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Investigation of fitness traits of Red Chittagong Cattle of Bangladesh

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ABSTRACT

The study was carried out to investigate the fitness traits of Red Chittagong Cattle (RCC), indigenous cattle of Bangladesh. For that purpose accumulated data on a total of 362 animals from two different herds (Bangladesh Agricultural University -BAU) Nucleus Herd and Char Jailkhana Community Herd in Mymensingh district). The varying production systems that affected the performance of the individuals were looked at. The main factor considered for analysis of the traits was herd. Data were analyzed by General Linear Model (GLM) procedure of SPSS 11.5 version program to find out the least squares means and least significant difference for thefactor in every trait. The mean survival ability was 88.92. Survival ability was divided into different stages like birth to 3 months, birth to 6 months, birth to weaning, birth to maturity. Survival ability of RCC at BAU nucleus herd were 96.98±0.010, 98.96±0.007, 91±0.011and96.8±0.001 respectively. Whereas survival ability of RCC at Community herd were99.4±0.010, 96.91±0.009, 84.88±0.012 and 97.44±0.013 respectively.There were no differences between the herds. The least squares means of age at puberty (AP) and age at first calving (AFC) were 37.0±2.16 and 49.67±2.1 months, respectively. There were differences in case of age at puberty between herds. The least squares means of reproductive traits were 469.57±20.91 days, 55.30±7.55%, 287.11±4.55 days, 60.35±5.96%, 1.65±0.13 and 195.29±19.47 days respectively for calving interval (CI), first service conception rate (FSCR), gestation length (GL), non-return rate to first service (NRRFS), number of services per conception (NSC), postpartum estrous period (PPEP).There were significant differences in calving interval, gestation length and post-partum estrous period between the herds. According to the previous and present study CI, FSCR, GL, NRRFS, NSC, and PPEP traits are always changed in different production system.

INTRODUCTION

Red Chittagong Cattle (RCC) is one of the promising variety of cattle genetic resource of Bangladesh found in everywhere in the Chittagong region (Chittagong coastal plain zone) (Hossain et. al., 2006) having distinct identity with attractive red color in the different parts of the body like coat, muzzle, eyeball, eyebrow, eye lashes, tail switch, hoof, horn, vulva with delicious milk and meat compared to other indigenous make them top preferred in that region (Bhuiyan, 2007). It is small headed and comparatively small body sized (mature females 150-200 kg and males 300-350 kg) but physical condition is very strong and stout (Habib et al., 2003; Hossain et al., 2006; Khan et al., 1999). Their power of draught and spirit of endurance were appreciable. The bullocks of this breed are active, useful for light ploughing and carting and are remarkable for their speed and stamina.

The positive attributes of above mentioned Indigenous cattle of the country can be summarized as: (a) small size and hence lower metabolic heat production and lower feed requirement, (b) more resistant to prevailing local diseases and parasites, (c) adaptable to a wide range of environmental condition, (d) thrive very well in fluctuating nutrient supply condition (draught, flood and natural calamities), (e) marginal calf mortality (less than 5-6%), (f) possess a lot of more unique characteristics e.g. 8-10 calves in life time, (g) high phenotypic variation, (h) regular breeder and (i) can utilize low quality roughages. In contrast, the major threats to indigenous cattle are: (a) scarcity of pure high yielding indigenous breeding bull, (b) indiscriminate national crossbreeding program, (c) lack of well-planned initiative for sustainable conservation and development program for indigenous cattle and (d) farmers preference on

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crossbred to meet immediate need (Bhuiyan and Sultana 1994). Therefore, use and development of Red Chittagong cattle genetic resources of Bangladesh in its native form can be seen as a solution to increase production.

Present status of a livestock breed in terms of population size and the breed characteristics (both in phenotypic and genetic) is essential to formulate the conservation and improvement strategies for the breed. Several methods for the conservation of animal genetic diversity have been developed. Cryogenic storage is a conservation method free from human interference which might bring about genetic change. Though storage of frozen semen and embryos has been known and used for years, the most important and practical method of conserving genetic diversity now and in near future is to manage genetic variability on some small living populations.

