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BARD

FINAL REPORT

PROJECT No. I-106-79

**Breeding Efficiency and Milk Yield of Dairy Cows in
Relation to Nutritional Status and Planned
Differences in Conception Intervals**

H. Schindler, R.H. Foote

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62	Table 1 1st column	0.01 in lieu of 0.1
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74	Fig. 1	Add footnote: n for each curve is presented in Table 2.
97	Table 1	Post-partum periods (days) I (1-28) II (29-63) III (64-91) Footnote a: total digestible nutrients, kg.
98	Table 4) Table 5)	Post-partum periods (days) I (1-28) II (29-63) III (64-91)
102	12	Emery
111	Table 10	Post-partum interval (days) 35-59 54-94 124-154
152	21	The trends in milk production in the 365-day (12-month), 420-day (14-month) and the 476-day (approx. 16-month) intervals are similar in both herds.

Abbreviations: T or TR mean Treatment, i.e. assignment to planned calving-conception interval.

CC means Calving Cycle in experiment.

The objective of the study was to determine the influences of early, recommended and delayed breeding (35-59, 60-90, 120-150 days postpartum) and prepartum feeding levels (110 and 160% National Research Council, NRC, standards) on reproduction, milk production and energy balance in high yielding Holsteins. Detailed records for five years on about 275 partial or complete lactations with individual feeding (Experimental Herd), and about 1400 partial or complete lactations with group feeding (Cooperating Herd) were maintained, edited and analyzed. This study introduced the concept of animal response to reproductive management during fixed planned postpartum intervals. The proportions of animals conceiving during the three fixed breeding periods were about 30, 50 and 60%. This difference resulted from more animals submitted for breeding (more in estrus) and higher conception rates, particularly for multiparous cows, as the postpartum period increased. Conception rates in hot months were reduced, especially in multiparous cows. Metritis was the only genital disorder studied which significantly delayed breeding and conceptions, affecting especially the early breeding group. Thus, calving-conception intervals for the three breeding groups (35-59, 60-90 and 120-150 days postpartum) were 87, 105 and 165 days for primiparous animals and 94, 105 and 147 days, respectively for the other cows. Milk progesterone analysis revealed that the luteal phase began at 15.8 ± 8.9 days in primiparous cows and at 17.5 ± 11.1 days in multiparous cows. First cycles tend to be short, but are accompanied by ovulation. Conception rates after cycles ≤ 11 days were 52% versus 59% following 19-21 day cycles.

Actual 300-day milk yields for primiparous cows was 6900 kg and for all other cows in the cooperating herd was 8200 kg. Cumulative milk yield within fixed time periods of 12, 14, and 16 months postpartum was affected by the numbers of days in milk and days dry, which, in turn, were determined by the length of the planned calving cycle.

Body weight and condition score was increased by the 160% level of feeding, however this resulted in the lowest cumulative negative energy balance. Cows with three or more lactations were particularly affected. Blood nonesterified fatty acids were correlated with energy balance ($- .727$ for the 160% NRC level). Details in the report provide the basis for recommended intensive management of high producing Holstein cattle.

Part 1. Background of the Problem and Objectives

Part 2. Materials and Methods

Part 3. Data Base -- Cooperating Herd: Kibbutz Givath Haim (Ehud)

Part 4. Data Base -- Experimental Herd

Part 5. Inventory of Animals

Part 6. Appendices

The dairy animal is potentially one of the most efficient converters of forages and plant by-products into high quality animal protein, primarily in the form of milk (Reid and White, 1978). The efficiency of milk production and the number of calves available for replacement and for meat production is highly dependent upon reproductive efficiency. This reproductive efficiency can be measured many ways. One variable widely used is calving interval, but information previously available on optimal calving interval has limited value because it was not based on planned different calving intervals. Rather, data came from herd recordings, where a multitude of factors may have contributed to the variation, resulting in different conclusions concerning recommended reproductive management for optimal calving interval and economic gain (BarAnan, 1973; BarAnan and Soller, 1977; Harrison et al., 1974; Heimann, 1974, 1976; Lamb and Kopland, 1963; Louca and Legates, 1968; Speicher and Meadows, 1967; Smith and Legates, 1962; Trimberger et al., 1972).

The worldwide trend has been for Holstein cattle to produce an increasing share of the milk. Secondly, the trend has been towards larger herd size. Thirdly, the level of herd production has been increasing through the use of intensively selected sires in artificial insemination, and improved feeding and other management practices.

The large Kibbutz herds of Holsteins in Israel and the Holstein herd at the Volcani Center provided most suitable animals and conditions for imposing management systems and measuring multiple responses in reproductive and productive performance (Eger et al., 1976; Eger and Schindler, 1977). Cornell University has had a long history of studying nutrition, reproduction and milk yield (Morrow et al., 1966; Reid, et al., 1955; Spalding et al., 1975; Trimberger, 1954; Trimberger et al., 1972).

This report highlights some of the detailed results which have been obtained through five years of collaborative effort under this BARD agreement. These data sets are extensive and comprehensive. Measurements taken on many animals include milk production, body weight, body condition scoring and feed intake. Many observations

and measurements of reproductive function (dates of calving, estrus and breeding, and veterinary exams, for example) were made. Cows were assigned at random to different planned calving - conception intervals, in an experimental and a commercial cooperating herd under close scrutiny and in accordance with an experimental design. The findings, related to the interrelation of reproductive and productive performance and nutritional status of the cows, should be selectively applicable to a large segment of the dairy producing animals housed in large groups and fed and bred for high milk yield in many countries.

Objectives

There were five major objectives.

1. To study the relationship between the postpartum interval and the function of the reproductive system as measured by interval to first ovulation determined by milk progesterone analysis, by time of conception, number of inseminations per conception, and frequency of disorders of the genital tract.
2. To clarify the relationship between the shape of the lactation curve, body weight changes and time of conception.
3. To relate breeding efficiency to changes in the nutritional balance during the pre- and post-partum period as measured by milk yield, body weight and compositional changes and energy intake.
4. To study the effect of length of the calving interval on milk yield in a fixed time period (i.e. per unit of time).
5. To measure the response rate of groups of cows subjected to different planned calving - conception intervals and to assess influencing factors.

Materials and Methods

General Description

Herd 1. Experimental Herd at ARQ.

This herd consisted of about 120 milking cows at the Volcani Center. The employees had been associated with research projects for several years. A technician with a college degree was in the barn full-time on this project. This person regularly checked the daily records and transferred the information to coding forms. The professional research team also was in regular contact with personnel recording the routine information. This experimental project was conducted from October, 1979 through May, 1984.

Cows were housed in a unit which contained stanchions for individual feeding, a freestall area and an open yard (Plate 1,A). Feed was supplied as chopped forage plus concentrates in covered stalls designed for individual feeding. Cows had access to their own feed supply five times per day for about one hour each time. Unconsumed portions of feed were weighed back daily and sampled occasionally for chemical analysis. There was free access to water at all times.

Cows were milked three times per day at 0600, 1300 and 2300 hours. Milk weights were recorded at each milking. The fat percentages were determined every two weeks.

Milk samples were taken twice a week at intervals of 3 or 4 days for progesterone analysis. The sampling was continued until pregnancy was diagnosed, but not longer than for the first 150 days postpartum.

Cows were examined by a veterinarian every two weeks after parturition. If disorders were found, such cows were checked weekly. The conditions observed were recorded, coded and transcribed on coding forms.

