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136 Male broiler breeder management: Paradigm and paradox. J. T. Brake*¹ and H. Romero-Sanchez², ¹North Carolina State University, Department of Poultry Science, Raleigh, ²University of Antioquia, Medellin, Colombia.

Two of the paradigms of male broiler breeder management have been that fertility would be improved by using a low density separate male diet during the laying period and by the use of light control during rearing. Practical data from 29 commercial flocks that completed 60-wk production cycles during 2005 to 2007 in Brazil, Colombia, and Peru were collected to evaluate these paradigms. Each flock contained an average of 28,000 females. Data regarding feed consumption, BW, fertility, and hatchability were collected from each flock. The flocks were grouped according to open house or brown-out house rearing for an initial ANOVA and then grouped according to the use of a male diet or female diet for the males during the production period for a second ANOVA. The commercial data revealed that managers who fed males a female laying diet rather than a low-density male diet during the production period also fed more feed throughout life, which produced slightly greater male BW as well as better fertility. The commercial data also revealed that males that had been grown in open houses exhibited better fertility than males that were grown in low light intensity "brown-out" houses. The data revealed that males grown in open houses achieved the same BW as males grown in "brown-out" houses but consumed more feed in so doing, probably because of greater physical activity in the open houses. Therefore, in spite of practical paradigms to the contrary, it was the simple presence of less than adequate nutrition of the male broiler breeder that was associated with fertility problems in the commercial flocks that were examined. This was consistent with published controlled experimental data that the strict control of BW alone was not necessarily associated with optimum fertility and hatchability.

Key Words: broiler breeder males, fertility, body weight

137 Infrared beak treatment: An alternative to conventional beak trimming. R. L. Dennis*^{1,2}, A. G. Fahey^{1,2}, and H. W. Cheng², ¹Purdue University, Department of Animal Sciences, West Lafayette, IN, ²Livestock Behavior Research Unit, USDA-ARS, West Lafayette, IN.

Infrared lasers have been widely used in human medicine and its results are reliable, predictable and reproducible. Infrared lasers have recently been designed with the expressed purpose of providing a less painful, more precise beak treatment compared with conventional beak trimming. This study was designed to examine the potential of infrared (IR) beak treatment to provide a welfare friendly alternative to the conventional hot blade (HB) method in chickens. The birds were beak trimmed by IR at the hatchery or HB at day 7 at a commercial production setting, in accordance with standard procedure. The beak trimming and associated physiological characteristics including production and aggressive

behavior were analyzed in the birds at 30 weeks of age. There was no difference in egg production ($P > 0.05$) or bird body weight ($P > 0.05$) between the 2 beak trim treatments. Birds also exhibited no difference in additional stress physiology measures such as fluctuating asymmetry ($P > 0.05$) and heterophil and lymphocyte profiles ($P > 0.05$). Surprisingly, IR birds showed superior feather condition ($P < 0.05$) and reduced aggressiveness ($P < 0.05$) under high light intensity, even though less of the beak tip was removed. Infrared trimming may even further reduce the damage done by aggressive and feather pecking without the painful procedure of the HB method. Indeed, IR trimming may provide a more welfare friendly alternative to conventional beak trimming without compromising productivity.

Key Words: beak trim, infrared, egg production

138 The effects of feeding broiler breeders on different crude protein levels. D. E. Yoho*, J. R. Moyle, R. S. Harper, and R. K. Bramwell, University of Arkansas, Fayetteville.

Managing the modern broiler breeder for optimum production is a constant challenge for the commercial integrator. Feed management is one of many critical factors that affect desired results. In the past, crude protein levels in broiler breeder diets have been manipulated with mixed results. There is some evidence that lower protein can improve egg production in addition to lowering feed cost. The objective of the current study was to feed a control diet (15.5% CP; T1) and 2 lower protein diets (14.5 and 13.5% CP; T2 and T3, respectively) at onset of egg production and measure reproductive parameters such as: hen body weight, egg production, egg weight, egg shape, eggshell thickness, fertility, hatchability and hatch of fertile.

