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AVIAN Advice

UofA
UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE
COOPERATIVE EXTENSION SERVICE

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INSIDE

Avian Pox in Exhibition & Backyard Poultry

Dr. F. Dustan Clark
Extension Poultry Veterinarian

Birds Affected. Avian pox often causes problems in exhibition and backyard flocks. The pox virus is also capable of causing disease in almost any avian species including pigeons, wild birds, turkeys, ducks, quail, pheasant, and all breeds of chickens. Affected birds exhibit poor growth, reduced egg production, weight loss, and pox can cause death in severely affected birds.

Forms of Avian Pox. Avian pox is a viral disease that occurs in two forms: the dry (or skin) form and the wet (or diphtheritic) form. The dry form of avian pox causes lesions on areas of the head, legs, and body that contain no feathers. These lesions start as small blisters, then progress into wart-like nodules and later become dry scabs. Wet pox causes throat and upper respiratory tract lesions that usually begin as white nodules and may become large patches which interfere with eating, drinking, and breathing. The wet form of pox, when severe enough, is likely to cause death in affected avian species.

Spread of Avian Pox. Avian pox usually spreads relatively slowly throughout the flock by two methods: mosquitoes and scabs from infected birds. Mosquitoes (*Culex* and *Aedes* species) can harbor the virus for more than a month after feeding on the blood of an infected bird. Following feeding on affected birds the mosquito is capable of transmitting the virus to every unaffected birds on which she feeds. The avian pox virus is high resistant in the dry scabs from recovering birds and may be easily transmitted to uninfected birds. Unaffected birds can be infected from the scabs by virus entering through skin abrasions and cuts. Birds of all ages are susceptible to pox and the disease may occur at any time of the year. However, fully recovered birds do not remain carriers.

Control of Avian Pox. Since no satisfactory treatment exists for avian pox, it is best to prevent the disease by vaccination. Several pox vaccines are available for use in backyard and commercial flocks. A wing-stick method of vaccination using a two needle applicator usually is used in chickens and pigeons. Turkeys are most often vaccinated by the thigh-stick method; this method may also be used in pigeons. Birds can be vaccinated for pox at any age if necessary, however, the recommendations listed on the vaccine should be followed as to age and route of administration. Vaccinated birds should be examined for "vaccination takes" 7 to 10 days after vaccination. A "vaccination take" is an area of swelling and scab formation at the injection site. Satisfactory vaccination in a flock is indicated by a large number of birds having "vaccination takes." A vaccination program that routinely includes pox will help prevent the problems associated with disease and make the hobby of keeping backyard flocks more enjoyable. For more information about pox in birds contact Dr. Clark at 501-575-4375 or your local Arkansas Cooperative Extension Service county agent.

From: http://www.cvm.okstate.edu/~groups/students/web/2001/virology/DNAviruses/poxvirdae/fowl_pox1.jpg *Used with permission.*

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

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Dr. Frank T. Jones • Extension Section Leader
Center of Excellence for Poultry Science • University of Arkansas

New Extension Poultry Specialist Arrives at U of A

Dr. Keith Bramwell joined our team at the Center of Excellence for Poultry Science, University of Arkansas in November. Dr. Bramwell is new to Arkansas, but not new to Poultry Science.

Dr. Bramwell's interest in poultry began when he was in grade school when he won a contest at the county fair. The prize was a live chicken! This first chicken was no prize, but he became interested in poultry and began breeding and showing chickens as a hobby. When college opportunities came along, Dr. Bramwell eventually decided on a career in Poultry Science and completed his Ph.D. in 1995 at the University of Georgia. After graduation Dr. Bramwell worked for a year as a Post Doctoral Fellow at Colorado State University before accepting a position as an Extension Poultry Specialist at the University of Georgia in 1996. In this position, Dr. Bramwell was stationed at Tifton, Georgia, some 200 miles from the main campus.

WELCOME!
Dr. R. Keith Bramwell has joined the University of Arkansas poultry science faculty as an Extension Poultry Specialist.

In spite of the fact that he was the only Extension Poultry Scientist in a rapidly growing poultry area, Dr. Bramwell accomplished much. Dr. Bramwell was responsible for breeder management, hatchery management, broiler management, game bird and ratite management, waste management and 4-H/youth program development in his position. Yet Dr. Bramwell addressed each of the educational needs of his clientele and also managed to become involved in several research projects. Many in Arkansas know Dr. Bramwell because of his frequent involvement as a speaker on the Breeder Program of the Arkansas Poultry Symposium.

We are extremely pleased to have Dr. Keith Bramwell join our team at the Center of Excellence for Poultry Science, University of Arkansas.

If you would like to contact Dr. Bramwell, you may log onto his website at http://www.uark.edu/depts/posc/bramwell.html. His e-mail and contact information is located on his personal web page.

Tom Tabler • Applied Broiler Unit Manager - Savoy
Center of Excellence for Poultry Science • University of Arkansas

Importance of Litter Quality to Broiler Producers

Because birds are in continuous contact with litter, litter conditions significantly influence broiler performance and, eventually, the profits of producers and integrators.

Introduction. The quality of litter on the floor in our broiler houses probably does not in most cases receive sufficient emphasis. As broiler producers, we are greatly concerned about the quality of our chicks, feed and water, but seldom do we worry about litter. However, because birds are in continuous contact with litter, litter conditions significantly influence broiler performance and, eventually, the profits of producers and integrators. Litter serves the following important functions[1]:

- It absorbs moisture & promotes drying by increasing surface area of the house floor,
- It dilutes fecal material, thus reducing contact between birds and manure, and
- It insulates chicks from the cooling effects of the ground and provides a protective cushion between the birds and the floor.

Table 1. Advantages and disadvantages of various litter material.[1]

Pine shavings and sawdust	Preferred litter material; limited in supply and expensive in areas.
Hardwood shavings and sawdust	Often high in moisture and susceptible to dangerous mold growth if stored improperly prior to use.
Pine or hardwood chips	Used successfully, but may cause increased incidence of breast blisters if allowed to become too wet.
Rice hulls	A good litter material where available at a competitive price. Young chicks may be prone to litter-eating (not serious).
Peanut hulls	Very inexpensive litter material in peanut-producing areas. Tends to cake and crust, but can be managed. Some problems with pesticides have been noted in the past.
Sugarcane pomace (bagasse)	Prone to caking first few weeks, but can be used effectively.
Crushed corn cobs	Limited availability. Possible breast blister problems.
Chopped straw, hay or corn stover	Considerable caking tendency. Mold growth also a disadvantage.
Processed paper	Various forms have proven to be good litter material in research and commercial situations. Topdressing paper base with shavings may minimize caking. Careful management essential.

