

REPRODUCTION AND PRODUCTION STRATEGIES FOR HIGH YIELDING DAIRY COWS*

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The relationship between the length of days open and days dry periods and milk performance in first three and first five complete lactations of high yielding Polish Holstein-Friesian var. Black-and-White cows was studied. The following classes of the mentioned periods were distinguished: days open — I — <115 days, II — 115–195 days, III — > 195 days and days dry — I — < 30 days, II — 30–60 days, III — > 60 days. The highest yields of milk, fat, protein, FCM and VCM were found in open period longer than 195 days and dry period shorter than 30 days. Milk performance in dry period longer than 30 days was similar. The lengthening of days open resulted in the extension of the lactation even to 484 days - on the average. Often the highest yields per lactation were accompanied by the lowest yields per day of lactation. Higher number of lactations was associated with lower yield of milk, fat and protein per lactation. The obtained results suggest that the lengthening of open period positively affects milk performance of high yielding dairy cows. The shortening of dry period to less than 30 days can be advantageous only in case of the best cows.

Key words: DAYS OPEN, DAYS DRY, LACTATION LENGTH, MILK PERFORMANCE, HIGH YIELDING COWS, HOLSTEIN-FRIESIAN

For many years the main goal of dairy cattle breeders was to increase the individual milk yield of a cow. The enhanced genetic potential and better environmental conditions resulted in a considerable improvement of milk performance and lengthening of the lactation period to 12–15 and even 18 months in many herds [17, 25]. However, higher milk production is usually associated with the decreased fertility and the increased incidence of mastitis. The declined reproductive performance manifests itself in the lengthening of the resting period after parturition, the increase of the average number of inseminations per conception, and consequently, the lengthening of days open period [20]. It is believed that failures in conceiving of high yielding cows are caused by the negative balance of energy at the beginning of their lactation [17]. Such cows are often dried-off at relatively high daily milk yield resulting in the increased danger of the inflammation of mammary gland. Low fertility and health problems are the most important reasons of involuntary culling of cows in high yielding dairy herds. They considerably contribute to the decrease of cow longevity and profitability of milk production [26]. On the other hand, that profitability is positively affected by the increased revenues from a high milk production in the extended lactations [1].

Therefore, the hitherto standard recommendations on the organization of production and reproduction cycles seem to be verified in the herds of high yielding cows. The investigations on the relationship between the length of successive lactations, calving intervals, days open and days dry periods and lifetime milk and beef production per cow are numerous [3, 5, 7, 9, 11, 13, 15, 27, 31]. Until recently the recommended length of calving interval was 12 months, including approximately 280 days of pregnancy and 80-90 days of open period. The production cycle consisted of 305 days of lactation and about 60 days of dry period. Currently it is suggested that the practice to breed cows early after calving, with the aim of establishing a calving interval of 12 to 13 months should be recommended only if milk yield per lactation does not exceed 7000 kg. In case of higher milk production the lengthening of the lactation period by extending the open period or/and reducing the dry period seems to be desirable (5, 16, 17, 23, 32, 33). Such changes in the management strategy require the detailed analysis accounting for the production and economic consequences, including possible effects on fertility, health condition and longevity of cows (1, 21, 30).

The aim of the study was to estimate milk performance of high yielding dairy cows at different length of days open and days dry periods. Since a high level of milk yield is often associated with the reduced life span and length of productive life, milk performance of cows with first three and first five complete lactations was compared.

Materials and methods

The studies were carried out on the data on reproduction and milk performance in first three and first five complete lactations of the cows of Polish Holstein-Friesian var. Black-and-White breed. The data were collected from breeding documentation of one of the largest Polish dairy farms and from the official milk recording performed in 1997–2009 years.

The cows were maintained in free-stall barns and milked in a milking parlour. Depending on the physiological status and the average daily milk yield, they were fed with three types of Total Mixed Ration

(TMR), balanced according to INRA feeding standards. The cows with daily milk production higher than 25 kg were milked three times a day.

