

# **40<sup>th</sup> Annual Dairy Cattle Day**



**Department of Animal Science  
University of California, Davis  
March 21, 2001**

# **Proceedings of the 40<sup>th</sup> Annual Dairy Cattle Day**

**Hosted by:**

**University of California  
Department of Animal Science  
Davis, California**

**Main Theater  
March 21, 2001**

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# DAIRY CATTLE DAY COVER

University of California, Davis

March 21, 2001

## Teaching, Research and Outreach ... Activities of the Dairy Facility.

The picture on the cover of this year's proceedings has the three Student Herd Managers. They are from left to right, Douglas Thomas, Gina Defazio, and Victoria O'Nion. Each student is completing a 12-month Student Herd Manager Internship program. Each student works a minimum of 20 hours a week; 10 hours for internship credit and 10 hours for salary. The goal of the internship is to prepare each student to be capable of managing the Dairy Facility. The internship provides hands-on experiences to support concepts learned in formal coursework. Vicki is majoring in Agricultural and Managerial Economics and is completing a minor in Animal Science. Vicki commented that "through this internship, I've been able to apply my coursework, as well as learn new skills that I would never have been able to obtain in a classroom setting. The internship ... creates a leadership and community role ...skills to carry with me into my career". After graduation Vicki plans to work in New Zealand in the dairy industry. Gina is majoring in Animal Science and Management. Gina did a Calf Internship, which stimulated her interest in dairy cattle. Gina applied for the Student Herd Manager Internship because "I knew I would learn a lot about managing dairy cattle. My career goals are a little uncertain, but I would like to work in some aspect of the dairy industry when I graduate." The students participating in the Student Herd Manager Internship program are motivated and dedicated, and they contribute to all teaching and research activities at the dairy.

The Student Herd Manager Internship program was initiated in 1990, and 15 students have completed the internship. Students completing the internship have been successful: 4 completed veterinary school, 2 are currently in veterinary school, 4 are teaching agriculture, 2 are still undergraduates, 1 is in graduate school, and 1 completed graduate school and works for a large cheese company.

There are a number of ongoing research studies. The dairy herd is divided into two separate breeding populations for a project conducted by Juan Medrano and Ed DePeters. The objective is to increase the frequency of the B variants of kappa casein and beta lactoglobulin in the Holstein population. The homozygous cows for the B variant of these milk proteins results in about 8% more cheese per 100 pounds of milk than the A variant. Frequency of the B variant of kappa casein is higher in the Jersey and Brown Swiss breeds than the Holstein breeds. At the present time the A Herd (A variant of kappa casein) has a 100% frequency of the A variant. The B Herd (B variant of kappa casein) where bulls of the B variant have been used has resulted in a frequency of the B variant at 44%, which is higher than the 18% frequency in the Holstein population. This past year milk from each herd, the A Herd and the B Herd was collected four times. Milk was transported to the Hilmar Cheese Company and cheese was made from the milk to determine cheese yield qualities of the milk. From the most recent milk collections, milk was also shipped to the Dairy Processing and Technology Center at CSU Cal Poly SLO. Working with Phil Tong, the milk from each herd was made into cheese and the yields of cheese and whey and their compositions are being determined. If significant increases in cheese yields in the B

herd are found it could signify the efficacy of a breeding program to increase the B variant of kappa casein in Holsteins.

Gary Anderson and his graduate student, Marcelo Bertolini, are studying the use of ultrasonography as an aid to improve reproductive efficiency. This technology is used at the Dairy Facility to assess and characterize the reproductive status of animals in the herd. Ultrasonography is being used to detect abnormal pregnancies and pathologies of the reproductive tract, to determine embryonic and fetal viability, to identify twins, to determine fetal gender, and to find early embryonic losses. Ultrasonography is one of the demonstrations during the afternoon portion of today's Dairy Cattle Day program.

There are numerous other studies in progress that are finding solutions to problems facing the dairy industry and California agriculture. Deanne Meyer, Cooperative Extension Waste Management Specialist, is doing nitrogen balance studies to follow the flow of dietary nitrogen to milk, tissue, urine and feces. This information will contribute to future efforts to develop nutrient budgets on dairy farms. Peter Robinson and Ed DePeters completed one feeding study with cracked Pima cottonseed. Pima cottonseed is higher in gossypol content than whole, fuzzy Upland cottonseed. This study is looking at the effect of Pima cottonseed on plasma gossypol and production performance of dairy cows. A second study feeding Pima cottonseed will begin this spring. The research with Pima cottonseed involves collaboration with Jose Santos at the Veterinary Medicine Teaching and Research Center in Tulare. Michael Delwiche from Biological and Agricultural Engineering has successfully developed automated sensors (biosensors) to determine the progesterone and urea nitrogen in milk. These can be measured in the milk for individual cows during milking and the information reported within minutes. Milk progesterone information can be used in reproduction programs, and milk urea nitrogen information can be used to evaluate feeding programs. An automated sensor is being developed for antibiotics, which would eliminate the possibility of a drug residue in milk. Steven Berry, Cooperative Extension Dairy Management Specialist, is continuing his efforts on foot care and locomotion scoring of cows. Maintaining functional foot care of the herd enhances reproductive performance and milk production. Steven will be conducting a demonstration at the Dairy Facility during the afternoon portion of the Dairy Cattle Day program.

The UC Davis herd consists of 113 milk cows. The majority of the cows are Holstein with about six Jersey cows, one Guernsey, one Brown Swiss, and one Milking Shorthorn. The various breed additions to the herd were donations from dairy producers. The various breeds support our undergraduate teaching programs and our education programs focused towards the general public. We are hoping for a donation of an Ayrshire heifer. The current DHIA herd average is 25,813 pounds of milk, 28,384 pounds of energy corrected milk, 1073 pounds of fat, and 840 pounds of protein. Milk production continues to improve, which is a reflection of the high quality staff. The staff includes Doug Gisi, herd manager, Alan Mazzoleni, assistant manager, and Walter Paroczai and Fred Stewart, milkers. There are also the three student herd managers, Gina Defazio, Vicki O'Nion, and Doug Thomas and the four student residents living at the Dairy Facility Ricardo Ertze, Sara Harrison, Eric Butler and Alecia Dinkins. The staff and students at the Dairy Facility work as a team and do an excellent job. You are welcome to visit the Dairy Teaching and Research Facility at any time

## **Planning for the Future – New Dairy Cattle Facility at UC Davis**

The following is a brief update of progress during the past year on plans to replace the current dairy facility on the UC Davis campus. The Department of Animal Science is preparing a Project Planning Guide (PPG) Abstract. The PPG Abstract will be submitted to the campus administration and must be approved so the planning for a new capital project to replace the existing Dairy Facility can proceed. The PPG Abstract contains the program goals for the dairy project, space needs, expected costs and planned funding sources, site related issues, and an inventory of known environmental issues. The committee working on the PPG Abstract consists of dairy producers, industry leaders, and university faculty and staff. Researchers from the Departments of Animal Science, Food Science and Technology, and Biological and Agricultural Engineering, and the School of Veterinary Medicine are participating in the planning process. The PPG Abstract will contain information to support teaching, research, extension, and outreach for the College of Agricultural and Environmental Sciences, for the UC Davis Campus, and for UC Systemwide.

The plan is to build a dairy facility that will address emerging and future issues facing agriculture in California. The new dairy facility will have 300 cows in the milking string. However, the dairy will be built to feed and manage 400 milking cows. This ability to expand will allow the University to respond quickly if a critical issue arises. Regional, national, and global markets require that the California dairy industry, the largest dairy industry in the country, is capable of responding quickly to consumer issues. The dairy will be designed to support research in nutrient management to ensure environmental quality, food safety and quality, and animal welfare and care. The proposed dairy will do fundamental research and a herd size of 300 milk cows is adequate for this purpose as well as for teaching and outreach. There will be unique aspects to the proposed dairy. There will be 2 to 3 small 250-gallon bulk tanks. This will allow researchers to isolate milk, which can be used in the Dairy Products Laboratory for manufacturing studies. In the future, milk from cows producing pharmaceutical products will be separated from the remainder of the herd milk. A TRE (Teaching, Research and Extension) Unit will allow intensive animal studies. Presently there is no animal metabolism room. Nitrogen balance studies providing information for nutrient management research will benefit from improved facilities. These are only a few of the unique aspects planned for the new dairy facility.

Anyone interested in participating in the planning process for efforts to replace the existing Dairy Facility on the UC Davis campus can contact Gary Anderson or Ed DePeters (530-752-1250).

### **Information from the 2000 UC Dairy Cattle Day proceedings follows for background:**

The planning process for a new Dairy Teaching and Research Facility on the UC Davis campus began last year (1999). The current facility opened in 1959 and although it has served the dairy and allied industries and the campus well, it no longer represents the technology present in the industry, and it does not support the most innovative research and teaching. Milk is the Number One agricultural commodity in California, and California is the leading dairy state. To support a dynamic dairy industry and its future needs and to ensure that the industry remains the premier industry in California and the US, new facilities are needed.