Cows were weighed weekly. This was done at a uniform time between 0600 and feeding at 0900 hours. Every two weeks cows were evaluated subjectively for body condition on a score of 1 to 5. This was continued for the first 150 days postpartum (Figure 1; Plates 2 and 3).

PLATE 1

EXPERIMENTAL DAIRY FARM

COOPERATING DAIRY FARM

Figure 1. Method for scoring cows for body condition. (From C.U. Animal Science Mimeo. Series 67:46. 1983)

All open cows were observed three times per day for estrus at 0600-0630, 1400-1430 and 1800-1830 hours. During the first two-thirds of the study a bull with a deviated penis was introduced into the herd for 20 to 30 minutes three times per day. Only cows which stood when mounted by other cows or the teaser bull were considered as being in estrus.

Details concerning treatments imposed and parameters measured are given later in this report.

Herd 2. Cooperating Herd Kibbutz Givath-Haim (Ehud).

This herd is located on the coastal plain north of Tel Aviv. The herd is managed by a cadre of experienced full-time personnel with B.S. or higher degrees. This Kibbutz has collaborated in previous research studies and was found to be cooperative and reliable. Prior to initiating the present study a research team visited the Kibbutz and discussed the objectives of the study with the dairy management personnel.

PLATE 2

BODY CONDITION SCORING

PLATE 3

BODY CONDITION SCORING

The dairy barn records were modified to include all parameters monitored in the study. Cow sheets and coding forms were designed to assure complete orderly transition of the data for eventual statistical analyses. A member of the research team visited the Kibbutz regularly.

There were about 400 cows in this herd. They were divided into four corrals, each with a shaded resting area and an unshaded feeding area (Plate 1, B). The four groups of cows consisted of the following: 1) Primiparous cows, 2) high yielding multiparous cows, 3) low yielding multiparous cows and 4) dry cows. The period of the study was November 1977 to September 1982.

Cows had free access to complete rations and water. The rations contained concentrate and roughage in different proportions, depending upon the stage of lactation. The quality of feed distributed per day per group was recorded. Feed analyses were made at appropriate intervals.

Cows were milked three times per day. Milk yield was measured twice a month. The fat percentage was determined once per month.

Cows were examined by a veterinarian for genital disorders at weekly intervals, starting about 30 days postpartum. Various conditions and diagnoses were recorded to provide a complete veterinary record for each cow, including routine pregnancy diagnosis.

Cows were weighed weekly. This was done at a fixed time after morning milking and before distribution of the feed.

All open cows were observed for estrus. This was done three times per day, in the morning, near mid-day and in the evening.

Details concerning variables measured are presented later in the report.

Experimental Design.

Herd 1. Experimental Herd at ARO.

1. Cows were equalized as far as possible and randomly assigned to trios to be inseminated 35-59 days (early), 60-90 days (normal) and 120-150 days (late) postpartum.
2. The dry period was planned to be 60 days in all groups so that the effect of the dry period would be equalized among groups.
3. Two feeding treatments were applied during the dry period: (i) feeding 110% according to National Research Council (NRC) standards; (ii) feeding 160% of NRC energy requirements.
4. Protein levels were maintained in both groups as far as possible, according to NRC recommendations; however, in the 160% group protein was probably slightly higher due to the impossibility of keeping the protein in the fortified ration at the desired 11% level.
5. The ration during the dry period was calculated according to body weight and adjusted biweekly. Feed intake was recorded on an individual basis.
6. Cows were allocated to the three breeding groups at the end of their preceding lactation. At that time they were fed according to NRC recommendations. At the start of the dry period they were subdivided in two feeding groups described in item 3.
7. Cows were fed ad libitum during the first 150 days after calving. Rations contained 35% hay and 65% concentrate (on a dry matter basis). Feed intake was recorded on an individual basis. During the 2nd part of the lactation cows were fed according to NRC recommendations.

Herd 2. Cooperating Herd Kibbutz Givath-Haim (Ehud).

Cows were paired according to parity, age at first calving and the next expected calving date, and assigned randomly to be inseminated during one of two periods postpartum. One group was the control (normal) group (Treatment 1) inseminated 60 to

90 days postpartum. Treatment 2 was a delayed group to be inseminated 120 to 150 days postpartum. In typical herds some cows are first inseminated during this late period, but this usually is because of some problem. In this experiment cows with equal potential were pre-programmed to be inseminated either during a "normal" time or later than normal. The criteria used to compare the response of the cows to the two breeding treatments are described later in the report.

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Data Base in the Cooperating Herd Kibbutz Givat Haim (Ehud)

Contains:

- 1) Description of Data Base as Collected
- 2) Description of Data Processing Cornell
- 3) Data Editing

with - Appendices

- 1) Codes of veterinary control
- 2) Disposal codes
- 3) Original data recording forms
- 4) Cornell record format
- 5) List of specific edits

Data Base

Data collected in the cooperating herd can be classified into the following categories:

1. Identification Information:

- a. ID number of animal
- b. Treatment number
- c. Parity group code number
- d. Number of calving on experiment (cycle number)
- e. Sire ID number
- f. Date of birth; day, month, year
- g. Age in months at first calving
- h. Date of calving initiating lactation being recorded
- i. Number of parity

Items a,b,c and d uniquely identify a particular record, and consequently were used as the constant identification for all data recording relevant to a particular record.

2. Body Weight Data

- a. The body weight, to the nearest kilogram
- b. Number of days postpartum weight was taken

3. Milk Production

- a. Test date; day, month, year
- b. Kilograms milk, to nearest tenth kilogram
- c. Fat percentage

4. Reproduction

- a. Dates of observed behavioral estrus; day, month, year
- b. Dates of insemination; day, month, year
- c. Date of conception, where applicable; day, month, year

5. Health

- a. Date of veterinary examination; day, month, year
- b. Record of diagnosis made, or action taken
(A list of diagnosis is given in Appendix 1).

6. Chronology

- a. Date of drying off; day, month, year
- b. Date of consecutive calving; day, month, year
- c. Date of disposal; day, month, year
- d. Cause of disposal

Any combination of items in number 6 above can be possible. A list of disposal causes used is given in Appendix 2.

Data were recorded on coding forms in triplicate (Appendix 3). The first sheet was detached for data processing after 150 days postpartum in the group of cows assigned to 60-90 days postpartum conception, and after 210 days in the group of cows assigned

to 120-150 days postpartum conception; or when cows have been disposed of. Recording was continued on the second sheet. This was detached for data processing when the consecutive calving has taken place; or when cows have been disposed. The last copy remains in the original copy book. The copies were collected at intervals of about three months.

Columns 1 through 7, given at the top of the coding sheet (refer to Appendix 3) are the identification information, and repeat at the beginning of each line on the data coding forms. The design of the coding forms conforms to the 80 column capacity of computer keypunch cards. This was a good way to facilitate the transfer of data from the forms to a computer usable form. Categories of information were grouped into four types of "card" entries: Type 1, items e through i of identification with body weight data; Type 2, milk production only; Type 3, reproduction only; and Type 4, health and chronology data. The type of data is given by the card code in column 80 and the sequence number of recording by the number in column 79.

These card image data files were stored in Israel so that information could be accessed randomly in a cumulative manner.

