Animal & Grassland Research and Innovation Centre

Moorepark

Moorepark Dairy Levy Research Update

Breeding Strategies for an Expanding Dairy Industry

Moorepark Animal & Grassland Research and Innovation Centre
Dairygold Research Farm Open Day

Wednesday 9th April, 2014
Series 23

Teagasc
Agriculture and Food Development Authority

Dairygold

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Chairman's Welcome
Bertie O'Leary

Welcome,

On behalf of Dairygold Co-Operative Society I welcome you to the Kilworth Farm Open Day.

Today is all about knowledge transfer, giving you, the farmer, the benefit of the dairy farm research undertaken by Teagasc and I hope that you will benefit from it.

The success of Ireland's post quota expansion ambition is entirely reliant upon the capacity of our dairy farmers to expand their dairy enterprises in a manner that is profitable and sustainable. This will require a greater level of support in terms of information, education and mentoring.

Dairygold is committed to helping provide that, and we believe that the dairy research undertaken by Teagasc across its eight farms has never been more relevant and timely.

Many years ago our shareholders acquired the Kilworth Farm for such purposes and now we are extremely pleased to ensure their vision is being delivered on by our on-going partnership with Teagasc.

Enjoy the day.

Bertie O'Leary

Dairygold, Chairman

Breeding strategies for an expanding dairy industry

Pat Dillon

Teagasc, Head of the Animal & Grassland Research and Innovation Programme

Introduction

The progeny produced from the 2014 breeding programme will be milking in a no quota scenario. With quota abolition there will be a requirement for an increased supply of high EBI replacements. Although fertility performance has improved on Irish dairy farms, suboptimum performance is still the biggest cause of involuntary culling in dairy herds. Reducing empty rate from 15 to 10% will result in an increase of 1 cent/litre in net margin for the average Irish dairy herd. Improved herd fertility performance will increase grass utilisation. Based on ICBF data, the average calving interval is 394 days compared to an industry target of 365 days. Similarly, the six-week calving rate of mature cows is 58% compared to an industry target of 70%. The targets for optimum herd fertility is: 90% submission rate in 24 days, 55 – 60% in calf rate to first service, 70% 6-week in-calf rate and >90% 12-week in-calf rate.

Improved reproductive performance at farm level will be achieved through the application of an optimum breeding management programme, good herd nutritional status (body condition score), increased number and quality of replacements, maintaining a good herd health status and the use of genetically superior AI bulls (EBI). Experience from other countries suggests that improvement to herd reproductive performance will include (1) the identification of areas for improvement; (2) setting of farm specific targets; (3) developing management plans to meet those targets and (4) monitoring the outcomes. Changes are likely to be incremental and continuous, but will require herd owners to measure current performance with a reasonable accuracy using an approved production recording service.

The Next Generation Herd currently being evaluated at the Dairygold Research Farm has an average EBI of €246 representing the top EBI herd in the country. These are the type of cows that Irish dairy farmers will be milking in 10 years based on current rate of genetic gain. The first year's results confirm yet again that a breeding strategy based on using high EBI sires will result in increase overall farm profitability. Additionally, in association with the Irish Grassland Association a grass-based robotic milking system is currently being developed in the Dairygold farm. At this Open Day, Dairy farmers will have the opportunity to see the key management factors that are required to operate a successful automatic milking system. The results from the sexed semen study carried out in spring 2013 will also be discussed; initial results suggest that this technology has the potential to both increase number of high EBI dairy replacements while at the same time increase the value of beef output from the dairy herd.

The Open Day is an ideal opportunity to meet research and advisory personnel from Teagasc. There will be an open forum at the end of the farm walk with the opportunity to discuss the latest developments in reproductive technologies such as sexed semen and genomics. The event also offers dairy farmers an opportunity to meet with ICBF, AHI and the main AI organisations.

The financial support for the research programme from state grants and dairy levy research funds is gratefully acknowledged.

Breeding for profit post quota

Frank Buckley and Donagh Berry

Teagasc, Animal & Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork.

Summary

- The economic breeding index (EBI) is achieving gains in milk solids production by 1) increasing milk solids production genetic potential per cow, 2) achieving longer lactations through improved fertility, and 3) achieving mature herd yield potential as a consequence of improved cow survival
- Crossbreeding is not exclusive to EBI; rather it is a breeding strategy that compliments genetic improvement within breed. A well-planned and well-managed crossbreeding programme will result in greater performance once high EBI alternative breed and Holstein-Friesian sires are used.

The ideal cow post quota

For the first time in 30-years, Irish dairy farmers have the opportunity to exploit our competitive advantage in milk production with removal of quota. Expansion will, however, put significant additional pressures on the existing dairy farm business and only those who fully capitalise on the inherent competitive advantages associated with low cost grass-based seasonal milk production systems will be successful. This will be based on using key technologies such as compact calving, high stocking rates, cows that are fit for purpose – productive and fertile (high EBI genetics), high quality pasture management and low cost labour efficient farm infrastructures; these are the basic components of a high profit, low risk and resilent business, now, but even more so as farmers strive to sustainably expand.

Integral to success is a herd of cows that will maximise profit. The fundamental requirement of a cow post-quota is the same as a cow in a quota environment – profit! Profit being the sum of economic output (i.e., milk and meat) less economic input (i.e., feed costs, veterinary costs, housing). It is vitally important that Irish dairy farmers stay focussed and continue to select for a cow that is balanced and capable of delivering high profit from a well-managed low cost production system *consistently*. Irish dairy farmers must not revert to the strategies employed prior to the introduction of the Economic Breeding Index (EBI). Aggressive selection for milk production while neglecting fertility and longevity will invariably erode profitability. This has been proven time and time again. Intensive selection for milk production without due cognisance of functionality will result in a deterioration in reproductive performance and health. This point is all the more valid given the current national statistics. Favourable progress is being made year-on-year but national reproductive performance statistics clearly demonstrate that our national herd is still considerably below target for seasonal calving herds. The national six week calving rate, at 58%, is below the target value of 90%. The mean calving interval at 394 days, is well below the optimum of 365 days. The top 5% of producers are achieving an 85% calving rate in six weeks. Teagasc economic analysis estimates that the difference in profit between the top 5% and those with the average calving pattern could be as much as €200/cow annually. Although management (e.g., heat detection) influences herd reproductive performance, it is now well recognised that animal breeding contributes substantially to differences in reproductive performance (Figure 1).

You can easily manage a genetically fertile cow to be sub-fertile but it is difficult and often very expensive to manage a genetically infertile cow to be fertile.

Milk production and the EBI

Three complementary components to increasing herd productivity and subsequent profitability post-quota include: 1) increasing cow genetic merit for production potential (milk solids yield), 2) earlier calving with optimal lactation length and thus lactation yield, 3) improved survival reducing replacement rate, promoting an older age profile that will express a higher mature production potential, and also providing a greater opportunity for voluntary culling including the option to cull low producing cows. The EBI actively targets all three components simultaneously.

Milk solids yield

Under average herd management, a 1-kg difference in sire PTA for fat or protein yield manifests itself as, on average, 1-kg difference in progeny performance. Average milk production per cow on farm in recent years has declined (Figure 1) but this has not been due to genetics since genetic merit for milk solids in the same cows is still increasing (Figure 1) at a rate comparable to that observed internationally. Reasons for the decline in milk production on-farm include many factors like the milk quota, weather, herd expansion (and thus a greater proportion of younger cows), and spiralling concentrate prices. Genetic merit for milk solids since the introduction of the EBI is increasing annually at a rate of 50% of what it was prior to the introduction of the EBI. This is because the EBI also includes emphasis on non-production traits, most of which are unfavourably correlated with milk production. Equivalent figures in the UK and US for genetic gain following the introduction of functional traits in national breeding objectives is 45% and 65%, respectively of the gains prior to the introduction of the functional traits.

Optimal lactation length

The national average lactation length in Ireland is 279 days, due mainly to a later than optimal calving date. Late calving dates are partly attributable to inferior genetic merit for fertility following decades of aggressive selection for milk production. Relative to a 305-day lactation, a cow milking for only 279 days yields 4% less; this equates to 262 kg of milk for a 6000 litre cow or 390 kg of milk for a 9000 kg cow. Equivalently assuming a dry off date on the 20th December, a March 1st calving cow will yield 6% more than an April 1st calving cow equating to 312 kg for a 6,000 kg cow. In a seasonal production system achieving optimal lactation lengths can be best achieved with superior genetic merit for fertility. A one day shorter calving interval equates to a one day shorter lactation length. This is cumulative and permanent; a one unit PTA for calving interval equates to a 3 day longer lactation by third lactation and this has knock-on effects for heifer progeny. Cow genetic merit for calving interval is improving year-on-year (Figure 1) since the introduction of the EBI and this is being reflected in on-farm improvement in reproductive performance (Figure 1). If the genetic trends in the past 3 years persist, by the year 2020 the fertility performance of the Holstein-Friesian females born in 2020 will be equivalent to Holstein-Friesian females born 30 years previous; this will be despite a 60% increase in milk solids production during the same time period of which half was due to genetic gains in milk performance.

Achieving herd mature yield

A second lactation cow yields 14% more than a first lactation cow while a third and greater lactation cow yields 22% more than a first lactation cow. Therefore reducing replacement rate and therefore the proportion of younger animals in the herd will increase herd milk solids output. Lower replacement rates (i.e., greater survival) can be achieved through selection of animals, within the EBI framework, for improved survival. Moreover, improved genetic merit for fertility will reduce the level of involuntary culling thereby providing more opportunity to voluntary cull lower yielding cows.

Sire selection

Sire selection cannot be undertaken taking cognisance of herd performance alone. Herds of the same genetic merit can differ considerably in performance despite similar herd genetic potential due to differences in management practices. For example, Figure 2 illustrates the variation in herd average lactation milk yield for herds with an average genetic merit of +95 to +105 kg PTA for milk; mean cow yield varied from 4000 kg to 9000 kg of milk. Therefore, gauging the genetic merit of a herd and making sire selection decisions based on the performance alone is unreliable since management (e.g., concentrate input) has such a large influence. Sire selection decisions should be made by consulting your herd genetic potential. This will provide you with a guide to your current herd genetic potential and the implications for future genetic gain. The genetic merit details for your herd are best obtained from the ICBF HerdPlus® reports.

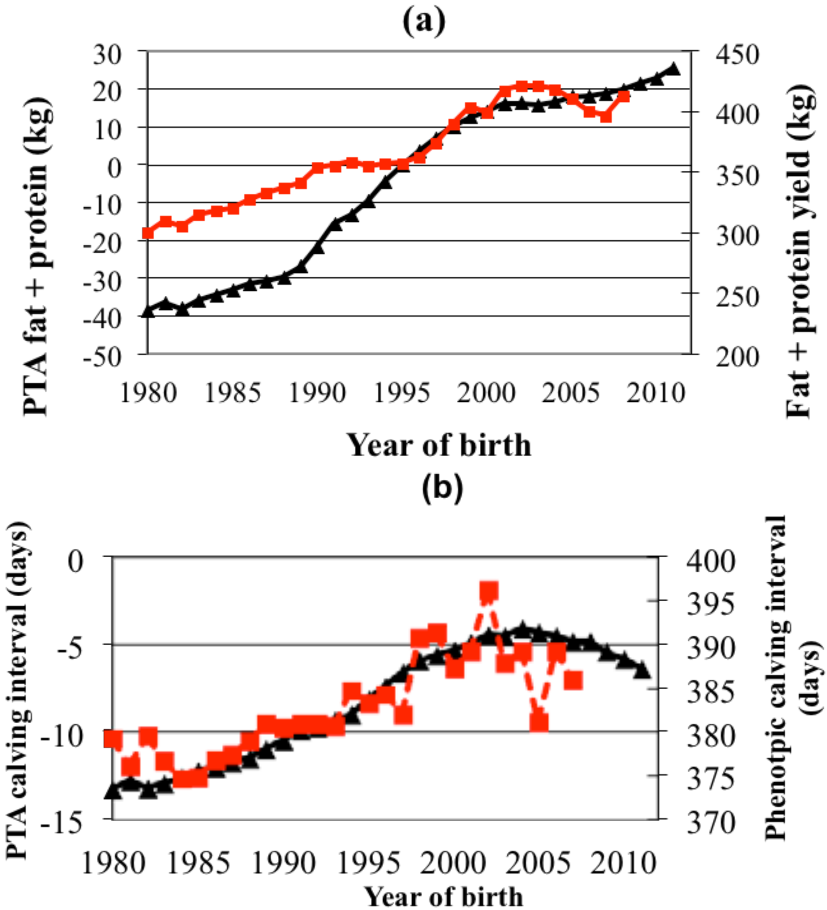

Figure 1. Genetic (black) and on-farm (red) trends in a) fat plus protein yield and b) calving interval in Irish dairy cows by year of birth

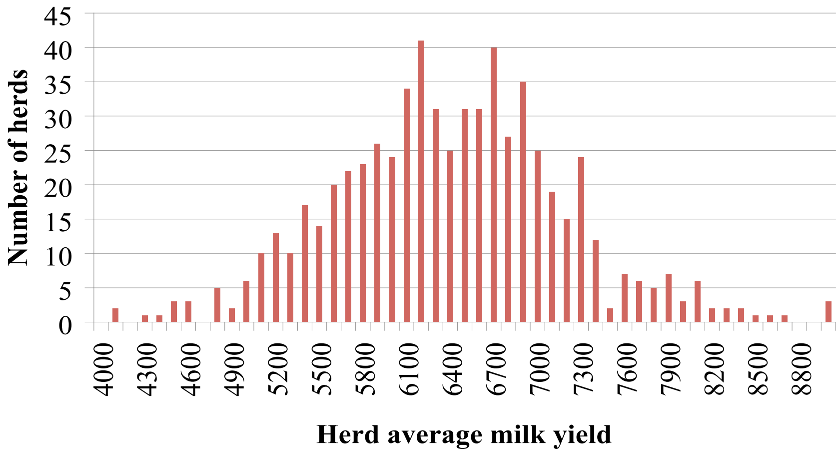

Figure 2. Mean milk yield/cow in herds with a mean milk predicted transmitting ability (PTA) of 95 to 105 kg

Sires should ideally be selected from the Active Bull list as these are the available genetically elite bulls. To achieve a target gain of €5 EBI annually, a bull team with an average EBI €70 greater than the herd average is required; the same is true for gains desired in any of the sub-indexes.

To achieve optimal fertility performance under average herd management a minimum herd fertility sub-index of at least €125 should be targeted. Teagasc and ICBF research independently show that cows with a fertility sub-index of €125 or greater achieve calving intervals three weeks shorter than the average cow. The average fertility sub-index of the national herd is approximately €60. Therefore to achieve a fertility sub-index of €125 in one generation, sires with a minimum fertility sub-index of >€190 need to be used.

Easy calving bulls for use on heifers should have a direct calving difficulty value of ≤1.5.

If using genomic bulls, then a minimum of 4 bulls should be used in a team. This is because the reliability of genomic bulls (~58%) is less than that of traditional proven bulls (~90%) and using a team of bulls will minimise the risk of individual bull fluctuations in proofs with the accumulation of daughter records.