The information recorded for an individual cow were: the dates of calving, conception and drying-off, yields of milk, fat and protein per lactation and the contents of fat and protein in milk. From the collected data the following indices were estimated: length of days open (DO) and days dry (DD), length of lactation, milk yield per day of lactation, FCM (Fat Corrected Milk) and VCM (Value Corrected Milk) per lactation and per day of lactation.

Fat Corrected Milk and Value Corrected Milk were calculated according the formulas [1, 15]:

$$\text{FCM} = 0.4 \times \text{milk (kg)} + 15 \times \text{fat (kg)}$$

$$\text{VCM} = -0.05 \times \text{milk (kg)} + 8.66 \times \text{fat (kg)} + 25.98 \times \text{protein (kg)}$$

To carry out the basic statistical analysis of the effect of DO and DD on milk performance the following classes of the studied periods were distinguished:

days open (DO) I — <115 days, II — 115–195 days, III — > 195 days

days dry (DD) I — < 30 days, II — 30–60 days, III — > 60 days

Results and discussion

The tables 1 and 2 present milk performance of the cows in first three complete lactations at three different lengths of DO and DD. In the highest number of the reproduction and production cycles the length of DO was at the range of 115–195 days (IInd class) and DD at the range of 30–60 days (IInd class). The highest yields of milk, fat, protein, FCM and VCM per lactation were obtained with open period longer 195 days (IIIrd class) and dry period shorter than 30 days (Ist class). Since the average daily yields of milk, FCM and VCM in IIIrd class of DO were the lowest, the highest lactation yields resulted from a high number of days in milk (the average length of lactation was 484 days). The highest milk performance per lactation in Ist class of DD was accompanied by the highest values of daily yields of milk, FCM and VCM. However, this class consisted of very small number of production cycles. Production indices in IInd and IIIrd classes of DD were similar.

Milk performance in first five complete lactations of the cows at three different lengths of DO and DD is shown in the tables 3 and 4. The highest share constituted the cycles with the shortest DO (Ist class) and the longest DD (IIIrd class). The average lactation length in Ist DO class was close to the standard (305 days). The average yields of milk and its components per lactation and per day of lactation were lower in all classes of DO and DD, compared to those obtained in first three lactations. Similarly, as in case of first three lactations the highest yields of milk, fat, protein, FCM and VCM per lactation were found in the longest DO (IIIrd class) and the average lactation length of 467 days. The highest yields per lactation in this class were accompanied by the lowest daily yields. Also, as in first three lactations the highest yields of milk, fat, protein, FCM and VCM per lactation and per day of lactation and the highest contents of fat and protein in milk were found in the shortest DD (Ist class). However, this class included only 20 production cycles of the cows of probably very high production potential. Milk, fat, protein, FCM and VCM yields per lactation and per day of lactation in IInd and IIIrd classes of DD (≥ 30 days) was comparable.

According to the performed analysis the highest milk performance in first three as well as in first five complete lactations were observed in DO longer than 195 days. The studies carried out in Poland and in other countries indicate that the lengthening of voluntary waiting period after parturition and, consequently, the extension of open period can be advantageous in the herds of high yielding cows [1, 18, 22]. In such cows the insemination efficiency, comprising estrus-detection rate and conception rate, can be decreased because of the negative energy balance and lower body condition at the beginning of the lactation [17]. With proper feeding the energy equilibrium in high yielding cows is reached in approximately 100–120 days postpartum [8]. reported that in cows of the average yield higher than 10 000 kg the shortening of DO resulted in a lower fertility (especially in older cows) and in a decreased milk yield. Bar-Anan and Soller (1979) found that in high yielding herds the highest productivity in the current and subsequent lactations was achieved by primiparous cows that were inseminated not earlier than 70 days postpartum and by multiparous cows at 41 to 90 DO. Bogucki et al. (2006, 2007) observed the increase of the length of DO period along with the increase of milk yield: from 105 days (milk yield less than 5000 kg) to 146 days (milk yield higher than 8000 kg) and even to 264 days (milk yield higher than 14000 kg). He found that the extended DO period was associated with the increase of the length of the resting period after parturition and the length of service period. The insemination index was distinctly higher in the group of the cows with the highest milk yield. The lengthening of DO period reduces the need for hormonal treatments due to anoestrus and other