The current Dairy Facility has a milking herd of about 90 cows, too small to support current and future research and teaching needs. The new facility will handle 300 to 400 milk cows.

A new dairy facility at the UC Davis campus will complement the activities currently conducted at the California State Universities at San Luis Obispo, Fresno, and Chico, at the Community College level, and at the new dairy facility proposed at the VMTRC in Tulare. A primary mission of the State Universities and Community Colleges is teaching. UC Davis has a triple mission including teaching, research, and extension. These missions and universities complement one another. Many current and future graduate students who conduct dairy research come to UC Davis from the State Universities and Community Colleges. These graduates will work in the dairy and allied industries as technical support professionals, including nutritionists, herd managers, sales and marketing, and commodity- group promotion.

The UC Davis campus has a major role in the Land Grant system for California. Our current campus programs in health, medicine, nutrition, reproduction, molecular genetics, animal behavior and welfare, food science, engineering, environmental sciences, wildlife biology, human resources, plant science, and engineering will continue to expand and position the campus to address new and emerging issues related to agriculture and society. A dairy facility on the UC Davis campus will ensure that the dairy industry receives the support needed to remain competitive.

Teaching is a role of the dairy facility at UC Davis. Animal Science undergraduates totaling over 750 students use the dairy facility in numerous classes. The School of Veterinary Medicine uses the dairy facility in at least three of its courses, and the dairy is important to the training of veterinary students in the food animal program. Undergraduate and veterinarian students are exposed to dairy care and management practices through hands-on training. Although it is difficult to quantify, exposing students to dairy cattle has resulted in some students changing their focus from companion animals to food animals.

Research is supported by the dairy facility at UC Davis. The UC Davis dairy facility is the primary State facility conducting production research. This research includes nutrition, molecular genetics, reproduction, and health to name only a few. The California Dairy Center program (CA Dairy Research Foundation) is unique among other Center programs, because of its investment in preharvest milk production. Improving the nutritional value and manufacturing qualities of milk through genetics, nutrition, and molecular techniques is a priority of the California Center; consequently, UC Davis and CSU Cal Poly are the national leaders in preharvest research. Much of the information related to waste management and used in the environmental stewardship component of the Dairy Quality Assurance program was developed at UC Davis. The current facility does not provide research opportunities for waste management, but a new facility will. Dairy animals are available to a wide variety of researchers in the School of Veterinary Medicine. The J5 vaccine was developed on the UC Davis campus, and development of the vaccine involved animals at the UC Davis campus. Other health research includes footwarts, protozoal abortion, and Salmonella. Agricultural engineers have developed biosensors to measure automatically progesterone and urea nitrogen in the milk of cows in the milking parlor. These advances will be used to improve management programs on commercial dairies.

A new dairy facility will allow the UC Davis dairy research programs to expand and address new areas. Waste management programs have been developed, but the current outdated facility does not allow research that will provide information that is immediately applicable to the dairy

industry. Biosecurity and animal welfare are issues that require solutions. Again, the current facility does not support the most advanced research and teaching programs. A modern facility at UC Davis will allow research programs to expand, will offer new opportunities for research, and will improve the ability of faculty to obtain funding for research that will benefit agriculture and society. The proximity of the UC Davis dairy facility to the State capitol will also be important in the future. With an ever-increasing proportion of the population unaware of how food is produced, the UC Davis campus is situated in a politically important region of California.

The new dairy facilities at UC Davis and the VMTRC will be complementary, not redundant or competitive. The VMTRC dairy will be larger and well suited to applied research studies, many with a health-care focus, and to teaching small numbers of food animal veterinarians. The UC Davis dairy will be smaller with an emphasis on fundamental research and teaching large numbers of undergraduates and veterinary students. The majority of the dairy research faculty, graduate students, and veterinary students are on the Davis campus. The UC Davis dairy will be the site for a wide variety of research projects. To conduct intensive studies requiring frequent sampling and animal monitoring, the animals and facilities need to be close to the researchers and the supporting laboratory facilities. The intensive studies will result in small, applied studies being conducted at the UC Davis dairy; however, many of the new technologies will be transferred to the VMTRC dairy where larger, applied studies can be performed and the findings extended to the surrounding dairy industry. All new technologies need to be adequately evaluated prior to industry introduction. The size, value and importance of the California dairy industry justify more than a single dairy research facility (e.g., UC Davis, VMTRC, Cal Poly) to conduct fundamental and applied research that will benefit the dairy industry and society.

**40<sup>th</sup> Annual Dairy Cattle Day Dedication to  
R. Lee Baldwin**  
**Thank you for 40 years of contributions to dairy science.**

“I do not know of another individual in the world who has contributed as much as Lee Baldwin to our knowledge of ruminant biology, physiology and nutrition over the span of the last 30 years,” said his colleague Marvin Bryant, professor emeritus at the University of Illinois and member of the U.S. National Academy of Sciences. Gary Anderson, Professor and Chair of Animal Science at UC Davis, said of him, “Professor...Baldwin is one of the rare individuals whose contributions to education, to science and to society continue to accelerate in value. His service to the dairy industry emerges from his role as an educator and mentor, a research scientist and a servant of the industry and consuming public.” These are among the reasons Lee Baldwin was selected to be a member of the U.S. National Academy of Sciences.



Joining the faculty in Animal Science at UC Davis in 1963, Dr. Baldwin taught two courses for over three decades that had an unquestioned impact on the dairy industry: Biology of Lactation and Nutritional Energetics. Biology of Lactation integrated the biochemical, genetic, nutritional, physiological and structural components of mammary development and the initiation and maintenance of lactation, the chemical composition of milk and limits to animal performance and productivity. He emphasized the integration of the basic, disciplinary sciences in solving real-world problems confronted by dairy scientists and dairy producers. This course alone led many students from around the world to chose dairy nutrition as their own field of research and teaching and they, in turn, have made many contributions to dairy science.

In Nutritional Energetics, too, Dr. Baldwin’s goal was to integrate disciplinary knowledge with a quantification of problems of metabolism, and he managed to find a way to present the mathematics necessary for scientific insight without scaring off the typical biology student with tedium and abstraction. Through humor and a command of the subject, he managed to carry his students through the rigors of advanced mathematics to a clear understanding of metabolism. Through these two courses, Dr. Baldwin trained a generation of nutritionists and produced outstanding graduate students and faculty around the world, people who will carry on his legacy as messengers and investigators themselves.

Dr. Baldwin’s research spanned a number of disciplines including nutrition, biochemistry, physical chemistry, and microbiology. He has the unique ability to integrate research information

from divergent fields of study to find solutions to complex problems. This ability led to Lee's development of dynamic simulation models to predict animal growth and lactation. Lee was one of the first people in the field of animal science to use modeling techniques to quantify and predict animal performance. He is a national and international authority on modeling of animal systems. Lee developed Molly, a computer model describing digestion and metabolism in lactating dairy cows. In contrast to most models used in the field that are static, Lee's model is dynamic; it tracks responses to dietary inputs over time. At the present time, his models are used around the world at universities to teach undergraduates and in research to identify areas where more information is needed to improve our understanding of the biology of growth and lactation. The past few years, Lee has been working on a user friendly version so that his model can be used in the field by nutritionists, allied industry personnel, and dairy producers. It is possible to use Molly to predict responses in the production performance of lactating cows to dietary changes as well as predict the excretion of nutrients, which in the future may help dairy producers remain environmentally friendly. Lee's modeling efforts will be felt for many years in the future.

Professor Baldwin has been a mentor to many nutrition faculty members in Animal Science. To many he is the "Big Daddy" for nutrition and biochemistry research. If you have a question, you know that you can always find Lee in his lab at 7 a.m. Just grab a cup of coffee, pull up a chair, and discuss whatever topic you wish. Lee possesses a wealth of information, and he is always willing to help.

Professor Baldwin is a model university citizen, and his service to society is unusual and has both national and worldwide impact. He was a major contributor to an influential document, *Contributions of Animal Agriculture to Meeting Global Human Food Demand*, done for the Council on Agriculture Science and Technology. Since he was elected to the National Academy of Sciences in 1993, his service increased dramatically as he served on numerous national and international committees and workgroups. Lee has always been a prolific writer of top level research, his relatively recent book, *Modeling Ruminant Digestion and Metabolism*, may be the most important, as it encapsulates the 40 years (actually 39 years and 9 months!!) of Dr. Baldwin's research career at U.C. Davis. In it he refines his mathematical models of liver and mammary gland function, adipose tissue metabolism and digestion in ruminants.

We wish Lee the best in his retirement, and we thank him for his contributions to dairy science.

## DAIRY DAY CONTRIBUTORS

The Department of Animal Science would like to thank all of the contributors for their generous financial support. If not for these individuals and companies, Dairy Cattle Day would not be possible. Donors contributed up to \$100, Sponsors contributed \$250, and Patrons contributed \$500 or more to help cover printing the proceedings and other event costs. Patrons and Sponsors also support the dairy products provided during the break and at lunch. This select group generously supports the teaching, research and outreach activities associated with the event. The information presented on the program and published in the proceedings is for the benefit of the dairy producers, allied industries, and the dairy industry of California. We hope that you will thank these individuals and company representatives for their support of the 40<sup>th</sup> Annual Dairy Cattle Day program.