Crossbreeding

Crossbreeding is not exclusive to EBI. Rather it is a breeding strategy that compliments genetic improvement within breed. A well-planned and well-managed crossbreeding programme will result in greater performance once high EBI alternative breed and Holstein-Friesian sires are used. The benefits of crossbreeding to further improve animal performance are epitomized by its successful use in the pig and poultry industries. The benefits of crossbreeding is achieved through a combination of breed complementarity and hybrid vigour. For example, Figure 3 shows the mean cow milk solids yield (adjusted to a common parity structure) for Jersey×Holstein crossbred animals differing in Holstein proportion generated from the ICBF database. A 50% Holstein animal is equivalent to a first-cross Jersey×Holstein crossbred; heterosis equates to 29 kg milk solids or 7.4%. A 25% or 75% Holstein (i.e., 75% or 25% Jersey, respectively) is what is achieved if the first-cross Jersey×Holstein cow is, in turn, mated to a Jersey or Holstein bull, respectively. A two-way rotational cross will stablise at 33% and 66% Holstein depending on the breed of sire last used. A similar effect is observed for other performance traits; 100% heterosis for example from a first cross is worth approximately 5 days shorter calving interval. Moreover, on average 18% more crossbred cows (from a range of dairy breeds) survived to the start of 6th lactation

Teagasc and ICBF research have independently demonstrated that crossbred cows will generate more profit (+€100/cow/lactation) when compared to their straight bred contemporaries of similar EBI. This analysis is very much in line with the findings from New Zealand that crossbred cows are more profitable that either straight bred Jersey or Friesian cows. In New Zealand currently crossbred cows are the most popular (over 50% of the national lactating herd). Of practical consideration is the fact that crossbreds maintain their superiority regardless of Breeding Worth, supporting the theory that in Ireland the most profitable cow will be a high EBI crossbred cow.

Based on the most recent ICBF Active Bull List (Spring 2014), when the contribution of heterosis is taken in account, Jersey crossbred cows sired by a Jersey sire team comprising the 4 highest EBI Jersey sires available (average EBI of €266) will on average deliver €58 or 14% more profit per daughter per lactation, compared with straight bred Holstein-Friesian daughters sired by the 4 highest EBI Holstein-Friesian sires available (average EBI of €308).

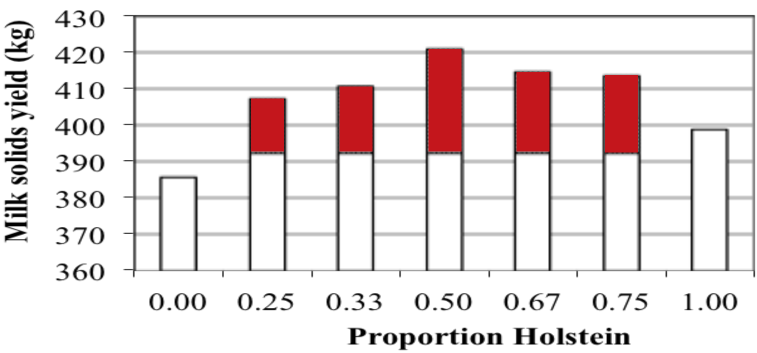

Figure 3. Mean milk solids production in Jersey-Holstein crossbreds with different proportion of Holstein bloodline (i.e., a 0.00 proportion Holstein is a purebred Jersey while and 0.50 proportion Holstein is a first-cross Jersey×Holstein crossbred). The unshaded part of the bars represents parental average and shaded bar represents non-additive effects (i.e. heterosis plus recombination loss).

Where to after the first cross?

Performance of the first crosses will please even the most critical. First crosses tend to tick all the boxes: display full hybrid vigour, productive and fertile. They also tend to be uniform in appearance (colour, size, etc.). For traits displaying a lot of hybrid vigour, e.g., fertility and longevity, subsequent generation performance may decline, depending to varying extents on the additive genetic contribution of the subsequent sires used. It is critical to remember that hybrid vigour is not fully passed on to the next generation *but it is not lost*. The extent to which hybrid vigour is expressed in later generations is dependent on the strategy taken after the first cross. Several schemes are available for creating replacement animals via crossbreeding. The three most common are as follows:

- Two-way crossbreeding. This entails mating the F1 cow to a high EBI sire of one of the parent breeds used initially. In the short term hybrid vigour will be reduced but over time settles down at 66.6% or €66/lactation.
- Three way crossing. Uses high EBI sires of a third breed. When the F1 cow is mated to a sire of a third breed hybrid vigour is maintained 100%. However, with the reintroduction of sires from the same three breeds again in subsequent generations, for example Holstein-Friesian, hybrid vigour averages out at 85.7% or €86/lactation.
- Synthetic crossing. This involves the use of high EBI crossbred bulls. In the long term a new (synthetic) breed is produced. Hybrid vigour in this strategy is reduced to approximately 50% initially and is reduced gradually with time.

Concluding remarks

Post quota removal Irish dairy farmers must focus to continue the genetic progress that has been made to remove the greatest constraint to maximising profitability from a seasonal grass-based system; poor fertility and longevity. Continuing to use the EBI to identify superior sires that will deliver balanced profitable dairy cows is still the preferred *modus operandi* post-quota. A well-planned and well-managed crossbreeding programme will result in even greater performance once high EBI alternative breed and Holstein-Friesian sires are used.

Keys to reproductive success on farm

Stephen Butler[1], Paul Fricke[2] and Matt Lucy[3]

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Summary

- A successful reproductive program begins with a commitment to a management plan that is initiated long before the mating start date.
- Calving pattern is a pivotal driver of farm profitability; examine your 2014 calving pattern and develop a plan for realistic improvement in 2015.
- Managing heifer reproduction is the first step to improved calving pattern.
- Cows that are too thin are difficult to get in calf. Manage body condition score (BCS) during the dry period, early lactation and breeding period to achieve appropriate BCS. A good reproductive program cannot overcome poor nutrition and low BCS.
- Shorten the breeding season to 12 weeks or less. This will require maximising both submission and conception rates through traditional means as well as adopting new technologies.
- Identify and treat problem cows (sick cows, late calvers, anoestrous cows, etc.) before mating start date. Doing nothing is not a solution for problem cows.

Introduction

For most spring-calving systems, the breeding season will commence sometime between mid-April and the first week of May. The primary objective is to get as many cows and heifers pregnant as quickly as possible after the start of the breeding season. The two factors that determine the rate at which cows become pregnant after the mating start date are the submission rate and the conception rate. While you have some control over conception rate, achieving high submission rates in both heifers and cows is critical and can be dramatically improved through good management practices and new reproductive tools. Good reproduction requires a commitment to a management plan that addresses the reproduction of the entire herd. Having a plan in 2014 will improve your calving pattern next spring and increase the profitability of your farm.

Heifers

When reared under good management, reproductive performance of heifers should exceed that of lactating cows. Heifers should be reared with the goal of reaching puberty by 10 to 12 months of age, and cycling regularly by 13 to 15 months of age. The specific weight targets vary depending on the breed, strain and cross (Table 1). Achieving target weights at 13 to 15 months of age will improve fertility at first breeding, and achieving target weights at first calving will increase milk production as well as conception rates for first lactation cows.

In general, about 5% of a group of yearling heifers should be in heat on any given day. If you do not see this, then tail paint the heifers to identify those that have not expressed heat within a 3 week period. The primary reason that heifers do not express heat is that they have failed to reach appropriate body weight (Table 1). It is also possible that the heifer is a freemartin (deformed reproductive tract) or she is pregnant (it happens!). To maximize heifer reproduction, weigh your heifers regularly and target feed light heifers to ensure that the target weights outlined in Table 1 are met.

Table 1. Bodyweight (BW) targets for maiden heifers at breeding and for heifers pre-calving by breed/crossbreed

	HF	NZ	HF*NZ	NR	HF*NR	J	HF*J
Maiden heifer BW (kg)	330	315	330	315	330	240	295
Pre-calving BW (kg)	550	525	550	525	550	405	490

HF = Holstein-Friesian, NZ = New Zealand HF, NR = Norwegian Red, J = Jersey

There are several advantages in starting to breed the heifers 7 to 10 days before the lactating cows:

- Initial heat detection and AI efforts can be focused on the heifers before the breeding period begins for the lactating herd.
- Heifers will calve early in the calving season and can receive extra attention before the rest of the herd calves.
- Calving early in the calving season will ensure that first-calf heifers will have extra time to resume cycling and hence achieve high submission rates at the start of the breeding season. This will increase the likelihood that they will again calve early the following year and increase their productive lifespan in the herd.

A recommended reproductive management plan for heifers is depicted in Figure 1. If all heifers are cycling, heifers not inseminated in the first 6 days should respond to a single injection of prostaglandin (PG), resulting in the majority of heifers being bred by day 10 of the breeding season.

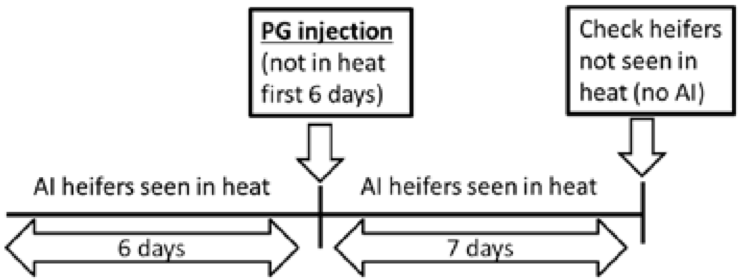

Figure 1. A simple, inexpensive and highly effective reproductive management plan for heifers.

You should expect to breed about one-third of your heifers before the PG injection and most of the remaining heifers within 2 to 4 days after the PG injection. If a heifer does not come into heat within 7 d after PG then check her reproductive tract. If she has a CL then treat her again with PG. If she is pre-pubertal (non-cycling) then she can be treated with a CIDR program but also consider culling her for low fertility. Heifers with delayed puberty are likely to be anoestrus and have low fertility after they enter the cow herd.

Heifers that do not become pregnant to first AI will return to heat 18 to 24 d after AI. If possible, heifers that repeat should be rebred with a second AI. Most heifers (approximately 80%) should be pregnant after two rounds of AI. After this, introduce an easy calving short gestation stock bull. Heifers that become pregnant to the stock bull will be at a distinct disadvantage because they will calve later in the calving season. Attempt to minimize the percentage of bull-bred heifers by using PG to maximize submission and conception rates to AI at the start of the breeding season.

Use easy calving bulls for breeding heifers (both AI and natural service). Dystocia (calving difficulty) will result in increased incidence of retained placenta, metritis, and delayed resumption of cyclicity after calving. Collectively, these problems are associated with reduced submission and conception rates during the breeding period. When identifying AI sires for heifers, choose bulls with calving difficulty values less than 2%.

Two new technologies that enable you to maximise the efficiency of your heifer management are:

- Genomic testing
- Sexed semen

Consider performing a genomic test on all heifer calves within one month of age. After all heifers are tested, identify heifers with the lowest EBI and plan to cull them from the herd. For most herds, culling the bottom 25% of heifers will leave an adequate number of replacements. The EBI is heavily weighted toward fertility so culling low EBI heifers will improve your herd's fertility without affecting milk solids production.

In addition to genomic testing, consider using sexed semen on your heifers. There are three advantages to using sexed semen. First, 90% of your heifers will have a heifer calf. The small size of a heifer calf compared with a bull calf will reduce the incidence of dystocia in your heifers. Second, the slightly lesser conception rate with sexed semen will be offset by the greater conception rate in heifers. Finally, you will be breeding your genetically superior heifers to superior AI sires with a high likelihood of creating replacement heifers for your herd. A good strategy would be to use sexed semen for first AI, conventional semen at second AI followed by natural service.

Lactating cows

There is no substitute for good management when it comes to lactating cow fertility. Approximately 95% of the variation in cow fertility is explained by the management on your farm. The major management factors that you can control that affect fertility of dairy cows are:

- Genetic merit for fertility traits
- The interval from calving to mating start date (MSD)
- Nutritional management to control body BCS postpartum
- Management of reproduction during the breeding period

Genetic merit for fertility traits

Most improvements in reproduction occur through better management. Nonetheless, cows with good genetic merit for fertility traits (high fertility sub-index) have better reproductive performance than cows with poor genetic merit for fertility traits. This arises from better body condition score, earlier resumption of cyclicity, better uterine health and stronger heats. Identifying AI bulls that increase the herd average EBI will improve reproductive performance while also increasing milk solids production. Consider culling low EBI mature cows and replacing them with higher EBI heifers.

The interval from calving to MSD

The single biggest factor that influences a cow's reproductive performance during the breeding season is the number of days from her calving to MSD, and this interval is a direct reflection of the reproductive performance during the previous breeding season. In other words, farms with poor reproductive performance in any given year will pay the price for that poor reproductive performance in subsequent years. Cows that calve early will have resumed cyclicity, be regularly displaying strong behavioural oestrus, have completed uterine recovery, have passed peak milk production and finished losing BCS by the time the breeding season commences. As a result, early calving cows are likely to be submitted for AI during the first 3 weeks of the breeding season and have high fertility. The importance of ensuring that heifers calve at the start of the calving period and using replacement heifers every year to achieve improvements in calving pattern was stated above. Early calving confers equivalent advantages to mature cows. The reproductive system of most cows is fully recovered (maximum fertility) by 60 days after calving. Gaining control of your calving pattern and calving more cows early in the calving season will increase herd fertility.

Nutritional management to control BCS postpartum

A good reproductive program cannot overcome poor nutritional management on farm. Dairy cows experience a rapid increase in milk yield and a slow rise in dry matter intake (DMI) after calving. This results in a deficit in energy intake (more energy required for maintenance + milk than energy supplied from the diet) that is generally referred to as Negative Energy Balance (NEB). The cow responds to NEB by mobilising energy from fat reserves to fill the energy deficit. Cows have evolved physiological mechanisms to coordinate fat mobilization so that they remain healthy while losing weight. It is entirely normal for dairy cows to mobilise fat in early lactation. Fat mobilization becomes a problem when cows mobilise excessive amounts of fat or when the duration of fat mobilisation is prolonged. Cows that lose less BCS after calving or gain BCS after calving have better BCS at MSD and better fertility (6 week in calf rate) during the breeding season (Figure 2, left panel). Losing one-half point of BCS from calving to MSD does not affect fertility (Figure 2, right panel). Cows that lose more than one-half point of BCS from calving to MSD will have lesser 6 week in-calf rate (Figure 2, right panel).

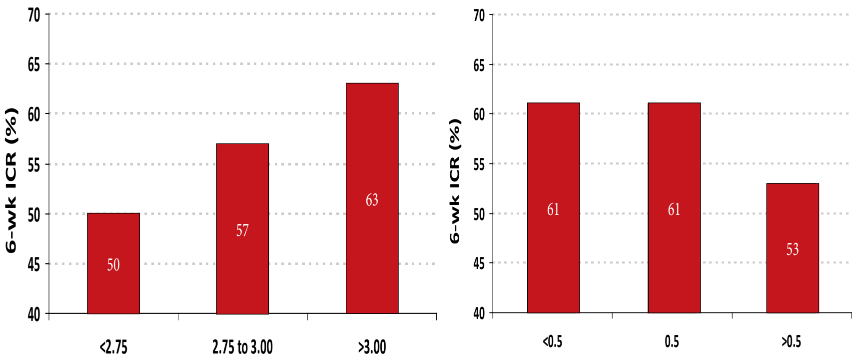

Figure 2. Body condition score and reproductive performance. *Left panel:* Association between body condition score (1 to 5 scale; 1 = very thin, 5 = very fat) during the breeding season and 6 week in-calf rate. *Right panel:* Association between body condition score change from pre-calving to start of breeding and 6 week in-calf rate (for cows with a pre-calving body condition score of >3.00).