1 Lacy, M.P. 1991. Litter quality and broiler performance. Univ. of Georgia Cooperative Extension Service Publication No. L426-W.

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An effective litter material must be absorbent, light, affordable and non-toxic. In addition, it must be compatible as a fertilizer or livestock feed after it has served its purpose in the broiler house. Many poultry growers also raise cattle, and view litter as a valuable fertilizer for pastures and hay meadows or an economical feed ingredient for beef cattle. In view of its value, steps should be taken to insure its litter quality for poultry and cattle producers alike. Table 1 (page 3) lists various materials that have been tried with some degree of success and briefly discusses advantages and disadvantages of particular litter sources.

Ammonia and Pathogen Challenges. Today's modern broiler strains have the genetic potential to gain weight and convert feed- to-meat at a remarkable rate. However, broilers do not perform to their genetic potential in a less-than-optimum environment. Environmental quality is highly dependent on litter quality and litter quality is influenced by 1) manure production and 2) moisture. As growers, we have little influence over the manure production portion, but we can and must control litter moisture if we expect to maintain the quality litter conditions necessary to produce a healthy, efficient and profitable flock. Excess litter moisture increases the incidence of skin burns, breast blisters, condemnations and downgrades at processing. Wet litter can further aggravate coccidiosis by providing an ideal environment for oocysts to sporulate, increasing challenge levels. In addition, wet litter leads to ammonia production — one of the greatest challenges affecting broiler production today.

Volatilization of ammonia in poultry houses is caused by microbial decomposition of nitrogenous compounds, principally the uric acid, in poultry house litter. Once formed, free ammonia will be in one of two forms: the uncharged form of NH_3 (ammonia) or the charged ammonium ion (NH_4^+), depending on the pH of the litter. The gaseous release of ammonia (NH_3) can be inhibited if it is converted to ammonium (NH_4^+), which can be accomplished by lowering litter pH. Ammonia concentration tends to increase with increasing litter pH. Ammonia release is small when litter pH is below 7.0, but can be substantial when litter pH is above 8.0. Uric acid decomposition is most favored under alkaline (pH > 7.0) conditions. Typically, litter pH in a broiler house tends to be alkaline unless a litter treatment has been applied. Various litter treatments are available for lowering litter pH including chemical, microbial and enzyme-based products. In the past, the primary reason for using a litter treatment was to control ammonia levels. However, in recent years, the reasons for using a litter treatment and potential benefits from its use have expanded to include improvements in flock performance as well as environmental concerns (mainly phosphorus issues).

Many poultry growers underestimate the serious detrimental effects of ammonia.

Many poultry growers underestimate the serious detrimental effects of ammonia. Humans are able to detect ammonia levels at around 20 parts per million (ppm) but most growers (including the author) gradually lose this level of sensitivity over time. Ammonia concentrations of 50 to 100 ppm cause the human eye to burn and tear. Birds are also sensitive to ammonia. Prolonged exposure to high levels (50 to 100 ppm) causes keratoconjunctivitis (blindness). This is most often seen in broiler flocks grown during cooler weather when the curtains are up and minimum ventilation is used. Ammonia levels that are high enough to blind birds obviously affect production; however, low levels of only 25 ppm can depress growth and increase feed conversion. Yet it is possible to get litter too dry.

Litter that is too dry and dusty can cause dehydration of young chicks, respiratory disease and increased condemnations. For ideal conditions, litter moisture should be maintained at 20 to 25 percent. However, we all know that there are times when this is just not possible. A good rule of thumb in estimating litter moisture is to squeeze a handful of litter. If it sticks together tightly and remains in a ball, it is too wet. If it sticks together slightly, it has about the proper moisture content. If it will not stick together at all, it is probably too dry.

The practice of using litter to grow multiple flocks before a total cleanout is performed is commonplace in Arkansas. However, this practice requires a higher degree of management since ammonia is always more of a problem on built-up litter than on new litter. In addition, growers must be aware that, over time, used litter can become seeded with pathogens that negatively affect bird performance. We at the Applied Broiler Research Unit used litter for an extended period (3-4 years) and observed a slow, but steady increase in condemnation percentage as the number of flocks grown on the same litter increased. Parasites, such as roundworms, tapeworms and coccidia, can be a potential problem in built-up litter as well. Laryngotracheitis, avian influenza, gangrenous dermatitis, reovirus, gumboro, bronchitis and botulism are some of

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the more serious viral and bacterial diseases also known to spread easily in contaminated litter. While a total cleanout after each flock could minimize the possibility of disease spread and parasitic infestation, cost and time restraints make this practice an unrealistic option for most producers.

Proper Litter Management. There are a number of factors that affect litter moisture and quality and some factors can be controlled with farm management practices, some can=t. For instance, growers can control whether or not new litter is damp before spreading. However, nutrition (an area where growers have little control) can also influence litter quality. Certain dietary ingredients (salt for one), when fed in excess, cause broilers to consume and excrete large amounts of water resulting in wet litter conditions. Some drugs may also stimulate excess water consumption and excretion. Environmental conditions such as very cold temperatures or several days of wet and humid weather can also result in wet litter if the broiler house ventilation system is unable to eliminate moisture effectively. During periods of hot weather, waterers, foggers, and evaporative cooling pads can contribute to wet litter problems if not managed and maintained properly. Some key points to remember concerning quality litter management include:

Some Key Points to remember concerning quality litter management:

1. Increase minimum ventilation rates the first few days of the flock to reduce ammonia levels at this critical stage in the life of the birds.
2. In colder weather, bring adequate fresh air into the house. In negative pressure houses, static pressure should range from .05 to .10 inches of water so that air velocity through inlets stays within the 600 to 1200 feet per minute range. This will keep a jet of air above the birds, prevent cold air from dropping to the floor as it enters the house and promotes good air mixing.
3. Use stir or mixing fans to move air within the house. These fans will move hot air, which can hold more moisture, off the ceiling, closer to the floor and help dry the litter.
4. Maintain proper height and pressure adjustments on nipple water systems.
5. Check for water leaks often, and promptly repair.
6. Promptly remove the affected litter when leaks or spills occur.
7. Add supplemental heat when necessary to facilitate moisture removal. As the inside air is warmed, its ability hold moisture increases. This combination of heating and ventilating will remove considerable amounts of moisture from the house.
8. Ensure adequate drainage around the house so that no moisture seeps in from outside.
9. Remove all caked litter after each flock if a total cleanout is not undertaken.
10. Leave curtains down between flocks to allow fresh air to blow through houses. This will help dilute ammonia release and pathogenic challenge.

