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Today's Issues in Reproductive Management of Dairy Herds

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The present paper describes challenging issues in reproductive management in dairy cattle. The analysis results are reported, and the effect of several technological parameters on the herd-replacement rate is explored.

Key words: *reproductive management of dairy herd; sexed semen; increase in the percentage of heifer calves born to improve the replacement heifer development.*

According to official statistics reported by the State Statistics Committee of Ukraine as of October 1, 2014, the number of cattle on farms of all types is 4,804 thousand heads, which is 2.9% down year-on-year. The total number of cows on farms of all types of ownership is 2,439 thousand heads, which makes 2.3% down, respectively. Suppose the trend analyse of the numbers of cattle on Ukrainian farms of all types over the last century is carried out, the figures obtained are impressive indeed (Table 1).

Table 1

Dynamics of the number of cattle on Ukrainian farms of all types*

Year	Total, million heads	As % of the base year 1980	Including cows, million heads	As % of the base year 1980
1916	7.9	31.1	3.1	33.3
1928	9.9	40.0	4.9	52.7
1935	5.1	20.0	2.5	26.9
1940	11.0	43.3	6.0	64.5
1950	11.1	43.7	4.8	51.6
1960	17.6	69.3	7.9	84.9
1970	21.4	84.3	8.8	94.6
1980	**25.4**	**100**	**9.3**	**100**
1990	24.6	96.9	8.4	90.3
2000	9.4	37.0	4.9	52.7
2014	**4.8**	**18.9**	**2.4**	**25.8**

** 1980 used as a reference base year with the highest number of cattle.*

As can be seen from the table, both the total number of cattle and that of cows have been declining every year. Over the last twenty years, the number of cows in this country has been reduced with a tendency for the milk yields to grow. And an increase in commercial farm milk production has been observed. For example, in the first nine months of this year it has amounted to 2.06 million tons which is up 4.1% year-on-year. The average milk productivity of cows on commercial farms is forecasted at 5,300 kg per head to the end of the current year while this value was just 3,926 as lately as five years ago. There are some commercial farms in Ukraine which report annual milk production per cow higher than 12,000 kg. Having analysed the performance of dairy farms, we emphasize the urgency of the reproductive management issue in high-yielding dairy herds [1, 2].

The study was aimed to examine reproductive performance of herds on three farms in two regions of Ukraine.

Materials and methods. The study was conducted using herds on the neighbouring farms in the North of Ukraine, namely Zorya Ltd in Krasnograd sub-region of Kharkiv region, Ryasnyanske Ltd in Krasnopillya sub-region and Mayak Ltd in Trostyanets sub-region of Sumy region.

The following factors were examined: the impact of cows' milk productivity on their longevity in dairy herds; number of calvings per cow per lifetime; number of heifer-calves born per 100 cows; heifer retention rate on herd level. The relationship between cows' milk yields and calvings per lifetime was also explored.

The effect of several technological parameters on the herd-replacement rate was examined in depth.

The herd-replacement rate which is the number of heifers required to replace productive cows in the herd was determined. The herd-replacement rate was defined by the following formula:

$$\mathbf{HRR = CL \times HB \times HR}$$

where HRR – the herd-replacement rate;

CL – the number of calvings over cow lifetime which is conditioned by animal health;

HB - the percentage of heifer calves born per 100 cows which is about 50% and is naturally conditioned;

HR - the heifer retention rate per 100 cows which is conditioned by young stock health.

Results. The analysis of the obtained results shows the negative relation between milk yield per lactation of a cow and the number of calvings over the cow's productive life. In particular, decreasing number of successful calvings over lifespan with growing milk yields was reported for 1600 cows whose productivity had been evaluated.

The calving interval in high-yielding cows is rather long (longer than 400 days in milk) and it directly depends on the prolonged days open period. It was found that cows with milk yields higher than 9,000 kg per lactation were culled from the herd at the age of 6-7 years with 3.6 successful calvings. Cows with milk yields of 5,000 kg per lactation and lower calved successfully 5-6 times (Fig. 1).

