Cakrawala
JURNAL LITBANG KEBIJAKAN

http://cakrawalajournal.org/index.php/cakrawala
Volume 13 Nomor 2 Desember 2019

Effect of Growth Rates and Age at First Calving of Dairy Heifer on Subsequent Lactation Performance

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DOI: https://doi.org/10.32781/cakrawala.v13i2.307

ARTICLE INFO

Dara,
Pertumbuhan,
Umur,
Produksi,
Heifers,
Growth,
Age,
Production

Article History:

Received : September 2019

Accepted : December 2019

Abstrak:
Tujuan dari kajian ini adalah untuk mengetahui dampak pertumbuhan dan umur beranak pertama terhadap produktivitas sapi perah dara secara keberlanjutan. Metode kajian bersifat deskriptif dengan mencermati data-data sekunder dan pustaka. Penurunan biaya pemeliharaan dapat dilakukan dengan mempercepat pertumbuhan dan umur beranak pertama. Langkah ini dapat mempercepat umur kawin dara karena dapat mencapai 55% bobot dewasa tubuh lebih cepat yang merupakan syarat minimal bobot tubuh untuk kawin dari sapi dara. Beberapa studi menunjukkan bahwa percepatan pertumbuhan dan umur beranak pertama berdampak pada rendahnya produksi susu pada laktasi pertama. Namun, setelah 5 tahun, induk sapi memproduksi susu dengan jumlah hari produksi yang lebih tinggi dan mempunyai total produksi susu yang lebih tinggi dibandingkan yag beranak di atas 2 tahun. Dengan percepatan pertumbuhan dan umur beranak pertama dapat meningkatkan keuntungan jangka panjang dari industri sapi perah.

Abstract:
The objectives of this study are to know the effect of growth and age of first calving on subsequent lactation performance of dairy heifers. The study method is descriptive by looking at secondary data and literature review.Decreasing cost of rearing dairy heifer without sacrificing future lactation should be done to increase profitability by accelerating growth rates and reducing age at first calving. By increasing growth rates, heifers will bred early because heifers will quickly achieve 55% of mature body weight. Some study show that improving growth rate and reducing age at first calving will effect on reducing lactation performance at first lactation. However, after 5 year of life heifers will have more days in milk and % life spent in milk. It will make heifer have more total milk yield and average milk of life. Therefore, accelerating growth rate and age at first calving can increase lifetime profit of dairy industry.

Introduction

Rearing heifers, the second or third largest costs in dairy industry, have a contribution of total cost milk production up to 20%, with 73% of this is feed cost (Heinrichs, 1993). It means that increasing cost of dairy heifer management will decrease profitability. So, it's reasonable to reduce the cost of dairy heifer management to increase profitability without decreasing the future productivity. As we know, the goal of rearing dairy replacement heifer is to reduce economic and environmental cost without sacrificing future lactation performance (Hoffman, et al, 2007). Age at first service and age at first calving of small scale farm in East

Cite this as:

Abdurrahman, A. M., Setiasih. (2019). Effect of Growth Rates and Age at First Calving of Dairy Heifer on Subsequent Lactation Performance. *Cakrawala, 13*(2). 196-204. https://doi.org/10.32781/cakrawala.v13i2.307.

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p-ISSN 1978-0354 | e-ISSN 2622-013X

Java, especially in Malang Regency, was reported about 18 to 23 month and 28 to 32 month (Sarwiyono, et al, 1993).

The cost of rearing dairy replacement heifers can be diminished by accelerating growth and reducing age at first breeding that automatically lowering age at first calving (Hoffman, et al, 1996). The present study provides evidence that a high age at 1st calving and a high body condition at 1st breeding are associated with low lifetime net milk revenues (Hultgren, 2011). An increase of growth rate from 400 to 850 g/d can decrease age at first oestrus from 16.6 to 8.4 months (Sejrsen, 1994). By reducing age first calving, the time of rearing heifer will be reduced, that will suppress the cost of rearing heifer. Pirlo, et al, (2000) reported that decreasing one month of age at calving can reduced the production cost around $50 per heifer. Other report presented by Grexton (2015) that lowering the first calving age could save $35 to $150 per heifer per year. Tozer & Heinrich (2001) also reported that reducing age at first calving from 25 to 24 or 21 months decreased replacement costs by 4.3% or 18% respectively.

