STUDY OF NUTRITIONAL AND REPRODUCTIVE CONSTRAINTS OF FRIESIAN DAIRY CATTLE IN THE MITIDJA AREA OF ALGERIA

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Abstract

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This work aims to improve reproduction and milk production of Friesan dairy cows used under the environmental conditions of the Mitidja Plain (Central region of Algeria) by analyzing the quality of feeding and studying the resumption of ovarian activity of cows after calving.

The first phase of the study started during 1995/96, by surveying a sample of 47 livestock farms in the Mitidja area in order to identify available feed resources and husbandry practices and to record data on reproduction parameters, individual body weights, body condition score and milk production. Ovarian activity was monitored by radioimmunoassay of progesterone in blood and milk samples collected twice a week, after 15 days post-partum.

The second phase was conducted in 1996 and 1997 in two dairy farms. Data were collected on the same parameters of reproduction and production. During the second year, the results of dairy herds were better than those in the first year. That was probably due to monitoring provided by the research project.

1. INTRODUCTION

In Algeria, mixed farms consisting of dairy cattle and crops are a dominant farming system in the plain areas and the majority of the cattle population are kept in small farms of less than 5 ha. However, new livestock farming systems have recently developed in peri-urban areas, where milk production predominates with feedstuffs being bought at the market. The milk production is extensive on a relatively small agricultural area (3.16%) because land exploitation is strongly dependent on rainfall. The increase in cattle population has been slow which is mainly due to nutritional and reproductive constraints. The annual calving rate has been about 60% with a long interval between calvings [1].

Available feed resources are: 38% cultivated forages, 10% fallows, 28% rangeland, 15% concentrate feed and 9% by-products. Cattle consume around 30% of these feed resources. The annual availability of concentrate feed is about 1.6 million tons and only 7% have been ear marked as ruminant feed. Comparison between feed availability and animal requirements indicate a deficit which may be reduced by utilizing by-products and minerals in animal feeding.

The effects of dairy herd managment on reproduction and milk production have been studied through a Coordinated Research Project of the Joint FAO/IAEA Division, IAEA. This paper presents results from these studies conducted during 1995/1996 and 1997.

The study aims to contribute to increased productivity and milk production of dairy cows in farms monitored by the project. It consists of a study of reproduction parameters by using radioimmunoassay (RIA) of progesterone in milk and blood samples of cows after calving, the introduction of milk recording to develop the productivity of dairy herd and the monitoring of other production parameters such as body condition score (BCS) and body weight.

2. MATERIALS AND METHODS

2.1. Surveys

Surveys were carried out on livestock farms in the Mitidja plain to determinate the characteristics of their feeding systems and dairy herd management in order to examine the possibilities of utilizing the feed resources for increasing the contribution of dairy cattle to producer income. The Mitidja area was chosen because of it contrbutes to the milk supply of the peri-urban population of Algiers. A total of 47 questionnaires were completed after consultation with farmers in the study area. The data collection focused on the kind of feeds provided to animals throughout the year.

2.2. Livestock farms selected

After carrying out surveys, two livestock farms A and B were chosen to collect data on the characteristics and the performance of dairy cows. The two farms are located in the Mitidja plain (fifty kilometers around Algiers) at an altitude of 200 metres above sea level. The soils are clay-loams with good fertility. The climate is typically mediterranean with an average annual rainfall of 370 mm. The average temperature varies between 7°C in December to 32°C in August.

2.3. Animals

Farms surveyed had a total number of 650 cows. The herd size varied from 4 to 50 cows with a majority of smallholders possessing less than 12 head. All cows involved in the study were Friesan, typical of those in the Mitidja plain. The number of cows considered in Farm A was 67 for the first period (1995/96) and 40 for the second period (1996/97), respectively. In Farm B, the study was carried out only in the second period using 30 cows. In both cases, cows were stall-fed but grazed on natural pasture when the weather was good. Data were collected on all cows of the farms chosen during the second phase of the study. The herds of these farms were chosen because they presented better working conditions to evaluate feeding strategies and the performance of dairy cattle.

