

AVIAN

## Advice

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UNIVERSITY OF ARKANSAS  
DIVISION OF AGRICULTURE  
Cooperative Extension ServiceBrooding Chicks and Poult:  
Environmental Critical Control Points

by G. Tom Tabler

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**Introduction**

Farm management during the early brooding stage in the life of the chick or poult will determine whether they will reach their full potential. Every hour that a chick's or poult's environment is less than optimum reduces growth rate and increases feed conversion ratio and that loss recovered by the end of the growout (Dozier and Donald, 2001). Costs to both the grower and the integrator will be high if a proper brooding environment does not ensure that birds get off to a good, healthy start. The focus of this article will be on how to best meet the needs of the broiler chick and turkey poult brooding.

**Brooding the Broiler Chick**

The objective in brooding chicks is to provide growing birds a comfortable and healthy environment, efficiently and economically (Vest, 1997). Temperature (particularly of the floor), ventilation rates, humidity, litter conditions, dust and gas levels are all environmental critical control points that growers must monitor and manage. Failure to properly manage these environmental critical control points during the brooding period will likely result in lower economic returns.

The body temperature of a day-old chick is about 3° F below that of an adult, but by five days of age body temperature has reached 106° F, the same as the adult (Vest, 1997). Newly hatched chicks have little or no ability to regulate their own body temperature and depend on the grower to provide an ideal growing environment (Dozier and Donald, 2001). Yet the ability of chicks to regulate their body temperature has a direct impact on the birds ability to grow efficiently. This means that exposing

chicks to temperatures too high or too low will result in energy and nutrients being expended to cool the bird by panting or to warm the bird by heat production (Lacy, 2002). However, ever increasing fuel costs usually mean that over heating of chicks is a rare occurrence.

When a newly hatched chick is placed in a cool environment, its internal body temperature begins to drift downward toward the environmental temperature and may reduce the growth efficiency of the bird. Keep in mind, that in broiler houses, floor temperature is often 5 to 15° F below air temperature (Lacy, 1997). The temperature of the broiler house floor during brooding is more important than air temperature, since chicks are in direct contact with the floor. Even fairly brief exposure to cool floors can adversely affect chicks.

In one research experiment, 175 newly hatched chicks were placed in either a constant temperature of 95° F or were exposed to a temperature of 65° F for two hours and then at a constant 95° F. After four days the internal temperature of chicks subjected to that brief cold exposure was only 100.5° F, versus 102° F for the control group reared at a constant 95° F (Dozier and Donald, 2001).

Normal development of the digestive, circulatory, nervous and immune systems of the chick depends on the bird using the nutrients and antibodies provided by the yolk sac to ready these systems to begin getting nutrients from the feed (Dozier and Donald, 2001). If chicks are chilled, nutrients that might have been used for body development are used to maintain body heat. Chilled chicks also tend to huddle together,

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... helping ensure the efficient production of top quality poultry products in Arkansas and beyond.



and most do not seek out feed or water, so a number of birds may die. The performance of the chicks that survive chilling is likely to be limited due suppressed digestive or immune system functions. Periods of extended cold stress force the chick to begin breaking down the carbohydrates and fats in its own body tissues to maintain body heat, since it is unable to acquire enough from the feed alone.

Deaton et al. (1996) brooded chicks at starting temperatures of 95°, 90°, 85°, or 80° F, then decreased brooding temperatures by 5° F each week for three weeks. After three weeks temperatures were held constant at 70° F. At three weeks of age body weight and feed conversion were better for the chicks brooded at the warmer temperatures (Table 1). Since low environmental temperatures cause increased feed intake and higher oxygen demand, chilled birds are in an ideal situation to develop ascites (Table 2) (Lacy, 1997). University studies have shown increases in ascites as high as 11% in broilers raised in too-cool brooding environments (Dozier and Donald, 2001).

**Table 1. The effect of brooding temperature on body weight and feed conversion of broiler males at 3 weeks of age<sup>1</sup>.**

Temperature ° F			Body Weight	Feed
Week 1	Week 2	Week 3	(lbs)	Conversion
95	90	85	1.76	1.35
90	85	80	1.75	1.37
85	80	75	1.74	1.39
80	75	70	1.66	1.42

<sup>1</sup>Adapted from Lacy (1997)

**Table 2. The effect of brooding temperature on mortality of broiler males at 6 weeks of age<sup>1</sup>.**

Temperature ° F			Total Mortality	Ascites Mortality
Week 1	Week 2	Week 3	(%)	(%)
95	90	85	2.29	0.83
90	85	80	3.12	0.83
85	80	75	1.67	0.62
80	75	70	4.79	2.50

<sup>1</sup>Adapted from Lacy (1997)

The proper temperature for brooding broiler chicks will depend on the system being used. However, it is important to realize that supplemental heat will be required even in the summer and especially at night (Dozier and Donald, 2001). Brooding systems have been classified various ways. Dozier and Donald (2001) suggest that forced air furnaces and brooders are the two

basic methods of providing heat for chicks, while Lacy (2002) mentions three methods of warming chicks ( warm room brooding, hover (or pancake) brooding and radiant brooding). Lacy (2002) lists recommended temperatures for each brooding method (Table 3).

**Table 3. Recommended Temperatures for Broilers**

Weeks of Age	Brooder Type		
	Warm Room ° F	Hover ° F	Radiant ° F
1	88	90	85-88
2	83	85	82-85
3	78	80	77-80
4	73-76	75-78	73-76
5	70-73	70-73	70-73
6	65-70	65-70	65-70

Adapted from Lacy (2002)

Furnace heat (or warm room brooding) is more difficult to manage than pancake or radiant brooders for two primary reasons. First, furnaces produce warmth by producing heated air. This means that the floor must be warmed from hot air, which can require a long period since hot air rises, and temperature stratification can develop with hot air at the ceiling and cold air at the floor. Mixing fans near the ceiling work well to break up stratification and should be utilized to increase floor temperature and decrease gas usage (Dozier and Donald, 2001). Second, furnace heat does not allow chicks to select a comfort zone. The entire room is heated and chicks must grow at the selected temperature. This means that there is little room for error with furnace heat; the temperature maintained must be exactly what chicks need, since they can not find a warmer or cooler area (Lacy, 2002).