Dairy heifers are typically ready to be mated at about 55% of their mature body weight. Adequate nutrition can lower the time to first breeding and accelerate the heifer's entry into the milking herd. However, accelerating growth rate can also decrease eventual milk production. If heifers are fed diets too high in energy, the developing mammary gland will contain more fat and less secretory tissue, that will affect to decrease potential milk production (knowlton & Nelson, 2003; Rincker, et al, 2008). In some case, accelerating growth rate and reducing age at calving have reduced milk production in first lactation (Van Amburgh, et al, 1998; Lammers, et al, 1999; and Radcliff, et al, 2000).

Some papers show the effect of growth rates and age at first calving on lifetime productivity, reproductivity and profitability on dairy industry. This review paper was done to investigate the effect of growth rates and age at first calving on subsequent lactation performance, including reproductivity and lifetime profit.

Result and Discussion

Growth rates on lactation performance

Growth rates effect on age and bodyweight at first calving.

Dairy replacement heifer should be properly fed and managed to produce to their inherited potential after calving. It is important to realize that heifers reach puberty at a specific size, rather than a certain age. Dairy heifers are typically ready to be mated at about 55% of their mature body weight. Diets should be formulated for growth rates that will result in Holstein heifers weighing 350 to 375 kg at 13 months, and 545-570 kg after calving (Knowlton & Nelson, 2003).

Nilsforooshan & Edriss, (2004) reported that Iranian Holstein Heifer at Isfahan Province have age at first calving between 21 to 39 month (Figure 1). This data shows that heifers can achieve 55% of body weight around 10 to 11 month of age. It's no different with Italian Holstein Heifers that have age at first calving between 20 to 36 month of age (Pirlo, et al, 2000). Grexton (2011) reported that around 45% of dairy replacement heifers have age at first calving more than 26 month. So, Frequency of age at first calving of some dairy industry is start from 20 to 39 month of age.

Accelerated pre and postpubertal ADG, from 700 g/d to 900 g/d, have no significantly reduce calving age and postpartum body weight. This result is different with Hoffman, et al, (1996), Accelerated ADG postpubertal could significantly reduce calving age and postpartum body weight. Heifers with ADG 900 g/d can reach age at first calving 2

months earlier than those with ADG 700 g/d. The problem is that postpartum body weight of heifers with higher ADG is smaller than control. Heifers with accelerated growth rates have body condition score higher than control. This indicates that there has been an improvement of fat deposition caused by the increasing of feed quality. Heifer with high body condition score would reduce feed intake and increase fat mobilization at 10 day prepartum. Therefore, heifers with high body condition score will lose more body weight than heifers with less body condition score (Grummer, et al, 1995; Hoffman, et al, 1996).

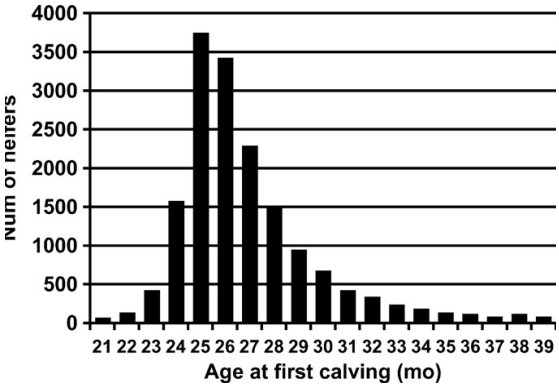

Figure 1. Frequency of age at first calving on Iranian Holstein
Source: Nilsforooshan & Edriss, 2004

Growth rates effect on subsequent lactation performance.

Abeni, et al, (2000) reported that no significant different between control ADG (700 g/day) with accelerated ADG (900 g/day) on average milk yield. In contrary, Van Amburgh, et al, (1998) reported that the different ADG at 600 , 800, and 1000 g/day, at prepubertal (150 to 320 kg BW) has negative effect on actual 305 day milk yield at first lactation, 9873, 9620 and 9387 kg, respectively. However, the different ADG has no negative effect on actual 305 day milk yield at second lactation. This report is supported by Radcliff et al. (1983) that different ADG (770 and 1120 g/day) at prepubertal, shows the reducing of average of 270 day milk production (29.1 and 25.6 kg/d, respectively) and projected total 305-d milk production (8618 and 7503 kg, respectively). It's indicated that the ADG pre and post pubertal should be not more or equal than 1000 g/day. The ADG that more than 1000 g/d has an effect on fat deposition in mammary gland, that will reduce mammary parenchymal mass at puberty, that potentially decreased subsequent milk production (Rincker, et al, 2008).

Age at first calving on lactation performance

Relation of age at first calving and subsequent reproductive performance.