Five hundred female and one hundred male commercial strain broiler breeders were raised separately from 8 weeks to 21 weeks of age. All birds receive the same diet and were fed according to industry standards in order to maintain acceptable body confirmation. At 21 weeks of age, hens were randomly sorted into the 3 treatment groups each represented by 6 replicate groups. Twenty-five females and 3 males were randomly placed in each of the 16 treatment pens. Hens were fed an identical ration until egg production reached 5% for an entire treatment group, at which time the treatment group was placed on T1, T2, or T3 CP diet and fed daily amounts to meet industry requirements for age. Results indicate that age at first egg for T2 and T3 was 24 weeks 2 days and 24 weeks 6 days for the control group. All groups peaked in the same week at 81.1, 81.4, and 78.4%, respectively. There was no significant difference in egg weights or number of eggs per hen housed through 35 weeks of age. Therefore, through 35 weeks of age, these results indicate that lowering dietary crude protein did not negatively affect egg production.

Key Words: broiler breeder, egg production, crude protein

139 Production performance of broiler breeder hens raised on various growth curves. J. R. Moyle*, D. E. Yoho, R. S. Harper, and R. K. Bramwell, *University of Arkansas, Fayetteville.*

With the continual development in genetics of broiler breeder, new lines that are generated need to be tested to evaluate their reproductive capabilities. This study was undertaken to determine the best growth curve to use in rearing a new Cobb line of broiler breeders. At one day of age, 3,375 Cobb pullets were randomly placed into 1 of 3 treatments, and 1,125 Cobb 500 pullets were placed for a comparison of performance and acted as a control. In treatment 1 and 3, pullets were reared to achieve target weights of 18 or 9% less than the recommended weight at 21 weeks of age, respectively. Treatment 2 and the control group were reared to meet the standard growth curve recommended for the control 500 breed strain. Production parameters analyzed were hen body weight, egg weight, egg production per hen housed, and mortality through 61 weeks of age. All data were analyzed using JMP statistical software comparing the means from each set of observations, with significant differences determined at the $P < 0.05$ level. Results found that hens from treatments 1, 2 and 3 produced significantly less eggs per hen housed (149.9, 143.2, and 142.1, respectively) as compared to 158.2 eggs per hen housed for the Cobb 500 strain. Among the different growth curves, treatment 1 produced significantly more eggs than the other 2 treatments. Results for mortality showed no significant difference between any of the treatments. The results indicate that a reduction in the 21-week target weight resulted in increased egg production without affecting mortality.

Key Words: broiler breeders, pullet growth curves, egg production

140 Effect of maternal feed management and maternal efficiency on chick quality, residual yolk utilization, and early growth of broiler chicks. A. Naeima*¹, M. J. Zuidhof², L. F. Romero¹, R. A. Renema¹, and F. E. Robinson¹, ¹*University of Alberta, Edmonton, AB, Canada*, ²*Alberta Agriculture and Food, Edmonton, AB, Canada.*

A total of 894 broiler chicks from 3 maternal BW profiles and 3 maternal feed energy categories were examined to assess yolk utilization and chick quality. The maternal treatments were as follow: 3 BW target profiles, Standard (Std), High (Std X 1.1), and Low (Std × 0.9). Hens were sorted in to 3 maternal efficiency groups (High = HE, Medium = ME, and Low = LE).

Specific gravity, yolk weight, albumen height, albumen weight, eggshell thickness, and eggshell weight were assessed on eggs from 58-wk-old hens. Chick traits included chick reflex, navel condition, hock color, chick length, shank length, and abdomen score by manual palpation. One quarter of chicks at each of 0, 1, 3, and 6 d were weighed and dissected to assess growth rate and yolk absorption.

The HE hens produced eggs with lower yolk% ($P < 0.0001$), shell% ($P < 0.0034$), and specific gravity ($P < 0.0012$) but higher albumen% ($P < 0.0001$). BW profiles did not affect these characteristics. Maternal efficiency affected egg weight ($P < 0.005$), egg weight at transfer ($P < 0.0266$), and chick length ($P < 0.0184$) where HE hens produced heaviest eggs, heaviest chick at 0 d, and their offspring had longer length in comparison to LE hens. Maternal BW profiles did not affect these traits.

Pooled chick quality was affected neither by maternal BW profiles nor by maternal efficiency. Maternal efficiency affected beak color ($P = 0.015$). Interaction between BW profiles and maternal efficiency affected chick reflex time ($P = 0.038$).

Maternal efficiency affected residual yolk utilization in 1 d old chicks, where chicks from HE showed greater yolk absorption compared to ME and LE hens (6.8%, 9.0%, 8.1%, respectively; $P < 0.05$).