It appears that there may be a way to develop and conserve our local farm animal genetic resources (FAnGR) utilizing the sustainable potential genetic resources from our existing indigenous cattle of Bangladesh for minimizing our huge demand of animal protein. However, this potential genetic resource has been declining drastically due to indiscriminate breeding, artificial insemination with the semen of exotic breeds like Holstein Friesian, Sahiwal, and Sindhi etc. for enhancing milk and meat production during last few decades, but these could not fulfill national expectation due to lack of adaptability and viability of crossbred progenies in our native environment (Bhuiyan and Sultana 1994). Therefore, improvement and conservation of the Red Chittagong Cattle genetic resource could be a step forward to face the crying need of time.

Improvement of RCC through selective breeding program is underway. The estimation of genetic merit of an individual animal by making use of estimated genetic parameters like heritability, repeatability and genetic correlation is the pre-requisite of fundamental breeding program. These genetic parameters are essential tools in animal breeding research as well as design and application of practical breeding program (Koots et al., 1994).

Studies on some local indigenous cattle along with some traits of RCC have also been carried out by some other researchers (Habib et al., 2003; Bhuiyan and Sultana 1994; Majid et al., 1995) but a comprehensive study on indigenous RCC cattle is yet to be done. But traits measuring reproduction and survival sometimes show a negative genetic trend in livestock populations despite their importance to profitability. This occurs due to inbreeding depression and selection for other traits. For many traits there are genes with an allele that increases the trait value but is initially at low frequency due to negative effects on fitness. Therefore, theory suggests that fitness traits will tend to decline due to selection for other traits even if this is not predicted by the genetic correlation in the base population. The most important recommendation to overcome this problem is simply to include fitness traits in the breeding objective, the recording scheme and the selection index. The economic weight given to fitness traits should take account of the high likelihood that they will be important in the future whereas other breeding objectives are more likely to change with time (Michael and Goddard 2009). Therefore, before formulating any breeding strategy, comparative study on the fitness traits of Red Chittagong cattle under varying environments is necessary. The present study was therefore undertaken to compare the efficiency of fitness traits of RCC in two production systems (on-station and on-farm).

METHODOLOGY

Data source

The study employed use of accumulated data on animals of the two different locations. Site-1 was Bangladesh Agricultural University (BAU) Nucleus Herd and site-2 wasChar Jailkhana Community Herd in Mymensingh district.

Site-1data werefrom the records maintained at the Nucleus Herd of the USDA funded Red Chittagong Cattle project at BAU, Mymensingh.

Site-2 data were from the records being maintained at farmer’s house outside of its place of origin in Mymensingh district.

Animal management data collection, checking, scrutiny, database management and preparation of secondary data files were prepared.

Climate

The climate of Mymensingh is moderate, much cooler than Dhaka, as it is closer to the Himalayas. The monsoon starts in May or June and continues till August. It rains heavily and sometimes for days and weeks. During the monsoon, the temperature varies between 15 and 20 degrees. The temperature falls below 15 °C (59 °F) in winter which is spread over December and January and may well include November and February. The highest temperature is felt during April–May period, when the temperature may be as high as 40°C (104 °F). High humidity causes heavy sweating during this period. For western travelers, the best time to visit is between November and February (en.wikipedia.org/wiki/Mymensingh).

Cattle feeding system

In site-1cattle were fed withconcentrate, rice straw, green grass.In site-2cattle were fed in mainly pasturing animal in fallow land and crop field. Sometimes farmers supplied concentrate with straw to the animal.

Cattle management

In Site-1 cattle were breed through AI and in site-2cattle were breed through AI and sometimes farmer's bred their animal with RCC bull.

Traits considered for the study

Fitness traits are not concerned with athletic prowess rather with feathers of reproduction and viability. Examples: conception rate, litter size, calving interval, gestation length, survival ability etc. However, in this study fitness trait are considered. Fitness trait include: 1) survival ability and 2) reproductive performance.

Survival ability

How much calves are alive in a herd in the period of time. This trait has economic value to the breeders because farmers always expect more alive calf from a heifer.

