Spring 2002 • Volume 4, Number 1

AVIAN Advice

UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE
Cooperative Extension Service

INSIDE

Spreadsheet for Broiler Farm Economic Analyses

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Introduction

The poultry industry has experienced unprecedented production and marketing efficiencies since 1960 in large part due to vertical integration facilitated by production contracts between growers and integrators**.** Contracts have worked very well for a number of years; however, recently complaints have arisen largely as a result of unrealistic expense and revenue expectations by poultry growers. Yet the lack of realistic, publicly available data makes it nearly impossible for poultry growers to determine the overall financial situation. At present growers make their business decisions regarding the feasibility of new or expanded poultry farms based primarily upon information provided by an informal network of other poultry growers in their area or by integrators. Many integrators give the grower only oral information about the profits that they will receive under the contract, perhaps because the integrator does not have complete information. Growers and potential growers need complete and unbiased information about all aspects of the process, especially the potential income.

Problems with Economic Estimates

It is extremely difficult to forecast profitability of broiler operations for three primary reasons. First, because of the grower pay system, it is nearly impossible to effectively determine revenue for poultry growers. Payment amount may not actually reflect the grower's performance since performance is compared to the other growers who sell in the same weekly pool. This means that an "average grower" may do very well when selling with inefficient producers, but fare poorly when selling with efficient producers.

Secondly, estimating income may be difficult because of varying poultry house size. While most new poultry houses are built on a standard house size, many older houses were not built to any standard sizes. Variable dimensions of older houses can lead to difficulty in estimating profitability. Many potential growers are faced with trying to determine their revenues and expenses from an estimate sheet provided by the integrators based on standard-sized houses and secondary information.

Finally, many potential poultry farm sellers are not usually willing to supply all of their past records to be evaluated before the sale of their farm. This situation leaves buyers with little actual data upon which to judge the profitability of their impending purchase, and potential growers are faced with the difficult task of approximating of the farm's past performance.

IBIS development to Address Farm Economic Issues

The Interactive Broiler Income Spreadsheet (IBIS) was developed to help prospective and current poultry producers to better estimate profits. IBIS is an unbiased tool that uses a spreadsheet format to assist growers in making decisions regarding the current and potential profitability of raising broilers. Specifically, IBIS will provide growers to:

- Precisely estimate revenues and expenses;
- Assess feasibility of new investments;
- Easily change any of the factors that will influence revenues and
- Readily alter expenses to reflect current weather, price, interest, or regulatory conditions.

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

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Developing Farm Budgets for New Investments using IBIS Default Data

Budgets play an important role in planning for any new investment. The two types of budgets of particular interest to poultry farmers are capital investment budgets and enterprise budgets. Capital investment budgets allow growers to analyze major purchases, while enterprise budgets allow growers to examine profitability prior to farm building or purchase.

Obviously, developing budgets requires cost and income estimates (data). Yet growers do not always have the data required. For this reason default data were developed for the IBIS program. Default data was gathered from four growers with four different companies (16 total) over a four-year period. Participating companies approved of the project and provided the names of at least four contract growers. Growers names submitted were from the top one-third of each production complex based on their past performance and record-keeping practices. Actual data were collected though personal contact with growers. All grower information was averaged to provide default values for the various cost and income components of IBIS.

IBIS is divided into two parts: assumptions and budget analysis. The assumptions section is the "input" part of IBIS where the data on costs and income are provided for analysis in the budget section. The budget analysis section uses the data provided in the assumptions section to generate revenue, expenses, income and returns for the farm.

Assumptions Section of Interactive Broiler Income Spreadsheet (IBIS)

The assumption section of IBIS, outlined in Table 1 is divided into initial qualifying questions (house dimensions and property tax information), estimated revenues, estimated expenses and loan information. If the information entered in this section provides IBIS with the data necessary to do a budget analysis on your farm.

IBIS is designed so users may enter up to three unique house sizes along with the number of houses of that particular size. The total square footage data provided in this section allows IBIS to determine the net cash returns on a square foot basis. In addition, the budget data generated by IBIS allow users to compare returns on different sized operations.

The income section separates all areas of possible income-generating activities associated with broiler production, but excludes any associated activities such as livestock or hay production. Default information is provided for almost every category except gas and utility allowances. These two items vary tremendously by company, geographic location, and individual grower preferences so default values would be meaningless. Although bonus pay may vary greatly by grower and company a default was generated using a high, medium and low grower performance.

The expense section is divided into variable and fixed expenses. Fixed expenses include taxes, insurance, depreciation, and opportunity costs. Many of the fixed expenses do not have default values because they are unique to each farm. Variable expenses include items such as bedding, clean-out, propane or natural gas, electricity, water and labor.

The loan information section includes three areas: house loans, equipment loans, and upgrade loans. Many IBIS users may not utilize all three areas. Some may have a combined house and equipment loan. Also, current producers may only need to compute the payments on an upgrade if that is what they are considering.

Budget Analysis Section of Interactive Broiler Income Spreadsheet (IBIS)

The budget analysis section of IBIS uses the information provided in the assumptions section to compute total operating revenue, total operating expenses, total fixed expenses, total expenses, net farm income, net farm income per square foot, net cash returns, and net cash returns per square foot. The budget analysis includes both budget value and cash value. IBIS computes the operating revenues by using the revenue information supplied in the assumptions section and the following formula: Chicks per flock* Flocks per year* (100-Percent mortality)/100* Average pounds per finished bird* cents per pound (contract base)/100. Other broiler related, income-generating activities (such as litter revenue, gas allowances, utility allowances, or performance bonuses) are then add to the pay formula to get the total operating revenue. Total operating expenses are then subtracted from total operating revenues to get net cash returns. Net cash returns per square foot is simply net cash returns divided by the total square footage computed in the assumption section. Net farm income is computed by taking the total budget value expenses, which includes depreciation and opportunity costs of the land, from the total operating revenues.

