OESTRAL CYCLES AND CONCEPTION RATES IN TWO *TRICHOMONAS FOETUS* INFECTED DAIRY HERDS IN QUEENSLAND.

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SUMMARY.

Data are presented for two Queensland dairy herds comprising 132 cows.

The 264 no-service oestral cycles of 88 cows followed the normal pattern, over 76 per cent. being less than 26 days and under 19 per cent. over 34 days.

Oestral cycles following service, and where no evidence of abortion was noted were delayed and irregular in both herds, but the pattern of returns differed. In herd 1, long cycles prevailed. Only 8.1 per cent. of 37 returns from 27 cows were less than 26 days and 83.8 per cent. over 34 days. Most returns (24.4 per cent.) occurred in the 101-150 days range. In herd 2, 33.8 per cent. of 136 returns from 61 cows were less than 26 days and only 50 per cent. over 34 days. The normal range (16-25 days) comprised 28.7 per cent. of the total and the 35-45 days range 23.5 per cent.

Both herds showed a secondary peak for delayed returns at 61-80 days, the figures being 18.9 per cent. and 10.3 per cent. respectively.

Statistical analysis of the records of 24 brucellosis reactors and 24 non-reactors in herd 2 showed that there was no significant difference between their oestral cycles. Hence, the departures from the normal pattern of no-service cycles which occurred after service have been attributed to trichomoniasis. The difference between the no-service and service cycles within both groups was highly significant.

No tendency for a quick return to three-weekly cycles after infection was observed in these herds, some of the longest cycles being recorded after the fourth and fifth services. Re-infection apparently occurred following sexual rest of 30-130 days or on re-exposure to an infected bull after calving normally.

The average number of services per conception was 2.5 for herd 1 and 2.1 for herd 2. In herd 1, 11.8 per cent. of the herd were not in calf after the fourth service, in herd 2, 34.0 per cent.

Differences in both service cycles and conception rates occurred between these two herds and no single pattern emerged which may be considered typical of trichomoniasis from a diagnostic viewpoint.

I. INTRODUCTION.

Literature on the course of trichomoniasis in a dairy herd indicates that the oestral cycle is lengthened in some cows following service by an infected bull but is normal in others. Initially, due to the occurrence of a prolonged cycle, conception rate may appear to be satisfactory. Early abortion is usually given as the cause of delayed return to service, but as this frequently escapes notice, the only dominant feature observed in many cases is the long oestral cycle.

Laing (1955) stated that the cardinal symptom in the early stages following the introduction of trichomoniasis into a herd is many infertile services with variations of oestral cycle length, mostly within the normal range, though some cycles may be prolonged to 30 days or more. Abortion may occur at from 21 days to 200 days. Later in the course of the disease, cycles as long as 70 days without evidence of abortion are not uncommon.

Millar and Ras (1952) contended that in the initial stages of infection conception rate is not markedly lowered, but the foetus is destroyed at from 42 to 84 days, with abortion occurring at from 63 to 105 days; hence it may be expected that the first post-infective oestral cycle will be prolonged. In the next phase of the disease, conception rate is low, but oestral cycles are regular, although some cows may not return for from 42 to 63 days.

American authors also described similar behaviour patterns. Bartlett (1949) expressed the opinion that initial infection results in returns to oestrus within 21 to 35 days in the majority of cows, but that some do not return to service for from 90 to 120 days, where the foetus has developed for some time before its death or abortion. Morgan (1946) noted irregular and retarded cycles where failure to conceive occurred, but most cows returned at intervals of three weeks. When conception has taken place, he stated, abortion may occur between 7 and 112 days after last service and oestrus recurs a few days later.

An opportunity to study the pattern of oestral behaviour in two trichomoniasis-infected dairy herds presented itself during the years 1950 to 1955. The data which follow are derived from the breeding records kept by the owners of these two herds. This paper is, therefore, a record of a field study conducted in herds with better records than are often available in the investigation of infertility problems.

In herd 1, data are available from the first service by a bull infected when purchased. Records cover 34 cows served up till the time trichomoniasis was diagnosed and control measures were instituted. Brucellosis and vibriosis tests carried out proved negative. The previous breeding history had been good. Details of the outbreak in this herd and its control by artificial insemination were reported by Alexander (1953).

In herd 2, records are available for the five months prior to the diagnosis of trichomoniasis. The disease was undoubtedly present throughout this period but the date of infection is not known. It is therefore not possible to follow the effect from its introduction as was the case in herd 1.

