Borneo Akademika *Vol. 4 Special Issue October 2020*, 21 - 32
UiTM Cawangan Sabah

RETROSPECTIVE STUDY ON THE PRODUCTIVE PERFORMANCE OF SAHIWAL X FRIESIAN CROSSBRED DAIRY COWS

Navin Kumar Nadarajah *, Nur Hardy Bin Abu Daud

ABSTRACT

A retrospective study was carried out at one selected dairy farm located in Keningau, Sabah in order to evaluate the effect of age at first calving (AFC) on the productive performance of the primiparous Sahiwal x Friesian crossbred dairy cows. The retrospective data was collected from 123 Sahiwal x Friesian crossbred dairy cows. AFC was classified into 7 groups such as: ≤22; 23-24; 25-26; 27-28 months old; 29-30; 31-32 and >32 months old, respectively. The productive performance parameters that were evaluated consisted of the first-lactation milk yield, lactation length, average daily milk yield and dry period. Cows with AFC of 23-24 and 25-26 months of age showed the highest first-lactation milk yield, 7210.14± 384.84 litres and 7053.80± 342.98 litres, respectively. Cows with AFC of 23-24 months old have also showed the longest lactation length of 410.25± 19.51 days. However, cows with AFC of 23-24 months of age produced the least average daily milk yield, that was about 17.62± 0.60 litres/day and cows that were calved at 29-30 months of age and >32 months of age produced the highest average daily milk yield, that was about 24.10± 0.94 litres/day and 24.16± 0.79 litres/day, respectively. The study showed that AFC had a significant effect on the first-lactation milk yield, lactation length and average daily milk yield of the Sahiwal x Friesian crossbred dairy cows ($p<0.05$). However, it was found that AFC had no significant effect on the dry period ($p>0.05$). Overall, cows with the AFC of 23-24 months old have showed the best productive performance.
Keywords: Productive performance, age at first calving, primiparous Sahiwal x Friesian crossbred dairy cows

ABSTRAK

Satu kajian retrospektif telah dijalankan di satu ladang tenusu terpilih yang bertempat di Keningau, Sabah untuk menilai kesan umur beranak pertama (AFC) terhadap prestasi produktif laktasi pertama lembu tenusu kacukan Sahiwal x Friesian. Data retrospektif dikumpulkan daripada 123 lembu tenusu kacukan Sahiwal x Friesian. Umur semasa melahirkan anak pertama telah dikelaskan kepada 7 kumpulan masing-masing seperti: berusia ≤22; 23-24; 25-26; 27-28; 29-30; 31-32 dan > 32 bulan. Parameter prestasi produktif yang dinilai terdiri daripada hasil pertama penyusuan susu, tempoh penyusuan, purata hasil susu untuk setiap hari dan tempoh kering susu. Lembu dengan AFC masing-masing untuk 23-24 dan 25-26 bulan usia menunjukkan hasil tertinggi pertama penyusuan susu, 7210.14± 384.84 dan 7053.80± 342.98 liter. Lembu dengan AFC untuk 23-24 bulan juga telah menunjukkan tempoh penyusuan yang paling lama iaitu 410.25± 19.51 hari. Walau bagaimanapun, lembu dengan AFC untuk 23-24 bulan usia menghasilkan purata hasil susu harian dengan nilai yang terendah, iaitu sebanyak 17.62± 0.60 liter/hari dan lembu yang beranak pada umur masing-masing, 29-30 dan > 32 bulan menghasilkan purata hasil susu harian yang tertinggi, iaitu sebanyak 24.10± 0.94 liter/hari dan 24.16± 0.79 liter/hari. Kajian mendapati bahawa AFC mempunyai kesan penting ke atas hasil susu laktasi pertama, tempoh penyusuan dan purata hasil susu harian lembu tenusu kacukan Sahiwal x Friesian ($p<0.05$). Walau bagaimanapun, ia telah mendapati bahawa AFC tidak mempunyai kesan yang besar ke atas tempoh kering ($p>0.05$). Secara keseluruhan, lembu dengan AFC pada 23-24 bulan telah menunjukkan prestasi produktif yang terbaik.

