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DAIRY HERD FERTILITY - EXAMINATION OF EFFECTS OF INCREASING GENETIC MERIT AND OTHER HERD FACTORS ON REPRODUCTIVE PERFORMANCE

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SUMMARY

- Results from this project clearly show that infertility is a major problem in Northern Ireland dairy herds, where it is the cause of considerable financial loss.
- Traditional methods of assessing fertility performance, such as calving interval, are subject to misinterpretation due to other confounding factors.
- There is a major requirement to radically review the methods used to assess fertility status in dairy herds to ensure that information is:
  1) Meaningful and easily understood
  2) Applicable across all farms (for between farm and between year comparison)
  3) Facilitates timely assessment of fertility performance, i.e. during the breeding period
- It is proposed that In-Calf Rate (ICR) should be adopted by dairy farmers in Northern Ireland to assess the reproductive performance of their herds, i.e:

  a) 6-week in-calf rate for herds with a compact seasonal calving pattern
  This is a measure of the proportion of cows intended for re-breeding that are in-calf 6 weeks after the start-date of breeding season. Target 6-week ICR should be 80%.

  b) 100-day in-calf rate for herds with a prolonged or spread calving period
  This is a measure of the proportion of cows intended for re-breeding that are in-calf within 100 days of calving. This measure is applicable to most dairy herds in Northern Ireland. Target 100-day ICR should be 80%.

Both measures are directly comparable as the 6-week (or 42 day) in-calf rate assumes a voluntary waiting period from calving to commencement of AI of approximately 56 days, when conception rates have reached their plateau. A 100-day In-Calf Rate of 65% is achievable and is currently being attained in Northern Ireland dairy herds with good reproductive performance, but a target of 80% should be considered. Points to consider in order to achieve this target include:

1. Keeping good records and making appropriate use of them (i.e. calving dates, all heats and services, etc).
2. Ensure good hygiene when assisting calvings and during AI inseminations.
3. Good heat detection is critical - observe cows closely and use aids to heat detection such as a teaser bull, tailpaint, kamars, pedometers, etc.
4. Inseminate cows early - results from this study have shown that cows can be inseminated from day 56 onwards without any decrease in conception rate. There is no evidence to indicate that delaying insemination will improve conception rate.
5. Ensure good A.I. technique - consider regular retraining courses.
6. Avoid severe underfeeding and/or abrupt dietary change in early lactation until cows are confirmed in-calf.

INTRODUCTION

Poor reproductive performance is a major problem on dairy farms throughout the United Kingdom (UK) and has been identified as the single most important problem in dairy herd management in Northern Ireland (AgriSearch Farm Survey). In addition to the direct financial cost, estimated to be approximately £50 million per annum in Northern Ireland (or £9000 per farm), infertility can result in increased management complexity as a result of inability to achieve a compact calving pattern. This is a particular problem in seasonal production systems where compact block calving is of critical importance in maximising milk production from grazed grass.

While reproductive performance is influenced by a large number of factors, including management practices and nutritional factors, the decline in dairy cow fertility is also associated with an increased genetic capacity for milk production. This has occurred largely as a result of substitution of the British Friesian by the North American Holstein, the percentage of Holstein genes in the UK dairy herd rising from 0% in 1975 to approximately 80% in 1998.

The association between increasing 'Holsteinisation' and declining fertility is not confined to the U.K., as similar observations have been reported in the Republic of Ireland, the Netherlands and New Zealand. However, the effects of increasing Holsteinisation are unclear as there is conflicting evidence on trends in conception rates with maiden heifers. In the United States, conception rates in non-lactating Holstein heifers in the U.S.A. remained high (70-80%) during a period when milk production per cow increased by 218%. However, a more recent study in the U.K. has shown decreasing conception rates in maiden heifers in the period from 1981 to 1998, during which time there has been a dramatic increase in the proportion of Holstein genes. Whilst there is evidence of a genetic trend towards lower herd fertility, the decrease observed at farm level may also be attributed to a number of other factors. These include management changes such as increasing herd size and also the increased incidences of underfeeding or severe negative energy balance (NEB) in early lactation, associated with higher milk yields and insufficient nutrient intake.

