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Original Paper

Prognostic impact of neck responders on conception rate of Czech Fleckvieh Simmental cows

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The climate in the Czech Republic is mild, transient between oceanic and continental, with a typical alternation of 4-year periods. The continental climate is characterized by high temperatures in summer and low temperatures in winter. During the extreme fluctuation of microclimatic conditions in the stable, there is also a change in individual reproductive indicators due to disruption of hormonal secretion, which further affects individual physiological processes, thus worsening conception or milder manifestations of heat, which we currently try to detect by neck responders and other modern systems.The experiment analyzed the effect of the average monthly temperature and humidity in the stable on the percentage of pregnant cows, in 2017 without the use of neck responders and in 2019, when all cows already had a neck responder. Monitoring was performed in 2017 and 2019 on the private farm GenAgro Říčany, a.s. (GPS 49° 12' 32.319" N, 16° 23' 42.666" V). The values of average temperatures and relative humidity were calculated from 15-minute interval recordings of HOBO brand data loggers (Onset), which were placed in the stable, at the height at the withers of the cows without the possibility of influencing the measurements by the cows themselves. The object of monitoring was a herd of approximately 700 cows of Czech Fleckvieh Simmental various lactations. Data on the conception of cows were obtained both from the monthly reports of the breeding organization and from the data of the breeder.Thermal stress can have a long-lasting effect observable for weeks or months after the summer. This is also evidenced by the results of the work, which shows the worsening conception of cows, especially in late summer and autumn. At the same time, the results show a positive effect of the used neck responders, which help with the detection of heat and thus improve the reproduction of the whole herd.

Keywords: Czech Fleckvieh Simmental, smart farming, neck responders, reproduction, heat stress

1 Introduction

Cattle are the most demanding category of all types of livestock kept on farms in terms of investment, work, materials, and organization. Ability to convert bulky feeds that are otherwise unusable into quality animal products (beef, milk). One of the basic preconditions for successful large-scale livestock breeding is the need to respect the biological demands of animals for their monitoring. In recent years, cervical responders have been used, which began to be used after the manifestation of Industry 4.0 in agriculture (Jelínek, Koudela et al., 2003).

In their book, Ustundag and Cevickan (2017) state that agriculture is a very important point of Industry 4.0, as it ensures the livelihood of the population. They also add that the agricultural sector has a very high potential for the use of digitization and mechanization. Agricultural production has been marked by progress many times during previous revolutions, such as the use of fertilizer chemicals, machine tools, etc. The previous revolution is summarized by Schwab (2016) as follows: the ability to a billion people. This industrial revolution is characterized by several new technologies that connect the digital, physical, and biological worlds.

With this industrial revolution, however, farming methods have changed. This change is needed, due to population expansion and food shortages. Such modernized agriculture is called „Smart agriculture". The term „smart agriculture" or automated agriculture is described by author Funnell (2015) in his article.

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There are many ways to help us detect heat. The most used devices include pedometers and neck responders – so-called activometers. Pedometers record the physical activity of cows for breeders for a certain period of time, usually, it is one whole day. Activometers record feed intake (eating time) and subsequent chewing (rumination), which are derived from typical neck muscle movements, but we can also record other activities using activometers. Some sensors also measure body temperature, resp. earlobe temperature, or allow accurate localization of the animal in the herd (Velechovská, 2016).

If the body temperature of the dairy cow rises, there is a risk of damage to the spermatozoids capacitating in the female's reproductive tract, as well as damage to the oocytes before or after ovulation or damage to the fetus during the second and third thirds of pregnancy. At the same time, high ambient temperature negatively affects the quality of bull semen (Bertipaglia et al., 2005).

2 Material and methods

Monitoring was performed twice to compare results without and with cervical responders to help detect heat. The first measurement took place during 2017 and the second in 2019 on the private farm GenAgro Říčany, a.s. (GPS 49° 12' 32.319" N, 16° 23' 42.666" V). The object of monitoring was a herd of approximately 750 cows of Czech Fleckvieh Simmental on various lactations, which were equipped with a neck responder – Vitalimeter. Data on pregnancy rates and the number of cows and heifers insemination were obtained from both the monthly statements breeding organizations and breeders of data. Average temperatures and relative humidity were calculated from 15-minute interval recordings of HOBO (Onset) brand loggers, which were placed in the stable at the height at the withers of the cows.