Measuring BCS is the best way to assess the nutrition program on farm. Achieving the appropriate herd average and range in target BCS (Table 2) requires monitoring of BCS at distinct times throughout the year. Ensure that the dry cow diet is properly balanced for energy, protein and minerals, and that the amount allocated is correct for the BCS target at calving. Thin cows need to be identified before dry-off, allowing longer dry periods and preferential feeding to achieve target BCS at calving. Intervene quickly to treat any metabolic disorders that occur around calving and minimise the duration that cows have reduced intake. Supplement the grazing diet with the necessary minerals to prevent deficiencies or imbalances. Feed concentrates in early lactation to minimise the deficit in energy intake.

Table 2. Target body condition scores at key times of the year

	Herd average	Range
Drying off	3.00	2.75 to 3.25
Pre-calving	3.25	3.00 to 3.50
Start of breeding	2.90	2.75 to 3.25

Management of reproduction during the breeding period

An achievable goal is to shorten the breeding season to 12 weeks. This will require maximising both submission and conception rates through traditional means as well as adopting new technologies on farm. A workable management plan and attention to detail for all aspects of the plan are essential. Efforts will be rewarded with better herd reproductive performance during the breeding season (greater submission and conception rates) and better control of your calving pattern the following year. Key components of a management plan are:

- Treat problem cows early. Doing nothing is not a solution for problem cows. Treat problem cows (cows with any postpartum disease, late calvers, and non-cyclers based on pre-breeding heat detection) with a timed AI (TAI) program that begins approximately 10 d before MSD so that first AI is at the start of the breeding season (Figure 3). Inclusion of progesterone (CIDR or PRID) in these protocols is important and improves conception rates to TAI. Regardless of how they are bred, problem cows will have reduced conception rate. This is especially true for late-calving cows submitted to a TAI protocol. Using timed AI will ensure 100% submission rate to first AI, advance the time of second AI in cows that do not conceive to first AI and increase the total number of pregnancies.
- Improve your AI skills before the breeding season. Semen handling (thawing and loading guns) and AI technique (semen placement) are major factors affecting conception rate. If using DIY AI, take a refresher course before the breeding season. Examine reproductive records to identify farm personnel with the highest conception rates and use these people to breed all cows.
- Retrain your staff to accurately detect oestrus. Accurate oestrous detection is critical for good reproduction, whereas poor oestrous detection accuracy dramatically reduces reproductive performance. Studies show that approximately 10-20% of cows submitted for AI are actually not in oestrus. Low accuracy of oestrous detection will decrease conception rate to AI by 5 to 10%. In addition to not getting pregnant, cows inseminated at the wrong time have a delayed interval to the subsequent AI. Another negative consequence of poor oestrous detection accuracy is that the risk of pregnancy loss is increased by 8-fold for pregnant cows that are incorrectly re-inseminated. Combine heat detection aids with at least 3 periods of observation in the field to improve submission rates and heat detection accuracy.

- Monitor daily submission rates during the first 10 d of the breeding season. By day 10, 43% of the herd should be submitted for breeding. If the submission rate is markedly lower than this, consider implementing timed AI (Figure 3) to achieve 100% submission rate for your herd before d 21.
- Preg check early and treat non-pregnant cows. Consider performing pregnancy diagnosis (rectal palpation, ultrasound, milk test, or blood test) during the breeding season for all first service cows that were inseminated and did not return to service by 6 week after AI. The key to early pregnancy diagnosis is to identify non-pregnant cows early and aggressively rebreed them. Synchronize cows diagnosed not pregnant by using timed AI (Figure 3).
- Provide adequate bull power. Ensure adequate bull power during the period of natural service (1 bull per 20 cows not in-calf). Bulls should be rotated every 3 to 4 days. Remember that some natural service bulls are subfertile or infertile. Consider submitting bulls to a breeding soundness examination before using them for natural service.
- Perform a final pregnancy diagnosis and make a plan for the coming year. Pregnancy diagnosis for the whole herd should be carried out ~5 weeks after the end of the breeding season. Confirm pregnancy status for cows in calf to AI, and determine the stage of pregnancy for cows in calf to natural service. Compile expected calving dates, and use these dates to determine dry off strategy and dry cow nutritional management.

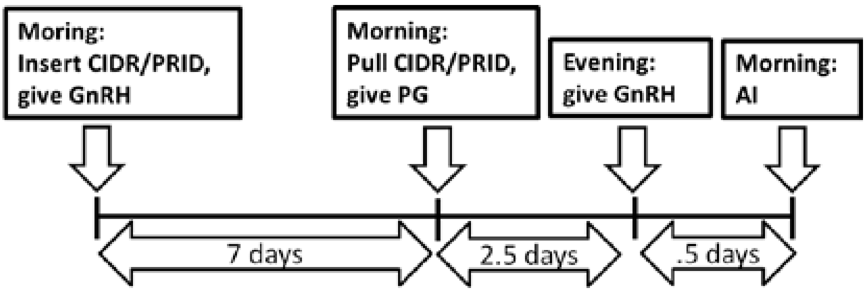

Figure 3. A simple timed AI program that can be used on dairy cows. This program is suitable for normal healthy cows at first or later services as well as "problem" cows (late calvers, anoestrous cows, etc.). *Expect slightly lower timed AI conception rates for problem cows compared with normal healthy cows.*

Conclusions

A successful reproduction program begins with committing to a management plan that is initiated long before mating start date. Reproductive performance is the key to seasonal calving systems because of its effect on calving pattern and reproductive performance in the following years. Calving pattern is a pivotal driver of farm profitability. Managing heifer reproduction is the first step to improved calving pattern. Within the cow herd, manage BCS during the dry period, early lactation and breeding period to achieve appropriate BCS at first postpartum AI. Focused periods of intensive management are required during calving, the pre-breeding period and the AI breeding period. It may be necessary to use timed AI on problem cows to ensure 100% submission rates. An achievable goal is to shorten the breeding season to 12 weeks. This will require maximising both submission and conception rates through traditional means as well as adopting new technologies on farm. The compact calving pattern that arises from a more compact breeding season is beneficial for herd management during the following spring, allows longer lactations, greater grass utilisation, and increased profitability.

Is there a role for sexed semen in seasonal-calving systems?

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Summary

- Sexed semen is normally sorted to 90% purity (i.e., 90% heifers, 10% bulls).
- Conception rates achieved with sexed semen are reduced compared with conventional semen.
- Results from a field trial conducted in Ireland in spring 2013 indicate significant improvements in the fertility of sexed semen compared with previous data.
- Conception rates improved with increased duration since calving (cows) and greater BCS (cows and heifers).
- Modelling work identified faster, more profitable expansion with sexed semen
- Other benefits of sexed semen use include increasing the beef output from the dairy herd, improved biosecurity, and reduced calving difficulty.

Introduction

With conventional semen (fresh or frozen), the likelihood of a heifer or a bull calf is roughly equal at 50%. Sexed semen (90 % X-sorted) will alter this ratio to 90% heifer calves and 10% bull calves. Sperm can be sorted because sperm containing an X-chromosome (female offspring) contain approximately 4% more DNA than sperm containing a Y-chromosome (male offspring). The sorting process distinguishes male and female sperm by measuring differences in fluorescence following staining the sperm with a non-toxic, DNA-binding dye. Relative to the number of sperm required for each AI straw, sperm sorting is slow. As a result, the number of sperm per sexed semen AI straw is lower than conventional AI straws (2 million sperm vs. 20 million sperm). Due to a combination of the lower dose and unavoidable sperm damage sustained during the sorting process, the fertility of sexed semen is reduced compared with conventional semen. Previous studies in the USA have found a reduction in conception rates using frozen sexed semen to approximately 75 to 80 % of those achieved with conventional semen. A study in NZ using fresh sexed semen indicated conception rates were approximately 94 % of those achieved with conventional semen. For example, if conception rates with conventional semen were 60%, expected conception rates with sexed semen would be 56% (fresh) and 45% (frozen).

Field trial

To date, there has been limited use of frozen-thawed sexed semen in Ireland, and fresh sexed semen has never been used. In spring 2013, a temporary sexed semen laboratory was established at Moorepark to facilitate a large field trial. The main goal was to identify the optimal strategy to employ sexed semen in Irish dairy herds. The trial compared four different types of semen (fresh conventional, frozen sexed, and two different does of fresh sexed semen) in cows and heifers as outlined in Figure 1. The lab operated 24 hours per day, 7 days a week. The Irish Cattle Breeding Federation recruited 394 herds onto the trial, and 110 AI technicians linked to the partner AI companies (Dovea Genetics, Munster AI and Progressive Genetics) carried out all the inseminations. Every day, three ejaculates were delivered to the sexed semen lab by the partner AI companies (2PM, 10PM, and 6AM). The semen from the first three bulls was dispatched on the evening of April 16th for use on dairy farms all over the country on April 17th and 18th. This daily routine continued until the required number of inseminations was achieved. In total, the dairy trial involved ~15,000 units of semen.

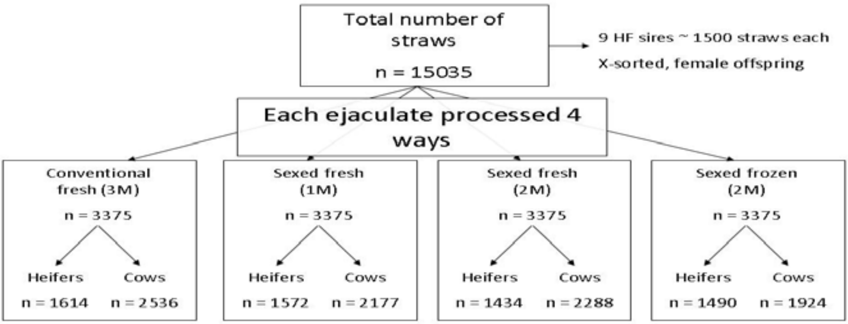

Figure 1. Experimental design of the sexed semen field trial conducted during the breeding season of 2013.

Results

The results based on ultrasound exams of 4,000 animals is summarized in Table 1. The 2013 breeding season began in the midst of a sustained fodder shortage, and cows and heifers on many farms were below target BCS and weight, resulting in poorer than normal fertility performance. This was particularly true for heifers, where conception rates with conventional semen were well behind target and only marginally better than those in lactating cows. In many ways, this provided an ideal opportunity to test sexed semen; if it could work in a difficult year, it could work in any year.

Table 1. The effect of sexing on conception rate to first service and per cent of heifer calves in both cows and heifers based on ultrasound exams of 4,000 animals			
	Conception Rate to 1st Service (%)	Conception rate as a % of Conventional	Heifer calves (%)
Treatment	**Cows**		
Conventional	49	100	54
Sexed Fresh 1m	32	64	88
Sexed Fresh 2m	37	76	94
Sexed Frozen	42	85	92
	Heifers		
Conventional	53	100	56
Sexed Fresh 1m	39	75	93
Sexed Fresh 2m	46	87	87
Sexed Frozen	46	87	90

The results suggest that the fertility performance of the frozen sexed semen is much improved compared to previous reports in the literature, and outperformed expectations. The performance of the fresh sexed semen, however, was disappointing. The results indicate that the expected 90% gender bias was achieved.

The performance of the frozen sexed semen has beneficial implications for the future use of sexed semen in Ireland. The use of frozen sexed semen (rather than fresh) relieves the logistical pressures of transporting the semen from the bull stud to the sorting laboratory, and from the sorting laboratory to the farm in a short time period throughout the breeding season. The use of frozen sexed semen will also provide greater opportunity for DIY AI farmers to utilise the technology.

Body condition score data was also collected on ~4,000 animals that were scanned as part of the trial. Figure 2 summarises the effect of body condition score on conception rate to first insemination. These results are consistent with previous research conducted by Teagasc, and demonstrate a clear link between BCS and fertility. Days in milk at insemination has also been shown to have a significant influence on fertility (Figure 3). Cows that are longer than 9 weeks calved at the time of first insemination will have a greater likelihood of conception compared to those with a shorter period from calving to first insemination.

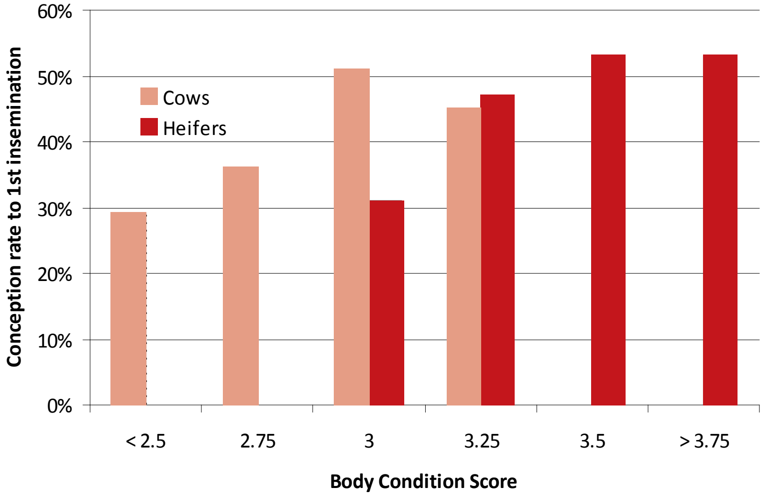

Figure 2. Effect of body condition score on conception rate in cows and heifers inseminated as part of the sexed semen field trial.

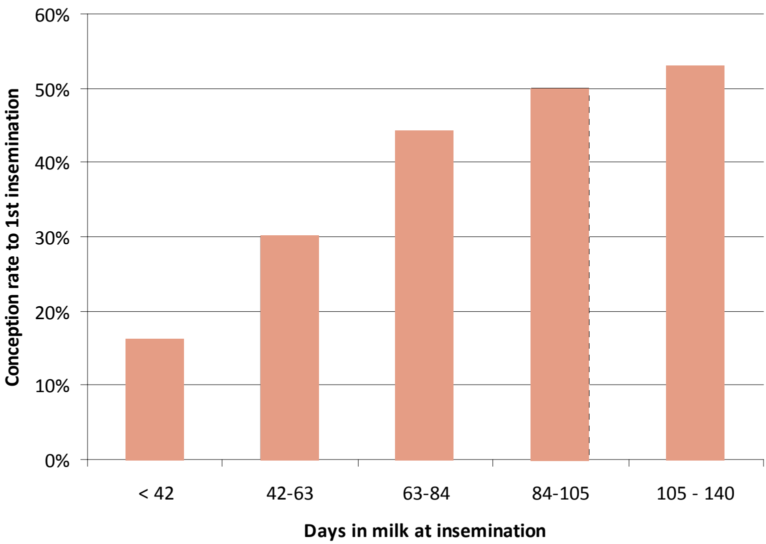

Figure 3. Effect of days in milk at insemination on conception rate in cows inseminated as part of the sexed semen field trial.

Scenarios for sexed semen use

The potential benefits to a dairy farmer and the wider industry of a sexed semen product that delivers a 90% gender bias with minimal reductions in fertility are transformative. The direct effect of increased numbers of dairy heifer calves born in a herd using sexed semen presents the farmer with a number of options. Any breeding program that incorporates significant quantities of sexed semen must take into account the reduced fertility of the sexed semen product and increased price per straw (approximately €30 premium) compared with conventional semen.

