Spring 2008

Avian Advice, Summer 2008

Dale Bumpers College of Agricultural, Food, and Life Sciences (University of Arkansas, Fayetteville). Center of Excellence for Poultry Science

University of Arkansas (System). Cooperative Extension Service

Summer 2008 • Volume 10 no. 2

Avian Advice

UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE
Cooperative Extension Service

Poultry Litter: Issues and Opportunities

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INSIDE

Introduction

Many farm families throughout the southeastern and Delmarva regions of the United States rely on poultry production as their primary source of income. This has worked well for years but that is changing; due in part to urban encroachment, environmental concerns, increasing regulations, and legal ramifications impacting how producers manage poultry litter. What are some issues associated with litter and what opportunities exist to best deal with this byproduct?

Major Issues

Until recently, most producers spread litter on fields and pastureland. Many producers also have beef cattle as a supplemental income source; taking advantage of litter's fertilizer value. This practice has proven beneficial for decades, but after years of spreading litter on fields, soil nutrient is no longer balanced on many fields. Crops need nitrogen (N) present in litter, but many soils no longer require phosphorus (also present in litter). Fertilizer applications once based on N needs of crops are now based on soil phosphorus (P) levels; preventing or limiting amount of litter some producers may apply.

Producers able to apply litter based on nutrient management plans and soil tests are also at risk. Concerns over N loss from ammonia volatilization, P in surface runoff, odors, dust, and complaints from neighbors take their toll on producers and their families. Poultry and livestock operations in both Europe and the United States are the largest sources of ammonia emissions; accounting for an estimated 70 to 90% of total emissions (Mukhtar et al., 2006). Ammonia volatilization decreases litter N content and represents a significant loss of fertilizer value (Tabler, 2006a). In the past, ammonia was considered a nuisance odor emitted from poultry houses. However, due to its large output from poultry farms and its rapid reaction with strong atmospheric acids (nitric and sulfuric) to produce ammonium salts (PM2.5), ammonia emissions are now being heavily investigated (Baek et al., 2004). In many parts of the United States, the fraction of PM2.5 associated with ammonia emissions is as much as 50% of total fine particle mass (Strader and Davidson, 2006). It is likely regulations addressing ammonia emissions are in agriculture's near future. Best management practices (BMPs) should be in place and utilized in several different areas to help reduce ammonia emissions. Major sources of ammonia emissions from poultry production include the poultry house itself, litter storage facilities, and fields where litter is applied; each source requiring its own specific BMPs.

Dust and odor associated with litter is another critical issue for producers. Even though dust and odors have always been associated with livestock production, as operations become larger and more concentrated, management of dust and odors becomes more important (Ullery et al., 2003).

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Dust and odors from livestock operations have recently become a highly emotional issue due to the influx of city dwellers to rural, agricultural areas. Producers and newfound neighbors have vastly different ideas about what "life in the country" means. This has led to an escalating number of complaints to authorities and an increase in the number of local governments considering setback requirements or other siting regulations for new or expanding agricultural operations.

It is difficult and expensive to study the exact make up of odors because most odors are made up of many different gases at extremely low concentrations (Jacobson et al., 2006). Spilled feed, bedding material and the poultry or livestock themselves account for a portion of livestock odors but most poultry and livestock odors result from decomposition of manure (Tabler, 2006b). Odor concentration can be quite variable depending on level of microbial activity in the litter or manure. Microbial activity and growth are dependent on moisture content, pH, temperature, oxygen concentration and other environmental factors such as wind speed, wind pattern and season (Tabler, 2006b).

Dust aggravates the odor situation by acting as a transport mechanism capable of carrying odors long distances depending on air currents. Excessive dust in poultry houses is also a detriment to house environment and may adversely affect health of birds and workers. Several sources in the poultry house can contribute to dust generation including bedding, manure, feed, dander, feathers, and bacteria. Proper management can maintain in-house dust at manageable levels. Unfortunately, spreading litter usually generates significant amounts of dust and, in some cases, complaints, as well. Therefore, use common sense and good neighbor practices whenever it is time to spread litter.

