Aviagen

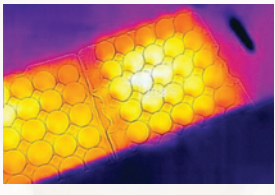
Hatchery TIPS 28

THERMAL IMAGING CAMERAS

Thermal imaging cameras used to be large, heavy and very expensive. In the last few years smaller, much more affordable versions have become available, often as attachments for a mobile phone. This has opened up new possibilities for investigating egg handling and holding conditions. Allowing hatching eggs to cool down promptly and evenly, and to stay cool, is very important if the eggs are to hatch well. Starting when eggs are collected from the nests, we need to make sure that embryo development is completely paused. Do we really know if all our fertile eggs are kept under ideal conditions? There may be thermometers or temperature sensors in a farm egg room or hatchery egg room that indicate temperatures in a limited number of locations, but we do not get a full picture of the thermal environment to which the eggs are exposed. Nor can we see how the cooling eggs interact with the environment.

Thermal imaging has proved to be a valuable tool for investigating not only the environment where the eggs are stored but also egg temperature in different locations within the trolley, egg boxes or pallet. All objects emit infrared radiation (heat) that is invisible to the human eye, but can be captured by the thermal imaging camera. The camera software then converts the temperature into colours depending on the surface temperature. The final result is a picture where each colour represents a specific temperature. Thermal imaging can be used to audit egg handling practice and conditions in farms and hatchery egg stores.

The picture, left, shows uneven temperatures in between the eggs in a farm storage room. The dark blue spots show the coldest eggs, while the orange eggs are still warm. In this case we can see that very warm eggs are brought inside the room and are being stacked on the top of eggs that are already cold, which can be a problem – each additional layer of warm eggs will re-heat the eggs that have already cooled down. Just looking at the egg room (right) and the read out of the room thermometer, we would not be aware that the situation is occurring and the problem would only be detected when pre incubation is seen when opening fresh eggs. Thermal imaging can also be useful to show if the eggs are being boxed while they are still warm, which can also cause pre incubation in the farm or during transport. Eggs should always be allowed to cool down before being boxed into cardboard boxes. Cardboard is an effective thermal insulator and will slow cooling of the eggs if they are put into the boxes still warm. The picture, left, shows eggs that were not allowed to cool down before being boxed. They arrived in the hatchery still warm.



In the hatchery, the thermal imaging camera can be used to check that a delivery of eggs is at the correct temperature, and that all the eggs in the delivery are of a uniform temperature. Getting this stage right gives a better hatchability, because all the embryos will be properly cooled at the same time. It will also minimise the hatch spread within a batch of eggs.

First published in International Hatchery Practise volume 32.2

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Hatchery TIPS 29

MEASURING CHICK YIELD CORRECTLY

Most commercial hatcheries now measure and use chick yield as a Key Performance Indicator (KPI) to evaluate both hatch timing and incubation. But are you recording your chick yield correctly? Chick yield is the average weight of the chicks at pull, expressed as a percentage of the average egg weight at set. It tells you when the eggs are losing enough water during incubation, and also whether the chicks are being pulled at the right time at the end of the hatcher period. It is usually measured on sample trays – two or three trays per farm per set. It is worth auditing the procedure regularly to make sure that the method being used is correct, and has not drifted over time, or with changes in staff.

At the start

- The fresh egg weight is based on the average weight of the eggs on a full setter tray. The empty tray weight must be measured and recorded, and subtracted from the full tray weight every single time. Even in a new hatchery, tray weights will vary; and, once they have been topped up to replace damaged units, it is highly likely that there will be between-tray differences in weight.
- Check the eggs on the sample trays before they are weighed, including a quick pass over a candling table. Remove and replace any dirty eggs, any with abnormal shells and any broken or hairline-cracked eggs before the full tray is weighed. When setting these trays, make sure to place them in different representative locations in the setter, distributed top to bottom and front to back of the incubator. Record setter number and location.
- Calculate average fresh egg weight (1).