Data Processing

Data files stored in Israel were duplicated on magnetic tapes and shipped to Cornell for use. To facilitate later manipulations, a five step system of processing the incoming data inventory files from Israel was developed. The final form of each record was designed to accommodate the anticipated complete record of one lactation on each cow.

The first stage in processing was merely, but importantly, to copy the incoming file and, at the same time, duplicate each 48 field record. In the second stage, the first copy of each record was read and the second copy moved to a work tape for subsequent processing. In this way, the original copy was maintained unchanged. The first 30 records were printed for inspection. Then, the work tape records (still 48 fields in

80 column format) were sorted so the records were ordered as record sequence within the record type within calving number within cow.

The second half of the record processing sequence consolidated all information on one breeding cycle into a single record for each animal. The fourth step brought together all record types on one cow while at the same time it expanded the amount of record space available. The final step eliminated repeated information within the large record such as identification information and the record type and sequence number since these are no longer needed. The remaining data was compressed and moved to fill the gaps left by removing repeated information. This, in turn, resulted in the generation of large blocks of empty record space, which could be filled later.

Certain essential information was not inherently present in the data as recorded. Therefore, as this information was generated from the data, it was saved and incorporated into the record. An example is the interval between significant dates such as calving and conception (days open), which in turn determined response status for the record. Likewise, as cumulative milk yields were calculated, these became permanent entries in a record. The format of a Cornell lactation record is given in Appendix 4, and shows these additions. One important innovation was the conversion of key dates to a perpetual day calendar for ease of calculating the number of days between events.

Ultimately, the data file for the cooperating herd developed at Cornell contained information for 1400 lactations.

Data Editing

Much time has been invested in the establishment of reasonable editing limits and protocol by examining certain characteristics of the dairy cattle involved in this study. The following procedure of editing was adopted.

1. Each record was examined for omission of any information. The best procedure to follow is the one which asks the computer to print out any records not meeting the editing criteria. Then the offending entry can be checked against

the original and the change needed can be made. A list of information that must be present has been compiled (Appendix 5).

2. The sequence of events is an important aspect of this study. Therefore, a list of checks was prepared which included all dates of events and the intervals between them (Appendix 5).

3. Body weights. Following a discussion which occurred at Cornell concerning the allowable difference between successive body weight measurements, the decision was made to examine individual cows rather than look at average differences. It is safe to assume that differences between averaged weights vary less than individual weights within animals. Obviously any difference of 100 kg or more between two successive weights probably represents a punching error. Cows were randomly sampled from each treatment-parity-response (TPR) sub-group of animals for closer scrutiny. However, after examining the individual cows, it appeared important to look at the weights for possible errors when a difference of greater than 50 kg occurred. This is not an impossible difference, but one that would be unusual. The largest difference found among all cows in the random sample was 63 kg. Within TPR sub-groups, the average maximum differences ranged between 20.9 and 30.1 kg. These are representative values because any record which contained an obviously erroneous weight was discarded from the sample.

Values of 300 and 900 kg appeared to be realistic for lower and upper limits, respectively, on individual weights of both primiparous and multiparous cows.

4. Milk weights. The same procedure was followed for examining successive milk weights as was used for body weight differences. The maximum change in milk yield recorded between any two test days among all the cows randomly sampled was 11.3 kg. A realistic limit for the magnitude of change would be 15 kg. Within first lactation TPR sub-groups, the lowest average milk weight was 17.9

kg and the highest, 27.8 kg. The lowest average milk yield among second and later TPR sub-groups was 15.3 kg and the highest, 38.0 kg. Using these values as guidelines and after looking at the actual values recorded, a lower milk weight limit of 10.0 kg seemed reasonable and 50.0 kg would be appropriate for the upper limit.

Despite many combings of the data, errors and omissions previously overlooked became apparent throughout the period of data manipulation. Interim processing of this vast data resource provided useful insights to the nature and characteristics of this information, as well as guidance for future processing and analysis.

Such processing included, for example, generating milk yields, curves of milk yield, and body weight changes. In addition, summarization of the data on arbitrary bases, such as monthly milk yield per cow, quickly exposed errors in data recording which had slipped through usual edit limits. One example is accurate data that becomes incorporated in the wrong data file. Another problem frequently encountered was finding a date which met the edit requirements, but made no sense in the context of the record, e.g. resulted in a negative number of days open. The value of these "scout" programs cannot be overemphasized. Every effort was made to correct every error or omission, but in some cases a record may have been deemed unusable for certain purposes because the correction could not be made.

Codes of Veterinary Control

Abortion	1
Dystocia	2
Twin calving	3
Prolapsus uteri	4 64
Milk fever	5
Retention of fetal membranes	6
Necrotic vaginitis	7
Lochiometric	8
Primary ketosis	9
Displaced abomasum	10
Cervical inflammation	11
Normal uterus	12
Normal ovaries	13
Follicles	14
Corpus luteum	15
Cystic follicle	16
Cystic CL	17
Atrophied ovaries	18
Other findings	19
Many small cysts	20
Normal cow	21
Endometritis	22
Pus	23
Enlarged cervix uteri	24
Gestyl treatment - lack of estrus	25
Postparturient contamination	26
Anaplasma tick fever	61
Udder troubles	65
Massage of ovaries	67
Prostaglandin treatment	68
Vaginitis	69
Loss of appetite	70
Digestive tract upset	71
Foot or leg problem	72
Ovarian inactivity for no apparent reason	73
No finding	74

APPENDIX 2

Codes of Causes of Disposal

Abortion	1
Strange body	53
Non-conception	54
Low milk yield	55
Mastitis	56
Nymphomania	57
Suckling	58
Death	59
Metritis	60
Tick fever	61
Accident	62
Various	63
Uterine prolapsus	64
Udder problems	65
Dystocia	66
Termination of experiment	90

Coding Form - Cooperating Herd

1	No. of calving in experiment
2	Herd
3	Treatment
4-7	Cow ID
8	Code of cow
9-11	Sire ID
12-16	Date of birth
17-18	Age at 1st calving
19-23	Date of calving in experiment
24	No. of calving
25-27	Body weight
28-30	Days from calving to weighing
:	
:	
73-75	Body weight
76-78	Days from calving to weighing
79	Sequence number of card
80	Code of card
9-13	Date of milk test
14-16	kg Milk
17-19	Fat percentage
:	
:	
64-68	Date of milk test
69-71	kg Milk
72-74	Fat percentage
75-78	Unused
79	Sequence number of card
80	Code of card
9-13	Date of estrus
:	
:	
39-43	Date of estrus
44-48	Date of insemination
:	
69-73	Date of insemination
74-78	Date of conception
79	Sequence number of card
80	Code of card
9-13	Date of veterinary examination
14-15	Diagnosis
:	
:	
44-48	Date of veterinary examination
49-50	Diagnosis
51-59	Unused
60-65	Date of drying off
66-71	Date of consecutive calving
72-76	Date of disposal
77-78	Reason for disposal
79	Sequence number of card
80	Code of card