Reproductive performance

The reproductive traits are related with reproductive capabilities of cattle. These include age at first calving (AFC), Age at puberty (AP), Calving interval (CI), First service conception rate (FSCR), Gestation length (GL), Non-return rate to first service: (NRRFS), Number of services per conception (NSC) and Post- partum estrus period (PPEP).

Data analysis

The study covered various economic traits of Red Chittagong Cattle of different generations and parities. The animals were of different ages and there were both patents and progeny groups. Therefore, there was sufficient non-orthogonality and hierarchy in data material. In other words, the numbers of observations were different from class to class and sub-class to sub-class. Therefore, statistical design of the study was essentially non-orthogonal factorial in nature.

Animals were arranged in contemporary groups, based on herd year-season, age, sex, and parity/ lactation number. Initially the general linear model (GLM) procedure of SPSS 11.5 was used to adjust all effects as well as to test all possible linear models. Least significance difference (LSD) (Chew, 1977) was used for mean comparison. The generalized linear models were used:

$Y_i = \mu + H_i + e_i$for reproductive trait)
Where,
Y_i= Dependent variables (AP, AFC, NSC, FSCR, CR, NRR, PPEP, DO, GL and CI)
μ = Population mean for the said trait;
H_i = effects of i^{th} herd (where, i = site-1, site-2)
e_i= Random error associated with $O_b$servation

RESULTS AND DISCUSSION

Survival ability

The survival ability percentage in BAU Nucleus Herd and Community Herds was 94.69 and 85.02 (Table 1). The difference in survival ability of

RCC at Community Herd and BAU Nucleus Herd was not significant (p>0.05) (Table 1).

Survival ability of RCC at BAU nucleus herd was divided into different categories as like birth to 3 months, birth to 6 months, birth to weaning, birth to maturity respectively were 96.98±0.010, 98.96±0.007, 91±0.011and96.8±0.001.Survival ability of RCC at Community herd was divided into different categories as like birth to 3 months, birth to 6 months, birth to weaning, birth to maturity respectively were 99.4±0.010, 96.91±0.009, 84.88±0.012 and 97.44±0.013. There were a significant difference in nucleus herd among different categories but there were a significant difference in community herd among different categories. The useful life of zebu cattle ranges from 4.5 to 8.5 years, during which they produce 3 to 5 calves. Very high levels of inbreeding depress fertility and fitness traits, while crossbreeding appears to increase both traits.

Table 1
Least squares means (LSM) and standard errors of means (SEM) of survival ability (%) as affected by different herds.

Survivability	Nucleus Herd		Level of significance	Community Herd		Level of significance
	LSM ± SEM	N		LSM ± SEM	N	
Birth to 3 months	96.98±0.010	94	*	99.4±0.010	171	NS
Birth to 6 months	98.96±0.007	97		96.91±0.009	166	
Birth to weaning	91.00±0.011	88		84.88±0.012	146	
Birth to maturity	96.80±0.001	94		97.44±0.013	167	

N= number of observation, NS = Non-significant (p> 0.05), *= Significant (p<0.05)

Reproductive trait

Reproduction in any species is required for the propagation of generations. Reproduction of livestock is the beginning the next attempts for economic yields like meat, milk etc (Bakir and Cilek, 2009). Low fertility is of economic importance for dairy enterprises, because it results in higher levels of involuntary replacement and reduced annual milk production (Goshu et al., 2007). Reports indicated that calving interval of 12 to 13.5 months; number of services per conception of 1.3 to 1.5 and days open of 85 days are considered as standard values (McDowell 1985).

Accurate evaluation of the reproductive efficiency of indigenous stocks and their crossbred in different production systems is essential for the development of appropriate breeding strategies (Negussie et al., 1998). Low reproductive efficiency hinders genetic improvement efforts and causes direct economic loss (Mukasa -Mugerwa et al., 1989). Reproductive efficiency of dairy cows is influenced by different factors including genetic, season, age, production system, nutrition, management, environment and disease (Alberro 1983; Agyemang and Nkhonjera 1990; Mukasa-Mugerwa et al., 1989; 1991; Negussie et al., 1998). In general, low fertility rates of cattle in the tropics compared to temperate regions are probably related to environmental differences including inadequate nutrition, prevalence of diseases and parasites as well as the interaction between genotype and environment (Mukasa-Mugerwa 1989).