1

$$\frac{\text{Weight of full egg trays - weight of empty trays}}{\text{Number of eggs in the tray}}$$

At transfer

- When transferring, make sure to move the labels correctly to each hatcher basket so that the final chick weight can be associated with the correct initial egg tray weight.

At hatch

- Chicks should be weighed immediately after they are removed from the hatcher.
- Before weighing any chicks, place an empty chick box on the scales and zero (tare) the display. Skipping this step will give an artificially high chick weight.
- It is important to count all the first class chicks from each labelled hatch basket into the empty box one group at a time. Record the number of chicks and the weight.
- Do not weigh cull chicks as they will not be typical of first class chicks on the tray, and so will affect the average weight.
- Calculate average chick weight for each tray (2).
- Calculate chick yield % (3).

2

$$\frac{\text{All chicks weight in the box}}{\text{Number of chicks in the box}}$$

$$\frac{\text{Average chick weight}}{\text{Average fresh egg weight}} \times 100$$

Record all the background details on a spreadsheet, along with the weights and calculated yield. This will allow you to check which machines are delivering the best chick yield, and to focus attention on the machines which need adjustment. The ideal chick yield for broilers placed on the farm the same day is 67-68%.

First published in International Hatchery Practise volume 32.2

HEAT TREATING STORED EGGS

Aviagen's early SPIDES trials were aimed at defining the safe limits for heat treating eggs during storage – how long, how often and how hot the treatments should be. In these trials, we held eggs for 21 days, and gave up to five treatments during the storage period. We found that in this situation, individual treatments were best kept as short as possible. If we pushed the length and number of treatments too far, hatchability got worse. Fig. 1. shows the percentage of lost hatch that was recovered after different treatment combinations, compared in terms of the cumulative time the egg shell temperature was held above 32˚C (EST>32˚C).

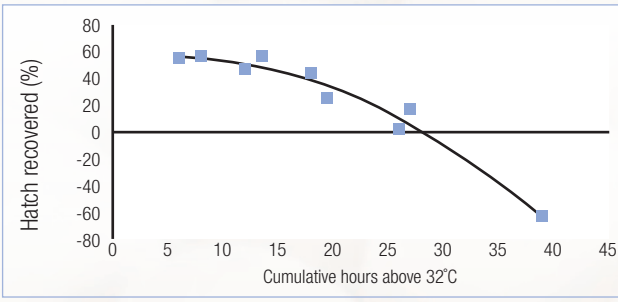


Fig. 1. Percentage of lost hatchability due to storage recovered after multiple SPIDES treatments.

We showed that hatch recovery was achieved in any treatments where the cumulative time above 32˚C was between 6 and 24 hours, but that the optimum effect was seen when the cumulative time above 32˚C was 12-15 hours. There was a steady deterioration in the hatchability recovered for treatments above 15 hours, which dropped to no benefit when EST>32˚C was over 26 hours and almost complete hatch failure when the cumulative treatment time was 39 hours.

The trial summarised in Fig. 1. does not show what impact, if any, there might be in further shortening the cumulative exposure time from six hours. However, some recent trials which were performed in collaboration with Prof Okan Elibol at the University of Ankara have shown that shorter treatment times can also be suboptimal.

These trials were done using a Petersime Re-store cabinet, and a storage period of 14 days. The eggs were treated once only, on the fifth day of storage, and were given either 3.5 or 5.5 hours above 32˚C EST. There were three repetitions, using eggs from flock ages of 37, 54 and 55 weeks. There was no fresh egg control in these trials; so it was not possible to calculate how much hatch was lost due to storage, or the percentage recovery. However, in each of the three comparisons, a single exposure of 5.0-5.5 hours gave a higher hatchability than the shorter exposure of 3.0-3.5 hours.

When designing a SPIDES programme, for optimal results the treatments should be set up so that the cumulative EST>32˚C is between five hours and 15 hours.

First published in International Hatchery Practise volume 32.3

CHICK WEIGHT LOSS POST PULL – WHAT IS NORMAL?

Chicks have a natural powerful robust provision when they hatch, the yolk sac, which keeps them well supplied with food and water for a number of days until they start consuming feed and drinking water for themselves.

