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Effect of Breeding Groups and Environment on Conception Rate in Pabna and its Crossbred Cows of Bangladesh

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Abstracts: This experiment was conducted with 21,153 cows and heifers of 3 (three) genetic groups viz. Pabna (PB), Pabna x Sahiwal (PBx SL) and Pabna x Friesian (PBx FN) inseminated with frozen semen of Sahiwal (SL), Friesian (FN) and Sahiwal x Friesian (SLx FN) bulls to investigate the effects of breeding groups and environmental factors on conception rate (CR). Among the factors considered, it was reflected that parity of dam ($p < 0.05$), time of insemination ($P < 0.01$), season of insemination ($p < 0.05$) and all interactions ($p < 0.05$) had significant effects on CR. The highest CR were found for cows in 0 parity (heifer) (52.11%) or cows inseminated in spring season (51.30%) or inseminated between 8 to 14 hours after onset of estrus (53.24%). The highest CR were also observed in the interaction effects of PBx FN dams x SL sires (52.75%) or SL sires x spring season (52.17%) or PBx FN dams x winter season (52.21%) or cows inseminated within 8 to 14 hours after the onset of estrus x spring season (54.55%) – indicating that combination of inseminating dams in right time of estrus using appropriate sire in appropriate season would contribute greatly to improve the status of CR in PB and its crossbred with SL and FN cows of Bangladesh.

Key words: Breeding groups, parity, season and time of insemination, interaction effects

Introduction

The main goal in a commercial cow-calf operation is to optimize pounds of calf produced per cow as economically as possible. It is well established that maintaining a satisfactory fertility level is the fundamental aspect for successful operation of any cattle-breeding program. Conception rate is a key factor influencing the productivity of cows. If fertilization, conception and initiation of pregnancy do not result from the minimum number of services, it constitutes an economic loss to the farmer reducing total productive life. Artificial insemination is being used as an economic tool for the rapid exploitation of superior germplasm. It does not only transfer the semen to the female reproductive tract but also exerts some beneficial effects such as genetic gain, cost effectiveness, eradication or reduction of transmittable reproductive diseases and improvement in the fertility by increasing conception rate (Peters, 1985; Garcia, 1988).

Conception rate is directly associated with the production attribute and responsible for monitoring lifetime productivity of an individual animal. Conception is the first pre-requisite of an animal for entering into the productive life. Fusion of sperm and ovum to form a zygote is a very complex and sensitive phenomenon (Salisabury *et al.,* 1978), without which the maintenance of reproductive life is meaningless. Conception rate determines directly to the total profitability of farm enterprises. In Bangladesh, around the year a large number of animals remain barren or unproductive having exposed many times for natural mating or artificial insemination and become a burden for the farmers. Heat detection is a constraint to the reproduction of indigenous cows. Thus, to hold the maximum profitability of the cow owners of Bangladesh interventions are needed to increase the conception rate to optimum level.

Many genetic and non-genetic factors like genotype of bull and cow, age and parity of cow, season of insemination etc. have direct contribution for increasing conception rate (Fengxum 1997). Therefore, through this study responsible factors for influencing conception rate will be identified and adapting appropriate approaches, which minimize necessary measures against the prevailing constraints. Considering the above facts and circumstances, the present study was carried out to see the effects of breeding groups and environment on conception rate of cattle in a dairy pocket of Bangladesh.

Materials and Methods

This experiment was conducted at Baghabarighat milk shed area under Bangladesh milk producers' cooperative union limited (Milk vita), a large dairy pocket of Bangladesh, located at Sirajganj district. Genetic improvement program of cows in this area through Artificial Insemination (AI) was initiated by Milk vita in 1987. Cows under the study area belonged to Pabna cattle loosely regarded as Pabna type (PB), Pabna x Sahiwal (PBx SL) and Pabna x Friesian (PBx FN). A total of 21,153 cows and heifers of 0 to 5th parities of the above 3 (three) genetic groups were inseminated with frozen semen of 3 (three) different genetic groups of bulls viz. Sahiwal (SL), Friesian (FN) and Sahiwal x Friesian (SLx FN). The whole activities considered in this study covers the period from February 1991 to June 1996. AI were done by trained field-assistants in 32 sub-centers within the Milk vita area and inseminated cows were verified for their conception after 60-90 days post service. Only a few cows might die or sale, which were ignored while calculating the data in this study. The feeding and management of the cows kept by the farmers were almost similar. Factors influencing conception rate (CR) studied were genetic groups of sires and dams, parity of dams and season and time of insemination. The interaction effects of genetic groups of sires x genetic groups of dams, season of insemination x genetic groups of sires, season of insemination x genetic groups of dams and season of insemination x time of insemination were also considered in the analysis. To determine the influence of season on CR, the experimental period was divided into monsoon (*July-September*), winter (October-December), spring (January-March) and summer (April-June).

