COMPATIBILITY OF MILK PRODUCTIVITY AND REPRODUCTIVE CAPACITY IN HOLSTEIN COWS OF DUTCH ORIGIN

Vera GRANACI, Valentin FOCSHA, Alexandra CONSTANDOGLO

Scientific-Practical Institute of Biotechnologies in Animal Husbandry and Veterinary Medicine, Maximovca Village, Anenii Noi District, Republic of Moldova, Phone: +373359351, Fax:+ +373359351, Mobile:+37368815335, Emails: ms.granaci@mail.ru, focsha@mail.ru, aliek55@mail.ru

Corresponding author: ms.granaci@mail.ru

Abstract

The chronology of reproductive indices over 4 years, the interrelationships between milk productivity and reproductive indices in Holstein cows of Dutch origin and the share of action of milk productivity on reproductive indices were investigated. In the specific operating conditions created, the maximum level of milk productivity, at which optimal indicators of reproductive capacity were observed was up to 7,000 kg of milk per lactation. Regression analysis shows that with the increase in service period and calving interval by 1 day, the milk production of the animals will increase by 11.0 kg and 13.1 kg, respectively. The share of action of milk productivity on the coefficient of the reproductive capacity of cows is 0.9008 (P<0.01), on the service-period – 0.147 (P<0.05), on the birth coefficient - 0.0568. For a full realization of the potential of milk productivity and reproductive indices of Holstein cows of Dutch origin, it is necessary to optimize feeding conditions, microclimate, veterinary control, etc. Increasing the duration of the service period and prolonging lactation leads to the slowing down of the reproduction rate of the herd, due to the losses of milk and calves, as a whole on the herd. For this reason, livestock farms should monitor the duration of the service period.

Key words: *Holstein cows of Dutch origin, milk productivity, reproductive capacity, regression analysis, correlation*

INTRODUCTION

For a long time, selection and breeding activity in the dairy cattle branch was focused on creating animals with increased milk productivity. The reorientation of this vision took place after it was established that milk productivity did not correlate with increased cow longevity [11]. [20] report that in the USA, the amount of milk per lactation, between 1940 and 1990, increased approximately by 3 times (from 2,600 to 8,000 kg)). At the same time, the excessive intensification of a function, in this case lactogenic, does not pass without consequences for other body systems. Researchers and practitioners in many countries indicate a decline in reproductive performance in dairy herds [18; 10] due to an antagonistic relationship between the high level of milk productivity and the functionality of the reproductive system. [3] argue that as herd milk productivity in New York State (USA) increased, the fertility rate after first insemination decreased from 66% (1951) to 40.0 % (1987). [19] mentions that in animals with high productivity, due to the increase in food consumption and milk production, the intensity of metabolism increases significantly, while essentially increasing the catabolism of estrogen and progesterone. Cows with high milk yields have a shorter duration of oestrus, a high incidence of anovulatory cycles [22] and the highest rate of infertility [5; 13; 12], the main cause of significant decrease in fertility being abnormal sexual cycles, expressed, by the absence of basic sexual phenomena: estrus, general reaction, libido and ovulation [18]. If the sexual cycle is disturbed, sterility sets in, so a healthy calf will not be obtained from the cow for a year, and the previous high milk production is no longer important, because the animal is reformed due to infertility and sterility [21].

The genetic and phenotipic correlation between the average 305-days milk yield and the age of first calving is extremely weak and

negative, rG = - 0.257 și rF = - 0.090 as found for number of 2,237 half sibs, offspring of 989 Friesian bulls and raised in various farms in Romania. And for fat percent as well (rG = - 0.187) and (rF = - 0.032) [16].

In case of the Romanian Brown breed, using 950 lactations, it was found that for the cows whose calving interval was longer than 400 days, milk yield accounted for 4,682.5±124.92 while for the cows whose calving interval varied between 351 and 400 days registered 4,240.0±215.10 kg [17].

An indicator of good adaptability of animals to specific environmental conditions is the combination of high milk productivity and reproductive capacity, serving as a fundamental criterion for breeding breed improvement.

In this order of ideas and in the situation, when about 70% of the herd of cattle for milk production, exploited in the zootechnical units of the republic of Moldova, is constituted of imported animals, in order to develop the strategy of selection and improvement works with this contingent, we proposed to investigate the compatibility of milk productivity with reproductive indices in Holstein cows of Dutch origin.