Maternal efficiency affected egg characteristics, weight, length of 0 d chicks, and yolk absorption at d 1. Maternal BW profiles did not affect residual yolk utilization. Growth rate was not affected by any of maternal treatments.

Key Words: maternal effect, residual yolk, chick growth

141 Effect of the inclusion of phytase on low available phosphorus broiler breeder diets on fecal moisture. M. Arguelles-Ramos*¹, J. T. Brake¹, and A. B. Leytem², ¹*North Carolina State University Department of Poultry Science, Raleigh,* ²*USDA-ARS, NISRL, Kimberly, ID.*

A 21-d experiment was conducted to determine the effect of inclusion of phytase in low available phosphorus (AvP) broiler breeder diets on fecal moisture (FM) content. A total of forty-eight 30-wk-old female broiler breeders were fed a standard broiler breeder diet (2.7% Ca, 0.375% AvP). Collection of feces were performed for determination of FM content at 7 d in order to group birds as High, Average, and Low FM. From 8–21 d birds were fed with 1 of 4 treatment diets that consisted of a Negative Control (NC) with 0.25% AvP, a Positive Control (PC) with 0.50% AvP, the NC with 275 FTU/kg (1XPase), and the NC with 550 FTU/kg (2XPase). A randomized complete block design with 12 replications per treatment and 4 replications per FM group was used. Egg production, egg characteristics, fecal liquid portion (urine) produced, and change in FM were determined. There were no significant differences among treatments for egg production or egg characteristics. Nevertheless, birds fed the 1XPase and 2XPase diets produced numerically fewer eggs than the NC and PC treatments. Urine production was increased in all treatments after the change from the standard broiler breeder diet to the treatment diets (8–14 d). However, there was also an increase in average daily house temperature during this period, which could have affected urine production. After allowing 7 d for the birds to adapt to the treatment diets (15–21 d) urine production decreased in all treatments. At 14 d FM was decreased in all treatments, with the feces produced by the PC and 1XPase treatments numerically drier than the other treatments. On the other hand, the FM at 28 d was similar to that at 7 d for all treatments, with the exception of the 2XPase hens, which exhibited significantly greater FM ($P < 0.005$). These results indicated that the inclusion of excess phytase in low AvP broiler breeder diets may increase FM content.

Key Words: broiler breeders, phytase, litter moisture

142 Effect of feed space during the growing and laying periods and the rate of feed increase at the onset of lay on reproductive performance and mortality of broiler breeder females. N. Leksrisompong*, J. T. Brake, and E. Oviedo-Rondon, *North Carolina State University, Department of Poultry Science, Raleigh.*

A study was conducted to examine how feed space during the rearing period interacted with feed space during the laying period as further influenced by rate of feed increase from photostimulation to peak egg production to affect broiler breeder female reproductive performance and mortality. Sixteen pens of 75 females were provided either 4 tube

feeders (7.1 cm/female) or 6 tube feeders (10.6 cm/female) each from 1 to 21 wk of age. The circumference of each feeder pan was 42 cm. Thereafter, 7 males and 65 females were moved to each breeding pen, photostimulated, and fed separately. The females were then provided either 3 (6.1 cm/female) or 5 (10.0 cm/female) feeders per pen with slow or fast feed increase programs. As a result, a $2 \times 2 \times 2$ factorial design with 2 replicate pens per interaction cell was used. Thus, the 4 feed space combinations included a similar feed space per female during both rearing and laying at either a low (7.1–6.1 cm) or high level (10.6–10.0 cm), an increase in feed space (7.1–10.0 cm), and a decrease in feed space (10.6–6.1 cm). There were no significant differences in egg production, mortality, fertility, or hatchability due to any of the main effects. However, there were significant ($P < 0.01$) interactions of the feed space during growing and laying for egg production and mortality. Female mortality was greater for the 7.1–10.0 cm combination than for the 7.1–6.1 cm and 10.6–10.0 cm combinations while the 10.6–6.1 cm was intermediate. Hen-housed egg production was higher for the 10.6–10.0 cm combination than for the 7.1–10.0 cm and 10.6–6.1 cm combinations with the 7.1–6.1 cm combination being intermediate. Hen-day egg production was similar. It was concluded that any change in feed space at photostimulation was detrimental while consistent feeder space was beneficial, regardless of the amount of feed space allocated.