2.4. Observations on herd feeding

Samples of forages were collected monthly from the farms to determinate the chemical composition (dry matter, ash, crude protein). The diet changes were calculated monthly. All cows were kept and housed in tie-stalls for feeding. The cow requirements and feed composition were estimated in French units for energy (UFL) and nitrogen (MAD).

2.5. Measurements

Resumption of ovarian activity post-partum of cows was determinated only on Farm A during the two periods (1996 and 1997). Blood samples were collected once a week from the 15th day post-partum by jugular venipuncture using heparinized vacutainer tubes. Blood samples are centrifuged immediately at 4°C for 15 minutes at 2 000 *g*. After decantation, plasma samples were stored in the freezer until progesterone assay. The progesterone measurement was carried out by radioimmunoassay (RIA) technique using FAO/IAEA solid-phase RIA kit. The inter-assay coefficient of variation for the low and high concentrations as calculated from a duplicate analysis of plasma controls plasma were 4.2% and 4.4%, respectively. The resumption of ovarian activity was defined as the moment at which the concentration of progesterone was greater than 2 nmol/L for plasma.

Cow weights and heart girth measurements were recorded in both Farms A and B using a weigh band for cattle. Monthly, BCS of cows was determined using the 1-9 scale method [2]. Individual data on milk production were collected monthly for each cow on both farms.

3. RESULTS AND DISCUSSION

3.1. Survey results

The chracteristics of farms surveyed during Phase I of the study are presented in Table I. Three farm types could be recognized. Farm Type I is characterized by a relatively small area of land, high number of cows and a very low milk yield. These farms belong to private farmers that possess small fodder areas and often buy forages at the market.

Farm Type II is characterized by a structure intermediate to one and three. They are situated in the peri-urban zone. The average milk yield is better than the other farm types.

Farm Type III represents farms which possess a larger land area as well as cows, than the other two types. The milk production is low relative to available resources. These farms belong to the co-operative or state sector. They are characterized by a system of polycultures associated with animal production. The two Farms A and B selected for the study belonged to Type I and III, respectively.

In the study area, the importance of feed resources varied according to their origin; it was 38.4% dried forages, 10.5% fallows, 27.6% natural pasture, 14.8% concentrates and 8.7% by-products. However, field-dried hay (78% of the whole forage area) was the dominant forage crop; green fodder areas represented only 22%. These observations are illustrated by the results of surveys [3] which showed that the majority of farms have winter and summer rations with poor forages such the hay of Vicia-avena (Tables II).

TABLE I. CHARACTERISTICS OF FARMS SURVEYED (MEAN ± SD)

	Type I	Type II	Type III
Number of farms	11	22	14
Farm area (ha)	7.5 ± 2.8	10.9 ± 7.4	71.4 ± 53.2
Fodder area (%)	41.5 ± 29.1	61.4 ± 35.3	66.8 ± 16.2
Irrigated area (%)	11.5 ± 19.1	6.6 ± 11.3	11.4 ± 12.
Number of cows	18.9 ± 10.6	13.1 ± 7.5	43.2 ± 25.8
Number of bulls	2.0 ± 1.0	1.0 ± 1.0	2.0 ± 1.0
Percentage of calves	30.6 ± 7.1	22.4 ± 19.2	18.2 ± 14.7
Percentage of heifers	8.2 ± 7.5	3.9 ± 8.5	6.1 ± 9.3
Milk yield (kg)	2724.5 ± 518.7	4168.0 ± 1244.7	3317.1 ± 931.9

