COCCI FORUM

NEW STRATEGIES FOR COCCIDIOSIS MANAGEMENT

KNOW THE SPORE

IDENTIFYING VIABLE, SPORULATED OOCYSTS IS KEY TO QUALITY

PLUS

IRREFUTABLE EVIDENCE

NEW COCCI CONFIDENTIAL

TECHNICALLY SPEAKING

COCCI FAQS: ANSWERS TO YOUR QUESTIONS

COCCI VACCINATION TAKES HOLD IN CHINA

SPAH-PBU-288

Schering-Plough Animal Health

NUMBER 7

Performance

Schering-Plough Animal Health

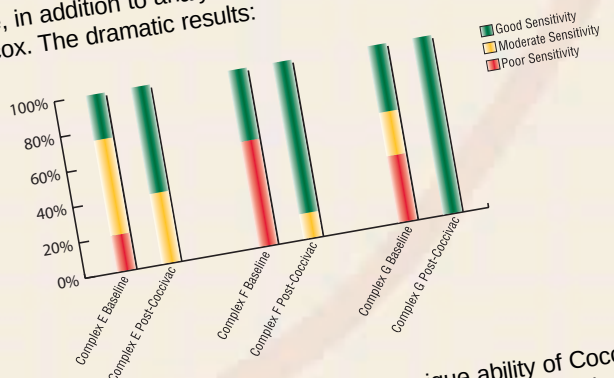
American Scientific Laboratories, Inc.

Dear Partner in Poultry Production:

Last year, while reporting on the success of Clinacox® (diclazuril), we reminded the industry to use this new-generation anticoccidial judiciously to minimize the development of resistance. We also mentioned having trials underway to help us formulate more precise recommendations for an integrated, multi-product anticoccidial program – one that would help restore the anticoccidial sensitivity of *Eimeria spp*. populations.

Working with a major US poultry company, we chose three complexes that had used Clinacox in either a continuous or shuttle program for at least one cycle during the prior year. Coccivac®-B – our live-oocyst coccidiosis vaccine that has been shown to seed houses with sensitive strains of *Eimeria* – was used for two full cycles.

We then compared the sensitivity of the field *Eimeria spp*. populations to Clinacox before and after Coccivac-B usage, in addition to analyzing and categorizing the sensitivity of the coccidial isolates to Clinacox. The dramatic results:



This study confirmed previous research showing the unique ability of Coccivac-B to restore the efficacy of in-feed anticoccidials – in this case, Clinacox. Based on previous field observations and this new information, we continue to recommend using **Clinacox** for only one cycle annually or in shuttle program (starter or grower ration, but not both) in two sequential cycles. **Coccivac-B** can be used for two to three cycles in an annual rotational program with Clinacox.

For more information, please contact your rep or call us today at **1-800-219-9286**.

Sincerely,

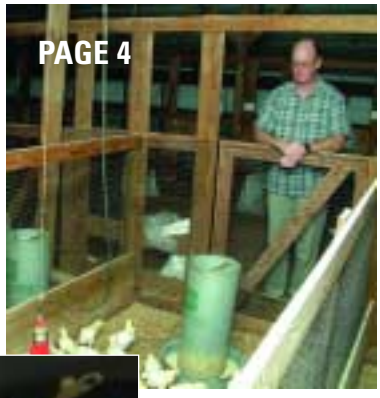
Rick Phillips, DVM
Director, Poultry Technical Services

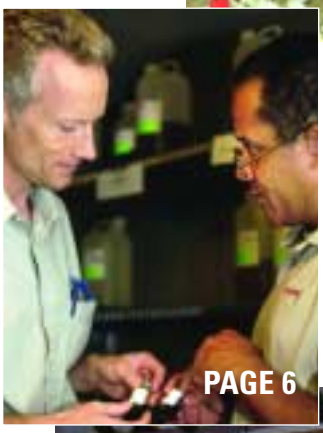
Schering-Plough Animal Health
EXPERTISE...COMMITMENT...VALUE

COCCI FORUM

NUMBER 7

FEATURES





IRREFUTABLE EVIDENCE

New study validates theory that vaccinating with Coccivac-B restores *Eimeria* sensitivity to diclazuril (Clinacox)

A long-held theory that vaccinating with Coccivac-B for just two cycles restores *Eimeria* sensitivity to the new-generation in-feed anticoccidial diclazuril (Clinacox) was validated recently in a large-scale field trial with a major US poultry company.

The results, according to poultry disease specialists involved in the study, could change the broiler industry's strategy for managing coccidiosis, a costly parasitic disease in poultry.

Dr. David Chapman

Dr. Harry Danforth

Previous investigations into the relationship between coccidiosis vaccination and in-feed anticoccidials — including studies by well-known researchers Dr. David Chapman of the University of Arkansas, Dr. Harry Danforth, USDA, and Dr. Greg Mathis of Southern Poultry Research in Athens, Georgia. — have demonstrated that vaccinating with Coccivac-B restores anticoccidial sensitivity in a poultry house by replacing resistant *Eimeria* organisms with ones still sensitive to in-feed anticoccidials used today.

"In addition, pen trials over the years have indicated that Coccivac-B used in a rotational program can effectively displace wild field strains of coccidia and restore sensitivity to the current in-feed anticoccidials," says Dr. Rick Phillips, director of worldwide poultry technical services, Schering-Plough Animal Health.

Those studies, however, focused on ionophore anticoccidials, not on diclazuril, now a widely-used, chemical anticoccidial.

"Despite the research and all the field reports in hand, we felt it was important to test our hypothesis in the field where the proverbial 'rubber meets the road'," Phillips says. "These latest trials with diclazuril without a doubt prove our hypothesis."

Study background and design

The study, sponsored by Schering-Plough Animal Health, was conducted at the site of a large US integrator. Independent investigators involved in the trial were the poultry company's veterinarian and Dr. Mathis of Southern Poultry Research, who conducted sensitivity testing.

The integrator, which asked not to be identified in this report, added Coccivac-B to its anticoccidial rotation to see if using the live-oocyst vaccine improved the effectiveness of diclazuril — or changed the coccidial population to one more sensitive to diclazuril — as well as conventional ionophores. The move was part of a concerted effort by the company to develop new tools and long-term strategies for managing coccidiosis.

The poultry company first collected litter samples from eight farms involved with its seven complexes to obtain baseline diclazuril sensitivity information. Prior to this, the complexes had been on a variety of in-feed anticoccidial rotation programs, all of which included diclazuril for one to two cycles the previous year, he says.

Dr. Charlie Broussard, worldwide poultry technical services manager for Schering-Plough Animal Health,

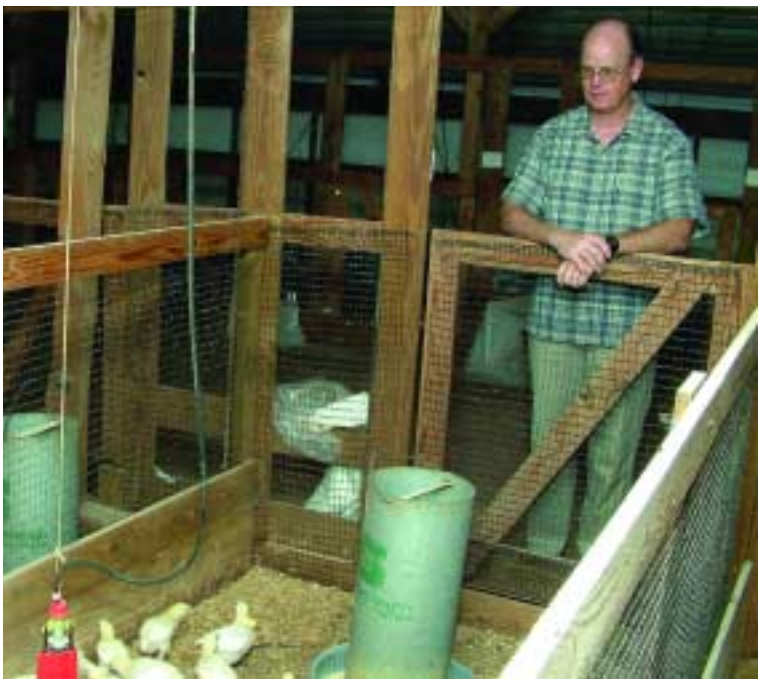
explains that after collecting initial litter samples, four of the seven complexes continued their annual rotation using ionophores or chemical-ionophore shuttle programs. The remaining three complexes incorporated two cycles of Coccivac-B vaccine into the annual rotation. Identical houses were re-sampled after two cycles of Coccivac-B or anticoccidial rotation.