Both pancake and radiant brooders allow chicks to move toward or away from the heat source to seek a comfortable temperature (Lacy, 2002). Most of the heat from these brooders is in the form of infrared light, which heats objects instead of heating the air (Dozier and Donald, 2001). Floor temperatures under the brooder will be higher than the surrounding air temperature, so that heat is delivered where it is most needed ... at chick level (Dozier and Donald, 2001). In recent years radiant brooders have become popular, since they have been shown to reduce fuel costs by 15 to 30% as compared to pancake brooders and forced air furnaces (Lacy, 2002).

Although warmth is a critical need for newly hatched chicks, these young birds also require a minimum amount of ventilation during the brooding period. Ventilation is necessary to add oxygen, remove harmful gases (carbon dioxide and ammonia) and to remove moisture added by the birds. As the ventilation system operates, cool fresh oxygenated air is brought uniformly through the inlets and jetted along the ceiling toward the center

of the house, mixing with hot air already in place and sending it back toward the floor. At the same time, humidity, ammonia, dust and carbon dioxide are removed from the house while the exhaust fans are in operation. Without adequate ventilation, ammonia, humidity and the lack of oxygen can reduce performance and increase mortality.

Many growers underestimate the effects of ammonia on flock performance. Ammonia levels of 25 ppm (barely detectable by the human nose) have been shown to depress growth by 4 to 8% and increase feed conversion by 3 to 6%. Just 5 ppm ammonia has been shown to irritate and injure the protective lining of the chick's respiratory system, causing the bird to be more susceptible to respiratory disease. If growers wait until ammonia levels are high enough to be detected by odor or a sense of smell, some damage has already occurred. To minimize ammonia problems it is important to provide adequate ventilation and control moisture in the poultry house (Lacy, 2002).

Birds add moisture to the poultry house environment by respiration and by feces excretion. Since birds, like all animals, exhale warm moisture laden air, respiration increases the humidity of the inside environment, which can, if not removed, cause increases in litter moisture. Broilers consume about one and a half to two times as much water as feed, but they only retain about 20% of the water, thus the other 80% is excreted (Dozier and Donald, 2001). A broiler chick excretes about 0.06 ounces of water per hour in the first week, and about 0.11 ounces per hour in the second week (Dozier and Donald, 2001). Assuming birds are provided 23 hours of light per day, this would mean that during the first week a flock of 20,000 birds would add slightly over 1,509 gallons of water to the poultry house environment. During the second week the same flock would add about 2,767 gallons of water to the poultry house. The amount of water excreted increases with bird age and weight. This, in part, is why we must increase ventilation rates as the birds age — to compensate for the additional water being added to the litter. If litter moisture and humidity are not removed, litter moisture increases, leading to damp, caked or wet litter conditions. However, the level of humidity also appears to be critical for poultry (Vest, 1997). Results show that increased relative humidity leads to depressed feed consumption, independent of temperature (Table 4) (Vest, 1997).

**Table 4. Feed consumption in grams as influenced by relative humidity in 4 week old broilers.<sup>1</sup>**

Temperature (°F)	Relative Humidity (%)					
	37	49	56	67	73	82
90	44		14			
81		56			50	
72				61		47

<sup>1</sup>Adapted from Vest (1997)

Be sure temperature sensors are located in the proper position and minimum ventilation rates correctly match the age of the birds. If temperature sensors are too close to the brooders, it can be difficult to obtain the proper, uniform floor temperature. If sensors are placed too high off the floor, they will not allow the heating system to operate properly, since the floor and air directly above the floor will cool much quicker than air three to four feet above the floor. At placement, temperature sensors should be three to four inches above the floor and then adjusted upwards as the birds age. Adjust the override thermostats so that they are high enough above the set point temperature that they will not chill the chicks by overriding the minimum ventilation timer and running the ventilation fans when they are not needed. A properly working ventilation and heating system will not only maintain the desired air and floor temperature, but also provide sufficient air exchange, control moisture, dust and ammonia levels as well as maintain the desired litter conditions. However, it can only do what you tell it to, and you must continually tell it something different as weather conditions change, the birds age and environmental conditions inside the house change. Thus, there is no substitute for the grower spending time in his houses.

### Brooding the Turkey Poult

Brooding turkey poult is as much of an art as a science. Each flock is different based on a variety of factors, and excellent husbandry skills are essential to be able to evaluate poult behavior and determine their needs. Compared to broiler chicks, all poults would be considered very difficult to start. Like broiler chickens, turkey genetics have improved the bird over the past 10 to 15 years but has required a higher level of management skill from growers to obtain optimum results. Wojcinski (N.D.) listed five critical control points she believes, if implemented correctly, will result in a healthy, vigorous, uniform flock with feed conversions and average daily gains which meet or exceed industry standards. These include:

- Barn preparation for poult arrival
- Poult quality assessment
- Brooding temperatures
- Barn ventilation
- Feed and water availability and quality

Many different kinds of stressors are present within the commercial turkey production environment. The one most often overlooked is that of the growth itself (Wojcinski, N.D.). When growers were asked when the stress of growth was the greatest, most replied that it is around 15 weeks of age. However, the tom poult is actually growing the most rapidly at three weeks of age (Wojcinski, N.D.). It is at this time that the percent increase in metabolic body weight is the greatest. Early in the brooding period when the poults are growing so rapidly, they are very susceptible to the adverse effects of poor ventilation management, poor feed quality and disease challenges. Even minor inadequacies during this period will be reflected in decreased growth and performance. This is why the first three weeks of a poult's life are crucial to its future performance (Wojcinski, N.D.).

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Optimizing the poult's environment at this time is one of the best investments a producer can make.

One of the most critical factors in managing the poult's environment is the proper temperature in the house and under the brooders. While having the air and floor temperature too cool is always a concern, a temperature that is too warm is also detrimental. Having the temperature too high can quickly dehydrate poult, with small poult being the most susceptible to the effects of overheating (dehydration and flip-overs) (Wojcinski, N.D.). Litter temperature is more critical than air temperatures at poult arrival. Poult can lose a great deal of heat through their feet when they sit on litter that is cold and/or damp. It is not uncommon to find floor temperatures several degrees lower than temperatures three feet above the floor. Therefore, make sure temperature sensors are near the floor at placement, not three to four feet above the floor.