TABLE II. NATURE OF RATIONS USED IN THE FARMS DURING WINTER AND SUMMER

	Farm number	Percentage of farms
Winter ration (basal forage)		
Trifolium	5	10.6
Vicia avena	20	42.6
Avena	19	40.4
Others	3	6.4
Winter ration (supplement)		
Bran	22	46.8
Bran + brewer's grain	14	29.8
Bran + concentrate	5	10.6
Others	6	12.8
Summer ration (basal forage)		
Vicia avena	16	34.0
Avena	9	19.0
Sorghum	7	15.0
Sorghum + Vicia avena	8	17.0
Sorghum + avena	7	15.0
Summer ration (supplement)		
Bran	30	64.0
Bran + brewer's grain	9	19.0
Bran + concentrate	2	4.0
Bran + carob	6	13.0
Total	47	100

The data in Table II above indicate that the system of cattle feeding in the Mitidja region is based essentially on the utilization of hay and oat fodder which is of low quality (0.4 UF and 10-20 g of MAD) [4]. Concentrate feed is expensive and farmers have a tendency to replace it by wheat bran which is relatively cheaper. Furthermore, a previous study [5] has shown that there exists in Algeria a strong dependence of livestock on cereals. 75% of ruminant feeding is based on cereals and their by-products. Cultivated forages and spontaneous herbs represent only 25% of the total feeding. Estimations [6] show that in the year 2000 the deficit would be 32% in energy (UF) and 61% in nitrogen (MAD). These estimations agree with the forage balance realized in 1989 [5]. They indicated a deficit of 31.2% of energy.

The deficiency of the feed base seems to be a major constraint for low milk production The increase in production is possibe by improving breeding methods and by utilizing feed resources, by-products and minerals as supplements in the animal's diet.

3.2 Feeding practices

The chemical analysis of forages used in Farms A and B are given in Tavle III. The daily requirements and supply of energy and nitrogen in winter (December to February) and summer (June to September) rations are shown in Table IV.

TABLE III. DRY MATTER (DM) AND CHEMICAL COMPOSITION (% OF DM) OF FEED GIVEN TO DAIRY COWS

Farm	Type of feed	DM (%)	Crude protein	Ash
			(% DM)	
A	Avena (hay)	86.7 ± 3.9	4.7 ± 0.5	9.2 ± 0.9
	Sorghum (green)	25.2 ± 2.4	61.4 ± 10.6	6.8 ± 2.0
	Concentrate	88.5 ± 0.5	15.4 ± 2.1	5.4 ± 0.7
B	Bran	87.1 ± 0.7	16.3 ± 0.5	4.9 ± 0.7
	Brewer's grain (fresh)	22.0 ± 0.1	29.9 ± 1.6	4.4 ± 0.5
	Vicia Avena (hay)	85.6 ± 4.5	13.3 ± 1.9	8.2 ± 0.4
	Cabbage (green)	14.3 ± 0.4	15.6 ± 2.2	12.8 ± 1.1

The daily requirement of energy and nitrogen were estimated on the basis of the average body weight of cows of 455 ± 5.4 and 585 ± 10.9 kg and average milk yield/cow/d of 9.4 ± 2.9 and 10.7 ± 1.4 kg, for Farms A and B, respectively. The daily nutrient supply was estimated by DM intake of the ration provided during the summer and winter. The nutritional value of the forage consumed by animals was determinated from the results of chemical analysis, which compared well with INRA tables [7] and those from the Institut National Agronomique, Algiers.

When comparing the nutrient supply and animal requirements it appears that in Farm A, the winter ration is deficient in energy (22%) but balanced in nitrogen because of the availability of green forage and the use of high levels of concentrate. However, the summer ration appeared to be deficient in both energy and nitrogen; the deficit being 37 and 23%, respectively. This is due to the low availability of green forage and concentrates; the hay provided in the summer being of poor quality. However, the observations were different for Farm B where both energy and nitrogen were in excess during winter as well as the summer. Farmers used wheat bran and brewer's grain at a 1:1 ratio as a supplementary feed. This type of mixture which contained high levels of energy and nitogen was consumed well by the cows.