To determine diclazuril sensitivity, Mathis looked at weight reduction and coccidial lesion scores in test birds and compared them to unchallenged controls. He then summarized diclazuril's efficacy as "good," "moderate" or "poor."

"Even though diclazuril was given a rest, diclazuril sensitivity did not improve or improved very little in the complexes that rotated diclazuril with other in-feed anticoccidials, rather than with the vaccine," Broussard says. "On the other hand, diclazuril sensitivity improved significantly in the complexes that used two cycles of Coccivac-B in the rotation. Not one of the samples tested scored 'poor' for sensitivity following Coccivac-B use." (See Figure 1.)

A few highlights from the trial follow, according to Broussard:

- In one complex, diclazuril sensitivity before vaccination was rated "good" in only 30% of samples. After vaccination, however, 100% of samples were rated "good."
- In another complex, only 33% of samples were rated good before vaccine use, compared to 83% after vaccination. (See Table 1.)
- In contrast, one complex where the vaccine was not used, investigators rated only 25% of samples as "good" for diclazuril sensitivity at the start of the study. After continuing on a traditional rotation program and "resting" diclazuril, 0% of the samples were rated "good" for diclazuril sensitivity.



Mathis: 'One of the most coccidiosis-significant studies'

Considering its 2-to 3-years' experience with coccidiosis vaccination and the results of this trial, the poultry company plans to continue using Coccivac and will carefully monitor results as well as assess the vaccine's role in long-term methodology. "Many other factors are involved with the selection process so we cannot say that the process is sensitivity driven, though that's a major factor," says a veterinarian for the company.

"…The take-home message is that to get the performance you got when you originally had diclazuril or other in-feed anticoccidials, you're going to have to use a vaccine."

Take-home message

Pointing to the good performance of the vaccinated flocks and the reduction in lesion scores, investigator Mathis

continued on page 19

KNOW THE SPORE

Identifying viable, sporulated oocysts key to a quality coccidiosis vaccine

Identifying viable, sporulated *Eimeria* oocysts and ensuring that birds get just the right amount is one of the most important steps that go into producing an effective coccidiosis vaccine.

Knight: 'It's critical to have the right balance of antigens…'

Even so, with thousands of chicks moving through the hatchery, it's difficult for busy poultry veterinarians and production managers to appreciate the technology, careful selection process, experience and rigid quality-control standards that need to go into a vaccine of this nature.

"Coccidiosis vaccination works by providing a controlled, carefully balanced dose of oocysts — coccidial eggs — to protect against the several species of *Eimeria* that cause the disease in birds," says Graham Knight, manager of coccidiosis vaccine production at Schering-Plough Animal Health Corporation's production plant in Millsboro, Delaware.

"It sounds easy, but there's more to it than gathering oocysts and putting them in a bottle. The preparation and identification of suitable oocysts is crucial," he says. "It's also critical to have the right balance of antigens, which are the individual components that lead to protection against the *Eimeria* species causing disease."

Stimulating immunity

Producers need to understand that for a coccidiosis vaccine to stimulate immunity, oocysts must be capable of releasing viable spores. "In other words, they must be sporulated. They also must be viable to be infective," Knight says.

"An infective oocyst is a sporulated oocyst, but a sporulated oocyst is not necessarily an infective one," Knight says. "We think this is an important distinction for producers to know and understand."

The reason is that sporulated oocysts age and die. In addition, some oocysts never fully develop; they are only partially sporulated, while others may be abnormal or damaged and are not infective.

"A major part of our job is the identification of fresh, fully sporulated oocysts," Knight says. "These are the oocysts that are infective and that convey immunity to birds against coccidiosis. It takes a lot of experience to build a quality coccidiosis vaccine."

Tried and true

Although it's a tedious and important process, identifying viable sporulated oocysts isn't rocket science, Knight insists, but it does require an educated eye.

"In Millsboro, we have well-trained, seasoned technicians — many have been involved since the operation was moved to Millsboro in the 1980s. With a good microscope, they can easily differentiate a fresh, fully sporulated oocyst from an oocyst that's not," he says.

Microscopic examination is the traditional method of determining whether an oocyst is fully sporulated and has been in use since the early 1900s. "It's a straightforward and proven method, one that requires no manipulation of the sample other than dilution and needs no specialized equipment or technique," Knight explains.

Dr. Steve Fitz-Coy, now a technical

Photos by Lisa Helfert.

service representative for Schering-Plough Animal Health, agrees.

"Poultry producers have been dealing with coccidiosis for nearly 75 years, since groundbreaking work by E. E. Tyzzer in 1929. Identifying sporulated oocysts with a microscope is a tried and true process that's improved with time," he says.

Knight points out that data collected over the course of many years as well as field experience have demonstrated that coccidiosis vaccine made from fresh, fully sporulated oocysts within a fixed time frame has enough viable oocysts of each species at the end of the stated shelf-life (12 months) to be efficacious.

Complementary procedures

Several other procedures built into coccidiosis-vaccine production at Millsboro complement the identification of viable, sporulated oocysts and contribute to the vaccine's efficacy, says Knight.

One is the way in which oocysts are produced. Each coccidial species in the vaccine is grown in birds in a room dedicated to that species. The rooms are located in an antigen-production facility. The birds are not used for multiple species nor are they re-used, he says.

"Although most species of coccidial oocysts can be differentiated by trained technicians, there are exceptions. Different species have different sizes and shapes, but some overlap occurs, particularly among small oocysts. Growing each type in isolation solves this problem," Knight says.

Technicians inoculate one group of birds with known and tested seeds of one coccidial species. Excreted oocysts are then harvested and cleaned. "We don't need to differentiate oocysts — we only have to determine whether an oocyst is fully sporulated or not and how many there are.

"We need different numbers of oocysts for each species to make Coccivac. Ultimately, the oocysts are blended, but we grow them individually," he says.

Oocyst production

Nevertheless, Fitz-Coy points out, oocysts excreted by birds are not sporulated when harvested and, therefore, are not infective.

"We have to transform the harvested, non-sporulated oocysts to the sporulated and infective form under controlled conditions by providing warmth, humidity and oxygen," he says.

Adds Knight, "We mimic nature, but with the benefit of controlled conditions, we can efficiently transform the majority of oocysts over a given period of time. Because the viability of sporulated oocysts decreases with time, the harvested material is processed quickly at the Millsboro plant, which works to cGMP (current Good Manufacturing Practices)."

Knight and Fitz-Coy: 'We need different numbers of ooycsts for each species…'

After sporulation, the antigen lot is

continued on page 20

VACCINE CONTROLS COCCIDIOSIS, IMPROVES PERFORMANCE IN INTEGRATOR'S CONTROLLED STUDY

Editor's note: The information for this article was provided by a major US poultry company on the condition that its name and location be kept confidential. The sources mentioned in the article have nevertheless reviewed the information for technical accuracy and approved it for publication in ***CocciForum****. It is presented here in our newest feature, Cocci Confidential, to help the poultry industry learn from these real-world experiences and improve their management of coccidiosis. If you have a story you would like to share with Cocci Confidential, please contact the editor at JFeeks@prworks.net or call 508-627-6949 (US).*

The veterinarian was still skeptical. He wanted proof that vaccinating broilers to prevent coccidiosis wouldn't hurt performance.

His employer, a major poultry integrator in the US processing millions of birds annually, hadn't been vaccinating against coccidiosis for long. Initially, there were some performance irregularities, but he couldn't ignore the numbers from the third cycle — the results were stellar.

A good study was needed, but comparing a coccidiosis vaccine directly to a feed-grade anticoccidial program under true field conditions would be difficult. Non-medicated feed would have to be provided to houses with vaccinated flocks; in particular, no anticoccidials could be fed to vaccinated birds — they could destroy the vaccine oocysts that help build immunity to coccidiosis.