Collected data were analyzed by least-squares procedure using SAS (1996) computer package program. The all effects were considered in this study as fixed effects except for error effects. The statistical model was:

$$Y_{ijklmno} = \mu + S_i + D_j + P_k + T_l + A_m + W_n + (S\times D)_{ij} + (S\times W)_{in} + (D\times W)_{jn} + (W \times T)_{ln} + e_{ijklmno}$$

Where,

$Y_{ijklmno}$	=	individual observation
μ	=	mean
S_i	=	effects of sires' genetic groups (i = 1-3)
D_j	=	effects of dams' genetic groups (j = 1-3)
P_k	=	effect of dams' parity (k = 0-5)
T_l	=	effects of time of insemination (l = 1-3)
A_m	=	effects of year (m = 1991-1996)
W_n	=	effects of season of insemination (n = 1-4)
$(S\times D)_{ij}$	=	interaction effects between sire' and dams' genetic groups
$(S\times W)_{in}$	=	interaction effects between sires' genetic groups and season of insemination
$(D\times W)_{jn}$	=	interaction effects between dams' genetic group and season of insemination
$(W\times T)_{nl}$	=	interaction effects between season and time of insemination
$e_{ijklmno}$	=	error

For the comparison of sub-class means Duncan's Multiple Range Test (DMRT) was performed.

Results and Discussion

Effects of genetic groups of sires: The least-squares means and their standard errors for CR in cows mated with different genetic groups of sires are presented in Table 1. From this table it has been observed that the highest CR (51.82%) was found in dams mated with SLx FN sires and lowest (48.01%) in dams mated with SL sires, irrespective of dams' genetic groups. But there was no significant difference in CR using different genetic groups of sires. The effects of sires genetic groups on dam fertility found in this study are comparable to the reports of Irramain and Owasoyo (1980), Bujarbaruah *et al.* (1982), Raju and Rao (1982) and Djimede and Weniger (1984). They reported that genotype of bulls do not have significant effect on the CR in cows. However Finland Central Association of AI Societies (1978) found small difference in conception rate of cows for various bulls genotype. They reported that 60 days non–return rate to first insemination were 66.8% for Ayrshire, 73.4% for Finish, 70.7% for Friesian, 69.2% for Charolias, 67.4% for Herefords and 62.8% for Aberdeen Angus. This was higher than the present study, which may be due to inappropriate approach or lack of knowledge of right time of heat detection by the farmers.

Effects of genetic groups of dams: Effects of genetic groups of dams on CR are also shown in Table 1. The highest CR (51.03%) was observed for PBx FN dams and lowest (48.31%) for PBx SL dam, irrespective of sires' genetic group although there was no significant difference in CR among genetic groups of dams. The effects of cows' genetic groups on CR found in this study are comparable to the studies reported by the authors in home and abroad. Gwazdauskas *et al.* (1975) found no significant difference in terms of CR for different genotypes of dam. They reported that the CR to be 33.80% for Ayshire, 34.60 % for Brown Swiss, 37.05% for Guernsey, 35.50% for Holstein–Friesian and 48.40% for Jersey. In practices, it is difficult to find including environmental and management conditions those might have much more influence on fertility. In Bangladesh, Ghosh (1995) recorded no significant difference in first service CR for different genotypes of cows (50, 43.75, 50, 43.75 and 43.75% for HFx L, SLx L, HFx L, Jx L and SLx L cows, respectively). Alam (1991) also in Bangladesh observed almost similar CR for different genotypes. Thus, insignificant difference in cow fertility among genotypic means in the present study indicated equal fitness of all the genotypes in terms of cow fertility.

Effects of parity of dams: The effects of parity of dams on first service CR can be seen from Table 2. The highest CR (52.11%) was observed in 0 parity (heifer) and gradually decline up to 4th (40.12%) and 5th parity (37.83%). The CR in 4 thand 5 thparity differed significantly ($p< 0.05$)) with rest of the parities. The findings of the present study are in agreement with the findings of Biochard and Manfredi (1994), Bhagat and Gokhale (1999) and Fengxum (1997). Biochard and Manfredi (1994) classified cows from 1st to 7th parity and found that the CR of cows were highest at 1st parity (54%) and the lowest to the 7th parity (38%). Bhagat and Gokhale (1999) also reported that CR increased from the 1st parity to the 4th parity and decreased thereafter. Fengxum (1997) observed highest CR in 1st, 2nd and 3rd parities that in later parities. They, however, meant cows of 1st parity as those of 0 parity of the present study.