Testing and Availability of IBIS

IBIS has been extensively verified for effectiveness and accuracy. Poultry integrators in the Northwest Arkansas area were consulted about the feasibility of this project. Current poultry producers gave advice on revenues and expenses that were incorporated, including many hidden expenses that were not on any of the published budgets. A panel consisting of four lenders is being asked to compare IBIS results with their records to see if projections are in line with what they see from their customers. Trial runs are being conducted through poultry companies as they consult with current and prospective growers before IBIS is released to the public. Continued monitoring of IBIS as the poultry industry changes will be necessary to keep the program up-to-date and functional.

IBIS will be available to producers, poultry integrators and area lenders and the Cooperative Extension offices through the University of Arkansas Home page. The complete package is expected to be ready to access in April, 2002. A nominal fee will be charged for the password-protected software. Poultry integrators may use IBIS as a decision tool with potential growers. With IBIS, field supervisors can quickly demonstrate to growers the effects of management decisions on farm income. IBIS will also allow users play "what if" games and to identify their risk tolerance to varying income and expense levels. Growers to gauge the effects of capital improvements/equipment upgrades and chicken placements per year may use IBIS.

Table 1. Information Required in Assumption Section

A. Initial Questions
- Do you have foggers?
- What are your house dimensions?
- Estimated value of poultry farm
- Total property tax millage rate

B. Estimated Revenues
- Chicks per flock
- Flocks per year
- Percent mortality
- Ave lbs/finished birds
- Cents/lb contract base
- Annual tons of litter
- Price per ton of litter
- Annual fuel allowance
- Annual utility allowance
- Annual average performance bonuses

C. Estimated Expenses

Variable Expenses
- Annual trailer loads of bedding
- Price per trailer load of bedding
- Annual number of clean out loads
- Pricer per clean out load
- Annual number of cake out loads
- Price per cake out load
- Annual number of propane gallons
- Price per propane gallon
- Annual number cubic feet natural gas
- Price per foot natural gas
- Annual number of kilowatt hour
- Price per kilowatt hour
- Annual gallons of drinking water
- Price per 1000 gallons of water
- Annual repair costs on facilities
- Annual cleaning supplies cost
- Annual pest and rodent control costs
- Annual dead bird costs
- Annual hours of paid farm labor
- Hourly wage, paid farm labor
- Annual paid labor for services
- Annual misc. expenses

Fixed Expenses
- Total initial house investment
- Salvage value on house
- Years in house life
- Total initial house equipment investment
- Salvage value on equipment
- Years in equipment life
- Annual insurance cost
- Annual property taxes
- Annual land charge

D. Load Information

Original House Loan
- Interest rate on house loan
- Number of years on loan
- Number of payments per year
- Amount borrowed on houses

Original Equipment Loan
- Interest rate on equipment loan
- Number of years in loan
- Number of payments per year
- Amount borrowed on equipment

Upgrade Equipment Loan
- Interest rate on upgrade loan
- Number of years on loan
- Number of payments per year
- Amount borrowed on upgrade

As useful as IBIS can be, it is also important to remember that the best budget planning cannot take the place of good management. IBIS is simply a tool to help management be more effective. **Those interested in obtaining access to IBIS should visit the website http://www.uark.edu/depts/posc/poultry.html or contact H.L. Goodwin at haroldg@uark.edu**

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The interactive broiler income spreadsheet (IBIS) Part II: Budget Analysis Section.

II. Budget Analysis Section	Budget	Cash
	Value	Value
Poultry contract	78081	78081
Litter revenue	2160	2160
Allowances	5112	5112
Bonuses	9760	9760
Total operating revenue	**95113**	**95113**
Litter removal	4905	4905
Utilities	11725	11725
Repairs	7590	7590
Maintenance	4500	4500
Labor cost	2700	2700
Misc. expenses	1200	1200
Total operating expenses	**32620**	**32620**
Insurance	1875	1875
Property taxes	680	680
Annual land charge	4000	0
Depreciation	14000	0
House payment	27154	27154
Equipment payment	0	0
Upgrade payment	5578	5578
Total fixed expenses	**53287**	**53287**
Total expenses	**85907**	**67907**
Net farm income	**9206**	
Net farm income per sq. ft.	**0.192**	
Net cash returns	**27206**	
Net cash returns per sq. ft.	**0.567**	

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Reproductive Biology of the Broiler Breeder Male

Introduction

In the poultry industry, there are numerous challenges facing individuals responsible for the reproduction of broiler breeders. Many of these problems stem from the knowledge that increasing body growth rate will generally result in a reduction in reproductive characteristics, and vice versa. This situation is likely to escalate due to increased consumer demands for more white meat and less dark meat, which are attained in the high yield faster growing birds. Therefore, the continued trend toward high-yielding, fast-growing broilers is evident. Consequently, it does not appear that the task of managing broiler breeders is going to get any easier in the near future.

Developing Fertile Males

The testes of young cockerel chicks contain cells that will form the structure of the testes (somatic cells) as well as cells that will later become sperm cells (germinal cells). Some somatic cells (called Sertoli or nurse cells) function to protect the developing sperm cells while other cells (called Leydig cells) are involved in testosterone production. Although the broiler breeder male can theoretically produce trillions of sperm, the number of Sertoli cells contained within the testes limits the actual number of mature sperm produced. Sertoli cell growth occurs sometime between 2 and 12 weeks of age (generally thought to be between eight and ten weeks) but not at anytime after this point (Kirby, 1998). Therefore, the maximum potential for sperm production is established in the first eight to ten weeks of age. Anything that may cause unnecessary stress to the developing male at this time may interfere with proper development of these very important testicular cells.

During this early period of development, portions of the brain (such as the hypothalamus) and the pituitary gland are also establishing a critical hormonal relationship with the testes. These portions of the brain must work together with the testes to maintain proper reproductive hormone levels so that testes functions (such as sperm production) can start and be sustained. During the early stages of maturation the testes help to establish a relationship called a “feed back loop” with the pituitary gland that will regulate pituitary function over the life of the male. Thus, appropriate levels of reproductive hormones (FSH, LH, etc.) are not only critical for the proper development and function of the testes, but also for the development of the relationship between the brain and the developing testes. These relationships can be established only at this time of male maturation.

