The effects and management of improper incubation conditions

by Jiggs Killgore and Nicolas Neyra, Hubbard.

Incubator temperature and humidity profiles in single stage incubation are selected for proper embryo development, hatchability, and quality based on average conditions throughout the entire machine. Often little consideration is given for the tray level or zone effects that can commonly occur within most incubators that are on the market today.

These differences in temperature throughout the machine can have a major effect on internal egg temperatures. Improper egg temperature can lead to problems with hatch of fertile, moisture loss, and retained yolk weights and chick quality in general.

Results from monitoring internal egg temperatures at transfer in our operation have shown that eggs in the top tray level are on average 0.32°F warmer than eggs in the bottom tray levels next to the floor.

This difference in temperature has resulted in a better hatch of fertile from those trays.

The top 10 trays on the front and back of the incubator racks have on average a 2.60% better hatch of fertile than eggs from the bottom 10 trays. Therefore the goal is to monitor, control and reduce this difference in temperature from the top to bottom tray levels.

In addition, this top to bottom temperature difference results in an average of 0.246% greater moisture loss from the top trays as shown in Fig. 3.

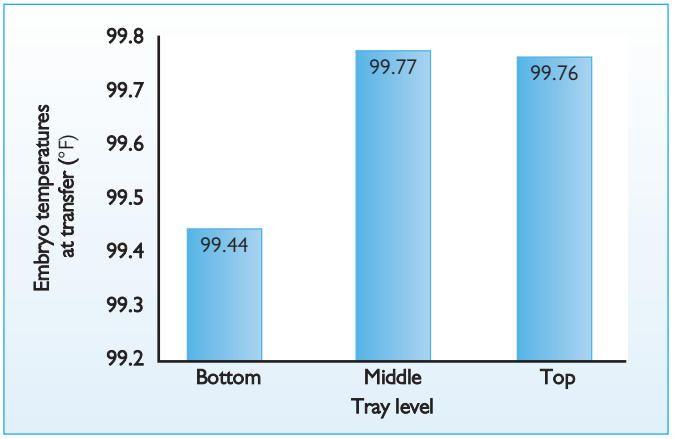


Fig. 1. Temperature difference from the top to bottom trays.

Our studies have shown that a higher moisture loss leads to smaller retained yolks in hatched chicks. The moisture loss and retained yolk sac share an inversely proportional relationship as greater moisture loss lead to less retained yolk and less moisture loss leads to a greater retained yolk sac.

Fig. 4 shows the relationship between total moisture loss and percent retained yolk sac. Once the yolk was removed there was no correlation between moisture loss and carcase weight.

This leads us to believe that this moisture is lost from the yolk of the egg. This loss of retained yolk can cause the young chick to have less reserve during its post hatch fasting period (sexing, processing, delivery, etc).

A balance of proper internal egg temperatures during the entire incubation process must be achieved. The internal egg temperature must be warm enough to maintain proper chick development, without creating too much moisture loss.

- **Day 1 to 10.**

Internal egg temperature should be maintained at 100-100.5°F (37.8-38°C).

- **Day 11 to transfer.**

Internal egg temperature should be maintained at 99.5-100°F (37.5-37.8°C). The greatest challenge is reducing the single stage profile step program temperature as the embryos become the heat source for incubation.

Often temperature zones that are below target are created in the bottom tray level positions due to improper air circulation and the basic principle that heat rises.

Tray level monitoring

Rack and tray level monitoring is necessary to identify and correct possible temperature variances throughout incubation.

Egg temperatures at transfer and during incubation should always be taken and recorded at the top, middle, and bottoms of the racks.

Recording embryo temperatures at each transfer ensures consistency of machine operations and establishes proper trends in the incubation process. Winter months require more heat at certain stages of incubation. Temperature modifications should be implemented after numerous internal egg temperatures are taken, monitored and recorded to show average embryo temperatures.

After profile changes are made, repeating the monitoring process is required to ensure ideal incubation.

Continued on page 8

Fig. 2. Hatch of fertile comparison from top to bottom trays.