Kata kunci: prestasi produktif, umur kelahiran pertama, laktasi pertama lembu tenusu kacukan Sahiwal x Friesian

1. Introduction

The total milk production for 2018 was reported to be only 38.5 million liters, whereas the consumption was 62.8 million liters (DVS, 2019). The self-sufficiency level for milk in 2018 is 61.27% (DVS, 2019). Thus, the dairy market in Malaysia is mainly dependent on imported milk and milk products. This importation of dairy products can lead to loss of foreign exchange. Besides that, with the increase in population and overall rapid development of the country, the demand for livestock products as source of high-quality protein is expected to continue to rise. The rising awareness of consumers in Malaysia on the nutritional benefits of dairy products together with the increase in the preferences towards dairy-derived products have contributed to the rise in the demand for dairy products in Malaysia. Hence, there is much more yet to be done to boost the dairy industry of Malaysia to attain a high self-sufficiency level in the dairy products. This can only be achieved by exploiting the full genetic potential of the existing dairy animal resources and thus, it is important to understand the productive performances of the dairy breeds in the country (Sim & Suntharalingam, 2015).

Lactation is defined as the process of the production of milk. This process normally occurs in all mammalian species (Boniface *et al.,* 2010). Milk is synthesized by the secretory cells in the mammary glands of the mammalian species. According to Payne and Wilson (1999) and Msanga *et al.* (2000), the milk production performance of a dairy cattle in the tropics is affected by a number of factors and they may include the genetic, climatic, diseases, feeding, age of calving, year of calving and managerial factors. A report by Bajwa *et al.* (2004) stated that the environmental factors such as year and season of calving and age affects the productivity of the dairy cattle. Tekerli *et al.* (2000) have also reported that the animal factors such as breed, age, lactation stage, parity and milking frequency have also affected the production performance of dairy cattle.

Previously, a few studies were conducted in Malaysia on the productive performances of the dairy cows (Azhar *et al.*, 2016; Boniface *et al.*, 2010). Azhar *et al.* (2016) have reported on the relationship between milk production, calving rate and disease occurrence of the dairy cows in a farm in Selangor. Besides, Boniface *et al.* (2010) have carried out a survey-based study on the dairy cattle lactation trend in Sabah to compare the lactation yield, lactation length and average daily production in a lactation of the dairy cows at different dairy farms located in Kota Kinabalu, Keningau and Ranau. Based on the previous studies on dairy cows in Malaysia, the age at first calving of the cows and the effect of AFC on the productive performance of the primiparous cows were not emphasized as AFC is an important factor that may influence the subsequent productive performance of the dairy cows. Thus, for the present study, the research questions that pertained were:

- How will age at first calving affect the productive performance of the primiparous Sahiwal x Friesian crossbred dairy cows?
- What is the age at first calving for the primiparous Sahiwal x Friesian crossbred dairy cows that showed the best productive performance in the current study?

Hence, based on the research questions, this have prompted the current study to be conducted to evaluate the effects of age at first calving on the productive performances of the primiparous Sahiwal x Friesian crossbred dairy cows. The results of this study can be used as a guidance to dairy farmers in Malaysia especially Sabah and hence, aid in the development of the production of milk and milk products in Malaysia.

2. Literature Review

2.1 Dairy production system of Malaysia

The dairy production system of Malaysia can be divided basically into two types, that is the medium input system and the high input system. For the medium input system, the breeding animals utilized are mainly the Sahiwal x Friesian and Jersey x Friesian crossbreds. It is estimated that 90% of farms employ a medium input system. As suggested by the Department of Veterinary Services, farmers will produce offspring of cattle having 60 to 75% Friesian and 25 to 40% Zebu inheritance. In this system, the cows are generally adapted to the tropical climate and they are maintained with local feedstuff. For the high input system, the dairy farmers utilized mainly the Friesian, Jersey and the Jersey-Friesian crossbreds. These breeds of cattle are used as breeders. In this system, the breeding is normally performed to preserve the temperate inheritance of the breeders. Hence, under this system, the dairy farmers are heavily dependent on the imported genetic materials. Cattle under this system are normally well-housed and in certain cases, they live in closed house system with controlled temperature facilities. In this system, the cattle are fed with high-quality feed via stalls. The feed was formulated using a high proportion of imported grains. In general, about 60 to 70% farmers practice natural mating in Malaysia while others use artificial insemination. In developed countries, almost 100% farmers utilize artificial insemination for their dairy cattle (DVS, 2013).

2.2 Lactation and factors that affect the milk production of dairy cows

According to Damron (2013), lactation can be defined as the process of the production of milk which occurs in all species of mammals. Lactation occurs after parturition, that is the process of giving birth. In the case of cows, parturition is known as calving, that is the process of giving birth to a calf (Thomas, 2005).

