DYNEVAL®

DYNAMIC EVALUATION

Identifying Subfertile Bulls with Time-dependent Fresh Semen Analysis

CASE STUDY

N. Johnson, E. Balla, T. Wood, V. Martinez

V 0.1

Introduction

In December 2024, Dyneval was invited by a farm vet and cattle breeder in the UK to perform semen analysis on two bulls that had failed to get cows in calf. This is a case study reporting the time-dependent measurements that were performed on fresh semen from these two bulls and third bull that successfully generated pregnancies.

In March 2024, all bulls on the farm had been assessed according to the Estimated Breeding Value (EBV) and Bull Pre-Breeding Examination following the British Cattle Veterinary Association (BCVA) guidelines [1]. This included gross and progressive motility assessment and morphology analysis.

In April 2024, all bulls were turned out into the fields at a ratio of one bull to a group of 30 cows. In October 2024, all cows were Pregnancy Diagnosis (PD) tested using ultrasound and PD negative cows were culled. Bulls 1 & 2 had each succeeded in getting only one cow in calf and had thus failed to get 58 cows in calf. In December 2024, Dyneval was invited to the farm to perform Dynescan semen analysis on fresh ejaculate from these two bulls. Testing was also performed on Bull 3, whose pregnancy results of 93% (28/30).

Method

Dynescan is a portable device that allows for automated measurement of the percentage (%) progressive motility and speed of spermatozoa over time. The sample was loaded into a pre-warmed $20\,\mu m$ channel slide and inserted into the Dynescan where it was held at $37.5\,°C$ within the instrument enclosure. Testing was carried out on a covered yard with 3 sides open to the elements. On that day, the temperature peaked at 6 degrees Celsius. All bulls were electroejaculated. Bulls 1 & 3 showed good semen production with a thick consistency. Bull 2 first produced watery semen and then was re-electroejaculated to obtain a better sample.

Using a Dynescan, the % progressive motility and speed of motile spermatozoa were measured for up to 15 minutes (in an anaerobic environment). Fresh ejaculate was loaded into a pre-warmed glass channel slide (Leja) without dilution. Performing measurements over time enabled the group to observe whether % progressive motility was sustained in low oxygen conditions similar to the reproductive tract. Entry into the low-oxygen condition is evident from the reduction in speed of the spermatozoa.

Results

Results of the measured % progressive motility are shown in graphs 1-3 below:

Bull 1: The ejaculate presented an initial progressive motility of around 50% that declined after 5 minutes reaching 0% progressive motility at 15 minutes, as shown in Figure 1.

Bull 2: The first ejaculate presented a poor initial progressive motility of around 20% that had declined to 0% within 6 minutes, as evident in Figure 2. The second ejaculate showed an improved initial progressive motility of around 45% which then declined after 10 minutes reaching 0% progressive motility at 15 minutes.

Bull 3: As shown in Figure 3, the ejaculate presented an initial progressive motility of around 70% which declined to around 55% within 5 minutes but was then restored to around 75% progressive motility at 15 minutes.

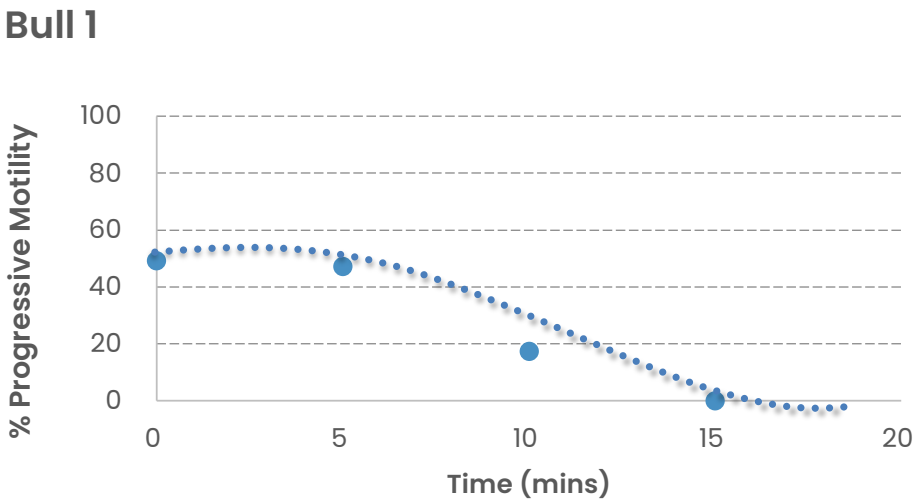

Figure 1. Percentage (%) progressive motility of undiluted semen from Bull 1 measured in a 20μm sample chamber over 15 minutes