Opportunities

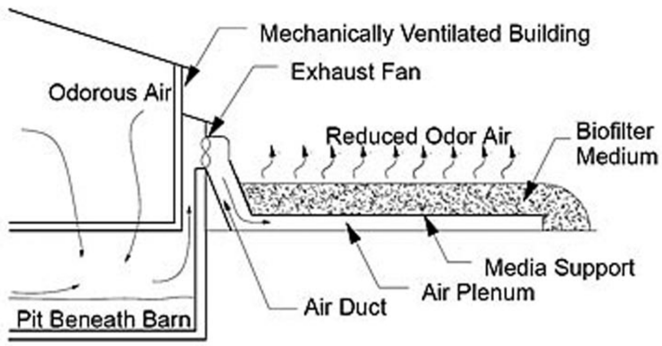
Addressing proper management and disposal of poultry litter offers opportunities for new and innovative thinking. For example, most poultry litter is spread on grassland surface which has raised serious runoff and water quality concerns in many areas. However, incorporation of litter into the soil has proven to be an effective technique for decreasing volatilization and runoff losses in some cropping systems. Pote et al. (2003) developed a knifing technique that minimized disturbance of the soil structure, forage crop, and thatch while incorporating poultry litter below the surface of established perennial grassland. Nutrient concentrations and mass losses in runoff from incorporated litter were significantly lower (generally 80-95% less) than in runoff from surface-applied litter. By the second year, litter-incorporated soils had greater rain infiltration rates, water-holding capacity, sediment retention, and showed a strong tendency for increased forage yield (Pote et al., 2003). In follow-up work, Pote et al. (2006) developed a mechanical incorporator that applied poultry litter under the pasture surface which decreased nutrient losses in runoff about 90% and tended to increase forage yield. Current research is focused on testing a multi-shank incorporator that can rapidly apply several tons of litter beneath a grassland setting before reloading (Pote, 2008); similar to surface application methods. Such innovative thinking and product development could potentially offer multiple benefits to producers and integrators. Not only would incorporation greatly reduce surface runoff and the threat to water quality but ammonia volatilization, dust, odor, and complaints would also likely be reduced compared to surface application.

Vegetative environmental buffers or windbreaks are an old technology that holds new promise for tunnel-ventilated, totally enclosed poultry houses. Windbreaks are able to buffer dust, odors, and noise emissions from poultry houses while adding to property values and aesthetics, as well as foster improved neighbor relations (Tyndall, 2008). As the windbreak matures, it also adds a visual screening effect to agricultural operations. The Applied Broiler Research Farm recently planted a 4-row windbreak in front of 4 tunnel fans at one broiler house. The windbreak contains 2 rows of a deciduous species (closest to the fans) and 2 rows of evergreens. Deciduous trees planted as the first rows opposite fans tend to withstand the high-particulate loads best, because particulate matter accumulating on leaves during summer when tunnel fans are in use will drop off with the leaves in the fall and new leaves will return the following spring. Mixing of species is recommended for two reasons: 1) increased species diversity reduces the risks of whole scale pest/pathogen loss; and 2) some species (e.g. poplars) featuring very rapid growth may have relatively short healthy life span (Tyndall, 2008). To insure livability, the minimum distance of the vegetative buffer from fans is to be 10 times the fan diameter (Malone et al., 2006). To encourage initial establishment and growth, an effective irrigation and weed control program is essential.

Biofilters are another odor control device recently adapted for livestock and poultry operations that are both economical and effective. The technology is popular in northern Europe and is attracting increased attention in the United States. Biofiltration can reduce odor and hydrogen sulfide emissions by as much as 95% and ammonia by 65% (Nicolai and Schmidt, 2005; Nicolai et al., 2006; Sun et al., 2000). Typically, a biofilter is a layer of compost and wood chips that support a microbial population, or simply a bed of organic material 10 to 18 inches deep (Schmidt et al., 2004). Microbes associated with the organic material convert odorous gases to carbon dioxide and water as air passes through the biofilter. Schmidt et al. (2004) illustrated elements of an open-bed biofilter (Fig. 1) which include:

• A mechanically ventilated space with biodegradable gaseous emissions
• An air handling system to move the odorous exhaust air from the building or manure storage through the biofilter
• An air plenum to distribute the exhaust evenly beneath the biofilter media.
• A structure to support the media above the air plenum.
• Porous biofilter media that serves as a surface for microorganisms to live on, a source of some nutrients, and a structure where moisture can be applied, retained, and available to the microorganisms.

Figure 1. Open-bed biofilter attached to livestock barn (from Schmidt et al., 2004).



Biofilters do require maintenance in four areas – assessing pressure drop across the media, weed control, rodent control, and moisture control (Nicolai and Schmidt, 2005). Moisture control is critical for the biofilter to properly reduce odor. Media selection is also important with critical properties including 1) porosity, 2) moisture holding capacity, 3) nutrient content, and 4) slow decomposition (Schmidt et al., 2004). Exhaust fans will also need to be checked (and possibly replaced) to be sure there is enough fan power to both ventilate the building and push the exhausted air through the biofilter.