fertility disturbances. Also, it results in the reduced number of AIs per serviced cow, shorten period from the first AI to conception and, finally, in lower culling due to fertility problems. [19] observed that longer DO period did not imply an increased risk for development of cystic ovaries and did not result in weaker heat symptoms over time. [22] when evaluating the effect of calving interval on milk performance of Holstein-Friesian cows found the highest yield of milk and milk components in cows with more than 250-day open period. The correlations between DO and fat and protein [14] were high and amounted to 0.53 and 0.52 respectively. But Juszczak and Hibner [16] maintained that if the average DO did not exceed 100 days the differences in milk yield were not significant. Similarly to the present results [4] observed that the average milk production per day of lactation tends to be lower when DO is extended. This is due to longer periods with low production. However, Dymnicki et al. [10] reported that high yielding cows with DO longer than 120 days have longer lifetime production and higher number of days in milk, and despite lower daily yield are characterized by higher lifetime production of milk, fat and protein compared with the cows of shorter DO. Also, Pytlewski et al. [23] found that cows in which the mean length of DO ranged from 121 to 160 days had the longest lifespan, productive life and milking period, as well as the highest lifetime production of milk, fat and protein.

High yielding cows are often dried-off at high daily milk yield which contributes to the increase of udder problems and thereby also need for antibiotics [17]. Shortening or omitting of drying period would probably result in the increase of milk, fat and protein yield in a present lactation, but also in the decrease of milk performance in the subsequent lactation. Quantification of the effect of days dry on subsequent milk production is, therefore, critical for establishing the optimal dry period length [29]. Generally, in the studied herd the tendency to maintain DD periods longer than 30 days was observed. Only small group of best cows had shorter DD period. Węglarzy [34], when analysing 305-day lactations of Polish Holstein-Friesian Black-and-White cows, found the highest milk, fat and protein yield in the cows with DD of 61–90 days. Dry period shorter than one month, as well as longer than three months had statistically confirmed negative effect on the milk, fat and protein yield in the subsequent 305-day lactation. Shortening of the dry period to less than 30 days negatively influenced udder health, especially in multiparous cows that require a longer post-lactation time for regeneration of udder glandular tissue than primiparous cows. In the study of Borkowska et al. [8] it was shown that too short dry period (up to 21 days) was connected with the lowest yield of milk, fat and protein in the standard lactation. Their results were confirmed later by Winnicki et al. [35, 24] found that in cows of Polish Holstein-Friesian var. Black-and-White breed the most advantageous lengths of DD, in terms of milk yield in the standard 305-day lactation, were 57–63 days (for cows with HF genes share less or equal 87.5%) and 64–70 days (for cows with HF genes share higher than 87.5%).

Table 1

Milk performance in first three complete lactations depending on the length of days open period

Days open class	N	Average open period (days)	Average lactation length (days)		kg milk/lactation	% fat	% protein	kg fat/lactation	kg protein/lactation	kg FCM/lactation	kg VCM/lactation	kg milk per day of lactation	kg FCM* per day of lactation	kg VCM** per day of lactation
I	749	94	322	\bar{x}	9138	3.90	3.34	352	304	8934	10476	28.38	27.74	32.53
				sd	1972	0.50	0.21	71	61	1755	2028	6.02	5.31	6.11
II	1053	150	370	\bar{x}	10118	3.97	3.38	399	340	10028	11784	27.38	27.13	31.88
				sd	2185	0.48	0.22	85	69	2059	2369	5.70	5.31	6.05
III	801	274	484	\bar{x}	12688	3.99	3.42	502	432	12606	14942	26.23	26.05	30.87
				sd	2957	0.48	0.21	116	98	2824	3344	5.10	4.72	5.46

*FCM – Fat Corrected Milk; **VCM - Value Corrected Milk

Table 2

Milk performance in first three complete lactations depending on the length of days dry period