APPENDIX 4

FORMAT: CORNELL TAPE VOLUME OF COOPERATING HERD

<u>Field Number</u>	<u>Information Given</u>
1	Cow id. no.
2	Treatment Group, 1 or 2
3	Code of Cow, 1 or 2
4	No. of calving on Experiment
5	Sire id. no.
6	Day
7	Month <u>Date of Birth</u>
8	Year (1 digit)
9	Age at first calving, months
10	Day
11	Month <u>Date of Calving Initiating Record</u>
12	Year (1 digit)
13	Parity no.
14-156	Body Weight, kg Unit repeats 72 times
14-157	No. of Days postpartum
158	Response group, 2 or 5
159	No. of Days open
160	"NC" group designation
161	No. of days open, new calculation
162	Herd id. = 1
163	"Funny cows", = 1 if first AI before planned interval
164	= 1 if disposal before end of planned interval
165	= 1 if disposal precedes drying off
389-684	Day
390-685	Month <u>Date of Milk Test</u>
391-686	Year (1 digit) Unit repeats 60 times
392-687	Milk at test, kg
393-688	Fat percent at test
689	30 dpp milk yield, kg <u>OLD</u>
690	60 "
691	90 "
692	120 "
693	150 "
694	Lactation milk yield, kg FCM
695	Days in milk (DIM)
696	DIM til disposal
697	No. days dry, actual
698	No. days dry til disposal
699	30 dpp milk yield, kg <u>NEW</u>
700	60 "
701	90 "
702	120 "
703	150 "

APPENDIX 4 (CONTINUED)

FORMAT: CORNELL TAPE VOLUME OF COOPERATING HERD

<u>Field Number</u>	<u>Information Given</u>
704	180 dpp milk yield, kg
705	210 "
706	240 "
707	270 "
708	300 "
709	30 dpp FCM, kg <u>NEW</u>
710	60 "
711	90 "
712	120 "
713	150 "
714	180 "
715	210 "
716	240 "
717	270 "
718	300 "
719	14 month milk yield, kg
720	16 month milk yield, kg
721	14 month FCM, kg
722	16 month FCM, kg
723	Lactation Milk Yield
724	310 dpp MY
725	320 " "
726	330 " "
727	340 " "
728	350 " "
729	360 " "
730	370 " "
731	380 " "
732	390 " "
733	400 " "
734	410 " "
735	420 " "
736	430 " "
737	310 dpp FCM
738	320 " "
739	330 " "
740	340 " "
741	350 " "
742	360 " "
743	370 " "
744	380 " "
745	390 " "
746	400 " "
747	410 " "
748	420 " "
749	430 " "

869-908	Day
870-909	Month <u>Date of estrus</u> -unit repeats 14 times
871-910	Year (1 digit)
911-944	Day
912-945	Month <u>Date of AI</u> - unit repeats 12 times
913-946	Year (1 digit)
947	No. services to conception
948	Temperature - season of calving, 1, 2, 3 or 4*
949	Temperature - season of conception, 1, 2, 3 or 4*
965-1057	Day
966-1058	Month <u>Date vet exam</u> - unit repeats 24 times
967-1059	Year (1 digit)
968-1060	Diagnosis
1061	Day
1062	Month <u>Date of Conception</u>
1063	Year (1 digit)
1064	Day
1065	Month <u>Date of Drying Off</u>
1066	Year (2 digit)
1067	Day
1068	Month <u>Date of Consecutive Calving</u>
1069	Year (2 digit)
1070	Day
1071	Month <u>Date of Disposal</u>
1072	Year (1 digit)
1073	Cause of disposal
1074	Day
1075	Month <u>Date of Feeding Group Change</u>
1076	Year (2 digit)
1077	PRPDAY** Calving date
1078	PRPDAY Conception date
1079	PRPDAY Date of drying off
1080	PRPDAY Disposal date
1081	PRPDAY Consecutive calving
1082	PRPDAY Feeding group change

* 1=Low,2=Vernal Moderate, 3=High, 4=Autumnal Moderate

**PRPDAY = date on perpetual calendar

APPENDIX 5

DATA EDITING - COOPERATING HERD

A. Information that must be present:

1. Treatment group number
2. Parity group number
3. Calving number (cycle) in experiment.
4. Birth date
5. Calving date
6. Parity number
7. Conception date
8. Date of consecutive calving or disposal
9. Disposal code, if animal disposed
10. Sire number

B. Sequence of events

1. Calving, conception, drying off, consecutive calving or disposal dates all must be later than the animal's birthdate.
2. Any date in card codes 1, 3, 4, must be later than date of calving.
3. Drying off precedes the consecutive calving.
4. The interval between calvings exceeds 250 days.
5. The "day" designation is between 1 and 31;
the "month" designation is between 1 and 12.
6. Sequence of postpartum body weights dates: each date must be later than the preceding one.
7. Sequence of milk recording dates: each date must be later than the preceding one.
8. Sequence of estrus dates: each date must be later than the preceding one.

9. Sequence of insemination dates: each date must be later than the preceding one.
10. Insemination dates must correspond to estrus dates.
However, there may be estrus dates without corresponding insemination dates.
11. Conception date must correspond with last insemination date.
12. Date of disposal must be later than any other date in card codes 1, 3, 4.
13. Date of consecutive calving must be later than any other date in card code 1, 3, 4.

C. Limits of differences

1. Body weights

- a. Lowest Body Weight (BW) at calving - 340 kg;
highest BW at calving - 900 kg.
- b. BW changes not exceeding 50 kg when interval between 2 consecutive weights is not more than 20 days.
- c. Intervals between weighings not exceeding 14 days.

2. Milk weights

- a. Milk fat percentage not more than 6.0.
- b. Milk fat percentage not less than 2.5.
- c. Milk yield not exceeding 60 kg.
- d. Milk yield difference between two consecutive test days not exceeding 15 kg.

3. Miscellaneous

- a. Age at first calving not less than 22 months.
- b. Age at first calving not more than 28 months.
- c. Calving year in experiment not earlier than 1977.
- d. Calving year in experiment not later than 1982.

DATA BASE - EXPERIMENTAL HERD

Original cow data were organized by subjects, and different files were established accordingly, giving a continuous complete record of each cow for her entire stay in the herd.

1. Reproduction (dates of estrus, insemination, conception, drying off, consecutive calving, disposal causes, reproductive disorders (Appendix 1)
2. Progesterone profile (progesterone concentrations in blood plasma as continuous record of each cow).
3. Body condition scoring (dates and scores).
4. Body weights (dates and weights; Appendix 2).
5. Milk yields (daily production , fat percentage; Appendix 3).
6. Feed intake (daily consumption of roughage and concentrate; Appendix 4).

Cows were identified by number, parity (primiparous, multiparous), feeding group, breeding group, number of calvings in life, number of calvings in experiment).

The general editing program is given in Appendix 5.

Reproduction

One file was established.

1. Storage of data as recorded in original coding forms. Data were edited as described elsewhere (Appendix 5).

Various Sorting Programs were executed for analysis of specific subjects.

These gave further opportunity for correcting errors and omissions.

Many reproduction summaries were made manually.

Progesterone profile

One file was established containing the original data.

From this file, progesterone curves were drawn for each cow.

Analyses and summaries were done manually, thus enabling detection of errors and omissions.

Body condition scoring

One file was established containing the original data.

From this file, scoring curves were drawn for each cow.

Analyses and summaries were done manually, thus enabling the detection of errors and omissions.

Body weights

The following files were established:

1. Storage of data as recorded in original coding form (Fortran). Data were edited using the criteria described elsewhere (Appendix 5).
2. Body weight changes - these were calculated in reference to body weights immediately after calving. An editing program was imposed to reveal missing weight records at first 3 days postpartum.