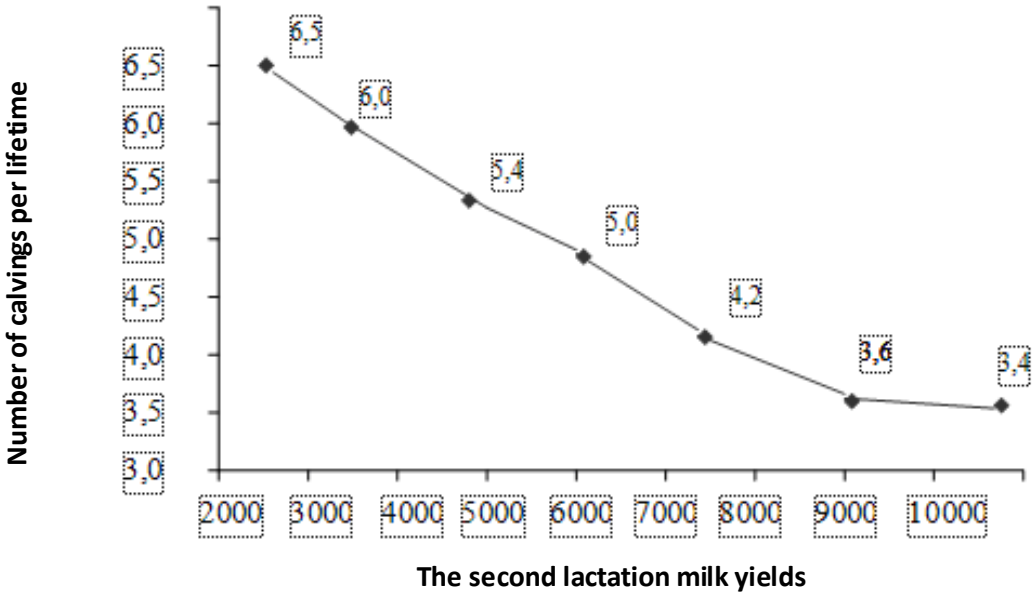

Figure 1. The correlation between cows' milk production and number of calvings

Using the herd-replacement rate formula, we defined the herd-replacement cycle and established its lower critical threshold.

Given the number of calvings over cow productive life equal to 3.0, the naturally conditioned percentage of heifer calves born per 100 cows - 49%, and the retention rate of those heifers - 70%, the herd-replacement rate equals to 1. In other words, one heifer is required to replace one cow culled from the herd.

$$\mathbf{HRR = 3.0 \times 0.49 \times 0.70 = 1.0}$$

where HRR – the herd-replacement rate;

CL – the number of calvings over cow lifetime – 3.0;

HB - the percentage of heifer calves born per 100 cows – 49% (0.49);

HR - the heifer retention rate per 100 cows – 70% (0.70).

The herd-replacement rate reflects the reproductive ability of the herd quite well. If the rate is higher than 1, the herd size is to increase; if the rate is lower than 1, there are some reproductive issues and the farm should consider improvement of the number of calvings per cow lifetime, as well as the heifer retention rate. The use of sexed semen with potential to increase the percentage of heifer calves born can be a good technique for sex control in the herd. With the herd-replacement rate equal to 1, the herd size is to increase by 10 extra heifers; when the rate is 0.9 – the will be a need of 10% heifers for replacement.

In the herds on farms which were evaluated the number of calvings in high-yielding cows averaged 3.6 that corresponded to the herd-replacement rate of 1.2, which is indicative of the fact that the process of the herd replacement is under control.

