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IDENTIFICATION OF THE BEHAVIORAL CRITERIA OF DAIRY CATTLE ON THE BASIS OF ELECTRONIC IMAGING

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ABSTRACT

The paper deals with the identification of the behavioral criteria of dairy cattle through Imaging. The objective of the study is the optimization of the rate of pregnancy in these cows. Indeed, the gestural behaviors of 200 cows belonging to a stable were observed by giving more attention to cows that show signs of heat known. A camera was used to record the different postures and the different behaviors of these cows. The quantitative data of reproduction studied farm showed that the rate of pregnancy in these cows is far from optimal. This is due essentially to a lack of monitoring and observation of cows in heat negatively affecting the economics of the operation. Detecting cows in heat can be made and improved by using Imaging. This will facilitate the life of farmers and increase their income and decreasing the time for detection of the heat.

Keywords: Imagery; system analysis; heat; cattle; behavioral criteria; management

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1. INTRODUCTION

Various studies and reflections on the development of the agricultural sector have stressed the importance of upgrading of farms. Exploitation of automated production systems is a reality especially in the cattle breeders structured at the level of the Treaty and complementation food rooms, the use of ICT remains shy in Tunisia.

Indeed, with the expansion of herds and the desire to improve offspring, cows are more covered by bulls but are artificially inseminated after their observation in heat (Bouraoui et al., 2002; Lakhoua & Karoui, 2019).

The production of milk and meat of a milk cow is directly related to their reproductive function. It is the birth of the newborn that triggers the production of milk in this animal. This birth called calving is direct function of the success of the artificial insemination following accurate detection of the reentry period in heat of the cow in question.

However the heat at farms size detection is often provided by workers and therefore prone to errors of observation. It is the result of a multitude of factors related to the accuracy of the observation of the signs of heat, to the effectiveness of artificial insemination as well as the fertility of the seed. To have a calving every 12 months, 90% of the cows must go into heat within 60 days after their calving. The interval between calving and fertilising insemination must be on average between 50 and 60 days.

Milk production plays a key role in the agricultural sector and in the Tunisian economy (Hammami, 2004). Since the 1990s, the State encourages investment in the breeding of dairy cows to meet the growing demand for milk and its derivatives. This encouragement enabled Tunisia to achieve self-sufficiency in milk since 1999.

Although the number of livestock has increased significantly and that the existing races in Tunisia, through import, can have very high yields, we're still far from the optimal production rate. This is due mainly to a low detection rate of cows in heat (Djemali & Kayouli, 2003; Hamrouni & Djemali, 2017).

Farming occupies, in Tunisia, the most important agricultural production part. It represents between 32% and 37% of the value of agricultural production with 769 thousand cattle heads, 7 million sheep, 1.5 million goats and 70 thousand units females of camelids.

The livestock sector plays an important socio-economic role. He contributed 22% of permanent positions in agricultural activities. It affects a total of 112 000 cattle producers, 274

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000 herders of sheep and 2300 breeders of camels in addition to farms poultry and rabbits (OEP, 2015).

Three classes of farmers are met, small (75%), the means and the ranchers. The latter (20%) are often advanced in the application of modern breeding methods (parlours, cold to the farm, Artificial Insemination and improved Genetics). As for the dairy cattle industry, it includes a total of 235 milk collection centers and dairy processing units, 43.

Meat production is considered as a by-product of milk and helps to supply a total of 183 slaughterhouses and 20 units of cuts of red meat. It has a tendency to increase in cows of pure breed at the expense of local and cross cows. In 2010, the purebred cows represented 51%. In 2015, they accounted for 65 percent. The dairy cow in Tunisia has become more specialized (El Ghezal, 2012).

In developed countries, several technological attempts have been adopted to help farmers better manage dairy cattle herds based in particular on the use of pedometers. In Tunisia, the breeding of dairy cows continues to pose problems due mainly to a bad heat detection and insemination time opportune (50, 60 days after calving). This has led to calving intervals exceeding 14 months (Salem et al., 2006; Lakhoua et al. 2019).

It is in this context that this work was proposed to identify the criteria of behavior of dairy cattle in a barn through the application of systemic analysis (Lakhoua, 2018, Lakhoua et al., 2016, Lakhoua, 2013) and electronic imaging (Ben Mansour et al., 2015, Cheikhrouhou et al., 2015, Soltani et al. 2018).

2. MATERAL AND METHODS

The economy of a cattle farm is based primarily on reproduction. The latter increases the production of beef as well as milk because a cow can only give milk after having calved at least once in her life. The first concern of all cattle producers is therefore to increase the breeding rate to increase their income. The traditional or rather natural way to have gestant cows is to protrude them from a bull. However, modern bovine barns no longer use this method and use genetically high animal seed using Artificial Insemination (Hamrouni et al., 2009).

Wanting to improve the offspring i.e. the dairy performance of girls or heifers, breeders import the seed of good bulls so that newborns have better genes than their parents and therefore produce more milk. In addition to the genetic side, the bull can pose a danger to breeders because of its ongoing agitation. It is for these reasons that modern reasons that modern breeders opt for artificial insemination and quality animal seed. However, to practice

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this method properly, the ovulation periods of each cow must be known precisely in order to be able to be inseminated and produce one calf per year.

Ovulation is a physiological phase of the female where the egg is ripe to be fertilized by the male's animal seed. This physiological stage is expressed by what is called the cow's "heat period." This is a cyclical period that appears on average every 21 days if fertilization of the egg has not taken place. Fortunately for breeders, a cow has several signs that indicate its entry into heat.

Indeed, a cow in heat climbs on its congener or let’s itself rises by the latter without slipping away (Figure 1). This often leaves traces observable with the naked eye on the back of the raised cow.