Summary

Many farm families rely on poultry production as their primary income source. The litter byproduct from this production is a major concern for producers and the industry today. It will require new and progressive thinking and development of new tools to solve the problem. Currently, this type of work is ongoing across the country. From innovative equipment design to vegetative buffers to biofilters and more, research continues to focus on efforts that help farmers farm while keeping neighbors happy and protecting the environment. However, producers should be proactive and involved when air emission controls are discussed to prevent misguided regulations that demand unrealistic expectations from the agricultural industry.

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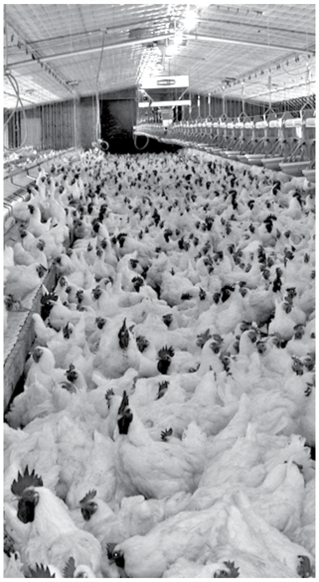
Skip-a-day and Everyday Feed Programs for Broiler Breeders in the Hen House



Introduction

Controlling body weight in replacement broiler breeders and breeders in the hen house is a portion of the poultry industry that will continue to evolve. Because of the genetic potential for growth in modern breeders, methods to control body weight and uniformity within a flock continue to receive attention in an effort to improve, or at least maintain reproductive performance.

In the United States, feed restricting pullets and young cockerels primarily involves one of several forms of a skip-a-day feeding program. The use of skip-a-day feeding in the pullet house often occurs in an effort to uniformly distribute small amounts of feed throughout the house to allow all birds' equal and immediate access to feed allotments. If feed distribution does not occur in a uniform and even fashion, this can result in poor uniformity of body weight and body conformation among the pullets and cockerels. While the technology and equipment exists to uniformly distribute small feed allotments, it is not found in the majority of pullet houses in the United States. When pullets and cockerels exhibit poor uniformity in the pullet house, this often translates to poor performance in the hen house as the maturation process is uneven and therefore all birds will not respond to reproductive stimuli the same. Therefore, various versions of skip-a-day feeding is still common place in the poultry industry.

As replacement breeders are moved to the hen house, the most common practice in the U. S. is to begin providing feed allotments on an everyday basis. However, in other countries, and occasionally in the U. S., the use of skip-a-day feeding may continue in the hen house in an effort to maintain bird uniformity and further control feed distribution prior to the onset of egg production. These programs usually involve feeding one of various versions of skip-a-day feeding until first egg or 5% production is attained. When utilized, the most common skip-a-day program in the hen house is a 5-2 feeding schedule, as this seems to be a sort of combination between the traditional true skip-a-day and everyday feeding.

Research Trial Design

At the University of Arkansas Broiler Breeder Research Farm a trial was designed to draw a direct comparison between everyday fed and 5-2 skip-a-day fed birds following housing in the hen house. This trial involved a total of 4080 Cobb 500 pullets which were raised together and according to industry recommendations. At 21 weeks of age, pullets were moved to a single production style hen house and randomly divided into 48 pens with 24 replicate pens of 85 hens per pen for each of the two feed treatment groups. Both groups were fed the same quality and quantity of feed per bird per week (feed allotments and feed formulations according to industry standards) with the skip-a-day fed birds receiving their weekly feed allotments in five days rather than seven. The 5-2 fed birds had two 'off feed' days each week each of which followed either two or three consecutive feed days. Once 5% egg production was attained for each individual treatment group, each group was fed into production the same and according to industry recommendations. All conditions and feed programs were the same for both feed treatment groups through 60 weeks of age.

Production results

As was expected, the onset of egg production was delayed in the skip-a-day fed group. The onset of egg production in the skip-a-day group occurred five days later than the everyday fed group and therefore peak in egg production was delayed as well (Figure 1). However, the skip-a-day fed group was able to maintain egg production following peak and followed a similar egg production trend. The periodic egg production results in Table 1 show that while the skip-a-day group came into production five days later and attained peak production several days later, by 30 weeks of age cumulative eggs produced per hen housed was similar. Additionally, at the conclusion of the 60 week production cycle, there was no significant difference in total eggs produced per hen housed.