Sexual Maturity in Males

As reproductive hormone secretions (primarily FSH) increase, there is a tremendous growth in testes mass that is associated with the onset of sperm production. This time period, also referred to as puberty, occurs between 16 and 24 weeks of age. Once the males attain peak semen production, testes weight and sperm production continue to decline thereafter.

The establishment of normal reproductive hormone secretion is at least partially completed within the first few weeks of a male’s life. Even mild stressors which cause either weight loss or reduced water intake can lead to complete shutdown of testes function when they occur during critical early stages of development (Kirby, 1998). These males may be those that are usually “grown back to the curve” due to problems during development. Additionally, it is possible to disrupt the normal pattern of testes development with too severe feed restriction between 6 to 8 weeks. This results in reduced testes size, sperm production, and the theoretical maximum number of sperm produced. Also, reduced reproductive performance has been demonstrated with severe feed restriction in males between 18-23 weeks of age (Kirby, 1998), suggesting that the resources

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and hormone secretion required for normal testes function can be negatively and permanently affected around the time of photostimulation.

Summary

Young cockerel chicks that are in stressful situations between 2 and 12 weeks of age may not develop the capacity to form sperm cells adequately. Testical development can also be disrupted by severe feed restrictions between 6 and 8 weeks. Normal testes function can also be negatively and permanently affected by sever feed restriction around the time of photostimulation.

Proper management of breeder males will reduces stress consideration these critical points in their development. Any unnecessary stress placed upon these birds at these critical points can have profound effects on the reproductive potential of the males. Many of these effects are either permanent or long lasting and can seriously affect the overall performance of the breeder males in the hen house. Once these biological systems are set firmly in place in the young breeder male, management to sustain these reproductive systems are less critical and more forgiving.

References:

Kirby, John D., 1998. Broiler Breeder Male Reproductive Efficiency: Where Management and Biology Collide. Proceedings, North Carolina Breeder/Hatchery Management Symposium.

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Don’t let Rodents Nibble Away your Profits

Damage By Rodents

Did you know that a single rat eats as much as 20 to 40 pounds of feed a year? Multiply this by 1000 and you can experience a loss that will impact feed conversion that will affect your bottom line. It has been estimated that rodents can increase poultry feed usage by as much as 2%. When the weather cools, mice and rats move indoors and can wreak havoc on not only feed conversion as well as jeopardize bird health and damage facilities.

Rodents spread diseases to flocks by contaminating feed and bird living area with urine or droppings. Rats and mice do not have bladders, so they continuously urinate and defecate on everything they contact. Rats and mice are linked to poultry diseases such as salmonellosis, colibacillosis, coryza, pasteurellosis, mycoplasmosis, hemorrhagic enteritis, hymenolepiasis, capilariasis and ascaridiasis. Rodents are often vectors that carry over disease organisms from one flock to the next flock. Even if the facilities are cleaned and disinfected, if rodents are present, they jeopardize sanitation efforts by keeping diseases active on a farm due to their ability to harbor pathogens.

Since the upper incisor teeth of rodents continue to grow throughout their life, mice and rats must chew constantly to keep their teeth from becoming too long. This means that insulation, wood, curtains, electrical wiring and even metal objects can be damaged.

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Rodent Reproduction and Habits

The most common rodent pests in poultry houses are the house mouse (*Mus musculus*) and the Norway rat (*Rattus norwegicus*). Rats mature in four to six months while mice mature in six weeks. Mice produce as many as 8 litters per year with up to six young per litter while rats produce three to seven litters with as many as 18 young per litter. This means that within a year, 42 mice and 16 rats can produce 4,000 rodents!

Mice usually nest within 10 to 30 feet of their food source, but rats will travel miles in search of food. Rodents are typically shy creatures that like dark hiding places. They prefer to travel along walls and stay away from open areas. Mice can crawl through openings the size of a dime and rats can contort their bodies to squeeze through openings the size of a quarter. The Norway rat will burrow under foundations or footings and can dig tunnels up to 48 inches deep with several entrances. Mice can live without a source of water, but rats need about .5-oz. to 1-oz. of water daily. Rodents are nocturnal and prefer to feed at night.

Don't Give Rodents an Invitation to Stay

Maintain a minimum three-foot space around the outside of poultry barns that is free of brush, trash and weeds. The more bare ground or short grass next to buildings, the less likely rodents will build nests or burrow under footings. Clean up spilled feed near feed bins or feed pans and keep medication rooms tidy and clutter free. Keep unused equipment stored away from production facilities. Keep dead bird disposal area clean and dispose of dead birds on a daily basis. If rodents don't find the living arrangements attractive, they won't stay.

If rodents do not find the living arrangements attractive, they will not stay.

Keep Rodents Out and Monitor for Signs of Activity

Prevent access to buildings by plugging holes and sealing doors. Carefully check the perimeter of all buildings for potential entryways and burrows. A common entry point for mice is the unprotected end of corrugated metal siding on buildings. Close openings around augers, pipes and wires with cement or metal collars. Burrows with signs of fresh dirt indicate new rat activity and should be addressed immediately.

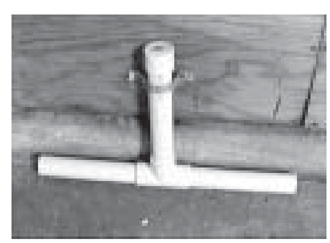
Don't leave rodent monitoring to chance. Develop a schedule for closely checking all facilities and stick to it. Addressing rodents when there are only tell tale signs such as droppings will be much more effective and less costly than waiting until you actually see rodents. It has been estimated that for every rodent, which is actually observed, there are 20 to 50 unseen. This is because of the rodent hierarchical structure. It is young and the old rats that are usually forced to scavenge for food during the day. Therefore seeing rodents during the day means the prime night feeding time is overrun.