Summary. Litter serves several functions in the broiler house; it absorbs moisture and promotes drying by increasing surface area of the floor, dilutes fecal material, insulates chicks from the cold ground and provides a protective cushion between birds and floor. It must be light, absorbent, affordable and non-toxic. In addition, it is a valuable commodity for later use as a fertilizer or livestock feed and should be managed with this in mind.

One of the greatest challenges to broiler production today is ammonia. How well growers manage ammonia determines, in large part, how well their flock performs. And how well they have maintained their litter quality determines how much ammonia they will have to manage. The gaseous release of ammonia from the litter tends to increase with increasing litter pH.

The practice of reusing old litter to grow multiple flocks is commonplace but requires a higher degree of management to be successful. Not only is ammonia more of a problem on built-up litter, but pathogens that negatively affect bird performance may also become seeded in the litter. While a total cleanout after each flock might be ideal, in reality, this practice is usually not an option for most producers due to cost constraints.

Numerous factors affect the quality of broiler litter. Growers should constantly be alert to changing litter conditions and take necessary steps to insure optimum litter quality for increased bird performance and, have a valuable commodity for use as a fertilizer or livestock feed at cleanout time. ■

Reference:
Lacy, M. P. 1991. Litter quality and broiler performance. Univ. of Georgia Cooperative Extension Service Publication No. L426-W.

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technology technology technology

Computers and Controllers: Technology Goes Down on the Farm[1]

Introduction. The average poultry farmer in the United States usually operates a farm with two to four grow-out houses. If this farmer is a broiler grower, the control of temperature, relative humidity, ammonia levels, feed consumption and water consumption within each house determines the size and quality of broilers produced. Most poultry producers presently utilize some type of electronic monitoring or control system (e.g. timers or thermostats) to help them control house conditions. In the past, farmers used their own judgment to determine when to turn brooders, furnaces, fans, foggers, and other equipment on or off and each piece of equipment was operated independently. Today, however, an increasing number of producers are turning to some form of computerized control. Farm computer systems allow the grower to simultaneously monitor and control equipment from one unit at a central location in or near each house.

Background History. Affordable personal computers, with their versatile capabilities, were first introduced in the U.S. market in the early 1980s. Researchers and commercial firms soon realized that poultry farmers could benefit from computer-based systems that would allow them to check house conditions and adjust equipment settings from a single location. Egg producers were among the first to move to totally computerized management systems, which allowed them to keep flock performance records, monitor house conditions and adjust equipment settings in multiple houses from a single remote location such as a farm office. However, individual broiler grow-out operations generally could not afford these initial systems. As a result, research groups began focusing on simpler, lower-cost alternatives. One of the earliest development efforts took place at the Georgia Tech Research Institute in the mid-1980s.[2] What has evolved from those efforts is a rather simple process where a personal computer within the farm office communicates with a central controller located within each grow-out house. Such a set-up can be modified for each farm allowing producers to keep an eye on their operations at all times and generate data for specific periods within a grow-out or for an entire flock

Some Currently Available Systems. Some of the companies actively marketing these systems include: Aerotech, Inc., Chore-Time Equipment Inc., Hired Hand Inc., Poultry Management Systems, Inc., and Rotem Computerized Controllers Ltd. Since systems offer unique features and differences with respect to ease of use, cost, reliability, etc., prospective buyers must evaluate his/her needs vs. system capabilities. As with almost everything else, you get what you pay for. The more features you get, the more the system costs. Depending on the functions ordered, the cost of a farm computer system could range from $1,500 to $10,000. Although some growers may not be able to pay this initial investment, these systems can provide useful information to integrators. In view of the benefits to integrators, programs in which growers and integrators share the initial investment costs could encourage the rapid adoption this technology.

The Up Side. Farm computer technology could provide potential benefits to virtually every aspect of poultry production. Processing plants could benefit from greater uniformity in bird weights. The feed mill could use on-line information provided by farm systems to schedule feed deliveries. Live-production managers could check average bird weights. Service technicians could identify possible symptoms that might indicate developing health problems requiring a necessary farm visit and growers would have a powerful tool to augment their management skills. Improved environmental control alone could help the poultry grower earn more money by reducing bird stress, thereby improving bird health.

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[1] Mention of trade names does not constitute endorsement by the University of Arkansas Cooperative Extension Service or the University of Arkansas Center of Excellence for Poultry Science and does not imply their approval to the exclusion of other products that may be suitable.

[2] Angela Colar, Georgia Tech Research Institute, personal communication.

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The Down Side. Two important challenges remain to large-scale integration of the more sophisticated farm computer technology: integrators/producer cost share plans and the establishment of a standard communications protocol for all systems. Working out equitable funding schemes between integrators and farmers to assist with system purchase costs is currently a work-in-progress in many companies. Development of a standard communications protocol is an area where integrators may need to become more assertive. Current controller systems operate using unique proprietary software. Without a standard communications protocol, integrators would be forced to maintain several different software packages to ensure access to data from each farm. In reality, maintaining any number of different software packages is not a viable option. Standard communication protocols must be developed.

Getting Started Right. Most new-house construction and many retrofitted older houses now have electronic systems that control most (if not all) of the heating, cooling and ventilation equipment in the house (e.g. fans, foggers, brooders, furnaces, curtains, and ventilation inlets). Growers must understand the workings of these sophisticated controller systems, otherwise they will be of little value. Spending thousands of dollars for a system you don't thoroughly understand and can't utilize to its maximum potential is money thrown away. Make sure that the salesperson or the technician who installs your system has thoroughly explained all of the system features and that you understand all of the system capabilities before you let the representative drive away. You have no way of knowing if the controller is working correctly if you are unsure how the system operates.

Backup Systems. Once you understand how your controller works you must then have a plan of action in place for **when** it doesn't work (in the event of a controller malfunction or an electrical power outage). Backup power systems are becoming more of a necessity each year as the poultry industry shifts to more sophisticated broiler housing. There was a time growers had little control over bird comfort and control of ventilation simply meant adjusting the curtain openings. In those days, if you didn't get things exactly right, nothing too drastic was likely to go wrong. However, the adoption of power ventilation has meant that those days are now long gone and far away. Today, the development of ventilation modes (minimum, transitional and tunnel ventilation) for different weather has yielded vast improvements in our ability to control the in-house environment. Growers are now able to achieve a much higher level of performance on a year-round basis because of the ability to keep temperature and air quality factors consistently within the birds' "comfort zone." However, this higher performance has a price tag.