Figure 1. Egg production in skip-a-day versus everyday fed breeder hens

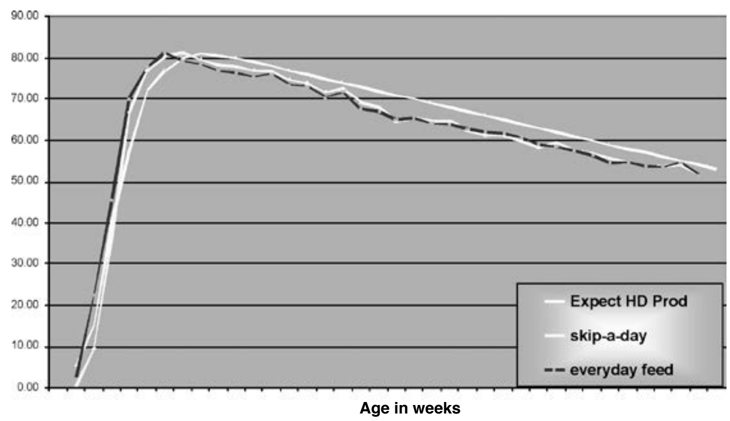


Table 1. Cumulative egg production per hen in skip-a-day versus everyday fed breeder hens through 60 weeks of age.

Feed Program	-----Weeks of Age-----						
	30	35	40	45	50	55	60
Skip-a-day fed	25.18	51.62	75.69	97.26	117.15	135.50	148.45
Every-day fed	25.67	51.60	75.14	96.41	116.19	134.25	147.09

Hen mortality for the trial was relatively low with 8.1% and 9.6% life of flock mortality for the skip-a-day and everyday fed birds with no significant difference found in hen body weight at any age. Egg weights were recorded by pen weekly through the trial and showed no significant difference in any week between the feed treatment groups with a 60-week life of flock average of 66.08 and 66.21 g per egg for the skip-a-day and everyday fed groups.

Conclusions

By industry recommendations, skip-a-day feeding broiler breeder pullets in the hen house prior to the onset of production is not common place in the United States. The results found in this project are consistent with those found by producers that have utilized this feeding program in the hen house both in the US and internationally. However, in this trial we were able to compare the two feeding programs side by side in a research setting designed to simulate production conditions. Although the skip-a-day fed birds were slower coming into production, by 60 weeks of age there was no significant difference in the total number of eggs produced per hen housed. Additionally, egg weight, bird weight, and livability are not negatively affected in skip-a-day fed birds. Therefore, feeding broiler breeder pullets in the hen on a skip-a-day feed program is not detrimental to reproductive parameters and can be used as an alternative feeding program in an effort to further control body weight uniformity.

Summary

1. Feeding broiler breeder pullets on a 5-2 skip-a-day feeding program is not detrimental to breeder performance.

2. Although pullets on this skip-a-day feed program come into production several days later than everyday fed birds, they make up for this in overall eggs produced per hen housed at 60 weeks of age.

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Understanding and Controlling Waterfowl

Native waterfowl in the United States are protected by both state laws and the Federal Migratory Bird Treaty Act.

These laws prohibit hunting, killing, selling, purchasing or possessing migratory birds without state and federal permits.

Introduction

Waterfowl are a valuable resource that is treasured by many. Arkansas is known by many as a prime spot for duck hunting. The "V" formation of arriving flocks is, for many, a familiar and welcome sign of the change of seasons. Yet waterfowl can easily become a nuisance as well as spread disease to both backyard and commercial flocks. In addition, waterfowl can be year-round residents and populations can rapidly get out of hand. In five to seven years one pair of geese can become 50 to 100 birds that foul ponds and damage lands or crops near the water (Williams-Whitmer et al., 1996). This article is intended to increase understanding of waterfowl characteristics so that effective control methods can be designed.

Waterfowl Biology

Waterfowl includes ducks, geese and migratory swans. Habitats suitable for waterfowl contain two primary components: a permanent body of water and suitable open feeding areas with abundant vegetation. Water is required for waterfowl to land, escape and rest. Land and vegetation are required for feed, mating and nesting. In short, waterfowl are generally quite adaptable with regard to site selection. Any site that provides them safety, food and nesting locations will be utilized (Anonymous, 2007; Williams-Whitmer et al., 1996). Since many poultry producers also have cattle operations with the required pasture land and stock ponds, these farms may be attractive sites to waterfowl.

Waterfowl are also very adaptable with regard to food. Ducks are filter feeders and will eat almost anything, while swans eat aquatic plants and geese generally eat terrestrial grasses. However, most waterfowl will usually come to land twice a day (morning and evening) looking for food. Normally waterfowl will roost on or near the open water at night (Cleary, 2008).

Waterfowl are normally monogamous and solitary nesters. Geese and swans mate for life, while ducks tend to seek a new mate each breeding season. Waterfowl will usually lay an egg a day or an egg every other day until the clutch is complete. The 28 to 34 day incubation period (depending on the species) usually begins when the last or next-to-last egg is laid. Newly hatched waterfowl are quick learners and begin foraging soon after hatch. However, studies have shown that first year mortality rates of 60 to 70% are not uncommon (Cleary, 2008).

