Artifical Insemination of Dairy Cattle in Queensland. Influence of Certain Aspects of Oestrus on Fertility.

G. R. FALLON*

Summary

Large-scale artificial insemination services in Queensland date from 1955. In that year a bull-proving project was inaugurated for the purpose of locating dairy sires of outstanding genetic merit from Queensland studs. The project requires the artificial insemination of at least 1,000 cows each year in the Nambour region of south-east Queensland.

In September, 1957, an artificial insemination centre was opened on the Atherton Tableland in north Queensland.

Fertility results to date have been quite satisfactory and far exceed the level of natural fertility.

An attempt is being made to study the various factors influencing fertility under artificial insemination conditions. In particular, the problem of anoestrus and the phenomenon of oestrous cycles atypical in duration are under consideration.

INTRODUCTION

To date, artificial insemination (A.I.) has been of no significance in the Queensland dairy economy. In 1951 some success was obtained with semen from U.S.A. air-freighted to Maleny. Chilled semen had not previously been transported over such a long distance. In the same year an outbreak of trichomoniasis in south-east Queensland was controlled with the aid of A.I. (Alexander **1953).** A limited service was established by the University of Queensland Veterinary School in 1954. In addition, a small number of private veterinary surgeons and stud-breeders have performed some inseminations.

Beattie (1952) and Wishart (1952) consider that the slow development of A.I. in Australia results from such factors as the large size of individual herds, low cow densities in the dairying areas, and the lack of proven sires. In Queensland low production, associated with low nutrition, is a further complication. Operational costs of A.I. in Queensland would conceivably be higher than in most other dairying countries because of the relatively low cow densities and the difficult nature of the travelling involved. The cost of A.I. to the farmer, whose profit margin is already low, may prove a real barrier to its general adoption.

PRESENT STATE OF A.I. IN QUEENSLAND

(i) ***The** Bull Proving Project.*—In 1955 the Queensland Department of Agriculture and Stock organised a bull proving project within the terms of the Commonwealth Dairy Industry Efficiency Grant. The aim is to locate dairy sires of outstanding genetic merit from Queensland studs. The programme is similar to that being currently pursued in the U.K. (Lord Rothschild 1954). Initially the Jersey breed is under consideration. Each year four young

*Department of Agriculture and Stock, Brisbane, Queensland.

bulls are selected from a number of studs, using Barker's analysis (1957) as a basis. The sires are kept at the Animal Husbandry Research farm at Rocklea in Brisbane. Semen from each bull is used for the artificial insemination of at least 250 cows within a limited breeding season. The bulls are used in rotation, and semen is collected on three days each week. The chilled semen is then railed to the Nambour region, approximately 70 miles north of Brisbane, and used within 2 to 3 days after collection. About 50 dairymen are co-operating in the project. They have undertaken to rear the heifer progeny of the bulls and to have their production recorded during the first lactation. Then it will be possible to make an assessment of the merit of the sires.

Progress has been summarised in Table I. The service is provided on each day throughout the season which commences about October 1. Two inseminators are engaged each day. Since the farms cover an area of 300 square miles, three telephone points have been arranged and call times set to suit milking times. It is the intention that cows observed in oestrus in the evening are inseminated before 2.00 p.m. next day, and those observed in the morning are serviced on the same day. An average of 20 cows are inseminated each day and the total may exceed 40. While these numbers are not high by some standards, the travelling involved is considerable. In the 1956 season, 14,272 miles were travelled, an average of 11.3 miles per first insemination. Each inseminator travelled an average of 87 miles per day.

TABLE I.

Artificial Insemination in the Nambour Region.

Year	Insemination Period*	No. of Farmers	No. of Cows	Fertility Rate
1955	110 days	60	1,275	62%
1956	82 days	53	1,267	64%
"Natural Fertility"†			670	51%

*The aim throughout the season is to inseminate 1,000 cows within the minimum period of time.

†Based on most recently available data—1953 calvings (McTackett, unpublished data).

(ii) ***Developments on the Atherton Tableland.***—During the period from November 1956 to April 1957, inclusive, 524 cows were inseminated on the Atherton Tableland (North Queensland). Chilled and frozen semen air-freighted from Brisbane was used. The work was undertaken as an exploratory trial with a view to ascertaining the practicability of an organised service on the Tableland and to demonstrate the operation of such a service to the farmers. Subsequently, an artificial breeding centre was established at Kairi, near Atherton, and became functional in September 1957. At present Jersey and A.I.S. semen is produced and a service is operated within a short distance of Atherton. An interesting development has been the establishment of A.I. committees within two Tableland branches of the Queensland Dairymen's Organisation. The function of the committees is to facilitate the development of A.I. within the respective areas.

