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The Influence of the Darkling Beetle (*Alphitobius diaperinus*) As A Vector and Repository of Food Borne Pathogens — A Literature Review

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While it is widely recognized that darkling beetles and their larvae harbor a variety of avian viral pathogens (IBD, Fowl Pox, NDV, ALV) and protozoal pathogens (*Eimeria spp.*), and that they can cause great destruction to poultry houses while negatively impacting costs and performance parameters in broiler production (1-9), it is only somewhat recently that their role as reservoirs for *Salmonella spp.* and *Campylobacter spp.* has gained clarity in the scientific literature. Perhaps this is due to the increasing emphasis placed on food borne pathogen reduction, as HACCP concepts and regulatory requirements are increasingly implemented in poultry processing plants. New research suggests that the effectiveness of darkling beetle pre-harvest control programs may impact food pathogen loads on carcasses (Salmonella, Campylobacter) via their impact on pathogen prevalence in broilers entering the processing window.

Broiler Performance Data (Region)
Live Production Cost

	SW	Midwest	Southeast	Mid-Atlantic	S-Central
Feed cost/ton w/o color ($)	144.39	132.53	142.43	143.80	140.27
Feed cost/lb meat (¢)	13.69	12.10	13.41	13.62	13.58
Days to 4.6 lbs	42	41	43	43	41
Chick cost/lb (¢)	3.81	4.04	4.24	4.29	3.50
Vac-Med cost/lb (¢)	0.07	0.05	0.06	0.08	0.12
WB & 1/2 parts condemn. cost/lb	0.20	0.27	0.14	0.24	0.18
% mortality	5.90	6.42	5.84	6.66	5.91
Sq. Ft. @ placement	0.83	0.82	0.79	0.76	0.83
Lbs./Sq. Ft.	7.04	6.39	6.67	7.19	7.54
Down time (days)	11	9	10	14	14

Data for week ending March 26, 2005

Contents

J. Wagenaar, et al, demonstrated that darkling beetles and larvae inoculated with a cocktail of three *C. jejuni* strains and one *Salmonella paratyphi B. var. java* strain readily infected previously uninfected 6-day old chicks when only 3 larvae were fed to each chick (10). The authors note that, "If *Campylobacter* or *Salmonella* are able to survive in the insects for at least 1 week (the period between consecutive broiler production cycles), it might be transferred to a next flock of birds via the insects." The authors conclude, "It can be stated that beetles and larvae of *Alphitobius diaperinus* are able to transmit *Campylobacter jejuni* and *Salmonella java* to chickens. Since it is known that as soon as one chicken is positive, *Campylobacter* will be transmitted to the other animals in the same house very quickly, it is imperative that control of beetles and larvae is included in the biosecurity system of broiler farms …"

C. Bates, et al., 2003, reported on the relatedness of *Campylobacter* isolated from broilers and from darkling beetles found in New Zealand broiler production units (11). The isolates were compared using genotyping of the *flaA* short variable region (SVR) with sequence analysis. The authors state that, "A large number of *Campylobacter* subtypes were isolated, indicating that *Campylobacter* colonization of poultry is likely to arise from a number of different reservoirs. However, a set of genetically distinct isolates were found to be common to the broiler flocks and to the beetles. This research provides data that indicates that *Alphitobius diaperinus* may serve as a source of *Campylobacter* contamination of poultry." The authors suggest that, "One explanation for the observed decrease in the diversity of *Campylobacter* clones recovered from beetles is that some subtypes of *Campylobacter* may be better adapted for survival in different niches than others. It may well be that the environmental stresses associated with having a beetle as a niche have led to preferential survival of specific *Campylobacter* clones. A second possible explanation is that beetle-associated isolates were recovered using enrichment methodology, whereas the fecal isolates were recovered using direct plating. It has been previously demonstrated that the use of enrichment media for recovery of Campylobacter may result in the preferential selection of certain subtypes. Molecular subtype analysis revealed that similar *Campylobacter* subtypes were common to the broiler flocks and to the beetles. Although the temporal cause-and-effect relation of transmission is unclear in this investigation, it could be suggested that the beetles may serve as an ongoing reservoir of contamination.