Body weight changes were calculated according to the following protocol:

1. If three weights have been recorded immediately postpartum, the average of the weights is used as reference weight for the consecutive body weight changes.
2. If two weights have been recorded immediately postpartum, the average of the weights is used as reference weight for the consecutive body weight changes.
3. If one weight has been recorded immediately postpartum, this weight is used as reference weight for the consecutive body weight changes.
4. Sequences of 7 days are counted as weeks postpartum. Day after calving may be the calendar day of calving or the next day (depending at which hour the calving occurred); the day is equalized for weight records, feed records, milk records and reproductive events.
5. Any body weight record occurring at any one day of "week postpartum" represents the weight of this week.

If a weight is missing then:

the change in the preceding week and the change in the following week are averaged and the average represents the change in the week with missing record.

If in the following week two weights are recorded, the first one is taken to represent the week with the missing record, and the second represents the weight of the week following the week with the missing record.

Milk production

The following files were established:

1. File of original data, i.e. daily records of milk yields. About 67,000 observations were stored. (One observation is date with milk yield, and fat percentage biweekly). This is equivalent to 67,000 milking days.
2. Total production of milk by weeks.
Fat percentage in respective weeks.

This file served the editing procedure which is described elsewhere (Appendix 1). An additional editing program was imposed showing errors in dates as well as deviations from "7 days week". These were checked by inspecting the lists, thus the correctness and continuity of the dates was ensured.

3. Average daily production by weeks, of

Milk

Fat

Fat corrected milk (FCM)

Weekly production of

Milk

Fat

FCM

Cumulative production from week to week, of

Milk

Fat

FCM

File 3 was formatted to conform with SAS data file requirements. It was used to establish separate sets of data for analyses of specific subjects (SAS User's Guide: Statistics, 1982. SAS Institute).

Various "Sorting Programs" in which cows were sorted and grouped revealed errors and omissions which were not covered by the Editing Programs. For instance, a list of cows sorted by group and parity codes (see coding forms), length of lactation, dry period, calving cycle, number of cycles in experiment and life showed a few blanks and suspicious values which were checked for correctness.

Feed intake

The following files were established:

1. File of original data, i.e. daily records of feed intake. About 88,000 observations were stored. (One observation is date with intake of 2 feedstuffs separately; equivalent to 88,000 feeding days). This file served the editing procedure described elsewhere (Appendix 5).

2. Total intake of

Dry matter (DM)

Protein (P)

Total digestible nutrients (TDN)

by weeks postpartum separately for roughage and concentrate.

Cumulative intake from week to week for roughage and concentrate separately.

Weeks were counted from date of calving. An editing program was imposed showing errors in dates as well as deviations from "7 days week".

These were checked by inspecting the lists for correctness and continuity.

3. a) Average daily intake of

DM

P

TDN

by weeks for both feedstuffs combined.

- b) Cumulative intake from week to week of DM, P, TDN for both feedstuffs combined.

- c) % TDN in dry matter.

- d) % Protein in dry matter.

- e) % Dry matter of roughage in total dry matter.

File 2 was formatted to conform with SAS data file requirements. It was used to establish separate sets of data for analyses of specific subjects (SAS User's Guide: Statistics, 1982. SAS Institute).

Since in the experimental herd the files for milk production, feed intake, body weights and reproduction were established separately, it was essential to ensure that codes and calving dates of the individual cows be matched and were consistent with each other across data files. This was achieved by creating a list in which these data were given in parallel columns. These were individually checked.

COMPUTERIZED ENERGY BALANCEA. Calculation of Total Digestible Nutrients (TDN)

During the experiment routine analyses of 71 roughage samples and 38 concentrate samples were made for Crude Protein (CP), Crude Fiber (CF), Nitrogen-Free Extract (NFE) and Ether Extract (EE) in Dry Matter (DM). From these TDN were predicted for each sample using the following regression equations (Utah Agr. Exp. Sta. Bulletin # 508, 1984).

1. $TDN = -17.26 + 1.212 (CP) + .8352 (NFE) + 2.464 (EE) + .4475 (CF)$
2. $TDN = 40.26 + .1969 (CP) + .4228 (NFE) + 1.190 (EE) - .1379 (CF)$

(1) Dry forages and roughages

(2) Energy feeds

The composition of the various feedstuffs in terms of TDN, DM and CP is given in Appendix 6. These values served for calculating the net energy values of the daily intake in context of the energy balance computation.

B. Calculation of Digestibility Depression

The depression of digestibility is dependent upon the number of TDN multiples which the cow consumes above the maintenance requirement, and upon the contents of roughage in the ration.

Maintenance requirement = MAINTTDN

Consumption = KGTDN

Number of multiples above maintenance = MULTTDN

MULTTDN = (KGTDN/MAINTTDN) - 1

The depression of digestibility per each TDN multiple (Y%) was calculated using the following regression equation:

$Y\% = 6.5 + 0.0796X$; X = percentage of roughage in the ration = PDM₂
(Amir, S. and Halevi, A., 1979).

Percentage digestibility depression = DIGDEP

DIGDEP = MULTTDN x Y%

TOTDEP = KGTDN - (KGTDN x DIGDEP/100)

The amount of TDN after deduction of the percentage depressed is TDNCOR

TDNCOR = DGTDN - TOTDEP

C. Calculation of Net Energy Contents of Ration

TDNCOR (i.e., the amount of TDN after deduction of the percentage depressed) as percentage of the Dry Matter in ration = PTDNCOR.

TDN is converted to net energy for lactation (NE₁) according to the following equation (Van Soest, 1979):

NE₁ (Mcal per each kg of Dry Matter in ration) =
(0.0266 x PTDNCOR) - 0.12 = NETENLAC

Total NE₁ in ration = kg DM x NETENLAC = NETENRAT

D. Calculation of energy balance

Net energy requirements for maintenance as given in NRC (1978) were converted to the following regression equation:

$$Y = 2.228 + 0.0124X = \text{MAINTNET}$$

$$Y = \text{NE}_1 \text{ Mcal}$$

$$X = \text{kg body weight}$$

Net energy requirements for maintenance during the last two months of pregnancy =

$$\text{MAINTNET} = 104 \text{ kcal/kg}^{.75} \text{ (NRC, 1978).}$$

The caloric value of milk (kcal/kg) is

$Y = 0.34 + 0.1X$; (X = fat percentage) derived by regressing values from NRC (1978) = NETENMLK .

The caloric value of total daily production = LACNET

$$\text{LACNET} = \text{NETENMLK} \times \text{kg milk}$$

Energy balance (surplus or deficit) = ENBAL

$$\text{MAINTNET} + \text{LACNET} = \text{TOTANET}$$

$$\underline{\underline{\text{ENBAL} = \text{NETENRAT} - \text{TOTANET}}}$$

Energy balance of each cow by weeks as well as cumulative balances from week to week are stored as a new data set. This set contains 13470 observations and 35 variables.

References

- Nutrient Requirements of Dairy Cattle. National Research Council, Washington 1978.
- Van Soest, P.J., Fadel, J. and Sniffen, C.J. Discount factors for energy and protein in ruminant feeds. Proc. 1979 Cornell Nutrition Conference for Feed Manufacturers. pp. 63-75.
- Amir, S. and Halevi, A. Concentrate-roughage proportions in the diet of dairy cows in early lactation. In: Dairy Science Handbook Vol. 14. Publ. Agriservices Foundation, Clovis, Ca. 1979.

