Breeding and management strategies to improve fertility in dairy cows

D Claire Wathes, BSc, PhD, DSc.
Royal Veterinary College, University of London
UK

dcwathes@rvc.ac.uk

Populations of Holstein-Friesian cows generally have an average lifespan of around 3.0 lactations with a culling rate of around 25%, primarily due to infertility, poor health and low milk production. Infertility problems in dairy cattle are multifactorial and are associated with adverse genetics (cow type), reproductive inefficiency, poor nutritional management and ill health. Many problem are initiated in the peripartum period when a combination of high yield together with an inadequate dry matter intake causes metabolic disease. This impacts on the welfare of the cow, the economic performance of the farm and environmental sustainability. Losses due to infertility require a large number of replacement animals to be reared to maintain herd size, increasing the total dairy cattle population. Conversely, improvements in fertility can reduce the animal numbers required to produce the same amount of milk. Tackling these issues necessitates a multifactorial approach, including developing a herd health scheme, altered management, more targeted veterinary intervention and careful choice of breeding goals to ensure that the replacement heifers can perform well under the particular farm system in place. An initial requirement is to ensure that the replacement heifers calve for the first time at the optimum age of around 24 months having achieved 90% of their mature body weight together with a sufficient frame size. These factors have been shown to promote good subsequent health, fertility and milk production which together maximise survival time in the herd. Negative energy balance occurs in early lactation when the feed intake does not meet the nutrient requirements of milk production and so cows mobilise body tissue to support the deficit. Glucose homeostasis is challenged and high levels of circulating non esterified fatty acids (NEFAs) contribute to liver disease. The circulating concentration of hepatic derived IGF1 is strongly related to the extent of the energy deficiency and multiparous cows in which the IGF1 concentration falls below 25 ng/ml in early lactation are significantly less likely to conceive again. In part this is due to direct signalling effects at the level of the reproductive tract as IGF1 plays a critical role in follicular maturation, embryo development, oviductal function and establishment of the placenta. In addition, the immune system is compromised as mounting an efficient immune response is energetically demanding. This makes cows more susceptible to any infectious diseases to which they are exposed. A high incidence of endometritis is the best known consequence. Cows are unable to clear uterine bacterial infections in a timely manner after calving and persistent inflammation of the endometrium is associated with delayed conception and a greater likelihood of failure to conceive at all.

Clinical mastitis and lameness are also associated with reduced fertility. All of these issues can be improved by optimising the nutritional management of the cows during the dry period. In addition, many of these problems can be reduced by breeding more robust cows. There is a negative genetic correlation between milk production and fertility. This influence is most apparent in multiparous cows which have the genetic ability to mobilise body tissues rapidly to sustain a high peak yield. Most countries have now followed the approach lead by Scandinavian breeders, in using a combination of traits in addition to milk output in their selection indices. The UK £PLI now includes production, survival, fertility, udder and leg health, calving ability and efficiency traits. There is also a separate fertility index which is calculated using calving interval, non return rate at 56 days, body condition score, measurement of milk yield around insemination (110 days), days to first service and total number of serves per conception. Promotion of bulls selected in this way has resulted in a reduced national calving interval, which has fallen from 432 days in 2009 to 405 days in 2017. There is, however, still a long way to go to get closer to the 365 days which is often considered optimum, particularly in seasonally calving herds. Many bulls are now chosen using genomic selection based on their DNA profile. However, genetic correlations with fertility remain low. This is in part becuse the trait of "fertility" encompasses many reproductive parameters (e.g. calving ease, heat intensity, non return rate) most of which are regulated by different genetic pathways. Future improvments in selection for fertility should become possible if more reliable phenotypes become available through improved recording schemes. One area where progress is being made is in undertanding the gentic contributions to embryo mortality. Embryo transfer studies indicate that about 30% of failures in early pregnancy are due to the embryo itself rather than to the environment in the dam. This can be caused by breeding two animals carrying the same embryo lethal recessive variant, in which 1 in 4 embryos will be non viable homozygotes. Such mutations can now be identified by screening populations for "missing" homozygotes using SNP chips or Whole Genome Sequencing (WGS) data. In summary, fertility problems are nearly always multifactorial and may vary between different groups of animals. Careful analysis of the herd data can help to pinpoint the most important issues on each farm and realistic goals should then be set to overcome these. These goals are likely to involve both improvements to particular aspects of management and careful choice of sires in order to breed suitable and healthier herd replacements.