Generally, less day-to-day adjustment of controls is required with environmentally controlled housing; but the need to monitor the house environment, the birds, and the desired target settings becomes an even more critical daily task, and the risk of a catastrophic loss from power or equipment failure becomes an even greater concern. A power failure or controller malfunction on one of the larger, more sophisticated, high bird density broiler houses of today puts the entire flock at great risk within minutes unless backup power systems are in place and work properly. Remember these backup systems cannot be part of the primary control system. All backup systems must be independent of the main power supply.

Curtain Drops. Perhaps the oldest form of system backup is the standard curtain drop which has the basic function of dropping the curtains in the event of a power failure. However, some producers (including the Broiler Research Farm at Savoy) also electronically tie curtain drops to the high-temperature thermostat so that the curtains drop if the house temperature gets too hot. While curtain drops may always function normally, it is a good idea to periodically inspect the release winches to make sure they spin freely and are in good working condition. During the winter, it is good to attach a short length of chain to the curtain cable and the wall to limit the amount that the curtain can open so as to not chill the birds if the curtain drops.

Controller Backup. Today a grower almost has to have an independent backup for any integrated electronic controller. This allows the controller to operate within the range that you set. However, the backup system will take over when the primary system gets to far away from the range you establish. This means that you want to set each system so that the backup system does not activate except in emergencies. For instance, if the desired electronic controller target temperature is 80° F, you may want to set the high limit temperature on your backup controller about 10° F above the target temperature. This will prevent the 2 systems from fighting one another but will not allow the temperature range to get totally out of hand. Growers must remember to adjust the temperature set points on **BOTH** the primary controller and the backup system to reflect the changing temperature need of the growing birds. The low limit for heating must also be set just as a high limit for cooling mentioned earlier. Most people will agree that this set point should be about 10°F below the target temperature. It is crucial that the settings on backup systems be adjusted when the primary controller is adjusted.

Generators. The ideal situation would be for all poultry houses to have generators, but conventionally ventilated houses can sometimes be managed without electricity. Curtain-sided houses can be set up so that curtains drop to reduce losses from heat stress. However, totally enclosed houses must have generators, since fans provide the only means of ventilation or cooling of these houses. The generators on totally enclosed houses must automatically start and provide power to the house within a few minutes in order to maintain suitable within the house. One of the features on your controller system should be the ability to stage start the fans so that the surge load on the generator is reduced. It is a good idea to start the generator periodically and allow it to run for four to five minutes so that it will start and run when needed. In addition, it is essential that you have enough fuel to run a minimum of 24 hours on hand. It is also wise to an adequate amount other essential fluids (i.e. motor oil, hydraulic fluid, coolant, etc) on hand.

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COMPUTER TECHNOLOGY continued from page 7

Summary. Electronic controllers and computers have been available for farm operations since the mid-1980s. As sophistication of houses increases within the poultry industry electronic controllers will become more commonplace. A wide array of controllers in various price ranges is currently available from various manufactures. This technology has the potential to provide valuable information to growers, service techs, feed mill, live production and processing plant personnel. However, proper training and a thorough understanding of system features are necessary to take advantage of the benefits. Challenges still remain in the areas of integrator/grower cost sharing and in standard communication protocols. Backup systems, including curtain drops, backup controllers and stand-alone generators, are essential to guard against catastrophic losses in event of controller malfunction or power outage. These backup systems must be routinely checked, serviced and maintained to guarantee performance when needed. ■

Special thanks to Angela Colar, Georgia Tech Research Institute, for portions of the information contained herein.

Dr. F. Dustan Clark • Extension Poultry Veterinarian
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Identification of Poultry Parasite Problem

Introduction. There are a large variety of parasites that cause problems in the avian species. These problems can be corrected easier if a few facts are known about the parasite's life cycle, clinical signs, parasite identification and treatment.

Poultry parasites can be grouped in two broad categories: (1) external and (2) internal parasites. The external parasites are more readily observed and include various species of lice, mites, ticks, fleas and biting insects. Internal parasites include the various species of worms and protozoa and are usually more difficult to detect.

External Parasites. When birds are parasitized by external parasites, the signs and methods of parasite detection depend on the parasite involved. The biting insects such as mosquitoes, gnats, beetles, and bed bugs usually cause some degree of poor growth in young birds or poor performance, anemia, and skin irritation in older animals. Often the parasites can be identified by close examination of affected birds (especially at night or late evening) to look for the actual insects on or around the bird. These species of parasites can be treated by sanitation, routine pest control protocols, insecticide strips in the area, screening, or use of flying insect electrocution devices ("bug zappers").

If birds have damaged feathers, excessively preen and scratch, and have decreased activity and productivity they may be infested with lice. The lice are easily detected on the bird. They are flat, fast moving and brown to yellow in color, many people call them dandruff that runs. Lice are usually found on the head, neck, or vent areas of the bird. Lice eggs (nits) may be observed attached to feathers in the above areas. A few species of lice live inside the shaft of the feather and can only be detected by splitting the feather shaft with a sharp blade. Lice are easily treated with sprays or powders that contain pyrethrins, rotenone, and carbaryl. The treatment should be repeated in 2-3 weeks and cages should be cleaned and disinfected.

Mites are another external parasite affecting poultry. Some species (*Knemidocoptes*) cause severe irritation and a crusty appearance on the legs. This mite is referred to as the scaly leg mite. If the infestation is severe enough, the bird may have weight loss, leg deformation, difficulty walking, poor

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production, and could die. These mites are very small and only visible with magnification. They can be readily observed with a microscope in a scrapings of the affected leg scales and dry crusts that form on them. The best treatment for scaly leg mites is ivermectin; however, topical preparations containing such chemicals as rotenone can also be used.

Other species of mites, such as the Chicken red mite, cause unthriftiness, feather damage from excessive preening, and anemia. However, this mite is not easily detected since it lives off the bird and only gets on the bird at night to take a blood meal. Birds should be examined at night for restlessness and the presence of tiny red to brown colored moving spots. The roosting perches and nest boxes can also be checked for the presence of mites.