INSTITUTE OF ANIMAL SCIENCE
DIV. OF REPRODUCTION

AGRICULTURAL RESEARCH ORGANIZATION
BODY WEIGHT RECORDS
EXPERIMENTAL HERD—BET DAGAN

DIV OF STATISTICS
& EXPER. DESIGN

Herd		No. of Cow		Feeding Group		Breeding Group		Code of Cow		No. of Calving in Experiment		Date of Calving in Experiment		Birth Date		Sire No.	
D	M	Y	Kg.	D	M	Y	Kg.	D	M	Y	Kg.	D	M	Y	d	m	y
2	1	2	5	6	7	8	9	10	11	16	17	22	23	25	1-25 DUP		
<p>LEGEND</p> <p>Feeding Groups (Column 6)</p> <p>1 - N.R.C. Recommendations</p> <p>2 - N.R.C. Recommendations + 60% energy</p> <p>Breeding Groups (Column 7)</p> <p>1 - 35 - 50 days pp.</p> <p>2 - 60 - 90 days pp.</p> <p>3 - 120 - 150 days pp.</p> <p>Code of Cow (Column 8)</p> <p>1 - Primiparous</p> <p>2 - Multiparous</p>																	
<p>Remarks</p>																	

Institute of Animal Science
Div. of Reproduction

Experimental Herd—Bet Dagan

Herd	No. of Cow	Feeding Group	Breeding Group	Code of Cow	No. of Calving	No. of Calving in Experiment	Date of Calving in Experiment	Card Code																																							
[2]	[] [] [] []	[]	[]	[]	[]	[]	[D] [M] [Y] [] - [] - [] 11 - 16	[16] 79-80 [DUP]																																							
1	2 - 5	6	7	8	9	10																																									
D	M	Y	Kg. Milk	% Fat	Week No.	D	M	Y	Kg. Milk	% Fat	Week No.	D	M	Y	Kg. Milk	% Fat	Week No.	D	M	Y	Kg. Milk	% Fat	Week No.	D	M	Y	Kg. Milk	% Fat	Week No.																		
17	-	21	22	-	24	25	-	28	29	-	33	34	-	36	37	-	40	41	-	45	46	-	48	49	-	51	52	53	-	57	58	-	60	61	-	63	64	65	-	69	70	-	72	73	-	75	76
No Punch			Total																																												
Average																																															

LEGEND

<u>Feeding Groups</u>	<u>Breeding Groups</u>	<u>Code of Cow</u>
1 - N.R.C	1 - 35 - 59 days	1 - Primiparous
2 - N.R.C + 60%	2 - 60 - 90 days	2 - Multiparous
	3 - 120 - 150 days	

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[illegible]

APPENDIX 5

Data Editing - Experimental Herd

A. Information that must be present:

1. Treatment group number
2. Parity group number
3. Calving number (cycle) in experiment.
4. Birth date
5. Calving date
6. Parity number
7. Conception date
8. Date of consecutive calving or disposal
9. Disposal code
10. Feeding group
11. Sire number

B. Sequence of events

12. Calving, conception, drying off, consecutive calving or disposal dates all must be later than the animal's birthdate.
13. Any date in card codes 1, 3, 4, must be later than date of calving.
14. Drying off precedes the consecutive calving.
15. The interval between calvings exceeds 250 days.
16. The "day" designation is between 1 and 31;
the "month" designation is between 1 and 12.
17. Sequence of body weight postpartum days: each date must be later than the preceding one.
18. Sequence of milk recording dates: each date must be later than the preceding one.

19. Sequence of estrus dates (columns 26-73): each date must be later than the preceding one (card code 13-23).
20. Sequence of insemination dates (columns 26-73): each date must be later than the preceding one (card code 33-43).
21. Insemination dates must correspond to estrus dates. However, there may be estrus dates without corresponding insemination dates.
22. Conception date must correspond with last insemination date.
23. Date of culling must be later than any other date in card codes 1, 3, 4.
24. Date of consecutive calving must be later than any other date in card code 1, 3, 4.

C. Limits of differences

I. Body weights

25. Lowest Body Weight (BW) at calving - 340 kg;
highest BW at calving - 900 kg.
26. BW changes not exceeding 50 kg when interval between 2 consecutive weights is not more than 20 days.
27. Intervals between weighings not exceeding 14 days.

II. Milk weights

28. Milk fat percentage not more than 6.0.
29. Milk fat percentage not less than 2.5.
30. Milk yield not exceeding 50kg.
31. Milk yield difference between two consecutive test days not exceeding 15 kg.

III.

32. Age at first calving not less than 22 months.
33. Age at first calving not more than 28 months.

34. Calving year in experiment not earlier than 1979.

35. Calving year in experiment not later than 1983.

IV. Feeding records

36. The daily consumption from feeds 1-200, not more than 12 kg/day.

37. The daily consumption from feeds 201-220, 221-240, 241-260,
261-280, not more than 22 kg/day.

38. Feeding group no. 2 must correspond with feeds 241-260 at least
30 days before each calving.

39. Feeding group no. 1 must correspond with feeds 221-240, 261-280
at least 30 days before each calving.

40. Feeds no. 201-220 are recorded during the first 160 days post-
partum of all cows.

APPENDIX 7

Energy balance calculations formulas. *

$$\Delta BW \approx \text{TDN BAL} = \text{TDN}_I - \text{TDN}_{\text{Maint.}} - \text{TDN}_{\text{Milk}} - \text{TDN}_{\text{Preg.}}$$

$$\text{TDN}_I = \sum_{i=1}^n (\text{TDN}_{f_i})(\text{DMI}_{f_i})$$

$$\text{TDN}_{\text{Maint.}} = (.0352)(\text{BW}^{.75})$$

$$\text{TDN}_{\text{Milk}} = (\text{kg Milk})(.15504 + .042286 \text{ Fat } \%)^*$$

$$\text{TDN}_{\text{Preg.}} = (.352 + .000133e^{.0174T^{**}})(\text{BW}^{.75})$$

$$\text{TDN}_{\text{Maint. (preg.)}} = (.0458)(\text{BW}^{.75})$$

where

$$1 \text{ kg TDN} = 4.409 \text{ Mcal DE}$$

$$\text{ME (Mcal/kg)} = [-.045 + 1.01(\text{DE})] \text{ Mcal/kg}$$

*** Coefficient .000133 est. approx. 8.7 grams of TDN/kg BW^{.75}

NRC to 8 month pregnancy allows 10.6 grams of TDN/kg BW^{.75} and one must change the coefficient from .000133 to .000163.

NRC = Each kg of body weight gain represents -2.26 kg TDN

= Each kg of body weight loss represents +2.17 kg TDN

* Derived by regressing values given in most recent NRC

** T = Days pregnant

*** J. Dairy Sci. 55:480. (1972).

* This formula was proposed in a discussion to quantify the relationship between body weight changes and energy balance, using the data from the experimental herd and applying the result to the cooperating herd.

