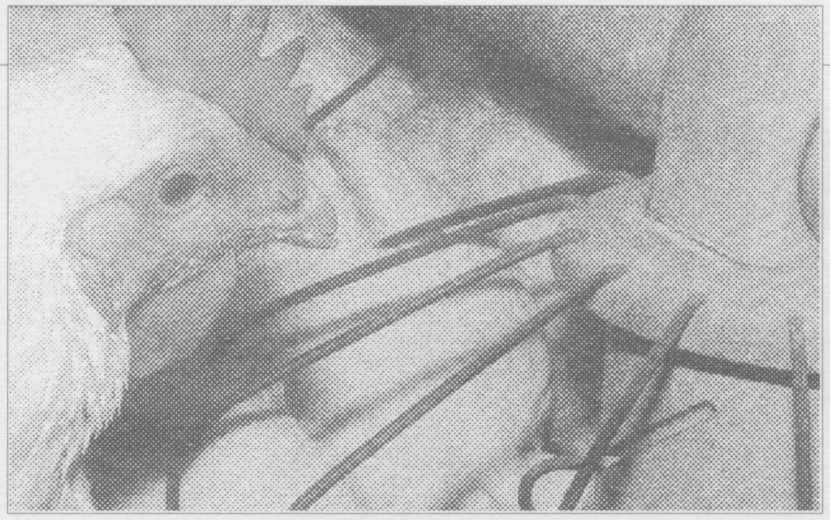

# Research Update 1992

# Poultry

## Evaluation of Spreader Distribution Patterns for Poultry Litter

After poultry litter is spread on pasture land, light green streaks often are noticed in the grass, indicating an uneven nutrient distribution across the field. An Alabama Agricultural Experiment Station study indicates this unevenness is caused by nonuniform distribution across the spreader swath rather than inconsistent nutrient contents in the litter.

For the study, a pull-type spreader distributing poultry litter was driven over the center of a set of evenly spaced collection pans. Samples from each pan were weighed and sieved into different particle size fractions to determine the distribution of particle sizes across the swath. The sieve fractions from each pan were analyzed to determine nitrogen (N) and carbon (C) concentrations for each pan sample. Poultry litter samples also were collected on a tarp spread across the swath, and these samples were used to determine N and C concentrations for each sieve fraction.

Particle size distribution data from the samples collected from the pans showed that the smaller-size material landed closer to the center of the swath. Laboratory analysis of the different particle size fractions showed a consistent increase in C concentration with increased particle size, from an average of 26 percent for the smallest size fraction to 43 percent for the largest. The N concentration varied randomly from 3.2 percent to 4.3 percent for the different size fractions, however, giving no indication of higher manure concentrations for the smaller size particles. Accordingly, the average N concentration in the pans spaced across the swath was relatively constant.

The weight of litter collected in the pans was used to calculate application rates and to determine distribution uniformity for different travel spacings (swath widths) with the spreader. Uniformity was best at a swath width of 28 feet, and decreased as the swath width increased to 40 feet. The application rate at a 28-foot spacing was 1.39 tons per acre.

The operator's manual for the spreader recommended a 40-foot swath width and indicated an application rate of 1.3 tons per acre for the spreader gate setting and bulk density of litter used in this test. At a 40-foot spacing, the application uniformity in this test was very poor and the application rate was less than 1 ton per acre. These results suggest that travel spacings used when spreading poultry litter may need to be lower than the manufacturer's recommendation.

J.H. Wilhoit, C.W. Wood, and K.H.Yoo

## Ensiling Johnsongrass with Broiler Litter Shows Potential as an Alternative Feedstuff

With approximately 2 million tons of broiler litter being produced each year in Alabama alone, creative uses of this resource are constantly being sought. An Alabama Agricultural Experiment Station study has shown that broiler litter can be ensiled with johnsongrass, turning two potentially troublesome resources into palatable, good quality feed for livestock.

For the study, johnsongrass/broiler litter silage and a corn/broiler litter silage were used. Johnsongrass was harvested in early June at 65 percent moisture and ensiled with 10 or 20 percent added broiler litter. Corn was harvested in late July and ensiled with broiler litter added at 10 or 20%. In mid-September, the silages were fed to growing lambs.

