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PERFORMANCES OF TROPICAL HOLSTEIN FRIESIAN (*Bos taurus)* X *THRABAM* (*Bos indicus*) F_1 DAUGHTERS MANAGED UNDER BHUTANESE FARMING ENVIRONMENT

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ABSTRACT

Local *Thrabam* cattle were inseminated with semen of four sire-lines of Tropical Holstein Friesian (THF) at selected sites of three agro-ecological zones of Bhutan. To understand their performances, progeny born from each sire-line were recorded and milk yield of F_1 daughters were measured. Management practices were observed through farm visits. Result indicated that insemination in natural heat produced significantly higher calves than in induced heat ($p<0.005$). Average daily milk yield of F_1 daughters was 5.2±2.5 l/day. Some farmers mated F_1 daughters at about one year of age, before animal reached the desired body weight. This disturbed growth of dam and few such dams faced calving difficulties. Cattle were managed through open grazing during the day (81%) and sheltered at night. Only 25% of farms provided supplementary feed to milking animals/calves. Minimal calf mortality (2.93%) with no reported adult mortality indicated the crossbreds adapt well to the local environment. The present study concluded that for more calf-crops, insemination in natural heat should be advocated and mating of F_1 daughter at tender age needs to be discouraged. Under prevailing management system, F_1 daughters were performing optimally. However, with the increase in THF inheritance level, cattle management needs to be improved to maximize output.

Keywords: F_1 daughters; Milk yield; Tropical Holstein Friesian; *Thrabam* cattle

INTRODUCTION

Dairy development in Bhutan started during first Five Year Plan (FYP) in 1960s with the introduction of Jersey breeding bulls for upgradation of local *Thrabam* cattle population (Siri breed, *Bos indicus*) and pursed over successive FYPs. In 1974, Brown Swiss (BS) cattle were introduced to Bhutan for crossbreeding with local

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cattle in temperate areas. However, demand of BS dwindled over the years and need for alternate dairy breed was felt necessary. Accordingly, in 2014, Royal Government of Bhutan approved procurement of Holstein Friesian (HF) cattle into the country as alternate dairy breed. Since then farmers have been procuring HF cows/heifers from India to improve their herds. The HF cattle population as of now is small (1009 heads), localized in pockets of 17 out of 20 districts of the country (MoAF, 2020).

To fast-track HF gene introgression into local *Thrabam* cattle population, frozen semen (four sire-lines) of Tropical Holstein Friesian (THF, *Bos taurus*) was acquired from Thailand. Artificial insemination (AI) of *Thrabam* cows with THF semen was initiated in late 2017 with the objectives to compare potency of four different THF sire-lines based on number of progeny born at test sites, measure milk yield of first filial (F_1) daughters (THFx*Thrabam,* 50:50) to derive reliable estimates of its milking potential and understand reproductive performance, management system and adaptability of F_1 daughters under Bhutanese farming environment.

MATERIALS AND METHOD

Site/locations of the study area

Three different Agro-Ecological Zones (AEZ) namely Barsong *Gewog* (sub-district) at 1200-1800 *masl*, Sergethang *Gewog* at 600-1500 *masl* of Tsirang district and Tading *Gewog* at 150-600 *masl* of Samtse district were identified as study sites/location (Table 1).

Table 1. Selected study sites in different AEZs

Sl No	Dzongkhags	Gewogs	AEZs	Altitude (*masl*)	Rainfall (mm)	*Thrabam* population	HF population
1	Tsirang	Barsong	Dry Sub-tropical	1200-1800	850-1200	635	0
2	Tsirang	Sergithang	Humid Sub tropical	600-1500	1200-2500	683	0
3	Samtse	Tading	Wet Sub-tropical	150-600	2500-5500	2521	0

Data source: Livestock Statistics, 2017; National Biodiversity Strategies and Action Plan, Bhutan, 2014

Insemination of Thrabam cows/heifers

Breedable *Thrabam* cows/heifers were selected and inseminated in induced heat as well as in natural heat with almost equal number of inseminations done from all four sire-lines (*pound, push, puzzle and poplar*) in each study location/site. The animals inseminated with THF semen were ear tagged, identified with unique identification number.

Data collection

Records of insemination and corresponding progeny born from four different sire-lines at each study sites were maintained from November 2017 to March 2023. All F_1 daughters that have calved and in milk production stage in each location (Barsong, Sergithang and Tading) were traced in close consultation with concerned Livestock Extension staffs. The individual animals in lactation were visited farm to farm to measure the morning and evening milk yields (one time). Milk yield was accurately measured using graduated measuring cylinder (Figure 1). However, for the cows which were in late stage of lactation and/or cows dried off, farmer's recall method was applied to derive best estimate of milk yield. Feeding and management practices of the F_1 daughters were observed, discussed with the owners and noted.