Herd expansion

The abolition of EU milk quotas in 2015, coupled with the government's target of a 50% increase in national milk production by 2020 presents a real opportunity for Irish dairy farmers to expand herd size and milk output. Sexed semen may have a key role in the expansion of the Irish dairy industry.

A model was developed to examine the effects of sexed semen use on rate of herd expansion and farm profitability in Irish dairy production systems. Expansion from a herd size of 100 to 300 cows was modelled over a 15 year simulation period, using either conventional or frozen-thawed sexed semen in virgin heifers for the first AI and in lactating cows for the first 3-wk of the breeding season.

Using the preliminary results generated from the field trial, conception rates with frozen sexed semen were set at 87% of those achieved with conventional semen. Sexed semen use generated greater numbers of replacement heifers, and facilitated faster herd expansion (Figure 4). The faster herd expansion facilitated by sexed semen use resulted in greater levels of farm profitability over the 15-yr simulation period.

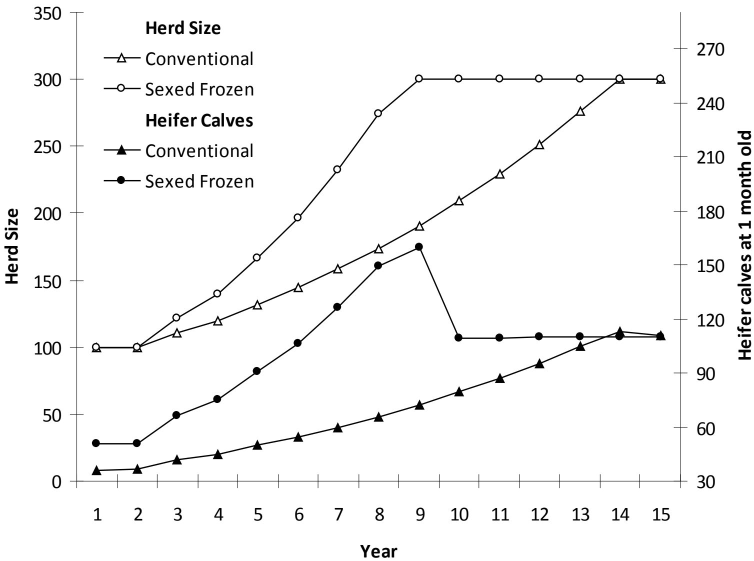

Figure 4. Herd size and number of heifer calves born in the first 6 week of the calving period surviving to 1 month of age in herds using sexed frozen-thawed semen or conventional frozen-thawed semen in both virgin heifers (for the 1st AI) and lactating cows (for the 1st 3-week of the breeding season).

Beef production from the dairy herd

In non-expanding herds, the use of sexed semen enables the number of replacement heifers required to maintain herd size to be produced from a smaller proportion of the herd. This provides dairy farmers with the opportunity to increase revenues from the sale of calves for meat production, by breeding the remainder of the herd with semen from beef sires (short gestation, easy-calving). Current calf prices from dairy cattle suggest a premium of approximately €150 - €200 for a beef sired calf compared with a male dairy calf. The current price differential between male and female beef calves from the dairy herd does not support the use of Y-sorted (male offspring) beef semen in dairy cattle.

Heifer rearing

In order to obtain maximum lifetime milk production, all replacement heifers should be first bred at approximately 15 months of age (to calve at approximately 24 months of age). An efficient heifer rearing system is essential to meet these targets and ensure that replacement heifers optimise their potential as lactating animals. Larger, well grown heifers have greater pubertal rates at mating start date (MSD), and are more profitable over their lifetime due to superior milk production. The use of sexed semen to produce all replacement heifers in a short period at the start of the breeding season may have a significant impact on the rearing management of these heifers. These heifer calves will be closely grouped in terms of age, and should be easier to manage as one group to meet the optimal target of 60 % of mature body weight at MSD.

Further benefits of sexed semen use

Use of sexed semen may also reduce the incidence of calving difficulty (heifer calves are lighter than male calves), and improve biosecurity by allowing farmers to increase herd size while maintaining a closed herd.

A common reason for farmers not wishing to use Jersey sires in dairy cross-breeding programs is the low value of the Jersey crossbred bull calf. Using sexed semen from Jersey bulls to generate predominantly heifer calves would eliminate this problem, increasing the attractiveness of cross-breeding programs for a greater number of Irish dairy farmers.

Conclusions

The large scale field study conducted in 2013 indicates significant improvements in the fertility of frozen sexed semen compared with previous reports, although the performance of fresh sexed semen was disappointing. Further work is required to determine the optimum conditions under which sexed semen should be used to maximise fertility performance. The use of sexed semen in Irish dairy herds has the potential to improve profitability on Irish dairy farms and add significant value to the wider agri-food industry.

Acknowledgements

The 2013 sexed semen field trial was a collaborative venture between Teagasc, ICBF, Sexing Technologies, Dovea Genetics, Munster AI, Progessive Genetics and NCBC. Financial support from ABP, Dawn Meats, Kepak, Slaney and the Agricultural Trust are gratefully acknowledged.

The Next Generation Herd – Year 1 results

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Summary

- The establishment of a Next Generation Herd represents a futuristic national herd. This is a strategically important resource, providing a "forward view" of the implications of high EBI herds under varying grazing intensities
- Initial results are very promising, and indicate that the EBI is working to identify more profitable dairy genetics. The importance of profitable genetics will be increased post-quota removal in 2015.

Introduction

The *Next Generation Herd* was assembled during 2012. In-calf heifers, maiden heifers and heifer calves were sourced from both commercial dairy herds and Teagasc dairy herds. Strategically, the Next Generation Herd is viewed as a very important genetic resource, providing a "forward view" of the implications of our national breeding programme; it will provide clear and precise indications of the compatibility of the EBI with future management conditions. It also provides a potential nucleus to supply genomically selected young bulls into the national breeding programme. The herd is situated at the Dairygold Research Farm in Kilworth.

For the purpose of comparison, the herd contains two distinct genetic groups. Each year there will be 90 ELITE (extremely high EBI; €246) and 45 CONTROL (national average EBI; €120) lactating cows (i.e., two thirds ELITE cows, one third CONTROL cows). To avoid confounding between EBI effects and the effects of hybrid vigour or the effects of specific sire lines, all heifers are Holstein-Friesian and genetic diversity (sire lines) has been maximised. Of the 90 ELITE heifers on trial, 40 sires, 83 grandsires and 27 maternal-grandsires are represented. The ELITE cows have an average EBI of €246, and are well inside the top 1% in the country on EBI. Prominent sires represented within the ELITE herd include SOK, IRP, HZS, BHZ and WGM. The CONTROL group have an average EBI of €120, in line with the average of heifers born in 2011. Commonly used sires within the CONTROL group include UPH, RXR, BYJ and WMZ. ELITE heifers purchased as weanlings in late 2012 have a current average EBI of €252. This is considerably higher than the average EBI of dairy females born in 2012 of €128. Table 1 provides a summary of the genetic merit for both genetic lines in the *Next Generation Herd*.

Before purchase, all heifers were subjected to rigorous health screening. The priority was to assemble a minimal disease herd that were free of the common infectious diseases: IBR, BVD, Salmonella, Neospora, Johnes disease and Leptospirosis. Best practices pertaining to disease screening, bio-containment and bio-security have been implemented on the farm.

Table 1. Summary statistics of the Next Generation Herd

		Sub-Indices (€)						
Genotype	EBI (€)	Milk	Fertility	Calving	Beef	Maint.	Health	Manage.
ELITE	246	60	145	37	-13	16	-1	3
CONTROL	120	37	62	26	-9	4	0	1

	Milk kg	Fat kg	Prot kg	Calv Int	Survival
ELITE	+46	+11	+8	-8	+4
CONTROL	+105	+7	+6	-4	+1

The two genetic lines are managed on one of three seasonal pasture based systems. The three management systems are: (1) intensive grazing with post-grazing residuals of 4 to 4.5cm; (2) high stocking rate with tight grazing residuals of 3.5cm; and (3) high stocking rate with post-grazing residuals of 4 to 4.5cm, with extra feed in the form of concentrates offered throughout lactation (average +4 kg/day). The objective of comparing three different management systems is to determine the relative performance of both sets of animals at varying levels of feed availability and dietary energy density.

Performance Year 1

The entire herd comprised first lactation animals. Mean calving date in year one of the study (first lactation) was February 12. The relative production performance was very much in line with the trends expected from their relative breeding values for production. The ELITE heifers had a lower milk volume (-173 kg) but substantially higher milk composition (+0.26 fat % and +0.17 protein %). The net effect was 6 kg more milk solids yield (fat plus protein) from the ELITE heifers; 345 kg for the ELITE vs 339 kg for the CONTROL). Ability to respond to concentrate supplementation would appear similar for both genetic groups. Udder health was satisfactory during the first lactation. Somatic cell count averaged 130,000 cells/ml during the year. During the full lactation, 4% of the ELITE herd (4 cows) and 7% of the CONTROL herd (3 cows) were treated for clinical mastitis lactation. A further 12% of the ELITE herd (11 cows) and 11% of the CONTROL herd (5 cows) were treated for elevated somatic cell count (somatic cell count >500,000 cells/ml on an individual milk sample indicating sub-clinical mastitis). On average, over lactation the CONTROL heifers were slightly heavier (additional 5 to 10 kg) but had lower body condition score. The difference in condition score throughout lactation was approximately 0.15 body condition score units greater in the ELITE cows.

The most encouraging finding from the first year's results was the fact that a large difference in fertility performance became apparent from early in the breeding season. With the exception of in-calf rate at the end of the 12 week breeding season, the various measures of fertility recorded were on or close to target values for the ELITE cows. Submission rate in the first 3 weeks and six week in-calf rate averaged 89% and 71% for the ELITE, and 82% and 61% for the CONTROL cows, respectively. Final in-calf rates were 85% and 77%, respectively. These final in-calf rate results were disappointing given the excellent start and mid-point values.

Although individual animal intake measurements were not conducted during year 1 of the study, pasture measurement results suggest that daily feed intake was similar for both genetic groups. This would suggest a slightly better energy balance status for the ELITE heifers, which would concur with the greater body condition score. More detailed measurements will take place in 2014 and the following years to confirm this finding.

Fertility management will be altered for 2014 to increase the likelihood of attaining target in-calf rates. Artificial insemination will be conducted for 6 weeks and thereafter a team of easy calving Angus bulls will be used to 'mop up'. Treatment groups are small (as low as 15 cows per group) on the study. This has negative implications for oestrus activity, particularly later in the breeding season. Consequently accuracy of heat detection at this time is comprimised. It is anticipated that the introduction of natural service sires at this point in the season will positively impact on in-calf rates. The natural service sires have been purchased from a reputable Angus breeder. They have been health screened to ensure they are of a similar high health status to the cow herd at Dairygold farm and they have been vaccinated against IBR, BVD and Leptospirosis in accordance with recommended best practice. They also have been fertility tested.

Conclusions

The Next Generation Herd is a fundamental industry good research project that will provide clear and precise indications of the compatibility of the EBI with future management conditions. The preliminary results are very positive for the Irish dairy industry, indicating that the EBI is working to identify more fit for purpose, profitable dairy genetics. Post quota removal, Irish dairy farmers must focus on continuing the genetic progress that has been made to date. This will facilitate improved herd fertility performance and greater cow longevity, thereby maximising profitability from a seasonal grass-based system.

Combining automatic milking with grazing

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Summary

- Automatic milking (AM) has been adopted at an accelerating rate in Europe, but cow grazing systems have not yet been well adapted to AM
- Successful integration of AM into a grass based milk production system was achieved in this study; however, adoption of the technology at farm level will depend on the economic viability.
- A preliminary study has showed that at the end of lactation it is possible to reduce the milking frequency (MF) from 2.0 to 1.5 milkings/day without reducing milk production. This has the potential to increase overall milk output from an AM system as a higher cow number could be maintained on the AM unit when accompanied by reduced MF.
- Potential advantages of AM systems include reduced labour input, more time available for management as opposed to manual labour and the ability to expand cow numbers on fragmented land bases. Increased data collection by the AM system at each cow milking could also facilitate greater precision in animal management.

Introduction

During the last several decades, new milking management systems have been introduced, amongst which the development of AM systems is a significant step forward. AM has become an established management system, and is recognised as an alternative to conventional manual milking methods, particularly in Western Europe (Jago, 2011). Uptake of AM systems is increasing, and it is envisaged that up to 20% of cows in Europe will be milked automatically by 2020. Indoor feeding systems have been well adapted to AM; however, grazing systems have not. This is leading to a decrease in grazing on farms with AM (Van den Pol-van Dasselaar *et al.*, 2011). This is undesirable since grass-based systems of animal production have a positive impact on milk quality, reduce the environmental footprint associated with milk production and increase animal welfare standards.

In a production system where grazing constitutes a significant proportion of the cow diet, such as in Ireland, grass has to be the main motivator for cows to move voluntarily from the field to the AM installation. Thus, new grazing technologies are needed to optimize integration of AM and grazing. The combination of AM and grazing has potential beneficial effects on labour, utilisation of cheaper feed (grazed grass) and milk quality. This system also offers possibilities for precision management of individual cows in a herd, freeing up of labour and allowing the cow greater control of her activities.

The objective of this study was to determine the feasibility of integrating AM with cow grazing.

Farm system description

A milk production system trial was established at Teagasc, Moorepark. The farm-let associated with the AM system consisted of a 24 ha milking platform. During 2013, 70 cows were milked in the system with a mean calving date of 19th February (range 2nd February-15th March). This herd comprised Holstein Friesian, Jersey Holstein cross and Norwegian Red cross cows. The land area was divided into 3 grazing sections of 8 ha each (A, B, C) which were further divided into 1 ha paddocks. Water was located at the dairy. Maximum distance to the furthest paddock was ~750m. The dairy featured one Merlin AMS unit (supplied by Fullwood for research) installed adjacent to the existing shed. The infrastructure incorporated a pre-milking waiting area and a post-milking area. There were two selection gates, one positioned at the entrance to the dairy that drafted cows to the pre- or post-milking area depending on readiness for milking and a second positioned at the dairy exit which drafted cows to the grazing areas (Section A, B or C). Automatic milk diversion (colostrum, antibiotic) was included and extensive milking and cow information was recorded at each milking (e.g. milk yield, milking time, conductivity [an indicator of SCC], concentrate dispensed).

Grassland management

Daily grass allocation was used to dictate the optimal frequency of cow visits to the AMS unit (to avoid overly frequent or infrequent visits). Cows grazed defined areas or portions of each of the 3 grazing sections during each 24 h period (Figure 1). Cows were allocated 5 to 6 kg DM in each of the 3 grazing sections (A, B and C) over each 24 h period. Cows moved between the grazing Sections A, B and C at 12:30 am, 9:30 am and 4:30 pm, respectively. During the May/ June period cows went into grazing areas with grass covers of 1400-1500 kg DM/ha. Pasture mass was estimated twice weekly. Grass covers greater than 1500 kg DM/ha may discourage cow movement to the AM unit and may reduce MF. Cows grazed to a post-grazing height of 3.5-4.0 cm. All cows received approximately 1 kg supplementary concentrate feed per day during the main grazing season.