Anticoccidial feed would have to be delivered to other houses on the same farms with unvaccinated birds. Care would have to be taken to avoid manufacturing or delivery errors for the life of the flock. It would be a challenge for a big and busy integrator, but data was needed to determine whether changes should be made to the standard coccidiosis control program.

Study design

In the fall of 2002, a multi-farm, paired-house trial was initiated. It involved four, 4-house farms raising heavy broilers (7.5 lbs). The integrator vaccinated two houses on each farm with Coccivac-B, a live-oocyst vaccine; in the remaining houses, birds were fed an anticoccidial shuttle utilizing narasin and nicarbazin, which was the integrator's standard program and served as the study's control. Evaluations were conducted on 156,000 birds from the vaccinated group and on 156,000 birds from the control group.

The ration formulation for the two treatments was consistent except that vaccinated birds received a virginiamycin premix in the starter and finisher ration and bacitracin methylene disalicylate and roxarsone in the grower ration, while controls received narasin, nicarbazin and bacitracin methylene disalicylate in the starter ration and narasin and roxarsone in the grower and finisher rations (Table 1).

Findings

At 4 weeks (28 days) and 7.5 weeks of age (52 days), veterinarians from Schering-Plough Animal Health and Alpharma Inc. conducted posting sessions on the 16 test houses, where they looked for evidence of coccidial

species. They used microscopic evaluation for *Eimeria maxima*, since this species does not always produce distinct gross lesions and is more likely than other *Eimeria* species to impair feed conversion and weight gain. By 51 to 55 days of age, most of the lesions received mild scores of +1 and +2 (Figures 1 and 2).

In addition, the integrator processed birds from each treatment separately. The processing plant reported standard performance parameters such as the percent livability, gross pounds sold, average weight, feed conversion and average daily gain (Table 2).

The results

Vaccinated birds and the controls receiving feed-grade anticoccidials each demonstrated mild coccidial lesions at 4 weeks of age. However, the lesions had resolved by the second post-mortem exam at 7.5 weeks of age (Figures 1 and 2). Vaccination did not appear to affect either 7-day mortality or overall livability compared to controls.

On a farm-by-farm basis, vaccinated flocks outperformed or equaled the performance of the control flocks for all significant parameters. Vaccinated flocks also demonstrated better performance on an averaged basis. Compared to flocks receiving standard ionophores, those that were vaccinated had:

- An average weight 9.6 points higher
- An average feed conversion 1.6 points lower
- A caloric conversion 11 calories lower
- An adjusted caloric conversion 33 calories lower
- A standard cost per pound 0.17 cents lower

Discussion & conclusion

Coccivac delivers a controlled, balanced dose of sporulated or infective oocysts of the economically significant *Eimeria* species. A new generation of oocysts develop in vaccinated birds and are then excreted, providing re-exposure to *Eimeria* oocysts. The process stimulates natural, long-lasting immunity.

Generally, it takes about two to three oocyst cycles for strong immunity to develop. Vaccinated birds may be presented with a field challenge from

continued on page 22

Table 1
Ration Formulation: Coccivac-B vs. Control

	Starter	Grower	Finisher
Coccivac-B	virginiamycin 20g	bacitracin methylene disalicylate 50g	virginiamycin 10g
Control	narasin 62g bacitracin methylene disalicylate 50g	nicarbazin 63g roxarsone 22g	nicarbazin 54g roxarsone 22g

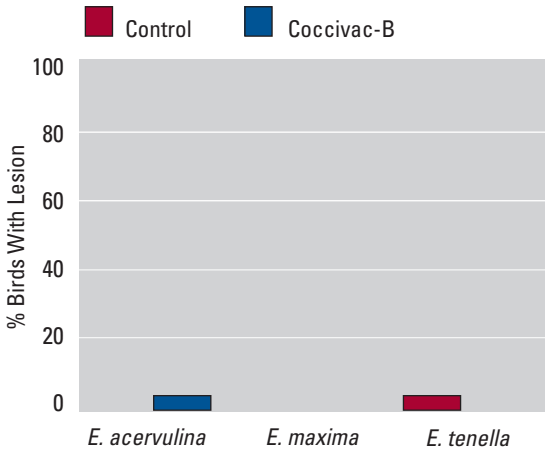


Figure 1. Birds Age 51-55 Days

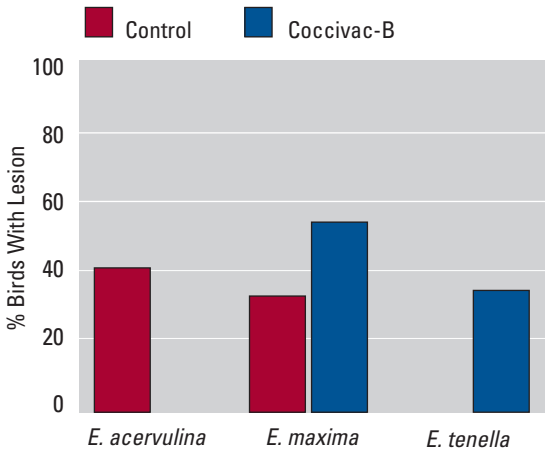


Figure 2. Birds Age 25-29 Days

SCHERING-PLOUGH'S TECH SERVICE TEAM ANSWERS QUESTIONS ABOUT MANAGING COCCIDIOSIS IN BROILERS

Charles Broussard, DVM
Steve Fitz-Coy, PhD
Lanny Howell, DVM
John McCarty, DVM
Linnea Newman, DVM
Rick Phillips, DVM
John Radu, DVM

Q. HOW PREVALENT ARE *EIMERIA MAXIMA* VARIANTS IN THE US, AND IS COCCIVAC-B CROSS-PROTECTIVE?

A. Based on a recent survey of 33 isolates of *Eimeria maxima* collected from 11 states and 18 major poultry integrators throughout the US, only three of the isolates (less than 10%) showed only partial protection by the Coccivac strain of *E. maxima*. In other words, the prevalence of *E. maxima* among US poultry integrators that is highly variant to the *E. maxima* in Coccivac is very low and is not of major significance at this time.

The results of the study also indicate that if birds are properly immunized, the vaccine strain of *E. maxima* in Coccivac-B would protect against a wide range of field isolates encountered in commercial operations in the US.

Q. IS THERE ANY MERIT TO USING AN AUTOGENOUS VACCINE FOR VARIANT SPECIES OF *EIMERIA*?

A. Autogenous vaccines are derived from uncharacterized *Eimeria* field species. These poorly defined species are not subjected to the same rigorous testing as the licensed, defined species of Coccivac. To develop a safe, consistent vaccine, it is imperative that the basic species characteristics such as pathogenicity, antigenicity and anticoccidial drug sensitivity are well defined. Using a poorly defined vaccine highly increases the risk of rapidly spreading unwanted contaminates from a few selected farms to all company farms, which could be an overnight disaster and a very expensive problem to control later; it also decreases the chances of maximizing production performance due to inconsistent product manufacturing from serial to serial.

Q. ARE YOU RE-ISOLATING THE VACCINE STRAINS FOLLOWING THE USE OF COCCIVAC?

A. Yes. All research to date supports our initial hypothesis that the vaccine strains over 2 to 3 flocks are displacing wild field strains. This is evident by the *Eimeria* population shift toward more sensitive strains as measured via anticoccidial sensitivity testing (AST).

Q. HOW STABLE IS THE POPULATION SHIFT TO *EIMERIA* STRAINS CONTAINED IN THE VACCINE?

A. It is not a permanent change — it's a shift. The vaccine strains become predominant in the absence of drug pressure. With drug pressure and time, the strains will shift back to those that are drug tolerant/resistant.

Q. HOW MANY CYCLES OF COCCIVAC USE DOES IT TAKE BEFORE NOTICING A CHANGE IN THE *EIMERIA* POPULATION?

A. It's difficult to say specifically how many, but the longer the removal of pressure from the drugs, the greater the chance of seeing a change in the *Eimeria* population. We can say, however, that there should be a minimum of two cycles and that three cycles are preferred.

