CORNELL POULTRY POINTERS

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THIS ISSUE IS DEDICATED TO DR. SYED NAQI

We are pleased to dedicate this issue of Cornell Poultry Pointers to Dr. Syed Naqi, Professor of Avian Medicine, College of Veterinary Medicine at Cornell University. Dr. Naqi received his DVM from India in 1961 and his Ph.D. from Texas A & M in 1969. From 1969 to 1987, he was a faculty member in the Department of Microbiology, Texas A & M, and since 1987, he has served as Professor of Avian Medicine at Cornell University. Dr. Naqi for many years has helped us in identifying topics for the Cornell Poultry Conference and quite often he was a speaker at this conference. Syed has helped the New York poultry industry immensely in learning more about infectious diseases, especially about infectious bronchitis. Dr. Naqi has decided to retire at the end of January 2002. We dedicate this issue to him for all of his service to the New York State poultry industry, and wish him and his wife a very enjoyable retirement for years to come.

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2001 FRIEND OF THE DEPARTMENT AWARD

Mark Adams is President of the New York Poultry Association (NYPA), and the owner of the Adams' Egg Farm in Naples, NY, and is the recipient of this year's Friend of Department award which was presented at the 2001 Cornell Poultry Conference on June 20th at the Ramada Inn, Ithaca, NY. Mark has helped the Department in various ways over the years. For many years he has helped us in selecting the topics and the speakers for the Cornell Poultry Conference. Several times he served as a member of the Advisory Committee of the Department of Poultry and Avian Sciences prior to 1991, and in recent years, he has been a member of the Advisory Committee of the Department of Animal Science. Mark has been quite dedicated in fulfillment of his duties as the President of the New York Poultry Association. Just in recent months he has had several talks with a number of Department Chairs at the College of Agriculture and Life Sciences, Cornell University, for increasing their involvement in helping the New York Poultry industry. For these and the many other contributions of Mark, we have been delighted to recognize him as the Friend of the Department for the year 2001. We wish Mark and his family good health and prosperity for years to come.

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IN MEMORY OF DR. MILTON LEONARD SCOTT

It is with sadness that we write this note about Dr. Milton Leonard Scott who passed away on Wednesday, July 11, 2001. He was 86 years old. Milton was born in Arizona in 1915. He received his B.S. degree from the University of California, Berkeley. After graduation for five years he was working as a chemist with Cooperative GLF Mills in Buffalo, NY. Then, he continued his education at Cornell University, and was awarded a Ph.D. degree in 1945. He was involved in teaching, research, and outreach programs at Cornell University up to 1979. He was carrying the prestigious title of Jacob Gould Schurman Professor of Nutrition at Cornell University and was named the Chairman of the Department of Poultry and Avian Sciences in 1976. Milton retired from Cornell University in 1979, but continued to function as an emeritus professor at Cornell University until he died. Dr. Scott, in addition to teaching, conducted research almost on all facets of nutrition, primarily with poultry, but also swine, fish and human. He authored four books in nutrition (Nutrition of the Chicken, Nutrition of the Turkey, Nutrition and Management of Ducks, and Nutrition of Humans and Selected Animal Species), and contributed chapters for eleven other books. He was a major professor for over 50 candidates for the Ph.D. and M.S. degrees, and published more than 250 articles in scientific journals and an equal number of technical articles for the feed industry. Dr. Scott was the recipient of 10 awards for Outstanding Research in Nutrition. Dr. Scott presented the results of his research all over the world. Dr. Scott's research mainly was concentrated in the areas of vitamin nutrition, muscular dystrophy, and pernicious anemia. Everyone in the area of poultry nutrition is familiar with the research work of Dr. Scott, and his book (Nutrition of the Chicken, by M. L. Scott, M. C. Nesheim, and R. J. Young) and is on the shelf of every poultry nutritionist throughout the world. Dr. Scott's help and guidance to his colleagues in the Department of Animal Science, Cornell University, and throughout the world, continued during the years after his retirement and even during the period of his illness.

Dr. Scott was predeceased by sons, James M. Scott and Baby Boy Scott; and by great-grandson, Edward James Rubino. He is survived by his wife, Dorothy; two daughters and one son-in-law, Nonie (Grace) and James Saroka, Greene, NY, June Kopald, Richmond, VA; seven grandchildren, Jamie, Greg, Kevin and Mark Saroka, Kerstin Saroka Driscoll, Jessica Kopald Crawford, Jennifer Kopald Rubino; thirteen great-grandchildren; sister, Clara Bergstrom, Miami, FL; sister-in-law, Grace Mols, and brother-in-law, H. Jack Jaeger, both of Buffalo, NY; and several nieces and nephews.

A memorial service will be held at the First Presbyterian Church of Ithaca, on Friday, August 17, 2001, at 2:00 p.m. with Rev. Lewis, Pastor, officiating.

In lieu of flowers, a memorial gift may be made to the Cornell College of Agriculture and Life Sciences, Milton Scott Graduate Scholarship Fund, 272 Roberts Hall, Cornell University, Ithaca, NY 14853.

We offer our deepest sympathy to Dr. Scott's family, and we want you to know that we too, feel the loss.

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DEVELOPMENTS IN RESEARCH

The following are extracts of some of the papers presented at the Southern Poultry Society annual meeting, January 15 and 16, 2001, in Atlanta, GA.

* Eggshell derived monocalcium phosphate (EDMCP) is a new source of monocalcium phosphate that is produced by using eggshell waste from the egg breaking industry. It contains 19% Ca and 21.5% P on a 94% dry weight basis (as compared to monocalcium phosphate that contains 16% Ca and 21.5% P). Ash and Scheideler (University of Nebraska) conducted an experiment to compare the relative biological availability of P in EDMCP as compared to dicalcium phosphate (DCP) in broiler starter diets. A 2 X 7 factorial experiment involving 2 sources and 7 levels of nonphytate P (NPP) was conducted. The 7 levels of NPP was varied from 0.1 to 0.45%. The experimental diets were used from 2 to 21 d of age in broiler diet. Body weight at 21 d of age was significantly different among P levels, but not P sources. At 21 days of age, the average body weight of birds on DCP was 861.6 g and for EDMCP was 853.6 g for 0.45% NPP level. A slope ratio assay using linear regression analysis was used to determine relative bioavailabilities of these two sources of P. Regression of NPP levels on P sources for wk 3 body weight resulted in a relatively bioavailability of 102.1% for EDMCP in comparison to DCP. Feed conversion was not different between the P sources, but it was significantly different between the P levels. Phosphorus sources did not have a significant effect on mortality. The results generally showed that EDMCP is as available as commercial standard of P for supplemental phosphorus in broiler chick diets.

* Abudabos et al. (Clemson University) conducted an experiment to determine if the dietary P can be reduced satisfactorily during the growing and finishing periods in broiler diets for diminishing P excretion to the environment. Three-week-old broilers were fed diets with a total P content of 0.5, 0.55, 0.6, and 0.65% from 3 to 6 wk of age. From 6 to 7 wk of age, either the birds were fed similar levels of P as those used during 3 to 6 wk of age or the supplemental inorganic P was removed from the diets. At 6 wk of age, no significant differences were detected between treatments on body weight gain, feed conversion, and breast yield muscle. Birds fed 0.65% total P had a significantly higher plasma P than those fed 0.5% total P. Intestinal phytase activity was 22% lower in birds fed 0.6 to 0.65% total P than those fed 0.5 to 0.55% total P. Also, at 7 wk of age, no statistical differences were detected on body weight gain, feed conversion, and breast yield muscle among birds fed different P levels. Plasma P was a function of amount of inorganic P level in the diets. The birds that received inorganic P had plasma P levels that were 49% higher than the unsupplemented groups. The difference in plasma P level did not affect the performance measured at 7 wk of age. The investigators concluded that dietary total P can be reduced to 0.5 to 0.6% from 3 to 6 wk of age, and it further can be reduced to 0.4% from 6 to 7 wk of age without any adverse effect on performance. Such an approach would be effective to diminish P excretion to the environment. Additionally, the results indicated that the concentration of dietary P influences the intestinal phytase activity.

* Kameri et al. (University of Sarajevo, Bosnia, and University of Georgia) conducted a 2 X 2 factorial experiment with laying hens to determine the efficacy of phytase on performance of laying hens. Hysex Brown laying hens were fed the experimental diets for 8 wk. The diets consisted of 0.12 and 0.42% NPP with or without 600 units Natuphos phytase (BASF). The diet with 0.12% NPP without phytase resulted in significantly reducing body weight, daily feed intake, egg production, egg weight, and shell weight. These adverse effects completely were ameliorated by phytase. Relative shell weight and specific gravity were not influenced by dietary treatments. Plasma P and Ca were significantly increased when the low-NPP diet was supplemented with phytase or inorganic source of P. Plasma P for hens fed 0.12% NPP, 0.12% NPP plus phytase, 0.42% NPP, and 0.42% NPP plus phytase were 0.37^{b}, 1.27^{a}, 1.24^{a}, and 1.68^{a} mmoL/L, and plasma Ca for these dietary treatments were 3.55^{b}, 4.01^{a}, 4.20^{a}, 4.06^{a} mmoL/L, respectively. Tibia ash was significantly increased due to adding phytase to the low-NPP diet. The tibia ash for hens fed 0.12% NPP, 0.12% NPP plus phytase, 0.42% NPP, and 0.42% NPP plus phytase were 48.9^{b}, 53.6^{a}, 52.5^{ab}, and 54.9^{a}%, respectively. The authors concluded that 600 units phytase improved the utilization of P in corn-soy diet for laying hens fed a diet containing 0.12% NPP. The use of 0.12% NPP in the presence of 600 units phytase was adequate to support maximum performance in this short-term study.

* Calcium requirements of laying hens although widely studied, keep challenging us with new genetic make-up, operation management, environmental concerns, and economic consideration. Hafiz et al. (Auburn University) conducted a short duration experiment (8 wk) to determine the Ca requirement of Bovans hens. Six dietary calcium consisting of 2.5, 3, 3.5, 4, 4.5, and 5% were used. Production criteria evaluated were egg production, egg weight, feed consumption and egg specific gravity. Increasing the dietary Ca had a significant linear effect on egg production and specific

gravity. Dietary Ca level ranging from 2.5 to 5% resulted in increasing egg production from 75.3 to 82.4%, and egg specific gravity from 1.078 to 1.083. Calcium levels did not have a significant effect on feed consumption or egg weight. Bovans hens required 5.57 g Ca/hen/day for the highest specific gravity index of 1.083. The decision to feed this level of Ca to achieve maximum shell quality, however, depends upon the nature and cost-benefits analysis of the layer operation.