Effects of season of insemination: The significant ($p< 0.05$) seasonal effects on CR were observed in cows in the present study (Table 2). These results are in agreement with the reports of Shamsuddin (1988); Dutta *et al.* (1980); Martinez *et al.* (1985) and Vargus *et al.* (1981). They reported that season of insemination had significant effect on CR of cows. In the present experiment, the highest CR (51.30%) was found in cows inseminated in spring and lowest (46.16%) in summer season. The seasonal variations in CR of cattle are not only due to effect of seasons alone on cows but may be other factors including influence of sire (Tomar *et al.*, 1985; Saxena and Tripathi, 1986 and Kim *et al.*, 1983). Seasonal variation in CR could be due to possible changes in nutrition ((Salisabury *et al.*, 1978), environmental temperature (Vrablikova 1975 and Badinga *et al.*, 1985), climate (Gwazdauskas *et al.*, 1975) and photoperiod (Kordts and Gravent 1972). High temperature and relative humidity (Zakari *et al.*, 1981) and poor management (Voh *et al.*, 1984) affect the fertility in cattle. It may be concluded that spring is the best season for conception of cows having suitable ambient temperature and humidity in Bangladesh with satisfactory level of availability of nutrition or necessary feeding of animals.

Effects of time of insemination: The effects of time of insemination during estrus on CR are also presented in Table 2. Time of insemination had highly significant ($p< 0.01$) effects on CR. The significantly highest CR (53.24%) was found when insemination was done between 8-14 hours of estrus and lowest CR (28.44%) was found when insemination was done at later than 21 hours. No significant differences were observed between first two periods but both of them differed significantly ($p< 0.01$) than the third one. The effects of time of insemination on CR found in this study are comparable to the studies reported in other literatures. Dutta *et al.* (1982), Bach (1983) and Balachandran *et al.* (1983) found significantly better CR when inseminating cows in the middle or late estrus. Das *et al.* (1990) reported that insemination of indigenous cows of Bangladesh at the mid-cycle had significantly ($p< 0.01$) higher CR (69.69%) as compared to early and late cycles. They observed significant ($p< 0.01$) variation in CR inseminating in early, middle and late estrus as 58.82%, 69.69% and 33.70%, respectively. Thus, the effects of time of insemination on CR as observed in the present study have got almost similar effects with the above findings.

Interaction effects of genetic groups of sires × *genetic groups of dams:* The interaction effects between genetic groups of sires and dams are presented in Table 3. Semen of different genetic groups of sires used in different genetic groups of dams had significant effects ($p< 0.05$) on CR, probably due to high variation existing among different interactions of sires' and dams' genetic groups. The highest CR (52.75%) was obtained when PBx FN dams were mated with SL sires, while PB dams performed lowest (44.39%) when mated with FN sires.

Table 1: Effects of genetic groups of sires and dams on conception rate

Parameters	Number of observations	Least-squares means	Standard errors	Level of significance
Sires' genetic groups				
FN	5824	49.58	0.89	
SL	9317	48.01	1.15	NS
SLx FN	6012	51.82	1.19	
Dams' genetic groups				
PB	4978	50.03	1.75	
PBx FN	6303	51.03	1.90	NS
PBx SL	9872	48.31	2.73	

PB = Pabna; SL = Sahiwal; FN = Friesian NS = Non-significant

Table 2: Effects of parity of dams and season and time of insemination on conception rate

Parameters	Number of observations	Least-squares means	Standard errors	Level of significance
Dam's parity				
0	6124	52.11^{a}	1.56	
1	5953	51.78^{a}	1.96	
2	3167	50.12^{a}	2.01	*
3	2877	49.67^{a}	2.13	
4	1705	40.12^{b}	3.15	
5	1327	37.83^{b}	2.74	
Season of Insemination				
Monsoon	3022	48.12^{ab}	1.81	
Winter	6113	49.78^{ab}	1.95	*
Spring	8392	51.30^{a}	2.72	
Summer	3626	46.16^{b}	1.98	
Time of insemination				
8-14 hours	9297	53.24^{a}	1.81	
15-20 hours	9644	50.78^{a}	1.95	**
> 21 hours	2212	28.44^{b}	2.72	

* and ** means p< 0.05 and p< 0.01, respectively.

Table 3: Interaction effects between genetic groups of sires and genetic groups of dams on conception rate

Interactions	Dams' genetic groups		
	PB	PB x FN	PB x SL
Sires' genetic groups			
FN	44.39^{b} ± 2.18 (1123)	50.48^{a} ± 3.24 (2187)	49.96^{ab} ± 3.22 (2514)
SL	49.14^{ab} ± 2.80 (1748)	52.75^{a} ± 3.10 (2949)	50.12^{a} ± 3.13 (4620)
FN x SL	45.84^{b} ± 2.67 (2107)	48.12^{ab} ± 3.17 (1167)	49.67^{ab} ± 3.28 (2738)

PB = Pabna; SL = Sahiwal; FN = Friesian Means with different superscript(s) differ significantly (P< 0.05)
Figures in the parenthesis indicate the number of observations.

