# USE OF INSEMINATION DATA IN CATTLE BREEDING; SOME EXPERIENCES FROM IRELAND.

A. Cromie[1], F. Kearney[1], R Evans[1], D Berry[2], D Wilhelmus[3].

[1] *Irish Cattle Breeding Federation, Highfield House, Bandon, Co. Cork, Ireland.*
[2]. *Teagasc, Dairy Production Research Centre, Moorepark, Fermoy, Co. Cork, Ireland.*
[3]. *Wageningen UR, Animal Sciences Group, the Netherlands.*

## ABSTRACT.

Experiences from Ireland have indicated many potential uses for insemination data in cattle breeding including; (i) genetic evaluations for traits of economic importance, e.g., gestation length, (ii) better breeding and management advice for farmers, including sire advice facilities and fertility management reports, and (iii) more accurate invoicing and stock control systems for AI service providers. These three main benefits, coupled with major improvements in technology for recording insemination data in Ireland, e.g., AI handheld technology and web-based systems of recording, has resulted in the quantity and quality of insemination data available for Irish cattle breeding doubling in the past three years (+115%). Similar improvements are being targeted over the next 3-5 years (currently some 40% of all inseminations on farms are recorded on the cattle breeding database), reflecting the high value placed on insemination data within the Irish cattle breeding industry.

## INTRODUCTION.

Insemination records have many potential uses in dairy and beef cattle breeding. In this paper we give some experiences from Ireland, regarding the role of insemination data in Irish cattle breeding. The paper will be divided in three distinct components;

1. Collection of insemination data.
2. Use of insemination data in ICBF genetic evaluations.
3. Use of insemination data as a support tool in decision making within the Irish cattle breeding industry.

In addition, we will also give some insights into our future plans for the recording and use of insemination data in the Irish dairy and beef breeding programs.

## 1. COLLECTION OF INSEMINATION DATA.

*(i). Trends in Recording.* The ICBF Cattle Breeding database was first established in January 2002 (ICBF, 2007). Whilst the initial work was largely focused on birth registration and milk recording data, the introduction of new genetic evaluations for gestation length (and calving performance) in 2005, coupled with a desire by AI service providers to move away from manual processing of insemination records, resulted in an increased emphasis in the potential importance of Artificial Insemination (AI) data in Irish cattle breeding.

*Table 1. Trends in recording of insemination data.*

| | 2005 | 2006 | 2007 |
|---|---|---|---|
| Technician AI | 213,719 | 291,081 | 498,073 |
| DIY AI | 91,396 | 137,046 | 156,651 |
| Total AI | 305,115 | 428,127 | 654,724 |

As a result, the level of AI data recorded in the ICBF database has more than doubled in the past 3 years, from 305,311 insemination records in 2005 to 654,724 records in 2007, an increase of some 115% (Table 1). This figure represents some 40% of all inseminations taking place in Ireland on an annual basis (some 1.5 million inseminations take place annually across 2.2 million dairy and beef cows).

*(ii). Technician Recording of AI data.* The main "driver" of this growth has been the introduction of AI handhelds, which are used by technicians, to record AI data on farms. This technology allows the AI technician link directly to the ICBF cattle breeding database (via GPRS), ensuring fast & accurate recording of insemination data on each individual dam (& sire). In addition to providing information for cattle breeding purposes, i.e., the genetic evaluation of gestation length, the new handheld technology also allows ICBF and AI service providers provide many more services to end-users, including;

- *Inbreeding & lethal gene checks*; By having a copy of all animals on the farm, including their ancestry on the handheld, inbreeding & lethal gene checks can be performed on all potential matings.
- *Breeding Advice*; ICBF HerdPlus (see section 3) provides farmers with a sire advice facility, the results of which can be stored on the handheld for use by the technician at the time of AI.
- *Fertility management reports for farmers;* which provide farmers with valuable benchmark information for their herd e.g., 3 week submission rate reports,
- *Fertility management reports for AI service providers*, which provide AI service providers with valuable benchmark information for their business e.g., Conception rate reports for AI sires and individual technicians.
- *Semen invoicing & stock control;* Access to "real-time" information on all insemination data allows for much more effective and efficient management of their business by AI service providers.