Several factors have an adverse effect on the lactation of dairy cows and they include the breed of cows, size of cows, age of cows, length of calving interval, lactation stage, milking frequency, length of dry period, feeding management, effects of climate and health condition of cows (Nevens, 2010; Eckles & Anthony, 2011; Sastry & Thomas, 2005; Gader et al., 2007; Ríos-Utrera *et al*, 2013; Cooke *et al.,* 2013; Sawa *et al.*, 2018; Österman, 2003; Mikesell & Baker, 2011; Flanders, 2012; Campbell *et al.*, 2003; Field & Taylor, 2012).

2.2.1 Breed of cows

The volume of milk produced by cows is also a breed characteristic. Assuming cows of equal productivity, Holsteins produce the greatest volume of milk and Jersey cows produce the least volume of milk (Nevens, 2010).

2.2.2 Size of cows

Eckles and Anthony (2011) stated that a smaller cow produces less milk due to the limit in their capacity to digest food and cannot compete with a larger animal that have higher capacity and strength to handle the feed necessary for high milk production.

2.2.3 Age of cows

The milk production of cows increases up to maturity, which is generally about 6 years of age for most dairy cattle breeds. The maximum yields are usually reached at about 7 years of age and then, there is a gradual decline in milk production thereafter (Nevens, 2010). A report by Sastry and Thomas (2005) indicated that *Bos taurus* cattle reared in temperate conditions reached their peak production by about the fifth lactation and *Bos indicus* cattle usually reach the max production by the third lactation. In certain studies, the effect of age of cows on the milk yield was conducted as the effect of lactation number or parity on the milk yield (Gader *et al.*, 2007; Ríos-Utrera et al., 2013). Gader *et al.* (2007) found that the third- and fourth-parity dams of the Holstein Friesian cows reared under tropical conditions of Sudan had greater milk yield per lactation and milk yield per day than the first- and second-parity dams and the second-parity dams had greater milk yield per lactation and milk yield per day than first-parity dams. This was also in agreement with the results of the study conducted by Ríos-Utrera *et al.* (2013). Besides, Cooke *et al.* (2013) stated that the age of cows at first calving is particularly important as it affects the milk yield. The age at first calving (AFC) can be considered as a trait specific to a cow population (Sawa *et al.*, 2018). Age at first calving (AFC) is defined as the period from date of birth to first calving date of the cows (Massawe, 2011). Singh *et al.* (2019) have reported that the dairy cows reared under tropical climate showed that AFC had a significant effect on the milk yield. Wondifraw *et al.* (2013) have also reported that the LL was significantly affected by AFC for the Friesian x Deoni crossbred cows reared in Parbhani, India. However, several studies have found the opposite results that indicated the effects of AFC on LL were non-significant ($p>0.05$) (Tekerli and Kocak, 2009; Habib *et al.,* 2010; M'Hamdi *et al.,* 2012).

2.2.4 Length of calving interval

By experience, dairy farmers found that under most of the farm conditions, it is highly desirable that each cow is calved at 12 months intervals. A study conducted by Österman (2003) reported that cows with a calving interval of 18 months produced higher milk yield compared to cows with 12 months calving interval during the second lactation. This is because an extension of the calving interval resulted in a better feed efficiency.

2.2.5 Lactation stage

According to Nevens (2010), it was stated that lactation stage has a profound effect on the daily milk yield of dairy cows. According to Mikesell and Baker (2011), it was stated that during early stage of lactation, normally the first 60-90 days after calving, milk yield will gradually increase as the feed intake of the cows also increase. Peak lactation occurs around 2 to 3 months after calving. Then, the milk yield of the cows gradually decreases after the peak of lactation.

2.2.6 Milking frequency

The number of milking or milking frequency will also affect the milk production of dairy cows. Nevens (2010) reported that as the quantity of milk present in the udder becomes greater, there will be an increase in the pressure within the udder of the cow. In high producing cows, frequent release of the pressure by the milking of cows from the udder allows the milk-making process to occur at a more rapid rate. For low yielding cows, milking more than two times daily brings little or no increase in the milk yield. However, high

yielding cows that have been milked three or four times daily has an increase in their milk yield. Flanders (2012) stated that regular milking is important to maintain high milk production. A commercial dairy cow is normally milked twice per day. Flanders (2012) even stated that milking cows thrice per day will increase the total milk production up to 20% compared to two times of milking per day.

2.2.7 Length of dry period

Dry period is the period of the cessation of milk production by the dairy cows (Habib *et al.*, 2010). According to Nevens (2010), it was stated that in general, the longer the dry period, the higher the milk production of the cows in the subsequent lactation. This is because a longer dry period allows a cow to build up her body condition and store mineral reserves, such as calcium and phosphorus. Eckles and Anthony (2011) had also stated that cows will produce more milk in a year if they were allowed to have a dry period of 42-60 days.

