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Broiler Management in Hot Weather

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Summary

Broiler producers aim to attain the best performance from their flocks. In order to achieve this target, they must provide the environment and conditions that will allow the birds to express their genetic potential in a wide range of environments. This involves paying close attention to bird welfare, chick quality, nutrition, management, and environment.

Achieving genetic potential during periods of excessive or prolonged high environmental temperatures creates a particular set of challenges for the broiler producer. The key is to have facilities in which the environment can be controlled and to use specific management strategies that will help to minimize the impact of high temperatures on bird performance.

This document looks at providing advice on how to best manage flocks during periods of high environmental temperatures.

For further information on the management of Indian River® stock, please contact your local Indian River representative.

The remainder of this article provides more detail on the points summarized on page one.

THE IMPORTANCE OF STOCKMANSHIP

While methods of accurate data recording for growth, feed consumption, and mortality continue to evolve and are an important means of monitoring flock progress and highlighting when a problem exists, the use of stock sense must not be underestimated. Often, changes in behavior will be seen before a drop in production occurs and a timely response to behavioral changes can prevent a more serious issue from developing. Being aware of what is normal flock behavior for the environment the birds are in, and knowing when that normal behavior changes and what those changes mean, is a key part of determining whether the environment is correct for the flock.

HIGH TEMPERATURES IN THE HATCHERY -- PREVENTING DEHYDRATION IN CHICKS

The newly hatched chick cannot regulate its own body temperature very well. Chicks are therefore wholly affected by the air temperature, humidity, and air speed of their environment. To maximize genetic potential and bird welfare from day one, the temperature and humidity in the hatchery must be such that chicks do not become dehydrated. During periods of hot weather, it is even more important that conditions within the hatchery are correct. If external environmental conditions are hot, the chicks may be exposed to higher than normal brooding temperatures upon their arrival at the farm, and in some areas those high external temperatures will be combined with low humidity.

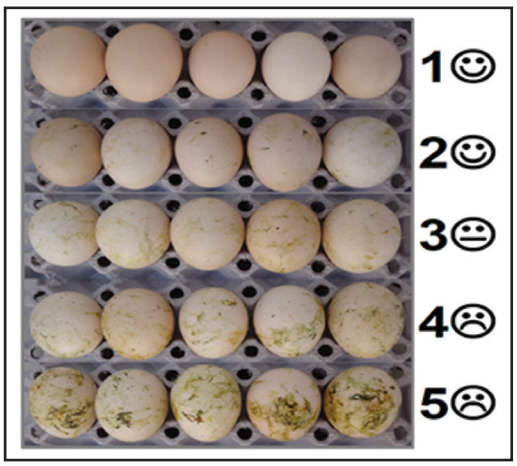
In the hatchery, the two main indicators that conditions are correct include:
- Chick yield (the weight of the chick at hatch as a percentage of egg set weight).
- Egg shell condition at chick take-off (meconium staining).

Ideal chick yield is between 67-68%. Chick yields of lower than 67% will result in dehydrated chicks, with little yolk reserve, that are very active and noisy.

There are three main reasons for having a low chick yield:
- High incubator temperature.
- Low incubator humidity.
- Chicks being hatched for a long time before take-off.

The degree of meconium staining on egg shells at take-off is a good indication of whether or not chicks have been held in the hatcher for too long and are therefore at potential risk of dehydration. The dirtiest egg shells from five randomly chosen baskets per flock should be scored for degree of meconium staining (**Figure 1**).

Figure 1: Egg shell meconium score at chick take-off.



Scores 1 and 2 should be the target.

CHICK COMFORT IN THE HOLDING AREA AND DURING TRANSPORT

In hot weather it is even more important to ensure correct conditions during chick holding and transport are achieved (**Table 1**) if subsequent broiler performance is not to be negatively affected. Temperature, humidity, and air circulation must be correct, taking care to ensure air does not blow directly onto the chick boxes.

Table 1: Summary of optimum conditions - chick holding and transport.

Temperature	22 to 28°C (72 to 81°F)
Humidity	Minimum 50% RH
Air Exchange	0.71 m^3/min (25 cfm) per 1000 chicks

The best way to monitor chick comfort at this time is through:
- Chick vent temperature.
- Chick behavior.