Another mite species, the Northern fowl mite, causes similar signs in chickens. This mite differs from the red mite in that it is grey to black in color and can be found on the bird during the day. Handling of affected birds may also reveal the mites on your hands. The treatment for red and fowl mites is the same (pyrethrins, carbaryl, rotenone, etc. sprays or powders) but the application is somewhat different. It is very important that the treatment for red mites include the perches and cage environment, in addition to the bird; whereas with fowl mites treatment of the bird is usually sufficient.

Fleas and ticks may be occasionally found on chickens. These parasites can cause anemia and unthriftiness and are readily visible. They should be treated with sprays or powders in the same manner as lice. Good sanitation of the birds' environment will also help control them.

Internal Parasites. The internal parasites are more difficult to detect by observation and examination; and as such usually require microscopic examination of feces to detect their eggs. One of the most common internal parasites is ascarids, usually referred to as roundworms.

Birds infested with roundworms may have weakness, diarrhea, weight loss, and poor condition. Occasionally, an obstruction of the intestines can result causing sudden death. The adult worms may be seen in droppings but usually the condition is diagnosed by microscopic observation of eggs in a fecal smear or flotation. The eggs are thick shelled and round in appearance. Ascarids are easily controlled by regular use of piperazine, levamisole, or ivermectin. Good sanitation is also very important to control ascarids since birds are infected by consuming materials which have been contaminated with ascarid egg laden feces from infected birds.

The threadworms or capillarial worms may also be a problem. The signs are similar to roundworm infestation in that weight loss, poor condition and diarrhea may be present in affected birds. However, one species of capillaria lives in the crop and esophagus and may cause vomiting or swallowing difficulty. These worms are rarely observed in feces or mouth discharges since they are very thin and filamentous. Eggs can be observed using a microscope and fecal flotation. A fecal smear may also be positive and a scraping or swab from the mouth or crop of an affected bird may show a few eggs. The eggs are readily distinguished from roundworm eggs since they are elongated with plugs at each end (bipolar). Treatment is similar to ascarids except that piperazine may not be as effective in capillarial infections. Sanitation is also important to prevent reinfection of birds via access to infected feces.

The worm known as the gapeworm (*Syngamus* sp.) should be considered if birds are having difficulty breathing and are constantly gaping (hence the parasite's name). They are commonly seen in pheasants and guinea fowl. These worms live in the trachea and bronchi of the birds' respiratory system and may be occasionally seen in the trachea by the owner when the bird gapes for air. A fecal flotation will show the eggs and a microscopic examination of excess mucous from the mouth and trachea may reveal eggs similar in appearance to capillaria worms. The worms eggs are passed from an infected bird and either ingested by a noninfected bird or eaten by an intermediate host (beetle, worm, etc.) which is in turn eaten by the bird. Sanitation is important to prevent infestations and good insect control is necessary. Affected birds can be treated with several compounds such as ivermectin or levamisole and in some instances the worms can be physically removed from the trachea of the bird using small forceps.

Two parasites which live in the gizzard and proventriculus are *Dispharynx* sp. and *Tetrameres* respectively. The worms use intermediate hosts such as beetles, arthropods, etc. which are in turn eaten by the birds. The signs are similar to other worm infestations and commonly include weight loss, diarrhea, inactivity, and unthriftiness. A routine microscopic exam of a fecal smear or flotation may not show the eggs and it is advisable to check the sediment of the fecal flotation for ovoid eggs. These parasites cause considerable inflammation in the gizzard and proventriculus. Treatment should be directed towards eliminating the worms and preventing access to or eliminating intermediate hosts. Ivermectin and levamisole are affective to treat the worms and intermediate hosts can be controlled with insecticides and better sanitation.

Tapeworms (cestodes) are one of the most common internal parasites observed by poultry owners. The reason is not that tapeworms are a widespread problem in birds, but that the tapeworm segments are usually large enough to be readily seen in feces. These parasites are flattened, ribbon like worms which attach to the small intestinal wall and compete with the bird for nutrients. Several species of tapeworms can affect birds. A severe infestation can cause diarrhea, weight loss, and even intestinal impaction. Microscopic examination of fecal flotations will reveal eggs or worm segments; often the segments are observed in the feces directly. Tapeworms also use an intermediate host such as a beetle or ant, in their life cycle. An effective treatment is the drug niclosamide or praziquantel coupled with improved sanitation and insect control.

Internal parasites, other than worms, which are of importance are protozoa. The most common gastrointestinal protozoal infections in pet birds are Coccidia, and Trichomoniasis.

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Coccidiosis is a common problem in backyard poultry...

Coccidiosis is a common problem in backyard poultry and can be caused by several species of the protozoa *Eimeria*. The signs associated with these infections include diarrhea (often bloody), weight loss, weakness, and death losses. These parasites reproduce in the cells lining the gastrointestinal tract and can reach large numbers of infective oocysts in a few days. A diagnosis of coccidiosis is done by microscopic examination of feces, either by direct smear or flotation, for oocysts shed in the feces. It is important to practice good sanitation. Treatment for coccidia includes sulfa drugs, amprolium, and other anticoccidial compounds available.

The parasite *Trichomonas* also affects the gastrointestinal tract of various avian species. Pigeons and doves are the most commonly affected species but the disease has also been observed in chickens and turkeys. Birds infected with *Trichomonas* sp may have weight loss, vomiting, respiratory difficulty and possibly dry or wet cauliflower type lesions observed in the mouth. An infection by Trichomonas may also lead to secondary bacterial infections because of damage to the gastrointestinal lining thus allowing bacterial invasion. The parasite can be identified microscopically using crop and saliva wet mounts. Treatment is similar to that for Giardia and proper sanitation is very important since it is spread to other birds by direct contact.

Summary. Parasite control in the avian species is dependent on recognizing signs of parasitism, identification of the parasite, and good sanitation. Poultry owners should carefully examine and observe all birds periodically to check for signs of parasite problems or diseases. Several of the parasites (or signs there of) can be easily found if care is taken to adequately examine the feathering (external parasites) and weight condition (internal parasites) of any bird. If available, a microscope can be used to examine a direct fecal smear, throat wet mount, or fecal flotation for the presence of internal parasite eggs or protozoans. If parasites are found they should be treated with an appropriate drug and, since there are many different drugs for parasites, a veterinarian should be consulted for the appropriate dose to prevent toxicity problems. In all cases of parasitism good husbandry and sanitation practices are important to prevent spread and reinfection. ■

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Biology and Control of Bed Bugs *(Cimex lectularius L.)* in Poultry Houses

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Introduction. The Bed Bug is associated with humans and poultry in most areas of the world. The life cycle consists of the egg, 5 stages of nymphs (each one progressively larger than the preceding) and the adults. Adults Bed Bugs are reddish brown in color while the nymphs and eggs are yellowish white. Bed Bugs feed only at night and hide in crevices or cracks during the day. They are gregarious, hiding in great numbers in dark areas where the eggs are deposited. The areas surrounding hiding places are generally covered with tarry black excrement and contain large accumulations of nymphs. Bed Bug infestations are most often a problem in breeder houses, but can also be occasionally found in broiler houses.