Q. WHAT ABOUT COMPETITION BETWEEN THE WILD AND VACCINE STRAINS OF *EIMERIA*? WILL A SHORT LAYOUT TIME INFLUENCE THE OUTCOME?

A. Layout time will influence the desiccation rate of *Eimeria*. Coccidia will not be eliminated, but the longer the layout period, the greater the reduction in numbers.

The advantage of vaccination is that birds are exposed early in life to vaccine strains; eventually, they will develop immunity. Using a live vaccine allows us to control the dose (level of exposure) as well as the timing (day-1) of exposure. These are two major advantages in controlling any disease process.

Q. DO COCCIDIOSIS VACCINES REQUIRE SPECIAL HANDLING?

A. Yes. Make sure the vaccines are never frozen, which will kill or damage sporulated oocysts and ruin their effectiveness. If ice crystals are noticed in the liquid, the vaccine should be discarded.

Store Coccivac vaccines at a temperature between 36°F to 47°F (2°C and 8°C). The vaccines should be kept at these temperatures during shipping as well as during transport to farms or hatcheries. When the vaccines are refrigerated, watch for uneven temperatures that might allow partial freezing.

Q. ARE COCCIVAC VACCINES TESTED FOR POTENCY?

A. Yes. Potency testing in live birds is conducted on every serial (batch) of Coccivac manufactured. Birds are vaccinated with the serial being tested and are then challenged with every species of *Eimeria* contained in the vaccine to make sure they develop immunity. If they have developed immunity, they do not develop coccidiosis. The validity of each potency test is checked by challenging unvaccinated birds.

Q. DOES THE METHOD OF VACCINATION AFFECT THE AGE WHEN CHICKS CAN BE VACCINATED WITH COCCIVAC?

A. Yes. When the Spraycox spray cabinet is used, chicks can be vaccinated in the hatchery because the sprayer enables uniform distribution; 21 ml of coarse spray is delivered for each box of 100 chicks. Chicks "preen" to clean and dry their feathers and ingest the vaccine. Red dye mixed in with the vaccine gets their attention and stimulates preening.

An alternative to using the Spraycox applicator is feed spray application. It does not deliver the vaccine as uniformly as the Spraycox applicator, but can be used when hatchery application is not possible. Chicks must be 4 days of age, however, since younger chicks may not have developed uniform feed consumption patterns.

Q. WHAT'S THE DUAL-NOZZLE SPRAYCOX CABINET?

A. It enables simultaneous administration of Coccivac-B and Newcastle/Bronchitis (ND/IB) vaccines, which in turn provides producers with convenience and reduced labor costs. The nozzle for Coccivac delivers the coccidiosis vaccine as droplets that are ingested by preening. The nozzle for ND/IB produces a flat, even spray across the box.

continued on page 21

LITTER MANAGEMENT

Review your program to minimize coccidiosis pressure and maximize control

Michael Czarick
Extension Engineer
University of Georgia
Athens

The hazards of poorly managed litter are well known to poultry producers. Too little moisture can result in dehydration and respiratory illness. Too much moisture leads to litter caking and ammonia, which causes a host of problems ranging from blindness to poor flock uniformity.

Good litter management is essential when it comes to managing coccidiosis. Wet litter sets up an ideal environment for the proliferation of coccidial oocysts, increasing the challenge to birds and the risk for coccidiosis outbreaks.

In birds vaccinated against coccidiosis, some exposure to coccidia is needed to stimulate immunity. If the litter is too dry, there might not be enough oocyst sporulation to stimulate immunity and make vaccination effective. To adequately stimulate the coccidial life cycle and immunity, a minimum of 25% litter moisture content is needed.

If litter is too dry, there may not be enough coccidia production to stimulate immunity; litter that's too wet can foster too much coccidia growth, overwhelming birds before immunity is fully developed.

On the other hand, if the litter is too wet and oocyst sporulation is too high, birds could be overwhelmed with coccidial challenge before immunity is fully developed. Wet litter can set the stage for development of necrotic enteritis (*Clostridium spp.*) since bacteria thrive in a moist environment.

Considerations

When devising a plan to control litter moisture, keep in mind that birds are continuously adding moisture to the house. As a general rule, birds drink almost two pounds of water (about one quart) for every pound of feed they eat. If 24,000 four-day-old birds eat approximately 1,000 lbs. of feed daily, they will drink close to one ton of water daily. As birds get older, feed consumption increases dramatically — and so does the amount of water they drink. By the end of a 7-week growout, a house with 24,000 birds has consumed over 100 tons of feed and well over 200 tons of water! Where does it all go? Less than a third of ingested water is retained by the birds. The rest is exhaled into the air in the form of water vapor or deposited into the litter.

When a grower operates exhaust fans, the moisture-laden air in the house is replaced with drier outside air, thereby removing water from the house. The drier air that the fans bring into the house will not only pick up water that the birds are placing into the air but also remove water from the litter, keeping it drier. Of course, if a producer does not operate exhaust fans enough, water will build up in the air as well as litter leading to house sweating and litter caking.

It's all relative

When it comes to removing moisture from a house, it is important to know that the amount of water that air can hold varies dramatically depending on temperature. The term *humidity* is used to describe how much water is in the air. For instance, if the humidity is 100%, we know the air is holding all the water it can. If the humidity is 90%,

the air can only pick up a little water from the litter and litter caking is more likely to occur. If the humidity in a house is 40%, it is capable of picking up a lot of water from the litter.

Because the amount of water the air can hold changes with the temperature, *relative humidity* is a better term than humidity. For instance, 1,000 cubic feet of 40°F air can only hold less than eight ounces of water, but 1,000 cubic feet of 85°F air can hold about 32 ounces. At 150°F, 1,000 cubic feet of air can hold an entire gallon of water. The fact that hot air can hold more water than cold air is why we use hot air when we want to dry something off, such as wet clothes in a clothes dryer.

As a general rule, the moisture-holding ability of air doubles for every 20 degree rise in temperature. If 1,000 cubic feet of 40°F air has 100% relative humidity, it holds approximately 6 ounces of water. If the temperature of that air is increased by 20 degrees, the moisture-holding ability of the air doubles and it can now hold about 12 ounces of water. Since the air now has only half the water it's capable of holding, the relative humidity is 50%.

Let's heat the same 1,000 cubic feet of air another 20 degrees to 80°F. There is still only less than 6 ounces of water in the air, but now the air is capable of holding about 24 ounces of water. Therefore, the air is only holding 25% of the water it can, and the relative humidity is 25%.

So, can you dry a house when it is cold and rainy outside? Yes you can, because as you warm the air to the proper house temperature you are increasing its moisture-holding ability and the relative humidity of the air decreases. Since the air can now hold more water, it can remove more water from the litter, keeping the house drier.

The key to drying cold wet air is to make sure that all incoming air is brought in through air inlets that directs the air toward the ceiling. As the fresh air moves along the ceiling, it is heated by the hot air produced by the birds and brooders/furnaces that tends to collect at the ceiling due to the fact that hot air is lighter than cold air. The longer that incoming air can be kept at the ceiling through maintaining the proper static pressure and inlet opening, the more the air will heat up and dry out. Maximum heating and drying of air is obtained if the static pressure and inlet openings are set so that incoming air stays at the ceiling until it has reached the center of the house.

Circulation fans can help maintain proper litter moisture, but should not cause a draft at bird level.

Circulation fans

Another way to promote litter moisture control is through the use of small circulation fans that are 18 to 24 inches in diameter. Circulation fans can help bring in drier air from the ceiling gently down to floor level; water is picked up from the litter, which keeps the house drier. Of course, if exhaust fans are not operated enough, moisture in the air and litter can build up.

Circulation fans, if operated properly, should not cause a draft at bird level. Generally, they should be controlled with an interval timer or variable speed controller. Interval timer settings

or speed can be adjusted according to house conditions. If there is significant temperature stratification or the litter needs additional drying, timer settings or the speed of fans can be increased. If the litter is very dry, the use of circulation fans can be decreased.

How much ventilation?