Optimum chick vent temperature is 39.4-40.5°C (103-105°F). Vent temperatures should be measured on a sample of chicks from the holding area (samples from the top, middle, and bottom of chick box stacks spread throughout the holding area) and during unloading at the farm (five chicks from one box at the rear, middle, and front of the vehicle).

General observations of chick behavior should also be made to determine chick comfort. Chicks at the correct temperature should vocalize contentedly and will be evenly spread out in the box. Chicks will pant if they are too hot (vent temperatures above 40.5°C [105°F]).

If vent temperatures are found to be above recommendations and/or chicks are found to be panting, the following should be checked:
- Holding temperature is correct.
- Air circulation around chick boxes may be poor and need improving. Also check the spacing around and between chick boxes; if it is not enough, air circulation will be impaired.

STOCKING DENSITY ON THE FARM

During the hot season or periods of hot weather it may be necessary to reduce stocking densities. Before a decision on optimal stocking density during hot weather is made, the following points should be considered:
- Is the house properly insulated?
- Does the house have tunnel ventilation?
- Does the house have proper control of negative pressure?
- Does the house have an evaporative cooling system?
- Is the house open-sided?
- What is the humidity in the area?
- Is final depletion weight above 3 kg (6.6 lb)?
- Does the farm have a history of poor performance during hot weather?

Stocking density during hot weather should be matched to target live weight and age at processing, housing type, and ability to control the environment within the house.

Even with reduced stocking densities in place it is important to ensure that birds are evenly spread throughout the house. If birds gather in one area of the house because the environment is uneven, they are at risk of becoming too hot, access to feed and water will be disrupted, and performance will suffer as a result. This can be a particular issue if tunnel ventilation is used as birds tend to migrate towards the air inlet end of the house in hot conditions.

Migration fences (**Figure 2**) installed at 30 m (100 ft) intervals, creating pens of equal size, will help maintain an even stocking density throughout the house. Fences should be installed as soon as birds have access to the whole house. Solid migration fences should not be used as they will restrict airflow.

Figure 2: Example of a migration fence.

BROODING PERIOD

During both the hot season and colder weather, the house environment must be stabilized 24 hours prior to chick arrival at the farm. The ideal conditions are:

- House temperature: 30°C (86°F).
- Litter temperature: 28-30°C (82-86°F).
- Relative humidity (RH): 60-70%.
- Air speed: 0.15 m/sec (30 ft/min).

If at placement the temperature inside the house is above 30°C (86°F), the following points should be considered:

- Place chicks early in the morning when temperatures are lower.
- Ensure the house is fully prepared prior to placement so that the birds can be placed as quickly as possible.
- Easy and immediate access to water is essential.
- Provide chicks with fresh feed, often and in small amounts.
- House insulation may need to be improved in the future, mainly at the roof level.

In areas where RH is low, steps should be taken to increase RH within the house to the recommended level (for example through the use of foggers or to a lesser extent the addition of open water sources).

In areas where the RH is high, the ability of the birds to lose heat through evaporative loss is limited and birds will effectively feel a higher temperature than indicated by the house thermometer. To compensate for this, the set temperature in the house may need to be reduced. **Table 2** gives an example of how dry bulb temperatures might need to be altered when RH increases. Any change to environment must be based on bird behavior.

Table 2: Example of how dry bulb temperatures required to achieve equivalent temperatures might need to be altered at varying RH. Dry bulb temperatures at the ideal RH at specific ages are shown in red.

Dry Bulb Temperature at RH%* °C (°F)					
Age (days)	**40**	**50**	**60**	**70**	**80**
Day-old	36.0 (96.8)	33.2 (91.8)	30.8 (84.4)	29.2 (84.6)	27.0 (80.6)
3	33.7 (92.7)	31.2 (88.2)	28.9 (84.0)	27.3 (81.1)	26.0 (78.8)
6	32.5 (90.5)	29.9 (85.8)	27.7 (81.9)	26.0 (78.8)	24.0 (75.2)
9	31.3 (88.3)	28.6 (83.5)	26.7 (80.1)	25.0 (77.0)	23.0 (73.4)
12	30.2 (86.4)	27.8 (82.0)	25.7 (78.3)	24.0 (75.2)	23.0 (73.4)
15	29.0 (84.2)	26.8 (80.2)	24.8 (76.6)	23.0 (73.4)	22.0 (71.6)
18	27.7 (81.9)	25.5 (77.9)	23.6 (74.5)	21.9 (71.4)	21.0 (69.8)
21	26.9 (80.4)	24.7 (76.5)	22.7 (72.9)	21.3 (70.3)	20.0 (68.0)
24	25.7 (78.3)	23.5 (74.3)	21.7 (71.1	20.2 (68.4)	19.0 (66.2)
27	24.8 (76.6)	22.7 (72.9)	20.7 (69.3)	19.3 (66.7)	18.0 (64.4)