MATERIALS AND METHODS

In order to achieve the objective, it was experimented with the population of Holstein cows of Dutch origin, exploited within the production activity: from SRL "Doksancom", Tomai village, Ciadâr-Lunga district. The dynamics of reproductive indices were evaluated: brest restenious (BR), service-period (SP), calving interval (CI), female herd reproductive capacity (CCR) and birth coefficient (CB), interrelationships and regression analysis between reproductive indices according to level milk productivity, and the degree of action of the level of milk productivity on the main reproductive indices. The direction and strength of the relationship between the main reproductive indices (BR, SP, CCR, CI, CB) and those of milk productivity was determined according to the value of the correlation coefficient (r).

The share (degree) of influence of the level of milk productivity (η_x) on the general variability (η_y) of the main reproductive indices (η_z) (SP, CCR and CI, birth rate) was determined by unifactorial dispersion analysis [15; 2].

The birth coefficient was calculated according to the relationship:

$$BC = \frac{365 - SP}{285} * 100 \dots \dots \dots \dots \dots \dots (1)$$

where:
BC – birth coefficient (%);
365 – the number of days in a year;
SP - duration of service period ;
285 – average length of gestation.

The coefficient of reproductive capacity of the female population was calculated according to [6].

The statistical processing of the data was carried out computerized based on Microsoft Office Excel programs, using biometric analysis formulas.

The aim was to obtain position and variation estimators: arithmetic mean - $\overline{X}$; standard deviation (mean square deviation) – S; standard deviation of the mean – Sx ; the coefficient of variation - VC% and the correlation coefficient - r.

The authenticity of the obtained results was verified according to the Student criterion - td.

RESULTS AND DISCUSSIONS

The breeding efficiency of dairy cattle is largely determined by the reproductive intensity of the female herd, which has a direct impact on milk productivity. Brest restenious is of great importance in increasing milk productivity in cows. It is during this period that the cow recovers its energy in relation to the previous lactation and the foundations are laid for the further increase in productivity, the mother's well-being and the product of conception are established, ensuring the favorable progress of parturition, the initiation of successive lactation, the resumption of function ovarian in the postpartum period, etc. In Figure 1, we present the dynamics of the main breeding

indices of the bull herd Holstein breed of Dutch origin.

The analysis of the presented results demonstrates that the duration of dray period as one of the main moments in the exploitation technology of dairy bulls, during 4 years of exploitation has an oscillatory character. The longest duration was in the year 2020, prevailing the best recorded result (year 2021), with a statistically genuine difference of 10.3 days (td =2.8. P<0.05), statistically genuine difference it is also found that compared to the year 2022 of 9.5 days (td=2.7. P<0.01), compared to 2018 the difference is 7 days (td=2.2. P<0.01).
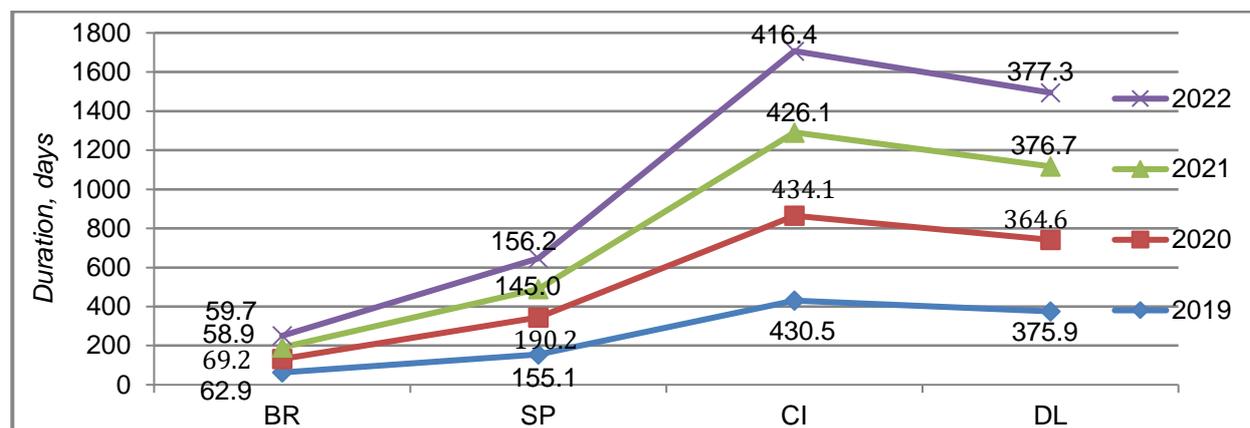
Fig. 1. Chronology of the main reproductive indices and duration of lactation in the Holstein breed cows of Dutch origin
Source: SRL "Doksancom", Tomai village, Ciadâr-Lunga district.