*(iii). Farmers recording of AI data.* The other key driver of the growth in recording of AI data has been technology improvements to facilitate easier farmer recording of "Do-it-Yourself" (DIY) AI data. Of the 156,651 farmer recorded inseminations in 2007, 9% were via Animal Event sheets (paper-base recording of AI data by the farmers), 63% were by Animal Events email (electronic recording of AI data by farmers via farm computer packages), and 28% were via electronic recording of AI data by farmers over the ICBF website (http://www.icbf.com). This last option was only made available to farmers in 2007, and represents an excellent return after only its first full year of operation.

*(iv). Future plans.* Future efforts in the area of data collection will continue to focus on the use of handheld technology (by both technicians and farmers) and web-based recording of insemination data. This year (Spring 2008) saw a further increase in the number of AI companies and technicians using handheld technology to record insemination data (up from 150 technicians in 2007 to 240 technicians in 2008). Combined these technicians represent some 90% of the total technician inseminations in Ireland. In terms of recorded AI events by farmers, we will continue to improve our web-based systems for recording AI data, as well examine options for direct recording of AI data by farmers via PDA's (Pocket Digital Applications) and also mobile phones. However, it should be noted that successes in these latter two areas will be completely driven by our ability to provide farmers with valuable management information to help promote the

benefits of farmer recording. Without good reports, Irish farmers will see little tangible benefit in recording this data.

**2. USE OF INSEMINATION DATA IN ICBF GENETIC EVALUATIONS.**

Currently insemination data is used in 2 key areas; (i) Data edits for genetic evaluations of female fertility, and (ii) Genetic evaluation of Gestation Length. Future work will focus on the role of AI data to evaluate other traits of economic importance for Irish farmers, e.g., Interval traits, and its potential role in sire verification at the time of birth registration.

*(i) Data edits for genetic evaluation of female fertility.* Female fertility is a trait of major economic importance for Irish farmers and represents about 34% of the relative weighting in the dairy Economic Breeding Index (*ICBF Annual Report, 2007*). Female fertility is evaluated on the basis of daughter calving interval (300-600 days) and survival% with records above 600 days set to missing. Concerns had been expressed by Irish farmers and the breeding industry that the exclusion of these records could result in proofs being biased downwards for lower fertility bulls and cows. By having access to insemination data, ICBF can now establish as to whether an attempt has been made to inseminate the cow and if so, then include this full calving interval record in the evaluation. The net effect of this change has been to introduce a further 3% of records into genetic evaluations for female fertility (Table 2). Test evaluations carried out in November indicated that correlations were generally high (>0.93 across AI sires and cows), with sires having the highest proportion of daughters in the 600-800 bracket, penalized most in the new evaluations. This new edit was therefore introduced into the routine evaluation for female fertility in February 2008.

*Table 2. Use of Insemination data to Improve Edits for Genetic Evaluation of CI (Days).*

| Parity | 1 | 2 | 3 |
|---|---|---|---|
| Old Evaluation (Nov 07) | 805,762 | 649,783 | 502,161 |
| New Evaluation (Nov 07) | 834,794 | 671,959 | 517,301 |
| Difference | +29,032 | +22,176 | +15,140 |

*(ii) Genetic Evaluation of Gestation Length.* Due to the seasonal nature of cattle breeding in Ireland (60% of all calves are born during the months of February, March and April – *EAAP, 2007*)), gestation length (both direct and maternal) are traits of major economic importance for Irish farmers. In fact, the economic value of calving interval (one of the objective traits in the dairy EBI) has been evaluated at €11/day, for each day over 365 days (www.icbf.com). Genetic evaluation of gestation length was first introduced in February 2005, using a un-variate Animal model approach in ASREML (Gilmour, 2007). Some results for AI sires (>40% reliability only) from the last evaluation run (May 2008) are presented in Table 3.