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The various cheeses available to snack on at the morning break were provided by the Dairy Research and Information Center (DRINC) at UC Davis, John Bruhn, Director. Travel for the speakers was supported by DRINC.

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**40th Annual  
DAIRY CATTLE DAY  
University of California  
Department of Animal Science**

**Wednesday, March 21, 2001  
Main Theater  
U.C. Davis Campus**

**MORNING SESSION:**

8:30 a.m.                   **REGISTRATION**

9:00 a.m.                   **WELCOME-** G.B. Anderson, Chair, Department of Animal Science, UC Davis

Transmission of Neospora Infection in Cattle – Mark Anderson, CA Animal Health & Food Safety Laboratory, UC Davis

Estate Planning for Farmers and Dairymen – Toni Porter, Baker, Peterson & Franklin, LLP, CPA, Fresno, CA.

Free Farmed Program: The New Niche Market – Carolyn Stull, Veterinary Medicine Extension, UC Davis

Graduate Student presentations (Clair Spackman, Marcelo Bertolini, and Gaston Prieto)

**BREAK**

Industry Headlines: CA Quality Assurance Program and Emerging Issues for the CA Dairy Industry. Chuck Ahlem, Charles Ahlem Dairy, Turlock, CA.

Crop biotechnology: Potential implications for the dairy industry. Bruce Thomas, Seed Biotechnology Center, UC Davis.

Impact of dry cow programs on body energy and protein status. Peter Robinson, Department of Animal Science, UC Davis.

1:30 p.m.                   **LUNCH BREAK**

**AFTERNOON SESSION:**

Demonstrations – Dairy Teaching and Research Facility

Dehorning of calves – Doug Gisi, Department of Animal Science, UC Davis & Tom Graham, DVM, Veterinary Consulting Services, Davis, CA.

Ultrasound – Marcelo Bertolini, Department of Animal Science, UC Davis.

Functional Foot Trimming – Steven Berry, Department of Animal Science, UC Davis.

3:30 p.m.                   **ADJOURN**

# Transmission of *Neospora* Infection in Cattle

Mark Anderson

California Animal Health & Food Safety Laboratory System

University of California Davis

Neosporosis is a newly recognized protozoal infection in cattle that is a major cause of abortion throughout the world. Since the first report of *Neospora* abortion in 1987 on a dairy in New Mexico, there have been numerous reports, confirming this infection as a significant cause of abortion, particularly among dairy cattle. Surveys in California, the Netherlands and New Zealand indicate that approximately 20% of all aborted bovine fetuses submitted to the diagnostic laboratory are diagnosed with this infection. The serologic evidence of *Neospora caninum* infection among individual dairy herds in the U.S.A. ranges from 5% to 98%. There are no signs of clinical illness in cows that abort due to *Neospora* infection. The aborted fetuses are usually autolyzed with no gross lesions and placentas are not retained. Abortions may occur throughout the year in both heifers and cows. The majority of abortions occur in the second trimester of pregnancy. Fetal mummification has been associated with *Neospora* outbreaks. Two patterns, endemic abortion and epidemic abortion, have been described in association with neosporosis in herds of cattle. In the endemic pattern of abortion, the herd experiences an elevated abortion rate of greater than 5% per year that persists for years. The epidemic pattern of abortion is less common and is characterized by abortions in a high proportion of pregnant cattle over a relatively brief period of time. In some instances, over 30% of pregnant cattle have aborted due to neosporosis within several months. A mixture of these patterns may be observed in some herds.

The confirmation of *Neospora* infection as the cause of abortion requires the assistance of a veterinary diagnostic laboratory. The preferred samples in cases of abortion include one or more aborted fetuses submitted with placenta and sera from the dam. The diagnosis is based on the presence of pathologic lesions, identifying the parasite and serologic results of tests to determine antibody titers in the fetus and dam. A variety of serologic tests are available to assist in the diagnosis of neosporosis including the indirect fluorescent antibody test, the modified agglutination test, and a number of enzyme-linked immunosorbent assays. The assays utilize *Neospora caninum* tachyzoites or specific derived antigens. The specificity and sensitivity of the various serologic tests are comparable depending on the minimum antibody titer that has been established as the cut-off for a positive result. Laboratories utilizing any of the serologic tests for *Neospora* should establish appropriate cut-off titers using sera from known infected and noninfected cattle. A single serum sample from an individual cow may not accurately reflect her infection status since titers in known positive cattle fluctuate and may fall below the cut-off value for some period of time. In rare instances, cows that abort a *Neospora* infected fetus may not have a significantly elevated titer. Also, previously elevated titers at abortion may decline over several months following abortion. In a portion of congenitally infected heifers that had a history of positive titers and had infected their fetuses, had titers below the cut-off at the time of parturition. There is no conclusive evidence to demonstrate that a serologic positive cow can revert to a consistently seronegative status. Enzyme-linked immunosorbent assays (ELISA) for detection of *Neospora* antibodies are widely used because the procedure is rapid,

inexpensive and consistent. Cutoff values have been established by which the probability of infection can be estimated in cattle. In the individual aborting cow, a positive serology result does not prove that the abortion was due to neosporosis but it can assist the diagnosis. In addition to its use in the routine abortion screen in individual abortion cases, the ELISA test is used on a herd basis. The test can be used to estimate herd seroprevalence of *Neospora* infection, to investigate the association between seropositivity and abortion, and to estimate the extent of herd infection attributable to congenital infection. At present, it isn't clear whether titers in the individual cow can be used to predict the outcome of a specific ongoing pregnancy.

The ways by which cattle may acquire *Neospora* infection are currently the subject of active investigation. The forms of the parasite that have been identified in infected fetuses and calves are the tachyzoite and tissue cyst stage. Tachyzoites can spread through the body and invade the cells of a variety of organs. The tachyzoite stage is associated with inflammation and necrosis at the site of invasion. The tissue cyst stage, containing multiple bradyzoites surrounded by a thick cyst wall, is found in neural tissues. The tissue cyst elicits minimal inflammatory reaction and can persist for long periods of time. There are several ways that cattle may acquire *Neospora* infection, either by horizontal (postnatal) infection or by vertical transmission of the infection transplacentally during pregnancy. The horizontal transmission model is based on the fact that *Neospora* is similar and related to other apicomplexan coccidia, such as *Toxoplasma gondii* and *Sarcocystis* spp. The life cycle of this family of protozoa parasites requires two hosts: a carnivorous predator is the definitive host and a prey species is the intermediate host. For example, in toxoplasmosis, the cat is the definitive host and can acquire the infection through ingestion of parasites contained in the prey species. *Toxoplasma gondii* parasites undergo sexual replication in the intestine of the cat and oocysts are shed in the feces. These *Toxoplasma gondii* oocysts are capable of infecting a wide variety of animal species (intermediate hosts). Among livestock species, toxoplasmosis is a significant cause of abortion in sheep and goats though not in cattle.

The taxonomic and morphologic similarities between *Neospora* and *Toxoplasma* support the hypothesis that the cow may be infected through the oral ingestion of coccidia oocysts shed from a carnivorous definitive host. The identification of this proposed definitive host has been difficult. Previous studies on dogs, cats, rats, mice, raccoons, and various bird species had found no confirmation of a role for these species in the transmission of *Neospora* to cattle. However, recently McAllister et al and later Lindsay et al were successful in transmitting *Neospora* infection from experimentally infected mice to puppies that shed oocysts in their feces. Calves have been successfully infected with oocysts obtained from experimentally infected dogs although at the present time there are no reports of similar experiments in pregnant cattle resulting in abortion. There is epidemiological evidence that suggests that dogs may play a role in the transmission of neosporosis. Pare' et al found an association between the herd seroprevalence of *Neospora* infection and the number of dogs associated with the herd. Bartels et al in the Netherlands and Mainar-Jaine et al in Spain have also found a significant association between herd seroprevalence and the presence of dogs in the dairy.

Although there are close similarities between *Neospora* and *Toxoplasma*, there are differences between neosporosis in cattle and toxoplasmosis in sheep. In sheep when toxoplasmosis infection is acquired during pregnancy, the ewe seroconverts to the parasite, and fetal infection and/or abortion may occur. In subsequent pregnancies the ewe is resistant to infection. However, neosporosis in pregnant cattle differs because the cow does not need to acquire *Neospora* infection or seroconvert during pregnancy for her fetus to become infected. Unlike toxoplasmosis, cows that abort in one pregnancy are susceptible to repeat infection and are at an increased risk of repeat abortion.