[1] argue that the condition of the cow before calving is of great importance for reproductive intensity. Therefore, in our situation the animals benefited from an optimal period of preparation for the new reproductive cycle.

The service-period determines, first of all, the milk production of cows, as a factor that determines the duration of lactation, but also the period of establishment of pregnancy. The comparative study regarding the service period (Fig. 1) shows that during the 4 years of exploitation of the population of Holstein cows of Dutch origin, under the conditions of SRL "Doksancom", it oscillates within the limit of 145.0 - 190.2 days. The best result was established in the year 2021, being lower compared to 2020 with a statistically genuine difference of 45.2 days (td=4.2. P<0.001). The result recorded in the year 2022 is higher with a genuine statistical difference compared to the year 2021 of 34 days (td = 2.8. P<0.01) and to the result of 2019 by 35.1 days (td=3.3. P<0.001).

Generalizing the analyzed data, we conclude that in all cases the service-period is significantly higher compared to the optimal value allowed, considered 2 - 3 months [4],

this being the main condition for accelerating the rate of reproduction of the herd in the household and for increasing the economic efficiency of the branch.

In chronological terms, the statistically genuine increase registered in 2020 may be a consequence of the adapting stress to the new exploitation conditions, and during the next two years it decreases significantly, a fact that witness to a tendency of the animals adaptability.

The duration of the interval between calvings in the dynamics of the years shows a more or less

uniform character, being the highest again in the year 2020, at the opposite extreme is the result recorded in 2022.

The established uniform character, being the highest again the year 2020, at the opposite extreme is the result recorded in 2022.

The established differences are insignificant. A similar character is attested during the duration of lactation.

The results obtained regarding the number of calves obtained per 100 cows per year state that increasing the duration of the service-period significantly decreases the birth rate,

with a very high negative correlation persisting (r= -99.9), which confirms that one of the main conditions for accelerating the reproduction rate of the herd in the household and for increasing the economic efficiency of the branch is that the cows are fertilely inseminated in the first 2–3 months after calving (Fig. 2).
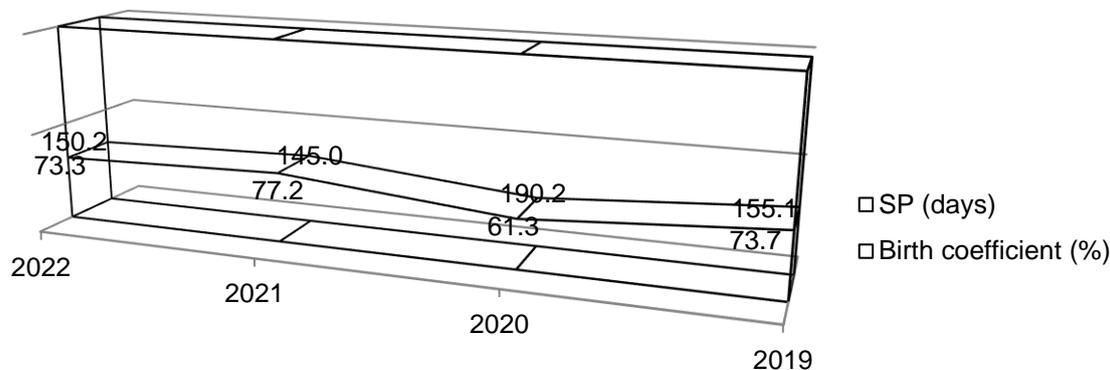
Fig. 2. Chronology of the birth rate in according with the duration of service-period of the Holstein breed cows of Dutch origin
Source: SRL "Doksancom", Tomai village, Ciadâr-Lunga district.

The combination of high milk productivity and reproductive capacity also serves as a fundamental criterion for breeding breed improvement. In Table 1 we present the dynamics of the main reproductive indices according to the level of milk productivity.
The obtained results highlight the presence of a statistically genuine difference in the duration of the service-period depending on the level of milk productivity, starting even with the first two batches of animals. Cows with a level of milk productivity of 5,000-5,999 kg of milk presented the lower service-period (66.6 days),
at the same time the lowest interval between calvings and the highest number of calves obtained per 100 cows (105 %) per year are attested, as a result they also recorded the highest coefficient of use of reproductive capacity.