* Bateman et al. (Auburn University) conducted an experiment to determine the earliest age at which the Bovans White hen would obtain a 48 lb case weight (60.5 g/egg) and also the most economical nutrient (protein and lysine) level to feed during phase 1 (21 to 36 wk of age) using cool temperature (68 F). Three diets were formulated based on protein (0.9, 1.02, and 1.17% lysine; 17, 18.7, and 20.8% protein) each containing 1305 kcal ME/lb. Three diets were formulated based on lysine (0.75, 0.83, and 0.92%; 14.98, 16.19, and 17.34% protein) each containing 1288 kcal ME/lb. The criteria used were egg production, feed consumption, and egg weight. Neither the diet nor the method of formulation had a significant effect on any of the criteria other than the egg weight. As the lysine content of the diet increased, egg weight was significantly increased. Egg weight was also significantly higher for diets formulated based on protein than versus the diets formulated based on lysine. An egg weight of 48 lb/case was obtained 3 wk earlier than stated in Bovans White management guide (34 versus 37 wk) using the diet containing 20.8% protein and 1305 kcal ME/lb. Egg production peaked at greater than 96% in birds in all treatments as early as 25 wk of age, and remained over 94% for the reminder of the study. Using an economic analysis, it was shown that for optimum profits Bovans White hens required 1,100 mg lysine and 20.22 g protein per hen per day during phase 1 for maximum profit. These values are higher than the 690 mg lysine and 15 g protein per hen per day as recommended by NRC (1994).

* Betaine, similar to choline and methionine, is a source of methyl donor. The results of some experiments have shown that both choline and betaine can have some sparing effect for methionine requirement. However, no information about the betaine content of feed ingredients is readily available and the tables of feed compositions of NRC (1994) do not have any information about the betaine content of feed ingredients. Recently, Chendrimada et al. (University of Georgia) has developed a sensitive method for the measurement of betaine content of feed ingredients. The results of their study indicated that the betaine content for several feed ingredients were as follows: alfalfa, 1.77 g/kg; wheat, 3.96 g/kg; wheat middlings, 4.48 g/kg; poultry meat, 0.77 g/kg; fish meal, 1.11 g/kg; peanut meal, 2.52 g/kg, and meat and bone meal, 0.6 g/kg. Using the method, betaine was undetectable in corn and soybean meal.

* Ledwaba and Roberson (Michigan State University) conducted two experiments to determine the effect of 25-OH-D_3 on performance and the incidence of TD (tibial dyschondroplasia) in broilers grown in battery. The results of a preliminary study showed that ultraviolet light can be effectively blocked by filters used on the fluorescent tubes. In experiment 1, chicks were fed a TD-inducing diet (0.65% Ca, 0.5% NPP, and 1,100 ICU/kg diet vitamin D_3) for 18 days. Four diets consisting of 0, 10, 40, and 70 µg/kg diet 25-OH-D_3 were used in experiment 1. Experiment 2 was similar to experiment 1, except that a normal broiler diet (0.85% Ca, 0.45% available P, and 2,200 ICU/kg diet vitamin D_3) were used. Body weight and feed conversion were not affected in either experiment, and tibia ash increased linearly from 41.8 to 43.9% ($P < 0.001$) in experiment 1, but was not affected in experiment 2. The incidence of TD was decreased linearly in experiment 1 (73 to 2%), and in experiment 2 (25 to 5%). In experiment 1, contrast analysis indicated that TD incidence and severity was not different between 40 and 70 µg/kg 25-OH-D_3. In experiment 2, 70 microgram/kg was needed to reduce TD lesions and analyzed by contrast analysis. Severity of TD was decreased linearly in both experiment, and eliminated by 70 µg 25-OH-D_3 in experiment 2. According to NLIN analysis, the estimated requirement for 25-OH-D_3 to prevent the incidence of TD overall and severe lesions specifically is 14.5 or 13.5 µg/kg, respectively with a TD-inducing diet. In experiment 2, 65.4 µg/kg 25-OH-D_3 was the estimated level needed to prevent TD. The results indicated that the 25-OH-D_3 requirement to minimize TD in broilers is higher when a typical broiler diet is fed compared to a TD-inducing diet.

* Fritts and Waldroup (University of Arkansas), also compared the effect of adding two forms of vitamin D (vitamin D_3 and 25-OH-D_3) on performance of broilers. Each form of vitamin D was used to provide 125, 250, 500, 1,000, 2,000, and 4,000 ICU activity per kg of a nutritionally complete broiler diet. Calcium and P was provided at NRC (1994) levels. The experimental period was fed from day-old to 42 days of age. Birds fed diets containing 25-OH-D_3 had significantly heavier body weight, at 21 and 42 days of age, than those fed diets with comparable levels of vitamin D_3. Differences were more pronounced at lower levels of supplementation. Tibia ash was also greater for birds fed 25-OH-D_3 than vitamin D_3, again the differences were more pronounced at lower levels of supplementation. The incidence and severity of TD was less pronounced

with 25-OH-D_3 than vitamin D_3 and also was more apparent at lower levels of supplementation. The results indicated that 25-OH-D_3 was a more potent source than vitamin D_3, and under critical situations, may aid reducing leg disorders under field conditions.

* Edwards et al. (University of Georgia) conducted an experiment to determine the effectiveness of 1-alpha-OH-D_3 as substitute for vitamin D_3 in the diet on performance of young broilers. A corn-soy diet that contained all the nutrients adequately except a source of vitamin D was used as the basal diet. The Ross X Ross mixed sex day-old chicks were reared in battery brooders in a room where sunlight was excluded and all the fluorescent lights were covered with plastic to prevent exposure of chicks to UV light. Feed and water were provided on an ad libitum basis and the experiment was terminated at 16 days of age. Vitamin D_3 was fed at levels of 0, 2.5, 5, 10, 20, and 40 micrograms/kg diet and 1-alpha-OH-D_3 was fed at levels of 0.625, 1.25, 2.5, 5, and 10 µg/kg diet. The criteria used to study the effect of dietary treatments were body weight, gain/feed, plasma Ca, incidence of rickets, percent bone ash, and mg bone ash/g tibia. Slope ratio analysis indicated that 1-alpha-OH-D_3 is very potent compared to vitamin D_3 with its activity being 10 times as active as vitamin D_3 for body weight, two times as active as vitamin D_3 for gain/feed, five times as active as vitamin D_3 for plasma Ca, six times as active as vitamin D_3 for the incidence of rickets, four times as active as vitamin D_3 for bone ash, and seven times as active as vitamin D_3 for mg bone ash/tibia. The requirement for vitamin D_3 and 1-alpha-OH-D_3 also varied depending upon the criteria, and in most cases, the amount of 1-alpha-OH-D_3 required was approximately one-fourth the amount of vitamin D_3 needed to maximize the specific response.

* Scheideler et al. (University of Nebraska) conducted a 4 X 3 factorial experiment to determine the response of four strains of laying hens to dietary energy level with and without supplemental enzyme. The four strains of laying hens used were: Babcock B300, Hy-Line W-36, Hy-Line Brown, and Shaver White, and the three levels of energy used were: moderate energy of 1,318 kcal ME/lb, low energy level of 1,277 kcal ME/lb, and low-energy level of 1,277 kcal ME/lb plus an enzyme (Avizyme 1500). Results showed no significant effect of diet, strain or their interaction on feed intake, specific gravity, hen weight, and dry shell percents. There was a significant strain difference on egg weight, egg mass, with Hy-Line Brown and Babcock having significantly heavier egg weight and egg mass in contrast to Shaver and Hy-Line W-36. Hy-Line Brown had the highest albumen weight among the four strains. Hy-Line W-36 had the highest wet and dry egg yolk among the strains, while Hy-Line Brown had the lowest. A significant diet X strain interaction showed that Babcock fed the low ME with and without enzyme had the highest egg production, while Shaver had the lowest egg production at the same time. An opposite trend was observed with moderate energy level; Shaver having the highest and Babcock having the lowest egg production. Supplementation of Avizyme to low ME diet had no significant effect on egg production parameters, even though there were strain differences for egg weight and egg mass, albumen and wet and dry yolk percents.

* Cramer et al. (Kansas State University) conducted a study to determine the effect of replacing 50 or 100% of corn fraction of a broiler starter diet with expanded corn. The expanding of corn was taking place at a temperature of 200 F (93.3 C). The period of study was day-old to 18 days. Only feed conversion was significantly different between the three treatments which consisted of 100% normal corn, 50% normal and 50% expanded corn, and 100% expanded corn. The feed conversion was significantly inferior for birds fed diets containing 100% expanded corn than the normal corn. The results of this study suggest that nutrient damage occurred to corn expanded under the condition of this experiment. However, the investigators felt more studies are needed to determine the nutrient damage.

* Kamyab and Ashtiani (University of Tehran, Iran) conducted an experiment to compare the effect of continuous feeding of a multiple enzyme as compared to groups feeding the same enzyme on various duration on performance of broilers. The six dietary treatments used in this experiment were isocaloric and isonitrogenous. The diets consisted of: 1) an unsupplemented enzyme corn-soy diet which was fed up to 56 days of age, 2) a barley-wheat diet plus enzyme, 3) as 2, but enzyme was added every other day, 4) as 2, but enzyme was added every two days, 5) as 2, but enzyme was added up to 42 days of age, and 6) as 2, but enzyme was added up to 35 days of age. Body weight at 49 days of age was significantly greatest for birds fed regimen number 3, i.e., enzyme was added on an every-other-day basis, and feed efficiency was significantly in favor of birds fed dietary regimen 6, i.e., when enzyme was added up to 35 days of age. Litter moisture was greatest for birds fed dietary regimens number 1 and number 5. Carcass quality and mortality were not influenced by dietary regimens. The results of this experiment indicated that a multiple enzyme complex can be fed on a non-continuous basis with satisfactory results and economic advantages.

* Cottonseed meal (CSM) usually is not used in the laying hen diets due two constraints, namely, its free gossypol content that causes yolk

discoloration, and also, due to the presence of cyclopropenoide fatty acids that causes pinkish albumen and gives a pasty structure to yolk. Probably the concentration of these compounds is less in the CSM produced in the modern expander-solvent cottonseed mills which leave little residual oil in the meal. Davis et al. (University of Georgia) conducted an experiment to determine the amount of discoloration produced from feeding CSM obtained from an expander-solvent mill. In an initial experiment, four groups of hens were fed diets containing 0, 10, 20, and 30% CSM which corresponded to free gossypol levels of 0, 100, 200, and 300 mg/kg diet. At the initiation of the study and after 2, 4, and 6 wk on the respective diets, 30 eggs from each treatment were opened and examined. Eggs were stored at 4 C for 28 days before examination. Egg weight was significantly reduced in the group fed the 30% CSM as compared to other groups. Although no discoloration was found in eggs from hens fed 10% CSM, hens fed the 20 and 30% CSM diets produced brown yolk discolored eggs at a rate of 16 to 70%, respectively. In the second experiment, the same levels of CSM were added to the diet, but the CSM did not contain the usually added soapstock which is a rich source of gossypol. The respective free gossypol of these diets were 0, 72, 144, and 216 mg/kg of the diets. The diets were fed to laying hens for 37 days. All the eggs were examined for egg yolk discoloration after two wk of storage at 4 C. Egg weights were equal between the four treatments. Objectionable egg yolk discoloration was detected only in a small number of eggs produced by the hens fed the 30% CSM. The results suggested that cyclopropenoide fatty acids are not a problem while free gossypol is still a potential problem in the CSM produced today. Cottonseed meal without added soapstock, however, could potentially be used in laying hen diets at 10% or less.