After chicks hatch it is normal for them to lose some weight. Some of that loss will be due to the residual yolk being used up, some will be meconium passed through the vent and some will be moisture loss as they breathe.

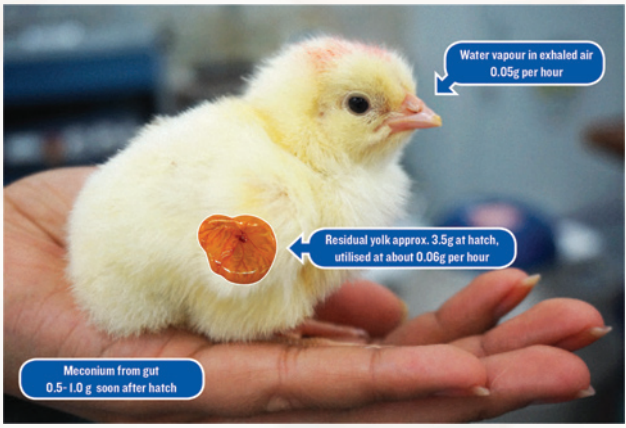
If the interval and the environment between take-off and placement on the farm are good, then the weight loss is likely to be very small. However, it is useful to have some idea of what is normal weight loss when assessing situations where things have not gone as planned.

Recently, we compared weight losses of hatchling chicks across two trials. In the first, the chicks were removed from the hatcher within six hours of emergence, and kept for 24 hours in a climate respiration chamber held at 91.4F (33.3C) and 40-60%RH. In the second, the chicks were pulled at the end of the hatcher period after approximately 504 hours incubation and held in chick boxes in the hatchery, also for 24 hours. Hourly weight loss over the 24 hours post hatch was 0.11g in both trials.

In summary, the picture below shows the normal losses under optimal environmental conditions which keep the chicks comfortable: around 0.05g/hour water vapourisation in exhaled air. Furthermore, the meconium will leave the gut soon after hatch, which means a loss of about 1g. Then, in addition, chicks have in their yolk sac residual yolk of about 3.5g at hatch, which will be used at a rate of about 0.06g per hour. After 24 hours, the chicks had lost between 9 and 10% of their weight at take-off.

In the field, under less optimal holding conditions, higher weight losses in 24 hours are often observed. This is especially common if the chick holding area is too hot. Chicks will start panting, a common mechanism to get rid of surplus heat, if their vent temperature reaches 105°F (40.5°C). Panting chicks will lose more weight and this is probably one of the factors causing dehydrated chicks when they are observed in the field.

Sources of weight loss in the hatchling chick



First published in International Hatchery Practise volume 32.4

HOW TO CALIBRATE AND USE TEMPERATURE READINGS

Over the last 20 years, the importance of controlling embryo temperature, as indicated by egg surface temperatures (EST), has become well understood. It is now very simple to record EST, using miniature data loggers with an external flexible thermistor probe, such as Tinytag made by Gemini Data Loggers (www.geminidataloggers.com).

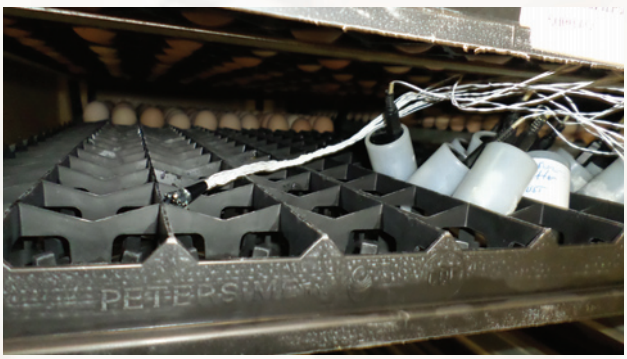
Temperature loggers will save records of EST within a setter, the data can be analysed and displayed in different ways and the record can cover the entire time eggs are in the setter. Their unit cost is low enough that several can be set up in a machine to assess temperature variability.

Their main disadvantages are that the loggers cannot be read in real time (newer models can be read in real time through a wifi or radio link, but they are more expensive), the records are accurate only to 0.5˚C and the probes cannot be recalibrated by the user. However, there is a way to check a batch of loggers so that differences between loggers can be identified and corrected as necessary.