Against this background, a major research programme was initiated at Hillsborough in 1998 with the objective of collating a comprehensive database on milk production and reproductive performance from a range of dairy herds in Northern Ireland in order to identify the key factors influencing reproductive performance at farm level. The objectives of the study were:

- To establish causes of severe dairy herd infertility and to develop suitable management and/or intervention procedures to improve fertility in these problem herds.
- To obtain data on reproductive performance from dairy farms across Northern Ireland and to use these data to identify key factors influencing reproductive performance at farm level.
- To develop management strategies to improve reproductive performance and to evaluate these strategies on a number of commercial dairy herds in Northern Ireland.

PROCEDURE

The research programme involved three separate studies, outlined briefly as follows:

1. **In-depth investigation of problem herds**
   The breeding records of ten dairy herds with acute infertility problems were studied and, where appropriate, more detailed assessments were made.

2. **Herd monitoring studies**
   A large-scale monitoring study was initiated in autumn 1998 involving 19 herds of Holstein-Friesian cows (approximately 2500 cows) from across Northern Ireland, representing a wide range of herd size, concentrate input, feeding methods, genetic merit, level of milk production, calving pattern and labour input. Monitoring of each herd was carried out for three successive years to establish a comprehensive range of data on:

   - Reproductive records including calvings, heats and service
   - Production information (available through UDF and HerdTech Herd Records)
   - Genetic merit information (available from Holstein UK and Ireland)

   In the early part of the study, detailed assessments were also made of milk progesterone, body condition score, feed records and labour availability. Fertility parameters investigated were:

   - Interval to first service
   - Heat detection rate
   - Conception rate (overall, to AI only, to first AI service)
   - Calving interval
   - Removal rate and reasons for removal

3. **Management strategies to help improve reproductive performance**
   Three intervention programmes were conducted on selected monitor herds in the fourth year of the study:

   a) *Use of good herd recording procedures.* This involved the development of an automatic computer-based fertility-recording program. Herd records provided by farmers were input to the program by ARINI staff and a series of lists were generated and returned to the farmer three times weekly. Lists returned included an action list, warning list and progress monitor based on details of calvings, heats and services. The action list highlighted cows expected to be in heat or served approximately 21 days ago, while the warning list highlighted cows eligible for service (i.e. greater than 42 or 60 days calved).

   b) *Nutritional intervention.* In this study, cows were offered a novel high-energy feed supplement designed to reduce the degree of negative energy balance and body condition score loss in the early postcalving period, thereby aiming to improve reproductive performance.

   c) *A.I. technique.* This study was conducted to examine the effect of AI technique and operator on conception rate. Insemination of cows was conducted by farmer (DIY) or AI Services on an alternate-day basis.

REVIEW OF FINDINGS

1. In-depth investigation of problem herds

A detailed analysis of the records of the 10 problem herds indicated that there was no apparent predominant cause of acute infertility in Northern Ireland dairy herds. Indeed, a range of causes were identified and in most cases the problem was not identified for some time after the cows had failed to conceive, and therefore only presumptive diagnoses could be achieved.

The underlying problems associated with infertility in the majority of herds investigated were essentially delayed and inadequate analysis of herd breeding records, over-estimation of forage nutritive value resulting in cows being underfed, and management changes/alterations. The following is a summary of the main factors that contributed to infertility in the ten herds investigated:

- **Inadequate nutrition.** This was primarily associated with poor quality silage fed during the winter of 1998 on many of the farms investigated.
- **Endometritis.** This was associated with poor hygiene at calving and at service on some farms. On these farms nutrition in early lactation was found to be inadequate and this may well have lowered immune function and the cows' ability to clear infections.
- **Poor heat detection.** This was observed in two herds, one of which only conducted heat detection at milking time (i.e. twice daily), and in the other, a rebuilding programme had reduced light intensity in farm buildings and created areas where cows could not be easily seen.
- **Poor AI technique.** This problem was observed in one herd, where semen storage and handling and AI technique were suspect.
- In one herd no cause for low overall fertility was identified.