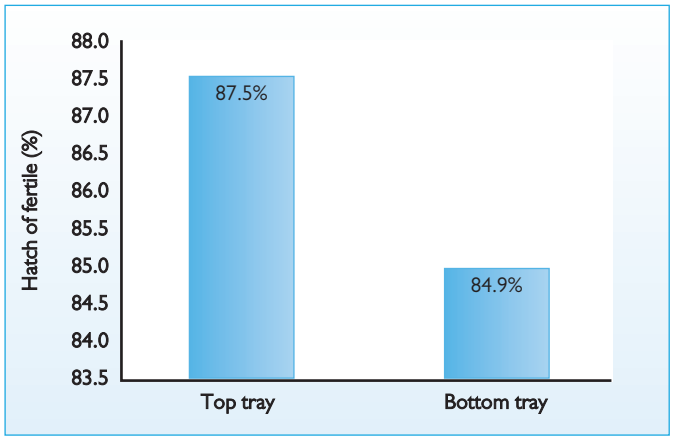
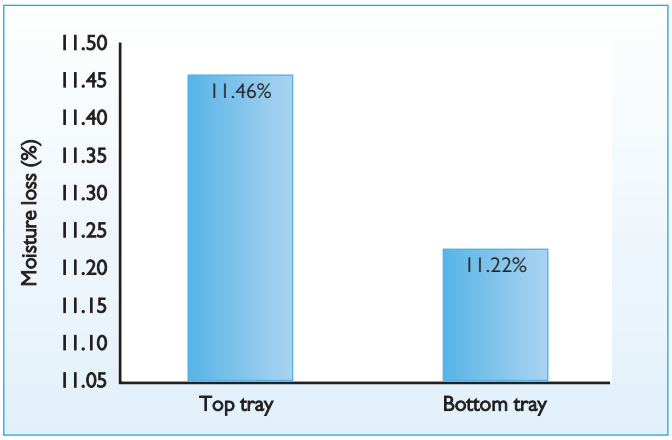


Fig. 3. Moisture loss comparison from top to bottom trays.



		Rack 2		Rack 4		Rack 6		Rack 8		Rack 10	
D:H	T (°F)	TN	T (°F)	TN	T (°F)	TN	T (°F)	TN	T (°F)	TN	T (°F)
(-) 8:00	88.0	7	100.4	14	100.4	9	100.2	16	100.6	2	100.1
0:00	100.7	7	99.8	14	99.7	9	99.5	16	99.9	2	99.7
1:18	100.5	7	99.6	14	99.6	9	99.6	16	100.0	2	99.8
4:00	100.3	7	99.3	14	99.4	9	99.3	16	99.2	2	99.1
5:18	100.0	7	99.1	14	99.3	9	99.0	16	99.5	2	99.3
9:12	99.8	7	99.2	14	99.3	9	99.2	16	99.4	2	99.3
10:18	99.5	7	99.5	14	99.4	9	99.3	16	99.6	2	99.3
12:00	99.2	7	99.2	14	99.3	9	99.5	16	99.3	2	99.0
13:00	98.9	7	99.2	14	99.2	9	99.3	16	99.2	2	99.0
14:00	98.7	7	99.0	14	99.0	9	99.3	16	99.3	2	99.2
15:18	98.6	7	99.9	14	99.7	9	100.0	16	99.8	2	100.0
16:18	98.4	7	101.0	14	100.0	9	100.0	16	100.0	2	101.0
17:18	98.2	7	99.8	14	100.0	9	100.0	16	100.0	2	100.0
19.06	98.2	7	100.0	14	99.9	9	99.3	16	99.8	2	100.0
19.12	98.0	7	101.0	14	99.9	9	101.0	16	100.0	2	101.0
19.18	97.8	7	99.4	9	99.3	11	99.5	1	99.4	8	99.5
* Lowered profile to 98.4						* Lowered profile to 98.2					
TN: Tray Number						T (°F): Temperature ° Fahrenheit					

Table 1. Internal egg temperatures at rack and tray level positions (taken to establish the proper and current incubator profiles).

Table 2. Seasonal profiles changes are also necessary for proper incubation with the appropriate temperature, humidity and damper control parameters.