Eradication by controlled breeding was undertaken. The method used was based on 90 days' sexual rest followed by the use of the two originally infected bulls (W and L) for exposed cows and of a young bull (H) for freshly calved cows. However, breakdowns occurred and the young bull and two new bulls (B and G) were exposed to infection and had to be culled. The difficulties of this system of control were pointed out by Bartlett (1949) and were evident with this herd.

Vibrio fetus was not recovered from either foetuses or genitalia. Positive reactions to the serum or vaginal mucus agglutination tests for vibriosis did not occur. However, 78 of the 98 cows under review were subjected to the serum agglutination test for brucellosis and 33 reactors were found.

II. OESTRAL CYCLES.

(1) Herd 1.

(a) No-service Cycles.

Figures are not available for no-service returns during the period of infection. For the season following the use of the infected bull there are records of 14 cycles. These were distributed as follows:—

Length.	No.
10–15 days	1
16–20 ,,	1
21–25 ,,	9
26–34 ,,	0
35–45 ,,	2
46–60 ,,	1

Approximately 78·6 per cent. of the cycles were less than 26 days and 21·4 per cent. over 34 days.

(b) Service Return Cycles.

The infected bull served 34 cows; 29 returned. Five services, involving two of the 29 cows, were not fully dated and are not included in Table 1, which shows the distribution of 37 recorded service returns for 27 cows. The range of cycle length following service varied from 20 to 288 days. The greatest number of returns occurred during the third and the fifth months. Only 8·1 per cent. of the cycles were less than 26 days, but 83·8 per cent were over 34 days. Observed abortions are not included.

Table 1.

DISTRIBUTION OF 37 RECORDED SERVICE RETURN OESTRAL CYCLES IN HERD 1.

Range.	Number.	Percentage.	Range.	Number.	Percentage.
Days.			Days.		
0–15	0	..	46–60	4	10·8
16–20	1	2·7	61–80	7	18·9
21–25	2	5·4	81–100	4	10·8
26–34	3	8·1	101–150	9	24·4
35–45	5	13·5	151 +	2	5·4

The average length of the 37 recorded cycles was 80·6 days. When the five undated service cycles are included, the average is reduced to 76·7 days for 42 cycles. One cow mated and sold before trichomoniasis was diagnosed is not included in these figures. She returned to service when due to calve.

(2) Herd 2.

Because of the heavy incidence of brucellosis (42 per cent. of infected animals) in this herd, a statistical examination was made of the oestral cycles of the brucellosis reactors and non-reactors to determine whether the presence of brucellosis affected the length of the oestral cycle.

Records were available for 24 reactors and these were compared with the records of 24 non-reactors mated during the same period.

Cycles for each cow were split into "no-service" and "service" returns. By inspecting the length of cycles within cows it was observed that the variances differed greatly. In order to equalise this within-cow variance, the data were weighted inversely as the mean variance for the particular group $(\frac{\sigma^2}{n})$. Thus the analyses were carried out in number of cycles per 100 days instead of in actual cycle length. For the reactors, the no-service value of the mean variance was 1·1 and the service value was 2·5. For non-reactors, the no-service value was 1·3 and the service value 5·1. It can be seen that the service figures were appreciably higher than those for no-service.

The results of the analysis of the difference in length between no-service and service cycles for both reactors and non-reactors are shown in Tables 2 and 3.

Table 2.

DIFFERENCE BETWEEN NO-SERVICE AND SERVICE OESTRAL CYCLES IN BRUCELLOSIS REACTORS.

Source of Variation.	Degrees of Freedom.	Mean Square.	F.
Between Groups	1	16·2938	10·257*
Within Groups	37	1·5886	

* Significant at the 1 per cent. level.

Table 3.

DIFFERENCE BETWEEN NO-SERVICE AND SERVICE OESTRAL CYCLES IN BRUCELLOSIS NON-REACTORS.

Source of Variation.	Degrees of Freedom.	Mean Square.	F.
Between Groups	1	20·1308	14·423*
Within Groups	41	1·3957	

* Significant at the 1 per cent. level.

In the brucellosis reactors the mean for the no-service group was $4 \cdot 50 \pm 0 \cdot 15$ cycles per 100 days (a cycle of 22·2 days), while the mean for the service group was $3 \cdot 41 \pm 0 \cdot 24$ cycles per 100 days (a cycle of 29·3 days).

In the brucellosis non-reactors the mean for the no-service group was $4 \cdot 60 \pm 0 \cdot 18$ cycles per 100 days (a cycle of 21·7 days), while the mean for the service group was $3 \cdot 04 \pm 0 \cdot 31$ cycles per 100 days (a cycle of 32·9 days).