Jacobs-Reitsma, et al, published an earlier study (12) involving Dutch broiler farms that is supported by Bates' findings ." Campylobacter serotypes from darkling beetles inside the broiler houses were identical to the ones isolated from the broilers ….Broilers from identical parent flocks were found to be colonized in one production cycle and campylobacter-free in another. These data do not support the likelihood of vertical transmission as an important pathway; although Dutch breeder flocks are frequently found to be campylobacter carriers …. In contrast to the findings of Jones and colleagues, campylobacter was isolated on several occasions from the internal contents of darkling beetles and lesser mealworms, although this never occurred before the organism was also isolated from broilers. Identical serotypes were isolated from both the insects and broilers within houses E1 and E3. This might indicate an infection route from insects to broilers, but the reverse infection route from broilers to insects is just as likely. More detailed studies are needed to determine the survival and colonization potential of campylobacter in these insects under the less optimal conditions of an empty (and generally cold) broiler house.

Some questions that remain to be answered are, "How long will darkling beetles harbor *Campylobacter* following broiler flock depopulation; is carriage time in beetles dependent on temperature, climate, and strain, and of a duration long enough to infect the subsequent flock post-placement?" If it is found that certain *Campylobacter* sub-types have, in fact, adapted to the darkling beetle niche, then these subtypes could be expected to better survive broiler depopulation and have the potential to transmit *Campylobacter* infections to subsequent flocks.

Still other studies focus on the finding that Salmonella spp. have been shown to survive in darkling beetles between flocks, and beetles have been implicated in the flock-to-flock transmission of *Salmonella*.

J. C. McAllister, et al., demonstrated *Salmonella typhimurium* carriage by the darkling beetle at the University of Arkansas in 1994 (13). These researchers allowed beetles and larvae to consume inoculated broiler feed for 24 hours, and were able to culture the *Salmonella typhimurium* challenge strain within 24 hours from both the surface and internal organs of the beetles and larvae. They then allowed larvae to mature into adults and found that a low percentage of the resulting adults showed infection as well. These researchers then fed *Salmonella typhimurium* infected larval and adult darkling beetles (one per day-old chick), and within 24 hours cultured the same strain from cloacal swabs of 9/10 chicks that were exposed to infected larvae, and 7/10 chicks that were fed a single infected adult beetle. Of great importance is that these researchers confirmed earlier studies (Des las

Casa, et al., 1968) by demonstrating that darkling beetle adults and larvae carried *Salmonella typhimurium* for 28 days subsequent to a 24 hour initial exposure to the organism. The authors conclude, "Our data show that the lesser mealworm may serve as a reservoir, which maintains *S. typhimurium* in Arkansas broiler houses during and between grow-out periods. Because beetles void *S. typhimurium* in their fecal droppings and thus contaminate feed and litter, beetles may be of equal or greater importance indirectly as by directly being consumed by broiler chickens."

It is noteworthy that work reported by Dorte L. Baggesen involving *Salmonella typhimurium* eradication attempts on a Danish broiler farm demonstrated that all sanitation and cleaning attempts failed to break the cycle between flocks until the beetle population on the farm was eradicated (14). Other work done in Denmark by M. N. Skov (15) did not demonstrate inter-flock carriage of *Salmonella enterica* by darkling beetles. There appear to be Salmonella species differences that result in varying carriage times by the beetles.

It becomes apparent from these studies that control of darkling beetle populations should have a high priority in any biosecurity or Integrated Pest Management program, both for purposes of reducing food-borne pathogens in processing plants, and because darkling beetles harbor and transmit viral, fungal and other bacterial pathogens of chickens. As previously referenced, heavy infestations of beetles can affect flock performance, and other reports indicate that occasionally they will attack healthy live birds, causing sores and scabs that down-grade carcasses and raise welfare concerns. (1, 16). The larvae of darkling beetles have, on rare occasions, been found on finished product, assumed to be "maggots " by the customer. This results from broilers consuming litter containing larvae during an extended feed withdrawal, and carrying these larvae to the processing plant in their crops, where subsequent cropping and chilling processes deposit larvae on carcasses (Personal observation). Additionally, research has shown that extended feed withdrawal increases Salmonella levels in crops before slaughter. Since darkling beetles have been shown to harbor Salmonella, they may contribute to this phenomenon as well. It is for all these reasons that integrated poultry companies should be knowledgeable and pro-active regarding on-farm practices to control darkling beetle populations.