TABLE IV. DAILY NUTRIENT REQUIREMENT OF COWS DURING WINTER AND SUMMER IN FARMS A AND B

Farm	Season	DM intake (kg)			Total DM intake	Daily requirement		Daily supply	
		Hay	Green	Conc.	(kg)	Energy (UFL)	Nitrogen (g MAD)	Energy (UFL)	Nitrogen (g MAD)
A	Winter	2.8	2.6	3.5	8.9	8.6	846	6.7	846
A	Summer	3.5	1.2	2.6	7.3	8.6	846	5.4	648
B	Winter	6.7	2.6	4.2	13.5	9.9	984	10.9	1574
B	Summer	1.4	4.3	7.0	12.7	9.9	984	12.0	1984

3.3. Reproductive performance

3.3.1. Distribution of calvings

Figure 1 shows the distribution of calvings in the two farms. In Farm A majority of calvings (73%) took place between January and March during the period 1995/96. However, during 1996/97 calvings were spread out between September and March, the month of October recording over 20%. In Farm B calvings were distributed throught the year; the highest (65%) occurring between the months of June and August.

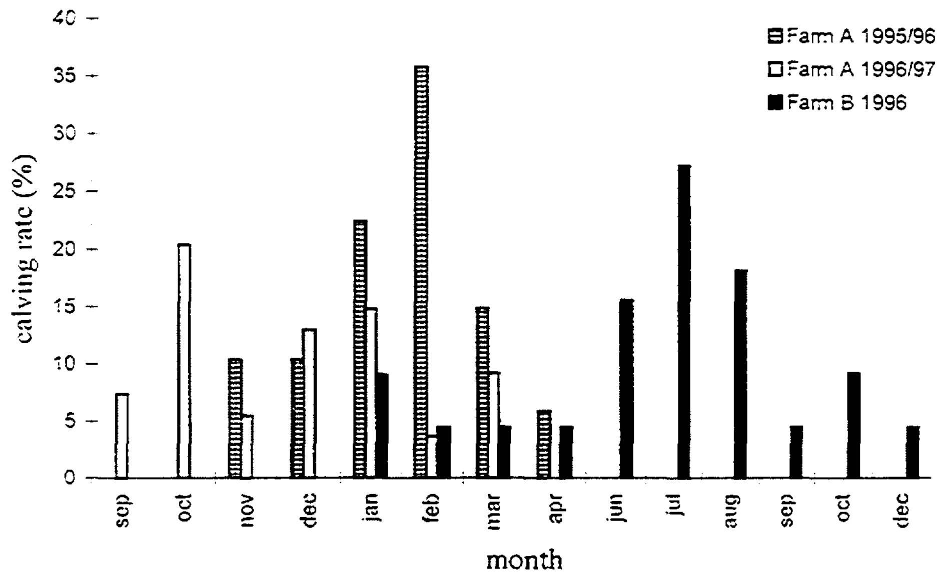

FIG.1. Distribution of calvings in Farms A and B during 1995, 1996 and 1997.

3.3.2. Resumption of ovarian activity post-partum

As shown in Table V, the rate of resumption of ovarian activity recorded at 35 days post-partum was relatively low during the two study periods 1996 and 1997 (37.3 and 20%, respectively). The average anoestrus duration was 26.3 ± 5.9 and 32.2 ± 2.1 days, for the two periods, respectively. However, at 60 days post-partum the rate of resumption of ovarian activity recorded was high for the first period (70%) compared to the second period (40%); but these results were poor compared to those recorded previously [8-10].