Figure 1. Milk yield measurement at study sites

Data analysis

- The variables: progeny born in induced and natural heat were analyzed using two sample t-tests (Minitab Version-18); total progeny born from four different THF sire-lines were analyzed using one way ANOVA and Tukey's HSD; and milk yield of THF x *Thrabam* F_1 daughters at different study sites were averaged.
- Qualitative data acquired through informal discussion with individual cattle owners were sorted and converted to percentage.

RESULTS AND DISCUSSIONS

Progeny born through THF semen inseminations in natural and induced heat

The success rates of AI in induced heat and natural heat were 18.09% and 37.10%, respectively, the latter being more effective (Table 2). Two sample t-test revealed that mean progeny born (success rate) from insemination in natural heat was significantly higher than inseminations of breedable female in induced heat (p<0.001).

Table 2. Success rate/progeny born from induced and natural heat

Study sites (location)	AI in induced heat/progenies born				AI success rate (%)	AI in natural heat/progenies born				AI success rate (%)
	Total AI	♀	♂	Progenyborn		Total AI	♀	♂	Progeny born	
Barshong	138	12		31	22.5	200	58	36	94	47
Sergithang	93	7	10	17	18.3	120	38	20	58	48.3
Tading	200	19	11	30	15	142	22	19	41	28.9
Overall	431	38	40	78	18.09	462	118	75	193	37.1

The results indicated that insemination in natural heat was better than in induced heat. Therefore, preferences may be given to inseminate cows/heifers on natural heat, observing heat signs for right time of insemination. Tamang et al. (2020) supported the view that owing to poor health/body condition of animals in village farms of Bhutan, AI in induced estrous/heat using hormonal drugs does not necessarily result in conception even when animals are inseminated by skilled technician. Rather selection of healthy animals with optimum body condition score and right season for estrous induction is suggested for better results.

Potency/progeny born from different THF sire-lines

A total of 271 progenies were born out of 893 inseminations done, giving overall AI success rate of 30.3% (Table 3). Among the progenies born, 57.5% were female. Progeny born were lower for *Puzzle* and *Push* than *Pound* and *Popular* sire-lines but result was not statistically significant (p=0.503). Nevertheless, Tukey's pair-wise comparison revealed that puzzle sire-line had significantly lower mean progenies born, proportionate to quality of semen assessed through post-thaw motility (PTM) test upon arrival of the consignment in 2017. The PTM of semen for *Puzzle, Push, Pound* and *Popular* was 30%, 35%, 45% and 55%, respectively (NDRDC, 2017). Among three study sites, Barsong had a significantly higher mean progeny born than other sites (p<0.037), probably due to proficiency and dedication of AI Technician.

Table 3. Progeny and AI success rate by THF sire-lines in three study sites

THF sire-lines	Total AI	Progeny (♀)	Progeny (♂)	Progeny total (♀+♂)	AI Success rate (%)
Push	232	39	22	61	26.29
Puzzle	258	40	23	63	24.4
Pound	216	44	31	75	34.7
Popular	187	33	39	72	38.5
Total	893	156	115	271	30.3

Milk Yield of F_1 daughters (THF x Thrabam 50:50)

Average daily milk yield of THF x *Thrabam* F_1 daughters was 5.2±2.5 l/day and estimated first lactation milk yield was 1576 litres (**Table 4**). Highest peak milk yield in the study area was 11.5l/day whereas lowest was 1.5l/day. First lactation milk yield of F_1 daughters of *Puzzle*, *Push* and *Pound* sire-lines was reported to be 5482kg, 4520kg and 5520kg, respectively in Thailand (DPO, 2016) which was higher than present finding. Better yield in Thailand could be due to higher THF inheritance or better animal management than in Bhutan. This yield in Bhutan was acceptable owing to management system with calf suckling and the animal was provided with little or no supplementary feeding. Moreover, 50% inheritance from *Thrabam*, a draught purpose cattle breed of Bhutan with average daily milk yield of 1.52±0.13l/day (Tamang and Perkins, 2014) could have affected the yield of these crossbreds. Nevertheless, milking potential F_1 daughter was comparable with F_1 Jersey x *Thrabam* crosses in Bhutan with an average yield of 4.9±1.33l/day (Rai et al., 2020).