Legal Cautions

Native waterfowl in the United States are protected by both state laws and the Federal Migratory Bird Treaty Act. These laws prohibit hunting, killing, selling, purchasing or possessing migratory birds without state and federal permits. Permits are not required to scare away waterfowl as long as the birds are not harmed. However, nesting birds are protected and may not be harassed without a federal permit (Williams-Whitmer et al., 1996).

Control Methods

No one control method is likely to be effective. Combinations of methods generally provide the best control. Control methods are classified into the following five categories: habitat modification, exclusion, harassment, chemical sprays and lethal control (Anonymous, no date). While time and space do not allow a complete description of control methods, several ideas will be outlined under each category.

Habitat Modification

• Eliminate man made food sources. If anyone is intentionally feeding waterfowl, it should stop immediately. Waterfowl should not be allowed access to food scraps or other refuse that would attract or nourish waterfowl (Williams-Whitmer et al., 1996).

• Remove domestic waterfowl. Domestic waterfowl tend to attract migratory waterfowl (Anonymous, No Date).

• Steepen banks of ponds and creeks. Waterfowl prefer gentle, grassy slopes so that it is easy to come in and out of the water for rest and food. Steep banks make sites less attractive to waterfowl.

• Manage grass and plants. Replace plants that waterfowl like to eat with ones they do not prefer (Anonymous, No Date)

<u>Waterfowl prefer:</u>

- Kentucky bluegrass
- Brome grass
- Canary grass
- Colonial bentgrass
- Perennial ryegrass
- Quackgrass
- Red fescue

<u>Waterfowl do not prefer:</u>

- Mature tall fescue
- Periwinkle
- Myrtle
- Pachysandra
- English ivy
- Hosta or plantain lily
- Ground juniper
- Switch grass

Exclusion

• Overhead Grid System. Grid systems are thin cables that are visible to both humans and waterfowl that are strung on 10 ft centers between 5 ft steel fence posts. Waterfowl (particularly geese) are generally discouraged by grid systems because they are seen as a barrier between them and the water. Grid systems generally work well for bodies of water that are less than 150 ft across, but can (with some effort) be made to work on bodies up to 300 ft across.

• Fencing. Installing a three foot poultry wire fence may discourage geese from coming ashore, but discouraging ducks may require higher fencing. Triple strand electric fence has been used effectively. Wires should be strung at 5, 10 and 15 inches above the ground. However, fencing must be clearly marked to prevent accidentally shocking humans.

• Vegetation and rock. Waterfowl prefer to exit a body of water where they have a clear view of predators. Trees, large shrubs or rocks along the shoreline may present a barrier that waterfowl are reluctant to cross (Anonymous, No Date; Williams-Whitmer et al., 1996).

Harassment

• Dogs. Use of trained dogs to control waterfowl is effective, but owners must be in control of the situation since the owner is responsible for damage to birds done by dogs. Border collies or other herding dogs often work well in these situations (Ziengenhagen and Tuck, 2005).

• Pyrotechnics. Bottle rockets that scream and explode or firecrackers can be effective harassment methods. However, individuals using pyrotechnics should be trained in their use and wear eye and ear protection

• Chasing. Chasing waterfowl on foot or in a small vehicle is labor intensive, but when used in conjunction with other control methods, can be effective.

• Other harassment techniques. High pressure water sprayers, air horns and beating pots or pans together can also be useful harassment techniques

Chemical repellants

While there are innumerable home remedies, few are legal and effective. Chemical repellants must meet specific legal requirements, which make them expensive and not suitable in all situations. In addition, caution should be exercised when using any chemical near poultry houses as they may interfere with bird performance or cause residues. Producers should check with their service tech or integrator to verify any chemical's acceptance before it is used near the poultry house.

Lethal control

Hunting. During hunting season, waterfowl can be effectively controlled with firearms, but regulations must be observed and hunting permits are required.

Biosecurity

Water fowl are known to carry a number of diseases. Therefore, it is imperative that people who have been in contact with waterfowl bathe, change clothes and use different footwear when entering commercial poultry houses. A better idea would be to have no contact with waterfowl at all prior to working in or around poultry houses.

Summary

Waterfowl are a treasured resource in the United States. However, waterfowl can become a nuisance and hazard around commercial poultry houses. Therefore, it is important to control waterfowl through habitat modification, exclusion, harassment or lethal methods. It is also imperative that individuals who have had contact with water fowl not enter poultry houses.