Although it appeared obvious from the mean values for each group that there was no difference between reactors and non-reactors for either the no-service or service oestral cycles, the data were analysed and the results are shown in Tables 4 and 5.

Table 4.

DIFFERENCE BETWEEN NO-SERVICE CYCLES OF BRUCELLOSIS REACTORS AND NON-REACTORS.

Source of Variation.	Degrees of Freedom.	Mean Square.	F.
Between Groups	1	0·2893	0·151
Within Groups	44	1·9219	

Table 5.

DIFFERENCE BETWEEN SERVICE CYCLES OF BRUCELLOSIS REACTORS AND NON-REACTORS.

Source of Variation.	Degrees of Freedom.	Mean Square.	F.
Between Groups	1	0·8531	0·923
Within Groups	34	0·9246	

The analysis showed that (*a*) there was no difference for either no-service cycles or service cycles between brucellosis reactors and non-reactors; and (*b*) the difference between the no-service cycles and service cycles for both reactors and non-reactors was highly significant.

Hence, reaction to brucellosis can be ignored in this herd and abnormalities in the oestral cycles attributed to the presence of trichomoniasis.

(a) No-service Cycles.

The distribution of 250 oestral cycles of 81 cows is tabulated in Table 6. Of these, 76·8 per cent were less than 26 days and 18·4 per cent. over 34 days.

Table 6.

Distribution of 250 No-Service Oestral Cycles in Herd 2.

Range.	Number.	Percentage.	Range.	Number.	Percentage.
Days.			Days.		
0– 9	4	1·6	35– 45	28	11·2
10–15	11	4·4	46– 60	11	4·4
16–20	84	33·6	61– 80	5	2·0
21–25	93	37·2	81–100	1	0·4
26–34	12	4·8	101–150	1	0·4

(b) Service Cycles.

Records are available of 136 returns following service to 61 cows. All but five of the services were by herd bulls. Their distribution is shown in Table 7. Returns of less than 26 days formed 33·8 per cent. and over 34 days 50·0 per cent. of the total. The range of cycle length for all bulls was 8 to 214 days. Observed abortions have not been included.

Table 7.

Distribution of 136 Service Return Oestral Cycles in Herd 2.

Range.	Bull L.		Bull W.		Bull H.		Bull B.		All Bulls.	
	Number.	Percentage.	Number.	Percentage.	Number.	Percentage.	Number.	Percentage.	Number.	Percentage.
Days.										
0– 9			1	2·2					1	0·7
10– 15			3	6·7	2	7·1			6	4·4
16– 20	4	10·0	3	6·7	9	32·2	3	27·2	22	16·2
21– 25	4	10·0	6	13·3	3	10·7			17	12·5
26– 34	8	20·0	8	17·8	3	10·7	1	9·1	22	16·2
35– 45	12	30·0	11	24·4	6	21·4	2	18·2	32	23·5
46– 60	7	17·5	4	9·0	1	3·6	1	9·1	13	9·5
61– 80	3	7·5	5	11·1	3	10·7	2	18·2	14	10·3
81–100	1	2·5	2	4·4			2	18·2	5	3·7
101–150	1	2·5	1	2·2					2	1·5
151 +			1	2·2	1	3·6			2	1·5
Totals	40	100·0	45	100·0	28	100·0	11	100·0	136	100·0

The distribution of returns following service by the four bulls most used is also indicated in Table 7. The percentage less than 26 days and over 34 days and the range in days for each bull were:—

L—20·0, 60·0 (16—145); W—28·9, 53·3 (8—178);

H—49·9, 39·3 (12—214); B—27·2, 63·7 (16—189).

(3) Pattern of Oestral Behaviour.

(a) No-service Cycles.

Records of both herds showed that the intervals between heats when mating did not occur followed the normal pattern. These are compared in Table 8 with records covering 18 years in the Kentucky Agricultural Experimental Herd (Olds and Seath 1951) and indicate accurate observation by the herd owners.

Table 8.

OESTRAL CYCLE DISTRIBUTION IN HERDS 1 AND 2 AND THE KENTUCKY HERD.

Herd.	No-service Cycles.			Service Cycles.		
	Under 26 Days.	26–34 Days.	Over 34 Days.	Under 26 Days.	26–34 Days.	Over 34 Days.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	78·6	..	21·4	8·1	8·1	83·8
2	76·8	4·8	18·4	33·8	16·2	50·0
Kentucky	73·2	3·3	23·5	55·2	11·5	33·3

(b) Service Return Cycles.