Monitoring. Because the Bed Bugs feed at night, the monitoring for the presence of Bed Bugs in poultry flocks should be conducted at night. Birds, cracks, crevices in roosts, slats, and nesting boxes should be thoroughly examined with a bright light to detect the presence of the Bed Bugs.

Biology. The female deposits eggs in batches of 10-50, totaling 200-500. The eggs are relatively large and are laid in a large yellowish white patch. Eggs usually hatch in about 10

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Water Quality can Influence Poultry Performance

Introduction. Since young rapidly growing birds typically consume twice as much water as feed, it is important to supply birds with a clean, healthy water supply. Water not only serves as a vital nutrient but it also has many essential functions. Water softens feed in the crop, serves as a carrier for feed moving through the digestive tract and acts as an aid in several digestive processes. In addition, water is the key component of blood and lymph that are vital for a healthy immune system. Birds rely heavily on the evaporative cooling effect of water loss from the lungs and air sacs for temperature control during heat stress. Therefore factors which might alter water quality such as changes in bacterial content, pH, nitrogen levels, hardness or mineral levels might directly impact water consumption or the bird's ability to utilize consumed water.

Unfortunately much of the water quality information is several years old and the modern broiler has undergone dramatic changes in growth rate, feed efficiency and immune system function. Recent field observations indicate the modern broiler may be more susceptible to water quality problems as compared to the type of broiler that was in the field just ten years ago. Complicating the issue, many water supplies such as well water, are very dynamic and can change in quality as often as season to season. If a producer experiences poor flock performance as measured by feed passage, poor weight gains or health problems that can not be explained, it might be worth while to have the water supply evaluated.

Table 1. Water quality standards for poultry

Contaminant, mineral or ion	Level considered average	Maximum acceptable level
Bacteria		
total bacteria	0 CFU/ml	100 CFU/ml
Coliform bacteria	0 CFU/ml	50 CFU/ml
Acidity and hardness		
pH	6.8 - 7.5	6.0 - 8.0
Total hardness	60-180 ppm	110 ppm
Naturally occurring elements		
Calcium (Ca)	60 mg/l	
Chloride (Cl)	14 mg/l	250 mg/l
Copper (Cu)	0.002 mg/l	0.6 mg/l
Iron (Fe)	0.2 mg/l	0.3 mg/l
Lead (Pb)	0	0.02 mg/l
Magnesium (Mg)	14 mg/l	125 mg/l
Nitrate	10 mg/l	25 mg/l
Sulfate	125 mg/l	250 mg/l
Zinc		1.5 mg/l
Sodium (Na)	32 mg/l	50 mg/l

Source: Muirhead, Sarah. 1995. Good, clean water is critical component of poultry production. Feedstuffs.

Acceptable Water Quality. Acceptable and unacceptable water quality parameters for poultry are outlined in Table 1. Note that CFU/ml means colony forming units of bacteria/ milliliter of water and mg/l is also the same as ppm or parts per million. A good rule of thumb for understanding how much is a ppm is think of one gallon of sugar dissolved into a million gallons of water. That would give 1 ppm of sugar. While parts per million of anything seems quite small, remember, the birds already receive a balanced diet and if they are also receiving such nutrients as salt in the water in the form of sodium and chloride ions, then over time the birds may exhibit poor performance because they just have more than their systems can handle.

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Water pH. While pH is not a chemical or specific contaminant, it can impact water quality. First, it impacts the effectiveness of disinfectants such as chlorine. If the pH is above 8.0, the chlorine is present mainly as chloric ions that add very little sanitizing quality. Chlorine is most effective when used in water with a pH of 6.0 to 7.0. This pH level results in a greater percentage of hypochlorous ions that are a strong sanitizer. Water treatments which acidify the water may provide a beneficial protection against bacterial action in the bird's digestive tract, but be careful not overuse acidifiers such as citric or acetic acid products because they may cause birds to consume less water. One company could not understand why all of their birds consistently experienced weight gains below average after seven days of age.The problem was discovered to be the addition of citric acid to the drinking water at six days of age for the rest of the growout cycle. Removal of the citric acid from the drinking water and supplementing it for short intervals throughout the grow cycle returned weight gains to normal.

Unfortunately interpreting the effects of water contaminates on poultry performance is not always straightforward. Several years ago, a company conducted an evaluation of water quality and its impact on bird performance. This company found that while certain contaminants might not cause problems when present alone, the contaminants would have a detrimental effect on performance when other contaminants were present. Table 2 shows the relationship on of several chemicals.

Table 2. Impact of chemical combinations in the drinking water of poultry.

Chemical combinations	Levels (mg/l)	Effect
Sodium Chloride	50 14	Detrimental to performance
Sodium Sulfate	50 50	Detrimental to performance
Sulfate Magnesium	50 50	Detrimental to performance
Sodium Bicarbonate	200 500 or greater	No effect
Nitrates	> 20	Detrimental to performance
Magnesium Sulfate	68 50	Detrimental to performance

Source: Waggoner, R.E., R.W. Good, and R.E. Good. 1984. Water Quality and Poultry Production, North Carolina Nutrition Conference.

Water Line Sanitation. A regular water sanitation and water line cleaning program can provide protection against microbial contamination and the build-up of bio-films, a clear slimy film, in water lines. While bio-films may not be a source of problem to birds, once established in water lines, bio-films provide a place for more detrimental bacteria and viruses to hide from disinfectants. On several occasions water samples taken at the well house have been compared to samples taken at the end of the water line in the poultry house and counts would be much higher in the latter samples. Once detrimental bacteria or even large numbers of normal bacteria become present in water supplies, then bird performance could be jeopardized. In addition, the warm environment of the poultry house can aggravate contamination by encouraging bacteria to grow in water lines. A single *E. coli* organism can multiply into 24 trillion organisms in 24 hours at a temperature of 90° F. Table 3 provides recommendations for routine water line cleaning and sanitizing.