2.2.8 Feeding management

The maintenance of lactation of cows is closely related to their adequate feed intake (Campbell et al., 2003). Nevens (2010) reported that when cows are fed amply, they would probably produce more amount of milk.

2.2.9 Effects of climate

Climate can either directly or indirectly affect the milk production of cows (Sastry & Thomas, 2005). The direct effect of climate on milk production includes the influence of environmental temperature, humidity and solar radiation. Constant exposure of cattle to high temperature will cause a rise in the rectal temperature and thus, decline the feed intake, reduce the growth and loss of body weight and lastly, leads to the reduction in the production of milk (Sastry & Thomas, 2005). Campbell et al. (2003) stated that high environmental temperature can cause the decrease in the appetite and reduction in the secretion of thyroxine that eventually causes a decrease in the milk production of the dairy cows. For the indirect effect of climate on the cows, Sastry and Thomas (2005) stated that climate influences the quantity and quality of feed available. Tropical plants mature earlier and cows have to digest coarser fodders and this will add to their heat load. In high humid areas, plants have more water content and cows might not get enough dry matter by consuming such plants.

2.2.10 Health condition of cows

Existence of diseases can cause a reduction in the amount of milk secreted by the cows (Campbell et al., 2003). The major disease in dairy cattle is mastitis and Field and Taylor (2012) have also deduced that mastitis in dairy cows can reduce milk production by 30% or more.

3. Methodology

3.1 Study area

The retrospective study was carried out at the Yun Fook Resources farm, a dairy farm located in Keningau, Sabah. The farm is located approximately 4.40 km from Keningau town. The farm is situated at N 5°19’46.2’’ and E 116°11’37.9’’. The climate of the study site was

tropical climate and characterized by the hot and humid weather. The average temperature of the farm area was approximately about 26℃ and the average humidity level was about 65 %. The farm was located 300 meters from the sea level and it lies on a highland area of Keningau, Sabah. Currently the farm has dairy cattle of the Sahiwal x Friesian crossbreeds (5194 heads), dairy goats (356 heads) and deers (224 heads).

3.2 Management systems

The lactating cows were supplemented with mixture of concentrates consisting of soybean powders, palm kernel cake, corn and minerals. The concentrate mixture was provided at 10.5 kg per cow. Concentrates were only provided to the cows before each milking sessions. Napier grasses were provided to the cows ad libitum after each milking sessions. The volume of the supplementary feed could be adjusted according to the level of milk yield. All the cows in the farm were raised in an intensive system under free stalls. All lactating cows were milked using the automated milking system (AMS) for two times a day, the first session at 4 a.m. and the second session at 4 p.m. Milking was done in the milking parlour.

3.3 Data collection

The retrospective data of the productive performance records were collected from 123 primiparous Sahiwal x Friesian crossbred dairy cows that first calved between 2017 and 2018. There was limited use of natural breeding. Hence, only records related to Artificial Insemination (AI) were considered. Besides that, cows with records of abortion or any anomaly were not included in the current study. The automated milking system (AMS) recorded the information of the cows each time they were milked by an AMS unit during the 24 hours period. Hence, the milking record was collected and update in a software known as DelPro 5.2.1. In addition to that, the dates for the drying off and calving of the cows were manually updated into the software by the farm technicians. Meanwhile, any information related to the management and feeding practices were also gained via personal interview with the farm manager, Mr. Prem Ananthan.

Age at first calving (AFC) was calculated by subtracting the date of birth from the date of the first calving of the cows (Massawe, 2011). For the present study, AFC was recorded as in months. The effect of AFC on the productive performance of the cows was evaluated by classifying them into 7 groups based on the modifications of the method by Sawa *et al.* (2018): Group 1 (≤ 22 months old), Group 2 (23-24 months old), Group 3 (25-26 months old), Group 4 (27-28 months old), Group 5 (29-30 months old), Group 6 (31-32 months old) and Group 7 (>32 months old).

To evaluate the effect of age at first calving (AFC) on the productive performance of the cows, four dependent variables had been retained, they were the first-lactation milk yield, average daily milk yield, lactation length and dry period. For the first-lactation milk yield (FLMY), it was calculated by summing up the amount of milk yields for the whole lactation period during the first lactation of the cows. In other words, it is the total amount of milk produced by the cow from the calving date to the dry off date (Massawe, 2011). First-lactation milk yield was expressed in litres (L). Lactation length (LL) was evaluated by subtracting the calving date from the dry off date (Rehman *et al.,* 2008). According to Rehman *et al.* (2008), it was suggested that the lactation length should be more than 60 days and thus, any data of lactation length that is lower than this value was not included in the current study. Average daily milk yield (ADMY) was calculated by dividing the first-

lactation milk yield by the lactation length of the cows and it was expressed as litres per day. Dry period (DP) on the other hand, was calculated as the interval in days between the cessation of the previous milking to the next calving dates (Massawe, 2011). The data regarding the dry period of the cows were adjusted according to the acceptable range as suggested by Rehman *et al.* (2008), in which only the dry period of 30 to 730 days was included for the current study.