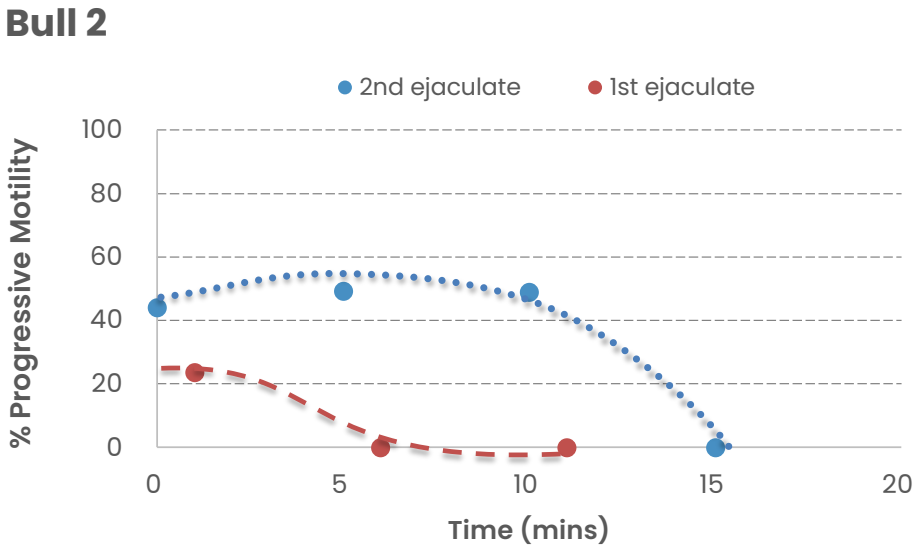

Figure 2. Percentage (%) progressive motility of undiluted semen from Bull 2 measured in a 20μm sample chamber over 15 minutes

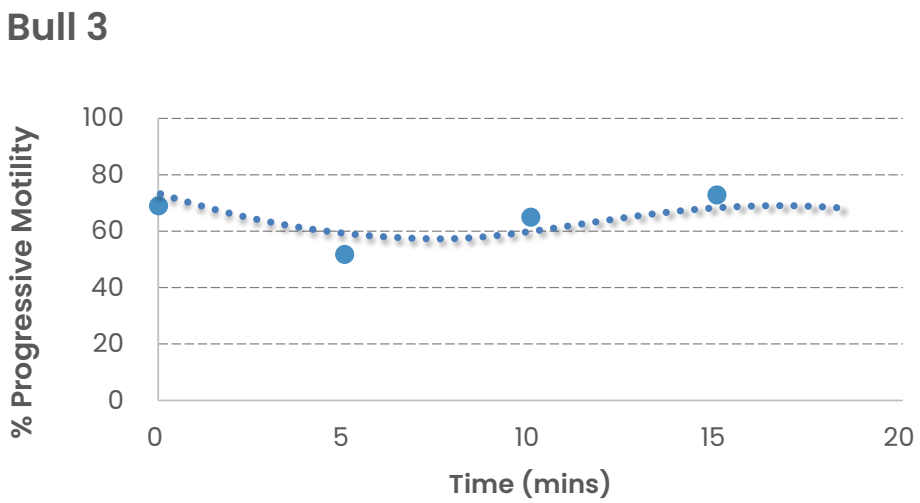

Figure 3. Percentage (%) progressive motility of undiluted semen from Bull 3 measured in a 20μm sample chamber over 15 minutes

It is important to note that vets usually assess the % progressive motility by placing a drop of diluted semen on a microscope slide and then covering the sample with a microscope slide before examining by eye. Precise measurements using an IVOS II Computer Aided Semen Analyser from Hamilton Thorne have shown that the % progressive motility is not constant across the width of the slide, consistently around 25% higher in the centre when compared with a channel slide which provides consistent measurements across the width of the slide [2], [3]. Although Bull 2 presented a progressive motility of 45% using a channel slide this would have appeared as a 70% progressive motility sample to a vet examining by eye using a cover-slide and microscope-slide. Since this exceeds the standard threshold of 60% progressive motility set by Veterinary Association standards, Bull 1 and Bull 2 pass both standard veterinary examination procedures.

Discussion

While poor-performing bulls are relatively rare, this case study strongly suggests that the ability for semen to maintain motility is critical for getting cows in calf. Time-dependent measurements are easy to obtain in parallel to performing standard Bull Pre-Breeding Exams and can help ensure that there are no nasty surprises further down the line.

Cost of Failure According to Teagasc in Ireland, both male and female beef calves should gain 0.7 kg/day during their first season at grass [4]. In this case study, 7 months passed before PD tests were performed. With approximately 30 cows to every bull, an infertile bull creates a total loss of weight gain of 5,670 kg over the 9 month pregancy term.