Table 4: Interaction effects between genetic groups of sires and season of insemination on conception rate

Interactions	Season of insemination			
	Monsoon	Winter	Spring	Summer
Sires' genetic groups				
FN	45.20^{b} ± 2.19(1164)	50.72^{a} ± 2.18 (1503)	49.48^{ab} ± 3.11(1760)	44.13^{b} ± 2.34 (1397)
SL	49.13^{ab} ± 3.09 (1862)	50.32^{a} ± 2.33 (2404)	52.17^{a} ± 3.28 (2816)	52.01^{a} ± 3.41 (2235)
FNx SL	47.46^{ab} ± 2.89 (1202)	48.97^{ab} ± 3.10 (1552)	49.80^{ab} ± 3.05 (1816)	49.19^{ab} ± 2.59 (1442)

PB = Pabna; SL = Sahiwal; FN = Friesian Means with different superscript(s) differ significantly (P< 0.05)
Figures in the parenthesis indicate the number of observations.

Table 5: Interaction effects between genetic groups of dams and season of insemination on conception rate

Interactions	Season of insemination			
	Monsoon	Winter	Spring	Summer
Dams' genetic groups				
PB	49.18^{ab} ± 3.18(1215)	48.14^{ab} ± 2.79(1252)	50.92^{a} ± 3.17(1337)	49.44^{ab} ± 3.57(1174)
PBx FN	49.39^{ab} ± 4.11(1070)	52.21^{a} ± 3.12(1695)	51.33^{a} ± 2.46(2012)	45.28^{b} ± 2.38(1526)
PBx SL	44.72^{b} ± 2.72(2143)	48.52^{ab} ± 2.76(2512)	52.40^{a} ± 2.66(2843)	50.92^{a} ± 2.13(2374)

PB = Pabna; SL = Sahiwal; FN = Friesian Means with different superscript(s) differ significantly (P< 0.05)
Figures in the parenthesis indicate the number of observations.

Table 6: Interaction effects between season and time of insemination on conception rate

Interactions		Season of insemination			
		Monsoon	Winter	Spring	Summer
Time of insemination	8-14 hours	51.66^{a} ± 3.18(1920)	53.42^{a} ± 2.18(2517)	54.55^{a} ± 2.18(2728)	52.77^{a} ± 2.18(2132)
	15-20 hours	48.51^{a} ± 2.89(1728)	52.39^{a} ± 2.17(2325)	52.49^{a} ± 2.18(3217)	48.54^{a} ± 2.15(2374)
	> 21 hours	27.53^{b} ± 4.68(580)	29.49^{b} ± 3.28(649)	29.81^{b} ± 3.45(447)	27.01^{b} ± 2.99(536)

PB = Pabna; SL = Sahiwal; FN = Friesian Means with different superscript(s) differ significantly (P< 0.05)
Figures in the parenthesis indicate the number of observations.

Interaction effects of genetic groups of sires × season of insemination: The interaction effects of sires' genetic groups x season of insemination on CR are shown in Table 4. The interaction between genetic groups of sires and season of insemination had significant (p< 0.05%) effects on CR. The spring was the best season for CR (52.17%) in cows when mated with SL sires and the lowest CR (44.13%) in cows was found in summer season when mated with FN sires. Concomitant comparisons of such interaction effects are not found in literature to compare the facts of this study.

Interaction effects of genetic groups of dams × season of insemination: The interaction effects between genetic groups of dams and season of insemination are presented in Table 5. The CR in the present study significantly (p< 0.05) affected by the interaction between genetic groups of dams and season of insemination. The PBx FN dams were performed best (52.21%) in winter season and PB x SL dams showed the lowest (44.72%) in CR in monsoon season, may be due to high seasonal variation exists within different genetic groups of dams.

Interaction effects of time of insemination × season of insemination: The interaction between time of insemination and season of insemination had significant effects on CR (Table 6). The highest (54.55%) and lowest (27.01%) CR were observed in 8-14 hours x spring season and > 21 hours x summer season, respectively. In all the seasons, the highest CR was observed when cows are inseminated between 8-14 hours and it was lowest when the insemination period was higher than 21 hours of onset of estrus.

The results of the present study clearly showed that among the contributing factors, time of insemination is the most important area where much more emphasis and attention should be paid to hold satisfactory level of CR. The given results also highlighted that to fix the appropriate time of insemination, it is very important to detect right time of estrus very carefully. Thus, with the combination of inseminating cows in right time of estrus using appropriate sire in appropriate season would contribute greatly for improving the status of CR to an optimum level in Bangladesh.

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