3.4 Data analysis

For the statistical analysis, the general linear model procedure (GLM) was used to analyse the data collected. This analysis was performed by using the SAS version 9.4 for Windows program software. Results were expressed as least square mean± standard error of the mean. Comparison between the means were evaluated using Duncan's Multiple Range Test (DMRT). A probability of less than 0.05 was considered significant ($p<0.05$). The CORR Pearson procedure was also used to calculate the coefficients of simple correlation between the parameters measured.

3.5 Limitations of study

There were no proper retrospective data records related to the health status of the cows such as the mastitis records, hoof problems or other disease records on the farm. Besides, previous records of milk composition of the cows were also not available on the farm. Thus, In the present study, health aspect and milk composition of the cows were not conducted.

4. Results and Discussions

Data from the analysis of variance showed the effect of age at first calving (AFC) on the lactation performance of the primiparous Sahiwal x Friesian crossbred dairy cows and this was presented in Table 1. The lactation performance of the primiparous Sahiwal x Friesian crossbred dairy cows was measured by evaluating the first-lactation milk yield (FLMY), lactation length (LL), average daily milk yield (ADMY) and dry period (DP). Based on the analysis of variance, it was found that the effect of AFC on FLMY, LL and ADMY were significant ($p<0.05$). Meanwhile, AFC showed non-significant effect on the DP of the cows ($p>0.05$).

Table 1: Least square means and standard error of first-lactation milk yield, lactation length, average daily milk yield and dry period of primiparous Sahiwal x Friesian crossbred dairy cows

Group	AFC (months)	N	FLMY (litres)	LL (days)	ADMY (litres/day)	DP (days)
1	≤22	12	5976.10± 314.48^{b}	279.67± 24.12^{c}	22.42± 1.40^{ab}	129.42± 23.06^{a}
2	23-24	8	7210.14± 384.84^{a}	410.25± 19.51^{a}	17.62± 0.60^{c}	106.88± 18.09^{a}
3	25-26	10	7053.80± 342.98^{a}	362.10± 21.95^{b}	20.02± 1.47^{bc}	126.50± 35.09^{a}

4	27-28	21	5797.25± 221.72^{b}	282.14± 11.06^{c}	20.97± 0.93^{abc}	107.52± 15.21^{a}
5	29-30	29	5891.39± 195.10^{b}	253.00± 11.07^{c}	24.10± 0.94^{a}	138.31± 13.71^{a}
6	31-32	15	5553.32± 233.76^{b}	264.47± 19.04^{c}	22.08± 1.36^{ab}	112.93± 16.52^{a}
7	>32	28	5623.09± 131.93^{b}	238.61± 8.66^{c}	24.16± 0.79^{a}	145.96± 10.38^{a}

a,b,c: Differences between the groups with same letter in the same column are non-significant ($p>0.05$), differences between the groups with different letter in the same column are significant ($p<0.05$)

4.1 Effect of AFC on FLMY

Based on the analysis of variance in Table 1, it was found that the AFC had significant effect on the FLMY ($p<0.05$). The results of the analysis of variance is in agreement with the results of the studies conducted by Singh *et al.* (2019), in which it was reported that the dairy cows reared under tropical climate showed that AFC had a significant effect on the milk yield. In comparison to the present study, studies conducted by Cooke *et al.* (2013) and Teke and Murat (2013) have indicated that AFC had no significant effect on the FLMY of the primiparous cows. The FLMY were the highest in cows with AFC of 23-24 months old and 25-26 months old of age at 7210.14± 384.84 litres and 7053.80± 342.98 litres, respectively. According to Nilforooshan and Edriss (2004), cows that calved at 23-24 months of age was the most profitable as it produces a good amount of milk. However, Table 1 shows that the cows that calved the earliest (≤ 22 months of age) produced lower FLMY and as stated by Nilforooshan and Edriss (2004), early calving is detrimental to milk yield of the cows. Cows that calved early probably produced less milk at first lactation because they need to compete with the older cows for resources (Nilforooshan & Edriss, 2004; Teke & Murat, 2013). The negative effect of early calving on milk yield can be due to the higher body weight gain before puberty (M'Hamdi *et al.,* 2012). According to Table 1 above, cows that belong to the AFC group of 27-28, 29-30, 31-32 and >32 months of age group produced less amount of milk at first lactation. The findings of Table 1 for the current study is similar with the findings of the study conducted by Sawa *et al.* (2018), that have indicated that there is a significant decrease in the milk yield for the cows that were firstly calved after 28 months of age.