**Temperature calculations based on a formula from Dr. Malcolm Mitchell (Scottish Agricultural College).*

Where litter is used, even during hot weather it is not advised to reduce initial litter depth to below recommended levels (not less than 5 cm/2 in). If the farms have inadequate environmental control and the external temperature is high, water intake will be increased and it is important that the litter is deep enough to absorb any increased water spillage that may result.

Even in high temperatures, releasing chicks into the whole house at placement should be avoided. At a maximum, chicks should be placed on 50% of the house floor area. This will encourage feeding and drinking behavior and make early chick management and control of brooding conditions easier.

During hot weather, stimulating and encouraging drinking behavior is essential. The correct number of drinkers and supplementary drinkers must be provided at placement so chicks can access water easily and quickly (**Table 3**).

Table 3: Drinker requirements for broilers.

Drinker Type	Requirements
Supplementary	10 mini drinkers per 1000 chicks
Nipple drinkers	12 birds per nipple (for birds grown to <3 kg (6.6 lb) or 9 birds per nipple (for birds grown to >3 kg (6.6 lb)
Bell drinkers	8 (40 cm/17 in) per 1000 chicks

If nipple line drinkers are used, nipple height (**Figure 3**) and pressure must be appropriate for bird growth and age. Prior to chick arrival, nipple lines should be shaken or tapped with a stick until a drop of water is visible on each nipple. It is also good practice to check the flow rate of nipples throughout the grow-out period to ensure correct water consumption. Depending on environmental temperature, flow rate should allow birds to drink a minimum of 1.8-2.2:1 water-to-feed ratio. Bell drinkers must be regularly checked to ensure they always contain water at a level that is easily accessed by the chicks.

Figure 3: Correct nipple drinker height adjustment with bird age.

The ideal water temperature for chicks is 18-21°C / 64-70°F (**Table 4**).

Table 4: Effect of water temperature on water intake.

Water Temperature	Water Intake
Less than 5°C (41°F)	Too cold, birds consume less water
18-21°C (64-70°F)	Ideal
Greater than 30°C (86°F)	Too warm, birds consume less water
44°C + (111°F +)	Birds refuse to drink

During hot weather it is important that water is kept as cool as possible and that birds receive clean, fresh water at all times. Methods of cooling water include:

- Flushing drinker lines.
- Insulating or shading water pipes.
- Positioning water tanks and pipes underground.
- Avoiding the use of black or dark colored water tanks.

Water intake should be recorded and reviewed daily. A water-to-feed ratio between 1.7:1 and 1.8:1 is normal, but depending on the temperature and humidity this can go up to 2.2:1. Requirements increase approximately 6.5% per 1°C (1.8°F) over 21°C (69.8°F) and in tropical areas, high environmental temperature can double the water consumption.

During brooding, chick behavior should be monitored constantly as behavior is the main indicator that birds are comfortable (**Figure 4**). As a general rule, if chicks are evenly spread over the brooding area the environment is correct. If birds are crowded near house walls or the brooding surround and/or they are panting, the environment is too hot and should be adjusted. Conversely, if chicks are grouped together within specific areas of the house or brooding area it suggests the environment is not consistent through the house. There may be a windchill effect, or relative humidity or effective temperature may be too low.

Figure 4. Chick behavior under different environmental conditions.

Chick behavior when environmental conditions are correct. *Chicks are spread evenly throughout the brooding area.*

Chick behavior when environmental conditions are too cold. *Chicks are grouped together under heaters or within the brooding area.*

Chick behavior when environmental conditions are too hot. *Chicks are crowded near house walls or brooding surrounds, away from heating sources and/or they are panting.*

It is always a good idea to check crop fill to make sure brooding conditions are correct and that feeding and drinking have been encouraged (**Table 5**).