Table 8 shows the differences between the service returns for the two herds and the Kentucky herd. Set out in this way, the shift to long cycles is more apparent.

Two distinct patterns of service returns are evident. The biggest single group of returns in herd 1 occurred in the 101–150 days range (24·4 per cent.), with only 8·1 per cent. in the normal range. In herd 2, however, 28·7 per cent. of returns occurred in the 16–25 days range and the biggest group of delayed returns in the 35-45 days range (23·5 per cent.). Both herds showed a secondary peak for delayed returns in the period 61–80 days, the figures being 18·9 per cent. for herd 1 and 10·3 per cent. for herd 2.

The pattern of service returns in individual cows was not consistent. Long cycles did not follow the first service in all cases. Cycle length in days for some of the cows in each herd were as follows:—

Herd 1. Cow No. 20—127, 57.

27—69, 84.

32—38, 131.

35—32, 103.

38—100, 39, 22.

Herd 2. Cow No. 9—20, 20, 36, 178, X30, 214.
13—22, 35, 21, 22, 145.
17—26, 36, 41, 25, 35.
20—40, 19, 47, 52, X20, X21, X20, X22, X17.
24—27, X16, 61, X22.
25—141, X37, X21, 20, X19, X19.
27—76, 78, X11, X28.
34—26, 27, 8, 54, 40, X20, X21, X20, X18, X22, 25.
45—85, X20, X20, X22, X22, 41.
47—X21, 23, 32, X21, 31, 42, X21.
52—24, 30, 98.
59—43, 57, X25, X17, X22, X23, A60, oestrus 52.

(X = No-service cycle; A = Aborted.)

In herd 1, 85·2 per cent. of the first service returns and 88·9 per cent. of the second were over 34 days. For those cows in herd 2 with complete records of service by bulls L and W, 60·0 per cent. of the first service returns, 47·1 per cent. of the second, 50·0 per cent. of the third, 40·0 per cent. of the fourth and 100 per cent. of the fifth were over 34 days.

IV. CONCEPTION RATES.

In the following analysis, conception is taken to have occurred only if the cow was noted to calve or abort.

In herd 1, the infected bull was mated to 34 cows retained in the herd. Services per conception were 2·5, with 11·8 per cent. of the cows not in calf. As a criterion of conception, 90 days without a return to service would have been incorrect for 35 per cent. of the herd.

Table 9 shows the number of cows, number of services, number of conceptions and percentage of cows pregnant at each service.

In herd 2, complete service records exist for 80 cows. Some of these cows occur twice during the period of infection, thus bringing the total number of possible conceptions to 125.

The performances of the five herd bulls are shown in Table 9. The better conception rates of bulls H and B are due to preferential mating to freshly calved cows and cows that had undergone a period of 90 days' sexual rest, particularly during the time when these bulls were considered to be uninfected. Bull G served an infected cow and his use was limited. For all bulls the average number of services per conception was 2·1, with 34·0 per cent. of the cows not in calf. There were only 2·8 per cent. of 90-day non-returns in the herd.

Table 9.

CONCEPTION RATES IN HERDS 1 AND 2.

Bull.	Data.	Service Number. 1.	2.	3.	4.	Total.	Percentage Not in Calf.	Services per Conception.
Herd 1	Number of cows ..	7	16	8	3	34		
	Number of services ..	7	32	24	12	75	11·8	2·5
	Number of conceptions	5	16	8	1	30		
	Per cent. pregnant ..	14·7	47·1	23·5	2·9	88·2		
Herd 2 Bull L	Number of cows ..	11	4	2	..	17		
	Number of services ..	11	8	6	..	25		
	Number of conceptions	3	3	0	..	6	64·8	4·2
	Per cent. pregnant ..	17·6	17·6	..	..	35·2		
Herd 2 Bull W	Number of cows ..	20	4	2	2	28		
	Number of services ..	20	8	6	8	42		
	Number of conceptions	11	3	1	0	15	46·4	2·8
	Per cent. pregnant ..	39·3	10·7	3·6	..	53·6		
Herd 2 Bull H	Number of cows ..	27	7	2	1	37		
	Number of services ..	27	14	6	4	51		
	Number of conceptions	19	6	2	0	27	27·1	1·9
	Per cent. pregnant ..	51·3	16·2	5·4	..	72·9		
Herd 2 Bull G	Number of cows ..	4	2	..	..	6		
	Number of services ..	4	4	..	..	8		
	Number of conceptions	1	1	..	..	2	66·6	4·0
	Per cent. pregnant ..	16·7	16·7	..	..	33·4		
Herd 2 Bull B	Number of cows ..	33	4	..	..	37		
	Number of services ..	33	8	..	..	41		
	Number of conceptions	28	2	..	..	30	19·0	1·4
	Per cent. pregnant ..	75·6	5·4	..	..	81·0		
Herd 2 Totals	Number of cows ..	95	21	6	3	125		
	Number of services ..	95	42	18	12	167		
	Number of conceptions	62	15	3	0	80	34·0	2·1
	Per cent. pregnant ..	49·6	12·0	2·4	..	66·0		