4.2 Effects of AFC on LL

Based on the analysis of variance in Table 1, it was found that the AFC had significant effect on the LL ($p<0.05$). According to another study by Wondifraw *et al.* (2013), it was also found that the LL was significantly affected by AFC for the Friesian x Deoni crossbred cows reared in Parbhani, India. Meanwhile, several studies have found the opposite results that indicated the effects of AFC on LL were non-significant ($p>0.05$) (Tekerli & Kocak, 2009; Habib *et al.,* 2010; M'Hamdi *et al.,* 2012). The longest LL was found in cows with AFC of 23-24 months of age at 410.25± 19.51 days, followed by the second longest LL, that was of the cows with AFC of 25-26 months of age at 362.10± 21.95 days. Cows with AFC of ≤ 22 months of age

showed lower LL and this can be due to the possibility that the cows were dried off earlier due to low lactation yield as they need to compete for feed with the bigger size cows that are older than them (Nilforooshan & Edriss, 2004; Teke & Murat, 2013). Commonly, in most modern dairy farms, a LL of 305 days was accepted as the standard. Thus, according to the current study, only cows of 23-24 months old and 25-26 months old were in a longer lactation duration than the standard 305 days of lactation length. The lactation length for the cows above 26 months of age was shorter and it may be related to the incomplete lactation due to the earlier drying off because of low total milk production (M'Hamdi *et al.*, 2012). According to Nilforooshan and Edriss (2004) and Teke and Murat (2013), the cows were most probably dried off earlier due to the higher chances of udder diseases when they are calved at an older age.

4.3 Effects of AFC on ADMY

Based on the analysis of variance in Table 1, the AFC had significant effect on the ADMY ($p<0.05$). The lowest ADMY was found in cows with AFC of 23-24 months of age at 17.62± 0.60 litres/day and the highest at 29-30 months of age and >32 months of age at 24.10± 0.94 litres/day and 24.16± 0.79 litres/day, respectively. This is because the cows that calved late have more developed mammary glands than the cows that calved early (Zhao *et al.,* 2012). Cows that calved early probably produced less milk at first lactation because they are smaller in size than the cows that calved late and they need to compete with the older cows for resources such as feed (Nilforooshan & Edriss, 2004; Teke & Murat, 2013). However, the results of another study by Habib *et al.* (2010) have found an opposite finding, in which the ADMY was not significantly affected by the AFC ($p>0.05$). This difference can be due to the difference in management or environment of the study conducted by the author.

4.4 Effect of AFC on DP

Based on the analysis of variance in Table 1, it was found that the AFC had no significant effect on the DP ($p>0.05$). The findings regarding the analysis of variance in the current study is similar to the findings of the study conducted by Habib *et al.* (2010), that indicated that the DP was not significantly affected by AFC. However, the results of the studies conducted by Erdem *et al.* (2007), Zambrano *et al.* (2006), Bilgic and Alic (2005) and Pelister *et al.* (2000) found a significant effect of AFC on the DP. The variations in the results by the different authors can be due to difference in the breed of cows, feeding, management or environment.

4.5 Correlations between production performance traits

Table 2 below shows the correlation coefficients (r-value) of the production performance traits investigated in the current study. There was a significant and positive relationship between the first-lactation milk yield (FLMY) and lactation length (LL) with an r-value of 0.61 ($r=0.61$; $p<0.0001$). This indicated that the longer the cows were in the first lactation, the higher the first-lactation milk yield.

Besides, it was found that FLMY had a significant and positive relationship with dry period (DP) ($r=0.43$; $p<0.0001$). It should be noted that longer dry period resulted from the higher first-lactation milk yield. However, FLMY had a non-significant relationship with the average daily milk yield (ADMY) ($P>0.0001$). This means that an increase or decrease in the first-lactation milk yield will not cause any significant changes in the average daily milk yield.

Meanwhile, significant ($p<0.0001$) and negative correlations were observed between LL with ADMY ($r=-0.73$) and DP ($r=-0.36$). This shows that higher average daily milk yield and longer dry period can be expected in cows with shorter lactation length. Lastly, ADMY was found to have a significant and positive relationship with DP ($r=0.79$; $p<0.0001$). The observation indicates that higher average daily milk yield is related to longer dry period.