3 Results and discussion

In the Table 1 the average and maximum monthly values (including the standard deviation) of the monitored parameters for the monitored years 2017 and 2019 are given. The year 2018 was not included in the results due to the purchase and installation of neck responders from Farmtec in that year – Vitalimeter. The table shows that cows in 2019 achieved better levels of conception (on average 44.43% and 44.07%) both in the evaluation after the first insemination and after all inseminations, from 34.09% to 55.74%. For cows in 2017 was found pregnancy rates average percentage of 40.26% and 40.62% and from 28.81% to 52.83% we can say that the relationship of cervical responders to the percentage of pregnancy rates is positive and improves reproductive herd.

Already in 1985, Bading et al. in Florida, conception decreased from 48% in March to 18% in June. Also, Bridges et al. (2005) state that the conception rate may fall by 10–20% during the summer months. Rensis and Scaramuzzi (2003) report a difference between the winter and summer months in the range of 20 to 30%. As reported by Bertipaglia et al. (2005), dairy cows have a worsening of conception because they have a larger body composition and a more intensive metabolism due to the efficiency and intake of high-energy feed. The result is a consequent higher heat production and deterioration of reproductive properties.

In Table 1 the numbers of inseminations carried out in each month are also given. A total of 1,517 inseminations were performed in 2017 and a total of 1,500 in 2019. In 2017 and 2019, cows were inseminated on average 126.42, respectively 125.00.

As for the micro-climatic parameters, they were evaluated using the average monthly temperature and relative humidity in the stable. In the monitored periods, average monthly temperatures and relative humidity of 11.16 °C and 55.21%, respectively, were recorded. 11.94 °C and 57.43%. In the case of minimum values in 2017 it was -3.53 °C and 40.06% and for 2019 the minimum values were 2.64 °C and 38.74%. Due to the opposite course of relative humidity and temperature in the conditions of Central Europe, no statistically significant relationship was found between the relative humidity and the observed reproductive indicators.

Table 1 Detected monthly values of monitored parameters (2017 and 2019)

% pregnancy	Average	Min.	Max.	*Sx*
Cows 2017 1. insemination	40.26	28.81	52.83	6.58
Cows 2019 1. insemination	44.43	34.09	55.74	7.16
Cows 2017 all insemination	40.62	32.06	52.83	4.40
Cows 2019 all insemination	44.07	36.17	53.72	5.55
Number of inseminations				
Cows 2017 1. insemination	55.08	42.00	70.00	6.95
Cows 2019 1. insemination	58.92	44.00	76.00	9.78
Cows 2017 all insemination	126.42	97.00	147.00	14.64
Cows 2019 all insemination	125.00	97.00	167.00	19.04
Micro-climatic parameters				
Temperature (°C) 2017	11.16	-3.53	22.13	7.14
Temperature (°C) 2019	11.94	2.64	22.51	7.32
RH (%) 2017	55.21	40.06	66.54	8.34
RH (%) 2019	57.43	38.74	83.78	14.44

In the case of cows in 2017 (Figure 1), the results are very variable, but even so, at the end of the summer, a worsening of % conception and a worst % conception of pregnancy can be observed for the first inseminations, with a value of 28.81%. This is evidenced by the low coefficient of correlation between the above parameters, which after the 1st insemination or after all inseminations was $r = 0.14$ and $r = 0.19$ in cows.