Key Words: broiler breeders, feed space, mortality

143 Hens or roosters: Which gender has a greater impact on fertility and broiler body weights as a flock ages? M. E. MacKenzie*¹, G. M. Fassenko¹, E. E. O'Dea Christopher¹, J. L. Wilson², and D. P. Froman³, ¹University of Alberta, Edmonton, AB, Canada, ²University of Georgia, Athens, ³Oregon State University, Corvallis.

Past research has focused on the breeder hen's reproductive ability as a flock ages. However, little attention has been given to the rooster. Two flocks, young (Y) and old (O) of Cobb 500 hens (H) ($n = 62$ hens/flock) were artificially inseminated (suboptimal dose of 70 million sperm per inseminate). Pooled semen from roosters (R) of the same flock ages ($n = 15$ /flock) was used. The objective of this study was to examine which gender has a greater impact on fertility, chick production and broiler performance as the parent flocks age. The parent age groups (PG) were: OH×OR (OO); OH×YR (OY); YH×OR (YO); YH×YR (YY). Hatching eggs produced by these hen/rooster combinations were collected twice and incubated when the birds were 28 and 51 wk [Trial 1 (T1)], and 37 and 60 wk [Trial 2 (T2)]. Saleable chicks were grown out for 6 wk (T1, $n = 26$ /pen × 2 pens/PG; T2, $n = 19$ /pen × 2 pens/PG). Data were analyzed using the SAS[®] Proc Mixed Model at $P \leq 0.05$; differences were separated using LSMMeans. Fertility (%) was different between the trials (T1 = 74.2^a; T2 = 67.9^b). In T1 the PG with young hens had higher percentage fertility (YY = 80.5^a; YO = 82.5^a; OY = 66.4^b; OO = 67.5^b). Trial 2 followed a similar pattern but percentage fertility in all PG was lower (YY = 79.5^a; YO = 70.0^{ab}; OY = 57.5^c; OO = 64.5^{bc}). Hatchability of fertile eggs (%) was pooled as there were no difference between the trials; there was also no difference between the PG (YY = 89.0; YO = 89.0; OY = 81.2; OO = 81.5). Early, mid, and late embryo mortality was not affected. Trial influenced 6 wk BW. In both trials YO had the lowest final BW (T1 = 2,287 g; T2 = 2,092 g), followed by the YY (T1 = 2,447 g; T2 = 2,407 g) and finally the OY (T1 = 2,488 g; T2 = 2,415 g) and OO (T1 = 2,571 g; T2 = 2,462 g) which did not differ from each other. The data from this study show that it is hen age that has the greatest impact; PG with YH had the highest fertility, but the lowest broiler BW at 6 wk. Semen from old flocks had the same fertilization

capacity as that of young flocks indicating that it is not suboptimal sperm quality that contributes to an age related decline in fertility.

Key Words: broiler breeder flock age, fertility and hatchability, broiler performance

144 The evaluation of selected disinfectants, chemicals and other agents to inactivate avian influenza virus (AIV). R. L. Alphin*, K. J. Johnson, B. S. Ladman, M. P. Lombardi, and E. R. Benson, *University of Delaware, Newark.*

Ten chemical, disinfectant and other agents at various concentrations were tested individually for effectiveness against the low pathogenic avian influenza virus (LPAIV), A/H7N2/Chick/MinhMa/04. For testing, the agents were divided into 2 groups: Group A and Group B. The Group A agents were 5% acetic acid [C₂H₄O₂], 1 and 3% citric acid [C₆H₈O₇], 750 ppm calcium hypochlorite [Ca(ClO)₂], 750 ppm sodium hypochlorite [NaOCl], powdered laundry detergent with peroxygen bleach (2, 4, and 6 g/L), and 1:300 commercial iodine/acid disinfectant. Group A agents were tested for viral inactivation efficacy on porous wood and nonporous plastic and metal surfaces. The Group B agents included 1 and 3% acetic acid, 5% sodium carbonate [Na₂CO₃], 1 and 2% sodium hydroxide [NaOH], 1% calcium hydroxide [Ca(OH)₂], and powdered laundry detergent without bleach (2 g/L, 4 g/L, and 6 g/L). The Group B disinfecting agents were tested for viral inactivation efficacy on nonporous metal surfaces only. Based on group, 12 coupons of the appropriate surfaces were coated with the virus mixture. At room temperature, all coupons were allowed to dry, then placed into 2 six-well plates and treated with an agent for 10 minutes per coupon type. The fluids from each plate were pooled into a single tube. For virus recovery, the 2 samples of each agent, per coupon type, were inoculated into eggs. Fluid from each egg found to have hemagglutination activity was considered to contain LPAIV, indicating the agent tested did not inactivate the virus. Several of these chemicals: acetic acid (1, 3, and 5%), citric acid (1 and 3%), sodium hydroxide (2%), calcium hydroxide (1%), calcium hypochlorite (750 ppm), and sodium hypochlorite (750 ppm) inactivated LPAIV on hard, nonporous surfaces. The laundry detergent with peroxygen was tested at several concentrations; however, only at a concentration of 6 g/L was inactivation of LPAIV observed on nonporous surfaces. Only citric acid and a commercial iodine/acid disinfectant were found to be effective at inactivating LPAIV on both porous and nonporous surfaces.