Summary. In conclusion, water is the most essential nutrient birds receive, yet the quality of water is often overlooked. Providing flocks with a clean, wholesome water source can make a difference in performance. Should water be a suspect for flock problems, contact your county agent for information on how and where to have a water sample tested. ■

Table 3. Water line cleaning recommendations for once a week cleaning when birds are present

Ammonia (Water pH is less than 7.2)	Citric Acid (Water pH higher than 7.2)	35% Hydrogen Peroxide	Household Bleach (Chlorine)	Vinegar	Iodine [1]
Stock solutions to be metered at a rate of 1 oz. stock/128 oz.					
6 oz. Clear household Ammonia per gallon water	1 pack Citric Acid per gallon water	1/2 to 3/4 oz. per gallon water	5 to 6 oz. Household Bleach per gallon water	64 oz. White Household Vinegar per 64 oz. water	2 oz. of 18.05% Iodine Complex Disinfectant per one gallon of stock solution

1 Use the 18.05% iodine product with rubber seated drinkers.
Source: Water is the most important nutrient, I.D. Russell, Company, Longmont, CO.

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Combating Floor and Slat Eggs in the Breeder House

Introduction. Hatching eggs laid on the floor or slats of the breeder house can present a signifi cant problem for the hatching egg producer as well as the integrator. Most eggs laid on the floor or slats are unacceptable as hatching eggs because of the increased likelihood of being cracked and/or contaminated. Unfortunately, often these eggs are, at most, gently wiped off and placed with nest clean eggs in the egg cooler. Once delivered to the hatchery, it only takes a small few contaminated eggs placed in the setter to further contaminate the environment and many of the surrounding eggs. The best case scenario is that only those eggs placed near the floor eggs in the incubator racks will be affected. Therefore, floor and slat eggs are costly to the contract breeder grower as they may cause reductions in overall hatchability of eggs from their own flock. More importantly, these contaminated eggs that somehow "slip in" with nest clean hatching eggs are often very costly to the integrator as they can affect hatchability and chick quality from eggs of other flocks placed nearby in the setters. The incidence of floor and slat eggs in the breeder house can range from moderate to severe with reports of floor and slat eggs exceeding 25 percent in some cases.

Laying and Nesting Behavior. The basic nature of the breeder hen tells her to find a nesting site where she can feel safe, secure and comfortable. She is searching for a place where she feels will be suitable to incubate and raise chicks. Obviously, commercial broiler breeders will never incubate and brood young, but their basic instincts tell them they should find an appropriate site to do so.

Manufacturers of nesting equipment, as well as those involved in designing breeder houses, have attempted to provide ideal nesting areas for breeder hens. However, ease of gathering and handling hatching eggs is of equal if not greater concern to the hatching egg producer. Therefore, the nature of the commercial poultry industry and the design of breeder houses in general, allow for egg laying in other than designated areas of the breeder house. Proper flock training and management, as will be discussed, can encourage hens to use the designated nest sites for egg laying. The design or setup of a breeder house should, as much as possible,

What Causes Floor Eggs? Floor and slat eggs are not a new problem to the poultry industry. Recently, this problem was readdressed with a group of hatching egg producers and a list of causes for their increase in the incidence of floor eggs was identified. As these areas were addressed, the percentage of flocks with floor egg problems was reduced by more than one half. Further improvements continue for this group of hatching egg producers.

The first area identified was ***poor initial training of the birds*** by the grower. This is a preventive measure in combating the incidence of floor/slat eggs in the breeder house. As a preventive measure, it is critical that training of the birds be performed prior to the onset of the chores of gathering hatching eggs. It is not uncommon for growers to want to extend their "resting time" after house preparation until the first eggs appear because they never had a floor egg problem before. Indeed, they deserve the time off as the demands are heavy for hatching egg producers. However, late training of birds is not effective once floor/slat eggs become a problem since birds are creatures of habit and tend to reuse the same nesting sites day after day.

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To properly train breeders to use the nest boxes, it is important that birds be "walked" several times each day prior to egg production. It is recommended that the slats and scratch area are walked at least six and up to 10 times each day prior to egg production. This will encourage hens to find the nests and acclimate them to the breeder house and the associated human activity. However, rapidly "walking" the breeder house and not "training" the birds to use the nests and get up on the slats is not effective. Rapid walking tends to startle the hens and scare them away from the nests. Walk the hens slowly, especially during the training period. Walk the houses in a pattern that will force the birds toward the nesting sites, not away from them. If the pattern of grower traffic forces birds into corners, they will be introduced to improper potential nesting sites. The slat area should be walked close to the side walls and corners to encourage bird movement away from the edges and toward the nest boxes. Walking the birds should be continued through their peak in egg production although less often as the birds become trained.

As previously discussed, housing design and equipment layout coupled with bird management protocol can often encourage floor and slat eggs. For instance, placing ***too many hens in the breeder house*** places limits on each hens access to proper nesting sites. Although the nest manufacturers suggested number of hens per nest hole will vary, the industry average is 5.5 hens per nest hole. Further complicating the matter is the fact that hens, being creatures of habit, will generally choose the same nesting site day after day to lay their eggs. That is why many times multiple hens will pile in one nest box when a neighboring box is empty. Each hen feels that box "belongs" to them and it is the same place they were the day before. If access to their specific box is denied, they may choose an alternative nest site such as the floor or slat area. Make sure that the number of birds housed does not exceed the recommendations for the nest type in the breeder house. Also, make sure that all nest boxes are accessible to the hens. Take into account hen houses that may be partially used for housing surplus males and consequently are rendering a number of nest boxes inaccessible to the hens. This setup can create additional dark spots and corners within the house at an impressionable age of the young hens.

Placing too many hens in the breeder house places limits on each hens access to proper nesting sites.

Another similarly associated factor was ease of ***access to the nest boxes*** and ease of going from the floor to the slat area. If a hen cannot see the nest boxes or they are difficult to get into she is less likely to enter. This problem can actually increase as birds age. Older birds are heavier and often have reduced mobility due to physical limitations caused by foot and leg problems. Ramps or perches on the fronts of the nests or slanted slats at the front edge of the nests have proven to be helpful. Slat height should also be kept to a minimum. It is recommended that slat height not exceed 20-22 inches from the ground to the front edge of the slat. As birds scratch in the litter below the slats, the slat height is often exceeded in houses with older flocks. Coincidently, this is also the time when birds are often less mobile.

