception rate, cows calving at a young age of 2 years produced 0.6 more calves over their production life time than those calving at the age of 3. Although, genotype did not significantly influence AFC (Table 1) and the numerical differences observed indicated that heifers with 75% HF and 100% HF inheritance calved at 1.5 and 1.2 months later than those with 87.5% HF blood, respectively. This is contrary to the findings of Petersen (1995) and Negussie *et al.* (1999), who reported that heifers with higher levels of HF inheritance above 50% had higher AFC. Negussie *et al.* (1999) attributed this to a decrease in heterosis and hence, lack of adaptability and genetic effect for faster growth rates at an early age, which is maximized in the F_1 while, half is expected to disappear in the F_2 and future generations.

In the genetic and non-genetic factors tested by least square analysis of variance (Table 2), only birth year significantly influenced AFC and NSC. This is in agreement with earlier reports of Negussie *et al.* (1998). Although, in their study, genotype did not have any significant effect.

The overall mean (2.0±1.0) of NSC (Table 1), was similar to the findings of Alberro (1983) in his study of the comparative performance of F_1 Friesian x Zebu heifers and that of Negussie *et al.* (1998) in their report on the reproductive performance of indigenous cows versus their F_1 crosses. The significant decrease in NSC with increasing years ranging from 3.6±0.5 in 1999 to 1.7±0.69 in 2003 (Table 1) corresponded with the period of poor herd management, which led to a reorganization in the farm and subsequent change in the ownership in 2004. The reduced NSC observed in 2003 was an improvement in the fertility of the up coming heifers after the reorganization, which resulted in improved herd management, breeding practices and efficient artificial insemination procedures.

Genotype was observed to have a significant effect on NSC thus, contradicting earlier findings of Negussie *et al.* (1998). Among the breed groups studied, cows with 75% HF inheritance required a significantly (p<0.05) higher NSC, while those with 87.5 and 100% HF were not statistically different. However, the numerical differences observed in cows with 87.5% HF was 0.2 times fewer services required per conception than in heifers with 100% HF. This implies that in the event of having few bulls in the farm it would be advisable to keep cows having higher than 75% HF inheritance. This finding contradicts the report of Cunningham and Syrstad (1987) and Petersen (1995), who observed a linear decline in all reproductive traits in *Bos taurus* x *Bos indicus* crossbreeds upgraded beyond 50% *Bos taurus* genes.

Seasons and annual climate fluctuation in the length of dry season, wet season and total rainfall are found to influence the number of services per conception (Azage *et al.*, 1981; Rajan and Dave, 1981). Although, season of service did not significantly influence NSC in this study, however, heifers served in early wet season tended to be more fertile, requiring 0.8, 0.2 and 0.3 fewer NSC than those served in early dry, late dry and late wet seasons, respectively. This high fertility during early wet season may be attributed to improved feed quality availability.

CONCLUSION

The results of this study demonstrated that with good management the 87.5% HF inheritance of the

Holstein Friesian x Bunaji crossbred cows, exhibited superior genetic potentials of early calving and less number of services per conception. Breeding of the crossbreeds can be done in early wet season when NSC is low and fertility is high.

ACKNOWLEDGEMENT

The authors are very grateful to the management of West African Milk Company (WAMCO) Vom, Plateau State, Nigeria for providing the data and allowing free access to their facilities.

REFERENCES

Alberro, M., 1983. Comparative performance of F_1 Friesian x Zebu heifers in Ethiopia. Anim. Prod., 37: 247-252. http://scholar.google.com/scholar?hl=en&rlz=IT4SPDA_en_NG2968q=author:%22Alberro.

Azage, T., E.S.E. Gala and B. Kebebe, 1981. A study on the reproduction of local Zebu and F_1 crossbred (European x Zebu) cows. 1: Number of services per conception, gestation length and days open till conception. Ethiopian J. Agric. Sci., 3: 1-14. www.ibc.et.org/ibc/pubn/files/CR.Main.

Bedrak, E., A.C. Warwick, J.F. Hentges and T.J. Cunha, 1969. Effects of protein intake on gains, reproduction and blood constituents of beef heifers. Agric. Exptal. Statn. Univ. Florida Bull., 678: 63-71.