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Avian Infectious Bronchitis ... The number One Research Priority for the Commercial Poultry Industry

"The job of infectious bronchitis virus is to continue to change so that it can cause disease in chickens. Our job is to try to stay one step ahead of this virus which causes big economic problems worldwide," says Mark Jackwood, PhD, a research scientist at the Poultry Diagnostic and Research Center at the University of Georgia.

Avian infectious bronchitis costs the U.S. poultry industry millions of dollars annually. So much so, that the American Association of Avian Pathologists continues to list avian infectious bronchitis as the number one research priority for commercial poultry.

The virus is highly contagious. It is extremely difficult to control because different types of the virus do not cross-protect. Compounding this situation is its ability to change rapidly and adapt to its host.

But Jackwood and his team of investigators have had a great deal of success battling the Group III coronavirus which affects the upper respiratory tract, causing the equivalent of a common cold in chickens, slowing their growth and diminishing egg production.

There are only a few licensed vaccines available in the U.S., representing just six serotypes of the virus. And for the most part, those vaccines are being used with mixed success to control over 20 different serotypes and hundreds of variants of the virus.

The UGA researchers just developed a vaccine due to be released early this year against Georgia 98, a new strain of the virus they isolated and identified in 1998. It has since been isolated all over the country.

Jackwood's team also developed diagnostic tests to keep track of where the virus is and what it's doing. "These tests can distinguish between the different types of viruses, and will show us when new ones start to crop up. We continue to keep upgrading the tests with new technology to make them even more sensitive and more sophisticated — quicker, faster, cheaper."

His laboratory was one of the first to develop a molecular diagnostic test for viruses in 1993. "It revolutionized how we can detect this virus," Jackwood explains. "We went from being able to type three or four viruses a year to being able to identify and type 10 or more viruses in one day." Instead of typing the virus in eggs or cell culture, the molecular test looks very rapidly at the gene sequence in the virus to determine what type it is.

But the problem of controlling infectious bronchitis virus is not solved yet because the virus continues to change.

"So what we do is monitor chickens and figure out which strains are out there, which ones are causing the problem," says Jackwood. "Our diagnostic tests are the key element in surveillance."

"If we have vaccines against the strains we identify, we use them. If we don't, we examine those viruses more closely and try to develop vaccines".

Jackwood's work with infectious bronchitis virus in chickens has had an unexpected bonus. "We've developed a diagnostic test based on our bronchitis diagnostic tests, to identify a new coronavirus which showed up in turkeys four years ago.

This virus, which had never been seen in turkeys before, has now spread all over the country after first appearing in North Carolina. It causes diarrhea in turkeys less than two weeks old and results in a huge economic loss for the industry–more than a million dollars a year.

What interests Jackwood most about the virus is that it is very similar to the ones they study in chickens. "Right now we're trying to find out how it's transmitted, we're looking to see how it evolved, and we're trying to see if we can use it as a model for studying SARS."

SARS — human severe acute respiratory syndrome — is also caused by a coronavirus and has evolutionary ties to other corona viruses, including chicken and turkey coronaviruses. "We are also working on a vaccine for this turkey coronavirus," Jackwood says.

Broiler Whole Bird Condemnation (Region)

	SW	Mid-West	S. East	Mid-Atlantic	S. Central
% Septox	0.181	0.431	0.137	0.256	0.223
% Airsac	0.108	0.188	0.073	0.202	0.131
% I.P.	0.099	0.014	0.017	0.014	0.023
% Leukosis	0.001	0.000	0.001	0.001	0.033
% Bruise	0.005	0.002	0.003	0.002	0.005
% Other	0.008	0.012	0.016	0.017	0.006
% Total	0.403	0.647	0.246	0.492	0.422
% 1/2 parts condemnations	0.412	0.627	0.323	0.440	0.363