Key Words: disinfectant, avian influenza, inactivation

145 Consequences of long term storage conditions and the addition of organic matter on the antimicrobial activity of diluted disinfectants. K. Stringfellow*¹, P. Anderson¹, D. Caldwell¹, J. Lee¹, J. Byrd², J. McReynolds², J. Carey¹, and M. Farnell¹, ¹Texas A&M University Department of Poultry Science, College Station, ²United States Department of Agriculture Agriculture Research Service, College Station, TX.

The correct usage of disinfectants is an important component of a successful biosecurity program. The objective of this study was to determine the effect of time, temperature and organic matter on disinfectant efficacy. Quaternary ammonium, chlorohexidine, phenolic and binary

ammonium based compounds were used in this study to represent disinfectants commonly used within the poultry industry. *Staphylococcus aureus* and *Salmonella* Typhimurium were used as indicator organisms to represent Gram positive and Gram negative bacteria, which are found in commercial poultry housing. The first study evaluated the effect of temperature (4, 20, 32 or 43°C) and long term storage on the efficacy of disinfectants, diluted to working concentrations, against our indicator organisms. The second study determined the effect of organic matter (sterilized broiler litter) on disinfectant efficacy against the same indicator organisms. We observed that only the phenolic based disinfectant had reduced efficacy against *Salmonella* Typhimurium after 6 weeks of incubation at the highest temperature of 43° and after sixteen weeks at the second highest temperature of 32°C. All of the disinfectants retained potency against *Staphylococcus aureus* regardless of temperature treatment. The addition of organic matter had deleterious effects on all 4 classes of disinfectants against *Salmonella* Typhimurium. Similar reductions in disinfectant efficacy against *Staphylococcus aureus* were observed, with the exception of the phenolic compound which retained its potency. These data suggest that working concentrations of disinfectants, with the exception of phenolics, may be stored for extended periods of time under a wide range temperatures without loss of efficacy. The organic matter study further illustrates the need for surfaces to be thoroughly cleaned of organic matter prior to the application of disinfectant regardless of its classification.

Key Words: disinfectant, biosecurity, poultry

146 Effects of eggshell sanitation using ultraviolet light and hydrogen peroxide in combination on hatch parameters of broiler breeder eggs. J. Wells*, C. Coufal, H. Parker, and C. McDaniel, *Mississippi State University, Mississippi State.*

Previous research in our laboratory has shown that exterior eggshell bacteria are greatly decreased using the combination of ultraviolet light (UV) and hydrogen peroxide (H₂O₂). However, it is unknown whether this reduction in eggshell bacteria has any effect on hatch. Therefore, the objective of this experiment was to determine if eggshell bacterial reduction using UV and H₂O₂ in combination could improve the hatchability of broiler breeder eggs. Eggs from 3 commercial houses (57-wk-old broiler breeders) were collected over 2 d. A total of 1,944 eggs were transported to the laboratory, where half were treated with UV and H₂O₂ and the other half served as controls, for a total of 54 total replications with 18 eggs per replication. At time of treatment, 1 egg was randomly selected from each replication for bacterial enumeration on TSA. The remaining eggs were stored at 18.3 C up to 2 d. Prior to set, 1 egg per replication from day 1 of collection was sampled for bacterial enumeration, and the 16 remaining eggs for incubation were weighed prior to set. Eggs were incubated for 21 d using 6 incubators, 3 each for control and treated eggs. At 18 d, eggs were weighed to determine egg moisture loss during incubation. At hatch, chick weights were obtained for each replication, and meconium samples were collected from 1 chick per replication. Meconium samples were plated on TSA agar to determine the presence of intestinal bacteria. Hatch residue analysis was performed on unhatched eggs after 21 d of incubation. A 1,000-fold reduction in bacterial counts was found for treated versus control eggshells. At hatch, no statistically significant differences in chick weight, egg moisture loss, positive meconium samples, or hatchability were observed between treatments. However, numerically, hatch of set and hatch of fertile was 2 and 5 percentage points, respectively, higher for the treated versus control eggs. In conclusion, UV and H₂O₂

in combination reduced eggshell bacteria on broiler breeder eggs and shows great potential for improving hatchability.