Newberry (1993) reported that cool brooding of turkeys was associated with a faster litter moisture increase than warm brooding. Inadequate ventilation and high density rearing can also lead to a rapid increase in litter moisture in turkey houses. Litter moisture was shown to rise from a low level of 2% at time of placement to a high of 40% by four weeks of age (Anderson et al., 1964). Make sure that adequate ventilation rates are provided at placement and that these rates are increased as the flock ages to account for increased moisture removal requirements.

The effects of cool temperatures, poor ventilation and wet litter conditions are generally more harmful to young poult than to young broiler chicks. Brooding management which is less



than optimal can decrease performance, increase feed conversion ratios and lead to conditions such as poult enteritis and mortality syndrome (PEMS). Poult enteritis and mortality syndrome has emerged as the most costly of the diseases affecting the production of turkeys (Edens et al., 1998). Afflicted poult suffer from severe diarrhea and dehydration, anorexia, weight loss and high rates of mortality when younger than six weeks of age (Barnes et al., 1996; Edens et al., 1997a,b; Qureshi et al., 1997). With the onset of PEMS, poult begin to huddle as if they are cold and crowd together to reduce body cooling. Litter moisture increases, presumably in association with severe diarrhea, and appears to be associated with increased severity of the disease (Edens et al., 1998).

Adequate ventilation rates are vital to replenish oxygen; remove ammonia, carbon dioxide and moisture; and reduce levels of air-borne disease organisms. When good air quality is provided, poult will be more active and quickly seek out feed and water. High levels of carbon dioxide in houses have been shown to impair the poult's ability to convert glycogen into glucose for energy (Wojcinski, N.D.). Therefore, in the presence of high carbon dioxide concentrations, poult may appear inactive, listless and disoriented and may lie on their sides paddling the air. Inadequate ventilation may also lead to spontaneous turkey cardiomyopathy (STC) or roundheart disease, a prevalent circulatory disturbance afflicting turkeys raised at moderate to high altitudes. Circulatory disturbances in turkeys are likely to become increasingly prevalent because of the economic need to continue to produce fast-growing strains of turkey (Frame et al., 1999).

### *Steps to Reduce Spontaneous Turkey Cardiomyopathy (STC)\**

1. Ignite stoves at least 12 hours before poult arrive to be sure they are burning cleanly with a mainly blue flame and no smoke.
2. Make sure air is circulating within the brooder building. Mixing or circulation fans should be started at a very low speed soon after placement of the brood.
3. Air exchange is just as critical as air movement. Poult should receive a minimum of 0.2 cubic feet per minute (cfm) of incoming air at placement.
4. Poult should not be unnecessarily disturbed during the second and third weeks of life. In a flock with 2% mortality caused by STC, it is likely that 80 to 90% of the poult have some degree of heart damage so how the flock is handled, even after STC mortality starts, may have a dramatic impact on how many birds remain alive.
5. Minimize the risk of turkeys becoming ill with poult enteritis. A risk study conducted in Utah turkeys indicated the risk of suffering significant STC loss was 21 times greater for a flock of hens brooded in winter with poult enteritis compared to a tom flock brooded in July with no poult enteritis.
6. Keep poult from becoming chilled or overheated since both increase in metabolic rate and the demand for oxygen.
7. Light reduction programs through three weeks of age have shown beneficial results.

\* From Frame et al. (1999)

While altitude is a definite predisposing factor, the time of year turkeys are raised also plays a significant role in STC development (Frame et al., 1999). Broods placed in winter have a higher incidence of STC than those placed in late spring or summer, possibly because of suboptimal air exchange during colder periods, since producers tend to skimp on ventilation time to save fuel. In underventilated houses, carbon dioxide builds up and oxygen availability lessens. A characteristic of STC mortality is that more turkeys die during the night than during the day. A possible explanation for this characteristic is that poults form microenvironments as they bed down and crowd together. Some of these microenvironments restrict air movement. If the ventilation is inadequate in the building, there is insufficient fresh air available, and birds succumb to the effects (Frame et al., 1999). Frame et al. (1999) indicated that various methods to reduce losses from STC have been identified, but some require very careful management by the grower.

### Summary

More flock performance is lost due to improper brooding than from any other single cause. Management during the first two to three weeks after hatch has a dramatic impact on bird performance throughout the remainder of the flock. Performance lost during the brooding period can never be regained. To brood properly pay particular attention to building setup. **Heat should be on several hours prior to bird arrival** to allow the floor to warm and prevent birds from becoming chilled. **Set brooders at the proper temperature** for each flock. **Ventilation and air exchange** is critical to an optimum environment. Proper ventilation provides oxygen and removes carbon dioxide, ammonia, dust, disease organisms and humidity. **Litter moisture** can also be controlled through adequate ventilation. Maintaining optimum environmental conditions throughout the flock (and especially during the early brooding stage) coupled with a sound feed and water management program will help ensure production of a healthy, efficient and profitable flock.

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## Coming Events

- ♦ **The Poultry Symposium**, April 8-9, 2003, Springdale Holiday Inn, The Poultry Federation (501) 375-8131
- ♦ **2003 Ozark Poultry Producers Symposium**, May 13, 2003, Whittaker Arena, University of Arkansas, Fayetteville, Donna Tinsley (479) 575-3250
- ♦ **The Poultry Festival**, June 6-7, 2003, Hot Springs, Ark., The Poultry Federation (501) 375-8131
- ♦ **Breeder Roundtable**, June 23, 2003, University of Arkansas, Fayetteville, Ark., Dr. Keith Bramwell (479) 575-7036
- ♦ **Hatchery Breeder Clinic**, July 15-16, 2003, Marriott Marquis Hotel, Atlanta, Ga., U.S. Poultry and Egg Association (770) 493-9401



# Breeder Flock Uniformity: How Important Is It?

## Introduction

Managing the breeder flock from day old chicks to the end of their production cycle entails innumerable tools, tricks and practices, many of which require some sort of measurements to be taken. It is not the aim of this article to list all of the necessary practices involved in the growth and maintenance of a breeder flock, nor is it possible to pick one aspect of flock management and say, “this is what you need to do to produce a great flock.” However, many management practices need to be revisited on occasion to reemphasize their importance.