Data for week ending March 26, 2005

Broiler Performance Data (Company)
Live Production Cost

	Average Co.	Top 25%	Top Co.'s
Feed cost/ton w/o color ($)	141.49	135.17	134.37
Feed cost/lb meat (¢)	13.39	12.66	12.20
Days to 4.6 lbs	42	41	41
Chick cost/lb (¢)	4.06	3.69	3.49
Vac-Med cost/lb (¢)	0.09	0.05	0.02
WB & 1/2 parts condemn. cost/lb	0.19	0.15	0.10
% mortality	6.15	4.97	3.79
Sq. Ft. @ placement	0.80	0.82	0.81
Lbs./Sq. Ft.	7.00	7.08	6.77
Down time (days)	12	12	13

Data for week ending March 26, 2005

REMINDER

All previous issues of the Poultry Informed Professional are archived on our website www.avian.uga.edu under the Online Documents and The Poultry Informed Professional links.

Broiler Whole Bird Condemnation (Company)

	Average Co.	Top 25%	Top 5 Co.'s
% Septox	0.204	0.205	0.194
% Airsac	0.119	0.056	0.070
% I.P.	0.039	0.015	0.025
% Leukosis	0.005	0.001	0.001
% Bruise	0.003	0.004	0.006
% Other	0.010	0.008	0.002
% Total	0.379	0.289	0.297
% 1/2 parts condemnations	0.419	0.427	0.386

Data for week ending March 26, 2005

COBB-VANTRESS

Aviagen

Hubbard

Primary Breeders Veterinary Association

HERITAGE

The Poultry Informed Professional Newsletter is published with support from The Primary Breeder Veterinarians Association.

Excerpts from the latest USDA National Agricultural Statistics Service (NASS) "Broiler Hatchery," "Chicken and Eggs" and "Turkey Hatchery" Reports and Economic Research Service (ERS) "Livestock, Dairy and Poultry Situation Outlook"

Broiler Eggs Set In 19 Selected States Up 1 Slightly

According to the latest National Agricultural Statistics Service (NASS) reports, commercial hatcheries in the 19-State weekly program set 214 million eggs in incubators during the week ending April 23, 2005. This was up slightly from the eggs set the corresponding week a year earlier. Average hatchability for chicks hatched during the week was 84 percent. Average hatchability is calculated by dividing chicks hatched during the week by eggs set three weeks earlier.

Broiler Chicks Placed Up 1 Percent

Broiler growers in the 19-State weekly program placed 175 million chicks for meat production during the week ending April 23, 2005. Placements were up 1 percent from the comparable week a year earlier. Cumulative placements from January 2, 2005 through April 23, 2005 were 2.80 billion, up 3 percent from the same period a year earlier.

March Egg Production Up 2 Percent

U.S. egg production totaled 7.73 billion during March 2005, up 2 percent from last year. Production included 6.60 billion table eggs, and 1.13 billion hatching eggs, of which 1.07 billion were broiler-type and 63 million were egg-type. The total number of layers during March 2005 averaged 347 million, up 2 percent from a year earlier. March egg production per 100 layers was 2,225 eggs, up 1 percent from March 2004.

All layers in the U.S. on April 1, 2005, totaled 345 million, up 1 percent from a year ago. The 345 million layers consisted of 286 million layers producing table or market type eggs, 56.9 million layers producing broiler-type hatching eggs, and 2.63 million layers producing egg-type hatching eggs. Rate of lay per day on April 1, 2005, averaged 71.8 eggs per 100 layers, down slightly from a year ago.

Egg-Type Chicks Hatched Up 6 Percent

Egg-type chicks hatched during March totaled 40.0 million, up 6 percent from March 2004. Eggs in incubators totaled 34.1 million on April 1, 2005, up 2 percent from a year ago.

Domestic placements of egg-type pullet chicks for future hatchery supply flocks by leading breeders totaled 314,000 during March 2005, down 22 percent from March 2004.

Broiler Hatch Up 3 Percent

The March 2005 hatch of broiler-type chicks, at 816 million, was up 3 percent from March of the previous year. There were 658 million eggs in incubators on April 1, 2005, up 1 percent from a year earlier.

Leading breeders placed 7.08 million broiler-type pullet chicks for future domestic hatchery supply flocks during March 2005, up 4 percent from March 2004.