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Effects of Temperature Variation in On-farm Hatching Egg Holding Units in Commercial Broiler Breeder Flocks

Introduction

Broiler breeder hatching eggs are commonly held in storage facilities at the breeder farm anywhere from one to four days and again at the hatchery until placed in the setters. In the poultry industry, some pre-incubation of hatching eggs following oviposition and during storage is inevitable, yet efforts should be made to reduce this occurrence. With the continued development of this industry there have been tremendous advances which have improved the available equipment to maintain hen house temperatures, and the quality of egg transportation vehicles and egg storage facilities in the hatchery. However, with this improved technology, on-farm egg storage facilities have been largely neglected which has made it extremely difficult for producers to maintain constant egg storage room temperatures at the farm level.

While one purpose of egg storage is to accumulate eggs to meet the demand for chicks and to best utilize hatchery facilities, ultimately the goal is to arrest further embryonic development while maintaining embryo viability. While an egg storage temperature of 68°F (20°C) is the most commonly practiced industry recommendation, the actual on-farm egg storage temperature can range from a low of 60°F (15.6°C) up to 75°F (23.9°C). The range in egg storage temperature from one farm to the next is often due to different management programs, while day to day fluctuations within the same company is a result of poor egg storage facilities that are unable to maintain a constant storage temperature. Hatchery egg storage conditions have been evaluated in the past, with recommendations presented to reduce losses in hatchability. However, research regarding egg storage at the breeder farm is limited and incomplete. Therefore, the objective of this study was to determine the effects of oscillating and variable on-farm egg storage temperatures on hatchability and embryo viability in commercial broiler breeder flocks.

Egg Storage and Hatching Procedures

Four thousand three hundred twenty (4320) hatching eggs were obtained from the University of Arkansas's Broiler Breeder Research facility and were placed into two separate egg storage chambers, with all eggs stored at a control temperature of 70° F (21.1° C) for 0-24 hours. After the initial 24 hour storage period, eggs were divided into 864 egg lots and assigned to treatment groups. One group of eggs remained at 70° F for the entire 72 hour storage period (Control). Four other groups were moved to separate storage chamber with temperatures set at either 66° F (18.9° C), 68° F (20.0° C), 72° F (22.2° C), or 74° F (23.3° C) to represent Treatments 1, 2, 3, and 4, respectively. Eggs were stored at these temperatures for an additional 24 hours for a total of 48 hours of storage time. Then eggs stored at 66° F were stored at 74° F, eggs at 74° F were stored at 66° F, eggs at 68° F were stored at 72° F, and eggs at 72° F were stored at 68° F for an another 24 hours for a total storage time of 72 hours. After 72 hours of storage all eggs were returned to 70° F. Treatment details are outlined in Table 1. This design ensured that all eggs in this experiment were held at an average of 70° F for the entire three day "on-farm" egg storage time period. To summarize this design, all hatching eggs from the different temperature treatment groups were subjected to either a 2 or 4 degree F temperature fluctuation above and below the 70° F base temperature, but were held at an average of 70° F.

After the storage period, eggs were transported to their original commercial breeder farm where they were placed directly on a commercial hatching egg transportation truck and sent to a commercial hatchery for incubation. No treatment or special care took place after the on-farm storage period.

Results and Discussion

The hatchability of eggs subjected to a 2º F temperature change from 70° F was reduced by nearly 2% as compared to the control group (74.69 vs. 76.47% hatch, respectively). Eggs that underwent a 4º F temperature change had nearly a 1% loss in hatch as compared to the control group (75.61 vs. 76.47%, respectively). It is interesting to note that the greater temperature variation did not necessarily result in a greater loss in hatchability.

However, regardless of whether the temperature variation was 2 or 4º F, all hatching eggs used in the study moved from the hen house at about 80º F to the 70° F storage chamber for 24 hours. Eggs that then increased in temperature for 24 hours and decreased for another 24 hours before increasing again to 70° F (i. e. 70º F-▲-▼-▲) experienced a significant drop in hatchability as compared to the control (3.55% and 2.16% loss in hatch, respectively, Figure 1). Eggs in this group experienced multiple changes in temperature from the hen house to the hatchery. From the time of lay, these eggs decreased in temperature to 70º F then the temperature was raised for 24 hours, then lowered for 24 hours, then raised for 24 hours, then lowered as they were moved to the hatchery (67º F) then raised when moved to the setters (three periods of decreasing temperatures and three with increasing temperatures).