Checking between-logger variability

Tinytags do not have a calibration option. However it is possible to check the variability of readings obtained within a batch of loggers, and correct the temperatures recorded using a simple excel calculation. For this purpose:

- Identify each thermistor/logger with a number.
- Hold all the thermistors together using adhesive tape and place them into a setter containing 2-4 day eggs for at least an hour (as shown in the picture below).



- Download and export the data from all the loggers into Excel.
- Calculate the average temperature readings of the last 30 minutes for each logger.
- Take one logger as the reference (the one closest to the average) and calculate how much each of the others loggers differ from this reference probe.
- Install the loggers in a setter for a full run.
- After completing the run, apply corrections to each logger before any further analysis.

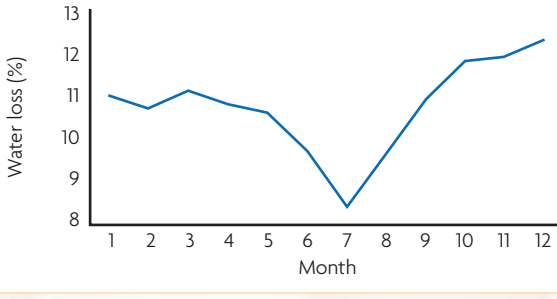
Once corrected, the EST values can be plotted versus time, to show where hot and cool spots lie within the machine, and also how temperatures change and become more variable during incubation.

First published in International Hatchery Practise volume 32.5

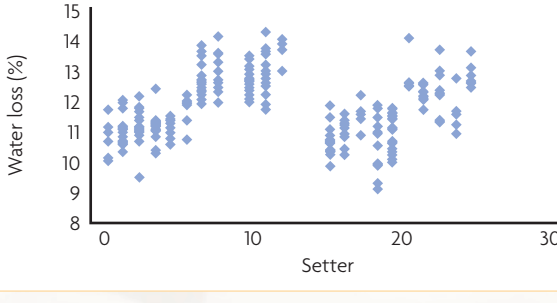
USING WATER LOSS DATA TO ASSESS SETTER FUNCTION

The water loss of hatching eggs will affect hatchability and chick quality. The ideal weight loss from 0-18 days is between 10.5-12.5%. The main factor affecting incubation water loss is the humidity of the air in the setter. Most hatcheries monitor water loss and use it as an effective management tool to fine tune setter humidity programmes. But sometimes, the water loss varies between machines or in different hatches over time, even when the setters are all running with the same humidity programmes and set-points. When this sort of variability is seen, it is usually because the humidity levels achieved in the setter have been affected by factors such as the humidity of the fresh air coming in to the setter, its ventilation rate or the functionality of the humidifier inside the machine. If one of these factors has changed even slightly, or is not working properly, water loss may change. So we can also use water loss data to assess the functioning of a hatchery.
Here are some examples.

● This was in a hatchery located in a temperate climate. The air supply to the setters was not humidity controlled. But warm air in the summer can hold more moisture, so actual incubation humidity is much higher and the eggs lose less weight.



● A different hatchery, again in a temperate climate. This hatchery had four setter rooms. Room 1 held setters 1-6, room 2 setters 7-12, room 3 setters 15-19 and room 4 setters 20-24. Setter rooms 1 and 3 shared one exhaust plenum. Setter rooms 2 and 4 shared another. After the exhaust fan was changed on the plenum for setter rooms 2 and 4, incubators in these two rooms were ventilated more than the others, causing relative humidity to be lower and as a result the eggs lost more weight.



These examples show how the local environment can affect humidity in different parts of the hatchery. If the issues are not identified and corrected, water loss will not be in the optimum range, and hatchability and chick quality will suffer.

First published in International Hatchery Practise volume 32.6

HOW TO CALCULATE WATER LOSS CORRECTLY

Correct egg water loss during incubation is important for hatchability and chick quality. Water loss is controlled by incubator humidity and critical to correct measurement of egg water loss is the correct calculation.
Water loss is the average weight of the eggs at transfer expressed as a percentage of the average egg weight at set.