* Paton et al. (University of Kentucky) conducted an experiment to determine the effect of adding Alltech phytase and a source of organic Zn, Mn, and Cu (Eggshell 49) on performance of Hy-Line W-36 laying hens. Hens were housed and subjected to photostimulation at 17, 18, and 19 wk of age. Dietary treatments consisted of feeding a low-P basal diet alone, or supplemented with Alltech phytase (1,500 ptu/kg diet) or Eggshell 49 (providing 4.5 mg Mn, 7.5 mg Zn, and 1 mg Cu/kg diet as proteinate) in factorial arrangement. The basal diet contained 3.75% Ca and 0.17% NPP. The trace mineral supplement used in this study provided 51 mg Mn, 60 mg Zn, and 8 mg Cu/kg diet as inorganic salts. Age at photostimulation did not have any effect on production parameters. Feed intake (97.4 g/hen), egg production (80.2%), egg weight (59.8 g), egg shell breaking strength and percent shell during 13 periods of 8 days were unaffected by dietary treatments. Bone breaking strength and percent ash of humerus and tibia, measured after 8 and 10 periods of production, were unaffected by diets. The results indicated that the level of NPP and the level of Mn, Zn, and Cu in the basal diet were adequate to support layer performance.

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The write-ups from talks presented at the 2001 Cornell Poultry Conference, held June 20th, at the Ramada Inn, Ithaca, NY, follow. Additional talks will be listed in the October 2001 issue as well.

APPROACH FOR COMPOSTING POULTRY MANURE IN ADAMS' EGG FARM

It is becoming more and more apparent that the spreading of raw manure will no longer be allowed in the near future. Neighborhood pressures make summer spreading difficult, with the threat of private nuisance lawsuits always present. CAFO regulations limit winter spreading, and the phosphorus index included in these regulations may make all of our acreage unavailable for spreading anyway.

Faced with this dilemma, we turned to composting as a means to export manure off our farm. With no "cookbook" procedures available, many experiments were necessary to develop the best method. Our ultimate goal was, and still is, to produce a fully composted product with all the nutrients tied up in complex organic compounds to be used as a soil amendment as well as a time-release nutrient source that is safe for any plant.

Our farm consists of about 100,000 laying hens, with half in a high-rise building utilizing a four-deck Dutchman system with conventional ventilation and no pit fans. The other half is in a four-deck Farmer Automatic battery system with manure belts and no manure drying system.

Our first goal was to compost in the high-rise using a Brown Bear windrow turner mounted on a skidsteer with the drying action of composting offsetting the daily addition of water in fresh manure. We were hoping to avoid the cost of installation and operation of pit fans.

After several failures due to manure being too wet we discovered we had a defective watering system. Although the system was only three years old, virtually all of the nipples were dripping, most at a rate of one drop every 10 to 20 seconds. We learned that nipples are available with different flow rates, a low flow system being necessary for in-house composting. As low flow nipples have close tolerances, a water conditioning system was needed since the slightest residue build-up on the nipple components will cause either dry or leaking nipples. After replacing all the waterers and installing a water conditioning system we began to see the composting system succeed.

To develop a procedure, compost basics must be studied. Since layer manure has an 11:1 carbon to nitrogen ratio, with a 20:1 ratio required as a minimum, a carbon source is necessary. We started by adding sawdust to the manure, which is very high in carbon, but found a very high release of ammonia. Not only did the operator need a respirator, but we were very concerned about flock health. Any time ammonia is noticeable it means there isn't enough carbon available. In the case of sawdust, which has a carbon-nitrogen ratio of 500:1, it isn't available fast enough.

There was also the problem of cost and availability of sawdust. We realized that for the system to be economically viable most of the materials would have to be produced on the farm. Since we produce grain corn, we decided to harvest the corn stalks after combining with a New Holland crop chopper.

After many trials using different mixes of sawdust and cornstalks we found the best procedure is to use about 2 inches of sawdust on the floor after manure removal, with 14 -16 inches of cornstalks placed on top of the sawdust. This mix is turned two or three times per week, depending on fly larvae activity, with heating from composting starting in six to seven days. This method reduces sawdust use by 75%, with a dramatic reduction in the amount of ammonia released.

The material added to the manure must not only provide additional carbon, but must also provide structure to the windrow so that it can retain more oxygen after turning. The cornstalk-sawdust mix works very well for this requirement.

An additional benefit of this procedure is that all mortality can be processed in the windrow. A dead hen will disappear in one week, with the exception of large bones. As the amount of manure increases in relation to the amount of bulking material structure is lost and the composting action slows. This is aggravated by the auger-style windrow turner. When this happens the windrow has to be removed. We found this process takes about six weeks in the winter and eight to ten weeks in the summer.

When the material is removed we place it in a larger windrow outside, and we have found that we can reactivate the composting action with a rotor-style turner. Material removed in the winter is allowed to go dormant and is covered with a special tarp that allows it to breathe and shed water. This partially composted material can be reactivated in the spring. Ideally, material removed during the winter could be composted under roof, which is what we intend to do in the future.

After encountering problems with mud last spring, we decided that a hard surface is necessary for outside composting. The most economical approach is soil cement, where hydrated lime is mixed into a clay-based soil. Water is added, resulting in a hard surface. This technique was developed by USDA and is NRCS-approved for composting.

Experiments we have planned for this summer will involve developing a method for composting manure from our manure belt system. The plan is to start an active windrow and then add manure, much as would occur in the high-rise but using a side-throw manure spreader. If this works, we should be composting 100% of our manure by next summer.

[Talk presented by Mark Adams, Adams Poultry Farm, Naples, NY.]

BREEDING FOR STRAINS THAT DO NOT NEED BEAK TRIMMING: PERSPECTIVE OF A POULTRY BREEDER

Animal welfare issues have risen in prominence as major public concern regarding animal agriculture in many countries. In the USA, two recent proclamations, one by The United Egg Producers (UEP) on humane guidelines for US egg laying flocks which includes guidelines on beak trimming and the second one, McDonald Corporation's welfare guidelines for laying hens, have brought more focus to the welfare issue in the poultry industry. Thus the topic, "Breeding for strains that do not need beak trimming" may be on the minds of many industry people in North America today.

In the poultry industry, the two components that form the cornerstone of all good bird welfare and, consequently, better economic performance of a flock are physical health and psychological health. Systems that lead to injury, disease and deformity affect physical health and cause reduced bird welfare. Psychological health implies that chickens are for most of their lives content and free from emotional states such as pain, fear, frustration, hunger, as well as excessive heat and cold. One important behavioral problem with poultry stocks that negatively affects their own welfare is associated with the use of their beaks.

Traditionally, many commercial poultry breeding programs incorporate strategies that improve behaviors associated with well-being as strains of birds are developed to produce more efficiently under a variety of management and environmental systems.

Generally, most genetic selection efforts are directed to reduce the incidence of beak-inflicted injuries and mortality under diverse flock management and husbandry systems. However, it must be noted that the genetics of the behavioral and physiological responses involved in the buffering necessary for chickens to cope with changes in their physical and social environments is complex.

THE MODERN POULTRY INDUSTRY AND BEAK-TRIMMING

It is generally agreed that as the modern poultry industry developed into major businesses, the environments in which poultry were maintained became intensified, flock sizes increased and poultry became more crowded. Consequently, cannibalistic pecking behavior became a serious hazard and poultry welfare was adversely affected. Thus, beak trimming became necessary to improve the welfare of chickens as it reduces cannibalism and feather pecking. However, as research continued on beak trimming, it became clear that it causes behavioral and physiological effects that adversely affect the welfare of chickens. The severity of the negative effects of beak trimming depends on the technique used. The public concern on beak trimming and its associated effects on well-being of poultry has been prominent in Western Europe for over 20-30 years and it is now gaining prominence in North America and other parts of the world. Under most flock management systems and husbandry practices today, beak trimming is indeed, still a pro-welfare practice.

THE PECKING BEHAVIOR

In poultry stocks the characteristics of aggressiveness, competitive behavior, the need for nests and behavioral vices such as pecking exists at different levels. The level of expression of these behaviors depends to some extent on the environmental conditions the chickens are in.

The pecking behavior is generally classified into aggressive pecking and non-aggressive pecking. The non-aggressive pecking is generally further sub-classified based on the location where the pecking is received such as the beak, toe, vent and cloacal area, tissue in denuded areas and feather pecking. The degree of injuries and mortality depends on the target of pecking. The results of studies at Babcock on intact (non-trimmed) beak birds in multiple-bird cages, suggest that most of the mortality is due to pecking injuries to the vent and cloacal areas. Pecking on these areas of the chicken's body also leads to vent gleet and yolk peritonitis as a result of infection by bacteria and other pathogens. The immune system is also affected negatively by the pecking behavior.

GENETIC SELECTION TO REDUCE PECKING INJURIES AND MORTALITY

It is well established that both heredity and environmental factors cause the pecking behavior. Therefore, whether birds have to be beak trimmed or not involves both genetic and environmental (flock management and husbandry) considerations. Genetic selection to reduce to appropriate levels the different classes of the pecking behavior is quite a challenge.

The results of genetic selection in the Babcock breeding program on birds with intact beaks in multiple-bird cages and under high light intensity as well as the results published in the scientific literature demonstrate that selection to reduce beak inflicted injuries and mortality is feasible in layer chickens. Our results show a general trend of reduced mortality from beak inflicted injuries in all the strains under selection. However, there are both positive and negative correlated responses to many important economic traits from such selection. Furthermore, such selection may affect fitness traits or cause other negative behavioral characteristics. Therefore these associations must be considered carefully in a balanced selection program.

From my perspective as a poultry breeder, I know that genetic selection is being applied to develop chicken strains with low genetic propensity to peck. However, as indicated earlier, there is a genetic component and an environmental component to the pecking behavior. Some of the flock management and husbandry practices that influence pecking and cannibalism include high density, crowding, poor nutrition, feed type, high light intensity, inadequate water and feeder space, over heating, poor ventilation, humidity and cage design among others. In many poultry operations, often times some of the factors mentioned above are not provided at optimal levels. As with other important economic traits such as egg production, a strain may genetically have low propensity to peck but how well the genetic potential is achieved in commercial operations will be determined by the level of flock management and husbandry practices employed. If the husbandry practices are such that they stimulate pecking then the birds may peck to some degree.

Primary poultry breeding companies such as Babcock continue to develop products that are more robust with the genetic ability to withstand stresses from different field conditions and have better behavioral characteristics. These products must also be able to produce efficiently high numbers of eggs with optimum egg size, better internal and external quality and also have better characteristics related to environmental issues in egg production. Genetic changes in individual characteristics from the simultaneous selection of the many important characteristics as required in the layer industry are gradual, generally permanent, cumulative, and lead to substantial progress in performance over time. Thus, through genetic selection biological changes will occur and the pecking behavior will reduce steadily in the commercial chicken. However, appropriate husbandry conditions will also be necessary to realize the genetic improvement and optimize the lower propensity to feather pecking.