Days dry class	N	Average dry period (days)	Average lactation length (days)		kg milk/lactation	% fat	% protein	kg fat/lactation	kg protein/lactation	kg FCM/lactation	kg VCM/lactation	kg milk per day of lactation	kg FCM* per day of lactation	kg VCM** per day of lactation
I	70	14	381	\bar{x}	10966	4.08	3.43	445	376	11066	13070	28.98	29.23	34.52
				sd	2493	0.44	0.19	103	85	2469	2914	6.01	5.83	6.91
II	1338	52	387	\bar{x}	10589	3.96	3.38	416	356	10476	12327	27.55	27.22	32.00
				sd	2783	0.49	0.22	110	92	2677	3146	5.78	5.21	5.96
III	1195	76	397	\bar{x}	10649	3.94	3.38	417	359	10507	12398	26.96	26.58	31.32
				sd	2815	0.49	0.21	111	95	2706	3225	5.51	5.05	5.77

*FCM – Fat Corrected Milk; **VCM - Value Corrected Milk

Table 3

Milk performance in first five complete lactations depending on the length of days open period

Days open class	N	Average open period (days)	Average lactation length (days)		kg milk/lactation	% fat	% protein	kg fat/lactation	kg protein/lactation	kg FCM/lactation	kg VCM/lactation	kg milk per day of lactation	kg FCM* per day of lactation	kg VCM** per day of lactation
I	640	77	301	\bar{x}	8141	4.00	3.30	323	268	8101	9340	26.98	26.86	30.95
				sd	1874	0.47	0.21	75	59	1802	2037	5.72	5.50	6.15
II	302	149	369	\bar{x}	10042	3.96	3.34	394	334	9931	11577	27.23	26.93	31.38
				sd	2222	0.48	0.20	85	70	2080	2385	5.68	5.27	6.00
III	201	260	467	\bar{x}	12107	4.03	3.38	486	409	12127	14229	25.99	26.03	30.52
				sd	2510	0.44	0.20	105	87	2502	2983	4.49	4.42	5.18

*FCM – Fat Corrected Milk; **VCM - Value Corrected Milk

Table 4

Milk performance in first five complete lactations depending on the length of days dry period

Days dry class	N	Average dry period (days)	Average lactation length (days)		kg milk/lactation	% fat	% protein	kg fat/lactation	kg protein/lactation	kg FCM/lactation	kg VCM/lactation	kg milk per day of lactation	kg FCM* per day of lactation	kg VCM** per day of lactation
I	20	18	373	\bar{x}	10438	4.12	3.37	424	351	10539	12267	28.04	28.36	33.06
				sd	3398	0.40	0.19	124	110	3183	3747	7.02	6.39	7.80
II	493	51	345	\bar{x}	9339	3.99	3.33	369	310	9276	10785	26.99	26.82	31.15
				sd	2725	0.48	0.21	105	89	2599	3039	5.80	5.42	6.08
III	630	75	350	\bar{x}	9307	3.99	3.32	370	308	9267	10748	26.74	26.60	30.80
				sd	2426	0.46	0.21	101	83	2434	2875	5.25	5.10	5.79

*FCM – Fat Corrected Milk; **VCM - Value Corrected Milk

Generally, the lengthening of DO and the shortening DD result in the lengthening of lactation and, consequently, in the increase of milk production. Salamończyk and Guliński [25] observed the positive relationship between the length of the extended lactation and milk yield. They concluded that the extension of standard 305-day lactation by 1 day resulted in milk yield increasing by 14.0 kg daily. Bertilsson et al. [4] suggest that cows with extended lactations may generate larger profits as a result of increased lifetime milk yield, extended length of productive life and lower cost of herd replacement.

Conclusions

The highest milk performance in first three and in first five complete lactations of high yielding cows of Polish Holstein-Friesian var. Black-and-White breed was found at open period longer than 195 days and dry period shorter than 30 days. However, the number of production cycles with such a short dry period was very small. In dry periods longer than 30 days milk production indices were similar. The lengthening of days open resulted in the extension of the lactation length even to 484 days — on the average. Independently of the length of days open and days dry periods higher yields of milk, fat and protein per lactation were found in the cows with three lactations compared with those with five lactations.

The obtained results confirm the suggestions on the necessity to change of the hitherto standard recommendations on the optimal length of the reproduction and production cycles in high yielding dairy cows. However, the determination of the most advantageous strategy of dairy herd management needs the thorough analysis, taking into account all production and economic aspects.