## Uniformity as a Management Tool

One management tool that is widely discussed is flock uniformity, particularly in the pullet house. Producing flocks of pullets or cockerels that are right on the body weight target is futile if flock uniformity is not present. Many consider uniformity of flock body weight the best indicator of future flock performance. This is likely due to the relationship between body weight and sexual maturity, or egg production in pullets. For instance, a 20-week-old flock of pullets with an average body weight which meets the company goal may have anywhere from five to 25% of the birds either severely over or under weight with no change in average body weight. As a matter of fact, in theory, a flock of breeders could have exactly 50% of the birds two pounds heavy and the other 50% of the birds two pounds light and still have an acceptable average body weight for the flock. While this scenario is not likely to occur, hopefully it demonstrates the importance of flock uniformity of body weight.

## Measuring Uniformity

Before proceeding, we need to briefly discuss how to measure uniformity. Uniformity is sometimes measured very subjectively by simply “eyeballing” the flock. However, in reality, eyeballing a flock to assess uniformity is of little use because the method of measurement is crude. Accurately measuring uniformity is essential, but how does a person measure uniformity?

Pullet growers should be familiar with percentage uniformity, but for those who are not it is the percentage of birds that fall within the target weight range. While this calculation certainly provides a valid measure of uniformity, there are other equally as valid measures of uniformity. Without getting too deeply statistical, standard deviation is one often-used measure of variation (or uniformity). However, standard deviation tends to increase with the population average so that when the average pullet weight increases the standard deviation will also increase. This means that if a person wanted to use standard deviation to compare the variation within two pullet flocks, the flocks would need to have the exactly the same average weight for the comparison to be valid. Clearly, standard deviation is of limited value when comparing pullet uniformity, but the standard deviation can be used to determine another measurement that is useful. When the standard deviation is divided by the average (or mean) and then multiplied by one hundred, we get a number called the coefficient of variation (or CV). The CV is a very valid method of comparing variation (or uniformity) in different population.

## Some Causes of Poor Uniformity

Poor uniformity is a result of some birds either not receiving feed like they should, not being able to utilize the nutrients that are present in the feed, or they are not housed in conditions that will

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allow them to respond to the nutrients they receive. So, what are some possible causes of a flock exhibiting poor uniformity?

- Diseases such as coccidiosis or other diseases that cause intestinal damage and therefore reduce nutrient utilization
- Poor bird response to vaccinations due to improper handling of vaccines or improperly administering vaccinations
- Improper or inconsistent beak trimming which affects feed consumption
- Less than ideal conditions in the brooding house, such as cold or hot spots
- Improper water restriction program
- Poor feed quality
- Not enough floor, drinker or feeder space
- Improper feed restriction programs (for example, the transition to feed restriction, or improper feed allotment adjustments)
- Poor feed distribution throughout the house during feed restriction

Obviously, each of the items listed above could be further discussed in detail, and each condition should be evaluated for flocks that have exhibited poor body weight uniformity. As previously mentioned, flock uniformity is a good measure of future flock performance as the more uniform flocks generally out produce those flocks with poor uniformity.

### Poor Uniformity and Flock Performance

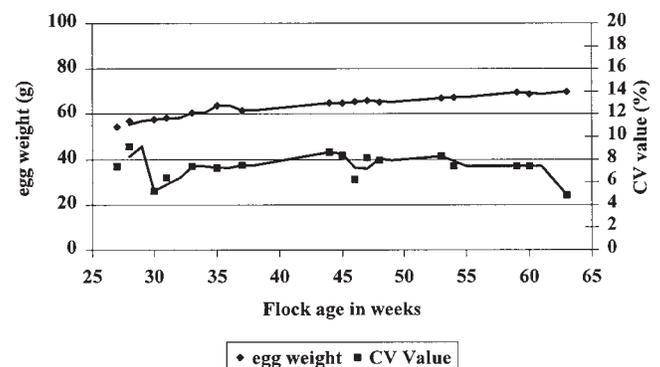
What can be expected from flocks with poor body weight uniformity? Initial egg production and hatchability will undoubtedly be reduced. Body weight is a key factor in pullets achieving sexual maturity and therefore responding to light stimulation. Pullets that are greatly underweight will not respond as quickly to light stimulation as heavier birds the same age. Using the extreme example of a flock with 50% of the hens two pounds heavy and 50% two pounds light, when trying to bring these birds into production roughly half the birds will not respond to light stimulation at the desired time. This flock would drag into egg production, and hatchability would also suffer for several weeks due to increased early embryo mortality.

A recently conducted study at the U of A illustrated this point. Hens of the same age were divided into two groups: sexually immature and sexually mature. Hatching eggs were collected from both groups, incubated and hatchability results compared. Hatching eggs from immature hens were shown to be more susceptible to embryo loss than eggs from more mature hens. What does this mean for underweight flocks? As flocks with a large percent of underweight hens are pushed into production, egg size can be achieved before the hen is mature enough to produce a completely viable germ cell capable of fully supporting embryo growth. This means that when eggs from immature hens are set, embryo mortality is elevated, and the flock, as a whole, takes longer to achieve optimum hatchability levels. Most hen feeding programs are adjusted weekly based upon flock performance, so the extreme flock we used as an example (50% two pounds heavy, 50% two pounds light) will never peak correctly because the lack of uniformity means that very few hens are being correctly fed at any given point in their production cycle.

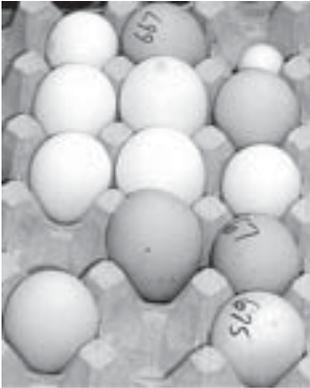
Another lingering effect of poor body weight uniformity is a lack of uniformity in egg weight. Light hens can be expected to lay small eggs, and heavy hens can be expected to lay large eggs. Therefore, a flock with poor body weight uniformity will likely produce eggs with poor uniformity in size and weight. Previously it was believed that most flocks maintained a coefficient of variation, or CV value, of 6% or less for egg weight and that this should be considered ideal. With this in mind, we collected egg weight data from three different hatcheries for flocks from 27 to 63 weeks of age. The mean CV value for the egg weights from the 17 flocks evaluated was 7.33% with only two flocks less than 6% as can be seen in Figure 1. We then went further to determine how much difference was seen between the hatchability of eggs from different egg sizes within a flock of broiler breeder hens. Four different flocks between the ages of 32 and 41 weeks of age were randomly chosen from

*Pullets that are greatly underweight will not respond as quickly to light stimulation as heavier birds the same age.*

Figure 1. Variation in Egg Weight



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three different hatcheries. A random sample of eggs was selected, weighed and separated into heavy, average or lightweight categories for each flock. The results from this study are shown in Table 1. Average sized eggs hatched slightly better than either the heavier or lighter weight eggs.