Turkey Eggs in Incubators on April 1 Down 4 Percent

Turkey eggs in incubators on April 1, 2005, in the United States totaled 29.1 million, 4 percent below April 1 a year ago. Eggs in incubators were 4 percent above the March 1, 2005 total of 28.1 million eggs. Regional changes from the previous year were: East North Central down slightly, West North Central down 1 percent, North and South Atlantic down 11 percent, South Central down 13 percent, and West up 11 percent.

Poults Placed During March Down 3 Percent From Last Year

The 23.4 million poults placed during March 2005 in the United States were down 3 percent from the number placed during the same month a year ago. Placements were up 10 percent from February 2005. Regional changes from the previous year were: East North Central down 8 percent, West North Central up 1 percent, North and South Atlantic down 8 percent, South Central down 14 percent, and West up 15 percent.

Broiler Production Higher and Exports Up

According to the latest Economic Resarch Service (ERS) reports, Broiler production in the first quarter of 2005 is estimated at 8.45 billion pounds, up 3.1 percent from the previous year. The increase is due in equal measure to an expected increase in the number of birds slaughtered and an increase in the average liveweight of birds. Exports in the first quarter are expected to total 1.25 billion pounds, a 22-percent increase from the previous year. The large year-over-year increase is attributable to bans by a number of countries on U.S. poultry products in the first quarter of 2004 due to avian influenza (AI) outbreaks.

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Normally with only moderate increases in production and growth in exports and lower stock levels, prices of broiler products would be expected to strengthen. Prices for whole birds averaged 71.9 cents per pound in the first quarter, down from the previous year, but up over 5 percent from the fourth quarter of 2004. Prices for whole broilers are expected to gradually strengthen during 2005, but not until the fourth quarter will they exceed last year's levels.

Turkey Estimates Reduced

The first quarter 2005 estimate for turkey production was reduced by 15 million pounds to 1.31 billion pounds, about even with production in the first quarter of 2004. Over the first 2 months of 2005, the number of turkeys slaughtered was down by 4 percent. This decrease in numbers has been offset by a 4-percent increase in the average liveweight to almost 29 pounds per bird. The turkey production estimate has also been reduced for the remainder of 2005, with the total for the year at 5.49 million pounds, down 90 million pounds from the previous estimate. The reduction in the number of turkeys being slaughtered is a reflection of the amount of turkey poults being placed for growout, which has been lower on a year-over-year basis for a number of months. Turkey exports over the first half of 2005 are expected to show considerable growth compared with the previous year. Like broilers, turkey exports in the first half of 2004 where held down by the bans on U.S. exports due to AI outbreaks.

Meetings, Seminars and Conventions

2005 May

May 23-26: ***XVII European Symposium on the Quality of Poultry Meat and the XI European Symposium on the Quality of Eggs and Egg Products,*** Golden Tulip Parkhotel Doorwerth, Doorwerth, The Netherlands. Contact: Dorien Kleverwal, Symposium Secretariat, Wolterinkhofstraat 39, 7437 AX Bathmen, The Netherlands. Phone: +31 570 541948; Fax: +31 570541948 or +31 55 506 4858; Email: info@eggmeat2005.nl; Website: www.eggmeat2005.nl

2005 June

June 1-3: ***Meat & Poultry Industry 2005,*** IVth international forum, Crocus City Exhibition Centre, Moscow, Russia. Contact: Elizaveta Melnikova, Asti Group. Phone: +7 095 797 6914; Fax: +7 095 797 6915; Email: info@meatindustry.ru
June 1-3: ***VIV Russia,*** Moscow, Russia. Contact: Website: sites.vnuexhibitions.com/sites/viv
June 3-4: ***Georgia Veterinary Medical Association Annual Convention,*** Sandestin Resort, Florida. Contact: Beth Monte, GVMA. Phone: 678-309-9800; Email: gvma@gvma.net; Website: www.GVMA.net
June 9-11: ***Turkey Production: Prospects for the Future,*** (WPSA Working Group 10, Turkeys), Berlin, Germany. Contact: Prof. H.M. Hafez, Institute of Poultry Diseases, Free University Berlin, Konigsweg 63, 14163 Berlin, Germany. Phone: +49 30 838 62 677; Fax: +49 30 838 62 690; Email: hafez@vetmed.fu-berlin.de