Another area identified was ***poor nest sanitation and preparation*** prior to egg production. Dirty belts and manure buildup on nest pads tend to discourage hens from entering the nest hole. Every factor needs to be attended to in order to encourage hens to use the appropriate nest sites. From a sanitation standpoint, eggs which are laid in dirty nests will be similar to many of the floor and slat eggs. Additionally, worn nest pads tend to be uncomfortable to the hens and may discourage them from using the proper nesting sites. Birds prefer a clean and dry area to lay their eggs. Clean and comfortable nest sites will assist in enticing hens to find and continue using the nest boxes provided for them.

A fourth factor was ***poor feeding methods and equipment problems*** that caused birds to spend too much time at the feeders. Excessive time intervals between feeder run times causes birds to spend extra time on slats near the feeders waiting for feed. In adequate feeder space for the number of hens housed will also cause birds to hover around the feed lines for longer than necessary. Feed spills over the slats not only create serious pest control problems and are costly to the integrator, they cause shortages in feed and, after accumulation under the slats cause additional areas where hens will hover. Time spent eating, looking or waiting for feed is time that should be spent in or around the nest boxes. Increases in slat eggs are often related to feed or water problems. Also, male feeders running for prolonged periods of time tend to attract hens to the scratch area during the peak egg-laying times of the day. Male feeder problems are confounded when feed spills occur. When hens are excessively drawn to the scratch area at this time of day, an increase in floor eggs usually results.

Poor ventilation was also found to contribute to the incidence of floor and slat eggs especially in the newer houses, such as tunnel ventilated houses. When air movement within the house is

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insufficient, birds have a tendency to migrate to a more comfortable area of the house. One additional problem identified was ***late transfer of pullets*** to the breeder house. Some producers feel that maintaining pullets in the pullet house several extra days will improve bird fleshing and conformation. This has been a somewhat recent trend within certain areas of the poultry industry. Producers believe they can hold birds in the pullet house longer in order to improve uniformity of sexual maturity within the flock. Although in many cases their desired results have been achieved, there have been several side effects of this practice. Obviously, the pullets have a shorter period of time in the hen house before egg production begins. This practice decreases the time available for training the flock and increases the likelihood that some hens will choose alternative nest sites as they come into production in their new and unfamiliar environment.

Summary and Conclusion. If floor and slat eggs are a problem, evaluate your management practices and housing conditions as soon as the problem is detected. The longer the problem persists, the more difficult it is to correct. Remember, birds are creatures of habit and habits are difficult to break. Observe your birds to try and determine the cause of them not choosing the provided nesting sites. Record and tabulate what time of day most of the floor or slat eggs are laid. What percent of the eggs are laid at first lighting, after feeding, late in the afternoon, etc. Keep a record of where they are found. What percent of the eggs are found against the walls, next to the slats, near the fans, on the slats and next to the feeders, etc. Managing to prevent a problem is always preferred. However, if a problem does exist, diagnosing where and when the problem is occurring will greatly increase the likelihood of correction.

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days, but can hatch 4 to 21 days after laying, depending on the temperature. The time within each of the 5 nymph stages depends upon the temperature of the hiding places and how soon nymphs are able to obtain a blood meal. Nymphs molt to the next stage only after completion of a blood meal. In poultry facilities nymphs generally obtain blood meals rapidly so the time within a given nymph stage is usually dependent upon the temperature of the hiding places. At 80°F, the interval between nymph stages is about 4 days. Thus, the entire life cycle from egg to adult requires about 30 days. Adult Bed Bugs feed at intervals of about 3 to 7 days depending upon the temperature. At 80° F, adult Bed Bugs may live up to 4 months. Adults may live even longer than 4 months at lower temperatures. Both nymphs and adults can survive several months **without a blood meal**. Thus, a Bed Bug infestation in a breeder house can easily survive through the down time between flocks.

Distribution. Bed Bugs may be introduced into poultry facilities as eggs, nymphs or adults attached to boxes, clothing, cages, slats, manure removal equipment or other equipment brought from infested poultry facilities. Bed Bugs can infest houses as 20-22 week old hens and/or roosters are initially placed on the farms to start the broiler egg production cycle or later as replacement roosters are placed on the farms. **Only one impregnated female Bed Bug can produce a well-developed infestation within a few months!!**

Control. **Successful control of Bed Bug infestations can not be attained without measures to prevent their introduction into poultry facilities. Control when the birds are present. -** At night when hens are not laying, spraying the inside of nest boxes at night is recommended. Nest boxes should be sprayed as early as possible in the evening to allow time for them to dry before morning. The slats and equipment should be sprayed with as high a pressure as possible. **Control when birds are not present:**When all birds have been removed from the facility a high-pressure (175-200 psi) spray should be used to penetrate the cracks, crevices, and hiding places of the Bed Bug. The spray should be directed at such places, particularly around the slats and nesting boxes. **Thorough cleaning and spraying of the house with the chemicals described below is necessary to eliminate the infestation. Slats, roosts, nests boxes and other equipment should be thoroughly cleaned and sprayed with chemical before introducing a new flock to prevent reinfestation**.

Insecticide Recommendations. When birds are present. Seven (carbaryl) 5% dust or 0.5% spray, **Malathion** 4 or 5% dust or 0.5% spray, **Rabon** 0.5% spray, **Permethrin** 5.7, 10, 11 or 40% spray (depending on the manufacture and formulation), and **Ravap** EC. can be used to reduce the bed bug population. The registration/label should be followed for each of these insecticides to determine application rates, determine restrictions of applications prior to bird slaughter, contamination of feed and water. Treatment of the facilities is least disturbing to the birds if hand application equipment is used (2-4 gallon hand-pump sprayers or small engine back-pack sprayers or dusters). **When no birds are in the facility.** The same insecticides described above can be used, but may be applied more effectively with high-pressure equipment. In addition to the insecticides listed above, **Tempo** can be applied when no birds are in the facility

Humans spreading Bed Bugs. Care must be taken by all humans that are involved with the poultry production system to prevent the spread of Bed Bugs from infested facilities. Bed Bugs can be easily transferred from one farm facility to another by becoming attached to the shoes, clothes, boxes or equipment. If precautions are not taken, pullet farms can supply both 22-week-old hens and infestations of Bed Bugs to breeder farms. In fact, Bed Bug infestations can spread in similar fashion to northern fowl mite infestations. In addition, Bed Bugs can infest human dwellings if precautions are not taken.

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