**Table 1. Hatchability of Heavy, Average and Light Eggs**

	Heavy eggs	Average eggs	Light eggs	Total flock hatchability
Hatchability	89.45%	91.38%	89.94%	89.27%

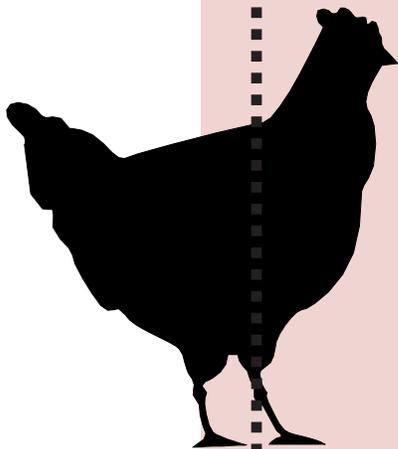
Therefore, flock uniformity affects egg production and hatchability as the flocks are coming into production. However, flock uniformity has even more far-reaching effects.

There is ample evidence shown that egg weight affects hatched chick weight. Heavier eggs tend to produce heavier chicks. Lighter eggs tend to produce lighter chicks. This means that flocks with poor uniformity produce chicks with poor uniformity and probably, in turn, broiler carcasses with poor uniformity. Clearly, uniformity is crucial to the success of the entire organization.

**In Summary**

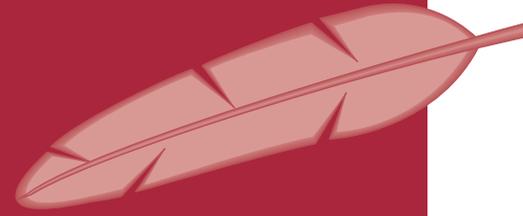
Measuring flock uniformity is undoubtedly an important tool when evaluating the success of a pullet program. When a flock leaves the pullet house with a great deal of variation in body weight a series of conditions can often be expected to occur. The flock will often come into egg production slowly, since a disproportionate number of hens are not ready to produce eggs at the time of lighting. Early hatchability will also be less than expected because there will be an increase in early embryo mortality from those eggs laid by the lighter weight hens that mature slower. The flock, as a whole, will likely not attain the egg production peak expected because many of the hens are being either over or under fed at this crucial time in the production cycle. And finally, egg size will often continue to show considerable variation throughout the life of the flock which will not only reduce hatchability but may also affect the quality of the chick produced. Just how important is flock uniformity? Or should we be asking, what is more important than flock uniformity? ♦

*Measuring flock uniformity is undoubtedly an important tool when evaluating the success of a pullet program.*



*2003  
Ozark Poultry Producer  
Symposium*

The second annual Ozark Poultry Producer Symposium will feature presentations of current information by recognized professionals on environmental stewardship, biosecurity, litter treatment options, drinking water management, and brooding. In addition, the symposium will include booths and displays of equipment and services frequently used by growers. The symposium is designed to help producers produce birds more efficiently and gain a fuller understanding of poultry production. Join us! Registration details are listed under Current Events (page 5).



# Nipple Drinker Management Critical to Broiler Performance

## Introduction

Water is the most important nutrient in poultry nutrition. An animal deprived of feed can lose up to 40% of its body weight and survive, but an animal that loses 10% of its water will have serious disorders, and death will result from the loss of 20% of body water. Water is the medium in which the chemical reactions necessary for life take place. Water aids in digestion, lubricates joints, aids in the formation of body tissue and keeps the body cool through evaporation.

Water consumption is highly correlated with bird age, body weight, environmental temperature and feed consumption. Clearly, as birds get older they get heavier and need more water. They also drink more water as the temperature gets hotter. However, the correlation between water consumption and feed consumption should not be overlooked. Feed consumption is obviously important because birds do not grow if they do not eat. If water consumption increases, feed consumption and growth rate increase, but if water consumption decreases, feed consumption and growth rate decrease.

In the past, cup-, bell-, and trough-type drinkers were the primary systems used in broiler production. Today nipple drinkers are the standard for most new broiler houses and many older houses have been retrofitted with nipple drinkers. However, more knowledge is required to properly operate nipple drinker systems than open systems. Growers must understand the importance of various flow ratings, water consumption patterns and water line height on broiler performance.

## Understanding and Monitoring Water Consumption of Broilers

Pesti and co workers (1985) estimated average water consumption using the following formula:  $\text{Water}/1,000 \text{ birds}/\text{day} = \text{Bird Age (Days)} * 1.396 \text{ gallons}$ . Pesti and colleagues suggested that in cooler months 1.349 gallons should be used to estimate water consumption, while in warmer months 1.507 gallons should be used. This means that 20,000 birds at 49 days of age in the cooler months would consume  $(20 * 49 * 1.349 =)$  1,322 gallons/day while in the warmer months the same birds would consume  $(20 * 49 * 1.507 =)$  1,477 gallons/day. Data collected from our four broiler houses on the Applied Broiler Research Unit over a 10-year period has indicated that water consumption averaged 41,010 gals per 40' x 400' house per flock (Tabler and Berry, 2001). This means a farm with four 40' x 400' broiler houses averaging six flocks per year would consume slightly over 984,000 gals of water per year. Thus, nearly one million gallons of water must pass through the water delivery system each year. With a water flow that great, you cannot afford to make a mistake in how you manage your watering system. However, there are other important reasons for properly managing your watering system.

Water is often used to deliver vaccines, medications, vitamins and other substances to the flock, but without knowing the amount of water birds consume on a given day, it is impossible to ensure that birds will receive the proper dosage of a given substance. Can we expect these expensive vaccines, medications, and vitamins to have a beneficial effect if they are not delivered at the proper dose? Monitoring daily water consumption of a broiler flock can also alert a grower to potential disease or management problems, so that treatment or corrective action can start before the problem becomes more severe (Goan, 1994). Water consumption is such an important indicator of poultry performance that many new houses now have water meters as standard equipment and many growers with older houses have installed water meters to monitor consumption.