In addition to establishing a monitoring schedule, keep records. Knowing where farm rodent havens are and when activity is likely to increase can help a producer to develop an effective control program that prevents infestations.

Maintain Bait and Trapping Stations

Any drastic change to their habitat may cause rodents to abandon a facility. Therefore, when cleaning the exterior of facilities or removing litter, first plan to eliminate the rodent population. Disrupting a rodent nesting area will only encourage them to move to a new location until the changes are no longer threatening.

Rodents are continuously exploring their environment and have a strong dislike for new objects. This makes it important to keep bait stations in the environment continuously. Rodents have poor eyesight and do not see color so adding color to bait is not helpful. In addition, rodents have a keen sense of smell and taste. They can detect even small amounts of toxic chemicals so overdosing baits may only discourage consumption. Rodents can learn to associate tastes with harmful effects of new foods and they can remember this for up to six months. Rodents also prefer fresh foods. Therefore, if a heavy rodent population is suspected, frequent baiting and changing the type of bait may be helpful.



The most common control methods for rodents are poisonous chemicals that are classified as anticoagulants. Anticoagulants disrupt the blood clotting mechanism and cause rodents to slowly bleed to death internally. Most anticoagulant baits must be consumed over several days before enough anticoagulant is built up in the rodent's system to cause an effect. However, second-generation anticoagulant baits can effectively kill rodents with one dose.

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Getting the Most From Rodent Baits

Since rodents must consume traditional baits for several days, it is critical that bait stations be kept stocked with fresh bait and that adequate numbers of bait stations are present to supply the whole population. Bait stations are important for presenting poison to rodents because they 1) provide a dark, enclosed environment that attracts rodents, 2) keep bait clean and away from children, pets and livestock and 3) prevent unnecessary loss of bait. Bait stations can be purchased or they can be made out of pvc pipe.

To make a bait station use a 1.5-inch diameter pipe for mice stations or 2.5- to 4-inch diameter pipe for rat stations. Construct a T with a cap for the bottom of the T. Make the base of the T up to 8 to 12 inches long and both sides of the top of the T at least 12 to 18 inches long. Turn it over and attach permanently to side walls along footings. (The picture pg. 7 illustrates these instructions.)

Table 1 shows the baits available as well as their effects on rodents. Familiarize yourself with the different types of bait and be aware that resistant rodent populations can develop if there are inadequate levels of bait for treating a population or baits are overused. This means that it is just as important to maintain records on what baits are used, as it is to maintain a monitoring schedule. One rodenticide company recommends that baits be switched as often as every two months for second-generation products, but traditional products may be effective for as long as six months.

Conclusion

Rodents can have a detrimental effect on poultry operations because they consume feed, harbor diseases and destroy equipment. Keep facilities clean so rodents don't want to stay. Monitoring for rodent activity on a set schedule, maintaining adequate bait stations and change baits on a set schedule to head off uncontrollable rodent problems. ■

Table 1. Commercially Available Rodenticides

Generic Name	Type	Dose	Trade Names	
Brodifacoum	Anticoagulant	Single feeding Slow acting death 5-7 days post feeding. Rodent continues to feed after lethal dose has been ingested	Attack Talon One Bite Ropax	Havoc Just Jaguar Weather-Blok
Difethialone	Anticoagulant	Single feeding Slow acting death 5-7 days post feeding. Rodent continues to feed after lethal dose has been ingested	Generation D-Cease Hombre	
Bromadiolone	Anticoagulant	Single feeding Slow acting death 5-7 days post feeding. Rodent continues to feed after lethal dose has been ingested	Boothill Maki Trax-one	Hawk Contrac Terminator
Chlorophacinone	Anticoagulant	Multiple feeding Slow acting death 5-7 days post feeding. Rodent continues to feed after lethal dose has been ingested	Rozol Rozol-Laq-Berry	
Diphacinone (rats only)	Anticoagulant	Multiple feeding Slow acting death 5-7 days post feeding. Rodent continues to feed after lethal dose has been ingested	Ramik Green Trap-N-A-Sak Tox II Tomcar Contrax-D	Ditrac Liqua
Warfarin	Anticoagulant	Multiply feedings Slow acting	Ferret Contrax RAX	Final Co-rax
Bromethalin	Metabolic inhibitor	Single feeding Quick acting-death 2-3 days post feeding	Clout Trounce Vengeance	Assault Rampage
Cholecalciferol	Vitamin D	Single-multiple feedings Death 3-5 days post feeding	Quintox	
Zinc phosphide	Stomach poison	Single feeding. Death immediately	Eraze Ridal-Zinc ZP Squirrel & gopher pellets	

Source: Leslie Hinkle, AgriLynx Corporation, Rodent Management on Poultry Farms

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Ventilation Considerations for Turkey Producers

Introduction

Today's genetically superior turkeys must be provided with an optimum environment to reach their genetic potential and receive maximum benefit from feed. Oderkirk (2001) has indicated that an optimum environment will ensure that livestock or poultry are:

Draft-free
Free from extremes in temperature
Free from rapid temperature fluctuations
Free from excessive humidity and odors
Dry
Provided with adequate space to avoid stress and reduce risk of injury
Provided with an abundance of fresh water and feed

The environmental factors which can be controlled by ventilation include 1) air distribution and circulation, 2) temperature, 3) humidity and 4) air composition (Oderkirk, 2001).

Purpose of Ventilation

Modern confinement turkey houses allow year-round production and provide substantial control of light and temperature (Noll et al., 1995). However, in confinement housing, air contaminants such as ammonia, dust, and microorganisms and their endotoxins can build up. Air exchange is one way these contaminants as well as heat and moisture are removed. The rate of air exchange needed must be controlled to economically maintain an appropriate environment all year-round (Janni and Jacobson, 1995).