V. DISCUSSION.

At times, attempts may have to be made in field investigations of infertility to diagnose the cause of service returns on clinical grounds alone. In affected cattle there is often an absence of particular signs that may help in arriving at such a diagnosis, and recourse is made to the herd breeding records in the hope that an examination of oestral cycles will assist.

Analyses of the records of the two herds reported indicate that differences in the pattern of oestral behaviour may occur between herds recently infected by *Trichomonas foetus*. A typical pattern which may be accepted as reliable evidence of the presence of trichomoniasis did not emerge from the study. Although a distribution of cycle lengths similar to that of either herd may cause trichomoniasis to be suspected, confirmatory tests based on laboratory techniques are necessary for positive diagnosis.

Both patterns described have been reported in less detail by various authors. Laing (1955), Bartlett (1949) and Morgan (1946) suggested that service return oestral cycles within the normal range, or slightly longer, predominate.

In herd 2, part subject of the present study, 50 per cent. of the service return cycles were less than 35 days. The use of bulls, uninfected for at least some of their working life in the herd, was a factor in increasing the number of normal cycles. Cycle lengths of over 34 days predominated in the case of cows served by the two originally infected bulls, L and W.

In herd 1, only 16·2 per cent. of the service returns were less than 35 days, the vast majority (83·8 per cent) being longer. This herd reflected more closely the description given by Millar and Ras (1952), where conception rate did not appear to be affected initially. Even so, a high proportion of the cycles were longer than these authors appear to indicate should be the case.

It is also clear from a consideration of the oestral cycles of individual cows that there was little tendency for a quick return to three-weekly cycles during the initial phase of trichomoniasis. Some of the longest cycles followed the fourth and fifth services. At the same time, it appeared that re-infection occurred after a sexual rest of from 37 to 130 days, but it is not possible to say whether re-infection did actually occur then or whether the infection had persisted from a previous service. In those cows which showed prolonged cycles after several services, the development of a solid immunity to *T. foetus* must have been slow. In an eradication programme based on controlled mating, such cows may be a source of infection for uninfected bulls.

It was also noted in herd 2 that immunity did not last long enough to resist re-infection in all cases of cows calving normally to an infected bull. This is in accordance with the view expressed by Pierce (1955).

Although there are other factors which cause cycles of over 25 days following service, it has been shown that brucellosis and vibriosis were not implicated in these two herds. Olds and Seath (1951) did not indicate the incidence of specific disease, if such occurred, in their Kentucky herd, but the proportion of service return cycles over 25 days was considerably less than for either of the trichomoniasis-infected herds.

The high incidence of delayed service returns in the two herds studied here has been attributed to trichomoniasis. In the cycles analysed, abortion was not observed nor suspected but it is possible that early abortion may have been missed in some cases. If failure to exhibit oestrus is evidence of pregnancy in most instances, then many of the delayed cycles must have followed conception and it would appear that foetal death and resorption is common in trichomoniasis.

Laing (1955) drew attention to the occurrence of cycles of over 70 days without evidence of abortion. Further evidence of the probability of conception lies in the fact that when mating did not take place, oestral cycles reverted to the normal pattern. This would also imply that the presence of *T. foetus* in the genital tract of the cow had no effect, *per se,* on the length of oestral cycles.

An examination of Table 9 reveals a low first service conception rate in the three bulls originally infected. The combined conception rate for these bulls was 27·8 per cent. In herd 1, the proportion of the herd non-pregnant when mating ceased was much lower than in herd 2. Services per conception were also high (except for bull B in herd 2) in both herds.

Although 88 per cent. of herd 1 proved in calf after the fourth service, the long delays between the occurrences of oestrus were the predominant infertility problem. In herd 2, these delays, though shorter, were also important, but only 66 per cent. of the cows were in calf after the fourth service. It was the low conception rate that led to the investigation of infertility in this herd.

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