For a cow/calf or suckler operation the typical price will be around £500/calf [5]. In this case study, by failing to produce 29 calves to sell on for finishing, each

subfertile bull cost the breeder £14,500 resulting in a total loss of £29,000 from two subfertile bulls. Since non-productive cows were culled the breeders had to spend £58,000 on replacement heifers, at a price of £2,000 per heifer. This resulted in a total cost of £87,000 for this breeder before considering losses from the cost of veterinary bills, feed and genetic testing for the cows that were culled.

In the UK, the average price of a steer is £1,750 [6]. For a producer breeding and finishing beef cattle themselves, each subfertile bull that fails to produce 29 calves will cost the producer £50,750. The producer in this case study could have lost £101,500 in one year. Together with the cost of replacement heifers and costs for caring for the cows that failed to get in calf, the producer will be facing losses of the order of £200,000 from the 2 subfertile bulls.

In some systems, producers may consider the risk to be reduced by introducing multiple bulls to the herd. In reality, not all bulls have an equal chance to serve the cows for there will always be one bull that is more dominant. On traditional UK farms many producers will rotate a few (say 3) bulls on a weekly basis to serve the cows. While this may help to reduce the chances of failed conception, the 10 cows that fall in heat during the week a subfertile bull is serving will not have the opportunity to conceive for another 21 days. With calves gaining 0.7kg/day, at £15/kg the loss in value from delayed conception for just 10 cows is £2,205 every 21 days. Very soon this cost accumulates and the cost of bull fertility testing with semen lifetime analysis seems insignificant.

Whatever, the system it remains essential to fertility test all bulls prior to the breeding season to ensure that dominant bulls are not subfertile and preventing more fertile bulls from accessing the herd. The cost of buying and maintaining each bull is around £5,000 over a 3 year period [7]. It is vital to ensure the bull is fit for purpose.

What next? Poor ability to maintain motility suggests that the sperm cells have poor metabolic health or the lipid membrane surrounding the head is damaged. This may be caused by a bacterial infection, nutritional deficiencies, stress or genetic faults. On finding that semen motility is not sustained, it is recommended that a veterinarian takes blood sample while the bull is in the crush and conducts further tests to explore whether nutritional supplements, or an infection, may be the cause of subfertility. When results are returned, the vet may be able to recommend an appropriate treatment to restore the bull to full health and productivity.

Environmental Impact For a herd of 20,000 cows the impact of increasing conception rates by 8% reduces emissions by 4.3kT of Carbon Dioxide Equivalent [Scottish Enterprise]. Raising conception rates not only improves our profit margin but also reduces emissions for our producers.

Conclusion

Time-dependent semen analysis is relatively new to the market but shows exciting potential to become a predictive technology enabling vets and breeders to take pre-emptive action to raise semen quality and conception rates. Quantitative data measured with precision technology provides clear information to guide decisions at the pen-side, where decisions matter.

Want to learn more? Go to www.dyneval.com/dynescan

References

[1] C. Penny, ``The new BCVA bull pre-breeding examination certificate,'' *Veterinary Record*, vol. 16, p. 551, 2010.

[2] A. Camus, C. Rouillion, L. Gavin-Plagne and E. Schmidtt, ``The motility ratio method as a novel approach to qualify semen assessment,'' *Scientific Reports*, vol. 14, p. 27 932, 2024. [Online]. Available: https://doi.org/10.1038/s41598-024-79500-1.

[3] H. Nicholson, T. A. Wood and V. A. Martinez. ``Can measurements be biased?'' (2023), [Online]. Available: https://www.dyneval.com/can-measurements-be-biased/ (visited on 15/01/2025).

[4] B. O'Brien. ``How much weight/day should dairy-beef calves be gaining?'' (2024), [Online]. Available: https://www.agriland.ie/farming-news/how-much-weight-day-should-dairy-beef-calves-be-gaining/ (visited on 15/01/2025).

[5] W. Oaks. ``The average cost to buy and raise calfs.'' (2022), [Online]. Available: https://farmpertise.com/how-much-does-a-calf-cost/ (visited on 15/01/2025).

[6] FarmingUK Team. ``UK beef deadweight prices surge to new record high.'' (2024), [Online]. Available: https://www.farminguk.com/news/uk-beef-deadweight-prices-surge-to-new-record-high_65400.html (visited on 15/01/2025).

[7] J. Keyes. ``A.I. versus natural service: An economic comparison.'' (2023), [Online]. Available: https://www.agproud.com/articles/56869-ai-versus-natural-service-an-economic-comparison (visited on 15/01/2025).