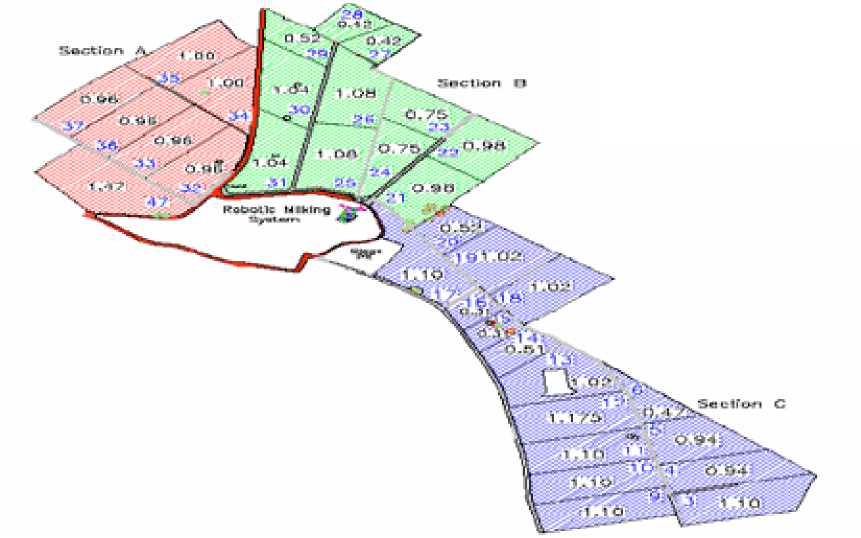

Figure 1. Map of AM farm incorporating sections A, B and C

Results

An average milk yield of 4,222 litres and milk solids yield of 369 kg per cow was achieved during the 2013 lactation, which is comparable with a large proportion of Irish dairy farms. Total milk volume and milk solids produced by the AM unit was 295,540 litres and 25,830 kg, respectively. The average number of milkings per day was 104, ranging from 66 to 128 per day in the March to August period. The average number of milkings/cow per day was 1.8, ranging from 1.6 to 2.1 (the complete 70 cow herd was not in place until May; 31 and 47 cows were milking in March and April, respectively). An average milk somatic cell count of 152,000 cells/ml was observed, while average total bacterial counts were at 10,000 cells/ml in the same time frame.

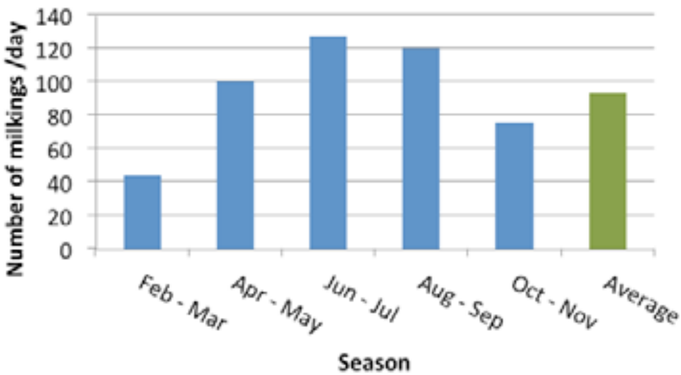

Figure 2. Average number of milkings over a 24 h period

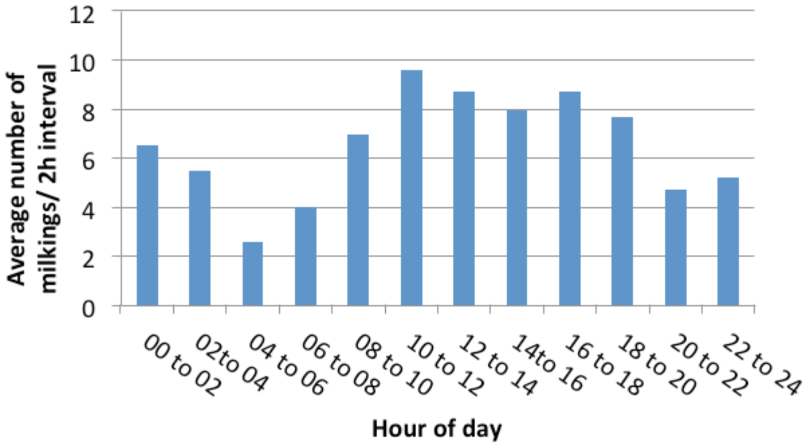

Figure 3. Average distribution of milkings over a 24 h period during the main grazing season

Discussion

The results obtained in this study are in agreement with those conducted in New Zealand in previous years, that AM can be successfully incorporated into pasture based milk production systems with moderate levels of supplementary feed (Woolford *et al*., 2004). The practical challenges to integrating AM and cow grazing include initiating cow movement to visit the AM unit, queuing of cows for milking, achieving high utilization of the AM unit and managing a seasonal calving pattern involving a peak milk yield period. Overall, the integrated AM and grazing system operated satisfactorily. The cows adapted relatively quickly to the system (within approximately 4 days). Milk output was negatively influenced in the first complete lactation for cows on the AM system, but this is considered normal; cow milk yield is expected to be reduced by 10-15% during the first lactation on AM (Wade *et al*., 2004). The grass allocation was critical to optimising cow visits to the AM unit. If automatic milking is to be considered a viable alternative to conventional milking in a grass based system, it has to operate with similar cow nutritional management focused on utilization of grazed grass. Factors such as daily milk yield, milk quality, feeding, cow traffic, grazing, and animal behaviour are essential elements of AM and grazing.

Irish dairy systems normally use high levels of grazed pasture and have seasonal milk production profiles. However, robotic milking systems are capital intensive, and up to now have been considered best suited to year-round milk supply due to the fixed capacity of the technology. Combining AM and a grazing system is possible, however, as long as the distance from the milking parlour to the pasture is reasonably short (Svennersten-Sjaunja and Pettersson, 2008). With proper management routines, it should be possible to achieve milk production levels and animal well-being with AM systems that are at least as good as conventional milking systems.

Preliminary study to optimize cow milking frequency

Introduction

The main objective of this study was to investigate the effect of MF on milk production characteristics and cow traffic. In a grass-based system it is important to focus on the total output of the AM system rather than the output per cow. Thus, a trial was designed to answer the following research question: will milking fewer cows with a relatively high MF and higher daily milk yield result in a more profitable system than milking a greater number of cows with a relatively low MF and lower daily milk yield?

Study details

A preliminary trial was carried out in autumn 2013 (September 1 to 20). Cows were randomised into two groups of 35 cows each and two MF treatments (approximately 1.5 and 2.0 milkings per day). This was achieved by allowing cows to be milked if their predicted milk yield (at the time of the cow visit to the AM unit) was >50% and >33% of their daily yield (averaged over the previous 10 days) for cows allocated to the 1.5 and 2.0 MF treatments, respectively.

Results

Although these milking frequencies were significantly different (1.4 and 1.9 times per day), the milk yield per day (13.4 and 13.7 kg/cow/day, respectively) was not significantly different between groups (Table 1). While concentrate feed allowance was similar, actual concentrate feed intake was higher with the 2 times/day milking group, as the cow was exposed to a greater number of feed allocations due to the increased MF of that group. While the number of times the cows in both groups returned to the AM unit per day was similar, and the waiting time was similar for both groups, the milking interval was longer by ~2.5 hours for the less frequently milked cows.

Table 1. Characteristics of low (Group 1) or high (Group 2) milking frequency treatments

	Group 1	Group 2	P-Value
Milking Frequency (times per day)	1.4	1.9	<0.001
Milk yield per cow (kg/day)	13.4	13.7	0.95
Conc feed allowance (kg/day)	3	3	0.99
Actual conc feed intake (kg/day)	2.3	2.7	<0.001
Number of returns per cow per day	2.8	3.0	0.20
Average return interval per visit (hh:mm)	06:07	05:45	0.14
Average wait time per visit (hh:mm)	01:24	01:16	0.61
Average milking interval (hh:mm)	14:29	11:52	<0.001

Implications

In the later stages of lactation, it is possible to reduce the MF of cows on an automated milking system without compromising milking characteristics of the herd, reducing milk production or affecting voluntary cow traffic performance. There is potential to obtain greater milk production output from AMS with lower MF as an increased cow:AMS ratio could be maintained. This was a preliminary study, however, a similar study over the full lactation is being conducted during 2014. This is necessary because it is a key question for grass based systems: is the AMS output the correct production focus for grass based systems?

Conclusion

Successful integration of AM into a grass based milk production system was achieved in this study; however the economic viability of AM will determine how widely the technology will be adopted. A major challenge with automatic milking currently is the high capital cost but the concept of combining automatic milking and cow grazing has potential advantages which could have a positive impact on the dairy industry in the long term. These include reduced labour input, more time available for herd management as opposed to manual labour, ability to expand cow numbers on fragmented land bases and increased availability of cow performance data to use as a management tool. However, further research needs to be conducted to establish if the concept presents a realistic alternative to conventional milking systems on dairy farms.

Next steps in AM research

The fact that cow grazing systems have not been well adapted to AM to date has led to a decrease in grazing on farms with AM across Europe (Van den Pol-van Dasselaar *et al.*, 2011). This is an undesirable trend since grass-based systems of animal production are becoming increasingly competitive. Allied to this is the positive impact on milk quality and reduced environmental footprint associated with increased quantities of grazed grass in the diet as well as increased animal welfare standards.

Thus, the desire to research the integration of AM and cow grazing both in Ireland and other EU countries has led to a current three-year FP7 funded EU project (coordinated by Ireland) (AUTOGRASSMILK), which commenced in January, 2013 (webpage http://www.autograssmilk.eu). The Irish Grassland Association support this project and are consortium partners within it. Planned outputs include: protocols for optimum feeding strategies; pasture management tools; a sustainability assessment tool; and a web-based decision support tool to optimise economic efficiency of AM in grazing scenarios.

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Appendix 1. Cows with their EBI details

Control Cows																	
Cow	Animal Number	Lact	Sire	EBI	Milk	Fert	Calv	Beef	Maint	Mmgt	Health	Milk Kg	FatKg	Prot - Kg	Fat %	Prot %	Calv Int	Surv %
1441	IE141859911441	2	RXR	132	47	49	29	-12	11	1	7	153	8.4	7.9	0.05	0.05	-2.6	1.4
1444	IE141859941444	2	RXR	150	38	87	33	-3	-5	-2	1	284	11.4	7.8	0.01	-0.03	-6.2	0.8
1570	IE351148230570	2	BYJ	125	50	54	22	-9	6	3	-2	163	12.8	7.8	0.12	0.05	-3.3	1.1
8003	IE151535370509	1	OMS	139*	48	63	25	-5	5	4	0	254	12.7	8.7	0.06	0.01	-4.4	0.6
8019	IE241357690853	1	WMZ	128*	27	64	33	-13	12	3	2	202	5	6.1	-0.05	-0.01	-4.4	0.8
8025	IE211372060869	1	GMI	152*	49	78	17	-4	3	7	3	295	6	10.4	-0.09	0.01	-3.8	2.6
8026	IE182148110870	2	RXR	138*	44	71	25	-7	2	2	1	312	7.2	9.7	-0.08	-0.01	-5	0.8
8028	IE241357660883	2	WMZ	139*	60	61	37	2	-14	-6	-2	228	11.9	10.3	0.06	0.05	-5	-0.1
8031	IE182148160891	2	BYJ	131*	33	68	25	-6	8	2	2	144	9.2	5.5	0.07	0.01	-4.6	0.9
8032	IE351158020892	2	UKJ	127*	22	69	25	-17	23	2	4	48	-0.1	3.9	-0.04	0.05	-3.9	1.7
8039	IE341255120963	2	UPH	127*	48	62	28	-16	0	-3	9	-117	6.9	4.5	0.22	0.17	-4.5	0.5
8040	IE341255150966	2	UPH	132*	60	61	24	-14	11	-6	-3	-98	8.6	6.3	0.24	0.19	-2.8	2.2
8074	IE241425321340	2	MZY	169*	54	92	38	-16	17	0	-15	129	9.9	8.3	0.1	0.08	-5.2	2.3
8076	IE151753121361	2	BYJ	122*	62	41	18	-6	0	0	7	358	12.9	12.2	-0.01	0.01	-1.3	2.1
8077	IE151753161365	1	RXR	138*	47	72	15	-1	-1	6	0	244	11.2	8.7	0.04	0.01	-5.4	0.5
8078	IE151753191368	1	CGH	111*	40	49	23	1	-2	0	-1	239	11.4	7.5	0.04	-0.01	-1.1	3
8095	IE241425361492	2	MZY	115*	34	59	22	-13	14	3	-3	-108	8.8	2.3	0.25	0.12	-3.3	1.4
8097	IE241425381569	2	BHZ	146*	43	94	20	-11	11	0	-10	-5	5.4	5.6	0.11	0.11	-5.6	2.1
8099	IE241425321605	2	SJI	110*	51	37	25	-10	4	3	1	86	10.9	7.1	0.14	0.08	-0.9	2.1
8138	IE341255120930	2	UPH	138*	55	66	31	-4	-12	1	2	101	13.2	7.5	0.18	0.08	-3.7	1.7
8227	IE191946061227	2	LYF	141*	35	79	24	-16	12	4	4	301	6.7	8.2	-0.09	-0.03	-4.9	1.5
8252	IE191946071252	2	LYF	115*	44	46	28	-14	12	-3	1	183	6.9	8	0	0.04	-2.7	1.1
8278	IE241152361278	1	MZY	136*	36	74	25	-8	17	4	-12	34	8.5	4.6	0.14	0.07	-4	2.1
8329	IE241152371329	2	DXM	118*	7	91	18	-17	23	-4	0	-144	3.5	-1.5	0.18	0.07	-6.6	0.8
8382	IE151758971382	2	UPH	133*	63	56	19	-10	7	-3	0	182	17.9	9.2	0.21	0.06	-2.4	2.3
8424	IE151758971424	1	KOZ	157*	53	74	26	-15	15	3	1	141	8.6	8.5	0.06	0.07	-4.3	1.7
8517	IE151586861932	1	GVV	130*	50	44	31	-5	13	1	-4	175	9.1	8.6	0.04	0.06	-2.2	1.4
8527	IE151604991027	1	SOK	114*	50	34	38	-6	0	5	-6	107	6	8.1	0.03	0.09	-2	0.7
8528	IE151586871925	1	SOK	115*	56	32	26	-11	8	5	-1	170	8.7	9.4	0.04	0.07	-2.8	-0.2
8530	IE151586821953	1	GMZ	121*	40	63	28	-6	-6	4	-2	90	3.4	6.7	0	0.08	-4.2	0.9
8531	IE151586812001	1	GMZ	117*	37	77	21	-11	-1	-3	-3	137	6.6	6.4	0.02	0.04	-5.7	0.6
8532	IE151586882016	1	HZC	151*	42	79	30	-15	20	3	-7	-89	13.8	2.9	0.33	0.12	-4.4	2.1
8533	IE151586832028	1	HZC	140*	46	64	31	-18	15	3	-1	158	9.6	7.6	0.06	0.05	-2.6	2.7
8534	IE151753131503	1	GMZ	104*	44	49	24	-8	-10	5	0	234	8.8	8.5	0	0.02	-3	1
8535	IE151753121460	0	BYJ	118*	28	52	43	-9	2	2	-1	87	9.6	3.9	0.12	0.03	-3.3	0.9
8538	IE151753161480	0	GMZ	137*	47	62	27	-7	-1	5	4	25	3.9	6.8	0.05	0.12	-4.1	0.9
8539	IE151753191475	1	ROF	130*	52	50	16	0	3	1	8	122	3.7	8.9	-0.02	0.1	-2.8	1.2
8540	IE151753161448	1	GMZ	146*	64	73	16	-16	6	4	0	256	6	12.2	-0.07	0.07	-5.4	0.5
8541	IE151753141479	1	GMZ	103*	59	22	32	-8	-5	3	0	335	8.3	12.1	-0.08	0.02	-1.7	0.1
8542	IE151753151513	1	GMZ	130*	69	43	25	-14	6	2	-2	292	6.6	13.4	-0.08	0.07	-2.8	0.7
8543	IE151753191491	1	GMZ	173*	65	72	38	-6	-8	5	6	342	7.4	13.3	-0.1	0.04	-4.1	1.7
8625	IE351238142758	2	ORL	118*	48	50	32	-7	-9	0	4	91	7.4	7.3	0.07	0.08	-4.8	-0.8
8626	IE351238162776	1	RXR	138*	71	66	22	3	-21	-3	0	236	8.5	12.6	-0.01	0.09	-5.1	0.2
8628	IE151940210001	1	IE151604920798	121*	15	93	15	2	3	-6	0	-2	3.6	1.7	0.07	0.04	-5.2	2.4
8631	IE351238192754	2	MJI	145*	41	72	36	1	-10	2	3	212	13	7	0.09	0	-4.6	1.2
8637	IE351238192746	2	RXR	170*	67	84	30	-6	-4	1	-2	521	14.9	14.8	-0.08	-0.04	-5.2	1.6
8674	IE351238152833	1	WMZ	157*	25	100	28	1	-8	4	8	236	4.2	6.3	-0.09	-0.03	-6.2	1.9
8859	IE151604950859	2	SOK	120*	48	39	36	-4	-1	3	-1	248	8.5	9.3	-0.02	0.02	-2.2	1