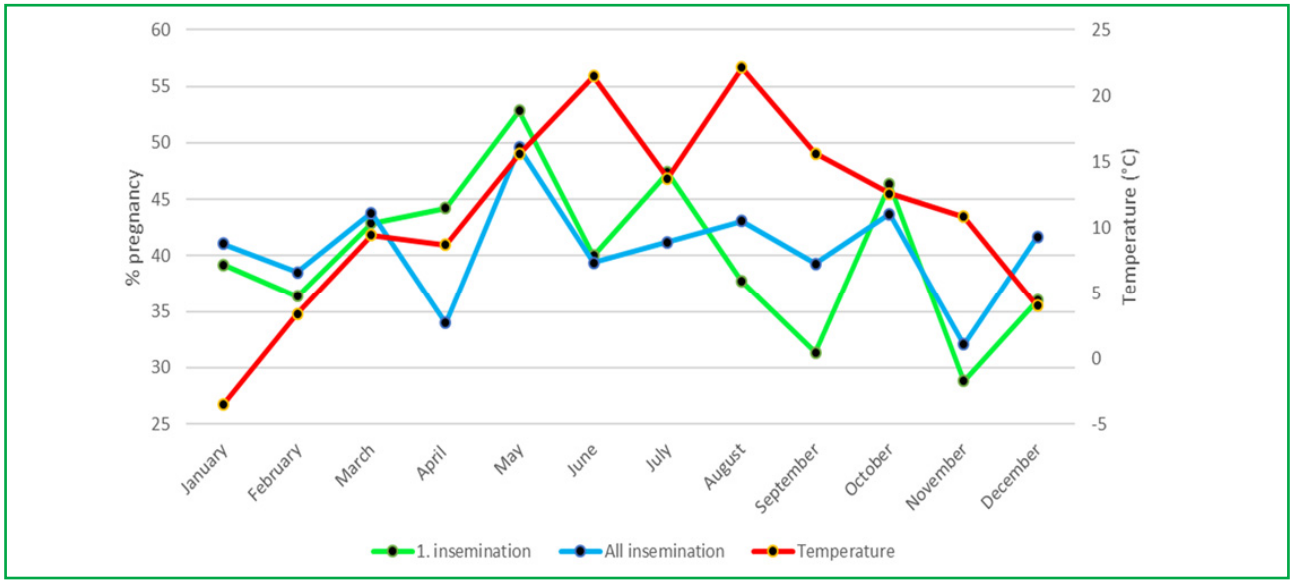

Figure 1 Relationship between percentage of pregnant cows and temperature in stable 2017

In the case of cows in 2019 (Figure 2), the effect of temperature on conception is much more pronounced. The reduced level of reproduction is manifested especially in the summer months with inertia until the beginning of the next season. This tendency is also confirmed by the coefficients of correlation between the temperature in the stable and conception after the 1st and all inseminations ($r = -0.78$ and $r = -0.59$).

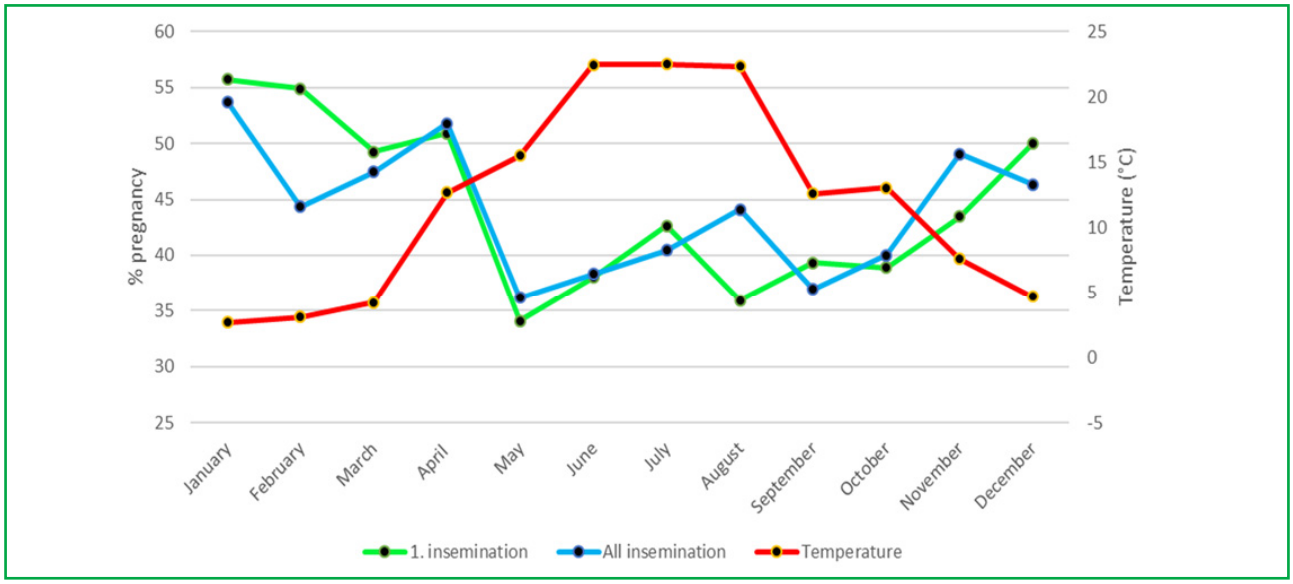

Figure 2 Relationship between percentage of pregnant cows and temperature in stable 2019

4 Conclusions

The work dealt with the relationship of microclimatic parameters to reproductive indicators of dairy cows to improve these reproductive indicators using neck responders. Monitoring was performed in GenAgro Říčany using Vitalimeters from Farmtec. From the given findings and cited authors, neck responders can be used and recommended for other breeds with free housing of cattle. The main advantage is the facilitation and refinement of heat detection, reducing the number of silent heat, and minimizing the number of cases for infertility treatment. This also improves the efficiency of work in breeding and saves time. At the same time, the management of the farm will draw attention to the health problems of individual dairy cows in time.

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