2. Herd monitoring studies

Summary of reproductive performance across herds:

- A major finding of this study was that average reproductive performance across the 19 herds over the three years was very poor, indicating that infertility is a major problem in many Northern Ireland dairy herds. However, much variation occurred between herds (see Table 1) and between years within a herd.
- The average interval to first service was very long at approximately 85 days, giving cows a limited opportunity to calve again within 365 days. Results from this study indicate that cows can be served from approximately 56 days (8 weeks) onwards without any negative effect on conception rate as shown in Figure 1.
- While some seasonal variation did occur, there was no evidence of a decline in conception rates following turnout of cows in the spring, with conception rates in April and May being similar to those in February (Figure 2).

Table 1 Range in fertility performance across the 19 herds for three successive years

	Average	Range (Min-Max)	Achievable Target†
Interval to first service (days)	84	67-119	73
Heat detection rate (%)	72	55-89	82
Conception rate (%):			
To 1st A.I.	41	18-61	55
To 2nd A.I.	40	19-58	55
To all A.I.	39	22-53	50
Overall (A.I. & natural service)	44	30-60	55
Calving interval (days)	404	371-447	380
Removal rate (%)	27	19-39	21
Re-appearance Rate (%)			
365-day	24	4-45	35
400-day	44	22-65	60
Overall	72	62-80	78
100-day In-Calf Rate (%)	46	16-71	65

† average of top 5 herds

Figure 1 Conception rate to first AI service in each week after calving across all 19 herds