Elite Cows

Cow	Animal Number	Lact	Sire	EBI	Milk	Fert	Calv	Beef	Maint	Mmgt	Health	Milk Kg	FatKg	Prot - Kg	Fat %	Prot %	Calv Int	Surv %
Jumbo	Animal Number	Lact	Sire	EBI	Milk	Fert	Calv	Beef	Maint	Mmgt	Health	MilkKg	FatKg	ProtKg	Fat%	Prot%	Calv Int	Surv%
1201	IE211169771201	2	LLK	265*	26	194	40	-6	11	-6	6	-40	12.3	1.5	0.27	0.05	-10.9	4.9
1220	IE241195611220	1	WGM	288*	101	155	38	-25	26	3	-9	141	22.2	13.6	0.32	0.17	-8	4.6
1390	IE191574491390	2	IRP	280*	66	173	29	-21	27	7	-1	21	12.9	8.2	0.23	0.14	-10	4.1
1442	IE331097831442	2	DVX	270*	55	171	37	-21	29	1	-1	-3	8.5	6.9	0.17	0.14	-9.6	4.3
1445	IE141859951445	1	RXR	184*	76	73	32	0	3	-1	1	297	11.6	13.6	0.01	0.07	-4.2	1.7
1487	IE151235371487	2	WDS	324*	103	167	44	-27	35	6	-3	324	19.3	16.9	0.13	0.11	-8.5	5.1
1764	IE151581581764	2	SOK	241*	54	147	31	-8	8	8	2	317	8.2	11.1	-0.07	0.01	-8.7	3.3
2081	IE141582082081	2	IRP	256*	87	135	33	-11	7	6	0	326	14.9	15.3	0.05	0.08	-7.9	3
2084	IE141582022084	2	OJI	242*	79	120	36	-2	3	3	2	408	13.5	15.4	-0.03	0.03	-6.2	3.6
2120	IE141582052120	2	OJI	305*	95	167	31	8	-9	4	9	346	16.1	16.5	0.05	0.09	-9.1	4.5
2133	IE151028192133	2	HZS	237*	52	142	43	-5	8	3	-7	187	11	8.6	0.07	0.05	-8.2	3.4
2193	IE151028132193	2	WNE	267*	125	96	39	-7	16	5	-8	136	21	17.4	0.3	0.24	-4.8	3
3080	IE151620933080	2	WGM	231*	84	116	35	-27	31	0	-7	135	15.5	12	0.2	0.14	-5.9	3.6
3086	IE151620993086	1	WGM	260*	80	147	30	-27	26	3	1	182	12.6	12.5	0.11	0.12	-8.1	3.8
6216	IE151549256216	2	SOK	200*	63	105	33	-16	7	7	0	63	12.5	8.4	0.19	0.12	-5.9	2.7
6217	IE151549266217	2	HZS	199*	79	84	37	-3	14	0	-11	196	18.6	11.6	0.21	0.1	-3.8	3
6249	IE151549256249	2	SOK	220*	68	98	38	-13	18	6	4	96	10.6	10	0.13	0.13	-5.6	2.4
6259	IE151549276259	1	SOK	226*	52	133	43	-6	-4	5	4	0	12.2	5.9	0.24	0.12	-7.4	3.4
6260	IE151549296260	2	HZS	237*	73	137	26	-2	7	2	-5	-94	10.9	8	0.28	0.22	-7.3	3.8
6269	IE151549296269	2	MWH	211*	72	86	43	-14	23	2	-1	188	16	10.8	0.17	0.09	-4.2	2.9
6338	IE151549236338	1	HRJ	242*	50	173	27	3	-14	1	3	116	7.1	7.9	0.05	0.08	-8.6	5.5
6376	IE151549296376	2	MWH	200*	67	107	27	-14	12	1	2	201	13.8	10.6	0.12	0.07	-5.3	3.4
6401	IE151549296401	1	WGM	244*	97	112	34	-14	17	1	-2	93	18.9	12.8	0.29	0.19	-5.7	3.5
6704	IE151549266704	1	SOK	224*	34	144	44	-9	8	6	-3	0	7.2	4	0.14	0.08	-8.5	3.2
6715	IE151549296715	2	SOK	245*	75	123	36	-12	8	9	6	14	15	9.1	0.28	0.17	-6.6	3.4
6723	IE151549296723	2	HZS	239*	79	135	29	-13	19	1	-10	61	9.7	11.1	0.14	0.17	-7.5	3.5
6739	IE151549286739	1	HZS	216*	61	122	39	-19	22	1	-10	-16	11.1	7.3	0.23	0.15	-6.6	3.3
6753	IE151549266753	2	MWH	248*	48	159	38	-18	20	4	-3	-6	8.4	5.8	0.17	0.12	-8.9	4
6763	IE151549286763	1	HZO	231*	74	115	26	-20	24	6	7	168	12.9	11.4	0.12	0.11	-6.3	3.1
6800	IE151549236800	2	CWJ	311*	90	168	41	-14	26	3	-2	197	16.3	13.6	0.16	0.13	-9.7	4
6902	IE151549266902	1	WGM	241*	90	110	44	-21	26	0	-8	48	19.8	11.1	0.34	0.19	-5.6	3.4
6925	IE151549246925	0	MJI	253*	64	134	53	-9	5	1	5	57	14	8.2	0.22	0.12	-7.2	3.6
7009	IE151549267009	1	DVJ	248*	91	112	29	-14	23	4	2	124	22.3	11.9	0.33	0.15	-6.3	2.8
7029	IE151549217029	1	MJI	226*	66	115	48	-2	1	-4	3	67	9.4	9.3	0.13	0.14	-6.3	3.1
7144	IE151549217144	1	MWH	285*	72	166	49	-16	22	2	-9	-51	12	8.3	0.27	0.2	-8.3	5.2
7161	IE151549227161	1	CBH	192*	63	92	38	-20	25	-6	-1	-126	10.6	6.2	0.3	0.21	-5.5	2
7163	IE151549247163	1	CWJ	239*	66	140	37	-21	29	-1	-10	-38	7.5	8.2	0.17	0.19	-7.9	3.5
7184	IE151549297184	1	MWH	251*	48	156	47	-28	31	1	-4	-43	6.7	5.6	0.16	0.14	-7.9	4.8
7204	IE151549237204	0	HZS	269*	91	137	42	-11	15	2	-6	59	15.1	12.1	0.24	0.2	-6.1	5.1
7214	IE151549257214	1	CWJ	252*	92	121	37	-17	24	1	-7	77	15.4	12.5	0.23	0.19	-6.4	3.5

Cow	Animal Number	Lact	Sire	EBI	Milk	Fert	Calv	Beef	Maint	Mmgt	Health	Milk Kg	FatKg	Prot - Kg	Fat %	Prot %	Calv Int	Surv %
7245	IE151549237245	0	HZS	211*	67	116	31	-13	11	6	-6	-111	8.9	7.2	0.25	0.22	-6.1	3.3
7288	IE151549257288	1	MJI	309*	65	192	36	-10	21	2	5	148	16.8	9.2	0.21	0.08	-9.5	6.1
8000	IE241917950022	2	IRP	225*	70	122	27	-11	15	5	-1	196	11.2	11.4	0.07	0.09	-6.8	3.2
8001	IE141608120420	2	OOK	241*	60	129	43	0	1	2	7	310	9	11.8	-0.05	0.03	-7	3.5
8002	IE151535330496	2	GIO	257*	52	160	38	-9	11	-3	8	58	6.3	7.6	0.08	0.11	-8.2	4.8
8005	IE131500820597	2	BYJ	237*	54	147	38	-8	3	1	2	-155	11.7	4.2	0.35	0.18	-9.8	2.1
8007	IE191188650634	2	LHZ	292*	79	166	33	-17	24	6	2	178	8.1	13	0.03	0.13	-8.6	4.9
8008	IE211355980644	2	GIO	214*	49	125	41	-4	12	-3	-5	204	5.7	9.3	-0.04	0.05	-6.6	3.5
8009	IE221270390690	2	OTH	277*	48	183	42	-7	0	3	9	23	8.2	6.3	0.14	0.11	-9.9	5
8011	IE211337430733	2	SOK	307*	59	218	31	-5	-5	5	4	-188	8.9	5	0.32	0.22	-13	4.7
8012	IE211160480743	2	HMY	272*	86	133	38	-7	13	9	0	47	15.8	11.1	0.27	0.18	-7.2	3.6
8014	IE341338770809	2	MJD	286*	95	152	33	-19	21	9	-5	88	17.5	12.8	0.27	0.19	-8.9	3.4
8015	IE131232390814	1	MWH	238*	74	117	38	-15	23	0	2	56	11.2	10.1	0.17	0.16	-7	2.5
8016	IE211256430842	2	SOK	250*	47	166	35	-11	6	4	2	-78	2.9	5.6	0.11	0.16	-9.9	3.6
8022	IE131232360860	2	GYK	283*	87	155	27	-13	25	4	-2	54	14.2	11.7	0.23	0.19	-7.8	4.9
8027	IE351158010875	2	UKJ	191*	40	110	36	-15	17	3	1	-64	9.1	3.7	0.22	0.11	-5.7	3.3
8029	IE341062050884	2	SLG	214*	29	151	33	-11	14	1	-2	-80	4.4	2.6	0.15	0.1	-9.1	3.2
8035	IE351158070906	2	UKJ	86*	30	36	17	-7	8	7	-4	60	6.7	4.2	0.09	0.04	-2.3	0.7
8036	IE351059580910	2	SOK	230*	49	149	23	-2	2	2	7	79	14.5	6.2	0.22	0.07	-8.6	3.5
8037	IE341255120922	2	MJI	236*	61	125	44	-3	1	4	5	147	15.2	8.8	0.18	0.07	-5.9	4.3
8044	IE191088911132	2	GIO	238*	58	146	34	3	-3	-1	1	116	5.9	9.4	0.03	0.11	-8	3.9
8050	IE151037051174	2	FLT	223*	77	105	33	-2	5	-1	6	311	12.6	13.8	0.02	0.06	-6.3	2.2
8052	IE191349451194	2	IRP	288*	83	161	34	-3	8	7	-1	64	15.6	10.9	0.25	0.17	-8.9	4.2
8055	IE151101941227	2	RMW	245*	65	141	39	-4	14	-2	-6	189	15.5	9.9	0.16	0.07	-8	3.4
8056	IE241039221233	2	LHZ	261*	68	156	31	-15	24	2	-6	-85	15.4	6.7	0.37	0.19	-8.1	4.6
8064	IE191946061292	2	MVD	222*	68	116	40	-3	2	2	-2	72	10.7	9.6	0.15	0.14	-5.5	4
8065	IE341359591303	2	OJI	254*	97	117	47	0	-9	3	0	346	21.5	15.9	0.15	0.08	-6	3.6
8067	IE151054021308	2	LWT	226*	56	137	30	-11	16	5	-7	-1	11.2	6.6	0.22	0.13	-7.7	3.5
8069	IE341359511312	2	OJI	242*	94	108	37	-6	4	5	1	380	13.2	17.3	-0.02	0.09	-6.7	2
8072	IE151054021324	2	CWJ	251*	95	108	45	-15	18	3	-3	197	18.2	14.2	0.2	0.14	-4.6	4.2
8080	IE241850321389	1	LHZ	265*	69	156	30	-19	30	1	-2	48	11.4	9.3	0.18	0.15	-8.1	4.5
8082	IE151753111410	2	RXR	192*	74	85	23	1	-1	6	5	389	13.6	14.2	-0.02	0.03	-4.7	2.3
8086	IE141859951429	2	RXR	215*	95	97	32	0	-10	1	0	211	22.3	13.7	0.27	0.12	-7	0.8
8087	IE351312681431	1	SOK	274*	64	175	34	-4	-1	7	0	71	12.3	8.6	0.18	0.12	-12.2	1.9
8088	IE191194751431	2	SOK	248*	55	166	28	-14	9	5	1	-20	8.5	6.6	0.18	0.14	-11.6	1.8
8089	IE141880941433	2	BQB	257*	83	135	34	0	-2	6	2	167	15.9	12.3	0.18	0.13	-6.1	4.9
8092	IE191194731470	2	WNE	208*	69	109	25	-13	20	2	-4	-99	7.9	7.8	0.23	0.22	-6.6	2.3
8093	IE191194751472	2	WDS	282*	98	137	32	-13	25	4	-1	103	14.9	13.8	0.21	0.2	-7.1	4.1
8100	IE221277541661	2	SYW	192*	43	109	32	-24	25	7	1	170	8.7	7.4	0.04	0.03	-4.2	4.7
8102	IE361003731775	2	SOK	286*	83	157	37	-3	-4	10	5	412	12.8	16.1	-0.05	0.05	-8.8	4
8104	IE331079931514	2	KXV	284*	32	203	44	-8	6	3	5	-241	4.7	0.8	0.28	0.18	-11.5	5
8105	IE141893621824	2	HZO	306*	58	203	22	-6	14	9	5	190	5.8	10.3	-0.03	0.08	-10.2	6.4
8106	IE141634591871	2	GNU	233*	38	172	22	-16	16	-1	2	-266	10	0.6	0.41	0.19	-9.5	4.5
8110	IE331332052095	1	IRP	236*	73	129	28	-16	26	2	-6	119	16.9	9.9	0.23	0.11	-7.2	3.3
8115	IE281436292204	2	LWT	264*	66	145	39	-19	26	2	4	-49	14	7.1	0.31	0.17	-7.7	4.1
8116	IE281436282252	2	BZR	270*	80	140	42	-4	2	2	7	182	11.8	12.7	0.09	0.13	-8	3.4
8120	IE281201773327	2	LWT	210*	34	155	23	-20	27	-2	-6	49	6.8	4.7	0.1	0.06	-8.1	4.5