In this part the cattle herd of a farm in Tunisia was presented (Jemmali, 2016). The barn is linked to the milking room by a protected area where cows congregate before being taken to the milking room. It is a barn where only the feeder is protected by a shelter, the rest is an open space (Figure 2). The heifers are separated from the cows in a second room. A new barn is currently being built. It will allow more well-being to cows and more access and work facilities for workers and livestock managers.


Figure 1: Acceptance of overlap


Figure 2: The current barn studied

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The cows are reproduced by Artificial Insemination using the imported seed of Bulls tested for their high genetic level. This is what has given this farm a reputation for producing quality heifers. Cows or heifers are inseminated as a result of heat observation. Specialized workers detect the females in heat and pass their number to the farm manager. Females observed in heat at night are inseminated in the morning. Those observed during the day are inseminated in the evening by the veterinarian.

The sign language behavior of 200 cows belonging to this farm was observed by giving more attention to cows that show signs of known heat (Jemmali et al., 2017). A camera was used to record the different postures and behaviors of these cows.

All photos and video footage were used to build a database. A computer program has been developed to translate these observations into recognizable indicators showing that a cow is in heat (Jemmali et al., 2017b).

The traditional but still most used method in the world to this day is heat detection by observing the behavioral changes of dairy cows. This method, if not well practiced, may give false alarms or not detect heat. In addition to the poor practice of observing cows with the naked eye, heat expression defects are becoming more common (Djemali & Berger, 1992).

In the 1980s, the time interval between the first and last acceptance of overlap varied between 6pm and 8pm, whereas today this interval has narrowed considerably and varies from 4am to 8am. In other words, the duration of heat expression in a dairy cow today is a quarter of those 30 years ago.

All the factors already mentioned make the method of detecting heat with the naked eye not very reliable. This does not allow breeders, in the majority of cases, to know precisely the ideal time to inseminate the cows, which eventually leads to large economic losses. Not being very reliable and very profitable, it was necessary to find solutions other than the traditional method to detect the ovulation of a cow in order to inseminate it in time.

3. RESULTS

Quantitative data on reproductive performance were analyzed separately for heifers and adult cows. The main results for heifers are in Table 1. Out of a total of 31 heifers, 94% (29 heifers) were conceived following the observation of the first heats as presented in Table 2.

Table 1: Breeding parameters for heifers

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Variable	Number	Middle	Minimum	Maximum
I12 (days)	3	36	19	51
I23 (days)	3	7	0	22
Age_IF (months)	31	16	15	18
Age_ calving (months)	31	25	24	27

Table 2: Design at the first heat observed

Variable	Number	%
Design at the first Artificial Insemination	29	94
>= 1 heat observed	2	6
Total	31	100

Only three heifers required more than one heat cycle. This shows that heifers are well observed by workers. Being separated from cows in independent housing with a reduced staff has made it possible to better observe the heat of the heifers.

The calving frequencies per year are shown in Table 3. In our database, the majority of calvings took place in 2015 (78%).

Table 3: Calvings per year

Year of calving	Number of cows	%
2014	17	8
2015	159	78
2016	28	14

The frequencies of calving per month are shown in Table 4. There are more calvings in autumn and early winter than in summer.

Table 4: Calvings per month

Month of calving	Number of calvings	%
1	23	11
2	24	12
3	8	4
4	5	2
5	12	6
6	8	4
7	8	4
8	13	6
9	32	16
10	27	13
11	20	9
12	24	12

4. DISCUSSION

The results represent a sign of good conduct of Holstein dairy cattle in the climatic conditions of Tunisia when there are more calvings in the most favorable seasons. Three main seasons affecting the milk production of Holstein cows have been identified.

Cows that calve in Autumn- early winter give more milk during their total annual lactation followed by cows calving in the spring. Cows that calve in the summer produce less.

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The explanation that was put forward was that cows calving in autumn-early winter would see their entire lactation take place in a favorable period.

Cows that calve in the spring have a good start in the spring but will be penalized by the summer heat in full lactation. As for cows that calve in the summer, they are penalized from the start by the summer heat.

In this section, we present indicators of the effectiveness of heat observations. Indeed, the intervals between the different heats observed show the difficulties in controlling reproduction. Averages and variations of the various calculated variables are presented in Table 5.

Table 5: Indicators of the reproduction

Variable	Number of cows	Middle	Norms
I12	94	39	21
I23	53	35	21
I34	32	40	21
% Intervals (18-24 days)	I12=17	I23=16	>85
IV_Ch1	101	77	< 40
IV_IA1	91	83	50-60
IV_IF	101	138	85-100

It appears from these results that reproduction is a problem at the level of this breeding. All parameters are far removed from the standards set for proper breeding of a dairy cattle farm. This complication stems mainly from the difficulty of observing the heat in a way just to be able to inseminate the cow in time.

5. CONCLUSIONS

The dairy cattle sector, like any other agricultural sector in Tunisia, can only improve if appropriate technologies are adopted. Information processing technologies generated in large barns and the application of imaging technologies could strengthen and strengthen the capacity of the agricultural sector in general and in particular the livestock sector.

This work has taken a step forward in a vital area that is agriculture and in particular cattle farming with a spirit of innovation. This breeding that has made our work target is both modern is classic: modern by its new barn and its automatic distribution of food as well as its milking room and classic in the methods of observing cows in heat that depends on the p resistance and vigilance of workers.

The latter is often lacking revealed by the results obtained where only 17% of the intervals between successive heats are normal, leading to a low heat detection rate (28%). Heifers did not pose detection problems due to their low numbers.

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