FILE: FEED	COMPBD
Code DM TDN P	
001 87.7 50.9 09.4	
002 87.0 51.9 10.2	
003 87.4 49.8 08.8	
004 86.9 50.8 09.6	
005 91.5 50.1 07.6	
006 87.0 50.1 10.6	
007 87.4 51.4 11.1	
008 88.5 51.8 12.0	
009 89.9 53.4 13.0	
010 89.2 51.5 13.5	
011 90.0 53.4 14.1	
012 91.0 53.2 13.1	
013 90.8 55.4 12.5	
014 89.8 54.5 13.9	
015 87.7 53.0 14.1	
016 90.5 53.0 13.2	
017 90.1 53.5 14.0	
018 89.0 54.7 14.8	
019 89.8 51.1 11.2	
020 89.4 50.7 12.3	
021 90.5 54.9 18.0	
022 89.8 52.0 12.6	
023 91.2 52.8 12.8	
024 91.2 52.8 12.8	
025 90.0 50.4 11.4	
026 90.3 52.5 12.6	
027 90.2 52.5 12.0	
028 88.3 53.8 12.4	
029 88.2 52.5 12.9	
030 89.2 55.8 15.2	
031 88.6 57.2 18.6	
032 89.7 54.2 13.3	
033 89.2 53.4 13.7	
034 89.1 55.2 16.0	
035 90.4 54.6 15.3	
036 91.5 56.9 17.5	
037 91.3 52.1 09.6	
038 88.7 53.7 11.8	
039 90.6 53.1 11.5	
040 90.1 52.8 16.0	
041 88.8 54.8 15.3	
042 91.4 57.6 15.5	
043 89.4 53.9 15.1	
044 90.4 56.2 14.6	
045 89.5 54.3 13.3	
046 88.6 54.2 12.4	
047 88.2 53.4 11.8	
048 87.7 55.4 12.5	
049 90.3 55.9 15.7	
050 89.6 52.7 13.7	
051 89.4 57.6 12.2	
052 89.7 56.3 17.3	
053 90.7 55.0 15.5	
054 90.4 51.4 16.0	
055 90.7 57.3 15.8	
056 91.2 54.1 13.1	
057 91.3 53.2 12.1	
058 90.3 53.8 12.2	
059 88.9 52.5 13.8	
060 87.6 53.5 14.4	
061 89.5 51.4 12.0	
062 89.6 50.0 12.9	
063 89.2 52.0 12.4	
064 86.4 54.8 16.6	
065 85.7 51.6 14.6	
066 86.7 56.0 15.5	
067 89.0 52.8 14.9	
068 88.5 55.0 16.5	
069 98.7 54.5 20.0	
070 89.9 51.8 14.8	
071 89.7 56.2 18.1	
201 88.0 75.6 19.4	
202 88.9 73.2 27.2	
203 89.2 74.8 21.5	
204 87.6 73.6 21.5	
205 89.1 74.6 21.9	
206 88.7 75.9 20.9	

FILE: FEED	COMPBD
Code DM TDN P	
207 88.5 74.3 22.4	
208 88.6 75.9 20.3	
209 88.0 75.4 19.5	
210 88.6 75.0 18.6	
211 88.4 74.5 22.2	
212 86.7 74.3 20.9	
213 87.0 74.4 22.0	
214 87.7 75.1 16.0	
221 88.0 75.7 15.5	
222 88.6 75.7 17.0	
223 88.3 75.6 18.1	
241 88.0 81.8 09.6	
242 87.0 81.5 11.6	
243 87.2 80.0 10.6	
244 85.9 81.6 10.4	
245 87.2 81.6 10.0	
246 87.0 82.8 09.3	
247 85.7 81.6 09.6	
248 86.9 81.5 08.6	
249 87.6 81.4 09.8	
250 93.7 81.0 08.8	
261 87.3 75.8 18.5	
262 87.7 75.7 15.1	
263 88.7 75.5 19.5	
264 88.9 76.0 18.7	
265 88.6 75.6 20.1	
266 88.4 75.3 17.4	
267 87.8 76.6 17.5	
268 88.3 76.5 15.3	
269 88.9 75.0 18.7	
270 87.6 75.2 19.1	
271 87.5 75.0 16.7	
272 86.8 74.3 22.5	

CODES

- 1 - 200 Hay
 201 - 240 Concentrate mixture
 241 - 260 Corn
 261 - 272 Concentrate mixture

Inventory of Cows

An inventory of the cows used in this project is given in Tables 1 and 2 for the cooperating herd and in Table 3 - 5 for the experimental herd.

The Tables present the following information: number of cows originally assigned to the different treatments; number of cows which were disposed of before the end of the planned breeding period and could not be used for any analysis of data; cows which were disposed of after the end of the planned breeding period and before calving. These cows served for analysis of reproductive data and milk yields in limited periods. They served also for analysing a possible process with regard to milk production. A further break-down refers to the final distribution of the cows between treatments, parity, seasons of calving, reproductive disorders and causes of disposal.

TABLE 1
Distribution of Cow Numbers (Cooperating Herd)

Category	Parity			Temp.-Season Calving				Age, first calving, months					Treatment			Health affecting record			Disposal	
	1	2	3+	Dec-Feb	Mar-Jun	Jul-Sept	Oct-Nov	≤23	24	25	26	≥27	60-90	120-150	Normal	Ret. Pl.	Metritis	Other	None	Before After
n = 1392																				
Overall	431	366	595	421	389	332	250	352	459	217	157	207	729	663	660	126	269	337	752	158 482
Parity																				
1	431	0	0	113	172	93	53	122	148	66	41	54	218	213	218	20	84	109	291	28 112
2	366	0	0	89	105	102	70	101	126	60	34	45	182	184	178	30	58	100	188	23 155
3+			595	219	112	137	127	129	185	91	82	108	329	266	264	76	127	128	273	107 215
Temp-Season Calving																				
Dec-Feb				421	0	0	0	90	145	58	57	71	212	209	188	35	97	101	229	57 135
Mar-Jun					389	0	0	102	127	59	47	54	218	171	185	34	68	102	215	32 142
Jul-Sept						332	0	88	113	52	24	55	164	168	165	39	58	70	172	36 124
Oct-Nov							250	72	74	48	29	27	135	115	122	18	46	64	136	33 81
Age, First Calving																				
≤23								352	0	0	0	0	196	156	183	26	70	73	197	40 115
24									459	0	0	0	228	231	225	43	82	109	244	61 154
25										217	0	0	118	99	87	24	46	60	112	150 90
26											157	0	74	83	75	13	30	39	85	20 52
≥27												207	113	94	90	20	41	56	114	22 71
Treatment																				
60-90													729	0	334	67	145	173	418	59 252
120-150														663	316	59	124	164	334	99 230
Health																				
Normal															660	0	0	0	383	85 192
Retained Placenta																126	0	0	65	16 45
Metritis																	269	0	129	28 112
Other																		337	175	29 133
Disposal																				
None																			752	0 0
Before beginning of planned breeding interval																			158	0 482
After end of planned breeding interval																				
Freq. (%)	31.0	26.3	42.7	30.2	27.9	23.9	18.0	25.3	33.0	15.6	11.3	14.9	52.4	47.6	47.4	9.1	19.3	24.2	54.0	11.4 34.6

TABLE 2

All Disposals - Cooperating Herd
(Percentages of group total)