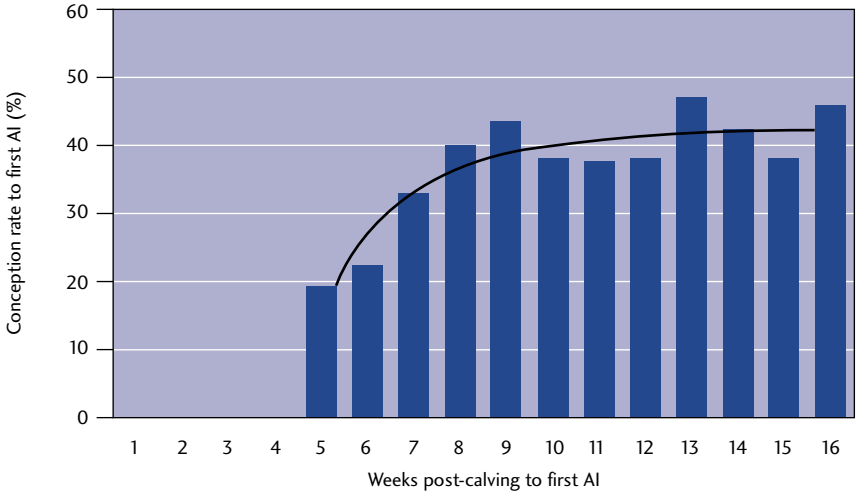
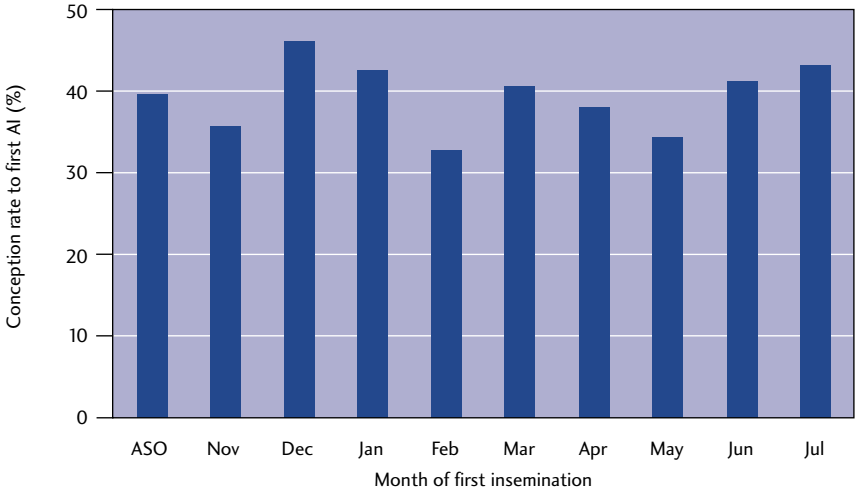
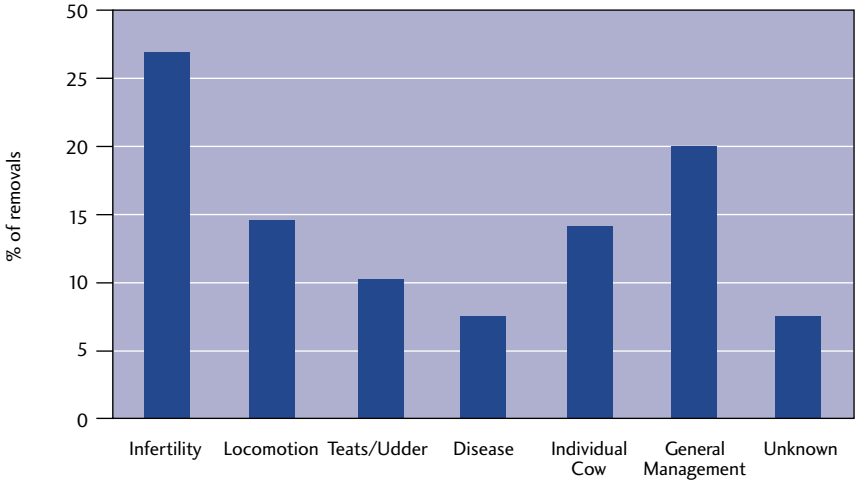


Figure 2 Conception rate by month of insemination



- Heat detection rates across the 19 herds was also lower than anticipated. Analysis of milk progesterone profiles in cows calved 42 days or more indicated heat detection rates of approximately 60% (herd range 9-82%). Assessment of heat detection rate using inter-heat and inter-service intervals gave an estimate of approximately 70% (herd range 55-89%).
- Average conception rate to A.I. was disappointing at approximately 40%, and consistent with results from similar studies in Great Britain and the Republic of Ireland, though the average conception rate varied widely between herds.
- Average calving interval was approximately 400 days. Calving interval is the culmination of various factors and was lower in herds with shorter intervals to first service, higher heat detection rates and higher conception rates. Cows in these herds also tended to lose less body condition in early lactation, indicative of less nutritional stress or negative energy balance.
- Approximately 28% of cows that calved were subsequently removed from the herd, giving an average cow productive life of 3.5 lactations. Of the six general categories describing the reasons for removal, infertility was the principle reason and accounted for approximately 27% of removals (Figure 3). Infertility, lameness/locomotion and problems associated with the teats and udder accounted for approximately 50% of all removals.