To date some 750,000 gestation length records have been collected through the ICBF cattle breeding database (i.e., recording of insemination event and subsequent Animals Events birth registration). Heritability estimates for this trait are some 40% (see table 4 for latest genetic parameter estimates), indicating considerable genetic variation in this trait within the Irish cattle population. For example, the difference between the Limousin and Belgian Blue beef breeds, based on Irish data, is typically 4 days in PTA terms (or 8 days in breeding value terms). In addition, all of the breeds show a within breed difference of at least 4 days (in PTA terms), which

is very positive from a breed improvement standpoint. The genetic differences (and breed rankings) are also consistent with the phenotypic data collected on farms (Table 3).

*Table 3. Genetic Evaluation of Gestation Length (Direct) for Popular Breeds (May 2008).*

| Breed of AI Sire | No. Sires Evaluated | Phenotypic Data | | Genetic Data (PTA's) | |
|---|---|---|---|---|---|
| | | Mean | St Dev | Mean | St Dev |
| Holstein | 1,796 | 281.9 | 5.6 | -1.0 | 0.98 |
| Friesian | 242 | 281.5 | 5.4 | -1.5 | 1.07 |
| Limousin | 166 | 289.6 | 6.2 | 3.6 | 0.98 |
| Charolais | 153 | 288.5 | 6.0 | 2.3 | 0.89 |
| Belgian Blue | 131 | 284.6 | 5.8 | -0.3 | 0.94 |
| Angus | 121 | 283.8 | 6.1 | -0.3 | 0.87 |
| Hereford | 119 | 286.4 | 6.0 | 0.8 | 0.91 |
| Simmental | 95 | 288.5 | 5.9 | 2.3 | 0.93 |
| Montbelliarde | 93 | 286.9 | 5.8 | 1.4 | 1.03 |

*(iii) Future Plans.* Future work on the use of insemination data in ICBF genetic evaluations will focus on a number of key areas, including;

*(a) Improvements to Genetic Evaluation of Gestation Length.* Current research work by ICBF, in conjunction with Wageningen UR, is focused on introducing a number of new improvements to how we evaluate gestation length. These include; (i) the inclusion of direct and maternal effects in the genetic evaluation model, (ii) breaking 1st and later parity records into 2 separate traits, and (iii) including data from other calving traits of economic importance (i.e., calving difficulty and calf mortality) into a single multi-trait evaluation. Initial results (for gestation length only) are summarized in Table 4

*Table 4. Genetic Parameters for Gestation Length**

| | GL Days; 1st Parity (Direct) | GL Days; Later Parity (Direct) | GL Days; 1st Parity (Maternal) | GL Days; Later Parity (Maternal) |
|---|---|---|---|---|
| GL Days; 1st Parity (Direct) | 0.36 | 0.74 | 0.01 | -0.03 |
| GL Days; Later Parity (Direct) | | 0.44 | 0.03 | -0.24 |
| GL Days; 1st Parity (Maternal) | | | 0.04 | 0.89 |
| GL Days; Later Parity (Maternal) | | | | 0.08 |

* Heritabilities on the diagonal and genetic correlations above the diagonal.

The above analysis is based on records from some 590,000 records from Holstein Friesian dairy cows, with parameters estimated from a Sire-MGS model, using MIX99 software (Mantysari, 2008). The initial results confirm the high heritability for direct gestation length (~ 40%), with a high genetic correlation across parities (0.74). The heritabilities for maternal gestation length are also of major interest, given their close biological association with female fertility (especially calving interval). Heritabilties are also high (in this regard), with a correlation across traits on 0.89. Correlations between direct and maternal effects are generally close to zero. We anticipate releasing these new gestation length evaluations to the Irish breeding industry in September 2008, with a view to making them official by the end of the year.