Bond, J., J.N. Wiltbank and A.C. Cook, 1958. Cessation of oestrus and ovarian activity in a group of beef heifers on extremely low level energy and protein. J. Anim. Sci., 17: 1207-1211.

Cunningham, E.P. and O. Syrstad, 1987. Crossbreeding *Bos indicus* and *Bos taurus* for milk production in the tropics. Food and Agricultural Organization (FAO). Anim. Prod. Health Paper, 68: 90. ISBN: 92-5-102629-7. www.fao.org/docrep/009/t0095e/T0095E00.htm.

Galina, C.S. and G.H. Arthur, 1989. Review of cattle production in the tropics. Part 1: Puberty and age at first calving. Anim. Breed. Abstr., 57: 583-590. www.blackwell-synergy.com/doi/abs/10.111/j.1751-0813.1994.tb00961.x.

Ibeawuchi, J.A., 1987. Production characteristics of F_1 Friesian x Bunaji cattle in Vom. Nig. J. Anim. Prod., 14: 51-59.

Ibeawuchi, J.A., 1988. Persistence of milk production in F_1 Friesian x White Fulani cattle in a tropical environmental. Bull. Anim. Health Prod. Afr., 36: 215-219.

Knudsen, P.N. and A.S. Sohael, 1970. The Vom herd: A study of the performance of a mixed Friesian/Zebu herd in a tropical environment. Trop. Agric. (Trinidad), 47: 189-203.

Mbap, S.T. and O. Ngere, 1989. Productivity of Friesian cattle in a sub-tropical environment. Trop. Agric. (Trinidad), 66 (2): 121-124.

Mbap, S.T. and O. Ngere, 1990. A note on the crossbreeding of Zebu cattle in Vom. Anim. Prod., 50 (1): 191-194.

Meaker, H.J., T.P.N. Coetsee and A.W. Lishman, 1980. The effects of age at first calving on the productive and reproductive performance of beef cows. South Afr. J. Anim. Sci., 10: 105-111. www.sasas.co.za.

Negussie, E., E. Brannang, K. Banjaw and O.J. Rottmann, 1998. Reproductive performance of dairy cattle at Arsella livestock farm, Arsi, Ethiopia 1: Indigenous cows versus their F_1 crosses. J. Anim. Breed. Genet., 115: 267-280.

Negussie, E., E. Brannang and O.J. Rottmann, 1999. Reproductive performance and herd life of dairy cattle at Arsella livestock farm, Arsi, Ethiopia II: Crossbreds with 50, 75 and 87.5% European inheritance. J. Anim. Breed. Genet., 116: 229-234. DOI: 10.1046/j1439-0388.1999.00191.x. www.3.interscience.wiley.com/journal/119078581/abstract.

Oyedipe, E.O., D.I.K. Oson, O. Akerejola and D. Saror, 1982. Effects of level of nutrition on onset of puberty and conception rates of zebu heifers. The Triogenology, 18: 525-539.

Petersen, P.H., 1995. Genetic improvement: Combined improvement of production and adapted traits in dairy cattle in the tropics. Workshop on Agric. biodiversity and sustainability in developing countries. Tune Landboskole, Denmark.

Rajan, M.R. and H.K.B. Dave, 1981. Effects of genetic and non-genetic factors on reproductive traits in halfbreds. Ind. J. Anim. Sci., 51: 1124-1127.

SAS, 1999. Statistical Analysis Software. SAS/STAT Users Guide, Version 8. 6th Edn. SAS Inc. Cary, N.Y.

Short, R.E. and R.A. Bellows, 1971. Relationships among weight gains, age at puberty and reproductive performance in heifers. J. Anim. Sci., 32: 127-131. www.jstor.org/stable/3897678.

Tarqui, M.D., D. Chupin, D. Gautheri, N. Perez, J. Pelot and P. Mauleon, 1982. Influence of Management and Nutrition on Post Partum Endocrine Function and Ovarian Activity in Cows. In: Karg H. and E. Schallendberger (Eds.). Factors influencing fertility in the postpartum cow. Martinus Nijhoff. The Hague, Netherlands, pp: 384-408.