Table 1. The dynamics of the main reproductive indices according to the level of milk productivity, Holstein breed cows population of Dutch origin

Productivity classes milk, kg .	SP		CI		CCR		The coefficient of birth, %	
	$\overline{X} \pm S_x$, days	Cv, %	$\overline{X} \pm S_x$, days	Cv, %	$\overline{X} \pm S_x$, days	Cv, %	$\overline{X} \pm S_x$, %	Cv, %
5,000-5,999, (n=11)	66.6±14.28	71.1	357.1±13.54	12.5	1.04±0.04	11.6	105.0±4.85	15.2
6,000-6,999, (n=16)	152.1±21.60**	56.9	411.4±22.15	19.4	0.92±0.05	18.5	74.6±8.25**	51.3
7,000-7,999, (n=16)	160.1±26.70**	66.7	434.9±29.80*	25.6	0.90±0.02**	9.2	75.1±6.00***	35.2
8,000-8,999, (n=29)	162.2±17.81***	59.1	431.7±16.47**	18.7	0.88±0.03**	13.5	73.9±6.20***	40.8
9,000-9,999, (n=24)	179.5±22.36***	61.0	424.4±20.39**	19.8	0.91±0.03*	12.6	66.5±7.35***	53.9
10,000-10,999, (n=21)	162.2±20.31***	57.4	421.1±19.24*	18.8	0.93±0.04	15.4	70.0±7.15***	46.3
11,000- >, (n=15)	169.9±27.0**	53.7	400.4±21.20**	15.0	0.93±0.05	15.1	69.±9.45**	51.0

*P<0.05. **P<0.01. ***P<0.001.
Source: SRL "Doksancom", Tomai village, Ciadâr-Lunga district.

The largest service-period was established for the group of cows with the productivity of 9,000 – 9,999 kg of milk per lactation, the differences compared to the other groups, except for the first one, are unauthentic. As the milk productivity increased from 5,000 to

9,900 kg of milk per lactation, the length of the service- period decreased by 2.7 times. The intragroup variation coefficient ranges from 53.3% in animals with a productivity of 11,000 kg of milk per lactation to 71.7% in animals from the first batch.

On the other hand, the interval between calvings was longer in cows with a productivity of 7,000 - 7,999 kg of milk by 10.4 - 77.8 days compared to the rest productivity classes. As the level of milk productivity increases, its value decreases with statistically genuine differences compared to cows with the lowest milk productivity. The coefficient of variation of this index decreased significantly compared to the previous one, oscillating in the range of 12.5% (for animals from the first batch) to 25.6% for those with a productivity level of 7,000 - 7,999 kg of milk. In the rest of the lots, the value of the coefficient of variability occupies an intermediate position. This homogeneity would be due to many factors but also to the fact that the duration of gestation has a constant value (285±2 days). All this contributed to the fact that from cows with a milk productivity level of over 9,000 kg of milk, the biggest losses were from lost calves (-33.5%) .

Regarding the use of the reproductive capacity of the female herd, statistically authentic differences were detected, of different degrees depending on the level of milk productivity. The coefficient of reproductive capacity decreased by 8.4 - 11.6%, compared to the contingent from the batch with productivity up to 4,999 kg of milk per lactation, the coefficient of variation was placed in the limit considered optimal, 9.2% - 18.5%.

In the operating conditions created in SRL "Doksancom", the optimal indicators of reproductive capacity, in Holstein cows of Dutch origin, was at the productivity of 7000 milk per normal lactation,

The results of the correlation analysis between the main reproductive indices and the level of milk productivity are presented in Table 2.

The analyzed data show that in the population of Holstein cows of Dutch origin, between the level of milk productivity and the main reproductive indices, both negative and positive

correlative links are found from very weak, weak to medium. Statistically authentic average positive correlation (td= td=2.1) between the duration of the service period, the value of the birth rate and the milk productivity is found in the group of cows with a productivity greater than 11,000 kg of milk per lactation correlative links are found from very weak, weak to medium.