The reproductive and fertility traits of RCC are comparable with *Taurus* and some other local Non-descript indigenous cattle available in Indo-Pak subcontinent and some countries of African continent. The least squares means with standard errors of mean (LSM±SEM) of various reproductive traits found from RCC are depicted in Table 2.

Age at first calving (AFC)

Age at first calving at BAU nucleus and community herds were found as 52.76±3.1 and 46.58±3.1 months with an overall age of49.67±2.1months respectively (Table 2). Age at first calving did not differ significantly (p>0.05) between herds, although slightly lower age at first calving was found in community herd (Table 2).

Tropical cattle are delayed to reach sexual maturity and though there may be some differences between breeds it is largely influenced by environment and especially poor nutrition, which can retard growth and development. In the majority of breeds age at first calving is generally about 36-48 months (Maule, 1990). Age at first calving for some breeds in Indian cattle may be cited here on this context for comparisons by Taneja and Bhat (1986). They reported age at first calving for Kankrej, Sahiwal, Tharparkar, Red Sindhi, Gir, Hariana, Deoni, Ongole and Non-descript cattle as 47±0.8, 40±0.2, 49±0.4, 42±0.6, 47±0.8, 53±0.3, 53±1.0, 40±0.4 and 59±2.5 months, respectively.

Age at first calving of RCC at BAU nucleus herd and Community herd was averaged 49.67±2.1 months (Table 2). Relatively earlier age at first calving (43.1±4.6 SD and 43.5±0.5 months) was observed on the field survey report of RCC in their home tract by Bag et al. (2010) and Hossain et al. (2006). There are some literatures on age at first calving ranging between 45.7±0.5 to 54.0 months reported by the studies of Singh et al. (2002) for Deoni cattle, Gaur et al. (2002) for Ongole also known as "*Nellore*" and Mwacharo and Rege (2002) for Kenyan small native indigenous cattle named South East African Shorthorn Zebu cattle (SEAZ) were in the line of this study. The variation of age at first calving among different authors for the same breed might be due nutrition and management. This supports the concept that appropriate feeding and management in early life should lower the age at first calving (Mahadevan, 1953). A number of previous works indicated that management factor especially nutrition determines pre-pubertal growth rates and reproductive development (Negussie et al., 1998). The better-managed and well-fed heifers grew faster, served earlier and resulted in more economic benefit in terms of sales of pregnant heifers and/or more milk and calves produced during the lifetime of the animal.

There were no significant (p>0.05) variation found in RCC for age at first calving between BAU nucleus herd and Community herds (Table 2). Similar result was reported in Ethiopia for different Holstein Friesian cow herds by Tadesse et al. (2010). In another report by Yifat et al. (2009) studied age at first calving for small holder crossbred dairy herds in urban and rural area of Ethiopia and found no significant difference between herds which agreed by this study. But the result disagreed when compared to the literature reviewed by Rahman et al. (2008) and Mureda and Zeleke (2007) who found different production systems (herds) to had significant difference (p<0.05) on age at first calving for Sahiwal cows in Pakistan and crossbred dairy cows in Ethiopia, respectively.

Table 2
Least square means (LSM) and standard error of means (SEM) of Reproductive Trait as affected by different herds.

Trait	Nucleus Herd		Community Herd		Level of significance
	LSM ± SEM	N	LSM ± SEM	N	
Age at first calving (month)	52±3.1	19	46±3.1	19	NS
Age at puberty (month)	41.36±1.67	20	34.09±1.37	30	NS
Calving interval(days)	436.53±12.59	58	527.63±16.69	33	*
First service conception rate (%)	60.00±4.88	75	51.92±7.55	104	*
Gestation length(days)	279.00±3.47	74	292.89±2.93	104	*
Non-return rate to first service (%)	64.60±4.60	113	57.48±3.78	167	*
Number of services per conception	1.60±0.10	75	1.70±0.09	104	*
Post- partum estrous period (days)	173.32±13.72	71	217.53±13.82	70	*

N= number of observation, NS = Non-significant (p> 0.05), *= Significant (p<0.05)

Age at puberty (AP)

The overall age at puberty in BAU nucleus herd and community herds was 37.0±2.16 months (Table 2). Age at puberty in community herd was found significantly ($p>0.05$) different from BAU nucleus herd (Table 2).