The addition of broiler litter increased the crude protein content and the mineral content in the four silages. All four silages were readily consumed when offered to the lambs. Johnsongrass silage was not equivalent to

**continued on page 2**

**Alabama Agricultural Experiment Station Auburn University**
**Lowell T. Frobish, Director Auburn University, Alabama**

# Pre-Slaughter Stunning Current Affects Carcass Quality of Broilers

Downgrading of broiler carcasses due to trims, broken bones, bruises, and hemorrhages causes tremendous economic loss to the broiler industry in the United States. Carcass quality of broilers can be optimized by defining and monitoring critical stages in live-production and processing phases. However, little information is available on the effects of various rates of pre-slaughter electrical stunning currents on carcass quality attributes of broilers and possible interactions due to strain-cross (SC) differences.

In a recent Alabama Agricultural Experiment Station study, 50-day-old male broilers from two SCs (6 replicate pens per SC; 30 broilers per pen) were individually stunned in a brine-bath stunner using a rectangular wave DC current (50 percent duty cycle, 100-Hertz frequency). Stunning current levels consisted of 25, 45, and 70 milliamperes (mA) per broiler. Following standard processing procedures, all carcasses were chilled and individually evaluated for the incidence of broken bones and hemorrhages.

Carcass quality attributes did not differ significantly between the SC used. However, a significant interaction was observed between SC and stunning current level for hemorrhages on wings. Incidence of broken clavicles (wishbones) more than doubled with each increase in stunning current. In contrast, broken wings increased linearly and hock bruises decreased linearly as current increased. Other carcass defects frequently attributed to stunning, such as engorged wing veins, red tail, or red feather tracts, were not affected by the current levels used in this study.

These results suggest that SCs used and quality characteristics of the end products should be considered when selecting pre-slaughter stunning current. Results further indicate that operating conditions of stunners at commercial processing plants (electrical current type, level, duration, and conductivity of the brine solutions) should be determined and closely monitored for optimum processing efficiency and product quality.

S.F. Bilgili

# Male Broiler Breeders Part of *Salmonella* Puzzle

Although proper food handling remains the best means for preventing foodborne disease, there are other opportunities during the live production of food animals for improving the safety of food products derived from these animals. Thus, research identifying points of entry of Salmonella during the live production phase has recently intensified.

Previous research has found that at the time of hatch, broiler chicks may be infected with salmonellae, indicating that live production management practices are crucial for the control of *Salmonella*. Hens have been indentified as a potential harborage of *Salmonella*. However, it is also important to evaluate the role of the male in *Salmonella* spread because, in commercial settings, one male can breed a large number of females. This was investigated in a recent Alabama Agricultural Experiment Station study.

Hens were artificially inseminated

**continued on page 3**

# Composting, Fermentation Show Promise for Dead Poultry Disposal

Every broiler production facility is faced with the reality of disposing of dead birds. Due to increasing burial or incineration costs and concern for forthcoming environmental issues and regulations, alternative methods of disposal are needed.

Composting poultry carcasses is one environmentally safe disposal method that can be utilized. During composting, organic wastes are decomposed by naturally occurring organisms into a product that can be used as a fertilizer.

Results of Alabama Agricultural Experiment Station (AAES) studies indicate that coliform bacteria and enteric pathogens, such as *Salmonella*, are inactivated by heat generated during a typical two-stage composting cycle. These results suggest that composting is a viable, environmentally sound, and safe way to dispose of dead poultry.

Another use for dead poultry is to render the carcasses into a valuable protein meal. However, the spread of avian and human disease while transporting dead birds to a rendering facility is a concern. Fermentation, a natural process that allows anaerobic microorganisms to reduce and stabilize organic materials, is an option for stabilized, pathogen-free storage of carcasses.

Preliminary AAES research on this subject indicates that long-term fermentation of poultry carcasses (5-10 weeks or more) is possible and that pathogenic microorganisms, such as *Salmonella*, are inactivated during the process. Such laboratory findings suggest that fermentation holds promise as an alternative method for the biosecure on-farm storage of poultry carcasses in the future.

J.P. Blake, D.E. Conner, and J.O. Donald

**Johnsongrass, continued**

corn silage; however, johnsongrass still produced acceptable digestibilities and was palatable.

The johnsongrass silages were adequate in crude protein content for all types of cattle, though energy contents were low. However, johnsongrass silages would be nutritionally adequate as a feed for brood cows early in their pregnancies.

B.J. Rude and D.L. Rankins, Jr.

**_Salmonella_ Puzzle, continued**

with 0.05 ml of test semen and, during a 14-day period, eggs were collected and sampled for salmonellae. At the end of 14 days the ovary and oviduct were sampled for the test strains of *Salmonella*.