Eggs that were stored at 70° F then decreased in temperature for 24 hours, then increased after 48 hours then were returned back to 70° F (70-▼-▲-▼) experienced no difference in hatchability and less than 1% loss in hatch of fertile. Eggs in this treatment group basically underwent one change in direction of the temperature they were subjected to from the time they were laid until the eggs reached the commercial hatchery. These eggs decreased in temperature after lay to 70º F, then the temperature was decreased again for 24 hours, then increased for 24 hours, then decreased for 24 hours, then decreased again as they were moved to the hatchery (67º F) then raised when moved to the setters (two periods where temperatures were decreasing and two with increasing temperatures). Each time the internal temperature of the egg is elevated to near 75º F, metabolic activity is again initiated and embryo development ensues only to be slowed again during additional egg cooling. While cooling hatching eggs is necessary, starting and stopping embryo development weakens the embryo and reduces its viability. As illustrated in Figure 2, the ideal situation is for hatching eggs to undergo only two temperature direction changes; one from the hen to the lowest temperature point at the commercial hatchery egg storage facility and the second temperature direction as eggs are moved into the egg setters.

Conclusions

It is well known that most hatchability problems are a result of poor fertility. However, when egg production is attained and the flock maintains high levels of fertility, how we care for hatching eggs can have a tremendous effect on overall hatchability. While current industry recommendations vary from 63° F to 70° F for on-farm egg storage, data from this research indicate that

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variations in on-farm egg storage temperatures of as little as 2 degrees F can reduce hatchability by as much as 3.5%. Experience from evaluating current on-farm egg room temperature values indicates that variation in the actual temperature and the set temperatures are great and often exceed those parameters established in this study. Therefore, regardless of the equipment in the breeder house and the hatchery facilities, hatchability is routinely lost in commercial hatcheries due to neglect of the on-farm egg storage facilities.

Summary

1. Maintaining a constant environment for hatching eggs prior to incubation is critical to achieve optimum hatchability.

2. Excessive temperature variation in on-farm hatching egg storage can cause hatchability losses of up to 3.5 %.

3. Monitor egg storage and transportation conditions using temperature data loggers.

4. Make adjustments to equipment to provide hatching eggs with a constant environment. This can include stirring fans in egg rooms, improved heating and cooling equipment, and improved insulation properties in the egg room.