Despite the fact that most tropical cattle are late in attaining sexual maturity, they are known to go on breeding for many years and it is not unusual to find cows that have had ten calves by which time they could be 15 to 20 years of age (Maule, 1990).

Different factors advance or delay puberty. Environmental factors, especially nutrition, determine pre-puberal growth rates, reproductive organ development, and onset of puberty and subsequent fertility. Substantial evidence exists that dietary supplementation of heifers during their growth will reduce the interval from birth to first services and calving (Kayongo-Male et al., 1982), probably because heifers that grow faster cycle earlier and express overt estrus.

Bag et al. (2010), Azizunnesa et al. (2010) and Hossain et al. (2006) on their field survey observations reported slightly lower age at puberty (32.4±3.6, 32.2±20.7 and 32.4±3.9 months, respectively) for RCC in their home tract. Other authors also reported similar values ranging from 32.5 to 42.5 months for Non-descript Deshi/indigenous cows (Majid et al., 1995; Ali et al., 2006), 39.2±4.3 and 35.1±9.2 months for Pabna and Sahiwal×Pabna crosses cows (Hoque et al., 1999). But in case of Friesian×Pabna crosses the value was 25.5±5.6 months reported by Hoque et al. (1999) which was much shorter than this study. Singh et al. (2002) reported 35.6±0.5 months for Deoni cattle in India which was closely nearer than RCC. The variation within and between breeds might obviously be due to nutrition, body condition score (BCS), management, environment and different genotypes. It was also evident that temperate breeds come into maturity at an earlier age than the breeds of tropical environment.
Significant variation ($p>0.05$) of age at puberty was observedbetween BAU nucleusherd and Community herd on herds (Table 2).Mureda and Zeleke (2007) in their published literature observed significant variations ($p<0.05$) of age at first service due to different production systems (herds) which was similar to this result.

Calving interval (CI)

The average calving interval in BAU nucleus herd and community herds was469.57±20.91 days with a significant ($p>0.05$) trend of community here<Nucleus herd (Table 2).

The maintenance of a lower calving interval is desirable in brood cows. Because of the low levels of feeding and the practice of running calves with their dams for a long period after calving, cows do not show sign of estrus after calving as early as is the case in *Bostaurus* breeds. The result is, therefore, a long or very long interval between calvings, which in many herds means a calf in alternative years. Where conditions are rather better an interval of 18 months is possible and this is not unusual in many Indian Zebu herds on government farms (Maule, 1990). Taneja and Bhat (1986) reported calving interval of some breeds in India ranging from 14.7±0.3 to 17.0±0.6 months. He also reported calving interval of Indian Non-descript cattle as 18.7±1.0 months.

The average calving interval of RCC found from this study was 469.57±20.91 days (about 15.6 months) (Table 2). The result of this study slightly higher that the range reported by Bag et al. (2010), Azizunnesa et al. (2010), Hossain et al. (2006) and Ghose et al. (1977) for RCC, Sultana and Bhuiyan (1997) for Non-descript Deshi, Munim et al. (2006) for Friesian×Local crosses, Singh et al. (2002) for Indian Deoni cows and Moulick et al. (1972) for Indian Deshi cattle, between 14.0 to 14.9 months (i.e about 420 to 450 days). Comparatively shorter calving interval between 11.6 to 13.7 months (i.e about 347 to 411 days) were found by Hoque et al. (1999) for Friesian×Pabna crosses, Habib et al. (2003) for RCC, Munim et al. (2006) for Local, RCC and Jersey×Local crosses and Ali et al. (2006) for indigenous cow.