TABLE V. CUMULATIVE PERCENTAGE OF COWS RESUMING OVARIAN CYCLICITY POST-PARTUM

Interval from calving	Period 1 (n = 67)		Period 2 (n = 40)	
	Number of cows	(%)	Number of cows	(%)
< 35	25	37.3	8	20.0
< 45	35	52.2	11	25.5
< 60	47	70.1	16	40.0
< 90	60	89.5	28	70.0

3.3.3. Fertility indices

The fertility rate is generally assessed by two criteria which are the first sevice conception rate and the percentage of cows inseminated 3 times or more. Results recorded in Farm A during both study periods and in Farm B during the second indicated poor conception rates. For Farm A the first service conception rate was 33.3 and 42.5% for the two periods, respectively. The first service conception rate was 16.7% in farm B during the second study period. The percentage of cows inseminated 3 times or more was 12.6 and 35.0% for Farm A and 36.7% for Farm B (Table VI). The delay to serve cows after calving depends on a complete uterine involution, resumption of ovarian activity and oestrus. Observations indicated low percentage of cows being inseminated on Farm A soon after calving; 7.6 and 2.5% respectively, for the two periods studied. However, on farm B 27.8% of cows were being inseminated soon after calving. Cows inseminated between 40 and 90 days after calving were 66.6 and 85% on Farm A for the first and second periods, respectively. On Farm B 33.3% of cows were being inseminated between 40-90 days.

TABLE VI. FERTILITY INDICES OF POST-PARTUM COWS

Fertility index	Norms*	Farm A Period 1	Farm A Period 2	Farm B Period 2
First sevice conception rate (%)	>60	33.3	42.5	16.7
% of cows inseminated 3 times or more	<15	12.6	35.0	36.7
Calving to first service		(n=66)	(n=40)	(n=18)
Mean ± sd (days)	65	81.1±47.4	66.6±38.0	75.2±38.0
Distribution (days)				
< 40 days	0 %	7.6	2.5	27.8
40 to 90 days	100 %	66.6	85.0	33.3
> 90 days	0 %	25.8	12.5	38.9
Calving to conception		(n=50)	(n=40)	(n=18)
Mean ±sd (days)	90	149.5±86.3	126.5±58.9	152.7±52.0
Distribution(days)				
< 40 days	0 %	0	0	0
40 to 110 days	85 %	46.0	52.5	27.7
> 110 days	<15 %	54.0	47.5	72.2

* From INRA; Number of cows within parenthesis

These values do not agree with stated norms for Algeria. They are not only the result of a delayed ovarian activity, but also the consequence of poor reproductive management, constraints in heat detection and the general lack of an animal health plan, especially during the peri-partum period. An increase in the average duration of calving to first sevice interval is related to the delay in the resumption of ovarian cyclicity post-partum. For the 44 inseminations carried out 43.2% appeared to have been carried out before the resumption of ovarian activity and 36.4% during the luteal phase of the cycle. The mean values recorded for the interval between parturition and conception were 149.5 ± 86.3 and 126.5 ± 58.9 days respectively, for the first and second periods on farm A, and 152.7 ± 52.0 days for farm B. The percentage of cows inseminated after 110 days was 54.0%, 47.5% and 72.2%, respectively. According to norms for the same interval the data recorded can be the onsequence of the prolonged delay in the resumption of ovarian activity or that of the interval between calving to first insemination.

Other observers have also indicated the low fertility of dairy cattle. The percentage of cows which did not conceive at 110 days post-partum were 27.5 and 33.2% respectively, in the Mitidja and the western region [11]. A low conception rate was also observed by Benabdelaziz [12].

3.3.4. Body weight and BCS of dairy cows

The average weight of cows in Farm A was 455.0 ± 5.4 kg with a range of 448 to 462 kg. In Farm B the weight was higher with a mean of 584.7 ± 10.9 and a range of 573 to 603 kg. The BCS was also better in Farm A than in Farm B. The mean was 6.1 ± 0.3 and 5.2 ± 0.8, for the two farms, respectively. The change of body weight and BCS of cows in the two farms over a period of 7 months are shown in Figures 2 and 3. Cows in Farm B maintained a higher body condition than those in Farm A probably due to the higher energy intake compared to those in Farm A. Cows in Farm B received a higher level of concentrate than those in Farm A.