Table 2: Correlations between the production performance traits of Sahiwal x Friesian Crossbred dairy cows

Trait	FLMY (litres)	LL (days)	ADMY (litres/day)	DP (days)
FLMY (litres)	1.00			
LL (days)	0.61	1.00		
ADMY (litres/day)	n.s.	-0.73	1.00	
DP (days)	0.43	-0.36	0.79	1.00

n.s.: non-significant relationship between variables ($p>0.0001$)

5. Conclusion

In summary, considering the first-lactation milk yield, lactation length, average daily milk yield and dry period, it is recommended that the cows should be first milked between 23 and 24 months of age. The findings in the present study could help farmers to identify the weaknesses and strengths in the breeding management of the cows through proper planning. Farmers must be encouraged to keep continuous record of the daily milk yield and relevant data regarding the production performances of the cattle as a guide to further improve the productivity of the cows on the farm.

6. Acknowledgement

The authors also thank the Farm Manager and staff members of Yun Fook Resources Sdn Bhd for making the relevant data available for this study.

References

Azhar H., Zamri-Saad M., Jesse F.F.A. & Annas S. 2016. Retrospective Study on Milk Production and Reproductive Performance of Dairy Cattle in a Farm in Selangor, Malaysia. *Universiti Putra Malaysia.* 157-162.

Bajwa I.R., Khan M.S., Khan M.A. & Gondal K.Z. 2004. Environmental Factors Affecting Milk Yield and lactation Length in Sahiwal Cattle. *Pakistan Vet. J.* **24(1):** 23-27.

Bilgic N. & Alic D. 2005: Milk Yield Traits of Holstein Friesian Cows Raised in Polatli State Farm. *In: Faculty of Agriculture, Sabancı University.* **19:** 116-119.

Boniface B., Silip J.S. & Ahmad A.H. 2010. Dairy Cattle Management: Survey on Dairy Cattle Lactation Trend in Sabah.

Campbell J.R., Kenealy M.D. & Campbell K.L. 2003. Animal Sciences- The Biology, Care and Production of Domestic Animals (4th Edition). McGraw-Hill, Boston.

Cooke J.S., Cheng Z., Bourne N.E. & Wathes D.C. 2013. Association Between Growth Rates, Age At First Calving And Subsequent Fertility, Milk Production And Survival In Holstein-Friesian Heifers. *Open J. Anim. Sci.* **3:** 1–12.

Damron W.S. 2013. Introduction to Animal Science: Global, Biological, Social and Industry Perspectives (5th Edition). Pearson, Boston.

Department of Veterinary Services (DVS). 2013. Malaysian Livestock Breeding Policy. http://www.dvs.gov.my/dvs/resources/user_1/DVS%20pdf/Livestock_Breeding_Policy.pdf (Accessed on 4 January 2020).

Department of Veterinary Services (DVS). 2019. Livestock Planning 2018-2019. http://www.dvs.gov.my/index.php/pages/view/1847?mid=42 (4 January 2020).

Eckles C.H. & Anthony E.L. 2011. Dairy Cattle and Milk Production. Biotech Books Publications, Delhi.

Erdem H., Atasever S. & Kul E. 2007. Milk Yield and Fertility Traits of Holstein Cows Raised At Gokhoyuk State Farm, 1. Milk Yield Traits. *Anadolu Journal of Agricultural Science.* **22:**41-46.

Field T.G. & Taylor R.E. 2012. Scientific Farm Animal Production (10th Edition). Pearson Prentice Hall, Upper Saddle River, N.J.

Flanders F.B. 2012. Exploring Animal Science. Delmar Cengage Learning, Clifton Park, N.Y.

Gader A.Z.A., Mohamed-Khair A.A., Musa L.M.A. & Peters K.J. 2007. Milk Yield and Reproductive Performance of Friesian Cows under Sudan Tropical Conditions. Arch. Tierz, Dummerstorf. **50(20):** 155-164.

Habib M.A., Afroz M.A. & Bhuiyan A.K.F.H. 2010. Lactation Performance of Red Chittagong Cattle and Effects of Environmental Factors. *The Bangladesh Veterinarian.* **27(1)**: 18-25.

M'Hamdi N., Bouallegue M., Frouja S., Ressaissi Y., Brar S.K. & Hamouda M.B. 2012. Effects of Environmental Factors on Milk Yield, Lactation Length, and Dry Period in Tunisian Holstein Cows. *J. of Animal Nutrition, Management and Health.* 153-164.