However comparatively longer calving interval ranged from 15.3 to 17.9 months (i.e about 458 to 536 days) were found by the studies of Rahman et al. (2001), Khan et al. (2000) for RCC, Majid et al.

(1995), and Ghose et al. (1977) for Non-descript Deshi, and Hoque et al. (1999) for Pabna cows, Hoque et al. (1999) for Sahiwal×Pabna crosses, Gaur et al. (2002) for Ongole, Munim et al. (2006) for Sahiwal×Local, Friesian×Local and Sahiwal×Friesian crosses. The variations of calving interval among different researchers might have resulted due to different genotype, herd, sample size, feeding, general and reproductive management, disease condition, number of services per conception, postpartum interval period, days open etc. The length of gestation and days open are the two main constituents of calving interval out of which the farmer cannot be expected to change much for physiological reasons. Since days open constitutes nearly all of the variation in calving interval, the only way to reduce the calving interval in Zebu cattle would be through an early conception within biological limits. Selection for calving interval is practically equivalent to selecting for days open (Zafar et al., 2008). However the calving interval in the present study is above the normal interval of 365 days expected to a dairy farm. This longer calving interval is mainly attributed to the result of longer postpartum oestrous and days open obtained which could be related to environmental factors, mismanagement practices like poor housing (Britt et al., 1986), poor nutrition or failure to detect heat by the farmer (Msanga et al., 1999).

Calving interval of RCC in this study reported the significant difference among two herds (Table 2). The result was consonance for the effect ($p>0.05$) of herd on this trait by the study of Parra-Bracamonte et al. (2005). The result agreed by Tadess e et al. (2010), Yifat et al. (2009), Mureda and Zeleke (2007) as they reported significant ($p<0.001$) difference of calving interval among different herds of Holstein Friesian and crossbred cows in Ethiopia and Tunisia could be due to difference of reproductive management, feeding, environment or climate in different herds.

First service conception rate (FSCR)

The mean first service conception rate in two different production systems was found to be 55.30±7.55% (Table 2). The comparisons of first service conception rates for different production systems indicates that the highest first service conception rate was found in first services followed by subsequent production system. First service conception rate did not differ significantly ($p>0.05$) among different sites studied. The highest first service conception rate was found in BAU nucleus herd (Table 2).

First service conception rate is the percentage of heifer/cow that became pregnant after the first AI service. The overall first service conception rate in two different production systems was found 55.30±7.55% (Table 2) which disagreed (63.1%) the report of Buxadera and Dempfle (1997). Bhattacharyya et al. (2010) reported 33.90% conception rate to first service for crossbred cows in Kashmir Valley which was half than the result of this study. In another studies by Mureda and Zeleke (2007) for crossbred cows in Ethiopia and Osei et al. (1991) for Friesian cows in Ghana reported 45.9% and 41% conception to first service rate which was lower than this study. The variation might be due to type of cattle (beef/dairy) or different non-genetic factors related to fertility traits.

First service conception rate did not differ significantly ($p>0.05$) among different studied sites (Table 2). Mureda and Zeleke (2007) in their works on crossbred dairy cows in Ethiopia did not find any significant difference ($p>0.05$) of first service conception rate due to different production system (herds) which was similar estimate to this study.

Gestation length (GL)

The gestation length in two different production systems was averaged 278.11±4.55days (Table 2).Gestation length did not differ significantly ($p>0.05$) on different production systems.

The average gestation length of RCC in two production systems was 287.11±3.47days (Table 2). The result was in inconsistent with the results of Azizunnesa et al. (2010) for RCC, Rahman et al. (2001) for local indigenous cows and Khan et al. (1999) for RCC who found gestation length ranged between 278.5±6.9 to 283.7±11.2 days. Although gestation length is more or less consistent within same species (Agyemang and Nkhonjera 1990) but relatively shorter gestation length was prevailed from the studies of Majid et al. (1995), Sultana and Bhuiyan (1997) and Ali et al. (2006) for Non-descript Deshi/indigenous cows and Singh et al. (2002) for Indian Deoni cows who reported gestation length between 273.5±2.3 to 278.6±2.6 days. Slightly longer gestation period (between 283.1±0.5 to 287±3.5 days) was found by the studies of Bag et al. (2010), Habib et al. (2003), Hossain et al. (2006) and Munim et al. (2006) for RCC, Munim et al. (2006) for local indigenous and crossbred cows.