Table 4. Milk Yield of THF x Thrabam, F_1 daughters in three study sites

Study sites	Average Daily Milk Yield (l)					
	n	Morning (l)	Evening (l)	Total l/day	±SD	Lactation yield (l) (305 days)
Sergithang	4	3.2	2.0	5.3	2.2	1601
Barsong	6	2.8	2.4	5.2	4.4	1571
Tading	6	3.5	1.9	5.1	0.8	1556
Average		3.2	2.1	5.2	2.5	1576

Note: 305 days standard lactation yield is estimated; l means litre/day

Study on Friesian x Zebu cross cattle population showed that crossbreds with an intermediate grade 50% Holstein x 50% Zebu *(Bos indicus)* produced a lactation yield of 1637±35 kg in 246±5 days in Venezuela (Vaccaro et al., 1999) which was similar to findings of the present study. Present finding however was lower than 11.01±0.399 kg (3358 kg, lactation milk yield) for Friesian x Kanana F_1 crosses in Sudan (Ahmed, 1992); mean first lactation milk yield of 5541±1202 kg obtained for first lactation Turkish Holstein (Teke and Murat, 2013) and mean lactation milk yield of 4075±109kg for Holstein fraction of <0.625 in central Thailand (Koonawootrittriron, et al., 2006). Cows giving higher milk yield in other countries could be due to better breed mixture or management that could have favoured expression of genetic ability.

Reproductive performances of F_1 daughters

Average age at first service obtained through recall method was 28.2±9.6 months and age at first calving was 37.2±9.8 months (n=16). However, well-managed F_1 daughter was reported to show estrous/heat signs as early as 10 months of age and some farmers (18.75%) mated them as early as 13 months that calved at about 22 months. While other animals in poor health, and under low level of nutrition, first mating was possible at the age of 42.7 months. The early mating practice (before the animal reached two-third of adult body weight) under current low input production system at the village farms,, had affected the growth of the dam, faced calving difficulties (dystocia) that resulted in death of calves (two incidences) apart from low milk yield obtained from such cows. Friesian crossbred cattle (Friesian 50% x Sanga 50%) at Ghana, the mean age at first calving was 41.2 ± 1.2 months (Obese et al., 2013) longer than the present finding which was suggested to be due to poor plane of nutrition. Average age at first calving in the Thai multi-breed dairy population with Holstein bloodline was 30.3 ± 5.3 month (Koonawootrittriron et al., 2006). Similarly, age at first calving for Turkish Holsteins in the Mediterranean Region in Turkey was 29.81 months (Teke and Murat, 2013). Hence, it could be deduced that age at first calving for F_1 daughters (THF x *Thrabam)* under Bhutanese farming environment is satisfactory as it falls between the findings of other countries.

Management of F_1 daughters (THF x Thrabam)

The cattle in the study sites were mostly open grazed during the day (81%) and tethered in a shelter near the house during the night mostly in semi-permanent sheds, while others (19%) practiced tethering in crop land or managed through stall feeding. However, unlike more conventional management system where herder/farmers followed traditional patterns of cattle migration within and beyond the district boundary (Gyeltshen and Bhattarai, 2003), such practice was uncommon in the study areas.

Green grasses including locally available forages, improved Napier grass, tree fodder and agricultural by-products were commonly fed of the crossbreds. Milking animals and calves were also provided with gruel (cooked rice or maize bran, mixed with chopped banana stem or grasses). Feeding concentrate feed to milking animals and calves were practised only by about 25% of the farmers of the study areas. In similar studies, Tamang and Perkins (2005) reported that feeding of concentrate feed was rare in the village farms in Bhutan and most farmers (61%) fed cooked porridge mixing salt with locally available grains, rice bran and brew residues to milking cows and calves.

Adaptability of THF crosses to Bhutanese farming environment

Most of THF x Thrabam F_1 crosses (cows, heifers, young bulls and calves) were in good health with average body condition score of 2.8 (*n*=46) (in the scale of 1 to 5). Mortality of calves including accidental dealth was reported to be low at 2.95%

(*n*=271),while adult mortality was not reported indicating that crossbreds were adapted to prevailing farming environment. Calf mortality in the current study was considerably lower than 24% reported by Tamang and Perkins (2005) under free grazing management system in humid sub-tropical region of western Bhutan.

CONCLUSION

The study concluded that AI in natural heat obtained higher AI success rate/progeny birth than AI in induced heat; hence AI in induced heat is preferable for Bhutanese farming system. F_1 daughters produced more milk/day than purebred *Thrabam* cows. This encouraged farmers to own such crossbred cattle. Early mating of F_1 heifers before reaching desired body weight resulted in stunted growth of dam, faced calving difficulties (dystocia) and compromised daily milk yield. Such practice is inappropriate for Bhutanese farming system and needs to be discouraged. Overall, F_1 crosses of THF x *Thrabam* had low mortality rate hinting that these crossbreds adapted well to Bhutanese farming environment.

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