To determine how much fresh air is needed, use the chart (see Figure 1) that provides the required minimum ventilation rate to get rid of moisture. It is based on how much water the birds are consuming, the inside house temperature and an average daily outside temperature of 40°F. The minimum ventilation rates that are determined from the chart should be viewed as a starting point that may need to be increased or decreased according to a variety of factors such as the type of waters used and how tightly the house is constructed.

"To adequately stimulate the coccidial life cycle and immunity, a minimum of 25% litter moisture content is needed."

One of the best ways to figure out if adjustments are needed to minimum ventilation fan settings is to monitor relative humidity in the poultry house. Ideally, relative humidity should be between 50% and 70%. If it is below 50%, the litter may become too dry and minimum ventilation fan settings should be decreased. If the relative humidity is above 70% for a prolonged period, litter caking and house sweating can occur and minimum ventilation fans settings should be increased.

Practical examples

Let's look at some examples of how to keep litter dry based on what we've discussed so far. Say a producer has older birds — which produce bigger, wetter droppings and are kept in lower temperatures than younger birds — that the house temperature is 70° F and the relative humidity is 65%. You start noticing that the litter is getting a little damp and want to dry it out before it slicks over.

First, you try turning down the timer fan thermostats to 65°F to bring in more air. Since the air temperature is lower, the moisture-holding ability of the air decreases, and the relative humidity would increase to about 78%. This will make it more difficult to remove water from litter. Yes, you would bring in more air, which would help to some extent, but the downside is that higher relative humidity will make it more difficult to pull out water from litter. In contrast, let's say we increase the house temperature just 3° and leave the timer fan settings the same. The relative humidity will decrease to approximately 58%, making it significantly easier to draw water out of the litter.

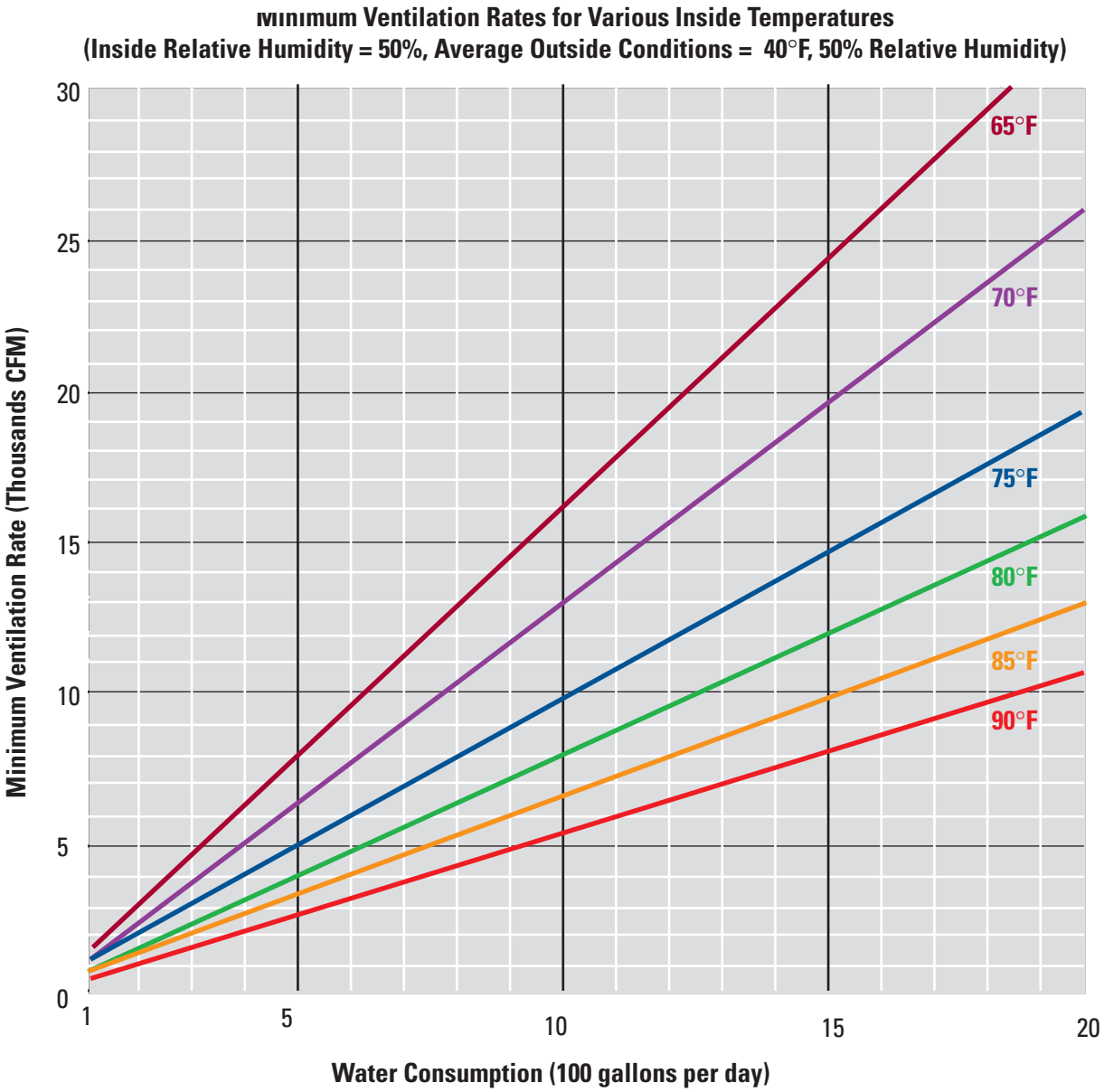
Another option would be to leave the house temperature the same and turn up the timer fan settings. This would work provided we do not let the house temperature fall. In some instances, this means adding heat to the house to maintain the desired house temperature. The key to keeping a house dry is the quality, not quantity, of air. Bringing in a lot of cold air and letting the house temperature fall usually is not as effective as bringing in a moderate amount of air and warming it up.

Contrary to common belief, using warm air to dry out litter does not always mean increased heating costs. As outside temperatures increase during the day, the moisture-holding ability of the air increases. Take advantage of that fact. During the day when the sun is out and the air temperature is warmer, increase timer fan settings to capitalize on relatively drier air.

Seasonal challenges

Cold weather is considered a time of year when controlling litter moisture is

Figure 1



a big challenge, but hot weather can present problems too. Even though evaporative cooling pads and fogging nozzles can decrease air temperature in a house by 10° to 20°F, they can also raise the relative humidity of the air to above 80%. Why? For every one degree of cooling produced by an evaporative cooling system, the relative humidity of air will increase by about 2.5%. Excessively high house humidity can be minimized by making sure that evaporative cooling pad/fogging systems are set to operate no lower than 82°F.

There's one other important way that excessive litter moisture can be kept to a minimum, and that's by making sure that the evaporative cooling system does not operate after 10pm or before 9am in the morning. These are times when outside humidity typically is above 80%, which limits the amount of cooling to be produced by pads and/or fogging systems. When evaporative cooling systems are operated between 10pm and 9am, they do little to cool the air and tend to saturate incoming air with moisture, increasing the chance of excess litter moisture and all its inherent problems.

YEAR OF THE VACCINE

China's producers are shifting to biological controls to manage coccidiosis, avoid drug concerns

Coccidiosis is one of the most severe parasitical diseases of broilers and broiler breeders in China, often presenting with severe clinical signs, including red blood in the feces, poor flock uniformity and mortality.

The costly parasitic infection can cause subclinical disease, too, characterized by signs such as poor weight gain. Subclincal disease is more likely to occur when other conditions, particularly necrotic enteritis, are present.

"In the past, we mainly adopted three methods for control of coccidiosis," says Tai Youhua, DVM, director of the Animal Health Center for Zhucheng Foreign Trade Broiler Co. Ltd, the second-largest broiler integrator in China's Shandong Province.

Veterinarians, nutritionists and producers in China fill room at recent meeting to learn more about coccidiosis vaccination.

"First we managed the rearing style, such as rearing birds on net. Second, we rotated and shuttled the anticoccidials in feed. Third, we administered various anticoccidial medicines, including diclazuril, or sulfa drugs," he says.

"But none of these methods generated the same efficacy as they had before. Due to resistance, in-feed anticoccidials such as ionophores and synthetic chemicals are no longer as efficacious as they once were, and it was time to adopt a new way of thinking in coccidiosis control by developing immunity through vaccination," Tai adds.