Set #	Temp	Day/hour
1	88.0	-00.06
2	100.7	00.00
3	100.5	01.18
4	100.5	04.00
5	100.3	05.18
6	100.0	09.12
7	99.8	10.18
8	99.5	12.00
9	99.2	13.00
10	98.9	14.00
11	98.7	15.18
12	98.6	16.18
13	98.4	17.18
14	98.2	19.06
Humidity		
1	52%	00.00
Damper control range		
1	0-0	00.00
2	5-5	9.12
3	10-35	10.18
4	30-50	14.00
5	45-65	15.18
6	60-90	17.18

Examples of problems that ca

Egg handling, farm and hatchery management:
• Internal egg temperature should be checked at top, middle and bottom trays as they are received.
• If received eggs are lower than 60°F (15.5°C) egg holding temperatures at the farm must be adjusted.
• Egg room temperatures should be adjusted to compensate for seasonal changes. Example: Egg room set point in summer 64°F (17.5°C); in winter 67°F (19.5°C)

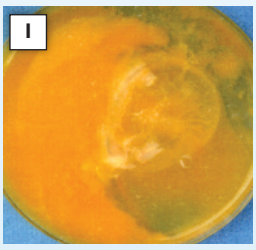
1 Mortality range (day 1-3):
• Eggs must attain a temperature range of 100-100.5°F (37.8-38°C), as soon as possible at the on-set of incubation.
• Pre-warming eggs as part of the profile will enhance livability percentages and reduce late dead mortality as a result of mal-position or abnormal embryos.

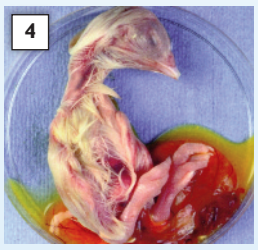
2 Mortality range (day 4-7):
• Internal egg temperatures must stay within the 100-100.5°F (37.8-38°C) target at this time; monitor these temperatures closely at the tray levels especially.
• Seasonal set-point changes are needed to ensure proper internal egg temperatures are maintained.
• Consistent temperatures during transfer and egg set (in multi-stage machines) must be maintained.

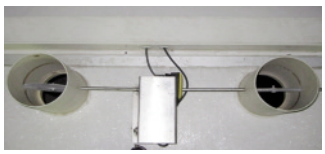
3 Mortality range (day 8-14):
• Correct reduction in incubation temperatures must occur during this critical time period; before 9-10 days: 100-100.5°F (37.8-38°C) as the embryo moves from accepting heat to after 10 days to transfer: 99.5-100°F (37.5-37.8°C) to radiating heat.
• Closely monitor to identify trends, by flock, incubator, etc.

4 Mortality range (day 15-18):
• Must have consistent incubation at this stage, at all tray levels: monitor closely at transfer: all trays should be 99.5-100°F (37.5-37.8°C).
• Abnormal embryos are normally associated with too much heat: normally in the 1-3 day old age embryo development stage.
• Mal-positioned embryos usually indicate below recommended temperatures.
Monitor the tray level position as these embryos will normally be in the bottom of the incubator.

5 Mortality range (day 19-21):
• Exceeded or did not attain the temperature goal of 99.5-100°F (37.5-37.8°C).
• Incorrect transfer schedules (19-19.5 days), transfer too soon: mal-position embryos (head-not-under-wing), transfer too late: excessive heat build-up.







The closed damper, above, and the open damper, below.

A few tenths of a degree can negatively impact the embryo's environment. In addition, intake and exhaust damper openings must be monitored for proper air circulation throughout the incubator and proper evacuation of carbon dioxide during incubation.

Damper maintenance is often neglected, but is critical to machine operation, temperature, air and humidity control.

The damper control and profile are important factors that maintain the air circulation and temperatures throughout the entire incubator, including racks and individual tray levels. We are as attentive to our damper profiles and management as we are to the temperature and humidity profiles.

Calibration of all machines must be performed regularly for proper temperature, humidity and ventilation.

Damper opening is programmed to be in a closed position for the first 9-10 days of incubation (the proper profile and position is critical for air-flow volume and proper CO2 concentration).