*Water is the most important nutrient in poultry nutrition. An animal deprived of feed can lose up to 40% of its body weight and survive, but an animal that loses 10% of its water will have serious disorders, and death will result from the loss of 20% of body water.*

NIPPLE DRINKER— continued on page 10

### Advantages and Disadvantages of Nipple Drinkers

Research studies and field trials have indicated that feed conversion may be improved in flocks on nipple drinkers. However, studies have also suggested that the weight-to-age ratio may be marginally decreased. Almost every study comparing drinker types has documented that broilers are healthier when drinking from nipple drinkers. Mortality, condemnations and medication costs are almost always lower with nipple systems since bacterial contamination of the birds drinking water is greatly decreased and litter conditions are usually improved (Goan, 1994). Nipple drinkers tend to save labor, waste less water and reduce processing plant condemnation (Lott et al., 2001). The primary advantage to growers is likely the labor savings, since nipple systems do not need to be cleaned and disinfected on a daily basis as open systems did.

While nipple drinkers have their good points, there are disadvantages associated with them as well. Nipple mechanisms (rubber seal, metering pin, etc.) don't last forever and new nipples can be expensive. Also, when nipple drinkers are not at a proper height there is almost always decreased water and feed consumption and thereby, reduced growth rate. There is concern that certain types of nipples restrict water flow as compared to open systems. There is also concern that during periods of extremely hot weather broilers on nipples do not perform or survive as well as birds on open systems.

### Managing Nipple Drinkers

Even a quick examination of nipples will show that they are precisely made devices that cannot be repaired with substances commonly found on the farm. Yet these devices control whether or not birds get water as well as whether or not water spills soak the litter. In view of this situation, growers should always have spare nipples on hand so that leaking ones can be promptly replaced before creating a serious water leak or spill. It is also wise to have replacement parts for other parts of the system on hand. While spare nipples and parts are expensive, buying parts is preferable to having poor flock performance or flooding the floor of the house.

Carpenter et al. (1992) noted increased body weights with high flow rates (2.3 mL/s) of nipple drinkers for broilers compared with low flow rates (0.4 mL/s). May et al. (1997), investigating water consumption of broilers at high cyclic temperatures (75 to 95 to 75° F), noted similar water usage with a bell-type drinker and nipple drinkers during the lower temperatures but reduced water usage for the nipple system during the high part of the cycle. In view of this, growers should ask questions to make sure the style nipple being used has an adequate flow rating for the type bird being grown. Otherwise you may

create a serious negative effect on your birds performance by restricting water intake which will, in turn, have a serious negative effect on feed intake and growth rate. If you are unsure of your drinkers flow rating, ask the manufacturer representative in your area or your drinking system installer to help you determine the flow rate. In some cases, the color of the metering pin corresponds to a particular flow rate. In other cases, you may have to physically determine the flow rate by measuring the flow from part of the nipples in your house during a given period of time. If adequate water isn't available, it won't matter how good your drinker managerial skills are or how well the rest of your management program operates; flock performance will suffer greatly.

Once nipples are installed in the system, water flow rates are regulated by water pressure. Nipple water systems use pressure regulators to control the amount of water released when the nipple mechanisms are triggered. Regulators must be adjusted on a regular basis (at least weekly and perhaps more often) to maintain water pressure at manufacturer recommended levels. Water pressure should remain low when chicks are very young so that it takes very little pressure to trigger the nipple and so the water flow rate will be less when chicks are small. This will decrease the possibility of excess water wastage leading to caked litter formation. As birds increase in age and weight, the pressure is gradually increased to allow more water to flow through the drinker when the nipple is triggered. The force required to trigger the nipple is greater at a higher pressure; however, as the birds get bigger and stronger they are able to apply more force allowing them

Age (Wks)	Average Temperature Inside Broiler House <sup>1</sup>		
	75°F	85°F	95°F
	----- Gallons per 1,000 Birds -----		
1	6	7	8
2	17	22	35
3	28	40	70
4	39	58	97
5	49	72	117
6	56	85	132
7	66	94	144
8	70	98	150

<sup>1</sup> Adapted from Goan (1994).

*While spare nipples and parts are expensive, buying parts is preferable to having poor flock performance or flooding the floor of the house.*

access to a greater amount of water over less time. Adjusting the regulator throughout the flock is important since improper pressure may result in an inadequate supply of water to the birds or may promote wet litter under the water lines. A small amount of caked litter under the water lines may be acceptable to let you know there is adequate water moving through the nipples. If you see only dry, dusty litter under the water lines with no sign of cake there may be reason to suspect that your drinkers are not putting out an adequate flow rate of water. This could be due to improper water pressure or the manufacturer's flow rating for the particular style nipple you have.

Filtering the water supply is more important with nipple drinkers than with open drinkers. Foreign particles must be kept out of the water lines and nipple mechanisms to prevent constant dripping. Check filters regularly and replace when necessary. Replacement intervals will be determined somewhat by water quality (iron and mineral concentrations or bacterial contamination in the water source).

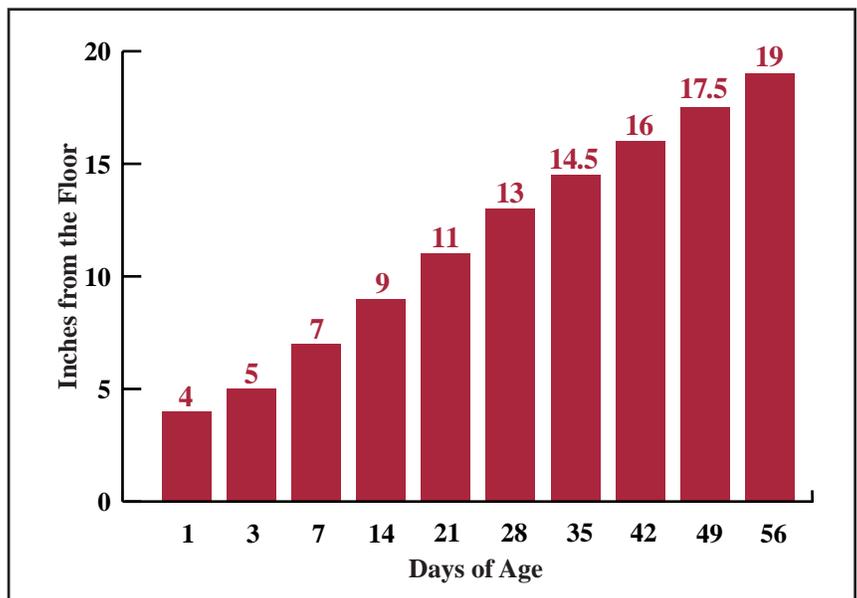
Air in water lines can cause "air locks" where air pockets prevent or severely reduce water flow in nipples near the pocket. Air locks can be an especially bad problem early in the flock when chicks are small and water pressure low. Air locks occur in high spots along the drinker line so it is important to keep the line level. This may require adjustments during the flock and especially after decaking, when the litter has been disturbed or a total cleanout when new bedding has been added and litter or bedding may no longer be level. Occasionally it is also a good idea to lift the regulator end of the water line a foot or two for two or three seconds so that air in the system can be let out. However, when raising the water line, use the metal support pipe or bar to lift the line. Avoid grabbing the regulator itself since that could break the water line.