The UEP scientific committee on animal welfare stated the following in their report regarding beak trimming. "It is clear that beak trimming causes both short- and long-term pain, but does this outweigh the pain and suffering experienced by a bird being cannibalized and so call for a prohibition of beak-trimming?" The statement continued: "We decided that it did not, but again this is a value judgement, weighing the welfare of one against that of another."

Under current flock management systems and husbandry practices in the poultry industry, I am of the view that most producers may agree with the above statement.

[Talk presented by George A. Ansah, ISA Babcock, Ithaca, NY.]

June 11, 2001, No. 4

Don Bell's Table Egg Layer Flock Projections and Economic Commentary - 2001

(*This report was written by Don Bell, University of California Poultry Specialist, emeritus, under the sponsorship of United Egg Producers.*) The data upon which commentary is based is from multiple sources and our compilation of this data in various tables can be accessed at the University of California Cooperative Extension web site each month at the following address: **animalscience.ucdavis.edu/extension/avian**

A Crisis in the Making

During the first three and one-half months of 2001, the U.S. egg industry experienced a strong egg market even though the flock size was up some 5.5 million hens over the previous year. Rarely do we see an increase in egg prices associated with an increase in flock size. During that period the industry enjoyed a profitable market. Since mid-April, however, the market has failed to keep up with costs and losses have occurred to the extent that most of the earnings of the first 16 weeks have now been used up.

In 2001, the flock size continues to increase over last year figures to the point that on May 1, the flock had 10 million more hens than 12 months earlier in 2000. This is at a rate 3 times the number required for an entire year's growth in human population and alarmingly, relief is nowhere in sight.

Estimates of the size of the upcoming US table egg layer flock are made by Ken Looper for UEP and Don Bell for the University of California and are based upon USDA reported layer counts, actual hatch numbers taken forward minus expected mortality, and recent historical seasonal relationships regarding mortality, and slaughter and other layer disappearances. Usually, such estimates made at the start of a given year will be within a few million of the number actually reported. Both estimates are continually updated to the new actual counts provided by USDA's National Agricultural Statistics Service (NASS).

In 2001, though, each of the last 3 months has required a major update in estimates to reflect the continuing increase of the hatch over last year and over the original estimates. The size of the nation's flock, therefore, has had to be adjusted upwards during April-June 2001. The industry's growth this year was way above anyone's expectations. The table below illustrates how current increases in the hatch and changes in the slaughter and other bird disappearances will affect the size of the flock for the next six months. The industry will be challenged to correct these figures in the next few months if major losses are to be avoided.

Estimated Beginning of the Month Layer Numbers for July Through December 2001

Date Projected	For July 2001	August	September	October	November	December	Average
March	267.8	267.4	269.4	271.9	274.8	277.7	271.5
April	268.7	269.0	271.0	273.5	276.5	278.9	272.9
May	271.6	271.7	272.9	275.3	278.3	280.8	275.1
June	274.0	274.0	274.9	277.4	280.4	282.9	277.3
Year 2000	265.8	267.3	267.5	270.0	271.7	275.4	269.6

As you can see, the estimate has increased steadily during the last three months of the year from 271.5 million in March to 277.3 million in our June 9 projection. The pullets are already being grown for the replacements to be added in September. Totals through September can only be altered by changes in slaughter and disappearance rates.

FLOCK-FRIENDLY MOLTING METHODS - ALTERNATIVES TO FEED REMOVAL

Introduction

Public concern about the welfare of farm animals has resulted in the need to re-evaluate current recommendations concerning the many facets of care for table egg chickens. In some cases, restrictive legislation has been the result of this public concern, specifically in Europe and Australia. In the US, in recent months, several state legislatures have considered and turned down proposals to mandate space requirements for commercial layers in cages and to disallow the use of induced molting. In addition, one major user of eggs has developed their own set of guidelines for their egg suppliers which include both space and molt method restrictions. Other major users are waiting to implement their own programs.

Over the past twenty or more years, traditional molting techniques, which involve feed removal, have been severely criticized by welfare groups. As a result, a variety of alternative methods have been studied and in some cases implemented. Still, today, the most common method to induce a molt in commercial chicken flocks involves the removal of feed for periods from 5 to 14 days.

What Does the Rest Accomplish?

There are many theories why a rest, and its associated physiological changes, yields a rejuvenation effect. First, traditionally initiated rests result in significant losses in body weight. At least 25% of this loss is associated with regression of the reproductive system (Brake & Thaxton, 1979). The remainder is attributed to loss of weight in body fat, feathers, liver tissue, musculature and skeleton. The regression of the ovary and oviduct have significant effects on the quality of eggs produced in the second cycle of performance. The efficiency of albumen secretion is improved as evidenced by increases in the thick albumen component. Calcium secretion is more effective as shell thickness is increased and shell smoothness is improved. The egg production rate is dramatically improved probably due to improvements in clutch size, fewer "loss" eggs, and the rejuvenation of non-layers. Some improvement in egg production can also be attributed to an increase in mortality (during the molt) of inferior non-producing birds. And finally, the improved appearance of the flock and its reduced requirement for maintenance energy results from the replacement of feathers.

Many experiments have studied the apparent relationship between loss of body weight and subsequent performance. In most cases, there appears to be a positive relationship between weight loss and economic returns in the 15 to 35% loss range. Attempts to reduce the weight loss while maintaining the non-productive rest period have usually not proven to be effective or economically viable options.

Fasting vs. Nutrient Restriction

Fasting is a term which means food removal - detractors of the practice prefer to call it "starvation". Regardless of the terminology used, it is a widely followed practice in many countries for humans and has been used extensively in the rejuvenation process for chicken flocks for decades. An extensive review of the subject of fasting in humans and animals has recently been completed at North Carolina State University and should be published sometime in the near future.

Early molting methods incorporated a 4-5 day feed removal period along with 1-3 days of water removal. Over the years, most flock managers have eliminated the removal of water and have increased the number of days of feed removal. World-wide, the use of fasting is by far the most common method of inducing a molt. Because of the perception that the birds are being starved, many countries now prohibit fasting as a means to initiate a molt.

In the 1960's, researchers experimented with "low nutrient molt mashes". The diets were meant to be full-fed. It was readily apparent that the reduction of protein, calcium or other critical elements to sub-requirement levels could sustain low (less than 5%) levels of egg production for extended periods and results appeared to be comparable to the methods using the fasting technique.

UC experiments with these methods have failed to show significant economic differences when compared to the standard 10 day fast method. Increasing the fast to 14 days, though, appears to improve returns over the 10 day fast method.

Today, low nutrient programs are the only ones available in countries with regulations prohibiting the complete removal of feed. Such methods are very simple to implement and oftentimes require only low nutrient ingredients with small modifications to meet vitamin and trace mineral requirements. Nutrient restriction, though, can also be criticized as these methods fail to meet all the known nutrient requirements of a mature flock in production. No list of nutrient requirements for poultry currently recommends a set of specifications for a layer flock in a maintenance condition - without egg production.

Based upon previous research at UC and other institutions, the following experiments were initiated to re-visit the subject of low nutrient molting methods for commercial layer flocks with current strains of chickens, new concepts of feeding, and with a new sense of urgency brought about by the increase in public concern over the issue.

National Egg Industry Guidelines for Induced Molting

The United Egg Producers (UEP) association of egg producers has established a "Scientific Advisory Panel" on animal welfare issues. This panel is made up of nine scientists, consultants and egg producers. Their charge is to make recommendations to UEP's "Producer's Committee" relative to various animal care practices including induced molting. Two of these recommendations are:

"**Producers and researchers are encouraged to work together to develop alternatives to feed withdrawal for molting.**"

"Until such time that these alternatives are available, the shortest period of feed withdrawal possible should be used to accomplish the goal of rejuvenating the hen's egg production capabilities and overall welfare."

Current Research

University-type research is organized in such a way to be able to measure variation within and between treatments. Considerably fewer birds are required to prove or disprove specific hypotheses. But, one of the very important issues, mortality, is almost impossible to evaluate in small University experiments. Thus, a combination of the two types of experiments is used to gain a more complete picture of what's happening in commercial conditions. The key to this is in the ability to have repeatable results from farm to farm.

In order to evaluate various molting procedures under commercial conditions, three California egg farms agreed to compare their traditional molting programs with a method which did not require the removal of feed. University of California Poultry Specialists have coordinated these comparisons and have done the analysis of results. Meaningful field tests are difficult to arrange because of the need for replication of treatment and controls (requiring multiple identical houses and sister birds), the extra labor requirements for conducting numerous measurements, and the "risk" that the treatment may result in poor performance and loss of income. Our California cooperators fully understood these associated problems while at the same time recognizing the need for repeated observations on multiple farms.

Objectives of a Molting Method

An ideal molting method should:

a. get the flock completely out of production within 5 to 6 days.
b. keep the flock out of production (zero production) until it has adequately rested.
c. bring it back into production rapidly (as determined by the manager).
d. be simple and foolproof to implement.
e. be low in cost.
f. result in low mortality.
g. lead to high subsequent performance.

Criteria for developing a flock-friendly molting procedure are:

a. no feed removal.
b. no major loss in body weight.
c. no increase in mortality.
d. no injections or use of toxic substances.
e. comparable performance results.
f. cost effective.

Experimental Design of Current Research

The current research (year 2000) used three farms, two to four identical houses per comparison (1 or 2 treatment houses vs. 1 or 2 control houses), sister birds (raised together), five strains (one farm used 2 sets of housing for 2 strains and one farm repeating the first test with a second strain in a new set of housing), and 440,000 birds in the five tests. Flocks were between 66 and 70 weeks of age at the start of the experiments and kept until 37-38 weeks in the second cycle of production.

Sample birds were weighed individually either daily or weekly during the molt phase of the experiment. Egg production, mortality, and feed consumption were summarized daily for the first 56 days, while egg weights were summarized once per week after the return to egg production. All data were entered into the UC flock indexing program for economic analyses. No statistical analyses were made due to the lack of replication within flocks.

Treatments consisted of:

1.) 10 to 12 pounds (per 100 hens) of ground corn, dical phosphate, limestone, and a grow-lay vitamin/ mineral pre-mix per day. Calcium was calculated at 0.8% and available phosphorus at 0.4%. No salt was added to the diet. This diet was fed for 28 days and shall be referred to as the "no salt" diet.

2.) Each farm's existing molt program: 6 to 13 days without feed followed by the farm's molt mash fed ad lib until the 28th day.

Artificial lights were turned off on day one of the molt in open houses (farms B & C) and were reduced to 8 hours per day in the environmentally controlled houses on farm A. Lights were turned back on following the first 28 days and birds were returned to layer diets. Farm A used 10 and 13 day feed withdrawal periods, farm B used 11 days, and farm C used 6 days.

Results

• In all five comparisons, the no-salt treatments had the same or slightly less first four-week mortality.