Figure 3 Reasons for removal of cows from the 19 herds during the three-year study



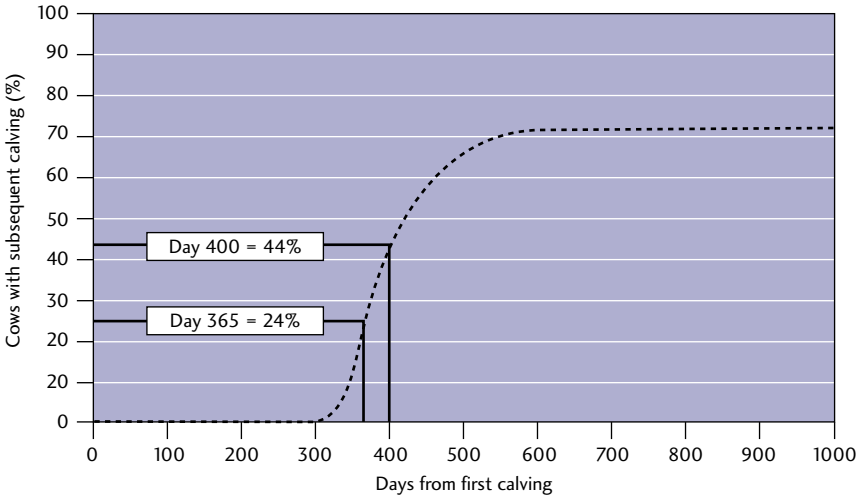
- Calving interval is the traditional measure of reproductive performance. However, it is a very poor measure of herd reproductive performance as it is prone to error and misinterpretation. Two herds may have a similar calving interval but widely differing removal rates for infertility, making direct comparison between them meaningless. Therefore, alternative methods of assessing reproductive performance such as Re-appearance Rate and In-Calf Rate should be used:

e.g. 365-day Re-appearance Rate = % of cows in herd which calve again within 365 days (Figure 4)

100-day In-Calf Rate = % of cows (intended for re-breeding) back in-calf within 100 days of calving

- These assessments provide more appropriate measures for between herd assessment of reproductive performance, and year to year assessment within a herd.
- The reproductive performance of the best herds can be used as targets for reproductive performance in all dairy herds (Table 1).
- A realistic and achievable target for all dairy herds should be to attain a 100-day in-calf rate of 65%, with the best herds aiming to achieve a target of 80%.

Figure 4 Proportion of cows which calve again (Re-appearance rate) across the 19 herds



Detailed analysis of results

- Average interval to commencement of resumption of oestrous cycles after calving was 36 days. Overall, 36% of cows had resumed oestrous cycles by day 20 postcalving and 80% by day 40, but approximately 12% of cows had still not resumed cyclicity by day 50 postcalving.
- Cows with a long interval to resumption of cyclicity (more than 50 days) tended to have:
  1. higher genetic merit for milk production (i.e. higher PIN_{2000} values)
  2. greater negative energy balance in early lactation, as indicated by a lower 100-day milk protein concentration and greater loss of body condition
  3. greater risk of being examined or treated for fertility
  4. higher incidence of retained foetal membranes and/or uterine discharge
  5. longer interval to first service
  6. longer calving interval
- The mean interval between successive ovulations was 21.4 days.
- Approximately 4% of all AI services were conducted at the incorrect stage of the oestrous cycle, i.e. when cows had high milk progesterone concentrations, and had little chance of conceiving.