While ventilation is important at all times, perhaps winter ventilation is the most critical. The heat produced within the house may come from that generated by the birds or from brooders and furnaces. The quantity of heat produced must satisfy the following three heat losses to keep the building at some selected temperature (Moore, 1993):

1. There will be heat loss through the roof, walls, doors, etc., depending on the type of construction and level of insulation.
2. Some heat will be lost in the exhausted ventilation air.
3. Heat will be needed to evaporate moisture.

If the building temperature is to remain constant, the heat produced must be warm enough to equal the three heat losses. All systems of ventilation work on this principle of heat balance. If a balance cannot be achieved then the building temperature will fluctuate until a balance can be reached. However, heat balance is a dynamic situation, always changing, due to such things as outside temperature, solar energy, wind, bird activity, growth of birds or ventilation adjustments (Oderkirk, 2001).

It is important to have sufficient insulation in the walls and especially the roof of the turkey house to help maintain heat balance. But remember, some supplemental heat will be required at various times even in well-insulated houses to maintain the desired temperature and to allow enough ventilation to remove the moisture produced by the turkeys. Adequate insulation, that helps

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maintain inside surface temperatures above inside dew point temperatures, reduces condensation formation. Figure 1 illustrates the relationship between temperature and water holding capacity (Vest and Tyson, 1991).

Types of Heat

Several types of heat exist within turkey houses (and other houses). Many of us probably think of a thermometer when we think of heat. This type of heat is known at **sensible heat.** Sensible heat is that heat that we can measure (like with a thermometer). Sources of sensible heat in a turkey house include turkey body heat; mechanical heat from lights, motors, etc.; supplemental heat from brooders or furnaces; and solar heat gain (Porter, N.D.). Figure 2 shows the sensible heat generated by turkey toms during their growth. However, it is important to understand that there is another form of heat present in turkey houses.

All of us have noticed that the evaporation of water (or sweat) from our skin makes our skin feel cooler, even if the temperature of the air around us is warm. Our skin feels cool because the water took energy from our skin to transform itself from liquid to vapor. This type of heat is called **latent heat**. Latent heat in the turkey house comes from sources such as the respiration of turkeys, turkey fecal material, spilled water, wet litter, or water vapor from incoming air. Latent heat is lost through ventilation (Porter, N.D.). Latent heat in a turkey house affects litter moisture conditions, the relative humidity, the potential for condensation and can affect bird comfort (Janni and Jacobson, 1995). While latent heat is difficult to measure, it has a real impact on ventilation costs. If you doubt this reality remember when your house got wet inside. How much extra air and gas did it require to dry out the house? That extra air and gas was because of latent heat. Figure 3 gives both estimated respirable moisture and feces moisture production rates for toms from 1 to 24 weeks of age (Janni and Jacobson, 1995).

Turkeys cannot change the environment they are provided with; only react to that environment.

Air Quality and the Turkey Respiratory System

Turkeys cannot change the environment they are provided with; only react to that environment. If the environment we provide is less than optimal, the turkey's performance will quite likely be less than optimal. Good air quality is vital to maintaining a healthy respiratory system. With each breath, the turkey's respiratory system is exposed to the environment inside the turkey house. Poor environments normally do not cause disease directly but they do reduce the birds' defenses, making them more susceptible to existing viruses and pathogens (Noll et al., 1995).

Birds were designed to be very efficient at extracting oxygen and removing air-borne organisms. When a turkey breathes in, the air passes through a long convoluted pathway in the upper airway (turbinates) and the sinuses (Wojcinski, N.D.). Here the air is warmed and particles of dust, bacteria and mold are filtered out with clean air being sent to the trachea. The turkey's respiratory tract is equipped with tiny hair like structures called cilia that sweep trapped particles from the trachea. Mucus is secreted which serves as a vehicle to transport particles and scavenging cells consume foreign materials. It is the integrated function of cilia, mucus and scavenging cells that keeps the airways free of disease-producing organisms. The impairment of even one of these components permits an accumulation of disease agents in the respiratory tract and may result in disease (Noll et al., 1995).

Research on the respiratory tract of turkeys has shown that as little as 10 ppm ammonia will cause excessive mucus production and damage to the cilia. Research has also revealed that ammonia levels of 10 to 40 ppm reduced the clearance of *E. coli* from air sacs, lungs and tracheas in turkeys (Noll et al., 1995). Ammonia is produced by the decomposition of turkey droppings in the presence of heat and moisture. Humans can initially detect ammonia at levels of 10 ppm or less. However, many people who work in turkey houses become desensitized to the smell of ammonia and can no longer detect it. People may be in the houses only a few hours each day while the turkeys live in the houses 24 hours a day, greatly increasing the ammonia challenge. Since the ammonia is highly soluble in water, it will react with the moist membranes of the eye and respiratory system (Morishita, 1991). Some of the signs of ammonia toxicosis include excessive tearing, shallow breathing, and clear or purulent nasal discharge. Look for birds with their eyes closed most of the time, listlessness, and reduced feed intake. Air for turkeys should contain less than 20 parts per million ammonia.

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Turkey growers must also ventilate for carbon dioxide. The main sources of carbon dioxide within a turkey house are the turkeys themselves and unvented combustion heaters. Turkeys exposed to increased levels of carbon dioxide may exhibit listlessness, disorientation, uncoordination, difficult breathing and, in extreme cases, death. Carbon dioxide concentration in outdoor air is around 300-350 ppm (0.030-0.035 %). Be aware however, that levels above 2,500 ppm have been linked with significant spontaneous turkey cardiomyopathy (or roundheart disease) mortality in turkeys raised at moderate to high altitudes (Frame et al., 1999).

Air for turkeys should have less than 5 milligrams per cubic meter dust at bird level. Dust levels of 8 milligrams per cubic meter can be tolerated if the birds are not being stressed by ammonia, heat, or presence of respiratory disease agents. Increasing the moisture level of the litter and increasing the humidity of the air can control dust. Relative humidity can be increased by lowering house temperatures or adding moisture through periodic sprinkling of the house space. Keeping relative humidity in the range of 60-70% and litter moisture at 35-45% will keep dust levels suppressed (Noll et al., 1995).