Key Words: broiler breeder, hatchability, egg sanitation

147 Alterations in gastrointestinal development by incubation temperature and posthatch transportation in broiler chicks. A. Barri*¹, M. Wineland², C. Novak³, and A. McElroy¹, ¹Virginia Polytechnic Institute, Blacksburg, ²North Carolina State University, Raleigh, ³Virginia Polytechnic Institute, Blacksburg.

This study evaluated the effects of embryonic incubation temperatures and posthatch transportation stress in the development of the small intestine in broiler chicks. Five thousand two hundred Cobb 500 eggs were incubated at eggshell temperatures of low (L, 36.7°C), standard (S, 37.5°C), and high (H, 39°C). Eggs were incubated at L or S for E1–7 (early), S for E8–17, and S or H for E18–21 (late) to generate 4 incubation treatments: SS, SH, LS, and LH. At hatch, chicks were separated into 2 transportation groups: control (1) and stressed (2). At d 0 (pre- and post-transport), 2, 4, and 6 posthatch, samples from small intestine (duodenum, jejunum and ileum) were collected from 8 birds per treatment. Samples were processed for histological analysis. Villus length, crypt depth, and villus length: crypt depth ratios (V:C) were evaluated. Prior to transportation, villi were significantly ($P \leq 0.05$) shorter in the ileum of chicks incubated at late H as compared to late S. An increased V:C showed that the duodenum had better mucosal development in chicks incubated at early S as compared to early L. After a 4-h transportation, morphological differences were found in all 3 intestinal segments. In duodenum, chicks incubated at late H had deeper crypts and lower V:C than late S temperature. Interaction of age by transportation was observed for crypt depth and age by temperature in V:C. In jejunum, villi from early L were significantly shorter than early S, and villi and V:C were increased in chicks transported under stress. Interactions of temperature by transportation were observed in villi and V:C measurements and temperature by age in crypt measurements. In the ileum, deeper crypts were seen in late H compared to late S, and an increase of V:C was observed in late S compared to late H. Villi and crypt measurements indicated interactions of temperature by age and transportation by age. An interaction of temperature by transportation was observed in V:C. The present study indicates that incubation temperature and/or transportation stress have an impact on gut development in broilers that may contribute to posthatch performance.

Key Words: stress, incubation, broiler

148 Embryonic incubation temperature, transport stress, and posthatch age impact gene expression of mucin and heat shock protein in commercial broilers. J. Sottosanti*, A. Barri, R. Dalloul, and A. P. McElroy, *Virginia Polytechnic Institute and State University, Blacksburg.*

Mucin and heat shock protein 47 (HSP47) play critical roles in innate immunity, and stress is among factors known to increase their production. This study examined the effects of embryonic incubation temperature and posthatch transport stress on gene expression of mucin and HSP47 in the intestinal brush border membrane of commercial broilers. Cobb 500 eggs were incubated with the following shell temperatures during

early and late incubation: low (L:36.7°C), standard (S:37.5°C), and high (H:39°C). Eggs were incubated at standard temperature from E8–17, and combinations of low or standard during early (E1–7) incubation, and standard or high during late (E18–21) incubation, yielding 4 incubation temperature treatment groups: LH, LS, SH, and SS. Chicks were separated into 2 transport groups at hatch: control (1) and stressed (2), which produced 8 total treatments: LH1, LS1, SH1, SS1, LH2, LS2, SH2, and SS2. On d0, 4, and 6 posthatch, intestinal samples were collected from each treatment to evaluate MUC2 and HSP47 expression in the duodenum, jejunum, and ileum. Results suggest that posthatch age played a role in mucin expression with younger birds exhibiting significantly lower expression than older birds. Changes in MUC2 expression were most affected over time (age × temp) in response to LH treatment. Birds incubated at LH had the lowest expression of MUC2 at d 0; however, expression increased to levels comparable to other treatments on d 4 or d 6. Age × temp and temp × transport interactions impacted HSP47 expression. Incubation at SS resulted in the highest HSP47 expression at d 0 which slightly decreased to d 6, while other treatment groups had lower d 0 levels which increased over time to d 6. SS group with transport stress increased in HSP47 expression, while other incubation treatments decreased or had no change in expression during transport stress. Results suggest that embryonic incubation temperature profiles altered MUC2 and HSP47 expression, which is further suggestive of incubation temperature variation as a stressor for the embryo, which could affect posthatch performance.