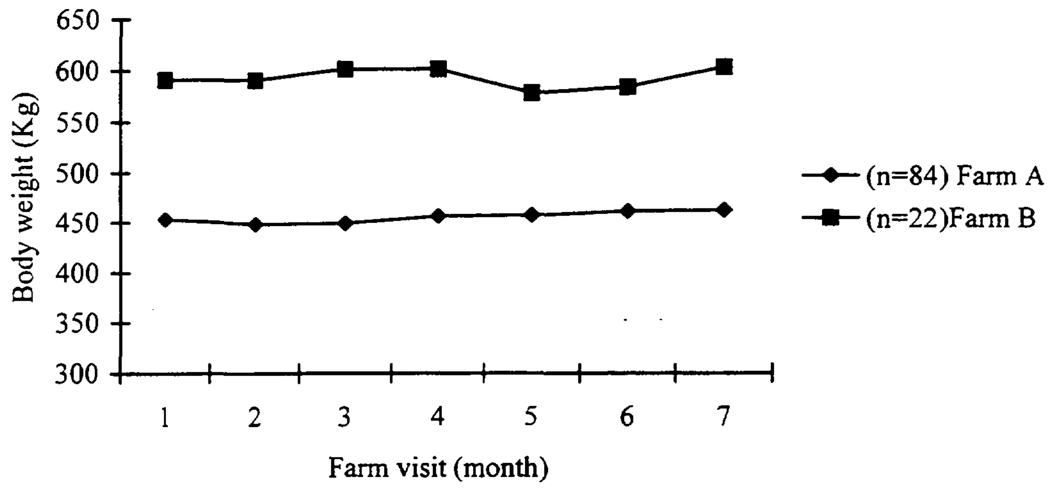

FIG.2. Change in body weight over 7 months in Farms A and B.

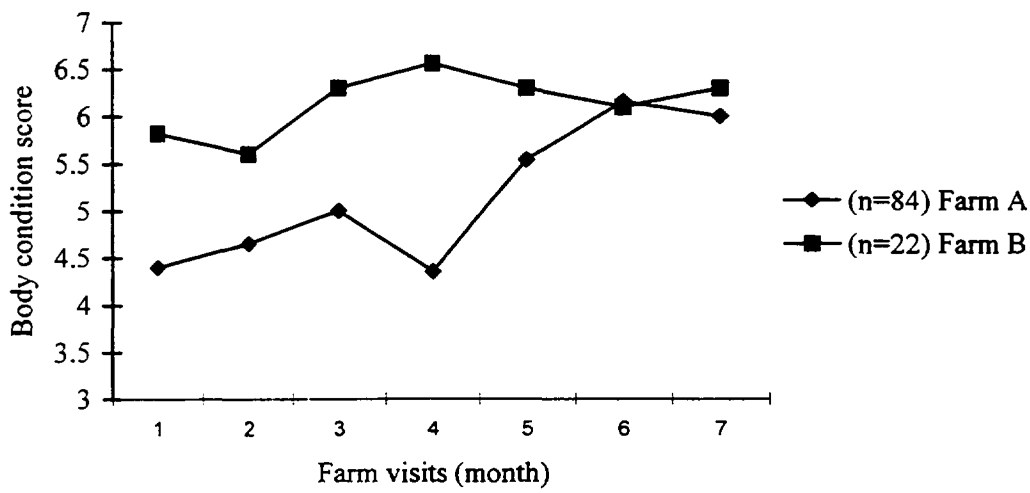

FIG.3. Change in body condition score over 7 months in Farms A and B.

3.3.5. Factors affecting dairy cow reproduction performances

The analysis of data on reproductive perfomance of dairy cows on Farm A during the second period (Table VII) shows a significant effect (P <0.05) of calving season and BCS at calving on the interval to first ovulation.