Medication problems

Besides resistance, he says, controlling coccidiosis with medications raises another problem: Residues. Sulfa drugs such as sulfaquinoxaline and sulfadimidine are highly efficacious in reducing mortality and controlling symptoms. As a result, sulfa drugs are frequently the product of choice in China when coccidiosis breaks out due to their efficacy and cheaper price.

"But there are restrictions on sulfa drug residues in poultry to be exported to Japan," Tai says. "It is difficult for us to monitor the choice of anticoccidial by contract growers, so residues are a big concern for poultry meat exporters."

In addition, there are restrictions on residues in exported broiler meat for medicines including clopidol and nicarbazine, which along with sulfaquinoxaline have been banned by the Ministry of Agriculture of China. It is likely that more in-feed anticoccidials will be banned in the future, he predicts.

The solution: vaccination

Because resistance and residue were serious concerns for export-oriented and "green" bird integrators, Zhucheng started vaccinating day-old chicks with Coccivac-B, which provides lifelong protection against four leading species

of *Eimeria* that affect broilers. The birds are vaccinated in the hatchery with a specially designed spray cabinet that provides uniform dosing.

The result, according to Tai, has been good control of coccidiosis. There has been a significant reduction in the need for treatment and subsequent concern about residues. The vaccine also has replaced field-resistant oocysts with highly sensitive vaccine oocysts, he says.

Vaccinating for coccidiosis, Tai continues, also provides an excellent method of avoiding problems with resistance and residues. The oocyst species used to produce the vaccine were isolated before in-feed anticoccidials on the market were launched and are therefore highly sensitive to all approved ionophores and chemical treatments. That's why replacing resistant field strains with oocysts in the vaccine is beneficial, he says.

"Since the end of 2001, we have vaccinated about 25 million birds with Coccivac-B," reports Wang Chunming, chief veterinarian of the Animal Health Center. "In fact, we mandated that all birds reared on the floor must be vaccinated at day of age by Coccivac-B through spraying in the hatchery.

"Our growers have accepted the concept of vaccination, especially since they saw the results obtained with the first 1.3 million birds either vaccinated or medicated respectively," he adds.

Those results showed that vaccinated birds had an equal or better performance index than non-vaccinated birds. "As a result, growers no longer use anticoccidials in feed for prevention or in drinking water for treatment, except for the occasional use of diclazuril to control mild post-vaccination reactions. We are free of coccidiosis and residues in broilers," he says.

Technical service crucial

Because biological prevention against coccidiosis is a new concept for the broiler industry in China, successful implementation of coccidiosis vaccination required good technical service.

According to Tai, Schering-Plough Animal Health's technical personnel introduced the advantages of coccidiosis vaccination and created interest in Coccivac-B. They defined a trial protocol based on local conditions with clients and taking into account the location, number of birds, groupings and measurement index. The team of specialists also provided crucial support

continued on page 22

Zhucheng hatchery workers use a specially designed spray cabinet to administer coccidiosis vaccine to day-old chicks.

Broilers vaccinated for coccidiosis have performed as well as or better than medicated birds.

EU Organic Trend More Perception Than Reality

Most poultry companies point to Europe when they think of the so-called trend toward producing organic and free-range broilers, but that may be more perception than reality, according to Isabelle Guillot, a veterinarian who heads Schering-Plough Animal Health's poultry business in Germany.

According to Guillot, organic and free-range birds make up only 1.2% of the 461 million birds produced in Germany, Austria and Switzerland. "Organic product is difficult because of problems with the feed," she says, "and the market is unlikely to increase past the present level of 0.8 million birds."

Lack of consumer demand for free-range birds is another turnoff. One German company has stopped producing them, and at one site 50% of the production was being sold as conventional broilers.

"Only one company in Germany now produces free-range birds — and it represents only 1% of their production," she reports. "They're also afraid to promote the product too much because it might discredit their conventional broiler products."

Despite the shrinking market for free-range and organic birds, she says more mainstream operations are still backing off in-feed anticoccidials and trending toward vaccination to avoid concerns over drug resistance and residues.

Guillot: 'Organic product is difficult because of problems with the feed.'

SCHERING-PLOUGH ANIMAL HEALTH

275

technical services bulletin

Clinacox™ Sensitivity of Field Eimeria Isolates Significantly Improves Following Vaccination with Coccivac®-B

A large US broiler integrator sought to maximize the long-term efficacy of Clinacox® through rotation of the dicluzuril program with conventional ionophore programs or with Coccivac®-B vaccination.

Study Design

The integrator collected litter samples from eight farms on each of seven complexes to obtain baseline Clinacox sensitivity information. Samples were submitted to Dr. Greg Mathis, Southern Poultry Research, Athens, Ga., for sensitivity testing. Prior to initial sampling, the complexes had been on a variety of anticoccidial rotation programs, all of which included Clinacox for one to two cycles the previous year.

Dr. Mathis determined the Clinacox sensitivity based upon a combination of the percentage of weight reduction in test birds compared to unchallenged controls and coccidial lesion scores (Table 1, Figures 1 and 2). Then he stigmatized the efficacy of Clinacox as "good," "moderate" or "poor" for each sample where oocysts were successfully isolated (Table 2, Figures 3 and 4).

Following collection of the initial litter samples, four of the seven complexes continued their normal rotations using ionophores or chemical-ionophore shuttle programs. The remaining three of seven complexes incorporated two cycles of Coccivac-B vaccination into the annual rotation.

The identical houses were re-sampled after two cycles of Coccivac-B or anticoccidial rotation.

Results

Complexes that continued to use a non-Clinacox anticoccidial rotation showed little or no improvement in Clinacox sensitivity following the additional "test" period.

Complexes that used two cycles of Coccivac-B in the rotation showed significant improvement in Clinacox sensitivity. None of the samples scored "poor" following Coccivac-B use, and all categories demonstrated consistent improvement.

Key Points

- A large US broiler integrator investigated the impact of rotation programs on the sensitivity of field *Eimeria* spp. samples to Clinacox™ (diclazuril).
- Resting Clinacox by rotating it with ionophores or chemical/ionophore shuttle programs produced neither consistent nor significant results.
- Two cycles of Coccivac®-B in the rotation resulted in dramatic improvement in Clinacox sensitivity.

New TSB Details Sensitivity Trial

Want more information on the anticoccidial sensitivity trial described on page 4 of this issue? Schering-Plough Animal Health has published a new Technical Service Bulletin summarizing the key data from the study, complete with tables and color charts. For a free copy, contact your company representative or send your request to Phyllis Middleton. Email: phyllis.middleton@spcorp.com. Fax: 908-629-3206. Ask for publication SPAH-PBU-275 and remember to include your full name and address.

More Support for Cocci Management

Paul Burke

Ray Abner

Schering-Plough Animal Health has realigned two US sales territories and appointed new representatives to service poultry customers in key areas.

Paul Burke (paul.burke@spcorp.com) — a 10-year veteran of the company's Poultry Business Unit and the winner of numerous sales awards, including top sales representative in 1994 and 2000 — will continue as a Senior Area Manager but will be relocating to Texas to serve his new western territory, which also includes California, Oregon and Washington. Earlier in his career, Burke was a grow-out manager for Cargill, Jacksonville, Fla., and attended Texas A&M University, College Station. He is currently based in Gallatin, Tenn.

Burke is being replaced by Ray Abner (ray.abner@spcorp.com) who recently joined Schering-Plough Animal Health with more than 20 years of industry experience, including sales positions with Hoechst Roussel Vet and Hoffmann-LaRoche. Abner has bachelor's and master's degrees in animal science and nutrition from the University of Tennessee, Knoxville. Based in Lowndesboro, Ala., Abner will cover his home state plus Indiana, Kentucky, Michigan, Ohio and Tennessee.

Got a Story Idea for *CocciForum*?

The editors of ***CocciForum*** welcome news tips and story ideas from its readers around the world. If there's a particular subject you'd like to see covered in a future issue — perhaps a specific area of coccidiosis management — please let us know. Write to JFeeks@prworks.net or call 508-627-6949 (US). We want to hear from you.