It is usually measured on three sample incubator trays from each breeder flock in each set. Trays should be placed in the incubator so that one is positioned near the top, one near the middle and one near the bottom of the incubator rack.

Based on the procedure, water loss can be calculated as;

$$\text{Water loss \%} = \frac{\text{Full tray weight at set} - \text{Full tray weight at transfer}}{\text{Full tray weight at set} - \text{Empty tray weight}} \times 100$$

If incubated correctly, eggs lose on average 11-12% of their weight by transfer at 18 days. Although the calculation by itself is simple, there are some important points to be aware of for the accuracy of calculations:

● Do not use a standardised weight for the empty trays. Setter tray weight can differentiate depending on tray production lots, quality of materials, degradation over time etc. To have an accurate result, empty trays must be weighed for every batch of eggs.

● Do not include dirty eggs with abnormal shells and broken or hairline-cracked eggs. These eggs will lose more water and consequently show higher water loss than normal.

● If egg transfer is not done at 18 days, the calculated water loss needs to be corrected to 18 days for accuracy and appropriate quality control. Example: Eggs are transferred at 19 days and water loss is 12.5%. Water loss corrected to 18 days can be calculated as:

$$(12.5 \div 19) \times 18 = 11.8\%$$

● During storage hatching eggs will lose about 0.5% per week and this number should be included in the total loss at transfer. For example: If the eggs lose 11.8% between setting and transfer (18 days) but are stored for one week before setting, the total moisture loss between laying and transfer will be 11.8 + 0.5 = 12.3%.

Egg water loss measurement has been implemented in most commercial hatcheries as a powerful tool of quality control for the incubation process. In order to have good information, correct calculation is critical to obtain accurate results.

First published in International Hatchery Practise volume 32.7

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CHECKING FRESH EGGS FOR UNWANTED EMBRYO DEVELOPMENT

The best way to look after hatching eggs is to collect them from the nests as often as possible (ideally 4-5 times per day), disinfect the shell surfaces, let them cool evenly and slowly and then hold them at around 15˚C until they are placed in the setter. It is important that conditions are even throughout the mass of eggs, and that temperatures are not allowed to fluctuate. It is especially important to keep the eggs below physiological zero – the temperature above which embryo development is possible.

When eggs cool unevenly, some of them will develop a lot further than others. After 18 days of incubation this range will be enough to widen the hatch window significantly, with the quality of the earliest hatching chicks suffering accordingly. Eggs held at temperatures that fluctuate around 20-24˚C will show distinct signs of embryo development which, if allowed to persist for too long, will give higher levels of early embryo mortality. A max-min thermometer read twice a day and the results plotted manually on a daily graph will tell you if the storage room is suitably insulated, cooled and heated for the local climate.

At a biological level, it can be helpful to look at the embryos directly, using hatching eggs from the flock of interest (do not use floor or cull eggs; they will have been held under different conditions to the hatching eggs). The work must be done in an area with good bright light. Label each egg to show date, flock and location it was taken from. Use forceps to make a small opening at the very top of the large end of the egg. Remove the shell and membranes around the hole, to expose the germinal disc without damaging it (the yolk will always float so that the germinal disc is at the top, so will be easy to find). Check that the egg was fertile and sort the fertile embryos into order of size.

When the egg is laid there will be 30-60,000 cells in the blastoderm, which will have reached stage x of development. Unmagnified, the embryo will look like a ring doughnut, with a transparent area in the middle of the ring. Once the egg is laid, provided that holding conditions are correct, there should be no more development. However, if the rate of cooling is uneven, or the eggs are held in fluctuating temperatures then some or all of the embryos will continue to develop.

Some embryos will have developed past the stage where they would survive the holding period, and even those which would be able to start developing again will develop to produce a very wide, hatch window. To stop this pattern being a regular part of embryo development in your hatchery, check sample eggs from positions you have concerns about and correct the problem as soon as possible.

Eggs opened in the hatchery after uneven cooling, showing very variable embryonic growth.

First published in International Hatchery Practise volume 32.8