Key Words: incubation, heat shock protein, mucin

149 A field comparison of hatch and broiler performance using both single stage and multi-stage incubation. M. J. Wineland^{*1}, E. O. Oviedo-Rondon¹, H. R. Cutchin¹, J. H. Small¹, K. M. Mann¹, and J. Beavers², ¹*North Carolina State University, Raleigh*, ²*Mountaire Farms, Siler City, NC*.

A comparison of single stage (SS) and multi-stage (MS) incubation systems of hatchery and broiler performance was made in a commercial broiler hatchery. Fourteen trials were conducted comparing MS and SS Chick Master incubators. Eggs from breeder flocks of various ages were split equally between the types of incubation and set at the same time. Both MS and SS incubators were run using appropriate parameter profiles. Within the SS incubation, a second profile was used after observing indices in the hatch residue indicating an adjustment should be made. Variables examined at hatch were hatchability, hatch residue, chick weight at hatch, percent residual yolk and moisture content of both chick tissue and yolk. At hatch the chicks were placed into paired houses on 4 house farms. A 200 broiler/house sample of broilers were weighed at 1 and 8 weeks of age. At approximately 9 weeks of age the broilers were processed and data was collected on plant body weights and feed conversion (FC). On selected trials, plant yield data was collected. In the first series of trials chicks hatched in SS incubators were

not significantly heavier, but this was due primarily to more residual yolk and less chick tissue mass in the chicks from MS incubation. There was a 1% improvement in hatch, and no difference in 1 week mortality. A significant 30-gram body weight advantage was seen at 8 weeks of age and 27 gram at the processing plant for SS incubation over MS. When examining results by sex the males showed a numerical increase while the females exhibited the significantly greater body weight when incubated single stage. The adjusted FC to 3.63 kilograms was 0.005 better for single stage.

Key Words: incubation, broiler performance, hatchery

150 The effect of incubation temperature on embryonic development of White Pekin ducks. J. Bowers^{*1}, H. Kohl², and M. S. Lilburn¹, ¹*The Ohio State University/OARDC, Wooster*, ²*Maple Leaf Farms, Syracuse, IN*.

The objective of the incubation period is to provide an environment that provides adequate heat for embryonic development during the initial stages of incubation and then allows for adequate heat removal from older embryos. In a series of experiments, commercial duck eggs were obtained from Maple Leaf Farms, Syracuse, IN. All eggs were individually weighed and placed in 1 of 2 incubators that were set at either 37.5 or 38.0°C for the first 10 days of incubation. Internal egg temperatures were determined on a sample of eggs from each treatment at 7 d of incubation to confirm that our treatments were in fact effective at altering internal egg temperature. All eggs were incubated at 37.5°C from 11 d through hatch (28 d). In Experiment 1, the weight of the wet and dry embryos were obtained from each incubation treatment at 14, 16, 18, 20, and 22 d of incubation along with hatchling weight and cloacal temperature. The 38.0°C treatment from 0 to 10 d resulted in a significant increase in embryo dry weight through 20 d of incubation but the differences disappeared by 22 d. There was likewise a decrease in hatchling weight in the 38.0°C ducklings (51.9 vs. 48.0 g) and a concomitant decrease in cloacal temperature (40.0 vs. 39.5°C). In a second experiment, the same incubation treatments and approaches were used. Embryos were sampled daily from 7 to 11 d and whole embryo skeletal development was determined using the procedures described by Nakane and Tsudzucki (1999). The length of the torso (base of the skull to the femoral head junction), femur, and tibia were individually measured in a blind, random fashion. Overall, the torso increased from 9.1 to 27.0 mm from 7 to 11 d and there was a significant increase in torso length in those embryos incubated at 38.0°C. Similar treatment effects were also observed for the femur and tibia. In summary, elevated incubation temperature during the first third of incubation can have a significant effect on early embryo development and skeletal growth in ducklings and these differences may carry over through hatch.

Key Words: duck, embryo, incubation