*(b) Genetic evaluations for other insemination traits of economic importance.* In addition to gestation length, there are a number of other insemination traits that are of interest to ICBF and the Irish breeding industry, including female fertility (especially compactness of calving traits) and male fertility. This work is being undertaken in conjunction with Teagasc, Moorepark (Berry et al., 2007, Evans, et al., 2007 & Twomey et al, 2008). Again initial results are promising, especially for the female fertility traits (Table 5), indicating that these traits could be used as additional predictors of calving interval in future evaluations of female fertility.

*Table 5. Mean & heritability estimates for Female Fertility Traits.*

| | Parity | Mean (days) | Heritability | S.Error |
|---|---|---|---|---|
| Calving Interval | 1 | 383 | 0.047 | 0.004 |
| | 2 | 382 | 0.031 | 0.004 |
| | 3 | 381 | 0.034 | 0.005 |
| Calving to 1st Service | 1 | 75 | 0.019 | 0.006 |
| | 2 | 73 | 0.012 | 0.006 |
| | 3 | 71 | 0.021 | 0.010 |

The next stage of this work will focus on estimating genetic correlations between insemination traits and calving interval, with a view to selecting appropriate early predictors of female fertility. Again we anticipate having this work completed and implemented by the end of this year.

*(c) Validation of sire births.* One additional advantage of having access to insemination data is its potential to validate sires at the point of birth registration (as misidentification of sires can cause biases in genetic evaluations). Initial work by ICBF has indicated that, based on some 57,000 births in January, February & March 2008 (the result of inseminations in April, May & June 2007), the average error rate between the sire identified through the technician recorded insemination event and the sire identified by the farmer at the point of birth registration was 6%.

*Table 6. Validation of Sire Identification between Insemination & Birth Record*

| Month of Insemination | Number of insemination & birth records* | Number of sire errors | Error rate |
|---|---|---|---|
| Apr | 17,341 | 488 | 2.8% |
| May | 25,102 | 1,769 | 7.0% |
| Jun | 6,192 | 914 | 14.8% |

* Number of records within allowable gestation length range of 280-290 days.

Of particular interest is the fact that the error rate appears to increase over time (breeding seasons in Ireland typically last about 10-12 weeks), suggesting that as the breeding and calving season progresses, establishing the correct sire becomes more difficult due to a combination of stock bulls (which are often joined with the herd at the end of the fixed AI period) and a certain level of farmer apathy (at the end of a long breeding & calving season). Based on these initial results, we intend to carry out further work, with a view to introducing this check as a component of our routine birth registration process.

**3. USE OF INSEMINATION DATA AS A SUPPORT TOOL IN DECISION MAKING.**
One of the major benefits of having access to insemination data is its potential role as a support tool for farmers and people involved in the cattle breeding industry. Examples where AI data is currently used to make better breeding and management decisions within Ireland include; (i) Farm fertility management reports, (ii) Sire Advice Information, and (iii) AI management systems.

*(i) Farm Fertility Management Reports.* The ability to benchmark performance is a critical component of profitable dairy and beef farming. Having access to increasing volumes of insemination data has allowed ICBF develop valuable calving & fertility reports for Irish farmers. These are marketed directly to farmers through the ICBF HerdPlus service. An example of one such report is the "Final Fertility Report" (Table 7), which includes herd and National summary information on a range of important calving and fertility traits.