Gestation length of RCC two production systems of this study, was statistically significant (p>0.05) (Table 2). The result was not accordance with Yifat et al. (2009) and Salah and Mogawer(1990) due to similar effect (p>0.05) reported by them.

Non-return rate to first service (NRRFS)

The mean non-return rate to first service of RCC bulls in the Nucleus Herd was 64.60±4.60% (Table 2).The non-return rate among different production systems did not shown any significant (p>0.05) variation (Table 2). The mean non-return rate to first service of bulls of RCC Nucleus Herd was 64.60±4.6% (Table 2). The earlier works in the same herd of RCC reported 60 day non-return rate of RCC bulls as 63.9±4.2% (Das et al., 2010) which coincided by this study. The result was also in agreement (65.4%) for another breed (Holstein-Friesian in Italy) reported by Miglior et al. (1997).

Williamson et al. (1978) in their study reported non-return rate to first insemination as 69.3% for dairy herds in Victoria. Schaeffer (1993) and Fryer et al. (1958) in their published literatures reported the value of this trait ranging from 52.1 to 75.7% and 44 to 71%, respectively in different ages of reputed exotic dairy breeds. Almquist (1995) reported the average non-return rate for high fertility bulls ranged from 65 to 74% and average non-return rate for low fertility bulls ranged from 52 to 65%. The result of this study felt within the range of their published literatures, while somewhat higher rate (78.5% and 82.9%) was reported by Sarder (2006) and Rabidas et al. (2010) in their published literatures. The variations among different authors might be due to small sample size and herd fertility management. Non-return rate was largely dependent on the number of service, age, and the number of cows' not returned 60 days and environmental condition.

The herd where the insemination was performed had no significant effect (p>0.05) on non-return rate of RCC bulls (Table 2). This result did not come in to agreement with Miglior et al. (1997) as they found highly significant effect (p<0.0001) of herd on this trait. Though, reproductive management, feeding and other environmental factors causes the variability of reproductive efficiency of cows in different farms as a consequence non-return rate may varied from herd to herd.

Number of services per conception (NSC)

The overall number of services per conception in two different production systems was 1.65±0.13 (Table 2). The number of services per conception had no significant (p>0.05) difference on different production systems. The mean number of services required per conception found from this study was 1.6±0.1 (Table 2). The result was closely in agreement with the findings of Hossain et al. (2006) and Ahmed and Islam (1987) for RCC (1.5±0.1 and 1.6±0.5) and Khan et al. (1999) for Pabna Deshi cows (1.6±0.1). Bag et al. (2010) reported mean (±SD) number of services per conception of RCC in their home tract to be 1.6±0.6 which was similar with the study for the same genotype. Comparatively lower number of services per conception (1.2 to 1.4±0.1) was reported byAzizunnesa et al. (2010), Habib et al. (2003) and Das et al. (2010) for RCC, Ali et al. (2006) for indigenous cow (1.2±0.4). In another studies conducted by Rahman et al.(2001), Jabber and Ali (1988), Majid et al. (1995), Sultana and Bhuiyan (1997), Ahmed and Islam (1987) reported higher values of number of services per conception ranged between 1.6±0.9 to 1.8±0.2 for Non-descript indigenous cows in their studies. Gaur et al. (2002) found 1.9 inseminations per conception for Ongole cattle in India which was also higher than that of RCC. The variations of services per conception from different workers for same as well as different breeds might be due to different genetic makeup, nutritional status of cattle, management, failure in proper heat detection or efficiency of inseminator. Shiferaw et al. (2003) found that cows with reproductive disorders required more services per conception and had longer intervals from calving to first service and to conception. Proper and accurate heat detection is a key to efficient reproduction and four to five checks each day to determine the onset of true standing heat gives a better idea when to inseminate. Although not significant, Tadesse and Zelalem (2003) also noted a decrease in the services required per conception for cows supplemented high level of protein.