Atypical progesterone profiles

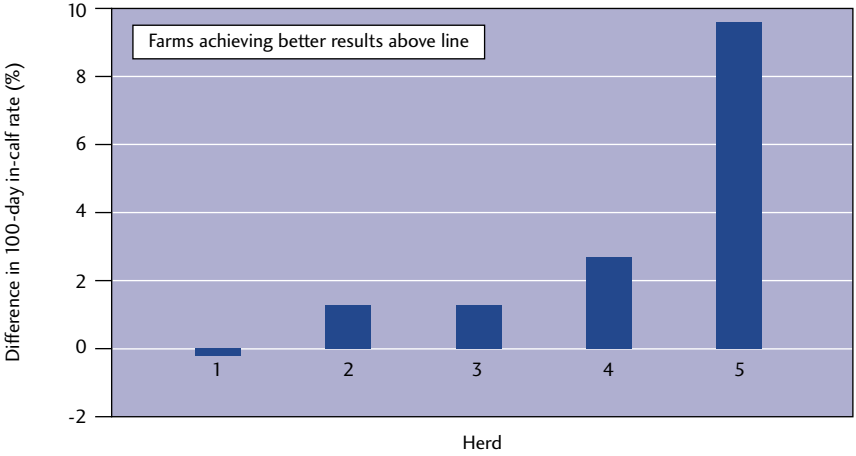
- Approximately 40% of cows had one or more atypical progesterone profiles in the early postcalving period, expressed as either delayed ovulation or and/or prolonged corpora lutea (luteal cysts) following ovulation.
- Cows with one or more atypical profiles had:
  1. increased interval to first service
  2. greater negative energy balance in early lactation, as indicated by a lower 100-day milk protein concentration and greater body condition loss
  3. higher 305-day milk yield and milk energy output
  4. higher PIN_{2000} values
  5. increased interval to first service and consequently calving interval
  6. increased risk of being culled

3. Management strategies to help improve reproductive performance

Major findings of the three intervention programmes were as follows:

a) *Use of good herd recording procedures*
Herd reproductive performance assessed by 100-day in-calf rate improved in five of the six participating herds, compared to the average of the previous three years (Figure 5). Disease problems contributed to poorer reproductive performance of a sixth herd, which was subsequently excluded from analysis. In year 4, the use of good recording procedures increased the 100-day in-calf rate by 3.7% on average (69.3 v 65.6%). This was achieved through an increase in the submission rate (i.e. number of cows served as a proportion of cows eligible for service) and a decrease in the interval to first service compared to the average of the first three years. Under intervention, the current submission rate remained high throughout the breeding period, indicating that interest in breeding was maintained for longer, thereby resulting in higher overall submission rates (Figure 6). Participation in this programme also significantly reduced the interval between successive services, indicating that a higher proportion of repeat breeding cows were detected at first repeat. This emphasised the importance of maintaining good herd records and using them appropriately.

Figure 5 Differences in 100-day in-calf rate between the average of the three control years and the monitor year when improved recording procedures were used for five herds. Comparsions are based on 60-day non-return rates in cows bred up to 30 weeks from the start of the breeding season.



b) Nutritional intervention
While the number of animals involved in this study was small, the feeding of a novel high-energy feed supplement designed to reduce nutritional stress and body condition score loss in the early postcalving period did not appear to have any beneficial effects on cow fertility.

c) A.I. technique
Provisional results, based on subsequent calving dates and 60-day non-return rates for cows not already calved, indicate that conception rates to insemination by 'professional' AI technicians were approximately 2% higher than those conducted by DIY-AI (41% v 39%). However, as seen in Figure 7, much variation existed between herds, with conception rates to DIY-AI ranging from 29% lower than those achieved by an AI Services technician through to 11% higher. These findings are consistent with a similar study in Australia where conception rates to DIY-AI were typically between 5 and 30% less than those of a professional technician. Details of further calving dates have yet to be included before final analysis, but the variable results observed between herds so far does indicate the need for good AI technique and regular retraining.

Figure 6 Average submission rate across the 6 participating herds at 3 week intervals from the start of the breeding season, based on submission rate in the current 3 week period or overall submission rate from the start of the breeding season.