The interaction of dust, ammonia, and warm temperatures in the environment of the turkey house can negatively affect the respiratory system. Once damage occurs in the respiratory tract, bacteria colonize damaged epithelial cells and can invade the blood stream. Osteomyelitis due to *Staphylococcus aureus* has been correlated with dry dusty house conditions and the subsequent air sacculitis (Wojcinski, N.D.). Thus, turkeys raised in a poorly ventilated house can expose birds to a variety of diseases.

Summary

Only with an optimum environment can today's genetically superior turkeys reach their genetic potential and maximize benefits from scientifically blended feed rations. The ventilation system present in the turkey house is a key element in providing this optimum environment.We ventilate to remove heat, moisture, disease organisms and gases such as ammonia and carbon dioxide while replenishing oxygen consumed by the turkeys and unvented supplemental gas heat sources. All ventilation systems work on the heat balance principle. This means the heat produced (by turkeys and supplemental sources) must equal heat lost (through evaporation, ventilated exhaust air, and roofs, walls and doors) plus the heat required to warm incoming ventilation air. Ventilation must account for and balance sensible heat gains and losses as well as latent heat gains and losses. Air quality in the turkey house is an important management consideration and vital to maintaining a healthy turkey respiratory system.

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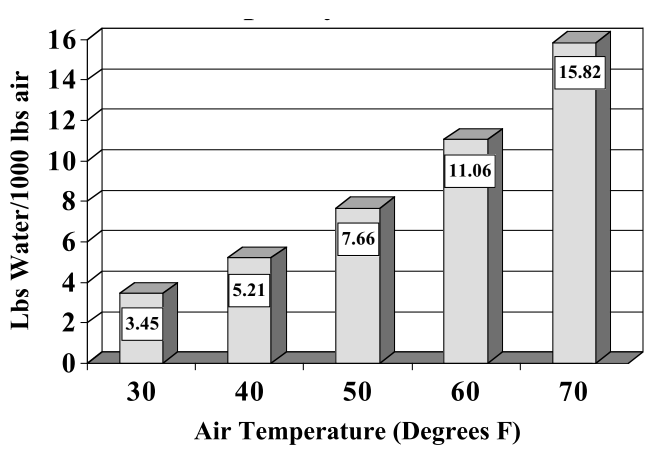
Figure 1. Moisture Holding Capacity of Air



VENTILATION- continued on page 12

Figure 2. Tom Turkey Weights and Heat Production

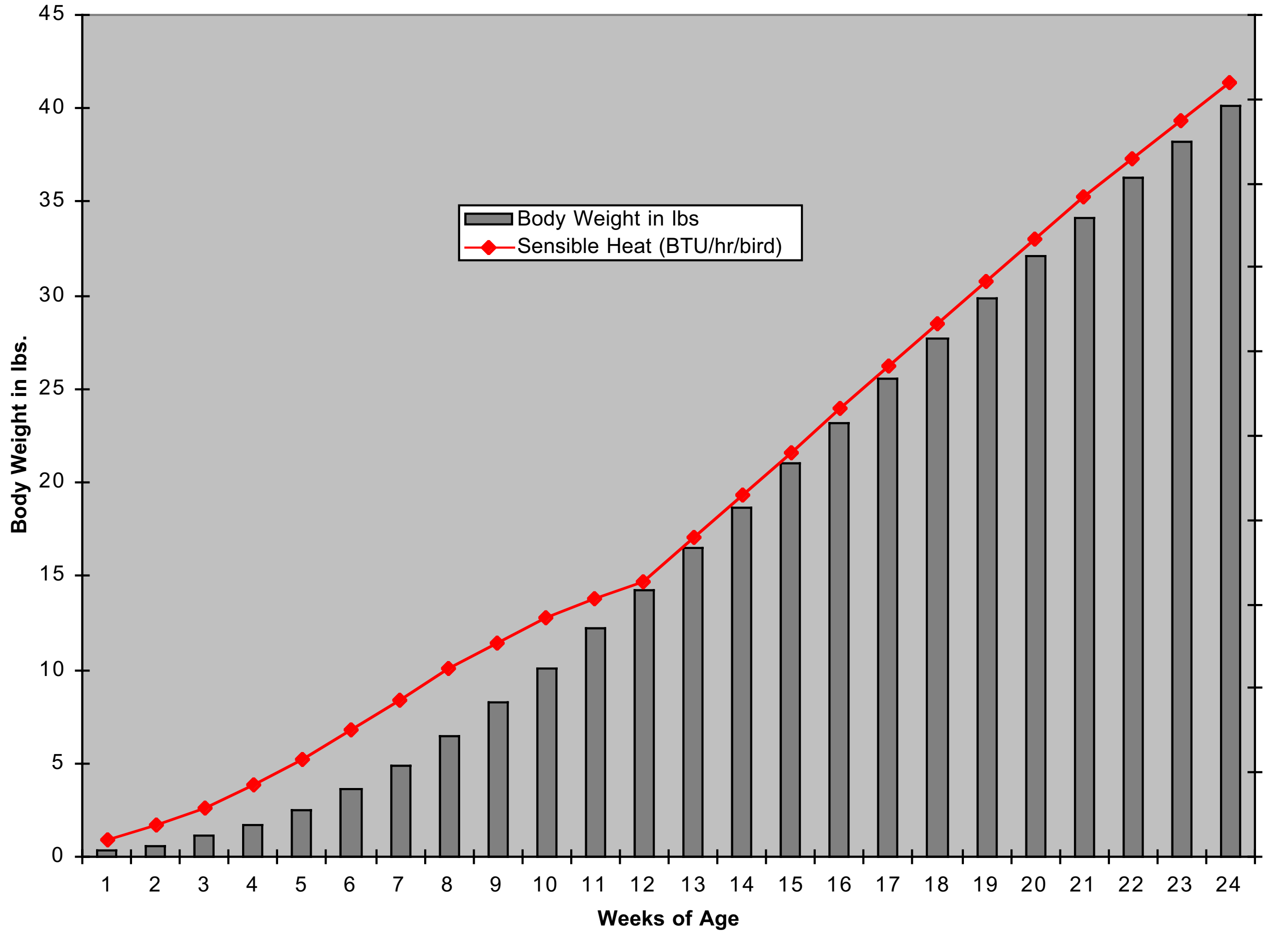
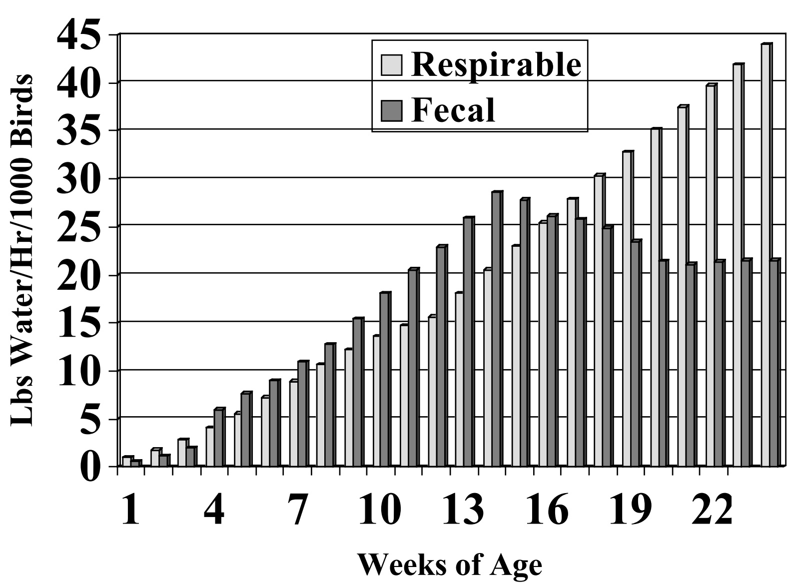