Cow	Animal Number	Lact	Sire	EBI	Milk	Fert	Calv	Beef	Maint	Mmgt	Health	Milk Kg	FatKg	Prot - Kg	Fat %	Prot %	Calv Int	Surv %
8121	IE281201743332	2	OOK	222*	68	120	32	0	-10	4	8	231	13	11.4	0.08	0.07	-6	3.8
8122	IE182348623916	2	IRP	224*	45	153	21	-7	7	4	2	29	1.6	6.8	0.01	0.11	-9	3.5
8135	IE151444141062	2	BQB	212*	64	131	22	-5	0	1	-1	92	9.6	9.3	0.12	0.12	-7.7	3
8259	IE241152331259	2	BHZ	232*	71	124	39	-3	6	2	-6	128	8.7	11.1	0.07	0.13	-5.6	4.5
8262	IE241152371262	1	BHZ	267*	89	143	36	-6	7	7	-9	230	16.4	13.9	0.14	0.12	-8.1	3.5
8264	IE191946021264	2	EDV	207*	29	145	25	-5	10	1	2	256	4.3	7.2	-0.1	-0.02	-8.6	3.2
8274	IE241152321274	2	BHZ	262*	90	138	33	-1	-1	4	-1	264	8.9	15.7	-0.02	0.13	-8.3	3
8301	IE191390551172	2	HZS	247*	67	146	35	-6	11	-4	-2	2	9.8	8.6	0.19	0.16	-7.2	4.6
8308	IE241152321308	2	BHZ	276*	77	175	25	-8	7	4	-4	45	10.5	10.5	0.17	0.17	-9.2	5.1
8323	IE151586881810	2	HZS	245*	54	159	30	-12	17	4	-8	12	9.3	6.9	0.17	0.12	-10.6	2.2
8346	IE241152381346	2	SXN	217*	33	160	16	-14	14	5	4	66	1	5.7	-0.03	0.07	-10.1	2.9
8500	IE151623472531	1	MWH	284*	63	176	38	-15	23	2	-3	-49	7.1	7.8	0.17	0.19	-10	4.4
8501	IE331018920976	0	BJL	272*	44	174	44	-14	14	2	8	101	11.5	6.2	0.14	0.06	-8.7	5.5
8502	IE151623492418	1	NIZ	313*	50	196	35	-9	29	1	11	261	7.9	9.8	-0.04	0.03	-10.8	5.1
8503	IE151623422493	1	SOK	278*	61	152	44	-5	10	10	6	72	14.4	7.9	0.22	0.11	-8.1	4.3
8504	IE331018931067	1	BHZ	258*	60	163	38	-10	12	0	-4	-22	11.8	6.9	0.24	0.15	-8.7	4.6
8505	IE331018911040	1	SOK	260*	83	148	37	-12	3	6	-4	118	11.5	12.3	0.13	0.16	-9.2	2.7
8506	IE331018921033	1	RPF	253*	37	183	25	-10	21	-1	-2	-152	6.6	2.5	0.24	0.15	-10	4.8
8507	IE151623442413	1	WNE	292*	101	142	43	-3	4	6	1	53	19.4	12.8	0.33	0.21	-6.3	5.3
8508	IE331018970997	1	GSX	243*	36	159	45	1	-4	1	5	87	3	6.1	-0.01	0.07	-10	2.9
8509	IE151623472473	1	BUG	251*	79	145	34	-18	15	1	-4	23	17.8	9.4	0.32	0.17	-7.9	3.9
8510	IE331018921066	1	SOK	243*	50	154	36	-2	-1	7	-2	-94	14.1	4	0.34	0.14	-9.2	3.4
8511	IE331018970989	1	BHZ	244*	59	150	39	-4	5	3	-7	-86	13.6	5.5	0.32	0.17	-8.2	4
8512	IE151623482433	1	HFT	267*	63	169	33	-13	18	3	-6	-143	8.7	6.1	0.27	0.22	-9.4	4.3
8513	IE151623412484	1	IRP	256*	64	152	32	-11	19	5	-4	-47	9.4	7.5	0.21	0.18	-6.6	5.8
8514	IE151623452463	1	WNE	269*	95	141	31	-16	12	5	2	-19	20.5	10.8	0.4	0.22	-6.3	5.2
8515	IE331018980981	1	KGZ	270*	2	211	46	-10	13	0	9	-297	-2.9	-3.3	0.17	0.14	-11.8	5.3
8518	IE331097831616	1	HYZ	243*	64	159	16	-15	19	-1	2	-131	12.9	5.8	0.35	0.2	-8.9	4
8519	IE182148110937	1	KGY	278*	94	141	39	-18	24	1	-2	24	17.8	11.6	0.32	0.21	-7.5	4
8520	IE151586852013	1	LLK	253*	61	149	39	-22	26	-3	2	-35	16.7	6.1	0.34	0.15	-8.1	4
8522	IE341062010955	1	SGC	232*	22	170	32	-12	21	1	-1	-125	2.1	1.3	0.13	0.11	-10.6	3.2
8523	IE151604951048	1	SJI	275*	75	147	51	-2	1	2	1	72	16	9.7	0.25	0.14	-8	4
8524	IE182148110961	1	SOK	247*	51	154	33	-9	3	11	4	60	11.9	6.7	0.18	0.09	-9.3	3.2
8525	IE151586892033	1	WDS	253*	88	132	33	-10	8	3	0	212	9.8	14.5	0.03	0.14	-6.2	4.6
8526	IE182148150924	1	GVV	218*	41	138	37	-3	0	4	1	27	2.8	6.1	0.03	0.1	-7.5	3.8
8623	IE351238182778	1	MJI	210*	48	124	36	-1	0	1	3	237	8.4	9.1	-0.01	0.02	-6.1	4
8717	IE151002490717	2	HFT	256*	84	145	27	-17	22	1	-6	-73	24.5	7.9	0.53	0.2	-7.7	4.1
8842	IE131512490842	2	LRZ	246*	41	160	38	-7	6	5	3	175	5.3	7.7	-0.03	0.04	-8.6	4.5
8854	IE321279270854	2	LHZ	257*	74	145	28	-9	21	2	-4	180	15.3	11.2	0.16	0.1	-8.1	3.7
8868	IE131512410868	2	LRZ	237*	53	146	34	0	-3	5	1	67	10.7	7.2	0.16	0.1	-7	4.9
9252	IE241152351252	2	CWJ	244*	55	148	33	-19	27	2	-2	58	13.2	7.1	0.21	0.1	-7.9	4.1

Appendix 2. ICBF Active Dairy Bull List - Spring 2014

Bull Details							EBI Details										Key Profit Traits									Semen Details			
Rk	Code	Name of Bull	Sire	Breed	Status	HO%	EBI	Rel%	Proof	Milk	Fert	Calv	Beef	Maint	Mgmt	Health	M Kg	F Kg	P Kg	F %	P %	CI	SU%	CD%	M.Time	M. Temp	Avail	Sexed	Price	Supplier
1	WLY	IMLEACH LUCKY WHISTLER	MWH	HO	SRM	63	€322	51%	GS	€86	€189	€41	-€13	€15	€3	€0	118	17	11.9	0.23	0.15	-9.4	6	1.6	-5.75	0.05	High	No	€22	Eurogene/LIC
2	PSZ	(IG) LISSANE PIRATE	IRP	HO	PED	72	€313	49%	GS	€91	€171	€47	-€24	€28	€3	-€2	65	16.1	12.1	0.25	0.19	-9.7	4.2	2.3	6.12	0.12	High	No	€18	NCBC
3	AMY	ADRIVALE MONTY	IRP	HO	PED	75	€305	61%	GS	€59	€204	€36	-€9	€7	€7	€1	-156	6	5.9	0.23	0.22	-10.4	6.2	2.6	0.69	0.21	High	No	€17	Dovea
4	DGC	DUNGOURNEY CREMIN	IRP	HO	PED	78	€291	59%	GS	€84	€168	€35	-€13	€13	€4	€0	271	16.1	13.8	0.1	0.09	-7.8	5.9	3.6	4.4	0.14	High	No	€17	Dovea
5	ABO	(IG) CASTLEB-LAGH ODIE	BHZ	HO	PED	81	€291	64%	GS	€104	€144	€42	-€12	€12	€5	-€4	146	14.7	15.4	0.17	0.2	-8.2	3.5	1	-0.55	0.13	High	No	€19	NCBC
6	HEK	KAIMORE HERO EARNIE S1F	M S HERO-ET S1F	HO	SRM	59	€291	43%	GS	€80	€165	€40	-€26	€36	€2	-€6	41	13.5	10.5	0.22	0.18	-8.9	4.5	1.1	-2.24	0.03	Medium	No	€21	Eurogene/LIC
7	KSK	(IG) BALLYBRIDE SHERLOCK	BZR	HO	PED	66	€290	55%	GS	€97	€143	€37	-€9	€15	€5	€2	341	14.8	16.9	0.03	0.11	-7.9	3.7	2	-2.55	0.14	High	No	€17	NCBC
8	XRB	MULLENBALLY IRP RUUVIXEN 612	IRP	HO	PED	72	€289	55%	GS	€80	€174	€31	-€15	€10	€7	€2	29	18.4	9.6	0.33	0.17	-9.7	4.4	1.8	-1.64	0.19	High	Yes	€19*	NCBC
9	JKF	(IG) DOONMANAGH FLT JACKO	FLT	HO	PED	81	€287	54%	GS	€98	€137	€46	€2		€1	€5	46	25.3	11.5	0.44	0.19	-8.2	3	1.5	2.6	0.04	High	Yes	€19*	NCBC
10	PDO	(IG) CARRIGAUN PEDRO	IRP	HO	SRM	53	€287	54%	GS	€87	€163	€35	-€5	€6	€4	-€4	60	13.7	11.8	0.21	0.19	-8.5	4.8	2	4.19	0.15	High	No	€19	NCBC
11	KZY	COOKSTOWN BUDDY	HFT	HO	SRM	59	€286	53%	GS	€62	€188	€31	-€17	€27	€1	-€5	-70	12.4	6.5	0.29	0.17	-11.6	3.6	2.2	-0.74	0.01	High	No	€17	Dovea
12	PBM	(IG) BALLINABOR-TA PRIMO	SOK	HO	PED	53	€285	54%	GS	€112	€129	€38	-€7	€6	€6	€1	233	16.7	17.4	0.14	0.18	-7.2	3.2	2	-10.31	0.11	High	No	€19	NCBC
13	KPV	(IG) KIPPANE VAMPIRE	IRP	HO	PED	78	€285	60%	GS	€75	€165	€34	€6	€1	€8	-€5	-43	15.8	8.3	0.33	0.19	-8	5.4	2	2.66	0.27	High	Yes	€19*	NCBC
14	MSF	MORRIS TF LAMONT S1F	TIZ	HO	SRM	56	€283	50%	DP-INT	€127	€116	€36	-€17	€25	€5	-€8	295	17.8	20.3	0.12	0.19	-6.4	3	1.8	-4.99	0.1	High	No	€21	Eurogene/LIC
15	OKM	OKURA LIKA MURMUR S3J	MKU	JE	XSR	0	€283	58%	DP-INT	€115	€114	€32	-€55	€74	€1	€2	-11	22.3	13.6	0.44	0.27	-4.5	4.8	0.5	3.09	0.05	High	No	€23	NCBC
16	LHZ	(IG) LAURAGH EVERT	WPE	HO	PED	88	€282	72%	DP-IRL	€67	€177	€35	-€20	€20	€5	-€3	-27	14.5	7.5	0.3	0.16	-9.8	4.6	2.3	-2.16	0.12	High	No	€19	NCBC
17	ZLR	(IG) DORE LAZEROUS	WAU	HO	PED	59	€281	55%	GS	€49	€194	€31	-€18	€27			-7	11.5	5.6	0.22	0.12	-11	4.7	1.8	13.87	0.06	High	No	€18	NCBC
18	GGP	GOINGS MECCA PRIDE S1F	O E MECCA S1F	HO	SRM	56	€281	41%	GS	€105	€125	€33	-€25	€40	€4		229	17	16.3	0.15	0.17	-5.4	4.8	2	-9	0.06	High	No	€20	Eurogene/LIC
19	LJS	CETARA GB LONESTAR S3F	GWZ	HO	SRM	56	€279	40%	GS	€97	€138	€31	-€17	€29	€3	-€3	259	16.8	15.4	0.13	0.13	-6.2	5.1	1.7	-5.42	0.06	High	No	€20	Eurogene/LIC
20	RHS	RAHEENARRAN MEB SOCHAR	MEB	FR	PED	0	€277	81%	DP-IRL	€14	€209	€48	-€17	€10	€5	€7	-240	-0.5		0.18	0.15	-13.8	3.1	1	5.97	0.19	High	No	€18	NCBC
21	FLG	GARRENDEN-NY LUCIFER	WGM	HO	SRM	66	€276	45%	GS	€74	€164	€38	-€25	€29	€3	-€5	54	17.8	9.1	0.29	0.14	-9.1	4.2	1.9	2.08	0.1	High	No	€17	Dovea
22	ZBK	BRACKHERD SWEETDREAM	HZS	HO	SRM	69	€276	54%	GS	€34	€197	€46	-€10	€9	€4	-€3	11	4	4.6	0.06	0.09	-10.6	5.5	1.7	6.9	0.16	Medium	No	€17	Eurogene/LIC
23	VSN	VAN STRAALENS HARRIER-ET	W P ELSTO-ET	HO		50	€273	67%	DP-INT	€80	€116	€49	-€11	€31	€7	€1	22	16.1	9.8	0.29	0.17	-6.2	3.3	1	-9.47	0.14	High	No	€20	Eurogene/LIC
24	UMG	(IG) MOGEHA ULTAN	SOK	HO	SRM	69	€272	56%	GS	€36	€187	€36	-€4	€6	€9	€3	-42	7.6	3.6	0.17	0.1	-11.4	3.8	1	-16.05	0.14	High	No	€19	NCBC
25	AKZ	ARKAN GH HORIZON S2F	G M HEFF S1F	HO	SRM	63	€272	39%	GS	€110	€137	€21	-€20	€28	€5	-€9	163	15.5	16.4	0.17	0.21	-7.2	4	2.5	-5.69	0.1	High	No	€20	Eurogene/LIC
26	HYD	MODELIGO HARRY	SOK	HO	PED	72	€271	56%	GS	€81	€136	€48	-€4	€1	€9	€1	201	19.2	11.9	0.21	0.1	-7.5	3.6	1.2	-8.41	0.19	High	Yes	€17*	Dovea