• 50% EP was reached between 37 and 46 days with slightly less time

required for the no-feed treatments.
- % EP in the no-salt birds averaged 1.4 to 7.2% during weeks 2-4 compared to zero in the control groups.
- % EP during the peak weeks was consistently higher in the control groups.
- % EP at the end of the cycle favored the no-feed treatment.
- HH eggs was higher in 3 of the 5 comparisons in the no-feed flocks.
- Feed per day was less in 4 of the 5 comparisons in the no-salt flocks.
- Case weights, and feed conversion results were variable.
- Average weekly mortality for the entire period was higher in 4 of the 5 tests in the no-salt treatments.
- One comparison of egg quality showed no differences between treatments.
- Egg income minus feed costs were higher in the no-feed groups in 3 of the 5 comparisons.

Conclusions

The results confirmed our previous conclusions that feed removal systems were generally superior to other methods. The excellent results of the no-salt diet on farm A in two experiments, though, indicates that other methods have potential for use in the future when more attention is given to the problems of applying controlled feeding principles equally to all birds.

Before abandoning traditional methods in the face of welfare advocate criticism, it's important that individual companies take a hard look at their present method of molting and if a new method is called for, careful comparisons should be made.

As usual, care must be taken to assure equal conditions for all treatments in farm tests with thorough analyses of **all** important factors. Use your nutritionist, veterinarian, or Extension Specialist when devising and interpreting such tests.

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[Talk presented by Don Bell, UC Poultry Specialist (Emeritus), Davis, CA.]

IMPACT OF THE RECENT WELFARE RECOMMENDATIONS ON THE ECONOMICS OF EGG PRODUCTION

Economics plays an essential role in the choice of management programs in the poultry industry as well as in most businesses. Economics drives the selection of systems, products, and procedures among a long list of alternative options. Costs, values, profit margins, competition, overhead, performance, efficiencies, etc. are all economic subjects and are of vital importance in their effect on the management of today's modern agricultural enterprises.

Management programs are chosen only following careful consideration of their relative worth compared to alternative programs. Managers are charged with choosing sound programs, enacting them in detail, monitoring their applications and continuing their evaluation when new alternatives come along or when price/cost conditions change.

This paper emphasizes some of the economic implications of program selection in the controversial areas of: caging systems for laying hens, beak trimming and induced molting. Analysis of relative biological performance is stressed with cost/price calculations emphasized to discover the economic impact on the operation. The impact of imposed regulations on systems is discussed.

Commercial management practices for laying chickens are chosen on the basis of their ability to perform a basic task with a minimum of detrimental effects to the flock or to the environment in a cost-effective manner. For example, feed must be delivered to a flock frequently and in an adequate quantity and quality to satisfy each chicken's basic needs for nutrients. The delivery system must be well designed, competitive in price, free of defects, and low in maintenance costs if it is to be selected. This same principle is followed for the selection of every management system in use today.

Obviously, there are many alternative systems which can do a comparable job and individual farmers have different needs which may require different systems. This is why we see a variety of systems and practices. Owners use different strains of chickens, different feeding programs, different poultry houses, and a wide range of other management techniques. Farmers strongly defend their choices and justify them on the basis of their own experience. They get good responses from their flocks, the help finds the systems easy to work with, and ownership believes they are cost-effective and yield the highest returns on their investments.

Some of the practices in use today by the commercial table-egg industry are being criticized by observers of the industry. These practices are perceived as being harmful to the flocks or ones which fail to address the specific behavioral needs of the chickens. They include:

1. the use of animals in any way.
2. the caging of chickens.
3. the use of beak trimming.
4. the use of induced molting
5. transportation and handling systems
6. and others.

This list includes items which may require absolutely no change from current procedures, others which may need some modification to eliminate problem areas, and some which might justify major changes or even elimination from the list of choices. The industry, as well as individual producers, must take a hard look at their systems to determine whether or not adjustments should be made in areas of flock welfare and health without adversely affecting the economics of the operation.

This paper will address three areas from the list above which have drawn the most criticism in recent years - caging, beak trimming and induced molting.

CAGES FOR TABLE EGG LAYING FLOCKS

The commercial application of cages for egg production began in the 1930's, became widespread in the 1940's and 1950's and is currently thought to represent 70-80% of the World's production. Today, we would estimate that 98% or more of the commercial production of the United States is in cage systems.

During this 50 or more years of use, cages and their associated equipment have been improved and modified, cage density has increased (more hens per cage and/or less space per hen), strains of birds have been developed to perform more efficiently in current management systems, and other programs (feeding, health, beak trimming, lighting, etc.), have been adjusted to conform to the needs of birds in cage situations.

Concern has been expressed that chickens should not be caged. The argument is that birds are not able to express their "natural behavioral needs". They can't "nest" their eggs, dust their plumage, choose their feed, run around, or attempt to fly. In becoming domesticated and managed, the caretaker has either eliminated some of these practices or changed the way these needs are addressed. Originally, these concerns were not expressed as layers were housed in single-bird cages. Cages were applauded for removing chickens from their own feces and for eliminating the centuries-old problems of internal worms and parasites. Eggs were cleaner, working conditions for the farm laborers were better and general management was easier. But, most importantly, egg farmers made money with these new systems. Under these conditions, crowding was not a concern and single birds did not develop anti-social tendencies therefore beak trimming was not necessary when pen-mates were not present.

The original single-bird cages provided each layer with 968 to 1290 cm^2 (150 to 200 $in.^2$) of floor space and 12.8 to 25.4 cm (5 to 10 inches) of feeder space. As time passed, egg producers found they could add additional birds to their cages with little if any performance losses. As space allowances were reduced, performance was lost to the extent that further crowding could no longer be justified.

University of California research with the cage density issue dates back to 1961 when we studied the effects of adding a third bird to a standard 2-bird cage. The reduction from 697 to 464 cm^2 (108 to 72 $in.^2$) did not affect hen-day egg production, but mortality due to prolapse and pick-outs increased from 1.4% to 7.4%.

A second study in 1963 added a fourth bird to this same cage size and compared it to a 3-bird cage (464 vs 348 cm^2) (72 vs 54 $in.^2$). In this case, hen-day egg production was reduced from 64.0% to 61.7% and prolapse/pick-out mortality was doubled from 3.4% to 7.8%. Obviously, this density was approaching an un-economic level.

During the 1960's and 1970's cage densities gradually increased until today, when 310 and 348 cm^2 (48 and 54 $in.^2$) per bird have become the standard space allowances for laying hens in the US (white-egg strains). This compares to the 450 cm^2 (70 $in.^2$) standard in Europe and other countries for predominately brown-egg birds. Current discussions in Europe center around the questions of increasing allowances to 800 cm^2

(124 in.^{2}) or complete re-designing or elimination of the cage altogether. Interestingly, government officials recognize the need to "block the import of eggs from countries with weaker animal welfare standards otherwise Economic Union egg farmers would be put out of business by cheap eggs from elsewhere in the world".

Also during this same time period, numerous research studies have demonstrated time and again that additional birds decrease hen-housed egg production and increase mortality. Our analysis of 45 different experiments conducted across the US and Europe show 14 fewer eggs and 3.9% higher mortality rates for each addition of one bird per cage. Even though performance is adversely affected by increasing cage densities, egg producers can often justify the more crowded cage densities at different cost/egg price relationships. With many producers, current levels of egg prices and feed prices will not justify the lower space allowances. On the other hand, some producers can justify crowding under almost any cost/price relationship because of their ability to manage such situations.

In the last 20 years, the laying cage has gone through many modifications. Whereas the original cages commonly held 1-4 birds, today's cages are designed for 6-10. As a result of University of California research relative to cage design and other factors, more emphasis is now placed on feeder space allowances with most systems allowing 7.6 to 10.2 cm (3 to 4 in.) per bird. Cages have become more "square", thus allowing each chicken more feeder space. Multiple drinkers are recommended to avoid problems when an individual drinker becomes inoperative. Manure systems are designed to store wastes in a different level of the building or to be removed on a daily basis.

Today, we use larger cages than in the 1950-1960 period and the most popular cages are for 6 birds with space allowances of about 348 cm^2 (54 in.^{2}) per bird. In 1994 a large scale experiment was set-up on a commercial California farm to measure the performance and economic differences in placing 5, 6, and 7 birds per 40.6 cm wide by 50.8 cm deep cage (16 in. by 20 in.). This experiment was conducted over a 38 week experiment (to 58 weeks of age) with 53,000 DeKalb Delta White Leghorn hens. Data was based upon 24 rows of 2200 birds each. Results are listed in Table 1.

Table 1 illustrates that the highest returns per bird were obtained in the 6-bird cage. This was due primarily to a reduction in feed usage. The highest return on investment was also obtained in the 6-bird cage during low profit years, but with high profit years, the higher density (7 birds per cage) maximizes returns on investment. A fixed high density choice over time, might result in company failure during periods of extended low profit margins.

The choice of cages (design, size, shapes, etc.) and their management systems have many economic implications as discussed above, however, the proposed legislated elimination of cages in Europe will have even greater economic effects for egg producers throughout the region, to their suppliers and to the consuming public. The current proposal to eliminate cages within the next ten years is a major step backwards in the way flocks are managed. Flock health will be severely affected with major food safety implications. The current non-washing policy for eggs will likely have to be changed to adjust to the dirtier eggs produced by litter or free-range systems. Higher flock mortality rates are likely to occur thereby offsetting some of the claimed welfare advantages for non-cage systems. One European legislator was quoted as saying "Changing from battery to free-range eggs would cost the average consumer less than £2 a year". This would represent $850 million per year in the US - not a small amount of money!

Cages have many advantages that should not be discarded in exchange for the one presumed disadvantage of "the flocks' inability to express their natural behavior". The scientific community must communicate the net losses and gains which accrue when husbandry practices are abruptly and totally changed. Total effects are much broader and more complex than a mere £2 ($3.20) increase in costs to the consumer.

Caging is a pro-welfare system of housing laying hens. It results in ***improved livability, healthier flocks and higher profitability.***

BEAK TRIMMING

Beak trimming is a management practice used to reduce cannibalism, feather pecking, and other anti-social behavior in chicken flocks. Its benefits are widely acknowledged in the commercial chicken industry. Benefits include:

1. Reduced mortality from pecking.
2. Reduced injuries and sub-normal performance.
3. A general calming of the flock.
4. Reduced feed wastage and feed usage.

Today's methods date back to the early 1940's when the University of California developed a technique using a sharp edged device capable of being heated to cauterize the beak. Dozens of experiments and field trials subsequently refined the practice as we know it today. Beak trimming involve a complex set of decisions which describe in detail the process:

1. Age of birds to be trimmed.
2. Timing relative to other management practices.
3. Amount of beak to remove.
4. Shape of the cut.
5. Blade type and sharpness.
6. Blade temperature.
7. Time of cauterization.

Table 1. Performance results - Univ. of California cage density experiment - 1994.