Results showed that the ovaries and all parts of the oviduct can be infected via semen, and that the pathogen can persist in the hen's reproductive tract for up to 14 days. Of the eggs sampled, only shell samples tested positive for *Salmonella* contamination, suggesting no transovarian transmission occurred since no internal components were infected. However, surface contamination of these eggs may contribute to the spread of salmonellae in the hatchery.

Based on these data, it appears that the male may play a role in contaminating the reproductive tract of the hen, thus continuing the cycle of *Salmonella* transmission. However, the hens in this study did not consistently produce infected eggs, illustrating the complex nature of *Salmonella* spread and control in live poultry.

Nevertheless, male birds and related breeding activity are critical points at which intervention may be effective for controlling *Salmonella* contamination of final food products. Thus, any additional reduction in *Salmonella* numbers at the breeder and hatchery levels that results from use of *Salmonella*-free breeders, additional sanitation, egg disinfection, etc., would likely help improve the microbiological safety and quality of poultry products at the retail level.

M.A. Reiber and D.E. Conner

# Vitamin C Improved Egg Shell Quality in Old Layers

The use of vitamin C (ascorbic acid) in chicken rations has been controversial because chickens can produce vitamin C in the body and it is assumed that they do not need an external supply. However, recent studies have shown that supplementation of vitamin C in chicken rations or drinking water improves the overall performance of chickens, especially during heat stress.

In laying hens, the ability to absorb intestinal calcium needed for egg shell formation is reduced as hens age. A recent Alabama Agricultural Experiment Station study was conducted to determine if vitamin C would improve egg shell quality in old layers. Results of the study indicate that feeding vitamin C to hens at 2,000 parts per million (ppm) increased blood calcium, resulting in increased egg weights of up to 5 percent and improved egg specific gravity.

The study involved two experiments. In the first experiment, 100 96-week-old white leghorn (Hyline W36) hens were randomly divided into five groups (five hens per group) and each group was provided rations containing one of four levels of vitamin C (1, 1,000, 2,000, and 3,000 ppm). In the second experiment, 384 hens (96-week-old, Hyline W36) were divided into four groups of 24 hens and provided a ration containing vitamin C at the same levels used in experiment 1. Hens in both experiments were fed the vitamin C diets for 4 weeks. Egg weight and specific gravity were measured weekly and, at the end of the experimental period, blood was collected from hens and analyzed for total and ionic calcium concentration.

Results demonstrate that feeding vitamin C at 2,000 and 3,000 ppm resulted in increased egg weight and egg specific gravity. The improvement in these factors might be related to vitamin C-mediated influence on calcium absorption. Blood calcium was higher in hens that were fed 2,000 and 3,000 ppm of vitamin C. These findings imply that vitamin C enhances calcium absorption in old layers, thus making more calcium available for deposit on the egg shell.

If vitamin C would improve egg shell quality in old layers under normal conditions, as was the case in these experiments, it is likely that it will be even more beneficial during hot weather. These results indicate that producers having egg shell quality problems should consider supplementing layer rations with vitamin C.

J.I. Orban and D.A. Roland, Sr.

# Fumonisins May Be Toxic to Broiler Chickens

Fumonisins are a recently discovered group of mycotoxins produced by *Fusarium moniliforme* and *F. proliferatum* fungi that are widely distributed saprophytes on corn and sorghum.

It is possible that fumonisins are a common contaminant of poultry feed that could be affecting southeastern flocks, particularly when locally-grown feed is used. A preliminary Alabama Agricultural Experiment Station study sought to evaluate the potential impact of this fungi on poultry.

For the study, day-old commercial broilers were fed rations containing 0, 22, or 112 parts per million (ppm) (F) B1 fumonisin (produced by *F. moniliforme* on corn) in a standard Auburn University corn-soybean broiler starter ration. Treatment groups, each involving 10 birds, were fed the rations for 3 consecutive weeks. Body weights and feed consumption were measured weekly for each treatment. The birds were killed at 3 weeks of age and examined for gross lesions.

Within 3 days of consumption of 22 or 112 ppm fumonisin, broiler chicks developed a watery diarrhea that persisted throughout the feeding trial. After 2 weeks of toxin consumption, birds in the 22 and 112 ppm groups produced a bright orange pigmented diarrhea. However, the birds showed no other signs of morbidity and mortality usually associated with mycotoxin consumption throughout the study.