Massawe. 2011. Evaluation of Current Performance of Dairy Cattle in Asas and Kitulo Farms in the Southern Highlands of Tanzania. *Dissertation regarding the Degree of Master of Science in Tropical Animal Production of Sokoine University of Agriculture, Morogoro, Tanzania.*

Mikesell R. & Baker M. 2011. Animal Science Biology and Technology (3rd Edition). Delmar Cengage Learning, Australia/ United States.

Msanga Y.N., Bryant M.J., Rutam I.B., Minja F.N.& Zylstra L. 2000. Effect of Environmental Factors and the Proportion of Holstein Blood on the Milk Yield and Lactation Length of Crossbred Dairy Cattle on Smallholder Farms in North-East Tanzania*. Tropical Animal Health and Production.* **32:** 23-31.

Nevens W.B. 2010. Principles of Milk Production. Axis Books (India), Jodhpur.

Nilforooshan M.A. & Edriss M.A. 2004. Effect of Age at First Calving on Some Productive and Longevity Traits in Iranian Holsteins of the Isfahan Province. *Journal of Dairy Science.* **87:** 2130-2135.

Österman S. 2003. Effects of Extended Calving Interval and Increased Milking Frequency on Productivity and Welfare of Dairy Cattle. Department of Animal Nutrition and Management, Swedish University of Agricultural Sciences. 383.

Payne J.A. & Wilson T.R. 1999. An Introduction to Animal Husbandry in the Tropics. Oxford, UK, Blackwell Science Ltd.

Pelister B., Altinel A. & Gunes H. 2000. An Investigation On The Milk Yield Characteristics Of Black Pied Cattle Of Different Origin In Commercial Farm Conditions. *Istanbul University Veterinary Faculty Journal.* **26:** 201-214.

Rehman Z., Bhatti S.A., Khan M.S. & Iqbal J. 2008. Factors Affecting First Lactation Performance of Sahiwal Cattle in Pakistan*. Arch Tierz Dummerstorf*. **51:**305–317.

Sastry N.S.R. & Thomas C.K. 2005. Livestock Production Management (4th Edition). Kalyani Publishers, Ludhiana, India.

Sawa A., Siatka K. & Krezel-Czopek S. 2018. Effect of Age at First Calving on First Lactation Milk Yield, Lifetime Milk Production and Longevity of Cows. *Annual Animal Science*. **19(1)**: 189-200.

Sim R.M.L. & Suntharalingam C. 2015. Dairy Sector in Malaysia: A Review of Policies and Programs.

Singh P., Panchbhai G. & Prasad C.K. 2019. Optimizing Age at First Calving in Dairy Animals Under Tropical Climate.

Teke B. & Murat H. 2013. Effect of Age At First Calving On First Lactation Milk Yield, Lifetime Milk Yield And Lifetime In Turkish Holsteins Of The Mediterranean Region In Turkey. *Bulgarian Journal of Agricultural Science.* **19(5):** 1126-1129.

Tekerli M. & Kocak S. 2009. Relationships between Production and Fertility Traits in First Lactation and Life Time Performances of Holstein Cows under Subtropical Condition. *Archiv Tierzucht*. **52(4):** 364-370.

Tekerli M., Akinci Z., Dogan I. & Akcan A. 2000. Factors Affecting the Shape of Lactation Curves of Holstein Cows from the Balikesir Province of Turkey.

Thomas H.S. 2005. Getting Started with Beef and Dairy Cattle. Storey Pub, North Adams, MA.

Wondifraw Z., Thombre B.M. & Bainwad D.V. 2013. Effect of Non-Genetic Factors on Milk Production of Holstein Friesian x Deoni Crossbred Cows. **4(7):** 106-112.

Zambrano S., Contreras G., Pirela M., Canas H., Olson T. & Landaeta-Hernandez A. 2006. Milk yield and reproductive performance of crossbred Holstein ×_Criollo Limonero cows. *Science Magazine, Faculty of Veterinary Science, University of Zulia, Venezuela.* **26:** 155-164.

Zhao X., Li R., Huang J., Li J., Hou M. & Zhong J. 2012. Association of Some Physiological Factors and Milk Performance in Chinese Holstein. *Asian Journal of Animal and Veterinary Advances.* **7(12):** 1356-1363.

Faculty of Sustainable Agriculture,
Universiti Malaysia Sabah,
Locked Bag No 3, 90509, Sandakan,
Sabah, Malaysia,
E-mail: navinkumar1793@gmail.com, nur.hardy@ums.edu.my*

* *Corresponding author*