Table 2. Interrelationships between the level of milk productivity and the main reproductive indices, of Holstein dreed cows population of Dutch origin, r±Sr

Productivity classes milk, kg	SP, days	CB, %	CI, days	CCR
5,000-5,999, (n=11)	-0.04±0.32	-0.13±0.31	0.01±0.32	0.02±0.32
6,000-6,999, (n=16)	0.17±0.25	-0.39±0.23	0.43±0.21	-0.39±0.22
7,000-7,999, (n=16)	-0.24±0.24	-0.22±0.24	-0.36±0.22	-0.15±0.25
8,000-8,999, (n=29)	- 0.34±0.17	0.33±0.17	-0.37±0.16*	-0.22±0.18
9,000-9,999, (n=24)	0.22±0.20	-0.25±0.20	-0.24±0.20	0.13±0.21
10,000-10,999, (n=21)	-0.16±0.23	0.24±0.21	-0.38±0.19	0.26±0.21
11,000- >, (n=15)	0.45±0.21*	0.45±0.21*	-0.41±0.22	0.37±0.23

*P<0.05
Source: SRL "Doksancom", Tomai village, Ciadâr-Lunga district.

Statistically authentic average positive correlation (td= td=2.1) between the duration of the service period, the value of the birth rate and the milk productivity is found in the group of cows with a productivity greater than 11,000 kg of milk per lactation. Between the duration of the interval between calvings and the level of milk productivity only in cows with the level of productivity 8,000-8,999 kg of milk per lactation the difference is statistically authentic (td=2.3).

The same trend can be seen regarding the interrelationship between the coefficient of utilization of the reproductive capacity and the

new milk productivity. To determine the nature of the change, we performed the regression analysis between milk productivity and reproductive indicators. The results are presented in Table 3.

Table 3. Regression coefficients between milk productivity and the main reproductive indicators of Holstein breed cows population of Dutch origin

Indices		R
Milk productivity, kg	Service-period, days	11.0
Milk productivity, kg	Calving interval, days	13.1
Milk productivity, kg	Coefficient of birth, %	2.8

Source: SRL "Doksancom", Tomai village, Ciadâr-Lunga district.

According to the obtained data, the regression coefficients between the milk production and the indicators of the functionality of the reproductive apparatus with the increase of the service-period by 1 day, the milk production of the animals will increase by 11.0 kg. An increase in the interval between calvings by 1 day, according to our calculations, leads to an increase in the milk production of a cow by 13.1 kg. However, some authors [7; 9] claim that the significant increase in the duration of the service period and the interval between calvings in order to increase milk productivity will eventually lead to followed a decrease in the amount of milk obtained, as a whole, per herd and the number of calves produced per 100 cows per year.

The share of action of milk productivity on the duration of the service-period is presented in Table 4.

Table 4. The share of action of the level of milk productivity on the general variability of the main reproductive indices

Breeding indices	$F_{empir.}$ de facto	Action of factors on total dispersion	
		Intergroup variability, η^2_x	Intragroup variability, η^2_z
SP, days	3.05*	0.147	0.853
CI, days	2,1	0.1146	0.8854
CCR	142.9***	0.9008	0.0992
BC, %	0.96	0.0568	0.9432

Source: SRL "Doksancom", Tomai village, Ciadâr-Lunga district.

The analysis of obtained data indicates that the share of action of milk productivity on the main reproductive indices is different. Thus, the greatest degree of action is found on the reproductive capacity of cows, being also authentic.

In the general variability of the duration of the service-period and the interval between calvings, the share of the factor's action is much smaller compared to that of the reproductive capacity. The lowest level of action is in the case of the birth rate.

Regarding the latter, according to the theory of K. Mather [cited by 14], prolificacy having a polygenic character shows continuous variability. In this regard, as a quantitative feature it is characterized by a high variability [8].

CONCLUSIONS

In the specific operating conditions created, the maximum level of milk productivity, at which optimal indicators of reproductive capacity were observed, in the population of Holstein cows of Dutch origin, was up to 7,000 kg of milk per lactation. The correlative link between milk productivity and reproductive indicators in most cases is weak, the regression being at a high level.

Regression analysis shows that with increasing service-period and calving interval by 1 day, milk production of animals will increase by 11.0 kg and 13.1 kg, respectively, but significant increase in the duration of the SP and CI in order to increase milk productivity will eventually lead to followed a decrease in the amount of milk obtained per herd and the number of calves per 100 cows per year.

The share of action of milk productivity on the coefficient of the reproductive capacity of cows is 0.9008 (P<0.01), the service period – 0.147 (P<0.05), the birth coefficient - 0.0568.

For a full realization of the potential of milk productivity and reproductive indices of

Holstein cows of Dutch origin, it is necessary to optimize feeding conditions, microclimate, veterinary control, etc.

Increasing the duration of the service period and prolonging lactation leads to the slowing down of the reproduction rate of the herd, due to the losses of milk and calves, as a whole on the herd. For this reason, livestock farms should monitor the duration of the service period.

ACKNOWLEDGEMENTS

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