Streszczenie

Analizując użytkowość mleczną wysoko wydajnych krów rasy polskiej holsztyńsko-fryzyjskiej odmiany czarno-białej w pierwszych trzech i pierwszych pięciu pełnych laktacjach stwierdzono, że najwyższe wydajności mleka, tłuszczu, białka, FCM i VCM można uzyskać przy >195-dniowym okresie międzyciążowym i <30-dniowym okresie zasuszenia. Jednakże cykle produkcyjne z tak krótkim okresem zasuszenia były bardzo nieliczne. Wydajność mleczna przy ≥30-dniowych okresach zasuszenia była podobna. Wydłużenie okresu międzyciążowego skutkowało wydłużeniem laktacji nawet do średnio 484 dni. Wyższa liczba laktacji związana była z niższą laktacyjną wydajnością mleka, tłuszczu i białka. Uzyskane wyniki wskazują, że wydłużenie okresu międzyciążowego pozytywnie wpływa na użytkowość mleczną krów wysoko wydajnych. Skrócenie okresu zasuszenia do mniej niż 30 dni może być korzystne tylko w przypadku najlepszych krów.

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РЕПРОДУКТИВНІ ТА ПРОДУКТИВНІ СТРАТЕГІЇ ДЛЯ ВИСОКОПРОДУКТИВНИХ КОРІВ

Резюме

Вивчено взаємозв'язок між тривалістю сухостійного та сервіс періодів і молочною продуктивністю високопродуктивних корів польської голштино-фрізької чорно-рябої породи у перші 3 лактації та перші 5 повних лактацій. Вирізняли такі етапи зазначених періодів: сервіс-період : — I — <115 днів, II — 115–195 днів, III — > 195 днів, сухостійний період — I — < 30, III — > 60 днів. Найвищі надой молока, вихід жиру і протеїну, молока базисної жирності та базисної білковості виявлено при тривалості сервіс-періоду більше 195 днів, а сухостійного періоду — менше 30 днів. Показники молочної продуктивності у сухостійний період довший за 30 днів залишалися незмінними. Подовження сервіс-періоду збільшує тривалість лактації в середньому до 484 днів. У багатьох випадках високий надій за лактацію супроводжувався найнижчими добовими надоями в окремі дні. Більша кількість лактацій характеризується нижчими надоями, меншим виходом жиру та протеїну за лактацію. Отримані результати свідчать про те, що продовження сервіс-періоду позитивно впливає на надой у високопродуктивних корів. Скорочення сухостійного періоду до менш ніж 30 днів може мати переваги лише для найкращих корів.

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РЕПРОДУКТИВНЫЕ И ПРОДУКТИВНЫЕ СТРАТЕГИИ ДЛЯ ВИСОКОПРОДУКТИВНЫХ КОРОВ

Аннотация

Изучена взаимосвязь между продолжительностью сухостойного и сервис периодов и молочной продуктивностью высокопродуктивных коров польской голштино-фризской черно-пестрой породы в первые 3 лактации и первые 5 полных лактаций. Выделяли следующие этапы указанных периодов: сервис-период: — I — <115 дней, II — 115-195 дней, III — > 195 дней, сухостойный период — I — <30, III — > 60 дней. Наивысшие удои, выход жира и протеина, молока базисной жирности и базисной белковости обнаружено при длительности сервис-периода более 195 дней, а сухостойного периода —

mniej niż 30 dni. Wykazy wskaźników produkcyjności przy suchostojnym okresie więcej niż 30 dni pozostały niezmienionymi. Wydłużenie okresu suchostojności zwiększało trwałość laktacji w średniej do 484 dni. W wielu przypadkach wysoki udój za laktacją towarzyszył niskimi codziennymi udajami w poszczególne dni. Większe licznictwo laktacji charakteryzuje się niskimi udajami, mniejszym wyciegiem tłuszczu i białka za laktacją. Uzyskane wyniki świadczą o tym, że przedłużenie okresu suchostojności pozytywnie wpływa na udój u wysoko produkcyjnych krow. Skrócenie suchostojnego okresu do mniej niż 30 dni może mieć korzyści tylko dla najlepszych krow.

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