Trait	5/cage *	6/cage*	7/cage*
Hen-housed eggs	198.0	194.3	185.2
Av. egg weight (g/egg)	59.8	60.1	60.3
Total weight of egg mass/hen-housed (kg)	11.84	11.65	11.16
Mortality (%)	6.5	8.4	9.4
Daily feed intake (g)	105.6	101.4	99.4
Profit index/hen-housed ($)	3.97	4.08	3.79
Profit/cage (high costs) ($/cage) **	4.68	6.18	5.32
Profit/cage (low costs) ($/cage) ***	11.98	14.66	15.06

*Cage size = 16 in. (40.6 cm) wide x 20 in. (50.8 cm) deep.

** High costs = $2.50 per pullet, $7.50/100 pounds of feed, $.50/dozen eggs.

*** Low costs = $2.00 per pullet, $6.00/100 pounds of feed, $.50/dozen eggs.

Table 2. Performance results - University of California beak trimming study - 1993/94[1]

(40 weeks of results with projection of economic results to 78 wk.).

Trait	Beak Trimmed	Not Trimmed	Statistical Significance[2]
Hen-housed eggs	191.5	195.7	***
Av. egg weight (g/egg)	58.9	59.7	***
Total weight of egg mass/hen-housed (kg)	11.27	11.68	***
Mortality (%)	3.39	4.73	***
Daily feed intake (g)	96.0	101.3	***
Profit index/hen-housed ($)	3.99	4.00	not significant
Profit (projected to 78 weeks of age) ($) + $.24/hen housed[3]			

[1]71,000 Hy-Line W-36 White Leghorn hens (18-58 weeks of age).

Non-trimmed versus 7-week trimmed.

[2]* ($P < 0.05$), ** ($P < 0.01$), *** ($P < 0.001$).

[3]Projected profits to 78 wk of age is based upon 1.25¢/wk profits during the 51-58 wk period.

Table 3. Performance results - North Carolina State University beak trimming study - 1996/97.

Trait	Non - trimmed	6 day precision method	11 wk severe method
Hen-housed eggs	316	335*	333*
Hen-day egg production (%)	79.8	81.2*	80.9
Av. egg weight (g/egg)	61.1	61.5	60.5
Fearfulness score[1]	2.95	2.50*	2.20*
Feather score[2]	3.00	4.80*	5.75*
Mortality (%)	26.3	18.7*	17.1*
Daily feed intake (g)	122	114*	107*
Egg income minus feed cost ($/hen-housed)	8.38	9.87*	10.23*

[1,2]The higher the number the greater fearfulness and greater feather cover.

*Significantly different than the non-trimmed birds.

Failure to monitor and control any of these can give less than desirable results. Even though, there are methods to reduce the severity of this problem, beak trimming still appears to be justified when one considers the advantages and disadvantages of this issue.

Lower light intensities in controlled environment houses will tend to reduce the problem of cannibalism and thus may eliminate the need to beak trim for cannibalism control per se. Some strains of birds have very low levels of anti-social behavior, but advantages can still be demonstrated for beak trimming. Reduced cage densities will lessen mortality problems associated with crowding, but economics may still dictate the use of beak trimming to control costs.

Commercial-scale experiments comparing beak trimming vs non-trimmed controls are difficult to conduct as farmers are reluctant to risk the increase in mortality they expect by not trimming a large number of their birds. In addition, proper experiment design requires replication of treatments and large numbers of hens in each replicate are required to make meaningful assessments of mortality effects.

In 1994 an experiment was set up on a large commercial farm in California to measure the differences in performance between beak trimmed and non-trimmed birds (Table 2).

The California experiment included 71,000 birds placed in 32 - 2200 bird rows. Cages were 40.6 cm wide by 50.8 cm deep (16 in. by 20 in.) and 6 birds were placed in each cage. The experiment was conducted for 40 weeks beginning at 18 wk of age and ending at 58 wk. Because the birds were to be molted at 60 wk, the last 20 wk of results were projected from performance levels during weeks 51-58. Economic differences at that time were due mainly to feed consumption savings for the beak trimmed birds.

Significantly higher egg production and egg weight was observed in the non-trimmed birds, but they also experienced more mortality and consumed more feed. Mortality in this experiment was exceedingly low in both treatments due to the strain of birds used. The 1.34% difference in mortality in favor of the beak-trimmed birds was highly significant ($P < 0.001$) and would have probably been missed in traditional smaller experiments. The 5.3 gram per day reduction in feed consumption in the beak trimmed birds was associated with lower body weights (105 grams/bird) and a slightly lower production of egg mass. Eighty percent of the differences in feed consumption were associated with these two factors. Waste did not appear to be a major contributor to the differences noted.

A similar experiment in 1997 by Anderson and Davis at North Carolina State University compared two beak trimming methods with a non-trimmed control. This experiment included 3160 pullets for 64 weeks of production. This experiment was unique in that “fearfulness” and feathering were evaluated. Results are listed in Table 3.

Unlike the California study, higher hen-housed egg production was observed. This was due principally to high mortality and major differences in mortality between beak trimmed and non-trimmed treatments. Similar trends to the California research for feed consumption were seen with a marked reduction exhibited by the trimmed groups. The fearfulness score was significantly higher for the non-trimmed treatment indicating a further advantage for beak trimming. And finally, the feather coating was markedly superior in beak-trimmed birds. This may be a significant contributor to the lower feed consumption observed. Individual beak trimming methods also show dramatic differences in flock performance as seen in Table 3. Even though the 6 day precision and 11 wk severe method birds laid practically the same number of eggs, feed consumption, feather score and economics favored the 11 wk severe beak trimming method.

Performance differences between beak trimming methods have always been seen in University of California experiments dating back to 1972 (Table 4). Interestingly, similar to the North Carolina research, the more severe (apparent) methods commonly outperform the less severe methods. No economic analysis was made in this experiment. A significantly higher egg production rate was observed in the severely trimmed groups. The 18 eggs improvement was unexpected because of the apparent severity of the method.

A comparable experiment was conducted in 1981 to verify the moderate/severe beak trimming comparison. A third method was added - a one cut technique for both beaks. All trimming was done at 12 weeks. This experiment was also designed to determine if results were different with different colony sizes. Results are shown in Table 5. Results of this experiment verify the results of the previous experiment by demonstrating the superiority of the severe beak trimming method but primarily in the more crowded environment. Feed consumption was similar for all methods, but mortality differences were large. In summary, the more severe method was the method of choice, especially in the more crowded condition. Mortality was reduced and profitability was higher.

Beak trimming is a practice that no one likes, but it does prevent higher levels of cannibalism and appears to be of major economic importance to the industry. The selection of the best method is also an important decision for poultry flock managers. But, of equal

Table 4. Beak trimming methods and performance - University of California - 1972[1].

Trait	7 day precision	12 wk moderate[2]	12 wk severe[3]
Hen-day egg production (%)	69.7	69.4	72.8
Hen-housed eggs	216	213	231
Mortality (%)	13.9	16.5	12.0
Egg weight (g/egg)	55.5	56.0	55.9
Daily feed intake (g)	116	113	114

[1]22 to 70 wk. of age.

[2]Top beak to 1/4 inch of nostril, bottom beak 1/3 trimmed.

[3]Top beak to 1/4 inch of nostril, bottom beak 2/3 trimmed.

Table 5. Performance results - University of California beak trimming study - 1981[1].

Trait	Moderate 3/cage	Moderate 4/cage	Severe 3/cage	Severe 4/cage	One cut 3/cage	One cut 4/cage
Hen-day egg production (%)	77.1	71.5	78.0	76.0	74.8	74.9
Hen-housed eggs	246	217	243	244	232	216
Daily feed intake (g)	104	105	103	103	103	105
Mortality (%)	7.3	18.0	11.5	8.6	15.6	24.2
Egg income minus feed cost ($/hen-housed)	3.24	2.35	3.18	3.11	2.84	2.63

[1]20 to 68 wk of age.

Table 6. Comparison of a single cycle program with a two cycle program - 1999.

Trait	Single cycle (80 wk sale)	Two cycle (110 wk sale)[1]
Av. hens (%)	95.6	93.4
Av. wkly mortality (%)	.150	.154
Hen-day egg production (%)	77.9	72.9
Eggs per hen-housed	312.9	428.7*
Large & above eggs (%)	76.9	81.1
Total egg mass (lbs/hen-housed)	41.7	58.1*
Undergrade eggs (%)	5.5	5.6
Av. egg value (¢/dozen)	52.7	53.4
Daily feed consumption (g)	101.6	98.9
Feed per dozen (lbs)	3.45	3.60
Feed cost (¢/dozen)	25.0	26.0
Pullet cost (¢/dozen)	9.6	7.0
Feed + pullet (¢/dozen)	34.6	33.0

[1]Molted at 65 weeks of age.

*Longer period of time.

importance, the monitoring of the practice is essential to be sure that techniques are applied evenly across the entire flock.

Beak trimming is a pro-welfare management technique and is done to ***reduce mortality*** and to ***improve profits in egg production.***

INDUCED MOLTING

Induced molting (forced molting) is a procedure used to rejuvenate laying flocks for a second cycle of egg production. Molting, as applied by the farmer, has been used off and on in the commercial egg industry for almost one hundred years. Early mention was made in Professor Rice's book in 1905. It was revived in the 1930's in the Pacific Northwest region and has been practiced at a high rate there ever since. Its second re-birth occurred in the late 1950's in Southern California and has been incorporated in a high percentage of replacement programs throughout the country.

Induced molting usually involves removal of feed for periods of 5 to 14 days followed by a low nutrient ration for the remaining days in a 28-day molt program. Molting, in nature or induced by the farmer, have the same effect - rejuvenation of the flock with resulting higher egg production, renewal of feathering, and improvements in egg quality.

Molting programs involve an estimated 75-80% of the commercial flocks in the US. At any point in time, 25-30% of the nation's layers are either in a molt or have been molted earlier - this represents some 75 million layers out of a total of 265 million. Molting is considered a part of the normal replacement policy on the majority of farms in the US today. Options for the farmer include 1, 2, or 3 cycle programs with disposal ages ranging from 75 to 140 weeks of age.

It's estimated that replacement programs that include molting result in at least 15% higher profit margins for the egg producer compared to all-pullet programs (1999). Model building computer software is available to construct typical 1, 2, and 3 cycle flocks. Such models are based upon individual owner experiences or can be developed from breeder standards. Although developed to determine optimum replacement policies, they can also be used to determine "what if" situations for different cost/price situations or for conditions unique to a particular region of the world.

An example of performance, cost, and income for a typical molt and non-molt program is shown in Table 6. In this example, after exclusion of other costs, the annual income per hen-housed from the molt program is estimated to be $1.32 compared to $1.15 for the one cycle non-molted program - an increase of 15% in profits. With lower egg prices or higher feed prices, even greater differences would exist. Molting is more justified under low margin conditions (low egg prices or high feed prices).