Analysis of variance showed no significant (p>0.01) difference of services per conception for different herds (Table 2). Similar results were reported by Mureda and Zeleke (2007) who found no significant difference (p>0.05) of this trait for crossbred dairy herds in urban and rural areas in Ethiopia. In contrast, Tadesse et al. (2010) detected significant effect (p<0.001) of herd on service per conception for Holstein Friesian cows in Ethiopia.

Post- partum estrous period (PPEP)

The mean post- partum estrous period in two different production systems was 195.29±19.47 days (Table 2). Post- partum estrous periodhave differ significantly (p>0.05) among different production system.

The average post- partum estrous period for RCC found from different production systems was 195.29±19.47 days (Table 2) that was higher from the study of Majid et al. (1995) reported 120.0±7.8 days for Non-descript Deshi cows. On a field survey of RCC in their home tract, Hossain et al. (2006) stated 43.1±5.4 days post- partum estrous period which was much lower than this study. Bag et al. (2010), Azizunnesa et al. (2010), Ali et al. (2006) found relatively shorter post- partum estrous period (44.5±3.5 and 92.5±30.3 and 57 days for RCC, 103.6±6.6 days for Pabna cows and 112.8±34.6 days for indigenous cow) in their studies. But Rahman et al. (2001) and Roy (1999) found relatively lowerr post- partum estrous period (141.3±88.4 days for Non-descript Deshi and 160.7±80.3 days for Pabna cows, respectively) than RCC from this study. The effect of low level of nutrition on extended postpartum period due to weight loss was noted by Gebregziabher et al. (2005). He also added that heavier cows at calving and cows that gained weight during the first three months postpartum were in a positive energy balance, which enabled them to return to normal estrous cycles. Moreover, Tadesse and Zelalem (2003) reported that increasing the level of protein supplementation from low (2 kg/day) to high (4 kg/day) reduced the post- partum interval from 159 to 100 days. Most investigators suggest that the reason for the delay in interval to first service is greater negative energy balance in modern dairy cows. Negative energy balance delays the resumption of ovarian activity (Butler 1989). Ovulation and estrus after calving are delayed when the positive feedback effects of estradiol on release of LH (leutinizing hormones)from the pituitary, and circulating concentrations of metabolic hormones such as insulin and insulin-like growth factor-I, are reduced by a variety of environmental factors (Rhodes et al., 2003). The main factors are limited energy intake, lower body reserves, increased partitioning of energy to milk production. Apart from nutritional effect poor estrus detection by herdsman, poor estrus expression could be the other factors for long postpartum estrous.

Post- partum estrous period had significant (p>0.05) effect among different production systems studied for RCC (Table 2) which was coincided by the study of Tadesse et al. (2010) and Mureda and Zeleke (2007) who found significant (p<0.001; p<0.05) influence on this trait among different herds that could be due to variation in herd management and difference in heat detection efficiency between herds.

CONCLUSION

Fitness traits are economically important traits. In this study it can be said that age at puberty, calving interval, gestation length and post-partum heat period are fit for varying production system.Performance levels of RCC for fertility traits are comparable with other results for indigenous and crossbreds in tropical countries, but had found better than temperate breeds reported by many workers. Since most fertility and reproductive traits have a low heritability, it is apparent that most progress can be achieved by paying attention to environmental factors, especially improving the nutritional insufficiency and ameliorating the herd fertility and reproductive management like heat detection, timely insemination, quality of semen and efficiency of inseminator and so on.

More rigorous and intense screening would have been required to form an effective foundation herd for this RCC breeding program.

Finally, The RCC may be considered as an adapted breed and any attempt at improving its performance should be seen as an attempt to preserve animal genetic diversity. Considering the phenotypic performance of RCC including the large variation within population, estimates of heritability and phenotypic and genetic correlations of the traits mentioned above, there is still chance of improvement for RCC population if proper breeding and selection methods can be applied along with optimum feeding, management and disease control measures. This study has demonstrated that with a well-organized breeding program, genetic improvement could be achieved in traits of economic importance, which may improve the production efficiency of farmers in the long run.

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