Cooke, et al, (2013) reported that Age at first calving has effects on some subsequent reproductive performance (Table 1). At first lactation, age at first calving have an influence on postpartum conception and no effect on postpartum service, while at the second lactation, age at first calving have an effect on postpartum service only and no influence on postpartum conception. Data on Table 1 shows that age at first calving at 23-25 month has the best of all subsequent reproductive performance except calving age. The number of postpartum service,postpartum conception and service per conception are lower than the other, but for age at every calving still higher than <23. There is a significant difference between age at first calving <23 and 23-25 on age at second calving, but no have significant different at age of third calving. Meyer, et al, (2004) also reported that reproductive performance of heifers which have low (22.3 mo) and high (25.9 mo) age at first calving are poorer than medium level (23.7 mo). The medium level has days open, conception rate and service per conception lower than low and high age at first calving that will cause shorter calving interval on low and high age at first calving.

Age at first calving on subsequent lactation performance.

The increasing of age of first calving has negative correlation with milk production of first lactation, and the best milk production would be achieved at 22 to 29 month of age at first calving (Murdani, 2018).Heifers with age of first calving less than 24 month have milk production lower than that at 24 to 26 month (Awan, et al., 2016)

Table 2 showed that age at first calving has no difference effect on first and second lactation performance. But, has significant differences on total DIM, total milk yield, % life spent in milk, cumulative in 5 year of life. Heifers Calving age at <23 and 23-25 months have more total DIM and milk yield than those with calving age more than 25 month as well as the milk per day of life. Total milk yield between of age at first calving 23-25 month is the highest than the other after five year of life. The difference between age at first calving at 23-25 with <23, 26-30 and >30 are 1405, 1872, and 6700 kg, respectively. The highest milk production of age at first calving at 23-25 months is caused by the highest number of DIM, as the effect of low calving interval. Lin, et al, (1988), studied 2 groups of early and late breeding (subsequently early and late calving) heifers in Canada, reported that no significant difference of herd life between early and late breeding. However, productive 1ife from first calving up to 5 year of age in life was longer for early-bred heifers than for late-bred heifers (730 vs. 623 d), and early calved heifers produced more total milk (10,693 vs. 9218 kg), and yielded more milk per day of 61 months herd life (6.8 vs. 5.9 kg). Grexton (2015) showed that the increasing of age at first calving will slightly reduce lifetime milk production, even though increase herd of life.

Age at first calving on lifetime profit.

The aim of reducing age at first calving is to suppress cost of rearing heifer that potentially increase profitability of dairy industry. Early calving is mainly based on findings of a longer productive life, a higher total lifetime production and reduced rearing costs at lower calving ages. Table 2 showed that the difference between age at first calving at 23-25 with <23, 26-30 and >30 are 1405, 1872, and 6700 kg, respectively, for one heifer. If the priest of milk is around ฿18, we will lose profitability per heifer around ฿ 25,290, ฿33,696, and ฿ 120,600, respectively. In another word, the loss of milk after 5 year of life on age at first calving <23, 26-30 and >30 months are 6.25, 8.32, and 29.80%, respectively than that at 23-25 months.

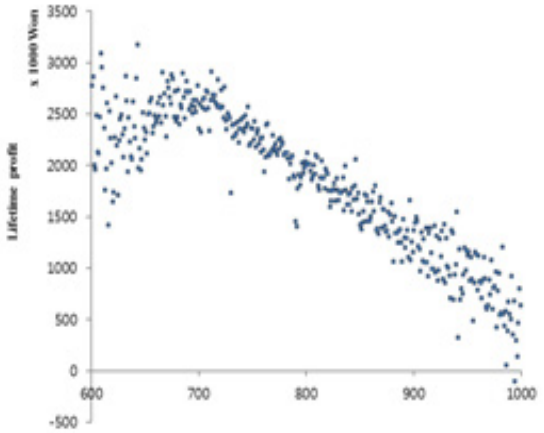

Figure 2. Distribution of lifetime profit according age of first calving

Source: Do, et al, 2013

Other report in Figure 2, showed that the relationship of ages at first calving in Korean Holstein with the simulated lifetime profits has a conjectural peak of lifetime profit coincidently was located around 690 d (22.6 months) at first calving and after that will reduce with an increase in age at first calving. By reducing age at first calving can also decline replacement cost and improve lifetime profit. Age at first calving is a standard that should be properly managed in order to achieve the highest economic return and longer

productive life. Lifetime profit Increased from approximately$727.3 to $2,363.6 when age at first calving decreased from 1,000 d (32.8 month) to 680 (22.3 month) (Do, et al, 2013).