An important feature to understand about neosporosis is that the parasite can be maintained in cattle as a chronic infection that can be passed on to the fetus during pregnancy. In some cows, this fetal infection may result in an abortion, however most infected cows give birth to a healthy, but congenitally infected calf. A heifer calf that is born congenitally infected is capable of transmitting the infection onto the next generation when she becomes pregnant, thus maintaining the infection in the herd. Vertical transmission of *Neospora* through generations of cattle appears to be the major method by which *Neospora* infection is maintained in herds. In a Swedish study, the role of congenital transmission of neosporosis was supported by evidence of the familial distribution of seropositive cattle through successive generations. In a German study, 93% of the descendants of seropositive cows were also seropositive indicating that vertical transmission was the major method of transmission of infection in the herds examined. In California dairies, several serologic studies also offer evidence of vertical transmission. In endemic herds, the majority of calves born to seropositive cows have serologic evidence of congenital infection. In addition, the rate of seropositivity in the herd is not associated with the age of the cow, suggestive that the rate of acquired infection after birth is low. There is additional pathologic and serologic evidence that indicates that these congenitally infected calves have a chronic persistent infection that can be passed on transplacentally to their offspring. In a survey of heifer calves in a known *Neospora* dairy herd, heifer calves with serologic evidence of congenital exposure were compared with serologically negative cohorts. The two groups were similar until calving, at which time all the offspring of the seropositive heifers had elevated *Neospora* titers, all seronegative heifers had serologically negative calves, and there was no evidence of seroconversion to *Neospora* among the negative heifers. A portion of the calves were necropsied, and the calves from seropositive heifers had histologic lesions in the brain and spinal cord consistent with congenital *Neospora* infection and protozoa were identified by immunohistochemistry. The calves from seronegative heifers had no lesions or other findings suggestive of congenital *Neospora* infection.

While vertical transmission appears to be the major way that cattle become infected with *Neospora* in endemic herds, there is serologic evidence that cows that have aborted during an epidemic probably acquired the infection after birth based on analysis of the seropositivity of dams and daughters. In addition, the pattern of abortion outbreaks in epidemic neosporosis is suggestive of a point source exposure with acquired infection. However, at present, there has been no confirmation that the cattle aborting in an epidemic acquired the infection during their pregnancy. In endemically infected herds that have been sampled more extensively, there is serologic evidence that a low level of postnatal infection apparently occurs.

Control of this infection must take in account that a major method of *Neospora* transmission in herds is through the infection of fetuses in cattle that are chronically

infected. These infected cows can be identified based on their serologic titers or from a history of previous *Neospora* abortion or congenital infection. With this knowledge, control of the infection could be focused on reducing the numbers of infected cows in the herd and limiting the introduction of infected replacement cattle into the herd. Culling decisions concerning cows that have had a confirmed *Neospora* abortion can be made with the knowledge that there is a higher risk of repeat abortion in these animals. Seropositive cows also have a greater risk of abortion (3 to 7 times greater risk of abortion than seronegative cattle) and there is a high probability of congenital infection (>90%) in the calves born to these cows. In addition, seropositive heifers have been shown to have a reduced milk production. In both dairy and beef cattle, epidemiological studies have found that seropositive cattle have an increased rate of culling for a variety of reasons. Although various antimicrobial agents have been tested against *Neospora caninum in vitro* there is currently no known method whereby an infected cow can be cleared of the infection. A provisional killed vaccine has recently become available for *Neospora* but there is no information on its efficacy in regard to reducing fetal infection or abortion in an infected cow or in preventing postnatal infection in a non-infected cow. There are no proven methods available to prevent postnatal infection. The details of the life cycle are still incomplete. However, based on the experimental evidence that the dog can be a definitive host and the association between dogs on the dairy and the seroprevalence in the herd, it would be prudent to take measures to reduce the potential for this type of transmission. The removal of all potentially infected tissues, such as aborted fetuses and placentas from the environment that might serve as a source of infection for susceptible hosts would be advisable. In addition, fecal contamination of feed and water sources by other animals should be minimized.

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# Estate Planning for Farmers and Dairymen

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Years ago, a person could write a one page document that could serve as a will and get the assets distributed as they wished. Tax law and state probate laws have made it more difficult to design an effective estate plan without professional assistance for even a moderate estate.

If you own land, it doesn't take long to get to the 2000/01 \$675,000 unified credit exclusion amount – for transfer taxes. Even if you are married and have less than 1.35 million dollars in assets, it takes a little bit of planning to keep Uncle Sam from taking part of the assets that can easily be passed tax free to your heirs.

- Choose professionals who you can work well with to plan your estate and help you make decisions regarding succession planning
- Prepare a will – without a will, state law and the courts will decide who will administer your estate and who gets your assets. A will must be notarized – beneficiaries should not sign as a witness. State law covers validity of the form of will – attorney prepared or hand written.
  - “Will substitutes” can avoid probate (these are not for everyone, but may be useful).
    - Living trusts
    - Joint Tenancy
  - If will and/or estate plan exists, they must be reviewed every few years or upon:
    - Getting married or remarried
    - Divorce
    - Death of a spouse
    - Birth or adoption of child
    - Moving to a new state
    - Receiving a windfall
    - Tax laws change
- When a person is over 21, they also need the following legal documents:
  - Durable power of attorney

- This allows your agent to make a variety of financial decisions in case of your incapacitation. Check writing, prep & sign tax returns, selling assets
  - Health care proxy
    - This allows your personal agent to make critical medical decisions for you when you are not able
  - Living will – regarding life support
    - This document allows you to decide, in advance, what measures should or should not be taken in certain medical circumstances. It can also express your preference about organ donation, keeping your loved ones from second guessing themselves when the time comes.
- Make a list of your assets and liabilities (and how they are held.)
  - Joint ownership – assets don't automatically go to the co-owner. Make sure that you have the right kind of joint ownership to meet your needs.
- Decide what you would like beneficiaries to get after allowing for administrative & probate cost and taxes.
- Decide on an executor – available time & ability – to manage your estate from the date of you death until distribution. If you do not find someone, the state will. It will not be difficult for the executor to determine the value of bank accounts or mutual fund investments, but if you have a business, the executor will face some challenges in determining its value.
- It is necessary to choose a guardian for your minor children, but there are many things you can do to assist your adult children when the time comes.
  - Trustee - A young adult or other family member may or may not be equipped to fulfill the duties of an executor. It may be a better idea to choose an unrelated person to act as executor or trustee.
  - Distribution – If money management by an heir is uncertain, it may be wise to set up a trust and plan distributions over a longer period of time.
  - Divorce – a well-designed trust can protect an heir's inheritance from a former spouse or from being consumed by expensive legal fees.
  - Special needs – insuring adequate care for a child who has emotional, mental or physical disabilities requires special estate planning.
  - Grandchildren – If you have considerable assets and are facing a large estate-tax bite, you may consider a generation-skipping trust. Assets placed in this trust skip your children and go directly to the grandchildren. This eliminates the tax on these assets in the children's estate. There are

limitations as to how much can be passed this way without paying additional tax.

- Gifting - Gifting may become an important part of your tax plan. Utilization of the \$10,000 annual gift exclusions and the lifetime exemption amount, currently @\$675,000, during your life can be an effective planning tool. Under certain circumstances, it may be desirable to give sufficient gifts during your life to cause gift tax to be paid instead of waiting to pay estate tax after death. -----The quality of the remainder of your life must be considered when using this tool to reduce potential estate taxes.

When designing a gifting plan, the potential usage of things like special use valuation or the Family owned business deduction must be considered. It may dictate which assets you may be able to gift and which ones you may want to keep. Weighing the potential savings for each strategy will determine how important it is to keep your estate within the criteria for the strategies.

**THE BIG QUESTION.** *Does my family want to keep the family farm after I am gone? The answer to this question may steer you and your advisors down a particular planning road. We are concentrating today on the yes answer and stressing some of the tools you may be able to use to keep as much as the farm in the family as possible.*

#### NEW BASIS AT DEATH

Property owned by a decedent passes instantly to the estate or new succeeding owner. Under current tax law, the transferred property receives a new basis. Example: an asset purchased by the decedent for \$100 but worth \$400 before death has an inherent gain of \$300. If the property is gifted to someone, the donee's basis remains @ \$100 and if sold for \$400 would still produce a gain of \$300.

The stepped up basis available to the heir after death is equal to fair market value that is subject to estate tax, currently at a higher rate than income tax or \$400. Thus immediate sale by the heir would produce \$ -0- gain for income tax purposes. The largest advantage is derived when assets are held in community property. This results in a stepped up basis for the decedent's 50%, that is subject to estate tax and the surviving spouse's 50% which is not subject to estate tax.

Crop inventory and livestock, that generally have a \$ -0- basis also qualify for a stepped up basis.

Any stepped up basis attributable to depreciable assets can be depreciated beginning at the date of death.

#### UNIFIED CREDIT EXCLUSION AMOUNT

The changing amounts that all decedents are entitled to depending upon the year of death. For 2000 and 2001, it is \$675,000. For 2002, it increases to \$700,000.

It will continue to increase until 2006 where it will top out at \$1,000,000. It is called a unified credit because it is applicable to both transfer taxes – for gifts and estates. Whatever is used for gifts is no longer available at death.