Figure 3. Tom Turkey Moisture Production Estimates



G. Tom Tabler • Applied Broiler Research Unit Manager
Center of Excellence for Poultry Science • University of Arkansas

Applied Broiler Research Unit Performance Report

Unit Description

The first flock at the Savoy Broiler Unit was placed on November 19, 1990. The unit contains four 40 x 400 foot broiler houses. Each house contains Cumberland pan feeders, Ziggity nipple waterers and about 1.5 million BTU propane heating capacity for brooding. Each house is equipped with a computer controller which controls fans, brooders and curtains for temperature control. Houses are also equipped with temperature monitoring equipment (about 80 sensors per house), an electronic water flow monitoring system, weigh bins for feed delivery to the house, sensors for the monitoring of fan run time and devices to determine gas flow from storage tanks.

Information Key

Variable	Units	Explanation
HSE	No.	House number
FEED CONV	LB/LB	Feed conversion or pounds of feed per pound of gain
HEAD PLACED	No.	Number of chicks place in the house at the beginning of grow-out.
HEAD SOLD	No.	Number of birds sent to the processing plant
LIV	%	Livability or Head sold/Head placed * 100
AGE	D	Age of birds at processing in days
AVE BIRD WT	LBS	Average live bird weight at processing
COND	%	Percentage of birds condemned by the government inspector at the plant. Condemned birds are not fit for human consumption.
FEED COST	$	Feed costs in dollars
CHICK COST	$	Chick costs in dollars
MED COST	$	Medication Costs in dollars
TOTAL COST	$	Total costs in dollars
COST/LB	Cent	Total costs per pound of live bird weight in cents per pount
PAY/LB	Cent	Payment received from the poultry company in cents per pound.
F.A.	$	Fuel allowance-a payment provided by the poultry company to help defray heating fuel costs
GAS USAGE	GAL	Propane usage in gallons
ELECT	KWH	Electrical usage in kilowatt hours

Houses 1 and 2 were built with steel trusses with R10 insulation in the ceiling while houses 3 and 4 were constructed with wood trusses, R19 ceiling insulation and drop ceilings. Houses 1 and 3 are conventionally ventilated with misters for summer cooling, but 2 and 4 are tunnel ventilated. House 2 contains a “sprinkler” cooling system for summer cooling. The system was developed at the University of Arkansas and utilizes a landscape sprinkler system to deliver a coarse, cooling mist to the backs of the birds. House 4 utilizes evaporative cooling pads to cool the inlet air.

PERFORMANCE- continued on page 14

PRODUCTION SUMMARY: FLOCK 61 (July 5, 2001 - August 17, 2001)

HSE (No)	FEED CONV (LB/LB)	HEAD PLACED (No)	HEAD SOLD (No)	LIV (%)	AGE (D)	AVE BIRD WT (LB)	COND (%).	FEED COST ($)	CHICK COST ($)	MED. COST ($)	TOTAL COST ($)	COST/LB (Cent)	PAY/LB (Cent)	F.A.[1] ($)	GAS USAGE (GAL)	ELECT USAGE (KWH)
1	1.96	23796	23077	96.98	43	3.78	0.67[2]	8573	4045	0.00	12618	14.555	3.0828	0.00	150	5701
2	1.86	23790	23121	97.19	43	4.31	0.67	9279	4044	0.00	13324	13.448	4.1890	0.00	154	5824
3	1.88	23854	23349	97.88	43	4.09	0.67	8977	4055	0.00	13032	13.753	3.8846	0.00	145	5925
4	1.86	23811	23297	97.84	43	4.43	0.67	9589	4047	0.00	13637	13.306	4.3318	0.00	380	6356
FARM	1.89	95251	92844	97.47	43.00	4.15	0.67	36418	16192	0.00	52611	13.736	3.9015	0.00	829	23806

[1] F.A. - Fuel Allowance
[2] Condemnation percentage could not be divided by house

Manager's Comments on Flock 61

Chick quality continued to improve. Placement was approximately 23,800 birds per house. Mortality by house at harvest time was as follows: House 1 - 719; House 2 - 669; House 3 - 505; and House 4 - 514. Condemnation percentage was 0.67 % ; improving from 0.81 % on the previous flock even though this was the ninth flock of birds grown on the same litter. A total cleanout is planned after the next flock of birds are sold which should be mid October. Down time between this and the last flock was 5 days. Ranking was 12th out 21 growers with the two tunnel houses performing better than the two conventional houses. House 4 performed the best (which rarely happens), followed by House 2, House 3 and finally House 1. The litter remained quite dry even though the foggers, sprinklers and cool cell system were running much of the time. Caked litter removed with the decaking machine after flock 61 was: House 1 - 1 load; House 2 - 2 loads; House 3 - 3 loads; and House 4 - 2 loads.