Table 5: Target crop fill assessment guidelines.

Time of Crop Fill After Placement	Target Crop Fill (% of chicks with full crops)
2 hours	75
4 hours	80
8 hours	>80
12 hours	>85
24 hours	>95
48 hours	100

VENTILATION

Ventilation and maintaining a consistent comfortable environment for the birds during hot weather are key to limiting the impact hot temperatures can have on broiler performance. The two main types of housing are:

- Power-ventilated, controlled/closed environment housing -- provides better control of house environment since fans and inlets provide ventilation.
- Naturally ventilated houses, commonly open-sided houses with natural ventilation although in some cases houses may have solid side walls -- more difficult to control environment but fans can be used inside the houses to circulate and move air.

Controlled/Closed Environment Housing

Controlled or closed environment houses have power ventilation and provide much better control of the in-house environment as they have either solid walls or curtains that remain closed, and fans and inlets are used to ventilate the house. The main features of these farms include:

- Proper insulation, mainly in the roof.
- Ability to cater for three stages of ventilation:
  « Minimum ventilation.
  « Transitional ventilation.
  « Tunnel ventilation.
- Adequately sealed to control negative pressure and airflow into the house.
- Provision of evaporative cooling systems.

To manage ventilation properly, it is essential to observe bird behavior throughout the whole house. Birds should be evenly spread throughout the house and not be huddled together or gathered in one area, nor should they be panting.

Adequate insulation in controlled environment houses helps to keep houses cool in hot weather. If insulation is inadequate, the in-house temperature will rise more than normal as external temperature rises.

It is important to note that if the internal house temperature exceeds the set point, the fans will start to work and airflow within the house will be increased thus causing a windchill effect. In young birds, even in hot weather, a windchill effect (over ventilation) will lead to birds becoming cold and must be avoided.

In order to avoid a windchill effect in young birds the following management advice should be followed:

- Transitional and tunnel ventilation should be avoided until 10 days of age, unless behavior indicates birds are too hot and ventilation needs to be increased.
- Minimum ventilation fans should only start working continuously if the temperature rises 2°C (3.6°F) over the set point.
- Houses should be checked that they are sealed properly and that the negative pressure is correct by using smoke tests. If the negative pressure is not correct and air circulation is inadequate, the air coming into the house, even if it is warm, could fall directly onto the birds causing a windchill effect or draft.

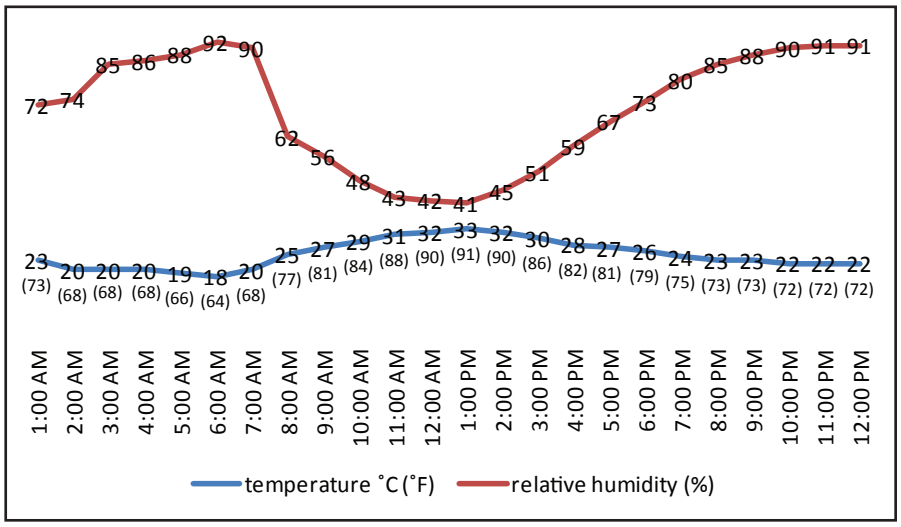
Transitional ventilation removes excess heat from the house when the temperature increases above the set point. Although there will be air movement over the birds, transitional ventilation does not blow air directly onto the birds.