## SPECIAL USE VALUATION

This concept allows a portion of farmland to be valued based upon what it will produce instead of what it would sell for.

Requirements:

- Material participation by owner or family for 5 of 8 years
- Qualified use for 5 of 8 years – sole proprietorship or crop share lease
- Farming assets = 50% or more of estate
- Real estate for Section 2032A = 25% or more of estate
- Value reduction – not more than \$750,000
- Election must be made
- Heirs must sign consent
- Property must remain in family with qualified use for 10 years after death with 5 of 8 years material participation.
- If requirements are not met, additional tax must be paid.
- Etc.

## DISCLAIMER

- Used if someone does not want an inheritance.
- When property passes to children, results in skipping one generation of taxes.
- Financially troubled heir can pass assets to children (protection from creditors)
- Requirements:
  - In writing within 9 months of death
  - Cannot accept benefits from property
  - Cannot direct where property goes.
  - Distributed as if person disclaiming was deceased.
  - No gift tax from the person disclaiming

## QUALIFIED TERMINABLE INTEREST PROPERTY – (Q.T.I.P.)

- Increases marital deduction.
- Delays payment of tax on assets until death of spouse.
- Requirements:
  - Income must be paid to spouse annually
  - Property must be included in estate of spouse
  - Ultimate disposition of property can be provided
  - Must have written election

- Property must be identified

## FAMILY OWNED BUSINESS DEDUCTION (FOBD)

This is one of newest planning techniques we have to utilize. Many of the rules for this deduction parallel the ones for special use valuation, yet some of the differences are significant.

Differences –

- Special use – land only valued specially
- FOBD – all assets used on farm or other small business valued at fair market value

Under the newest version of this strategy, the maximum deduction from the gross estate for 2000/01 is \$625,000. When using this strategy, the maximum amount of unified credit discussed earlier is set at \$675,000 for 2000/01. This creates a total possible combined amount of \$1,300,000.

If the estate includes less than \$675,000 of qualified FOB interests, the unified credit exemption amount can be increased on a dollar-for-dollar basis but only up to the exemption amount otherwise available for the year of death.

## SECTION 6166.....4%--15yr PAYMENT OF ESTATE TAX

- Used in order to assist the heirs in paying the tax without selling the farm.
- 4% on first \$ 1 million of value of the business
- Interest only is payable for the first 4 years, principal and interest thereafter.
- Requirements:
  - The business must constitute more than 35% of the adjusted gross estate.
  - Only the tax attributable to the business can be deferred.
  - Business must be retained during the 15 years.
  - Farmland that is rented on a crop share basis qualifies, but not cash rent prop
  - Election must be filed.
  - Etc.

## LIFE INSURANCE

Life insurance can provide the liquidity necessary to pay the estate tax. Planning for life insurance is extremely important. With no or poor planning, proceeds from life insurance may increase the estate tax due by being included in the

decedent's estate. With good planning, the proceeds may be eliminated from the gross estate and help to keep the farm intact by avoiding the need to sell part of the farm.

Issues need to be reviewed such as:

- who owns the policy?
- who is the beneficiary?
- is the insurance adequate?

There are many planning tools but, the more tools, the more coordination that is necessary to arrive at the proper result!

# Free Farmed Program: The New Niche Market

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## Introduction

A certification program monitored by an animal protection group and aimed at assuring high quality cow welfare on the dairy can't be in the producer's best interest, or can it be by being a marketing advantage? Do consumers really care about well-being of dairy animals or are they more focused on the lowest priced product? Possibly, you think that there are no welfare problems at the dairy as long as the cows produce milk. Is the media spreading realistic images of the dairy industry or just heightening awareness with a few "bad" apples? Do countries other than the U.S. have animal welfare modules at the level of the dairy in their quality assurance programs? Are these certified by an outside party, e.g., governmental or animal protection group, or by its own industry representative? Should society have federal/state regulations to level out the playing field and capture consumers' confidence and foreign trade? Collectively, these questions all represent the motivation behind society's animal welfare movement that has broadened its platform from animals in research laboratories to agriculture at the farm level.

## Recent Key Developments

In the past few years, several key leaders in animal agriculture and marketing have taken the movement seriously and developed in-depth programs for markets and species. Two years ago, the United Egg Producers empaneled a group of scientists and one animal welfare representative to examine the scientific literature on-key poultry issues such as cage size, forced molting, and beak trimming. The resulting guidelines suggested that larger cages are better, more research is needed on molting, and beak trimming can be minimized using selected genetic stock. These guidelines were approved by the UEP members in October 2000. McDonald's Corporation was forced to face the issues by pressure from the groups, Animal Rights International and People for the Ethical Treatment of Animals. McDonald's hired consultants for an advisory committee and established standards to be followed by their dedicated suppliers of eggs. Dr. Temple Grandin from Colorado State University has audited the handling practices at beef and pork packing plants for McDonald's and is developing guidelines for hens. Additionally, the company has awarded grants to Purdue University to examine gestation and farrowing crates, a contentious welfare issue for the swine industry.

In September 2000, the American Humane Association (AHA) launched their voluntary, third-party validation program, Free Farmed. This program is the first to

validate that farm animals are raised in a humane manner and includes standards for dairy, beef, laying hens, and chickens. A "Free Farmed" label on products assures consumers that these products are from animals that were treated according to the welfare standards developed by AHA. Free Farmed was modeled after a program in England called Freedom Foods, with standards developed and implemented by the Royal Society for the Prevention of Cruelty of Animals (RSPCA). Freedom Foods began to market its label in 1994 and is currently the largest and fastest growing farm animal welfare scheme in the U.K., with more than 19 million animals in the scheme (Johnson, 2000) and greater than 15% of the market.

### **Certification Process**

Animal welfare standards for the Free Farmed program have been developed by the AHA Standards Scientific Committee which is comprised animal scientists and veterinarians. These standards were modeled after the RSPCA's standards, but adapted to U.S. conditions. Additionally, the 1999 Federation of Animal Societies Guide and other practical guidelines were utilized in the process. These standards are expected to be reviewed and revised periodically as new information becomes available. The basic philosophy of the standards is based on the following framework:

Free from:

- Unnecessary fear and distress,
- Unnecessary pain, injury, and disease,
- Hunger and thirst, and
- Unnecessary discomfort including appropriate environment, expression of normal behaviors, sufficient space, and company of its own kind.

The program is administered by Farm Animal Services (FAS), which is an affiliate of the AHA. Additional compliance verification procedure is provided by the U.S. Department of Agriculture's (USDA) Agriculture Marketing Service (AMS). Applications for certification are initiated by reviewing the standards for the individual farm and completing forms for areas such as emergency procedures, health plans, nutrition, housing, husbandry practices, casual slaughter policy and other information. An assessor subsequently visits the farm to interview the management, assess the facility, observe the operation, and write an audit report. The FAS auditor then contacts the USDA's AMS, which may also elect to send an auditor for certification. Approximately 25% of the participants will be audited by AMS whose role is to verify FAS's inspection process. The audit report or checklist will itemize any finding not in compliance. These will further be classified as "continuous improvement point" (does not prevent certification but must be corrected in a timely manner) or a "hold point" (must be corrected prior to approval). Certificates of approval are valid for one year and the participant is allowed to use the "Free Farmed" logo. Certification can be revoked for reasons including failure to follow approved procedures or implementing significant changes without prior notification to FAS.

### **Dairy Care Standards**

Each set of welfare standards for Free Farmed is divided into four categories entitled Food and Water, Environment, Management, and Health. These are further divided into specific requirements which are numbered and must be in compliance. General basic standards apply to all the species. These general standards require that livestock and poultry have access to clean and sufficient food and water, that their environment is not dangerous to their health, provide sufficient protection from the weather elements and sufficient space allowance, and other features to ensure the health, safety, and comfort of the animals. Standards also require managers and caretakers to be fully trained, skilled, and competent in animal husbandry and welfare. There are more specific requirements under the umbrella of the general standards. Examples of the more stringent standards for dairy operations in California are given below:

**Food and Water** section:

- FW4. Dairy cows must not be treated with rBST; antibiotics only therapeutically.
- FW8. All cattle should have access to turn out lots for 4 hrs. per day, weather permitting.
- FW15. Every newborn calf must receive colostrum within the first 6-8 hrs. of life.
- FW17. Movement of calves must not occur at less than 5 days of age.
- FW22. All cattle, including calves over 8 days, should be provided with a continuous supply of water.

**Environment** section:

- E15. Provision of shaded areas for hot summer conditions (above 85<sup>0</sup> F).
- E16. Depth of mud in loafing area should not be above ankles.
- E17. Stocking densities will not exceed 110% of the number of available stalls.
- E20. Cows should calve in clean, dry areas separated from the rest of the herd, with free access to water.
- E50. Tethering of calves is prohibited. Calves must have access to a dry bed at all times.

**Management** section:

- M2. Managers develop and implement plan to cope with emergencies such as flood, fire, or interruption of supplies.
- M10. Tails of calves or adults must not be used to direct the animals, either by pulling or twisting.
- M14. No animal can leave the farm without walking unassisted.