TABLE VII. LEAST SQUARE MEANS AND VARIANCE (sd) FOR REPRODUCTIVE TRAITS OF DAIRY COWS

	Interval from calving to			
	First ovulation		Conception	
Source of variation	n	mean ± sd	n	mean ± sd
Overall	40	71.0±32.7	40	126.5±58.9
BCS[1]				
4	8	88.0±34.2 (a)	8	138.2± 65.9
5	26	72.5±30.4 (a)	26	119.1± 55.6
6	6	48.8±24.2 (b)	6	129.0± 65.2
Season[2]				
Fall	18	76.2±29.5 (a)	18	121.6± 50.6
Winter	17	76.5±34.2 (a)	17	132.9± 68.2
Spring	5	33.8± 8.8 (b)	5	122.6± 64.3

[1] BCS = Body condition score (1-9 scale)
[2] Fall, (Sep-Nov); Winter, (Dec-Fev); Spring, (Mar-May)
a,b Means with different superscripts indicate significant differences (P <0.05)

Cows which calved with a BCS of 6 (on a scale of 1-9) and above had ovarian cyclic activity earlier (48.8 ± 24.2 days) than those with a BCS of 4 and 5 (88.0 ± 34.2 days and 72.5 ± 30.4 days, respectively). This suggests that cows having BCS below a critical level have poor reproductive performance [13], although cows calving during spring had shorter interval to first ovulation 33.8 ± 8.8 days than those calving during fall and winter, These results are in accordance with those obtained by Gary *et al.* [9]. These authors found a significant différence (P <0.05) between the cyclicity rates of cows calved in January, February and March (29.1, 40.4 and 58.6%, respectively).

The BCS at calving and season of calving did not influence the interval to conception. However Kassa and Tegegne [13] found that cows with a BCS of 2-3 at calving had longer service to conception intervals than those with a BCS >4.

3.3.6. Milk production

Levels of milk production in the two farms studied were similar and the analysis of variance showed no significant difference bewtween the two farms. The average yield/cow was 9.4 and 10.7 kg/d for Farms A and B, respectivley, during a lactation period of 210 days.

There was a similarity in the average lactation curves between the two farms. Statistically, the two curves seem to be characterized by a similar level of production at the peak and a same daily production per cow. However, there was a difference at the fourth month of lactation where the curve declined for Farm A which was probably due to a feed deficit. On the contrary in farm B, a persistant lactation curve was observed which could be explained by the better feeding with high levels of concentrates (4-7 kg DM/cow/d). Nevertheless this excess feed in Farm B did not bring about a high milk production.

4. CONCLUSIONS

Results of the survey in the Mitidja region revealed a diversity of production types. Their management was often limited to constraints of environment such as as husbandry and feed availability. These aspects have been confirmed in the two studied farms. Observations indicated a deficiency of energy and nitrogen in the feed resources during the summer season. This could be attributed to inadequate forage stocks and poor feeding management. This situation has an impact on the body condition of cows, level of milk production and the resumption of ovarian activity after calving. In fact, the intervals from calving to the resumption of ovarian activity and conception were long and the percentage of cows served between 40-90 days after calving were relatively small. The resumption of ovarian activity was shorter in cows which calved with BCS of 6 and above compared with those having a BCS of 4 and 5, and in cows calving in spring than those calving in fall and winter.

The results on the two farms indicate poor reproductive managment and a low nutrional status of cows at calving which have an impact on post-partum ovarian activity. The forage production does not cover all feed requirements of animals and farmers often tend to buy feed from outside theirs farms. A decline in milk yield was observed in the two farms which are characterized by constraints related to management of reproduction and nutrition which have a direct impact on herd productivity. It shows particulary the influence of level of feeding on BCS for the first 100 days after calving. The study suggest the need for supplementing the dairy cattle. Any technical intervention concerning animal feeding must take in account the whole environment of each livestock farm studied.

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