Another study was done by Pirlo, et al (2000) in Italian Holstein, showed the positif lifetime profit can be achieve at calving age below 26 month (Figure 3). But, the higher lifetime profit would be reached by age at first calving at 23 and 24 month. Age at first calving reduction below 26 months of age consistently produced a positive effect on lifetime profit because income is more than rearing cost. Reduction of age at first calving would be profitable, if low milk prices and high rearing costs occur but should consider possible biological limitations (Pirlo, et al, 2000).

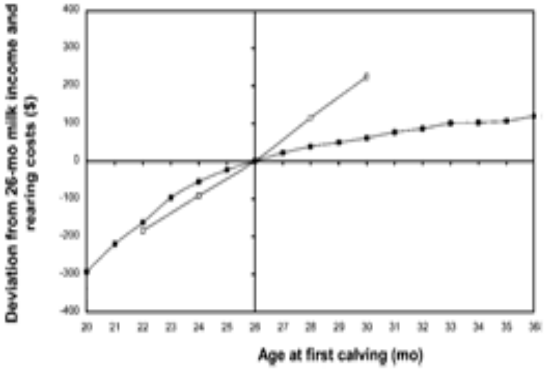

Figure 3. Effect of age at calving on income (Close Square) and rearing costs (Open Square)

Source: Pirlo, et al, 2000

Conclusions

Growth rates and age at first calving can be used for Increasing productivity and lifetime profit of dairy cattle. Growth rates at 700 to 800 g/d and age at first calving around 22-25 month are the best way to increase subsequent lactation performance and lifetime profit of dairy cattle. Government should create standard operational procedures of calf and heifers management that can be used by small scale of dairy farmer as guidance to increase the quality of calf and heifer management that would affect on their profitability. Government through dairy cattle breeding unit could produce dairy heifers with age at first service at 13 to 15 month and age at first calving at 22 to 24 month that can be used by small scale dairy farmer to increase their profitability.

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Table 1. Relation of age at first calving and subsequent reproductive performance.

	Age at first calving (mo)			
	<23	23-25	26-30	>30
Age at 1st calving	680±2[d]	729±1[c]	827±3[b]	1042±19[a]
1st lactation				
Postpartum service (day)	86±8	78±2	82±3	82±6
Postpartum conception (day)	128±33[b]	117±7[b]	137±9[b]	170±18[a]
Service per conception	2.4±0.3	2.2±0.2	2.5±0.2	3.0±0.4
Age at 2nd calving (day)	1088±12[d]	1131±10[c]	1248±11[b]	1492±24[a]
2nd lactation				
Postpartum service (day)	81±4[a]	72±3[b]	70±2[b]	92±7[a]
Postpartum conception (day)	127±11	111±7	133±11	144±20
Service per conception	2.7±0.3	2.1±0.2	2.6±0.3	2.2±0.3
Age at 3rd calving (day)	1512±21[c]	1521±4[c]	1638±15[b]	1944±38[a]

[abcd] Different superscript at same row shows significant difference
Source: Cooke, et al.,(2013)

Table 2. Relation of age at first calving and subsequent lactation performance

	Age at first calving (mo)			
	<23	23-25	26-30	>30
1st lactation				
Peak milk yield (kg/ day)	32±1	33±1	35±1	35±1
305 d yield (kg)	8494±206	8811±167	9103±166	8914±335
Total DIM (day)	355±14	349±11	357±12	377±17
Total milk yield (kg)	9384 ± 335	9420 ± 339	9985 ± 346	10,136 ± 585
2nd lactation				
Peak milk yield (kg/ day)	40 ± 1	41 ± 1	44 ± 1	43 ±
305 d yield (kg)	9340 ± 210	9908 ± 190	10,546 ± 183	9633 ± 537
Total DIM (day)	320 ± 12	325 ± 9	356 ± 11	340 ± 24
Total milk yield (kg)	9624 ± 408	10,055 ± 295	11,194 ± 325	9748 ± 678
5 year of life				
Total DIM (day)	731 ± 42[a]	763 ± 27[a]	692 ± 25[a]	587 ± 38[b]
Total milk yield (kg)	21,072 ± 1400[a]	22,477 ± 912[a]	20,605 ± 863[a]	15,777 ± 1237[b]
% life spent in milk	46 ± 2[a]	45 ± 1[a]	40 ± 1[b]	34 ± 2[c]
Up to 3rd calving				
Milk per day of life (kg)	12.0 ± 0.4[a]	11.8 ± 0.3[a]	10.9 ± 0.4[a]	9.0 ± 0.6[b]

[abc]Different superscript at same row shows significant difference

Source: Cooke, et al., (2013)