Fertility performance assessment of broiler breeder flocks

At a time when production costs are rising, output efficiency has never been more critical to a producer's financial return. One way to ensure that the reproductive flock performs optimally is by conducting a real-time fertility assessment to estimate the performance. If required, this can save losses and money through early intervention. However, more importantly, it can be used to determine why some flocks may not perform as they should.

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Several factors may cause poor fertility within a breeder flock. Quite simply, one reason for poor or lower-than-expected fertility is due to the male. Such as the male's age, fertility usually declines from post-peak. Fertility has declined over the last few decades below the recommended management manual.

This is mainly due to the intensive selection for body weight, which results in decreasing reproductive traits. However, this could likely be a genetic issue if many mortalities or embryonic deaths occur.

Other problems include nutrition, drugs or toxins in the feed, disease, or poor leg and foot conditions. This emphasises the need to examine a flock throughout production, which can be done by several methods, as discussed below.

Understanding embryo mortality

It is essential first to check that eggs contain an embryo and then assess its status. To clarify, 'clears' do not have a viable embryo inside the egg.

This can either be a true infertile, the egg has not been fertilised, or a fertilised egg, but the developing embryo has died in the first week of incubation.

This is defined as 'early embryo mortality' and happens before. It is usually related to a nutrition or disease issue in the breeder flock, egg handling, or hatchery issues, such as temperature fluctuations.

A rate of around 2.5-5.5% embryonic death is expected in this period and cannot be avoided. As many authors have indicated, when analysing clears, it is crucial to distinguish between true infertile eggs and early embryo death.

After an embryo dies, it deteriorates over time; therefore, the longer an egg is incubated, the more difficult it becomes to distinguish early dead from infertiles.

Complexity increases when high 'late embryo mortality' levels occur between days 17-19. The embryo has survived this period, so conditions have been optimal up to this point.

Still, there may be a change in the hatching condition, such as extremes in temperature for extended periods (more than 24 hours) or contamination.

Humidity plays a lesser role. Other reasons could be that the chick was weak (due to nutritional deficiencies or poor incubation conditions in the early stages of development) and could not physically hatch through the shell.

Most common nutrient deficiencies result from marginal vitamin levels in the diet and usually cause weak chicks with difficulty hatching without other symptoms.

It is possible that the embryo died from exhaustion due to prolonged overheating (after days 10-12), insufficient development due to permanent low temperatures, or temperature fluctuations in the setter.

Critical points in the embryo's development, such as the phase of gut absorption (days 16-19) or yolk sac absorption (day 20), helps identify the moment the embryo dies.

All embryos in the hatcher are in the late phase and highly sensitive to overheating and shortage of oxygen. Hatching takes several hours, so it requires a delicate balance between good ventilation and a comfortable environment; both must suit the hatched and as-yet unhatched chicks.

Calculating the fertility performance

Fertility status can be calculated using Reproductive Efficiency Values, a list of commonly used formulas (Table 1); these have been taken from Wilson (2002). Below are a few examples of formulas that can be used.

The methods below can be used to strengthen the hatchery-breeder quality control programme. Training can be provided so farmers can understand the results and introduce new management strategies if required.

Continued on page 9

Continued from page 7

Breakout analysis

Breakout analysis carefully examines eggs by opening the egg to understand the embryo's development stage or at what stage of incubation embryo mortality occurred. It can be carried out at any stage through incubation and is the quickest method to estimate fertility.

When the flock starts to lay or if the flock is being treated for a disease or fertility issue, this is a useful method. However, this method has disadvantages as it needs to gain valuable information on other reproductive failures such as embryonic mortality, contamination, or hatch of fertiles.

An infertile yolk will be brighter than a fertile yolk. The albumen of an infertile egg is thicker than the albumen of fertile eggs. An infertile yolk is held in the centre of the egg white, while a fertile yolk might sink near the pointed end.

It is imperative to note that this procedure uses valuable eggs; given the cost of day-old chicks, this can be very expensive. Furthermore, as this is a real-time evaluation of flock fertility, it uses a small sample of eggs, which may not gain a complete representation of the entire breeder flock and lead to sampling errors or misinterpretations. This method is more suited to a trial situation.

Candling

Candling can be carried out on large trays (multiple eggs assessed at once) or by spot candling (individual eggs assessed). Under industrial production conditions, candling offers more accuracy and affordability in determining fertility.

It can also be performed as early as five days, but more accurately between 9-10 days.

Early candling is usually applied if the level of fertility is uncertain, either very young or very old parent flocks.

When entire trays are candled, it is more time efficient; clear eggs indicate either infertile or early embryo mortality as they appear more luminescent when candled, while a fertile egg appears dark with noticeable blood vessels near the air cell. Therefore, these can be removed and broken out.

When a spot candle is used, this is slower but more accurate. Also, eggs set upside down or cracked are easier to distinguish and then be rectified.

The advantage of this method is that it does not destroy potential hatching eggs, and a bigger sample size can be used, which increases the accuracy percentage.

The disadvantages are that there are no results until nearly 14 days after lay, and internal egg quality issues are challenging to see.

Parameter	Formula and Example
Fertility (%)	100 – (Number infertiles/sample size) x 100
Example	100 – (50/672) x100 = 92.56%
Hatchability (%)	(Number hatched/number set) x 100
Example	(23,160/28,600) x 100 = 80.98%
Hatch of Fertiles (%)	(Hatchability/Fertility) x 100
Example	(80.98/92.56) x 100 = 87.49%
Spread	Fertility – Hatchability
Example	92.56 – 80.98 = 11.58
Estimated Hatchability (%)	100 – Reproductive failures (%)
Example	100 – (7.44 + 4.17 +0.30 + 2.08 + 1.04 + 0.74 + 0.30 + 0.30 + 0.74 + 0.30) = 81.85%
Sample Index	Estimated hatchability (%) – Hatchability (%)
Example	81.85 – 80.98 = 0.8

Table 1. Example of reproductive efficiency formulas used to quantify flock fertility.

Therefore, if flock intervention is required, this is delayed considerably. What is vital to the hatchery manager is whether the embryo died early in the first days, in the middle of the process, or at a late stage. For analysis, it is preferable to open eggs from the blunt side to classify the contents.

Mitigation

The embryo's growth and development depend on the nutrient deposits in the fertile egg.

The chick embryo derives all its nutrient requirements from the albumen and yolk (lipids and the primary energy source) during incubation.

All these factors greatly depend on egg weight, genetic strain, and hen age. Therefore, the mineral nutrition of the hen has a pronounced effect on the progeny performance.

Males' spiking can be used to improve fertility; this involves introducing young roosters into the flocks, where the existing males are over 40 weeks of age.

This encourages the older males to mate again while the young spiking males acclimatise to the house. Then when they begin to mate, their rate overtakes the older males, thus increasing fertility rates.

A high number of infertile eggs could be due to elevated-stress levels among male birds.

Within a breeder house environment, it can lead to male and female stress. Stress can have detrimental effects on sperm viability due to oxidation.

Delacon has been shown possible solutions to relieve this issue. The modes of action of the phytogenics allow for better antioxidant properties and therefore improved sperm quality. Improved sperm quality will increase the fertility rates within the flock.

A trial conducted feeding a phytogenic feed additive from Delacon in Hubbard broiler breeders between ages 43 and 53 weeks of age provided a 5% fertility improvement and enhanced the hatch of fertile by 2% and 6% in hatching rate at the trial's end. ■

References are available from the author on request