<u>Cause of Disposal</u>	<u>Primiparous</u>		<u>Multiparous</u>	
	<u>T1*</u>	<u>T2*</u>	<u>T1*</u>	<u>T2*</u>
Abortion	22.9	22.9	17.7	15.3
Various**	5.7	1.4	5.0	3.2
Strange body	7.1	1.4	10.4	5.8
Non-conception [#]	32.9	22.9	21.3	20.5
Low milk yield [#]	11.4	15.7	20.1	26.3
Mastitis	10.0	8.6	8.5	21.2
Nymphomania	-	-	0.6	-
Suckling	1.4	4.3	-	-
Death	1.4	2.9	3.7	1.9
Tick fever	-	2.9	0.6	-
Accident	1.4	2.9	1.2	1.3
Prolapsed uterus	-	1.4	2.4	1.3
Udder problems	2.9	8.6	4.3	1.3
Dystocia	-	-	1.2	0.6
Vaginitis	<u>2.9</u>	<u>4.3</u>	<u>3.0</u>	<u>0.6</u>
Total of group (No. of cows)	70	70	164	156
End of experiment (No. of cows)	-	-	77	101
Grand Total (No. of cows)	<u>70</u>	<u>70</u>	<u>241</u>	<u>257</u>

*TR1 = Planned calving-conception interval of 60-90 days

TR2 = Planned calving-conception interval of 120-150 days

[#]For definitions - see section - Reproductive Performance of Dairy Cows Managed for Different Open Periods

** Includes udder troubles, foot and leg problems, ovarian inactivity and unidentified causes.

TABLE 3

Inventory of Cows - Experimental Herd

	<u>Breeding group 1</u>			<u>Breeding group 2</u>			<u>Breeding group 3</u>			<u>Total</u>
	<u>Primiparous</u>	<u>Multiparous</u>		<u>Primiparous</u>	<u>Multiparous</u>		<u>Primiparous</u>	<u>Multiparous</u>		
	<u>Pre partum Feeding Level</u>									
	110%	160%	110%	160%	110%	160%	110%	160%	110%	160%
Animals disposed before planned conception interval	0	0	1	3	1	0	3	3	0	5
Animals disposed after planned conception interval	3	4	10	8	5	3	4	1	8	71
Animals completing calving interval	13	8	32	19	10	8	11	8	25	180
Total	16	12	43	30	16	11	15	12	39	276

TABLE 4

Inventory of Animals - Experimental Herd

	Primiparous						Multiparous					
	35-59 ^a		60-90 ^a		120-150 ^a		35-59 ^a		60-90 ^a		120-150 ^a	
	F1*	F2*	F1	F2	F1	F2	F1	F2	F1	F2	F1	F2
	Total											
1st calving-conception interval												
Complete cycles	13	8	10	8	11	8	13	8	5	3	14	6
Partial cycles	3	4	5	3	4	1	3	3	3	4	0	5
Disposals before planned time	0	0	1	0	0	3	0	1	2	2	1	1
Total	16	12	16	11	15	12	16	12	10	9	15	12
2nd calving-conception interval**												
Complete cycles	9	4	6	6	3	5	9	6	3	2	8	6
Partial cycles	4	4	4	1	4	2	3	1	1	2	4	1
Disposals before planned time	0	1	0	1	3	1	1	1	1	0	2	1
Total	13	9	10	8	10	8	13	8	5	4	14	8
3rd calving-conception interval												
Complete cycles							1	1	0	3	0	1
Partial cycles							0	0	0	0	0	2
Disposals before planned time							0	0	0	0	0	2
Total							1	1	0	3	0	5

^aPlanned breeding intervals, days postpartum.

*F1=110% NRC recommendations in dry period; F2=160% NRC recommendations in dry period.

**Cycle 2 continues the distinction between animals beginning the experiment as heifers versus cows, even though all by now are multiparous; this distinction is discontinued in Cycle 3.

TABLE 5
Causes of Disposal - Experimental Herd

	Disposed before planned calving-conception interval	Disposed after planned calving-conception interval
Abortion	-	20
Non-conception	-	2
Low milk yield	2	28*
Mastitis	6	2
Death	9	1
Accident	-	1
Various	2	4
Udder problems	3	6
Dystocia	3	-
Termination of experiment	-	7
T o t a l	25	71

*17 cows stayed 6 months or more in the herd

11 cows stayed less than 6 months in the herd

COOPERATION

The experimental part of the project was carried out in Israel. The data bases from the Experimental and Cooperating Herds were also created in Israel. A copy of the data base from the Cooperating Herd was transferred to the Cooperating Investigators at Cornell University, and there it was reorganized to suit specific objectives. Output made by the Cornell investigators from the records of the Cooperating Herd relates to the subjects described in Sections I, IV, V, VI, VII and VIII. Additional output from the data of the Cooperating Herd, as well as the output from the records of the Experimental Herd, were made in Israel.

There were two visits of Cornell Cooperators (R.H. Foote and Elizabeth C. Schermerhorn) in Israel, one visit of one of the Israeli Cooperators (S. Eger) in the U.S.A., and three visits of the Principal Investigator in the U.S.A. The visits served to analyse and interpret the data and results. Also one visit was made by S. Eger in the U.S.A. during the preparatory period of the project and one post-termination visit at Cornell was made by the Principal Investigator, to finalize the Report. Three out of the eight visits were financed by BARD. Between visits, interim summaries of data and final results were communicated by correspondence.

It is the strong opinion of the participants that the visits were vital to sustain the productive interaction between the collaborators. Although ample use was made of all available communication systems, these cannot be considered a substitute for face to face discussions and unrestrained exchange of ideas and opinions so necessary for a fruitful cooperation. It is planned to continue the cooperation in preparing articles and eventually in a new project.

The collaborators conclude this joint adventure with the feeling of fellowship and friendship far beyond the formal requirements and national boundaries.

ACHIEVEMENTS

The study threw light on several physiological aspects of a programmed reproductive and productive management. Luteal cycles began at about 2 weeks after parturition. First cycles tended to be short, but were accompanied by ovulation. The incidence of behavioral estruses accompanying ovulations increases with time post-partum. Early inseminations appeared to cause a higher rate of assumed embryonic deaths. The rise of the conception rates in later postpartum periods appeared to reflect a time trend and was independent of the number of preceding ovulations.

The results showed relationships between the nutritional status of the cows and certain reproductive parameters. Higher body condition scores are conducive to earlier estrus and fewer inseminations to conception. A shorter period of low energy balance tended to result in shorter calving-conception intervals. Non-response to planned calving-conception intervals was associated in multiparous cows with greater body weight loss and a longer interval to restoration of initial body weight. A high prepartum feeding level caused a considerable rise in the conception rate in the late breeding group.

It was concluded that in examining relationships between parameters of the nutritional status and reproductive performance in multiparous cows, further division into parity groups adds significant information.

The factors which determine the cumulative milk yields in fixed-time periods were: the level of milk production at drying off; the proportion of days dry to days in milk; the shape of the lactation curve; and the portion of the last two or three pregnancy-affected months of lactation in the entire lactation.

BENEFIT TO AGRICULTURE

This study introduced the concept of animal response to reproductive management during fixed planned postpartum intervals. The results provide estimates of the feasibility to maintain closed groups of cows which are similar in their reproductive and lactation stages and consequently in their nutritional requirements.

Factors reducing conception rates at different postpartum intervals were determined. The impact of this kind of factors can, in part, be moderated by managerial means.

The project brought forth unbiased data of cumulative milk yields in fixed-time periods of groups of cows which were experimentally exposed to different lengths of calving intervals. The results which were under strictly controlled conditions provide quantitative information for managerial decisions on the desired length of the calving interval.

Details in the report provide the basis for recommended intensive management of high producing cows.

PUBLICATIONS

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