As one can see, molting is an important tool for optimizing profits in the egg industry. Much of the controversy about molting is not about the practice itself, but is directed at the ***methods*** used to molt a flock. Practically all methods require some degree of feed or nutrient restriction and this is not acceptable to many. There are methods which limit specific nutrients (calcium, sodium and protein) which are used in countries that do not allow feed withdrawal. Most of the research with these methods has not proven them to be as satisfactory compared to traditional feed removal methods.

The elimination of induced molting in the egg industry would have far-reaching effects on egg producers, their suppliers and the general public. US egg industry's cost and egg price conditions result in very narrow profit margins and the choice of replacement programs has a major impact on a farm's profitability.

Technology is usually adopted slowly and the total effect is spread over the entire industry over a several year period. This prevents massive over-night changes in egg supplies and resulting disruption of the egg market. From time to time, different developments have come along that have dramatically changed the performance characteristics of the nation's flock and major changes in the industry's profitability have occurred. Examples of this include: major disease epidemics, large changes in feed prices, and significant changes in the performance characteristics of different strains of chickens. Eliminating a primary management technique (molting) arbitrarily, is an example of an extremely disruptive problem. It would result in:

1. The nation's laying flock would increase in size by about 3% as a result of higher house utilization.
2. All-pullet flocks would lay at a 4% higher rate than two-cycle flocks do today.

(Both of these would have a major negative effect on egg prices.)

3. Higher costs of production.
4. Approximately 47% more:
   a. Additional chicks to hatch
   b. More breeding farms and breeding flocks
   c. More hatcheries
   d. More male chicks to be destroyed
   e. More spent hens to market
5. Higher percentages and numbers of medium and small eggs.

Induced molting is a vital component of the replacement programs used throughout the industry. Without molting, flocks would be kept beyond the optimum age for high egg quality, costs to the industry would be prohibitive and the age at disposal for flocks would be shortened from the current 105 to 110 weeks to 75 to 80 weeks.

Induced molting is a pro-welfare management technique and is done to ***lengthen the productive life of flocks*** and to ***improve profits in egg production.***

CONCLUSIONS

The well-being of commercial laying flocks is the result of the systems chosen and the quality of management to make them work as intended. Oftentimes, simple changes can be made to improve these systems which result in both improvements in the well-being of the flock and the profitability of an operation. Careful monitoring of caging, beak trimming and induced molting procedures will minimize the risk of hurting our flocks and their performance. High reproductive performance is an excellent indicator of overall good management.

The choices the farmer makes are driven mostly by economics and economics cannot be arbitrarily dismissed from its important position. Most welfare issues are incremental ones:

* more birds per cage reduces performance
* more days off feed increases mortality
* the more beak removed, the greater the damage
* and so on

Regulations either eliminate practices altogether (no cages) or place numeric restrictions (450 cm^2 per hen) (70 $in.^2$) on a practice. Such regulations are usually enacted to address the exceptional problems but are imposed upon all. If the regulatory route is chosen, it must be based upon scientific fact and not the expedient approach of totally disallowing a practice for political reasons.

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[Talk presented by Don Bell, UC Poultry Specialist (Emeritus), Davis, CA.]

TIPS FOR MANAGING PHOSPHORUS IN THE FIELD

Producers often wonder if there are certain crops or combinations of crops that can be grown that will remove soil P at a much faster rate than other crops. The short answer is "no". While cropping systems for maximum P removal can be an important part of a P management effort, other tactics will need to be applied to address P related water quality concerns. This article will take a brief look at P crop removal, the New York Phosphorus Index and P in starter fertilizer.

Most field and vegetable crops that are produced in the Northeast do not remove huge amounts of P from the soil. This is especially true for crops where the reproductive parts alone may be harvested: grain corn, wheat, soybeans, sweet corn, potatoes, snap beans, peas, etc. For example, soybean removes about 1 pound P2O5 per bushel whereas corn grain removes about .4 pounds P2O5 per bushel (P times 2.3 = P2O5). But soybeans yield much less per acre than grain corn so the total P removal potential (about 40-50 pounds P2O5 per acre depending on yield) is similar for both crops (See Penn State Agronomy Guide for P removal of other common field crops: http://AgGuide.agronomy.psu.edu/sect2/tab2-11.htm).

In plants, P is concentrated in the reproductive parts to provide nutrition for young seedlings, yet in many crops, about 50% of total plant P is found in the stalks and leaves. So while corn grain has a relatively high concentration of P compared to the stalks and leaves, the total P content is about the same for both. This means that a 120 Bu crop of corn for grain removes about 50 pounds of P2O5 equivalent, while the same crop harvested for silage removes about 100 pounds of P2O5. So all you need to do is find a way to feed corn silage to your birds and you can double the P removal! OK, maybe not. But this does provide one clue as to how to manage soils for P. Any time that the whole plant can be harvested, significantly more P is removed. For example, can corn stalks be harvested and sold for bedding? Does this work with your soil management plan? Can organic matter and soil erosion concerns be dealt with by using cover crops? One NY poultry producer I know of removes corn stalks with a corn chopper and uses the stalks as a carbon source for composting poultry litter.

Maximizing yield is an important P removal tool too. Are crop yields limited by things under your control? Timeliness, weed control and tile drainage are just a few things that could be addressed.

Cropping systems should not be overlooked as a way to improve P management. However, most poultry farms will need to look at a combination of other P management practices to meet environmental expectations. One tool that will help with this is the Phosphorus Index or PI. A PI helps assess the P runoff risk of a field and indicates a range of appropriate management practices that should be undertaken to minimize runoff risk. Many states around the Northeast are developing a PI in response to federal policy. Of three available options, the PI offers the most flexibility to Northeast producers because it takes into account important differences between fields such as soil test, management practices and relationship to water. However, the PI may restrict manure applications on fields with soil test levels well beyond agronomic needs, particularly if they are close to a stream or watercourse.

The PI for New York is now available and it will need to be implemented as part of your CAFO plan over the next several years.

Public and private sector planners will be learning more about it in the coming months. You can find additional information about the NY-PI at: http://www.css.cornell.edu/nutmgmt/index6.html.

One last comment: the P balance of a farm can often be improved by closely scrutinizing fertilization practices, especially starter fertilizer. For example, small plot and on-farm research suggests that a complete starter fertilizer with as little as 10 pounds of P2O5 per acre in the starter band can support full yield of corn on soils that test high and very high for P. Talk to your agronomic advisor about the opportunities here and take a look at the material located at http://www.css.cornell.edu/nutmgmt/index6.html.

[Talk presented by Karl Czymmek, Field Crops and Nutrient Management, PRO-DAIRY, Cornell University.]

ACE FARM COMPOSTING

We do two types of composting at Ace Farm. They are outside windrows in which the chicken manure is mixed with leaves and composted and the second is turned under a high-rise house with a Brown Bear turner.

The outside composting is done with the use of a manure spreader, loader and excavator. The process is done by bringing the manure to the leaves with the manure spreader and dumping on a pile of leaves or manure and leaf mixture. Then, more leaves are mixed with the manure at the rate of 75% leaves and 25% manure. The mixture of leaves and manure is mixed in the pile and then set into windrows with either the excavator or loader. Once in windrows, the mixture is turned about six times every two weeks and then left to cure for several months. The compost is then offered for sale to be mixed with other soil to make top soil or screened and sold for compost.

The second method of composting we do is under our high-rise house with a Brown Bear turner. This is not true compost because we only add a small amount of wood shavings to start the process. When we start a new flock of chickens in the barn we put down a couple of inches of wood shavings on the floor. After a few days, we start turning the manure with the Brown Bear turner. The turning is usually done three times a week to keep the flies under control. If there is very little fly activity it can be stretched to twice a week. If there are flies in the pit, the maggots grow very rapidly on the top of the windrow due to its warm moist nature. We also find it necessary to run pit fans in the pit during the first few months due to the higher moisture content of the manure of the young birds. When a good dry windrow is established, the pit fans can be reduced or turned off. Our pit fans are on hangers mounted to the wall so they can be swung out of the way when turning the manure. The manure is turned in the building for about four months at which time it is taken out and stored under tarps for sale. When we take the manure out, we leave about 25% in the building to start the new cycle. The manure gets to about 120 degrees in the building and 140 degrees stacked outside.

We have made several observations since we started. The maximum height of the windrow is about 2.5 ft. to efficiently turn it. The turning greatly reduces flies without any spraying, but you must not stop turning for any length of time because the top is an ideal place for flies to breed. The composting also eliminates the beetles and other bugs in the manure. It reduces volume by about 50% and makes it easier to clean out at the end of the cycle.

I think that composting has many advantages, such as reducing or eliminating odor and pests, stabilizing nutrients, reducing volume, and increasing marketability of manure. The one major drawback is that it is time consuming and requires large capital expense for the return you get.

[Talk presented by Tyler Etzel, Ace Farm, Monroe, NY.]

STICKY TRAPS FOR LARGE SCALE HOUSE FLY TRAPPING IN NEW YORK POULTRY FACILITIES

The house fly, *Musca domestica* L., is the primary pest in New York poultry facilities. The potential for fly outbreaks on farms combined with a highly mobile adult insect and the possibility of nuisance fly litigation intensify poultry producers' anxiety. Insecticide resistance and loss of insecticides due to regulatory actions have reduced pesticide options available for fly control. Proven biological and cultural fly control options offer cost-effective alternatives to the use of insecticides. However, these methods often do not provide a reduction in adult house fly outbreaks that commonly occur 4-8 wk following repopulation or in fresh manure following a mid-year cleanout.

A new sticky trap, the Spider Web™ (Atlantic Paste & Glue Co., Inc., Brooklyn, NY), captures large numbers of house flies when fly densities are high. However, like other sticky devices, effectiveness can be reduced under dusty conditions that are commonly found in poultry facilities.

To determine the longevity of trap efficacy, we evaluated the Spider Web™ in two commercial conventionally-ventilated, high-rise, caged-layer poultry facilities in New York. Adult house fly densities were monitored using spot cards (3 x 5 inch white file cards) that were positioned on each side of the facility on the bird level.

The Spider Web™ trap is a spooled ribbon, 11 in. wide by 24 ft. long, that when pulled exposes increasing lengths of adhesive coated ribbon. The attractiveness of the adhesive is enhanced by the addition of several house fly attractants. Spider Web™ traps were positioned horizontally, between the fluorescent lamps above the walkway. The outer aisle on each side was not included in the trial because of dust accumulation caused by close proximity to ventilation baffles. On one side, 4 ft. of each trap was exposed, while 8 ft. of each trap was exposed on the opposite side of the facility (2 aisles each). Facility 1 held 30,000 birds and contained 12, 8-ft. traps and 12, 4-ft. traps (six traps per aisle). Twenty-four 8-ft. traps and 24, 4-ft. traps were placed in facility 2, which contained 60,000 birds (12 traps per aisle). This arrangement resulted in one-half the linear distance (i.e. total area) of trap being present on the 4-ft. sides of the facility on a given day. However, because the 4-ft. traps were stretched twice each week, an equal amount of "unexposed" trap was presented each week.