The open damper position percentage is critical from day 11 to transfer (for proper cooling, air distribution and humidity control).

At Hubbard we implement additional practices to help minimise the effects of inconsistent temperatures and humidities and to lessen the tray level zoning effect.

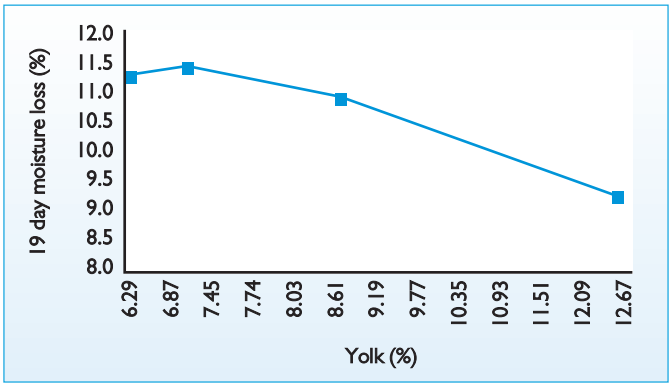
For example:

- A pre-warming schedule brings the eggs up to a uniform temperature before the incubation begins. 88°F (31°C) for six hours.
- If incubators are set short due to egg supply availability, the bottom trays are moved higher in the rack and away from the concrete floor, to utilise the trays with the better HOF capabilities.
- Set incubators at 100% capacity if possible, in order to provide the necessary heat in each machine for proper incubation, HOF and chick quality at all tray levels. Loss of hatch percentage, HOF, and chick quality can sometimes occur in spite of our best efforts. ■

Rack 1	Rack 3	Rack 5	Fan	Rack 7	Rack 9	Rack 11
Rack 2	Rack 4	Rack 6		Rack 8	Rack 10	Rack 12
	Door				Door	

Fig. 5. Example of incubator racks positions (internal egg temperatures are routinely taken from different racks for monitoring at transfer or for establishing the correct incubation profiles).

Fig. 4. Moisture loss vs. retained yolk sac.



Based on the work of Jiggs Killgore, director of hatcheries; Anthony Britt, hatchery manager; Nathaniel Collett, hatchery supervisor; and Nick Busey, hatchery intern, Hubbard LLC, Pikeville, Tennessee, USA.

n occur during incubation

6 Live pip:
• Inadequate total incubation hours (504 is still the target): incubation profile may be too cold.
• Can occur early in incubation (1-3 days): caused by a low early temperature, normally in the bottom trays: the embryo will use too much energy to incubate and become weak, which in turn increases the hatch window and spreads the hatch time from first to last chicks

7 Mal-position (head over wing):
• First week incubation temperatures too cold or too hot.
• Transfer times are critical: the embryo must be in the correct (head-under-wing) position for the in ovo vaccination schedule.

8 Anomaly/Abnormal:
• Incubation conditions: too hot (spiked heat): first week of incubation.
• Incubation conditions: too cold: first week of incubation.
• Pre-warm program needed: the difference between egg room temperatures and initial incubation temperatures may be too great for the embryo's survival.

9 Navel buttons:
• Occur mainly on late hatching chicks: high heat/humidity index in the hatcher.
• A spread in hatch window contributes to the problem: 'cold chicks'.
• Improper air-flow volumes through hatcher during actual hatch can contribute to navel buttons.
• Chicks in the cold bottom trays have the highest percent of navel buttons.

10 Navel wicks:
• Machine location (hatcher): Chicks with navel wicks often occur in trays adjacent to 'cold spots'.
• Ensure dry machines at transfer/ensure dry hatcher floors.

11 Red hocks:
• High humidity/low temperature throughout incubation: incubators and hatchers.
• The cooler bottom trays will lose less moisture. The highest percent of red hocks occur in the coolest tray level positions.

• Correct and uniform temperatures at all tray levels, is the most critical issue from the time the egg is received from the farm, during storage, and throughout incubation.
• Consistent monitoring is essential to produce viable chicks at hatch throughout incubation.
• Necessary profile or management changes must be implemented as soon as problems are discovered.