Irrefutable Evidence continued from page 5

Phillips: 'These are powerful findings that could revolutionize the way the industry controls coccidiosis for years to come.'

notes that two cycles of Coccivac-B prompted a dramatic shift toward increased diclazuril sensitivity.

"We followed exactly the same houses before and after diclazuril was used, then used Coccivac so we could pinpoint for sure whether we were replacing resistance," he says. "The results demonstrate that we can replace or at the very least dilute the amount of *Eimeria* resistance that's out there by using Coccivac for several cycles and making it part of a long-term control program."

Mathis, who calls the landmark trial "one of the most coccidiosis-significant studies" he's worked on in more than 20 years, thinks the results will go a long way toward directing coccidiosis management in the future.

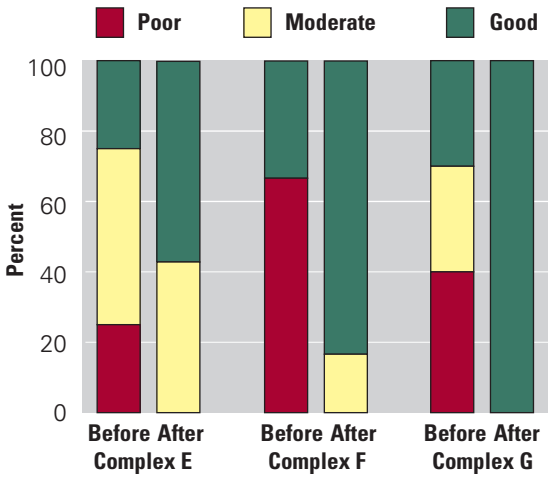
"The take-home message is that to get the performance you got when you originally had diclazuril or other in-feed anticoccidials, you're going to have to use a vaccine. Coccivac is the only coccidiosis vaccine that has clearly demonstrated that it can replace resistance."

Phillips agrees and says the results are almost an exact duplication of past

Table 1
The Results of Sensitivity Testing at the Seven Complexes in the Study

		Clinacox Sensitivity (%)		
Complex	**Rotation Program**	**Good**	**Moderate**	**Poor**
A - Before	Anticoccidial	25	12.5	62.5
After	Anticoccidial	0	12.5	87.5
B - Before	Anticoccidial	25	12.5	62.5
After	Anticoccidial	16.7	33.3	50
C - Before	Anticoccidial	16.6	0	83.3
After	Anticoccidial	0	50	50
D - Before	Anticoccidial	0	80	20
After	Anticoccidial	20	40	40
E - Before	Anticoccidial	25	50	25
After	Coccivac-B	57	42.8	0
F - Before	Anticoccidial	33.3	0	66.6
After	Coccivac-B	83.2	16.6	0
G - Before	Anticoccidial	30	30	40
After	Coccivac-B	100	0	0

Figure 1. Rotation with Coccivac-B for two cycles dramatically improved sensitivity of field isolates to Clincox.



pen study trial results. "These are powerful findings that could revolutionize the way the industry controls coccidiosis for years to come," he adds.

"For the first time in decades, vaccination is being viewed as a foundation to successful coccidiosis management — one that can be used either year-round or in a carefully planned, long-term rotation with in-feed anticoccidials to maximize their impact."

Know the Spore continued from page 7

sampled and technicians identify and count the number of infective oocysts per ml. "We get at least two independent counts on freshly produced material using light microscopy," Knight says.

The final product includes non-sporulated and partially sporulated oocysts, but only oocysts that are fully sporulated are counted as infective, he says.

Fitz-Coy says, "We must keep in mind that oocyst viability decreases over time. Not all originally counted infective oocysts will be viable by the expiration date on the vaccine."

Consequently, the Millsboro team makes sure that every vaccine formulation contains sufficient infective oocysts to allow for the decay of some infective live oocysts. "That way, the vaccine maintains potency through its stated shelf-life," he says.

Antigen production is complete once the harvest has been treated with a chemical sterilant and quality control has released the lot on sterility, purity and titer, he says.

Potency testing

To be absolutely certain every final vaccine serial (a blend of individual vaccine lots) is efficacious, technicians conduct potency testing in live birds, says Knight. "Vaccinated birds are challenged with each *Eimeria* line to make sure immunity has developed. Unvaccinated control birds also are challenged to ensure the validity of the test."

Besides making sure that every batch of vaccine contains enough viable, sporulated oocysts, the count also ensures that birds aren't exposed to too many, which could cause a stronger than needed immune response.

"Actually, the formulation ensures that fresh vaccine is not too potent," says Knight, "but as an extra precaution, we conduct safety tests in birds at an increased dose level.

"The nature of the potency test makes it both time- and resource-consuming. It also eats into the available expiration dating of the product. However, we still believe that a challenge potency test is the best way to demonstrate vaccine efficacy," he says.

Additional testing

Every batch of Coccivac also is tested for the presence of extraneous viable

bacteria and fungi, according to USDA regulations and, for added measure, for mycoplasma even though this testing is not a government requirement. "Although the potency test is critical because it demonstrates that all species are present in sufficient numbers to initiate the immunizing process, that alone is not enough to warrant release of the vaccine," he says. Further testing is carried out to demonstrate freedom from contaminating viral agents.

The effectiveness of Coccivac is ensured by a range of measures starting with the quality of raw materials and ending with shipment of the product, according to Knight.

"Every single stage of production, be it a quality-control test, an in-process check, an incubation temperature or storage time, is documented and reviewed for compliance prior to

Cocci FAQs continued from page 11

Q. HOW DOES STOCKING DENSITY AFFECT COCCIVAC VACCINATION?

A. You'll get more uniform results if the initial stocking density is 0.75 ft^2 to 1.0 ft^2 per bird. Higher stocking density could result in excessive litter moisture and a high litter oocyst density.

After vaccination, third-house and half-house brooding encourages proper Coccivac cycling for the first 7 to 14 days. Remember that for full immunity to develop, birds require not only the initial "dose" of live sporulated oocysts administered via the vaccine, but two or more life cycles of coccidia.

Q. WHAT'S THE BEST LITTER MOISTURE CONTENT FOR BIRDS THAT RECEIVE COCCIVAC?

A. A minimum litter moisture content of about 25% is needed to stimulate the coccidial life cycle, but too much moisture will lead to poor Coccivac results. If the litter is too wet, coccidial cycling may be heavy, causing too much reaction in birds and even overgrowth of the bacteria that causes necrotic enteritis. Too much litter moisture also can lead to transient immunosuppression due to "cold stress" as well as high ammonia, resulting in blindness and poor flock uniformity.

Q. WHAT TIPS DO YOU HAVE FOR GOOD MANAGEMENT OF LITTER MOISTURE?

A. One way to reduce litter moisture is by properly maintaining nipple drinkers, which reduce the amount of water spilled into the litter. Consider your ration formulation. Some rations reduce the amount of excreted moisture. Litter type and depth should accommodate the amount of moisture expected in the house. Ventilation also can be adjusted to control litter moisture. Bird density needs to be controlled to avoid the moisture concentration.

For more information on managing litter moisture, see the article by Mike Czarick on page 12.

Have more questions about coccidiosis vaccination? Send yours to the editor at JFeeks@prworks.net or by fax to 928-569-2491. You'll get a personal reply from a Schering-Plough Animal Health Corporation technical service representative and we may include it in our next issue of ***CocciForum****.*

Cocci Confidential continued from page 9

Table 2
Summary of Performance: Coccivac-B vs. Control

Treatment	Age (days)	No. started	% Liv	Gross lbs sold	Average weight	Feed conv	Cal conv	Cal conv adj 7.5lb	ADG	Cost per lb
Coccivac-B: Total or Average	59.8	156,600	97.33	1,161,909	7.623	2.096	3022	2994	0.128	.2088
Anticoccidial: Total or Average	59.8	156,600	97.47	1,148,824	7.527	2.112	3033	3027	0.126	.2105
Coccivac-B Advantages	N/A	N/A	-0.14	13,085	0.096	-0.016	-11	-33	.002	-.0017

previous flocks before their immunity is fully established, which explains why performance results may seem irregular with the first cycle of Coccivac-B.