### Nipple Height Critical to Performance

May et al. (1997) noted water consumption was decreased by increased nipple height. Optimum nipple height should be as high as birds are able to stretch their necks and drink from the end of their beaks (Dozier et al., 2001). However, if nipple height is increased so the bird must elevate its breast and then stretch its neck to reach the nipple, then inadequate consumption can occur (Dozier et al., 2001). Figure 1 shows the approximate heights that nipples should be above the floor through a typical growout. The breed of broiler that your integrator uses or integrator recommended management practices may require some adjustment to these general guidelines. Nipple drinker height, in most instances, requires daily adjustment to ensure adequate water consumption.

Proper nipple height becomes even more important during periods of high environmental temperatures. Lott et al. (1998) reported weight gains are reduced with nipple drinkers as compared with open-type drinkers at high ambient temperatures (86° F) with the reduction attributed to panting. Chickens normally drink by taking water from a pool and raising their heads to let the water run down the esophagus (May et al., 1997). The raising of the head must be coordinated with breathing, which is a reflex action. Obtaining water from a higher point is not as typical a behavior when the birds are panting (May et al., 1997). The chicken has trouble coordinating breathing and passage of water down the esophagus. It appears the chicken cannot coordinate the intake of water with breathing if it is not associated with the reflex action of raising the head (May et al., 1997). If panting reduces water intake on nipple drinkers then reducing panting should increase water intake and, in turn, feed intake and weight gain. In fact, Lott et al. (1998) demonstrated that a reduction of latent heat (less panting) by means of increased air velocity increased body weight gains with nipple drinkers. Simmons et al.

Figure 1. Nipple Drinker Height at Various Ages



Adapted from Goan (1994).

NIPPLE DRINKER— continued on page 12



(1997) noted a shift from latent to sensible heat dissipation with increasing air velocities. Therefore, increasing air velocity in an attempt to cool the bird and reduce panting may increase water intake from nipple drinkers and improve feed intake and weight gains during periods of high environmental temperatures. Lacy and Czarick (1992) noted improved weight gains of broilers in tunnel- versus cross-ventilated houses. The air velocity in a tunnel-ventilated house is greater than that in a conventionally ventilated one with similar air exchange rates.

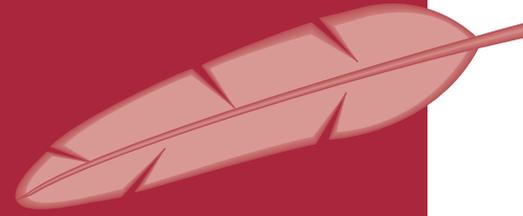
### Summary

In recent years, nipple drinkers have become the standard drinker used in broiler production. While providing major advantages in labor savings, less water wastage and reduced condemnations at the processing plant, nipple drinkers come with a price. They require a much higher level of management pertaining to proper water pressure and water line height than open-type systems. Adjustments must be made to water line height on an almost daily basis and to pressure regulators at least weekly. Nipple drinker height is absolutely critical, especially during periods of hot weather when birds are panting. Nipple drinkers are an excellent tool available to growers, and the advantages far outweigh the disadvantages; however, proper management on a daily basis is required if they are to perform as intended.

*Nipple drinkers are an excellent tool available to growers, and the advantages far outweigh the disadvantages; however, proper management on a daily basis is required if they are to perform as intended.*

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# Early Feed Intake and Bird Performance

## Importance of Early Feed Intake

Feed intake is the single most important factor in determining growth rate of commercial broilers and turkeys. The data in Table 1 were obtained from industry sources and show that birds consuming feed the fastest weighed the most at processing and converted feed best. These data show what experienced growers have known for some time — flocks that do the best tend to be active and consume starter feeds quickly.

It is also important to realize that feed intake is most important in the youngest birds. Figure 1 illustrates this fact. Most of the energy and nutrients consumed by birds younger than four weeks goes toward growth. After four weeks the majority of energy and nutrients goes toward maintaining the bird's body. This means that if energy and nutrients are restricted early in the bird's life, it will likely never catch up to birds that were provided a good start.

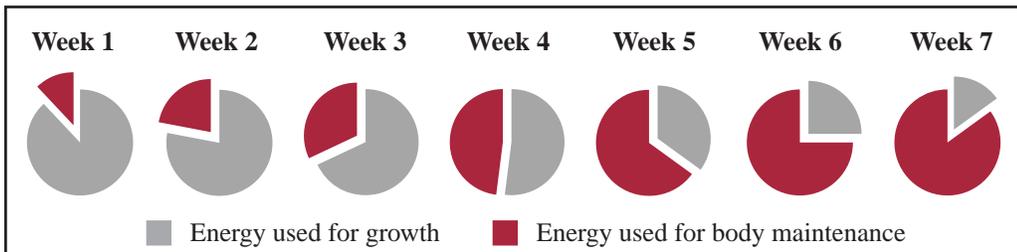
In addition, flocks in which the majority of birds start well tend to be relatively uniform in size, making management and optimum results easier. Flocks with the highest feed intake will almost always have the highest average daily gain and weigh most at processing.