Figure 1. Hatchability Loss due to Egg Storage Temperature Variation

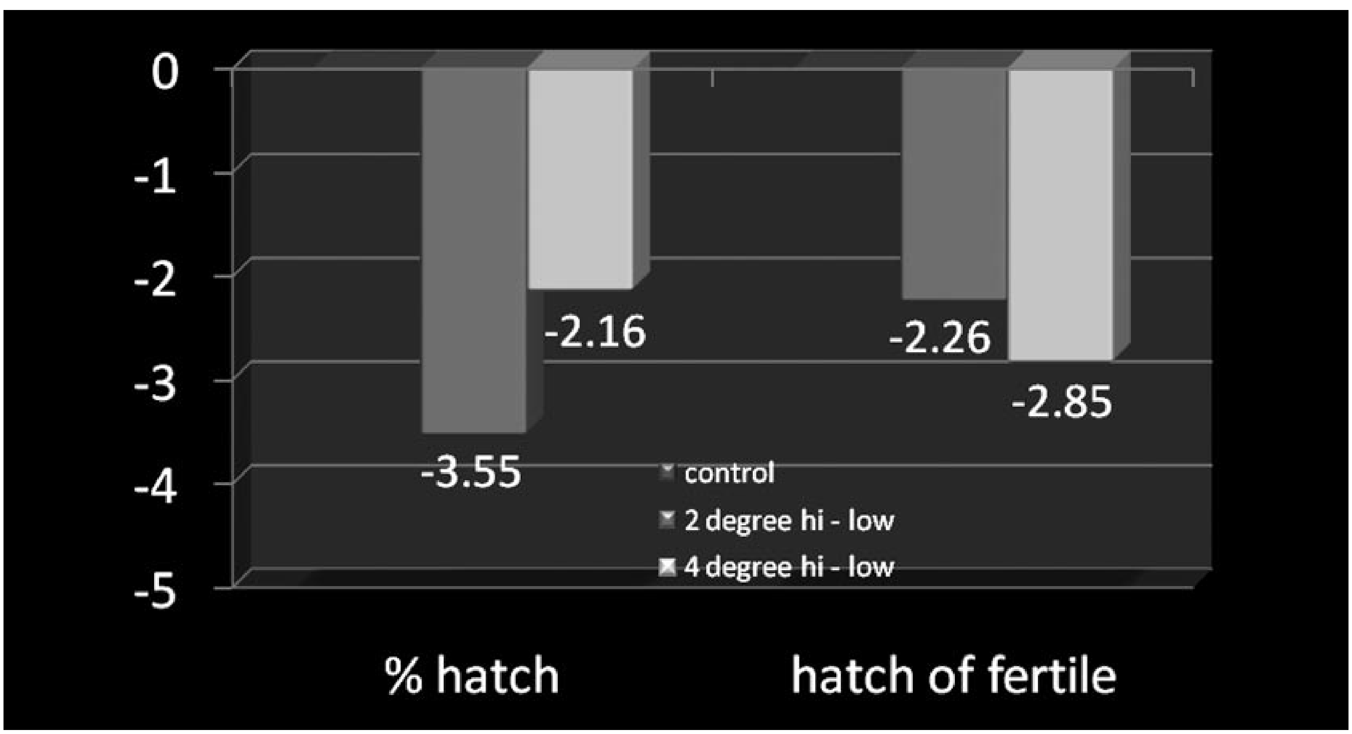

Figure 2. Ideal temperature changes for hatching eggs.

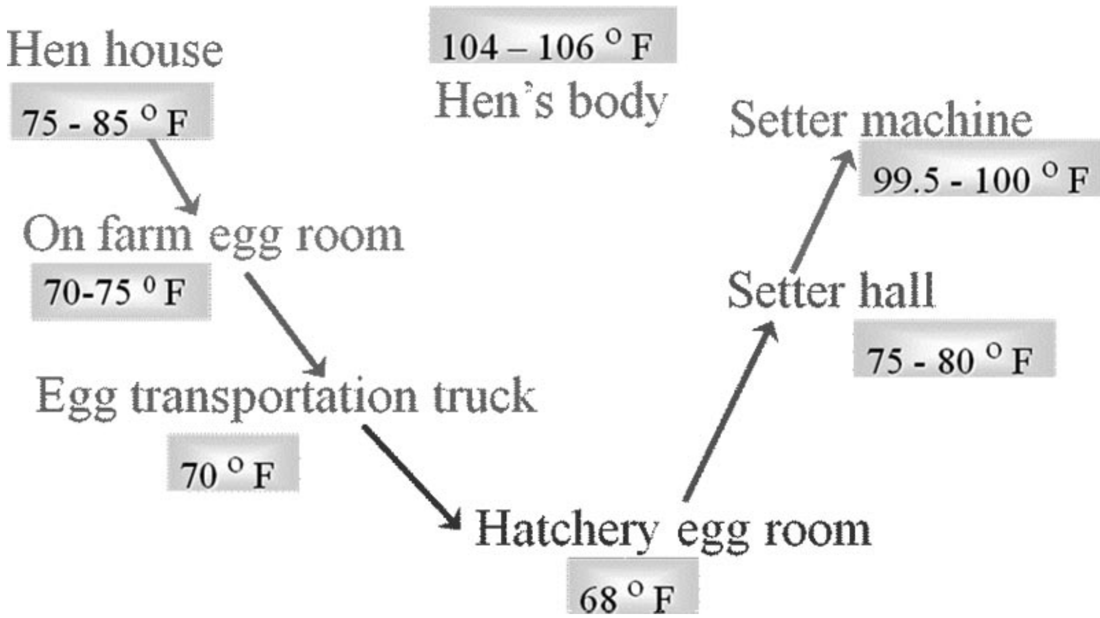

Table 1. Egg storage temperature treatments

Treatment	Holding Time	Storage Temperature	Temperature Pattern	Difference from 70°F
Control	0-24 hrs	70°F (21.2°C)	None	0
	24-48 hrs	70°F (21.2°C)		
	48-72 hrs	70°F (21.2°C)		
	72-84 hrs	70°F (21.2°C)		
1	0-24 hrs	70°F (21.2°C)	▼ - ▲ - ▼[1]	4
	24-48 hrs	66°F (18.9°C)		
	48-72 hrs	74°F (23.3°C)		
	72-84 hrs	70°F (21.2°C)		
2	0-24 hrs	70°F (21.2°C)	▼ - ▲ -▼	2
	24-48 hrs	68°F (20.0°C)		
	48-72 hrs	72°F (22.2°C)		
	72-84 hrs	70°F (21.2°C)		
3	0-24 hrs	70°F (21.2°C)	▲ - ▼ - ▲	2
	24-48 hrs	72°F (22.2°C)		
	48-72 hrs	68°F (20.0°C)		
	72-84 hrs	70°F (21.2°C)		
4	0-24 hrs	70°F (21.2°C)	▲ - ▼ - ▲	4
	24-48 hrs	74°F (23.3°C)		
	48-72 hrs	66°F (18.9°C)		
	72-84 hrs	70°F (21.2°C)		

[1] ▼ = decrease in temperature; ▲ = increase in temperature

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