Bull Details							EBI Details										Key Profit Traits										Semen Details			
27	WDS	WHINLEA DAN SUPERSONIC-ET	HZO	HO	PED	69	€271	76%	DP-IRL	€114	€116	€30	-€18	€19	€8	€2	527	17.5	21.5	-0.04	0.07	-5.3	4.2	2.5	-2.33	0.22	High	No	€25	Eurogene/LIC
28	BGJ	BAGWORTH PF GRANDEUR S1F	P FROSTMAN S1F	HO	SRM	50	€270	52%	DP-INT	€82	€140	€38	-€15	€22	€5	-€3	230	18.4	12.6	0.18	0.09	-6.4	5.1	2.1	-7.86	0.09	High	No	€20	Eurogene/LIC
29	MDW	MONOWAI HOM DELUCA-ET SIF	S711	HO	SRM	88	€269	61%	DP-INT	€62	€183	€38	-€21	€8	€3	-€4	284	9.4	11.8	-0.02	0.04	-10.2	4.7	1.7	4.96	0.12	High	No	€19	NCBC
30	GTW	(IG) BALLYNAGRANA CENTURION 2	DUO	FR	PED	13	€269	46%	GS	€11	€205	€35	-€12	€20		€12	-51	8.7	-0.5	0.2	0.03	-12	4.6	1.7	-2.15	-0.04	High	Yes	€18*	NCBC
31	ZBA	BENDALE AD BLAZA S1F	A V DYNASTY S2F	FR	SRM	44	€269	36%	GS	€65	€152	€37	-€29	€37	€4	€3	203	13	10.4	0.1	0.07	-7.6	4.7	1.2	-2.77	0.09	High	No	€19	Eurogene/LIC
32	ADY	(IG) ARDROE JOE	LLK	HO	SRM	72	€268	48%	GS	€64	€164	€38	-€13	€17	-€4	€2	-25	13.6	7.2	0.28	0.16	-9.5	3.8	2.2	-3.81	-0.14	High	No	€19	NCBC
33	PKA	PUKEROA TGM MANZELLO	T G MAUNGA ET SJ3	JE	PED	0	€268	60%	DP-INT	€128	€85	€43	-€39	€54	€5	-€9	-92	28.8	13.6	0.63	0.32	-3.9	3.1	0.5	-4.79	0.12	High	No	€19	NCBC
34	FFA	FARSIDE FM ACCOMPLICE S3F	F MINT-EDI-TION	HO	SRM	88	€268	39%	GS	€93	€128	€46	-€18	€27	€1	-€9	92	18.3	12.3	0.28	0.18	-7.6	2.8	1.2	-3.55	0	High	No	€20	Eurogene/LIC
35	CUW	CURRA ALLSTAR	SVB	HO	PED	63	€267	67%	DP-IRL	€66	€163	€45	-€24	€20	-€4	€1	13	10.5	8.5	0.19	0.16	-10	3.3	1.4	16.29	0.01	High	No	€16	NCBC
36	ZPB	BALLYOGAHA PHILIP	SOK	HO	PED	75	€267	60%	GS	€91	€116	€50	-€5	€3	€9	€3	23	19.1	11	0.34	0.2	-7.5	1.9	1	-10.83	0.19	High	Yes	€17*	Dovea
37	AWS	DERRINSALLOW AINE 75 ED	HMY	HO	PED	81	€266	58%	GS	€62	€158	€35	-€12	€12	€4	€8	-59	20.2	5.3	0.43	0.15	-8.5	4.4	1.7	4.47	0.14	High	Yes	€17*	Dovea
38	KAB	KAMAHI AB RUMBLE S2F	A T BUCCA-NEER S1F	HO	SRM	63	€266	41%	GS	€95	€126	€32	-€21	€35	€4	-€4	282	14	15.9	0.06	0.12	-6.9	3.4	1.4	-6.43	0.08	High	No	€18	Eurogene/LIC
39	XGR	GOOCHS FM REBELLION S2F	F MINT-EDI-TION	HO	SRM	75	€265	44%	GS	€83	€143	€23	-€14	€23	€4	€2	250	12.5	13.9	0.05	0.11	-8.4	3.2	2.9	-7.97	0.05	High	No	€17	Eurogene/LIC
40	GXY	GYDELAND EXCEL INCA S3F	WNE	HO	SRM	78	€265	53%	DP-INT	€103	€153	€9	-€14	€15	€5	-€6	131	15.3	14.9	0.19	0.2	-7.1	5.4	3.2	-3.71	0.11	High	No	€20	Eurogene/LIC
41	PZS	MODELIGO SUPREME	SOK	HO	PED	66	€265	56%	GS	€59	€165	€38	-€11	€10	€7	-€3	63	12.8	7.7	0.19	0.11	-10.2	3.2	2.2	-5.88	0.15	High	No	€17	Dovea
42	RVJ	RAHEENARRAN BCG SOCHAR	BCG	FR	PED	0	€264	86%	DP-IRL	€9	€194	€45	-€19	€21	€1	€14	-333	-4	-2.5	0.19	0.19	-12.1	3.7	0.8	2.14	0.04	High	Yes	€17*	Dovea
43	FMD	SCOTTS FROSTMAN DELUX S1F	P FROSTMAN S1F	HO	SRM	100	€264	47%	DP-INT	€93	€146	€22	-€15	€18	€5	-€4	348	16.2	16.2	0.06	0.08	-8	3.8	1.4	-4.43	0.12	Me-dium	No	€19	NCBC
44	WFP	WEARNES FE TE POI S3F	F MINT-EDI-TION	HO	SRM	81	€264	40%	GS	€81	€143	€38	-€18	€29	€2	-€9	46	15.3	10.4	0.25	0.17	-8.1	3.6	1.7	-3.7	0.02	High	No	€19	Eurogene/LIC
45	ZCR	(IG) CARROW-MANAGH ROY	MJI	HO	PED	69	€263	55%	GS	€63	€151	€45	-€6	€12	-€4	€3	25	17.4	7.1	0.31	0.12	-9.5	2.7	1.2	15.02	-0.02	High	No	€18	NCBC
46	TSK	(IG) KNOCK-CAIS TOSSY	RXO	HO	PED	84	€262	61%	GS	€55	€136	€45	-€7	€15	€8	€9	125	11.5	8.3	0.12	0.08	-8	3	2.3	-7.84	0.19	High	Yes	€18*	NCBC
47	KJT	KINGSDOWN MH JUBILANT S1F	M S HERO-ET S1F	HO	SRM	56	€262	42%	GS	€86	€131	€44	-€21	€27	€5	-€10	101	13.9	12.1	0.19	0.17	-7.6	3.1	0.8	-10.33	0.08	High	No	€17	Eurogene/LIC
48	YSH	SUMMERHAYS DI SHANTY S2F	D I IGNITE S2F	HO	SRM	56	€262	42%	GS	€81	€152	€38	-€21	€17	€1	-€6	126	18.5	11	0.25	0.13	-7.2	5.2	1.9	-1.77	0.02	Me-dium	No	€17	Eurogene/LIC
49	CVX	(IG) CURRA CONOR	MCL	HO	PED	91	€261	72%	DP-IRL	€75	€135	€34	€6	€6	€0	€5	154	12	11.5	0.11	0.12	-7	4	3	-13.63	-0.11	Low	No	€18	NCBC
50	AFD	(IG) ARDALLEN FEST	HFL	HO	PED	88	€261	71%	DP-IRL	€87	€116	€45	€8	€8	€0	-€4	215	19	13	0.2	0.11	-6.1	3.4	1.8	-0.07	0	Me-dium	No	€19	NCBC
51	HOW	HOWIES EASYRIDER	I RAMROD	HO		50	€260	65%	DP-INT	€103	€104	€39	-€37	€46	€5	-€2	-86	22.9	10.8	0.51	0.27	-5.2	3.3	0.8	-11	0.08	High	No	€20	Eurogene/LIC
52	HDJ	(IG) BRIDESTREAM HAROLD	KOZ	HO	PED	63	€259	58%	GS	€78	€111	€41	-€5	€20	€6	€8	212	17.6	11.9	0.17	0.09	-5.5	3.6	0.9	-2.38	0.17	High	Yes	€17*	NCBC

Bull Details							EBI Details										Key Profit Traits										Semen Details			
53	KHT	KAHURANGI GB TOPGUN S2F	GWZ	HO	SRM	56	€258	43%	GS	€87	€122	€29	-€26	€35	€7	€4	367	17.6	15.3	0.06	0.06	-5.6	4.3	1	-11.21	0.11	High	No	€18	Eurogene/ LIC
54	DJS	DJ JASON	W W MON-TANA JACE	JE	PED	0	€257	64%	DP-INT	€89	€132	€10	-€46	€76	€3	-€6	-170	23.6	7.4	0.6	0.26	-6.2	4.5	1.1	-11.61	0.01	Me-dium	Yes	€23*	NCBC
55	HWY	HAYWARDS TGM AIM S3J	T G MAUNGA ET SJ3	JE		0	€257	73%	DP-IRL	€146	€58	€34	-€41	€61	€3	-€4	25	33.5	17	0.62	0.31	-2.6	2.2	0.5	4.51	0.13	High	No	€20	Eurogene/ LIC
56	PGF	(IG) GLENSTAL DANDY	WGM	HO	SRM	63	€256	50%	GS	€100	€120	€39	-€26	€29	€3	-€8	243	21.4	15	0.22	0.13	-5.9	3.9	2.1	-3.24	0.06	High	No	€18	NCBC
57	MKK	(IG) MOORE-PARK LARRY	TZD	HO	PED	78	€256	70%	DP-IRL	€40	€149	€48	-€29	€42	€4	€1	-79	14.3	2.8	0.34	0.11	-8.3	3.8	1.4	-2.45	0.1	High	Yes	€18*	NCBC
58	HYZ	SCOTTS VHA HYDRAULIC S2F	V H AP-PLAUSE-ET S2F	HO	SRM	56	€256	60%	DP-INT	€86	€138	€27	-€12	€23	€1	-€7	185	16.6	12.8	0.18	0.12	-7.2	4.1	4.2	-1.02	0.02	High	No	€20	NCBC
59	IRP	MILLANDS PRINCE	BWZ	HO	PED	72	€256	87%	DP-IRL	€87	€132	€30	-€13	€13	€7	€0	159	14	13	0.15	0.14	-6.8	4	2.6	6.18	0.25	Me-dium	No	€19	NCBC
60	DYM	LOUGHREE DANDY	BZR	HO	PED	78	€255	52%	GS	€85	€106	€41	€5	€14	€5		170	14.7	12.9	0.15	0.14	-5.2	3.5	2.4	-0.78	0.14	High	No	€17	Dovea
61	IGG	(IG) ENAGLOU XB GOLD	SYX	HO	SRM	94	€255	56%	GS	€45	€153	€45	-€16	€24	€5	-€2	-19	15.7	4.1	0.31	0.09	-10	2.4	2.4	-11.58	0.06	High	No	€16	NCBC
62	RXW	(IG) ROSE XB WESTER	KNW	HO	SRM	63	€255	55%	GS	€59	€168	€42		€0		-€11	-24	15.7	6.1	0.32	0.14	-9.2	4.5	2.5	3.1	-0.02	High	No	€16	NCBC
63	ZKS	ZINKS GB FURNACE S2F	GWZ	FR	SRM	47	€255	46%	GS	€82	€128	€34	-€23	€32	€2		258	15.4	13.5	0.1	0.1	-6.2	4.2	1.3	-5.04	0.03	High	No	€18	Eurogene/ LIC
64	OPH	(IG) OLCASTLETOWN PHANTHOM	BQB	HO	PED	78	€255	56%	GS	€76	€132	€40	€2	-€4	€7	€1	85	16.6	10	0.25	0.14	-7.3	3.4	3	-13.91	0.09	High	No	€19	NCBC
65	RPZ	(IG) MARYBORO RASCAL	WGM	HO	SRM	63	€254	52%	GS	€87	€141	€24	-€21	€23	€5	-€6	89	16.3	11.8	0.24	0.17	-7.6	3.9	3	-5.13	0.11	High	No	€18	NCBC
66	KDX	(IG) BLACKNEY DIRECTOR	HFL	HO	PED	66	€254	58%	GS	€37	€190	€22	-€5	€15	-€3	-€2	-155	9.9	1.9	0.31	0.14	-11.4	4.1	1.5	12.7	0.01	High	No	€16	NCBC
67	ZCA	(IG) CURNAMU-LT SEANAD	LLK	HO	PED	91	€253	54%	GS	€66	€133	€46	€2	-€2	€2	€6	87	18.5	8.3	0.28	0.11	-7.3	3.6	1.6	-7.37	-0.01	High	No	€18	NCBC
68	FHS	(IG) FAHA SUNSHINE 12	HZS	HO	SRM	69	€253	56%	GS	€72	€143	€38	-€7	€12	€3	-€9	81	14.2	9.7	0.21	0.14	-7	4.7	2	-8.36	0.02	High	No	€18	NCBC
69	OCP	(IG) CARRI-GAUN GLEN	HMY	HO	PED	84	€252	52%	GS	€72	€121	€51	-€5	€9	€7	-€2	182	24	9.5	0.31	0.07	-6	3.9	0.9	-5.14	0.17	High	Yes	€17*	NCBC
70	MXR	MOOREPARK HOGGY	UYC	FR	PED	47	€252	81%	DP-IRL	€48	€178	€20	-€19	€26	€0		302	11.5	9.5	0	-0.01	-9.6	4.9	3.4	6.72	0.06	Low	No	€16	NCBC
71	AZG	DEANSGROVE ARGENT	HZS	HO	SRM	72	€252	57%	GS	€88	€119	€42	-€9	€12	€8	-€8	-2	13.1	11.2	0.25	0.22	-6.2	3.5	1.4	-10.94	0.16	High	No	€17	Dovea
72	KXL	(IG) KNOCK-ROUR ALIX	KOZ	HO	PED	88	€252	58%	GS	€61	€150	€35	-€5	€4	€1	€6	25	10.2	7.9	0.17	0.14	-8.1	4.1	1.8	11.37	0.1	Me-dium	Yes	€18	NCBC
73	TKG	GLEESON TRINKET	SOK	HO	PED	78	€252	56%	GS	€64	€140	€43	€0	-€3	€4	€3	231	10.2	11.2	0.02	0.07	-7.6	3.8	1.4	-17.01	-0.01	High	No	€17	Dovea
74	GYR	(IG) GLENROSE HARRY	DEU	FR	PED	47	€251	81%	DP-IRL	€48	€169	€23	€0	€0	€4	€7	-191	10.5	3	0.37	0.19	-9.4	4.3	4.2	-9.49	0.06	High	No	€17	NCBC
75	YBK	(IG) MEENASCOR-THY BLACKIE	SOK	HO	PED	56	€249	52%	GS	€43	€179	€24	-€3	-€3	€6	€2	-12	2.4	5.9	0.05	0.13	-10.7	3.8	6	-14.1	0.07	High	No	€19	NCBC

Key to Table: Ho% = Holstein Genes, PED = Pedigree Registered, SRM = Supplementary Registered, Proof = The status of the bull proof (DP-IRL = Daughter Proven based on milk recorded daughters in Ireland, DP-INT = Daughter Proven, based on milk recorded daughters outside of Ireland (International), GS = Genomically Selected), CI = Calving Interval Days, SU% = % Survival from lactation to lactation, CD% = % Calving Difficulty, M.Time = Milking Time, M.Temp = Milking Temperament, Avail = Availability (H=>6,000 doses, M= 4-6,000 doses, L=2-4,000 doses). Semen Availability information is given by each AI Organization. An Asterisk(*) indicates a higher cost for sexed straws. Farmers are strongly urged to use a minimum of 5 AI bulls from the list. For more information on the ICBF Active Bull List, please call 1850 600 900 or log onto www.icbf.com.Copyright ICBF 2014.

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National Development Plan 2007 - 2013

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