June 22-24: ***Georgia Egg Association's 44th Annual Meeting,*** St. Simons Island, GA. Contact: Robert Howell, Executive Director, Georgia Egg Association, 16 Forrest Parkway, Forest Park, GA 30297. Phone: 404-363-7661; Fax: 404-363-7664; Email: goodeggs@bellsouth.net
June 30-July 2: ***Agrena 2005,*** 7th International Exhibition for the Administration & Production of Poultry & Livestock, International Conference Centre, Cairo, Egypt. Contact: Crose Fairs Organisers. Phone/Fax: +1 202 30 38 994; Email: crose@access.com.eg

2005 July

July 16-20: ***AVMA/AAAP Meeting,*** Minneapolis, MN. Contact: AVMA (800) 248-2862, Ext. 268, or www.avma.org
July 16-20: ***94th Annual Meeting of the Poultry Science Association,*** Auburn University, Auburn , Alabama. Contact: James W. Kessler, Executive Director, Poultry Science Association, 1111 North Dunlap Avenue, Savoy, IL 61874. Phone: 909-677-0069; Fax: 909-677-2420. Email: jamesk@assochq.org

2005 August

August 22-26: ***14th World Veterinary Poultry Congress & Exhibition,*** Istanbul, Turkey. Contact: Congress organiser: IT Consortium, Mete Cad. 16/11, 34437 Taksim, Istanbul, Turkey. Phone: +90 212 244 71 71; Fax: +90 212 244 71 81; Email: info@wvpc2005.org. Website: www.wvpc2005.org. Scientific matters: Ankara University Veterinary Faculty, Department of Animal Nutrition, 06110 Ankara, Turkey. Phone: +90 312 517 25 65; Fax: +90 312 517 25 65; Email: akan@veteinary.ankara.edu.tr; Website: www.veterinertavukculuk.org
August 25-27: ***VIV Turkey 2005,*** (Postponed from June 2005), World Trade Center Yesilkoy, Istanbul, Turkey. Contact: HKF Fuarcilik AS, Barbaros Bulvari 135/2, Besiktas, 80700 Istanbul, Turkey. Phone: +90 212 216 4010; Fax: +90 212 216 3360; Email: hkf@hkf-fairs.com; Website: www.hkf-fairs.com
August 25-27: ***14th World Veterinary Poultry Congress Fair,*** Istanbul, Turkey. Contact: Mr. Levent Akdogan. Phone: +90 212 244 7171; Email: levent@ikontour.com

2005 September

September 15-17: ***Avian Gut Function, Health and Disease,*** 28th Poultry Science Symposium, Bristol, UK. Contact: Langford Continuing Education Unit. Phone: +44 117 928 9502; Fax: +44 1934 852170; Email: Langford-CE@bristol.ac
September 19-23: ***IX International Coccidiosis Conference,*** Hotel Mabu, Iguazu Falls, Brazil. Contact: FACTA, Av. Andrade Neves, 2501, Castelo, Campinas, SP 13070-001,Brazil. Phone: +55 19 3243 6555; Fax: +55 19 3243 8542; Email: facta@facta.org.br
September 24-29: ***15th European Symposium on Poultry Nutrition,*** Balatonfüred, Hungary. Contact: Dr K Dublecz, University of Veszprem, Georgikon Faculty of Agriculture, Hungary. Tel: +36 83 312 330; Fax: +36 83 315; Email: dublecz@georgikon.hu, Website: growcare.katki.hu/wpsa2005

2005 October

October 4-7: ***XIX Latin American Poultry Congress,*** Atlapa Convention Center, Panama City, Panama. Contact: ANA VIP, PO Box 6-3994, El Dorado, Panama. Phone: +1 507 226 3941; Fax: +1 507 226 9905; Email: anavip@anavip.com; Website: www.anavip.com/congreso
October 5-8: ***44th Fieravicola,*** Forli, Italy. Contact: Fiera di Forli, Via Punta de Ferro, 47100 Forli, Italy. Phone: +39 0543 793511; Fax: +39 0543 724488; Email: info@fieravicola.com; Website: www.fieravicola.com
October 6-8: ***4th European Poultry Genetics Symposium,*** (WPSA Working Group 3, Breeding annd Genetics), Dubrovnik, Croatia. Contact: Helga Medic, Phone: +385 1 4605126; Email: hmedic@pdf.hr