(iii) ***Fertility of Inseminations.***-Almost all known infertility factors are present in Queensland. A significant exception seems to be trichomoniasis. Natural fertility throughout the State is uniform and in the order of 50 per cent. at first service (McTackett, personal communication). In view of these facts, the conception rates of 60-70 per cent. obtained with A.I. have been gratifying and indicate the contribution which A.I. may make to improved breeding efficiency. However, higher efficiency is undoubtedly attainable (Willett 1956) and a number of factors are under investigation.

OPERATION UNDER QUEENSLAND CONDITIONS OF FACTORS WHICH MAY INFLUENCE EFFICIENCY OF A.I.

The efficiency of the artificial insemination technique may be influenced by factors relating to the farmer, the inseminator, the semen and the cow.

(i) ***Farmer.***- In new areas it is necessary that farmers should be assisted towards acquiring a minimum knowledge of the A.I. technique and the aspects of reproductive physiology relevant to it. For example, the fact that a cow may still be fertile when she will no longer accept the bull is a new concept to the majority of farmers. In Queensland every opportunity is taken to explain such matters to the dairymen concerned. It is then found that the farmers are induced to utilize the service more rationally, to maintain accurate breeding records and to regard the breeding efficiency of their herds more critically. This results in a most desirable interchange of information between the farmer and the inseminator and consequently in more efficient use of the service.

(ii) *Inseminator.*—It is well established that training, field experience, aptitude and psychological factors may directly influence the results obtained with A.I. The variation in results obtained by individual inseminators at Nambour is set out in Table II. It has been further noted that results obtained by any one inseminator may vary by as much as 30 per cent. throughout the season. The reason is being sought.

TABLE II.

Inseminator Efficiency in Queensland.

Inseminator	Efficiency %	
	1955	1956
A	71	—
B	59	60
C	55	63
D	62	60
E		70

(N.B.—"A" and "B" were experienced English inseminators.
"D" and "E" were holders of the Hawkesbury Diploma of Agriculture. "C" was the author.
"C", "D", and "E" had no effective field experience of A.I. before their first season.

The indications to date are that difficult inseminations and heifer inseminations do not seriously affect inseminators' efficiency (Fallon, unpublished data). Operational difficulties, such as are encountered initially with frozen semen, may influence efficiency. Inseminations performed in the morning tend to be more fertile than those performed in the afternoon, when due regard is taken of the stage of oestrus involved. On the other hand, the pressure of work, as measured by "cows per day", apparently does not influence inseminators' efficiency.

(iii) ***Semen***.-Fertility of chilled semen from individual bulls has been satisfactory under Queensland conditions in most cases. In addition, the rate of decline of semen fertility throughout three days' storage time has been satisfactory (Table III), although the semen is probably subjected to more rigorous conditions than those obtaining in some other places (Schultze et *al.* 1948; Hewetson 1955). Frozen semen was first used in Queensland in 1956. The material was imported from U.S.A. by a Guernsey breeder near Maleny. Eighteen cows were inseminated and seven calves resulted. A fertility trial with frozen semen from the Rocklea centre was conducted in the Nambour region during January 1957. The results were:—

Chilled semen (117 inseminations) : 65 per cent fertility;

Frozen semen (110 inseminations) : 58 per cent. fertility.

Considerable variation between inseminators was noted, due to initial difficulties in handling the material in the field. It is of interest that Emmens and Martin (1957) observed no between-inseminator variance in a frozen semen trial conducted in N.S.W.

TABLE III.

Effect of Storage Time on Fertility of Chilled Semen in Queensland.

Season	Age of Semen (Days)	No. of Inseminations	Fertility %
1955	1	549	64
	2	548	60
	3	178	60
	Total	1275	62
1956	1	713	65
	2	699	62
	3	251	61
	Total	1663	63

(iv) Cow.- (1) Anoestrus : Anoestrus is widespread in south-east Queensland and is considered to be primarily nutritional in nature. Blood phosphate and copper levels are often marginal or low. Limited assays suggest no vitamin A deficiency (Harvey, personal communication). However, the cattle are on a falling plane of nutrition following calving and at the time when breeding is desired. Preliminary trials utilizing protein, phosphorus and vitamin A supplements have yielded no significant response (Fallon, unpublished data). It is considered that long-term provision of adequate nutrients may be necessary and that the standard of calf-rearing may be of particular importance.

It has been demonstrated that fertility at first heat is largely a factor of the interval between calving and service (Fallon 1958). In the case of cows serviced after long periods of anoestrus fertility is usually satisfactory.