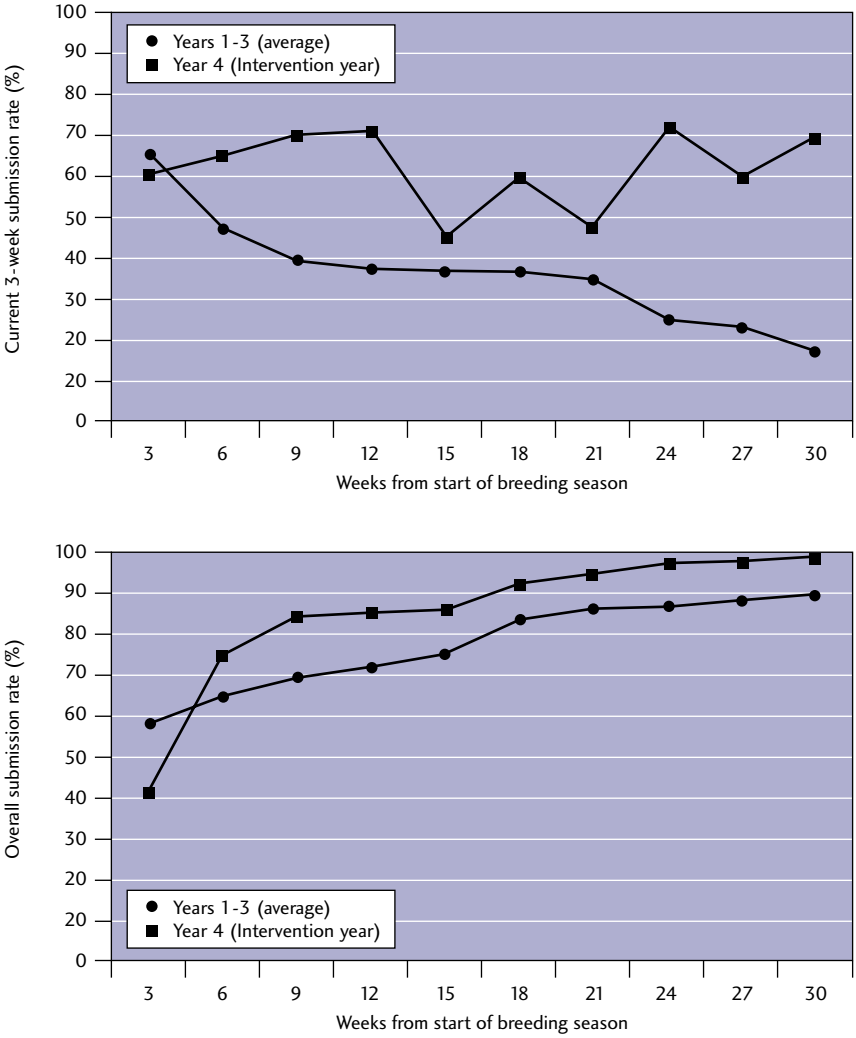
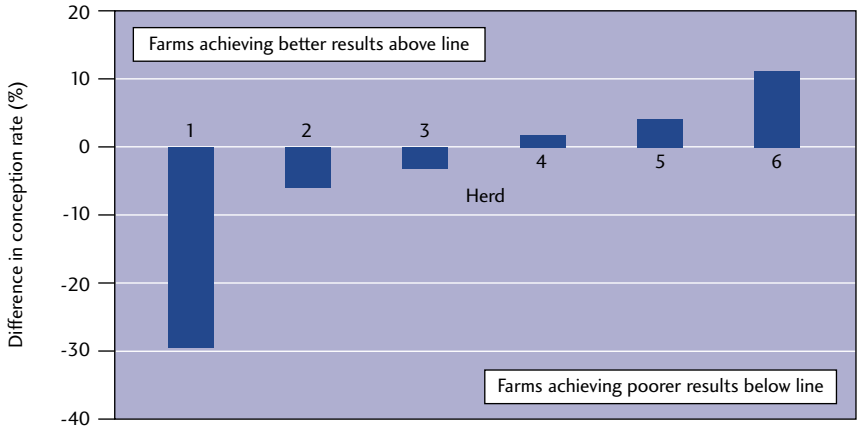


Figure 7 Differences in conception rate between insemination performed by the farmer and by professional AI technician for six herds. Comparisions are based on subsequent calvings where available, but otherwise based on 60-day non-return rates.



THE PROJECT TEAM

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