2005 November

November 1-4: ***VIV Europe 2005,*** Jaarbeurs, Utrecht, The Netherlands. Contact: VNU Exhibitions Europe BV, PO Box 880. 3503 RV Utrecht, The Netherlands, Phone: +31 30 295 2772; Fax: +31 3 295 2809; Email: viv.europe@vnuexhibitions.com, Website: www.viv.net
November 3: ***3rd International Waterfowl Conference,*** (WPSA China Branch), Guangzhou, Guangdong Province, China. Contact: WPSA China Secretary-General, Dr. Xiquan Zhang, College of Animal Science, South China Agricultural University, Guangzhou 510642, China. Phone: +86 20 8528 5703; Fax: +86 20 8528 0740; Email: waterfowl2005@scau.edu.cn; Website: www.scau.edu.cn/waterfowl2005
November 3-10: ***United States Animal Health Association,*** Hershey, Pennsylvania. Website: www.usaha.org.

Meetings, Seminars and Conventions

2006 January

January 25-27: ***2006 International Poultry Exposition,*** Georgia World Congress Center, Atlanta, Georgia USA, Contact: US Poultry & Egg Assn., 1530 Cooledge Road, Tucker, Georgia 30084 USA, Phone: +1 770 403 0401; Fax: +1 770 403 9257, Website: www.poultryegg.com

2006 February

February 20-22: ***Poultry Focus Asia 2006,*** Queen Sirikit National Convention Center, Bangkok, Thailand. Phone: +44 1377 256316;
Fax: +44 1377 253640;
Email: conf@positiveaction.co.uk;
website: www.positiveaction.co.uk

2006 April

April 3-6: ***6th International Symposium on Avian Influenza,*** St. John's College, Cambridge, UK. Contact: Dr. I. Capua. Fax: +39 49 8084360;
Email: icapua@izsvenezie.it or Dr. D. Swayne.
Fax: +1 706 5463161;
Email: dswayne@sepri.usda.gov

2006 May

May 15: ***Respiratory Diseases 2006,*** NH Utrecht Hotel, Utrecht, Holland.
Phone: +44 1377 256316;
Fax: +44 1377 253640;
Email: conf@positiveaction.co.uk;
Website: www.positiveaction.co.uk

May 16-18: ***VIV Europe,*** (Postponed from November 2-4, 2005), Jaarbeurs, Utrecht, The Netherlands. Contact: VNU Exhibitions Europe BV, PO Box 8800, 3503 RV Utrecht, The Netherlands.
Phone: +31 30 295 2788; Fax: +31 30 295 2809;
Email: viv.europe@vnuexhibitions.com;
Website: sites.vnuexhibitions.com/sites/viv
May 24-26: ***VIV Russia 2006,*** Moscow, Russia. Contact: Website:
sites.vnuexhibitions.com/sites/viv

2006 September

Sept. : ***VIV China 2006,*** (Postponed from June 2006-dates not yet specified), Beijing, P.R. China. Contact: VNU Exhibitions Europe B.V., PO Box 8800, 3503 RV Utrecht, The Netherlands.
Phone: +31 30 295 2772; Fax: +31 30 295 2809;
Email: viv.china@vnuexhibitions.com;
Website: sites.vnuexhibitions.com/sites/viv or Mr. Ruifent Xu, CNAVS Trade Fair Office.
Phone +86 10 649 50 373; Fax: +86 10 649 50 374;
Email: rfxu@china-av.net
Sept. 10-14: ***12th European Poultry Conference,*** Veronafiere Congress Centre, Verona, Italy. Contact: Secretariat XII WPSA European Conference, Department of Food Science, Via San Giacoma 9, 40126 Bologna, Italy. Phone: +39 051 209 4221; Fax: +39 051 251 936; Email: wpsa@alma.unibo.it;
Website: www.epc2006.veronafiere.it