**Health** section:

- H4. Availability of water and feed is necessary at all times even to non-ambulatory animals.
- H9. There should be a minimum dry period of 25 days.

- H11. *Supernumerary teat* removal must be performed within 6 months; otherwise teats removed by veterinarian under local anesthesia.

*Disbudding* is allowed during the first 4 months using a hot iron with/without local anesthesia. Cautery paste and scoop methods are not acceptable as routine practices.

*Castration* of calves older than 2 months must receive local anesthetic (burdizzo, emasculator). Castration may be performed by rubber ring band after 24 hr and before 7 days of age; burdizzo clamp or surgical castration after 24 hr and before 2 months age.

*Tail docking* is prohibited. Switch trimming is allowed.

- H14. Each farm must have provisions for timely and humane euthanasia of casualty cattle.

The Free Farmed program is not suitable for every dairy operation. It is focused toward the "natural" food, value-added niche markets. Some may ask if there is such a market for "humanely raised" animal products. In a 1998 survey by the Animal Industry Foundation, the results showed that 44% of the consumers would pay 5% more for meat and poultry products labeled as "humanely raised." The pathway to acceptance by consumers of these products in the supermarkets may be similar to the growth of organic food products over the last five years. Consumer education on animal welfare production issues may be enhanced by the visibility of the program and the supermarket, and thus increase the market base. The standards are expected to be reviewed and revised each year by the Standards Scientific Committee along with current certified producers. The Free Farmed program is proposed to evolve in the direction of more rigorous, dynamic animal-friendly standards.



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# California Dairy Qualify Assurance Program Activities

Michael Payne, Deanne Meyer & Chuck Ahlem

## Executive Summary

To date 1,500 producers have received at least partial Stewardship training, and 18 producers and their dairies have been certified. An evaluation hotline, certification database and web site have been established. The State and the California Dairy Quality Assurance Program (CDQAP) have cooperatively established an evaluation-certification program for novel environmental technologies. A partnership with the public-interest group Sustainable Conservation is developing financial incentive programs that would encourage producers to adapt environmentally friendly best- management practices. An environmental research priority document will assist researchers and funding agencies in directing resources towards projects most useful to producers. Development of a curriculum for a second environmental short course has begun. This course will expand the current surface-water program to include land-application of nutrients/waste. More than 100 print, television and radio releases have favorably depicted California producers as protecting the health and welfare of the state's consumers, livestock and environment. The program has continued to apply for and receive matching grants from non-dairy industry sources. The program's major achievements for the year 2000 are detailed by module below.

## Environmental Stewardship Module

### Environmental Stewardship Short-Course (ESSC)

(goal 10 sets for the year): A total of 20 sets (60 classes) of short courses were delivered during the year. The ESSC 1 was delivered in Bakersfield and Chino in January. Spring classes were delivered in Petaluma, Eureka, Stockton, Modesto, Orland, Los Banos, Tulare, and Riverdale. In May it was delivered again in Chino. Fall classes were held in Eureka, Petaluma, Orland, Elk Grove, Chowchilla, Tulare, Stockton, Modesto, and Chino. During 2000, 256 producers completed the ESSC 1 while an additional 267 attended at least one class. Spring classes have been scheduled for 2001. Processors have encouraged their producers to attend the short course. Land-O-Lakes has offered a \$300 rebate to producers who complete the series. To date 40 producers have taken advantage of the Land-O-Lakes' program.

### Training Provided To Service Organization And Creamery Field Personnel

(goal 3 classes) Eight allied industry classes were offered: Chino (2), Fresno, Merced, Davis (2), Tulare, and Modesto). These are 4.5 hr in duration and cover the material presented in the ESSC1. Considerable advertising was done to let people know about the availability of this training. Three of these sessions were targeted sessions. One was specifically for Department of Health Services employees, one was for partner staff members, and one was for American Registry of Professional Animal Scientists. A total of 123 individuals attended these sessions. Additionally, one full day course was

provided to train people to assist producers in preparation for the evaluation process. Members of organizations represented in the Partnership agreement attended this course as did consultants.

#### Dairy Certifications

Third party evaluations began in July. To date 18 producers have been certified (see “Software to Manage Short Courses...” section below).

#### Software To Manage Short Courses & Certification Records

Microsoft Access is used to track participant data. The program allows immediate generation of measures of total program delivery, such as the following summary of participation in ESSC I & certification (all years):

Number	producers completing all 6 hours (3 classes) = 972.
Number	producers completing 2-4 hours (1-2 classes) = 520.
Number	producers receiving some ESSC training (sum of above) = 1492.
Number	producers completing pre-evaluation meeting = 79.
Number	producers requesting evaluation = 33.
Number	producers certified = 18. (Note: these 18 come from 14 facilities.)
Number	Allied Industry reps attending compressed Short Course = 286

Evaluation Request Hotline Established Producers wishing to request a facility evaluation can call 530-574-0524. Messages left on the answering machine are answered daily by the same technician maintaining the certification database (see above).

#### CDQAP Web Site Established

A web site has been established at [www.cdqa.org](http://www.cdqa.org). It contains a wide range of information about the program including program description & history, annual reports, Question-and-Answer documents and primary contacts.

#### Upgrades Of Java Program To Estimate Lagoon Storage Capacity Needs

The CDQA program has developed software to estimate lagoon storage capacity. Output from this program is required for evaluation and certification. As the initial evaluations were conducted, user comments directed modifications for the software. This program is available to designated users on the internet by password.

#### Teaching Module: Dos And Don'ts Of Manure Management

Photos depicting good and bad manure management have been collected from a variety of sources and scanned in graphics files. The photos have all been reviewed by members of the interagency confined animal coordinating group, a process which began in May and took approximately eight months to complete. It is anticipated that the document will be printed in January.

#### Partnership with the Office of Environmental Technology

The State of California's Office of Environmental Technology (OET) and the CDQAP are collaboratively establishing a evaluation/certification program for novel environmental technologies for dairies. OET's program allows a technology sponsor (private company) to finance their own evaluations, which if satisfactory, OET publicly

certifies. Various CDQA partners are assisting OET in the development of dairy technology evaluation protocols. This program will offer some assurance of effectiveness to dairy producers interested in investing in novel technologies.

### **Partnership with Sustainable Conservation**

Sustainable Conservation is a non-profit public interest group lead by Stanford-trained MBA's. SusCon's mission is to develop financial incentive programs to encourage private business to adapt environmentally friendly best management practices. SusCon funds their activities through a variety of grants, primarily from philanthropic organizations. This year for its dairies program initiatives, SusCon was awarded a total of \$275,000 from the Goldman Fund, the Packard Foundation and the Joseph Drown Foundation. Among those initiatives includes a review of potential "green labeling", environmental training for training Portuguese-speaking dairy producers and the development of "satellite" composting facilities providing an inexpensive means of managing manure while generating a saleable compost product. SusCon does not receive any dairy industry funds.

### **Environmental Research Prioritization**

A particular problem facing the California Dairy Research Foundation (CDRF) has been determining which, if any, environmental research projects to support. To help address the problem the CDQAP & University of California's Dairy Quality Assurance Workgroup have drafted an Environmental Research Prioritization document. The Dairy Quality Assurance Workgroup is composed of a wide variety of University researchers and extension specialists having a dairy focus. Importantly all UC Cooperative Extension Dairy Advisors are members of the Workgroup. The document is also being reviewed by the (regulatory) environmental Inter-agency Workgroup which includes various state and federal regulatory agencies. The workgroup reviewed and ranked 57 different projects/areas (17 extension/education, 10 technical, 30 research, and 2 demonstration).

### **Coordination of Statewide Response to New EPA Guidelines**

The US-EPA has released its new Effluent Limit Guidelines (ELG) draft. This 900-page document outlines EPA's new Concentrated Animal Feeding Operation (CAFO) requirements. Importantly it requires dairy producers to complete a vaguely defined nutrient management program ("Permit Nutrient Plan" or PNP). Further confusing the issue was the concurrent release of the Natural Resource Conservation Service (NRCS, formerly the Soil Conservation Service) draft guide for a "Comprehensive Nutrient Management Plan" (CNMP). In addition, various private and academic organizations have or are drafting pollution prevention programs for either free distribution or sale. None of these documents outline exactly what procedures producers must complete in order to remain in compliance. The CDQAP partners have collaboratively initiated development of a curriculum that will clearly define a program that will ensure that producers meet all state, federal and local requirements regarding land-application of nutrients/waste. This will be offered to producers throughout the state as Environmental Stewardship Short Course II. The new course will simply expand the successful

education & certification program (ESSC I) dealing with surface-water regulations. Both EPA and NRCS will assist in development.