In this rare multi-farm, paired-house study, Coccivac-B was successfully used for the long-term management of coccidiosis without sacrificing performance. In other words, Coccivac-B used in real-world conditions not only controlled coccidiosis, it improved broiler performance compared to ionophore anticoccidials.

Coccidiosis Vaccination in China continued from page 17

during the trial, including on-site visits at 7, 14 and 21 days post-vaccination. The trial enabled customers to realize the advantage of Coccivac-B and helped Schering-Plough Animal Health learn how to adapt Coccivac-B to local conditions.

"We have about 2,500 growers," adds Wang. "It is very difficult for us to teach all growers about using Coccivac-B in a short time."

As a result, Schering-Plough Animal Health's technical staff in China provided training to most of the growers, which are located in 75 villages within a 200 km radius. In addition, the company provided a concise and easily understood post-vaccination management list, which included information on feed, litter, moisture, necrotic enteritis and vaccination reaction control, he says.

The training, coupled with post-vaccination on-site visits and management tips, enabled growers to develop adequate skills and knowledge about Coccivac-B. "That eventually solved the problems of resistance and residues — both issues that perplexed our business before," Wang says.

Schering-Plough Animal Health's technical service specialist David Xuan agrees, adding, "The success of Coccivac-B depends on post-vaccination management, which must be customized to the local situation. Coccivac-B can become the best choice for coccidiosis control if a concrete and practical technical service plan is provided."

Putting Ideas to the Test

These days, as we head into another US presidential election year, it seems everyone — politicians, talk-show hosts, newspaper columnists and even the kid at the video store — has an opinion or theory about how to fix the problems of the world. It's good to see people thinking and sharing their views. But as we all know from experience, it's one thing to present an idea. Making it work is entirely another.

Now I'm smart enough to realize that managing coccidiosis in poultry is a long way from balancing the budget, creating more jobs or bringing us lasting peace and security. Nevertheless, a recent experience I had evaluating long-term options for coccidiosis control underscored the value of presenting new ideas, putting them to the test and making them work in the real world.

Two years ago, Schering-Plough Animal Health launched Clinacox (diclazuril), a new-generation synthetic anticoccidial that was shown to be highly effective against the many wild and resistant strains of *Eimeria* in the field. Birds medicated with Clinacox also showed significant improvements in feed conversion — often a 5-point[1] boost — while also yielding significant gains in energy efficiency.

Knowing that all in-feed anticoccidials can lose some punch with continuous usage, we strongly urged the poultry industry to use Clinacox judiciously — either for one cycle annually or in a shuttle program (starter or grower ration, but not both) in two sequential cycles.

Because Clinacox cleaned up the resistant *Eimeria* populations, we then recommended rotating to the live-oocyst vaccine, Coccivac-B, and using it two to three cycles. The theory was that Coccivac could start from a clean slate while also seeding houses with older, highly susceptible strains of *Eimeria*. This practice had already been proven with ionophores, but the jury was still out when it came to using Coccivac in a program with Clinacox. As Dr. Rick Phillips puts it in the trial report on page 4: "Despite the research and all the field reports in hand, we felt it was important to test our hypothesis in the field where the proverbial 'rubber meets the road'."

So that's just what we did. We took a theory or a good idea, put it to the test in real-world conditions and showed how these two important tools — Clinacox and Coccivac — could be used to develop a long-term, integrated approach to coccidiosis management. It's gratifying to read that one of the independent cooperators in the study, Greg Mathis, PhD, of Southern Poultry Research in Athens, Georgia, called the landmark trial "one of the most coccidiosis-significant studies" he's worked on in more than 20 years.

This latest field trial is, of course, another good example of the commitment that Schering-Plough Animal Health has made to the worldwide poultry industry. We'll continue to bring this expertise and sound science to the field through articles in *CocciForum*, as well as through presentations at industry meetings and our new series of Technical Service Bulletins. We can't do it alone, however. As I said before, it seems everyone has an opinion about how to fix the problems of the world, including coccidiosis in poultry. We hope that you'll continue sharing yours with us.

Worldwide Technical Services
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[1] 0.05 improvement in pound of feed per pound of live weight gain during the period of the first treatment. Data on file at Schering-Plough Animal Health Corporation.

COCCI FORUM

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- Critical component of coccidiosis control strategy
- Efficient and efficacious administration via Spraycox™ cabinet
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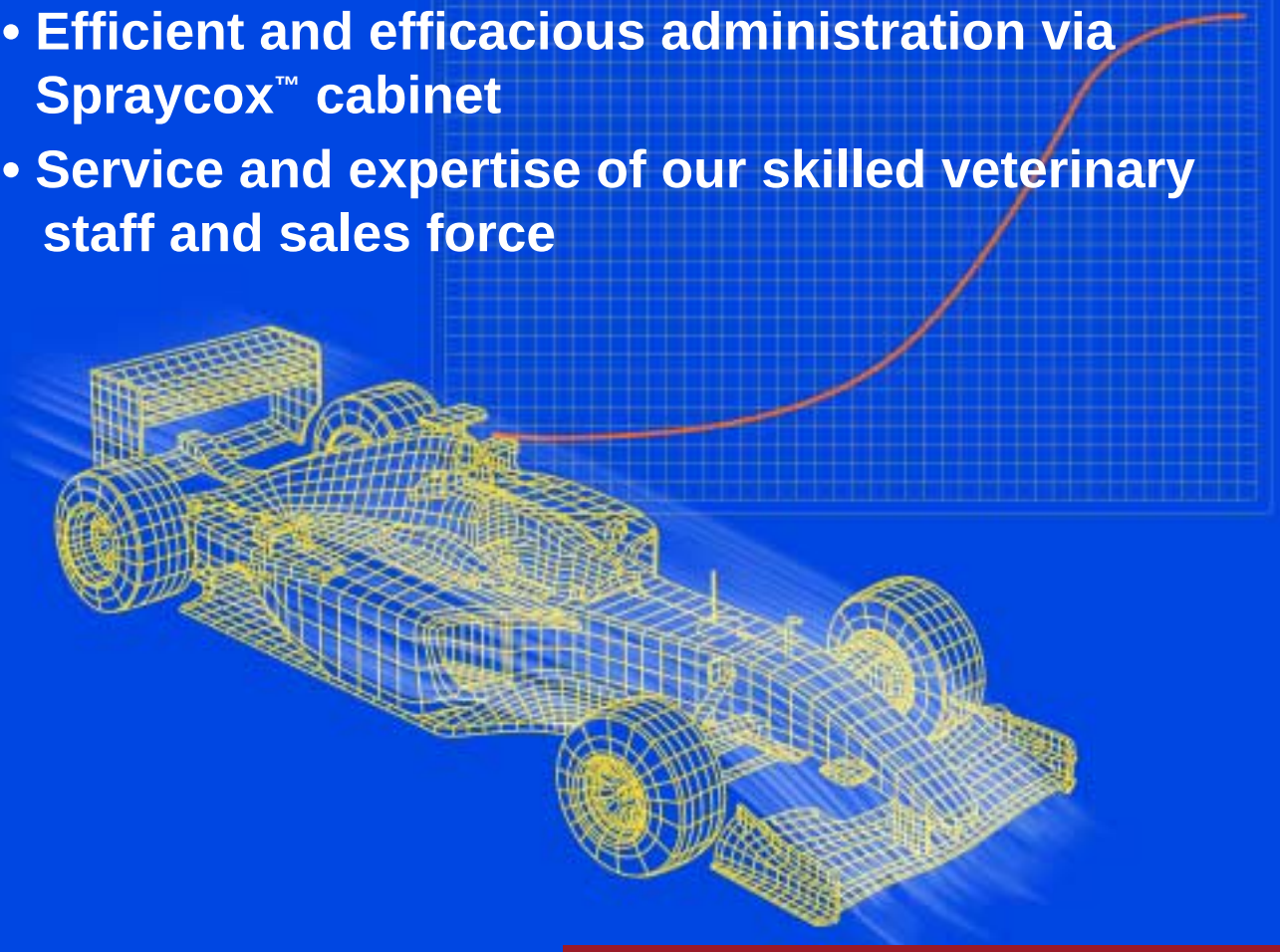

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