The 3-week body weights and feed consumption of birds fed fumonisin

**continued on page 4**

# Delaying Photostimulation May Result in Larger Eggs, Higher Productivity

Normally, broiler breeder replacements are photostimulated at 20 weeks of age. However, genetic changes in conformation and growth rate have resulted in a need to reevaluate the timing of photostimulation because, as growth rate has increased, feed efficiency, conformation, reproduction, and early egg size apparently have declined.

Alabama Agricultural Experiment Station experiments were conducted to assess the optimum time to photostimulate males and females into reproduction.

A standard lighting program of 8 hours light, 16 hours dark was used to rear 1,200 female and 120 male birds. Males were stimulated at either 19, 20, 21, or 22 weeks of age, and male response at all ages of stimulation was similar. Onset of semen production was slightly earlier in the 19- and 20-week males, however volume and semen concentration was similar.

Performance of females stimulated at 19 and 20 weeks was inferior to those stimulated at 21 and 22 weeks. Although onset of egg production was earlier in the 19- and 20-week groups, egg size was smaller and peak production was poorer than in the 21- and 22-week groups.

These results indicate that delaying photostimulation until 21 or 22 weeks for females would result in larger eggs and higher peak production.

G.R. McDaniel

# New Diagnostic Assay System Using Microbeads Developed

An immunoassay based on a latex particle agglutination slide test has been developed through the Alabama Agricultural Experiment Station for the assay of three avian antisera against New disease virus (NDV), infectious bursal disease virus (IBDV), and infectious bronchitis virus (IBV).

The latex-based diagnostic test generally requires only slides and a drop or two of reagents. The test could be done in 2-5 minutes and does not require professional laboratory skills to complete. The cost is about 5 cents per test. The virus-microbead complex can be stored for 10-12 months at 40°F.

The method compared well with commercial enzyme-linked immunosorbent assay (ELISA) and hemagglutination inhibition. The latex slide immuno-agglutination tests had sensitivities of 97.1 percent to NDV, 98 percent for IBD, and 76.1 IBV. Specificity relative to the commercial ELISA test was 98 percent for NDV, 80 percent for IBD, and 89 percent for IBV.

Because of the sensitivity, specificity, and reasonable cost of this test, the system has the potential of replacing more expensive currently used tests. Additional avian viruses are being tested for use in this diagnostic assay system using microbeads.

E.C. Mora

**Fumonisin, continued**

rations were lower than birds that did not receive toxin. Likewise, the 3-week feed conversion of birds fed either level of fumonisin was poorer than for the birds fed toxin-free feed.

This experiment was the first to show that low levels of fumonisin may cause enteritis and diarrhea in broiler chickens. Weight gains and feed conversion also were adversely affected by toxin consumption at this low level. This indicates that a potential problem does exist and appropriate procedures can now be implemented to test for and remove this mycotoxin from the diets of southeastern poultry flocks.

J.J. Giambrone, R.A. Shelby, K.L. Bowen, and F.J. Hoerr

# Broiler Breeder Males Can Be Given Feed Based on Corn

Male chickens are known to have low protein needs once sexual maturity has been attained. The essential amino acids provided by this protein are expected to correspond to the requirements determined for adult Leghorn males. A feed based entirely on corn appears very favorable for satisfying maintenance requirements if supplemented with methionine, vitamins, and minerals.

Experimentation was conducted through the Alabama Agricultural Experiment Staion (AAES) to compare the industry's standard 12 percent protein feed to a feed using corn as the sole source of protein. Breeder males of a commercial strain were given these two feed treatments from 22 to 68 weeks of age. Body weight and semen production was measured periodically. Feed intake was restricted to 325 kcal per bird per day to avoid excessive body weight gain.

The corn-based feed excessively restricted body weight gain of birds during the first 4 weeks, causing semen production to suffer. Once males were in semen production, performance was equivalent to birds given the standard feed.

Submarginal performance through the beginning of the breeder period occurred because corn did not provide sufficient balanced protein for reasonable growth. Further studies on utilization of protein in corn substantiated that lysine could be supplemented to relieve this submarginal performance. Approximately 0.45 percent added lysine in the feed at 22 weeks, which progressively decreases to zero between 30 and 35 weeks of age, overcame this early problem in AAES research.