2006 November

November 14-17: ***EuroTier 2006,*** Hanover, Germany. Contact: DLG (Deutsche Landwirtschafts-Gesellschaft e.V.), Eschborner-Landstrasse 122, 60489 Frankfurt-am-Main, Germany.
Phone: +49 69 24788 265; Fax: +49 69 24788 113;
Email: eurotier@DLG-Frankfurt.de;
Website: www.eurotier.de

2007 January

Jan. 31-Feb. 2: ***2007 International Poultry Exposition,*** Georgia World Congress Center, Atlanta, Georgia, USA. Contact: US Poultry & Egg Association, 1530 Cooledge Road, Tucker, Georgia 30084 USA. Phone: +1 770 493 9401;
Fax: +1 770 493 9257; Website: www.poultryegg.org

2008 August

August 10-15: ***XXIII World's Poultry Congress,*** Convention and Exhibition Centre, Brisbane, Australia. Contact: WPC 2008 Congress, Intermedia Convention & Event Management, PO Box 1280, Milton, Queensland 4064, Australia.
Phone: +61 7 3858 5594; Fax: +61 7 3858 5510;
Email: wpc2008@im.com.au; Website:
www.wpsa.info

Broiler Performance Data (Region) Live Production Cost					
	SW	Midwest	Southeast	Mid-Atlantic	S-Central
Feed cost/ton w/o color ($)	141.71	126.38	138.95	139.09	138.52
Feed cost/lb meat (¢)	13.56	11.07	13.13	13.52	13.08
Days to 4.6 lbs	42	41	43	42	43
Chick cost/lb (¢)	3.73	4.42	4.16	3.59	4.02
Vac-Med cost/lb (¢)	0.05	0.07	0.07	0.09	0.08
WB & 1/2 parts condemn. cost/lb	0.19	0.22	0.14	0.19	0.20
% mortality	5.30	5.18	5.57	5.65	5.83
Sq. Ft. @ placement	0.85	0.74	0.80	0.82	0.75
Lbs./Sq. Ft.	7.06	6.24	6.82	7.56	7.78
Down time (days)	13	10	12	15	14

Data for week ending February 26, 2005

Broiler Performance Data (Company)
Live Production Cost

	Average Co.	Top 25%	Top Co.'s
Feed cost/ton w/o color ($)	139.18	133.21	132.06
Feed cost/lb meat (¢)	13.16	12.47	11.64
Days to 4.6 lbs	42	42	42
Chick cost/lb (¢)	4.01	3.67	3.81
Vac-Med cost/lb (¢)	0.08	0.06	0.04
WB & 1/2 parts condemn. cost/lb	0.18	0.14	0.08
% mortality	5.68	5.28	4.22
Sq. Ft. @ placement	0.80	0.77	0.78
Lbs./Sq. Ft.	7.12	7.56	6.38
Down time (days)	13	13	14

Data for week ending February 26, 2005

Broiler Whole Bird Condemnation (Region)

	SW	Mid-West	S. East	Mid-Atlantic	S. Central
% Septox	0.209	0.388	0.146	0.250	0.246
% Airsac	0.098	0.039	0.062	0.119	0.009
% I.P.	0.105	0.021	0.013	0.036	0.014
% Leukosis	0.001	0.000	0.001	0.025	0.001
% Bruise	0.006	0.002	0.004	0.006	0.002
% Other	0.010	0.005	0.012	0.013	0.021
% Total	0.429	0.455	0.238	0.449	0.404
% 1/2 parts condemnations	0.390	0.718	0.310	0.350	0.411

Data for week ending February 26, 2005

Broiler Whole Bird Condemnation (Company)

	Average Co.	Top 25%	Top 5 Co.'s
% Septox	0.211	0.176	0.134
% Airsac	0.098	0.070	0.056
% I.P.	0.042	0.015	0.024
% Leukosis	0.004	0.001	0.000
% Bruise	0.004	0.004	0.006
% Other	0.013	0.010	0.002
% Total	0.372	0.276	0.223
% 1/2 parts condemnations	0.397	0.337	0.305

Data for week ending February 26, 2005