HRR = 3.6 × 0.49 × 0.70 = 1.2

It should be noted that the herd-replacement rate does not depend on the days open and percentage of live calves born. It is only the number of calvings per year which is dependent on the days open period, but it is the number of calvings per cow lifespan that should be accounted for. The percentage of live calves born indicates how many calves can be produced per year per 100 cows. The percentage of heifer calves produced by a cow over the lifetime is also important. If the days open period is shorter and the percentage of live calves born is higher while the number of calvings per lifetime is still unchanged, then the herd-replacement rate remains unaltered with the same reproductive performance issues. If the number of calvings per lifetime varies, the herd-replacement rate will change with unaltered heifer retention rate (Table 2).

Table 2

Impact of number of calvings on the herd-replacement rate

Calvings per lifetime	4.0	3.5	**3.0**	2.75	2.5
Heifer-calves born, %	49	49	**49**	49	49
Heifer retention rate, %	70	70	**70**	70	70
Herd-replacement rate	1.37	1.2	**1.03**	0.94	0.86

As can be seen from the table, when the number of calvings over cow productive life increases or decreases, the herd-replacement rate undergoes either upward or downward respective changes.

We have examined the effect of the heifer retention rate on the process of herd replacement. It was found that with this rate increasing on herd level, there is a positive response of the herd-replacement rate. For example, with the heifer retention rate of up to 85% we produce extra 50 replacement heifers.

HRR = 3.6 × 0.49 × 0.85 = 1.5

When the heifer retention rate is up to 85% and the percentage of heifer calves born is 49% while the number of calvings per cow lifetime is low which is typical for high-yielding cows and equal to 2.5, the herd replacement will remain within the range of critical limits. By the heifer retention rate we mean the number of heifers from their birth to the first calving. In other words, the number of stillborn heifer calves, the heifer calve mortality rate during the first month of life, their performance up to the insemination, as well as the number of heifers should be factored in.

The effect of the percentage of heifer calves born on the herd reproductive performance was examined using the naturally conditioned value of 0.5 (50% bull calves and 50% heifer calves born). The average percentage of heifer calves born on the target farms was 49% and was sperm viability and longevity applied as a factor of 0.49. Implementation of modern techniques for the reproductive management using sexed semen that allows of producing up to 90% heifer calves born per 100 cows enables to control the reproductive performance of the herd. As a case in point, with unchanged number of calvings and heifer retention rate it is feasible to produce extra up to 130 heifers.

$$\mathbf{HRR = 3.6 \times 0.90 \times 0.70 = 2.3}$$

Sexed semen has been still used on Zorya farm in Krasnograd sub-region of Kharkiv region for some period already.

Over the last decade, the use of sexed semen on many farms both in Ukraine and abroad allowed to improve the cow milk productivity and reproductive performance of the herd within a considerably shorter period.

Besides, the calvings are much easier for cows due to the lower birth weight of heifer calves that is essential when using tested sires with high live weight. Having applied this technique the selection programme is accelerated due to the improved alternation of generations. The biological security on farms is no less important. Using sexed semen makes it possible to increase the herd size using the replacement heifers available with no delivering of animals from other farms. However such semen is 2.5-3 times more expensive than not-sexed one. Moreover, during the technological processing the cells undergo specific treatment, which may deteriorate the sperm viability and longevity and subsequently affect the conception rate in the herd.

To achieve high-quality results, the developers of the described technique recommend using sexed semen for heifers' insemination [3, 4].

However, that fact that it is feasible to predict the heifer calve production with high accuracy thereby improving the level of management of the herd, its reproduction and replacement, is a forcible argument in favour of use of sexed semen.

Conclusions

1. A direct correlation between cows' milk productivity and successful calvings in lifetime was found.
2. The herd-replacement management issue can be solved by increasing the number of calvings over cows' productive life, improving the heifer retention rate and use of sexed semen in artificial insemination of heifer calves and cows.
3. Determination of the herd-replacement rate enables to analyse and monitor the reproductive performance of the herd while it is an element of management control for the indicated activities.

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