*Table 7. Summary of Key Fertility Parameters for ICBF HerdPlus Herds**

| Trait | Mean | St Dev |
|---|---|---|
| Calving Date | 25/02/2007 | 11.7 days |
| Calving Interval | 370.5 | 11.3 days |
| Total cows calved | 84 | 48 |
| Mating Start Date | 20/04/2007 | 10.4 days |
| Total Cows Calved & Served | 72 | 40 |
| 21 Day Submission Rate (%) | 59.8% | 15.4% |
| 42 Day Submission Rate (%) | 77.5% | 12.8% |
| Pregant to first service (%) | 53.9% | 16.0% |
| 6 Week Pregnancy Rate (%) | 58.4% | 15.2% |
| Overall pregnancy | 90.8% | 7.8% |
| Total AI Serves | 1.8 | 0.6 |
| Not in-calf | 9.2% | 7.8% |
| Length breeding season | 14 Weeks | 4 weeks |

* Summary statistics are based on 725 Spring Calving Herds, which received final fertility reports in October 2007.

In addition to individual herd fertility reports, ICBF also provides "discussion group" reports, for those farmers involved in Teagasc discussion groups (some 100 groups & 1500 farmers in total), which allows participating farmers benchmark their herd performance against their group peers as well as National performance data.

*(ii) Sire Advice Information.* In addition to fertility management reports, ICBF HerdPlus also offer farmer access to a "Sire Advice" facility, as an additional support tool. Suggested sires are identified for each farmer based on a combination of his defined goals, the genetic merit of his herd, the genetic merit of available AI sires and possibilities for close matings and/or lethal gene combinations. After selecting his preferred sires, these are then allocated to individual animals in the herd in advance of the start of the breeding season. The list of suggested matings are then returned to farmers via either; (i) breeding charts (for DIY AI users) and/or (ii) directly to handhelds (for users of an AI technician service). Over 1700 farmers used the sire advice facility this year (Spring 2008), with the average EBI of bulls selected being equivalent to the average of the top 20 bulls on the ICBF Active Bull List.

*(iii) AI Management Information.* As well as providing valuable benchmark tool for farmers, the availability of insemination data can provide AI service providers with valuable benchmark tools for tracking the performance of AI Sires, laboratory procedures and individual AI technicians. Close monitoring of reports on traits such as non-return rates can help to quickly identify potential problems in each of these three key areas.

*(iv). Future plans.* Future work in this area will concentrate on developing further fertility management reports (including group reports), as well distilling the volume of insemination data down to a number of key performance indicators that will help farmers (& AI service providers) during the breeding season. Getting information back to farmers in a quick and efficient manner is a high priority in this regard, with the role of mobile phone technology seen as a key component. In addition, we are currently looking at ways to improve the effectiveness of ICBF Active Bull List, by using information on insemination data to ensure that the bull list always active and up to date for dairy and beef farmers.

**SUMMARY.**

Access to Artificial Insemination data is an important component to ICBF's growing plans for Irish beef and cattle breeding. By tackling the issue from two sides, through better recording of the data (AI handhelds & over the web), and through better reporting of the data (better decision support tools for farmers and the industry), we are confident that we can continue grow the level of insemination data recorded over the next 3-5 years. Achieving this will ensure that profits from breeding will be increased in the future, through more accurate evaluation of economically important traits, and a greater use of AI in general within the Irish National cattle herd.

**REFERENCES.**

Berry, D.P., Coughlan, S, Evans, R. 2007. European Association of Animal Production, Annual Proceedings, Dublin, August, 2007.
http://www.icbf.com/publications/files/Sire_fertility_preliminary_analysis.pdf

Evans, R, Coughlan, S., Berry, D.P. 2007. European Association of Animal Production, Annual Proceedings, Dublin, August 2007.
http://www.icbf.com/publications/files/Female_fertility.pdf

Gilmour, A.R., Cullis, B.R., Welham, S.J., & Thompson, R. 2007. ASREML Reference Manual. New South Wales Agriculture, Orange, Agricultural Institute, Orange, NSW, Australia.

Lidauer, M., Matilainen, K., Mantysaari, E., Stranden, I., 2008. MIX99 Reference Manual, Agrifood Research Finland.

Irish Cattle Breeding Federation, Annual Report, 2007.
http://www.icbf.com/publications/files/Report_May_2008_ver_7.pdf