PRODUCTION SUMMARY: FLOCK 62 (August 30, 2001 - October 10, 2001)

HSE (No)	FEED CONV (LB/LB)	HEAD PLACED (No)	HEAD SOLD (No)	LIV (%)	AGE (D)	AVE BIRD WT (LB)	COND (%).	FEED COST ($)	CHICK COST ($)	MED. COST ($)	TOTAL COST ($)	COST/LB (Cent)	PAY/LB (Cent)	F.A.[1] ($)	GAS USAGE (GAL)	ELECT USAGE (KWH)
1	1.74	22867	22188	97.03	41	4.17	0.48[2]	8040	3887	7.85	11935	12.974	4.3547	0.00	365	1016
2	1.74	22790	22053	96.77	41	4.35	0.48	8356	3874	7.85	12238	12.818	4.5108	0.00	231	820
3	1.74	22844	22151	96.97	41	4.18	0.48	8040	3883	7.85	11932	12.956	4.3730	0.00	342	754
4	1.74	22797	22183	97.31	41	4.21	0.48	8141	3875	7.85	12025	12.939	4.3894	0.00	295	1736
FARM	1.74	91298	88575	97.02	41.00	4.23	0.48	32578	15520	7.85	48130	12.921	4.4079	0.00	1233	4326

[1] F.A. - Fuel Allowance
[2] Condemnation percentage could not be divided by house

Manager's Comments on Flock 62

Chick quality was similar to flock 61. Placement was approximately 22,800 birds per house. Mortality at harvest was: House 1 - 679; House 2 - 737; House 3 - 693; and House 4 - 614. Condemnation was 0.48 %. Ranking was 6th out of 19 growers with the two tunnel house again outperforming the two conventional houses although the differences were much smaller than on the previous flock. In fact, feed conversion was the same for each of the 4 houses. Average weight per bird was slightly heavier in the tunnel houses giving them the edge in performance. House 2 performed the best followed by House 4, House 3, and House 1. Down time was 13 days. A 32-stage controller was installed at House 2 after the flock was harvested which should provide better environmental control for that house. The controller is similar to the one installed at House 4 just over a year ago that has proved beneficial at controlling the environment in that house. The two conventional houses are equipped with the original six-stage controllers installed at time of construction although we are looking to gradually update these with more modern systems having expanded capabilities. The houses were cleaned out, washed down and disinfected after the flock was harvested. Ten flocks had been raised since the previous cleanout and litter removal was as follows: House 1 - 27 loads; House 2 - 28 loads; House 3 - 26 loads; and House 4 - 25 loads for a farm total of 106 loads. Assuming 5.5 tons per spreader truck load, litter removal was approximately 583 tons. Total caked litter removal since the previous cleanout was estimated at approximately 300 tons; bringing total litter removal since the previous cleanout to approximately 883 tons.

PRODUCTION SUMMARY: FLOCK 63 (October 20, 2001 December 7, 2001)

HSE (No)	FEED CONV (LB/LB)	HEAD PLACED (No)	HEAD SOLD (No)	LIV (%)	AGE (D)	AVE BIRD WT (LB)	COND (%).	FEED COST ($)	CHICK COST ($)	MED. COST ($)	TOTAL COST ($)	COST/LB (Cent)	PAY/LB (Cent)	F.A.[1] ($)	GAS USAGE (GAL)	ELECT USAGE (KWH)
1	1.88	22886	22536	98.47	38	3.62	0.34[2]	7676	3890	0.00	11566	14.229	3.7457	464.88	911	1948
2	1.88	22945	22577	98.40	38	3.60	0.34	7642	3900	0.00	11543	14.260	3.7151	464.89	724	1847
3	1.78	22886	22462	98.15	38	3.84	0.34	7651	3890	0.00	11542	13.443	4.5317	464.88	1321	1122
4	1.87	22965	22373	97.42	38	3.55	0.34	7441	3904	0.00	11345	14.314	3.6616	464.89	1094	1823
FARM	1.85	91682	89948	98.11	38.00	3.65	0.34	30410	15585	0.00	45996	14.051	3.9239	1859.5	4050	6740

[1] F.A. - Fuel Allowance
[2] Condemnation percentage could not be divided by house

Managers Comments on Flock 63

This flock was started on new litter, which was a mixture of rice hulls and pine sawdust. Chick quality was the best it has been in quite some time. Placement per house was approximately 22,900. Mortality at harvest was: House 1 - 350; House 2 - 368; House 3 - 424; and House 4 - 592. Condemnation percentage was 0.34%. Even though condemnation percentage was low, chick quality was good and we started the flock on new litter, flock performance was very disappointing. Our ranking was 14th out of 20 growers. On this flock, the two conventional houses outperformed the two tunnel houses. House 3 performed the best followed by House 1, House 2, and House 4. Caked litter removed after flock harvest was as follows: House 1 - 8 loads; House 2 - 9 loads; House 3 - 8 loads; and House 4 - 8 loads. ■

Avian Advice

Published approximately four times per year, Avian Advice is sponsored by The University of Arkansas Division of Agriculture, The Cooperative Extension Service and The Center of Excellence for Poultry Science.

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