E.T. Moran and W.H. Revington

# Lighting Programs for Broilers

Chickens used for production of meat are genetically selected for rapid growth and heavy body weight. These birds commonly develop problems with their circulatory and skeletal systems, and may have excessive abdominal fat. Manipulation of the lighting program by reducing the total hours of light or applying intermittent schedules has been reported to alleviate the incidence or severity of circulatory and leg disorders with slight or no loss of body weight at marketing.

An Alabama Agricultural Experiment Station (AAES) study was conducted to compare the effectiveness of restricted light or increasing light with near-continuous light for male broilers. The four light treatments are shown in table 1. Standard management procedures were followed and daily mortality, weekly body weight, and cumulative feed efficiency measurements were taken. The birds were processed at 49 days of age.

The incidence of general leg problems and tibial dyschondroplasia were recorded, and carcasses were scored for quality (bruises, scratches, tears, blisters, broken bones). Prechilled and chilled carcasses, abdominal leaf fat, wings, drumsticks, thighs, tenders, and fillets were weighed.

The 16-hour, 14-hour, and increasing light treatments resulted in lower mortality than the 23-hour light treatment (3.0, 3.5, and 3.5 versus 9.0 percent, respectively). Body weight at 48 days was not different among the 23-hour, 16-hour, 14-hour, and increasing light treatments (6.45, 6.42, 6.28, and 6.36 pounds, respectively).

Weights of the carcass and parts are shown in table 2. Weights of the breast meat (tenders and fillets) was greater in the 23-hour group than in the other treatments. Feed efficiency and incidence of leg problems were not different among the light treatments in this study.

The broiler industry can make economic decisions concerning the possible loss of yield versus the improved livability. The lighting program of 16 hours light:8 hours dark used in the AAES study was as efficacious as an increasing light program for improving bird livability and was easier to use.

J.A. Renden, S.F. Bilgili, and S.A. Kincaid

Table 1. Experimental Lighting Programs

| Age, days | Photoperiod, h light:h dark | | | |
|---|---|---|---|---|
| | 23h | 16h | 14h | Increasing |
| 0 | 23L:1D | 16L:8D | 14L:10D | 23L:1D |
| 4 | 23L:1D | 16L:8D | 14L:10D | 6L:18D |
| 14 | 23L:1D | 16L:8D | 14L:10D | 10L:14D |
| 21 | 23L:1D | 16L:8D | 14L:10D | 14L:10D |
| 28 | 23L:1D | 16L:8D | 14L:10D | 18L:6D |
| 35 | 23L:1D | 16L:8D | 14L:10D | 23L:1D |
| 49 | 23L:1D | 16L:8D | 14L:10D | 23L:1D |

Table 2. Carcass and Component Weights of 49-Day-Old Broilers Subjected to Four Lighting Programs

| Variable | Light treatment | | | |
|---|---|---|---|---|
| | 23h | 16h | 14h | Increasing |
| Prechilled carcass, lb. | 4.37 | 4.38 | 4.30 | 4 .29 |
| Chilled carcass, lb. | 4.40 | 4.40 | 4.33 | 4.34 |
| Abdominal leaf fat, lb. | .14 | .14 | .15 | .15 |
| Lean carcass[1], lb. | 4.26 | 4.26 | 4.17 | 4.16 |
| Wings, lb. | .52 | .52 | .51 | .50 |
| Drumsticks, lb. | .62 | .63 | .63 | .62 |
| Thighs, lb. | .76 | .77 | .76 | .75 |
| Tenders, lb. | .20 | .19 | .18 | .19 |
| Fillet, lb. | .86 | .80 | .79 | .80 |

[1]Lean carcass = chilled carcass - abdominal leaf fat.

# Feeding and Lighting Programs Influence Early Egg Production of Broiler Breeders

Broiler breeders are often reared under restricted feeding regimes and short daylength lighting programs. At the end of the rearing period, reproduction is stimulated by photostimulation (PS) with long daylengths, causing birds to begin producing adequately sized eggs at about 26 weeks of age.

Since feed restriction inhibits maturation, it may delay the onset of lay, which can contribute to increased rearing costs. Feed restriction also can reduce egg size, which is especially undesirable in young breeders that typically produce small eggs.

Rearing costs may be reduced by stimulating lay at an earlier age. However, rearing period feeding programs would need modification to allow for earlier maturation and to compensate for the reduced egg size of younger birds. A recent Alabama Agricultural Experiment Station study investigated the possibility of stimulating earlier production of adequately sized eggs by allowing greater body weights during rearing and by initiating PS at earlier ages.