### Special Projects

A considerable amount of researcher and partner time is spent on special projects that typically result from either technical questions or crisis management. Two 2000 special projects are of particular note:

*Back-Flow Prevention:* Irrigation well water pumps that have cross connections to piping carrying lagoon water have the potential to contaminate ground water. State regulations requiring “back-flow prevention” (BFP) devices for such pumps have existed for years but have not been publicized or enforced. The CDQAP partners have summarized technical information detailing which methods qualify as adequate BFP. With the announcement that proof of BFP will be required for renewal of a producer’s pesticide application license; this information has become crucial to even those producers not seeking CDQAP certification.

*Milk Diversion to Lagoons:* Starting as a project to streamline the process authorizing disposal of antibiotic-contaminated milk into retention ponds, this issue took on great importance when power black-outs closed down processing plants. The policy document which would allow producers to add milk to ponds is currently being reviewed by state regulatory authorities.

### Program Publicity

An enormous amount of positive publicity has been generated as a result of the CDQAP. Particularly after the awards ceremony on the steps of the State Capital, numerous print, TV and radio releases depicted California dairymen as producing a product in concert with the environment. A summary of the types of media releases appears below. Detailed information on these media releases appears in Appendix II.

• Original Print Articles	18
• AP Wire Service Repeats	55
• Dairy Trade Publications	7
• Internet Publications	7
• Television	18
• Radio	1
<b>Total releases</b>	<b>106</b>

### Potential Natural Resource Conservation Service Position

CDQA, the Department Animal Science and USDA’s Natural Resources Conservation Service have entered into discussions regarding the potential for a NRCS agronomist being placed in Animal Science. The Natural Resource Conservation Service is working

a job description that involves primarily leading development of Environmental Stewardship Short Course II.

## **Food Safety Module**

### **Food Safety Curriculum**

Development of the food safety short-course curriculum is proceeding. The first video “*A Dairy Producer’s Tour of a Slaughter Facility*” has been completed. A second video “*Residue Prevention for Dairy Producers*” has been funded through two non-dairy industry grants and scripted. The shooting schedule for it is being developed. The California Department of Food and Agriculture has developed a slide set, pamphlet and wall poster for its new emergency response program. University experts have been agreed to develop slide sets for antibiotic resistance and bootleg milk sections. Lastly, although part of the Animal Health and Welfare Module rather than the Food Safety Module, the CDQAP has been participating in implementation of the California Johne’s Disease Control Program.

### **Partnership with the Dairy Food Safety Task Force**

The California Department of Food & Agriculture organized the Dairy Food Safety Task Force in the wake of three devastating toxic events on California dairies (two botulism and one pesticide). The goal of the group is to establish protocols to mitigate animal death and condemned product in the event of future similar cases. A list of potential chemical contaminations was constructed and work begun. The FDA has accepted California’s plan for future nitrate cases in the State and is reviewing the monensin protocol. In addition a protocol which would allow antibiotic contaminated-milk to be shipped to calf raisers for use as feed is being reviewed by FDA.

### **Assistance to Dairy Issues Forum**

Various partners have provided factual information on and assisted in the development of press releases from DIF. Subjects addressed have included :

- Antibiotic Residues
- Antibiotic Resistance
- BST (“Bovine Growth Hormone”)
- BSE (“Mad-Cow Disease”)
- Johne’s Disease / Crohne’s Disease
- Diversion of milk into lagoons

# Crop Biotechnology: Applications for the Dairy Industry

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(graphics available at <http://sbc.ucdavis.edu/outreach/outreach.htm>)

**Methods of plant breeding and biotechnology.** Genetic modification of plants and animals has been practiced for approximately 10,000 years. By selecting the best plants and animals to serve as the parents for the next generation, our ancestors gradually modified wild plants and animals to create our familiar domesticated crops and livestock. Over the last century, new methods of plant breeding have been introduced, including wide crosses, F1 hybridization, mutagenesis, and induction of polyploidy. Biotechnology methods developed in the last few decades include tissue culture, embryo culture, anther culture, somaclonal variation, micropropagation, protoplast fusion, marker-assisted breeding, and transgenic plants. Although transgenic plant technology has become controversial, this is just the latest of many methods that have been used for genetic improvement of crop plants. The discussion below will focus on these transgenic crop plants and particularly on those used for animal feeds.

**Transgenic Crop Traits.** Among the transgenic crop plants approved for commercial production in the US are canola, corn, cotton and soybeans engineered for herbicide compatibility, protection against insects and protection against diseases. Feeding trials have demonstrated the safety and effectiveness of feeds derived from transgenic crop plants (Kaeppler, 2000). Feeding value of transgenic plant foods and animal health are normal, and the transgene DNA and the expressed proteins are not detected in meat, milk or eggs ([http://sbc.ucdavis.edu/outreach/resource/gm\\_food\\_safety.htm](http://sbc.ucdavis.edu/outreach/resource/gm_food_safety.htm)). In some ways, feeds produced from transgenic crops may be even better than conventional agricultural products. Mycotoxin contents are reduced in transgenic plants due to reduced tissue damage from insect feeding and fewer damaged sites at which fungal infection of the crop plant can occur (Munkvold et al., 1999; Munkvold et al., 1997). Engineering pest protection traits into the seed may reduce the need for pesticide chemicals in crop production, and may enable the grower to choose pesticides that are less harmful to the environment.

Potential future traits in transgenic crops include more "output traits" that will enhance crop qualities for end users. Transgenic crop traits that may reach the marketplace within the next 5 years include traits such as improved nutritional value through increased vitamin content, oil quality and protein quality. The content of antinutritional substances such as phytate can be reduced. Vaccinations engineered into feeds may help to maintain the health of livestock (Mason et al., 1998; McGarvey et al., 1995; Tuboly et al., 2000). Reduction of fungi and mycotoxins in feeds may improve

feed quality, animal health and dairy product quality (Cary et al., 2000; Suszkiw, 2001). New strategies may help protect alfalfa and other plants against insect attack and reduce the need to spray chemicals for insect control.

**Public Debate about Transgenic Foods.** There is now a worldwide debate about the use of transgenic crops and livestock. Opponents of agricultural biotechnology raise issues such as: food safety, food labeling, environmental contamination, reduction in biodiversity, corporate monopolization of food and concern about possible unknown consequences. New regulations proposed by USDA and FDA have tightened the scrutiny of biotechnology foods before they are allowed into the marketplace and enabled alternative choices for consumers who wish to avoid food products produced from transgenic crop plants. Scientific, social, economic and ethical issues are all involved in determining acceptance of agricultural biotechnology.

**Government Regulation of Transgenic Crops.** The use of crops produced via biotechnology is regulated by a number of US government agencies. The USDA Animal and Plant Health Inspection Service (APHIS) regulates field-testing of biotechnology-derived plant varieties ([http://www.aphis.usda.gov/biotech/not\\_reg.html](http://www.aphis.usda.gov/biotech/not_reg.html)). The US Environmental Protection Agency (EPA) is the lead agency for evaluating crop plants with pesticidal traits developed via biotechnology (<http://www.epa.gov/pesticides/biopesticides/>). The US Food and Drug Administration (FDA) is the primary agency regulating the safety of foods developed via biotechnology (<http://vm.cfsan.fda.gov/>). USDA has recently published new regulations for organic agriculture certification that exclude the use of transgenic crop plants and some other production technologies that are used in conventional agriculture. (<http://www.ams.usda.gov/nop/>).

**Conclusions.** This is an important time in the development of agricultural biotechnology. The initial “proof of concept” products have worked well in the field and have been rapidly adopted by farmers. Government regulators have worked to establish public confidence in their ability to ensure the environmental and food safety of crop plants developed using biotechnology. New biotechnology crop traits under development will provide additional benefits to the dairy industry. Gaining consumer and market confidence in agricultural biotechnology is critical for the further development of these products.

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# Impact of Close Up Dry Period Length on Body Protein and Energy Reserves: A Modeling Approach

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## INTRODUCTION

Protein and energy requirements of non-lactating (dry) dairy cows attracted little research effort until about 1990. This occurred in spite of the known increases in maternal protein and energy needs during the dry period in response to synthesis of mammary tissue and colostrum, as well as fetal and uterine development (NRC, 1978). However since about 1990, considerable worldwide research effort has been directed to defining protein and energy needs of non-lactating dairy cows with particular emphasis on protein needs of dry cows within about 14 to 21 days of calving (i.e., close up).

First reports in the protein area, by Van Saun et al. (1993) and Moorby et al. (1996), showed that increasing the level of crude protein (CP) in the close up dry period ration, with CP sources rich in undegraded dietary protein (UDP), to levels above NRC (1989) recommendations of 12% of dry matter (DM) intake could result in sharply higher milk and/or milk protein yields in the subsequent lactation. However, more recent reports have been equivocal with most groups reporting no increase in milk production in the subsequent lactation in response to higher CP levels of the close up ration (Murphy, 1999; Putnam et al. 1999; Vandehaar et al. 1999; Santos et al. 2001), with only one study reporting a strong numerical increase (Huyler et al. 1999). What is the reason for this lack of agreement?