All traps were changed weekly (new trap placed or an additional 4 or 8 ft. exposed). In addition, 4 ft. traps were refreshed (by pulling an additional 4 ft. of ribbon) following a 3-day exposure, providing an alternating 3- and 4-day exposure, equaling the single "fresh" 8 ft. exposure per week. Traps were initially placed on 2 July 1999 and the study concluded on 10 September 1999 (10 wk).

Following exposure, all traps were removed from poultry facilities and the numbers of house flies estimated. To make comparisons as to the relative loss in effectiveness of the trap over time, we converted the trap catch data to a constant, based on the estimated number of flies captured per foot of trap per day. Analyses were conducted on the fly-catch data to determine the impacts of linear distance exposed and to uncover a time-dependent reduction in effectiveness (accumulation of dust, feathers, etc.). To determine the impact of linear distance, the total numbers of flies captured on 3- and 4-day traps were summed and compared to the total fly-catch on 7-day traps. This allowed for a comparison between an equal time exposure, with only 50% of the linear distance presented with the 3- and 4-day traps. To determine the influence of time of exposure (duration) on trap efficiency, weekly fly catch data from the 3-, 4-, and 7-day traps were converted to a number of flies per foot of trap per day constant.

House fly populations in these poultry facilities were very high when traps were initially placed. Insecticides were not applied to either facility and manure conditions were very favorable for house fly production throughout the study.

Significantly more flies were captured using 8-ft. traps on 4 of the first 5 weeks when fly densities were highest. Whereas, during weeks 9 and 10, significantly more flies were captured on the 4-ft. traps. These study weeks also corresponded to weeks with lower fly catch rates and indicated that dust accumulation on traps may have reduced trap efficiency in as little as 7 days.

During all sampling weeks, both the 3- and 4-day traps captured significantly more flies *per foot per day* than the 7-day traps. Furthermore, on 7 of the 10 weeks, 3-day traps captured significantly more flies per foot per day than 4-day traps, indicating a rapid deterioration in trap efficacy due to dust accumulation.

Although the trap was not as efficient after a few days, it was certainly not ineffective. The display of 6 or 8 ft. of trap has surface area advantages over shorter presentations, especially when fly populations are high. Placing and stretching traps was labor intensive. Although shorter traps captured significantly more flies per foot per day, the additional labor required to maximize catch rates would render frequent trap maintenance impractical. The incorporation of an automatic stretching device would provide poultry producers with a labor saving investment as well as improve trap effectiveness. However, following an initial 6 or 8 foot exposure, the "refresh" or roll-up rate should be designed to offer a slow delivery. This would offer an excellent balance between trap effectiveness and economics.

The estimated total number of house flies captured on 3-day exposed, 4-ft. traps was 2,167,046 flies, on 1427 linear ft. of trap (equivalent to 60 traps). The estimated total number of house flies captured on 4-day exposed, 4-ft. traps was 2,353,086 flies, on 1427 linear ft. of trap (equivalent to 60 traps). The estimated total number of house flies captured on 7-day exposed, 8-ft. traps was 4,649,162 flies, on 2854 linear ft. of trap (equivalent to 120 traps). The estimated total number of house flies captured during this 10 wk study was 9,169,294.

Electrocuting black light devices placed in manure pits have been reported to kill over 29,000 flies per device per week. When the electrocution device was combined with muscalure (Z-9-tricosene), a sex attractant, the efficacy of the device was increased up to 76%. The Spider Web™ traps captured ca. 25,000 house flies per trap per week at the manufacture recommended rate (20 ft. of trap for every 600 $ft.^2$ area). These capture levels are comparable to those reported for electrocuting black light devices placed in manure pits; however, the Spider Web™ traps were positioned at the bird level.

Spot card data documented the

reduction in fly densities at the bird level (upstairs). There were no significant differences between fly populations on either side of the facility. This is not surprising given the high mobility of adult house flies. As discussed earlier, trap catches also decreased as the study progressed, further demonstrating the effectiveness of the Spider Web™ in reducing fly populations.

Cornell University Poultry Pest Management Recommendations suggest a treatment threshold of 100 spots per card. The numbers of spots per card in this study were above this threshold for the first 4 wk, and for 5 of the 10 wk of the study. This suggests that house fly populations can be reduced; however, they cannot be satisfactorily managed using only trapping. Furthermore, use of the Spider Web™ would be most advantageous in conventionally-ventilated facilities during house fly outbreaks when producers are most concerned about off-farm fly movement. The Spider Web™ provides an additional effective management tool to poultry producers facing severe fly outbreaks. It should be noted, however, that dust accumulation on the traps in turbo-style ventilated facilities was excessive and that the use of the Spider Web™ in these facilities is not recommended.

[Talk presented by Phil Kaufman, Department of Entomology, Cornell University.]

KREHER'S POULTRY FARMS

Kreher's Poultry Farms composts all of the manure from 600,000 hens and 200,000 pullets in two compost buildings. The original building was built in 1995 and the second building was built in the fall of 2000. The buildings both utilize in-vessel turned windrow technology and have 300-feet long bunkers that are turned and moved twenty feet every third day. The building constructed in 2000 has six bunkers that are each fifteen feet wide. The turning machine rides on rails installed on the three-foot high bunker walls. Both the 1995 and the 2000 facility turning machines were built locally by L-Brooke Farms (Jim Vincent) in Byron, New York.

The poultry manure is dried to approximately 50% moisture in the poultry houses and retains the original dropping shape and structure. It is belted to the buildings (rather than using augers or scrapers) in order to keep the original structure. This method does not utilize any added ingredients such as wood chips or sawdust. It yields a 5-4-2 N-P-K nutrient analysis, which makes a good organic fertilizer and spreads very evenly with a lime spreader.

The process behaves exactly like composting, rising to approximately 135 degrees Fahrenheit overnight after being belted into the facility, and staying approximately 135-150 degrees throughout the six-week retention time. However, at the end, it is not as stable as a cured compost, and users need to be careful to use it sparingly, not apply it heavily and "burn" plants.

[Talk presented by Brett Kreher, Kreher's Poultry Farms, Clarence, NY.]

AVIAN INFECTIOUS CORYZA: CAN NEW YORK STATE AFFORD IT?

Introduction

Avian infectious coryza (AIC) is an insidious disease that dramatically increases the cost of production. It reduces productivity, and increases mortality and number of culled chickens. In addition, its prevention and treatment through bacterin and antibiotic use is expensive.

Description

AIC is a disease of the upper respiratory tract, characterized by ocular and nasal discharge, sneezing, swollen sinuses and wattles. It is of economical importance because it reduces the rate of growth, increases mortality. In broilers there is a marked increase in condemnations due to air sac lesions. In layers, AIC is the cause of reduced egg production, increased culled birds and mortality.

Geographic distribution

To the author's knowledge, AIC has not been diagnosed in New York State in the last 15 years. AIC is rare, if not absent in most of the US Northeast. The situation changed in December 2000 when Opitz observed a very severe outbreak of AIC in a multiple-age farm in Maine.

AIC has a worldwide distribution; it has been identified in Argentina, India, Mexico, Morocco, and Thailand, to name a few. In the US, AIC is prevalent in California and in the South.

Importance

AIC may infect chickens of any age, but the effects of the disease depend greatly on the type of chicken, and complicating factors. In replacement pullets AIC reduces growth rate, and causes mortality when complicated with other respiratory diseases, but is of minor consequence in chickens free of *Mycoplasma gallisepticum* (Mg). In laying hens, egg production may drop as much as 40%, and mortality may be as high as 10%. In one of the few publications about losses caused by AIC, Bell estimated that losses in a flock of 100,000 Mg-free White Leghorn, amounted to $28,000 1995 USD. In this flock, there was a loss of an average of 7.3 eggs per hen, and 1% increase in mortality. In contrast, Cutler in 1980 reported an outbreak in Egg City, where 2.5 million layers were affected in the course of 60 days. Cutler observed drops in production from 15 to 40%, depending on the Mg status and age of the affected flocks. It has been observed that the worst affected flocks are those infected simultaneously with *Haemophilus paragallinarum*, and *Mycoplasma gallisepticum*, *E. coli*, *Pasteurella spp*., infectious bronchitis, and laryngotracheitis. In broilers, Hoerr described an outbreak that caused 19% mortality and 70% condemnation due to air sac lesions.

Etiology

AIC is caused by *Haemophilus paragallinarum;* a bacterium that does not survive well outside the host and that is susceptible to antibiotic treatment. The disease caused by *Haemophilus paragallinarum* may vary in its severity, depending on the pathogenicity of the strain, and complicating factors. From the standpoint of antigenicity (ability to induce antibodies), three major types have been described (A, B, and C). Infection or vaccination with one of them does not confer complete protection against the others.

Transmission

The main form of transmission between farms is by infected chickens. Moving, vaccination crews and contaminated equipment, and air transmission have been suspected also, but do not seem to be the most effective way of transmission. Within a house AIC is transmitted most effectively by the drinking water, followed by the air and personnel.

Clinical presentation

The first signs: nasal and ocular discharge, appear 18 to 36 hours after infection. Drop in feed consumption, depression and drop in egg production follow them. Nasal discharge becomes obvious with feed dust adhering to the nasal orifice and dirty feathers at the base of the neck, because the chickens try to clean their nose. Alteration of egg quality has not been described. As the disease progresses and other agents come into play, the clear nasal exudate turns turbid and acquires a foul smell. There is swelling of the face and wattles, and closed eyes.

Differential diagnosis

Velogenic viscerotropic Newcastle disease, infectious laryngotracheitis, infectious bronchitis, fowl cholera.

Prevention and control

Biosecurity. Introduction of AIC is relatively easy to prevent because the causative agent is very labile, and short-distance air-borne transmission is not very effective. Long-distance air-borne transmission is almost impossible. Most of the AIC outbreaks can be traced to introduction of carriers to a susceptible farm.

Eradication from single-age farms is possible after depopulation, cleaning and disinfection. In contrast AIC is very difficult to eliminate from multiple-age farms, where susceptible birds are added constantly.

Immunization

The effects of AIC may be prevented using bacterins. The best results are obtained when the bacterin is given twice at 12 and 16 weeks of age. It is preferred that the bacterin is prepared with the farm's own *Haemophilus paragallinarum* strain, or at least the three known serotypes of *Haemophilus paragallinarum.* Unfortunately bacterins do not prevent infection and do not always prevent a drop in egg production. Even though more effective, autogenous bacterins are more expensive than off-the-shelf products, and they take time to prepare.

In replacement pullets, bacterin application should be followed by exposure to the live organism.

Treatment

Treating AIC is difficult. The antibiotic should be given at a moment when most of the flock is infected, but before egg production drops. If given too early, many birds will not develop immunity, and will be infected after the treatment is withdrawn. If given too late, secondary infections may arise and productivity will be drastically affected.

Legal levels of chlortetracycline and erythromycin are seldom effective against AIC.

Increase protein and vitamin intake reduces the effects of AIC.

[Talk presented by Dr. Benjamín Lucio-Martínez, Department of Microbiology & Immunology, College of Veterinary Medicine, Cornell University.]

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