(2) Oestrous cycles : Both at Nambour (Fallon 1958) and at Atherton short oestrous cycles have been noted in significant proportions (Table IV). Fertility after such short cycles was depressed both in the case of first and repeat inseminations, in common with experience elsewhere (VanDemark and Moeller 1950; Moeller and VanDemark 1951; Bonfert and Fromm 1953; Bonfert 1956; Trimberger 1956).

TABLE IV.

Oestrous Cycle Lengths in Queensland Cattle.

Length of Cycles (Days)	Non-Service Cycles	Service-Return Cycles		
	(Nambour) (1956) %	(Nambour) (1955) %	(Nambour) (1956) %	(Atherton) (1956/57) %
0-17	18.4	18.7	10.9	18.6
18-25	70.1	64.6	53.8	58.5
26-	11.5	16.7	35.3	27.9
No. of Cycles	441	402	567	147

Furthermore, as noted in other places (Chapman and Casida 1934; Olds and Seath 1951; Erb 1955; McTackett 1956), service-return cycles have tended to be longer than non-service cycles (Fallon 1958). This is frequently to be explained by disease processes and may involve foetal death (Laing 1949; 1952 ; Tanabe and Casida 1949) and delayed regression of the corpus luteum of pregnancy. Fertility after such delayed returns has been depressed; whereas first inseminations after long non-service cycles are of high fertility (Fallon 1958).

(3) Post-conception oestrus : The occurrence of oestrus during pregnancy in the cow is well known and is regarded as something of a hazard in A.I. practice. Because of the possibility of inducing abortion in such cows, many organizations favour intra-cervical, as distinct from intra-uterine, insemination. Recent evidence from blood group studies in cattle (Rendel 1956a; 1956*b*) indicates that the problem of post-conception heats can no longer be regarded as merely of academic interest. Because of the variability of gestation lengths, the paternity of calves from cows inseminated with semen from different bulls at successive inseminations must be suspect in a proportion of cases. Certain breed societies have provided for this in their regulations (Osterhoff 1957).

It is to be expected that such studies will provide more information on the limits of gestation length in the cow than is now available. In the Nambour work, gestation lengths after first and repeat inseminations have been recorded (Table V) and are similar

TABLE V.

Gestation Lengths in Queensland Jersey Cattle Following First and Repeat Inseminations.

Gestation Length (Days)	Distribution after		Total %
	First Insem. %	Repeat Insem. %	
266-275	12.0	13.4	12.4
276-285	76.4	75.0	76.0
286-300	11.6	11.6	11.6
No.	242	112	354

in distribution. Some confusing cases have been encountered. However, the full significance of post-conception, inseminations in such an exacting undertaking as a bull proving project has yet to be demonstrated.

(4) Duration of oestrus: No study has been made of the duration of oestrus in Queensland cattle.

(5) Time oestrus first observed: Farmers usually observe oestrus at milking times. During the 1956 season at Nambour about two-thirds of the cows were first observed in oestrus in the morning. Most of those cows were inseminated on the same day with satisfactory results (Table 6). High fertility was also attained when cows observed in oestrus in the evening were inseminated before next mid-day. However, because of the travelling involved, more than half the cows observed in oestrus in the evening **were** inseminated during the next afternoon, with consequent reduction in fertility.

TABLE VI.

Influence of "Time of Day" on Breeding Efficiency of Jersey Cows in Queensland.

Time Oestrus First Observed	Time of Insemination	Number of Inseminations	Fertility Rate %
A.M.	Same A.M.	208	67
	Same P.M.	488	66
	Next A.M.	22	68
	Next P.M.	17	47
P.M.	Next A.M.	196	70
	Next P.M.	234	61
Total		1165	65

DISCUSSION

Recent developments in such aspects as semen preservation and sire evaluation have made widespread development of A.I. a practical possibility in Australia. The work reported here indicates that no special difficulties confront the application of A.I. in Queensland. The travelling involved and the time spent by inseminators in the field might well exceed experiences in other places; but it is clear that services could certainly be operated under practical conditions. Initially, the benefits of A.I. to the industry will be mainly indirect. Substantial advances in the control of reproductive diseases may be expected. Improvements in such husbandry practices as feeding, calf-rearing and the maintenance of herd breeding records have been associated with the establishment of A.I. However, the full realisation of these benefits depends on the utilization of adequate extension measures. The importance of the inseminator is immediately apparent in this regard. It is apparent that conception rates in the order of 65 per cent. may be attainable as the control of venereal diseases is effected. Progress beyond this level has been achieved in a number of places and requires the operation of an active research programme concerned with the many factors influencing A.I. efficiency. It is anticipated that more intensive investigation of such factors will be undertaken in Queensland in future.

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