Use transitional ventilation for as long as possible before switching to tunnel ventilation where all air is pulled through the tunnel rather than the sidewall inlets. Observe bird behavior to determine if it is necessary to switch to tunnel ventilation. Only use the tunnel inlets if behavior indicates that transitional ventilation is no longer keeping the birds comfortable.

During tunnel ventilation, large volumes of air generate high-speed airflow over the birds, creating a windchill effect that helps to keep the birds cool. Air speed and windchill effect can be varied by altering the number of fans operating. Decisions on how many fans should be operating should in turn be based on bird behavior.

In hot weather, tunnel ventilation can be enhanced by evaporative cooling. Evaporative cooling should always operate based on a combination of temperature and humidity and never just temperature or time of day alone. Evaporative cooling should not be used if RH is greater than 75% as it increases the RH of the environment and if RH levels are already high, the birds' ability to lose heat will be limited. However, during appropriate times of the day (**Figure 5**) or in areas where RH is naturally low, evaporative cooling is an essential next step in keeping older birds cool when tunnel ventilation is no longer adequate. Once again, observations of bird behavior must dictate changes/modifications to ventilation.

Figure 5: Example of temperature rising and humidity falling during the day.



Open-Sided Housing

Achieving adequate control of the environment in open-sided housing is particularly difficult in areas with high temperatures and high humidity. Open-sided housing should at least have good insulation and have circulation fans and foggers installed. During brooding, even if temperatures are above 32°C (89.6°F), unexpected temperature drops and high-speed air entering the house at bird level should be avoided.

Automatic curtains can help prevent unexpected drops in temperature and aid with the control of the amount, speed, and direction of air entering the house. Temperature sensors should be set inside the house, positioned on both sides of the house and near the house walls. A weather station on the roof for monitoring wind speed and direction can be linked to the curtain control regulator so that curtains can be opened and closed in response to the external environment allowing better control of the environment within the house.

After 10 days of age and once broilers have feather cover on their backs, they become more at risk of heat stress and bird behavior must be even more closely monitored to determine if environmental conditions are correct.

Circulation fans can be used in open-sided houses to increase air movement and improve air movement over the birds. On warm or hot days where there is little or no air movement, circulation fans will also help provide a windchill effect.

Circulation fans should produce an average of 3 m/sec (591 ft/min) air speed at the level of the birds, but air speed will vary depending on the distance from the fan. Ideally, fans should be installed in two rows down each side of the house so that they draw any available cooler, less humid air from outside. Fans should be set to blow air diagonally across the house and should not be placed close to any solid surfaces which may restrict airflow. During high temperatures, if the RH is lower than 75%, spray nozzles or foggers can be used in conjunction with circulation fans to provide an increased cooling effect. Spray nozzles should only be used when the circulation fans are working to avoid problems with wet litter and to reduce the impacts of increased RH without air circulation, which will result in a decrease in bird performance and possibly mortality.

NUTRITION

Feed and nutrition can have a significant impact on how broilers respond to hot environmental temperatures.

Feed Form

Providing good physical quality feed (**Table 6**) will minimize the energy expended and heat generated during feeding.

Table 6: Feed form and recommended particle size by age in broilers.

Age	Feed Type	Feed Form	Particle Size
0-10 days	Starter	Sieved crumble	1.5 – 3.0 mm diameter
		Mini-pellet	1.6 – 2.4 mm diameter 1.5 – 3.0 mm length
11-18 days	Grower	Sieved crumble	1.5 – 3.0 mm diameter
		Mini-pellet	1.6 – 2.4 mm diameter 1.5 – 3.0 mm length
19-24 days	Grower	Pellets	3.0 – 4.0 mm diameter 5.0 – 8.0 mm length
25 days to processing	Finisher	Pellets	3.0 – 4.0 mm diameter 5.0 – 8.0 mm length

There are two main feed quality issues to avoid during hot weather:

- Uneven particle size.
- High level of fines (particles below 1 mm in size).

Both of these feed quality issues result in increased feed wastage, reduced feed conversion efficiency, and increased energy expenditure. The aim is to reduce the amount of fine particles (<1 mm) in the feed to below 10%.