*Feed intake is the single most important factor in determining growth rate of commercial broilers and turkeys.*

**Table 1. Early Feed Intake and Broiler Flock Performance**

Time to Consume 1.5 lbs of Starter (Days)	No. of Farms	Av. Daily Gain (lbs/day)	Wt. at 49 days (lbs)	Adj. Feed Conversion
<17	19	0.103	5.05	2.04
17-19	33	0.101	4.95	2.10
>19	42	0.100	4.90	2.18

**Figure 1. Energy and Nutrient Utilization as Broilers Grow**



Adapted from: Donald, Eckman & Simpson, 2002

*The amount of feed a bird consumes can be limited by four factors: physical limitations, bird physiology, feed availability and water availability.*

## Understanding Feed Intake

Achieving maximum feed intake is much more complicated than just making sure your feed pans have feed. The amount of feed a bird consumes can be limited by four factors: physical limitations, bird physiology, feed availability and water availability.

EARLY FEED — continued on page 14

Birds start eating because of a lack of fullness in certain sections of their gut. While some farm animals start eating for the same reason, certain farm animals (like cows) will eat until they are full (if adequate feed resources are available) and then rest while the feed digests. However, chickens and turkeys tend to be nibblers. They will fill their crops, wait until some feed leaves and then fill the crop again. Yet there are physical limitations to the amount of daily intake a bird can handle. In addition, the amount of feed birds eat is based on the passage of non-digested feed from the digestive tract. The slower the rate of passage, the greater the amount of intake restriction.



The physiological limit to feed intake is controlled by the bird's energy requirements for growth and body maintenance. If feed is available and gut fill or other physical factors do not limit intake, then intake is determined by the bird's demand for energy. If birds are being fed a low energy diet, they will tend to eat more of that diet than if they were fed a higher energy diet. This situation is similar to that in humans and other species. How many of us as children ate candy and did not want to eat our supper? The reason we did not want to eat supper is the candy met our energy needs. What does this mean for us as poultry growers? It means that anytime we provide birds with an additional source of energy, we could reduce feed consumption and, in turn, growth.

If feed is unavailable then feed availability obviously limits intake. The lack of feed could be due to a mechanical problem, a feeder line set wrong or a missed feed delivery. Regardless, it is important to ensure that birds always have access to feed.

Water is, without question, the most essential nutrient. Without adequate water birds can survive a few days, but do not do well. This is because of the birds need for water and because the availability of water affects feed consumption. When kept at 70°F birds consume about twice as much water as feed on a pound-for-pound or weight-for-weight basis. Every effort must be made to insure the availability of an adequate amount of water by providing adequate drinker space as well as maintaining proper drinker height, pressure and flow rate throughout the entire water system.

### Management Considerations

On-farm management practices can cause feed intake to vary significantly across flocks and different housing set-ups (tunnel, conventional, dark-out, etc.). Even though growers may be feeding the same feed and following the same "general" management guidelines for their specific complex, feed intake will be affected by individual management styles, bird genetics, health status of the flock and the environment the birds are subjected to over the life of the flock. As growers, we must do our best to 1) provide birds with adequate access to feed and water, 2) reduce environmental stress due to temperature extremes, ammonia levels or wet litter and 3) minimize disease challenge. The only sure-fire way for growers to be confident all these management criteria are being met is to spend time in the chicken house. Automatic controllers are great, but **they do not take the place of someone being in the chicken house**. Numerous trips per day to the chicken house are required if you are going to catch a water spill, find a cross auger hung up, re-wire a feed motor or adjust the ventilation rate before major problems occur. Technology has removed much of the manual labor from growing chickens, but it has not removed the need for a person watching over growing chickens. It has been my observation from my early days as a broiler service technician right up through today that, as a general rule, how well a grower does on a flock of birds is directly proportional to how much time he spends in the poultry house. While there are exceptions, generally, growers who do the best spend the most time in the chicken house. Growers that spend time in their houses catch potential negative situations, maintain a more uniform environment by making almost constant little adjustments and fix little problems before they become big ones. Although taking care of these small things may seem like busy work, the cumulative effect over a six-to-eight-week growout may be the difference between being on top of the list and being average or below. Every grower is different, and some have off-farm jobs that prevent them from "living" in the chicken house. However, be aware that raising chickens or turkeys is like most other endeavors in life. The more time and effort you are willing and able to put into a project, the better you are at that project.

*Growers that spend time in their houses catch potential negative situations, maintain a more uniform environment by making almost constant little adjustments and fix little problems before they become big ones.*

Regardless of how many visits are made on a daily basis, certain things should be checked with each visit to the poultry house. Always check feeders and drinkers to make sure that feed pans have feed and drinkers have water. Also, feeder and drinker height must be adjusted throughout the flock to provide easy access to feed and water at all times. Feed intake will not be optimum if a bolt in the auger blows a circuit breaker or overheats a feed line motor and no one discovers the problem for four hours or longer. Even more dangerous is an in-line water pressure reducing valve failing on the hottest day of August and the problem not discovered until birds start dying. Almost constant vigilance is required to prevent little problems from becoming major disasters.

Temperature, humidity and ammonia levels should also be checked on each visit and necessary adjustments made. Birds under stressful conditions are not as efficient at converting feed to meat. When responding to environmental stress, birds will have increased levels of stress hormones in the body. Also, gut motility and nutrient absorption are decreased while body energy reserves are used to combat the stress and thereby, unavailable for growth and weight gain. The type of stress can have a major impact on feed intake levels. Acute stress, which lasts only a short period and is then corrected, may decrease feed intake for only a short period and have minimal performance effects. An example is running out of fuel and chilling the house until more fuel is delivered and the brooders are re-lit. Chronic stress, however, such as excessive ammonia levels throughout the life of a flock can have serious detrimental effects on both feed intake and performance. Stress may also lead to a weakened immune system and increased disease susceptibility which can decrease feed intake. In addition, when the bird is under stress or disease challenge, the bird uses energy and nutrients to mount an immune response rather than grow.

### Summary

Feed intake is the single most important factor regulating performance of agricultural animals. Feed intake controls the rate of output of all animal products and is the common denominator of efficiency, regardless if the output is meat, eggs, or reproduction. While numerous factors influence feed intake, as growers we control our own destiny when it comes to on-farm management practices. We must provide access to feed and water at all times. Feeder and drinker height must be adjusted and maintained at the proper level during the entire flock. Temperature, humidity, ventilation, and ammonia must be kept within acceptable ranges; otherwise, feed intake and flock performance will suffer. Spending time in the chicken house is the only way to guarantee that all these needs are being met. Automatic controllers are marvelous inventions and allow us more flexibility than ever before. However, don't let them take the place of you spending time in the chicken house. Today there is a substitute for almost everything **except** you being in the chicken house.

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