Female breeders were provided different amounts of feed during rearing and PS at different ages. Prior to PS, the birds were provided short daylengths and either heavy feeding (free choice), medium feeding (to result in projected weight of 6.2 pounds), or light feeding (projected weight of 5.3 pounds) at 20 weeks. Pullets from each feeding treatment were subjected to PS by long daylengths from 14, 17, or 20, through 64 weeks.

All treatments were provided the same feeding program following PS. A breeder diet was provided daily at levels of 22, 24, 26.5, and 30 pounds per 100 birds during weeks 1, 2, 3, and 4 after PS, and 33, 32, and 31 pounds per 100 birds during the 10-, 9-, and 9-week periods, respectively. During the remainder of the study, 30 pounds of feed per 100 birds was provided daily.

Heavy pullets weighed 6.6, 7.4, and 8.3 pounds when subjected to PS at 14, 17, or 20 weeks, respectively. Age at first egg was earlier in hens subjected to PS at both 14 and 17 weeks. But, since peak production was greater in hens subjected to PS at 17 and 20 weeks, total production was not affected by age at PS. Although heavy hens began laying earlier, total production by medium and light hens was greater than that of heavy hens.

Average egg weights were greatest in the medium, light, and PS at 20 weeks of age treatments. Similarly,

**continued on page 6**

# Variation in Response of Late- and Early-Maturing Pullets to Phosphorus Deficiency

Do early- and late-maturing pullets in a flock respond differently to varying levels of dietary phosphorus? An Alabama Agricultural Experiment Station study was conducted to answer this question.

The study examined the use of normal (0.7 percent, total) and low (0.4 percent, total) dietary phosphorus levels. In the study, the available phosphorus levels in normal and low diets were 0.18 and 0.48 percent, respectively. Six hundred Hyline W36 pullets, (18 weeks of age) were equally divided between normal and low phosphorus diets. Within each phosphorus group, the early-mature (EM), normal-mature (NM), and late-mature (LM) pullets were identified based on comb size and color and egg production records. Pullets that began laying on or before 19 weeks of age were considered EM, and the last 30 pullets to begin laying eggs were considered LM. NM pullets were excluded from the study.

As expected, pullets fed diets containing normal phosphorus performed better than the pullets on the low phosphorus diets. LM pullets on the low phosphorus diets had lower bone status than the EM pullets. However, the LM birds on the low diet also had lower plasma phosphorus concentrations, higher plasma ionic calcium concentrations, increased kidney tissue lesions, higher incidence of blocked ureters and weak bones, and higher mortality rates than the EM pullets. In addition, calcium depletion from the body increased in EM and LM pullets as dietary phosphorus level was lowered.

Because phosphorus is essential for bone growth, late-maturing pullets may fail to develop adequate medullary bone if pre-lay or early layer diets contain inadequate phosphorus. Lack of adequate medullary bone growth, which is a critical calcium reserve for eggshell, will decrease performance of these pullets and eventually lead to osteopenia (weak bones) and death.

EM and LM pullets exist in every flock, however, the proportion of these pullets may vary from flock to flock. Because EM and LM pullets respond differently to marginal and low dietary phosphorus, flock uniformity should be considered when setting dietary phosphorus specifications. If the flock in question is less uniform, then a higher margin of safety for dietary phosphorus may be necessary.

S.K. Rao and D.A. Roland, Sr.

*EDITOR'S NOTE*

*Mention of company or trade names does not indicate endorsement by the Alabama Agricultural Experiment Station or Auburn University of one brand over another. Any mention of nonlabel uses or applications in excess of labeled rates of pesticides or other chemicals does not constitute a recommendation. Such use in research is simply part of the scientific investigation necessary to fully evaluate materials and treatments.*

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**Early Egg Production, continued**

more eggs weighing greater than 21 ounces per dozen were produced by pullets subjected to rearing period feed restriction and PS at 20 weeks. Weekly egg weights increased similarly in all treatments from an average of about 19 ounces per dozen at 25 weeks to 25 ounces per dozen at 39 weeks. Egg weights were influenced principally by age and there were only slight differences among treatments at the same age. So, differences in average egg weights and the production of eggs of adequate size were due to the greater percentage of total eggs laid by hens of the heavy and 14-week PS treatments early in the laying period.

Based on these results, it appears that it may not be practical to stimulate early egg production by breeder hens since egg size is principally influenced by age and does not respond to increased body weights at the end of the rearing period.

R.J. Lien and G.R. McDaniel

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