Dietary Nutrients

It is important to use high-quality protein sources. Amino acid (AA) digestibility rather than density should be increased. Amino acids must be balanced to minimize protein excess. For balanced protein recommendations refer to the current **Indian River Broiler Nutrition Specifications**.

Supplying energy in the diet via fats rather than carbohydrates will be beneficial. Fats contain more energy and are more digestible, so produce less waste heat and a lower heat production during feeding.

In Starter feeds it is advisable to use fats containing a higher percentage of unsaturated fats. In the Grower and Finisher feeds, unsaturated fats must be limited (max 1% of linoleic acid) to prevent carcass greasiness.

The addition of sodium bicarbonate (to supply approximately 50% of dietary sodium) has been shown to reduce the impact of heat stress in broilers. In addition, feeding diets containing a Dietary Electrolyte Balance (DEB; as defined by sodium level + potassium level – chloride level) of 220-240 mEq/kg can help to reduce mortality related to heat stress and may also help to reduce the negative effects hot weather can have on growth rate. Potassium carbonate can also help to improve the electrolyte balance of the diet and reduce the impact of heat stress.

During brooding in hot weather, chicks can experience high temperatures and high humidity, which reduce feed intake. It can be beneficial to increase the sodium level (up to maximum of 0.23%) of the diet at this time.

Vitamins E, D, A, C, and niacin are known to have a positive effect on the bird's response to hot conditions. As a general rule these vitamins can be increased by 1.25% per 1°C (1.8°F) when the temperature is between 21 to 28°C (70 to 82°F). When the temperature rises over 28°C (82°F) then vitamins should be increased by 2.5% per 1°C (1.8°F).

In hot weather, the choice of anti-coccidial must be carefully considered; those that can generate an increase in body heat production should be avoided.

Feeding birds during the coolest part of the day is a useful strategy to employ during hot weather. However, if limiting feeding to the cooler part of the day, care must be taken to ensure that feed intake is not reduced. Birds must not go without feed for too long as this will have an impact on growth and may increase skin scratches at feeding. In closed-sided housing where light control is easy to achieve, dark periods can be provided during the heat of the day.

CATCHING

In periods of hot weather, catching should be done at night to avoid high temperatures. However, in some areas nighttime temperatures can still be high and RH will increase after sunset. In closed–sided housing, ventilation should never be switched off during catching, even if the main house door is open. This will help to maintain some airflow around the birds. The catching door should preferably be at the opposite end of the house to the tunnel fans. Unlimited access to water should be provided until the point of catching. Access to water will be helped by:

- Use of multiple drinker lines.
- Separation of birds into pens.
- The progressive removal of individual drinkers during catching where bell drinkers are used.

Installing fans close to the transport vehicle while birds are being loaded is beneficial and ensures that there is air circulation between the crates.

The number of birds per transport crate must adhere to local legislation and will further depend on broiler body weight, the distance from the farm to the processing plant, the health status of the birds, the farm history, and the temperature and humidity forecast. In high temperatures, the number of birds per crate must be reduced.

Once loading is finished, the vehicle should leave the farm as soon as possible, and during the route to the processing plant the driver´s breaks should be minimized according to local legislation requirements.

At the processing plant, trucks/lorries should be kept under cover. Fans in the trucks and in the areas where birds are held should be operating. If environmental temperatures are hot and RH is lower than 75%, foggers should be used in combination with the fans in the holding area. Unloading should be done as soon as possible.

CONCLUSIONS

When growing broilers in hot weather, it is essential to observe bird behavior to ensure they are comfortable, that welfare is maintained, and genetic potential can be expressed.

Key points for managing broilers in hot weather are:

- Observe bird behavior and manage the environment in relation to it.
- Prevent dehydration in the hatchery.
- Ensure proper management of chicks in the holding area of the hatchery and during transport to avoid overheating.
- Determine stocking density based on the type of farm and environmental conditions.
- Have appropriate brooding conditions which stimulate feeding and drinking behavior.
- Manage farm environment taking into account the relationship between dry bulb temperature and relative humidity.
- Provide a high-quality pelleted feed and consider adjusting nutrient density and feeding during the coolest parts of the day.
- Complete catching during the coolest part of the day.

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