Protein needs of dairy cows approaching parturition are difficult to assess in studies utilizing whole animals. In contrast to lactating cows, where the production oriented criteria used to define protein needs are immediate and relatively easy to measure, the appropriate criteria to determine protein needs of close up dry cows are difficult to define. While productive performance in an early portion of the subsequent lactation has often been utilized as the main index to assess close up dry period protein needs, this response is highly dependent upon the actual period of time that cows are exposed to the close up ration and, perhaps, the status of their labile protein reserves when they enter the close up period. Since breeding and calving dates of cows are seldom certain, the average time that cows are in the close up period can show substantial variation.

The objective of this ongoing research is to utilize a computer modeling approach to predict protein and energy needs of dry dairy cows as they progress through the dry period and integrate that with the planned sequence of diets in order to predict mobilizable protein and energy reserves at the end of the dry period. These predictions can then be utilized to assess, only

qualitatively at this time, the ability of the cows to sustain high milk, and milk component production, in their next lactation.

## **WHAT IS THE DRY COW QUESTION ?**

The appropriateness of the protein and energy levels of a ration formulated for lactating dairy cows is often assessed rather rapidly on commercial dairies (i.e., does the amount of milk in the bulk tank go up or down in the next 4 or 5 days). Indeed California dairy producers commonly use this as the major criteria to judge whether a new ration is an improvement over the previous ration. However no equivalent index is available to judge rations fed to dry cows. Often, as demonstrated by the work of Van Saun et al. (1993) and Moorby et al. (1996), a positive benefit takes months to occur and, due to the passage of time and other changes that have occurred in the meantime, it may never be detected at all.

Thus in contrast to lactating dairy cows, where the feed formulation question is in general terms: How much did the new ration change the production of the cows within 3 or 4 days ?, the question relative to dry cows is less clear. However in general, it revolves around judging the potential outcome of the dry cow feeding program in terms of the ability of the cows to sustain a high level of milk production in the next lactation. Stated more simply: given cows with certain defined characteristics at dry off and given a defined dry period feeding program, what are the anticipated levels of mobilizable protein and energy that will be available at calving to support milk production in the next lactation. The only way to predict this expectation is through a modeling approach.

## **PHASES OF THE DRY PERIOD**

Until the most recent NRC edition of Nutrient Requirements for Dairy Cows (i.e., 2001), the NRC considered the dry period of dairy cows to be a single nutritionally indistinguishable period (e.g., NRC 1978, 1989). In the most recent edition, NRC (2001), the dry period is recognized as being divisible into two distinct phases (i.e., the far off and close up periods) that divide at about 21 days prepartum. However in fact the dry period of cows entering their second or higher lactation can be broadly divided into three phases.

### *Just Dry Phase*

This period lasts for about 8 to 12 days after the cow has been milked for the final time. Even though she will not be milked again, the cow continues to secrete milk for about 48 hours (i.e., she is still a 'lactating cow') and then slowly resorbs that milk over the next 7 to 10 days as the udder undergoes involution and some mammary tissue is resorbed. Thus during this period the cow is in a positive protein and energy status regardless, within reason, of the diet that she is fed. Obviously this phase does not occur for heifers.

### *Mid Dry Phase*

This period lasts from about 8 to 12 days after the cow has been dried off until about 8 to 12 days prior to calving. It is characterized by the potential to achieve relatively high DM intakes (about 2.0 to 2.2% of BW) and by relatively modest protein and energy requirements, primarily to support fetal growth and maintain maternal tissues. Thus during this period the cow is generally in a positive protein and energy status, unless she is fed a high fiber and low protein diet with a low DM intake potential.

### *Close up Phase*

This period occurs during the final 8 to 12 days prior to calving, and is characterized by declining DM intakes (to as low as 1.1 to 1.4% of BW) and rapidly rising protein and energy requirements to support synthesis of udder tissue and colostrum as well as support underlying fetal growth and maintenance of maternal tissues. During this period the cow will virtually always move from a positive protein and energy status to a negative protein and energy status. The question is when it will occur (i.e., how close to calving) and how negative it will be. The higher the DM intake, then the closer to calving and less severe will be the negative balances, whereas the higher the genetic capability of the cows to produce milk then the greater will be the needs for synthesis of udder tissue and colostrum, and so the farther from calving will be the transition to a negative protein and energy balance and the more severe that it will be. It is critical to accurate predictability of future milk productivity that these negative balances be predicted and managed.

## **PRACTICAL MODELLING OF THE DRY PERIOD**

Modelling of the dry period means that based upon some characteristics of the cows at dry-off, the sequence and composition of the diets that they will be fed during the dry period and some characteristics of the cows at calving, then the DM intake, body weight (BW), labile (i.e., mobilizable) protein reserves and mobilizable energy reserves (estimated as body condition score (BCS)) are simulated to create 'pictures' of how the cows progress through the dry period and what their predicted status (i.e., mobilizable protein and energy reserves) are at its end (i.e., at calving).

However for a modeling approach to have practical application, it is critical that the animal and diet input parameters be obtainable on commercial dairies. The information that is required on the animals is not complex and is shown below:

Table 1. Animal inputs.

<b>Animal Inputs</b>		
Next Lactation	<b>3</b>	number
Body weight at dry off	<b>680</b>	kg
Body condition at dry off	<b>3.50</b>	units
Body locomotion at dry off	<b>1.50</b>	units
Milk yield at dry off	<b>15</b>	kg/d
Milk CP at dry off	<b>3.60</b>	%
Expected calf birth weight	<b>41</b>	kg
Expected peak milk yield	<b>45</b>	kg/d

The information needed for the diets is only slightly more complex. The proportion of each feedstuff in the diet, as well as its chemical composition, must be defined. In addition, the times prepartum that the cows are to be fed the diets must be defined. The information on a sample far off ration is shown below:

Table 2. Ingredient nutrient definition.

<b>Faroff Ration</b>	Intake % of DMI	DM %	OM % DM	Fat % DM	CP % DM	SP % CP	ADIP % CP	NDF % DM	dNDF % NDF
Corn silage (40-50% gr)	<b>25.4</b>	<b>26.3</b>	<b>94.9</b>	<b>3.6</b>	<b>7.5</b>	<b>54.7</b>	<b>9.3</b>	<b>49.2</b>	<b>55</b>
Oat hay	<b>36.9</b>	<b>92.8</b>	<b>93.5</b>	<b>1.7</b>	<b>6.3</b>	<b>22.2</b>	<b>11.1</b>	<b>67.9</b>	<b>46</b>
Alfalfa pellets (dehy)	<b>36.3</b>	<b>91.2</b>	<b>90.1</b>	<b>2.2</b>	<b>21.8</b>	<b>37.2</b>	<b>6.4</b>	<b>40.0</b>	<b>48</b>
TM Salt	<b>1.4</b>	<b>99.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0</b>

[Where OM is organic matter (100 – ash), SP is soluble CP, ADIP is bound or indigestible CP, and dNDF is the proportion of NDF digestible *in vitro* at 30 h. All of these values can be obtained from commercially available assays.]

The composition of all the rations that are to be considered in various dry period feeding sequences must also be defined as, for example:

Table 3. Ration ingredient definition.

<b>DIET SELECTION</b>				
<b>Number</b>	1	2	3	4
<b>Description</b>	Just dry	Faroff	Close up (Low CP)	Close up (High CP)
<b>Ingredients</b>	-----	Intake % DMI		-----
Corn silage (40-50% grain)	<b>10.0</b>	<b>25.4</b>	<b>16.9</b>	<b>15.8</b>
Oat hay	<b>80.0</b>	<b>36.9</b>	<b>24.6</b>	<b>23.2</b>
Alfalfa pellets (dehy)	<b>9.0</b>	<b>36.3</b>	<b>24.2</b>	<b>22.6</b>
Dist grain (wheat dehy w sol)	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>1.2</b>
Barley (steam-rolled)	<b>0.0</b>	<b>0.0</b>	<b>16.0</b>	<b>15.0</b>
Corn (steam-rolled)	<b>0.0</b>	<b>0.0</b>	<b>15.7</b>	<b>14.7</b>
Corn gluten meal	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.3</b>
Soymeal (chem trt meal)	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>3.7</b>
Blood meal (ring-dried)	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.6</b>
Feather meal	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.3</b>
Fat (animal)	<b>0.0</b>	<b>0.0</b>	<b>1.7</b>	<b>1.7</b>
TM Salt	<b>1.0</b>	<b>1.4</b>	<b>0.9</b>	<b>0.9</b>

Finally the diet sequences that are to be evaluated must be defined relative to days parturum (assuming a 60 day dry period).

Table 4. Ration feeding sequence.

<b>Sequence</b>	<b>Diet</b>	<b>Diet ID</b>	<b>Start Day (parturum)</b>
<b>1st</b>		<b>1</b>	<b>60</b>
<b>2nd</b>		<b>2</b>	<b>50</b>
<b>3rd</b>		<b>3</b>	<b>14</b>
<b>4th</b>		-	-

[i.e., three diets will be used (in the sequence 1, 2, 3) with start dates for their feeding at day 60 (i.e., at dry off), days 50 (i.e., a 10 day just dry group) and at day 14 (i.e., a 14 day close up group).]

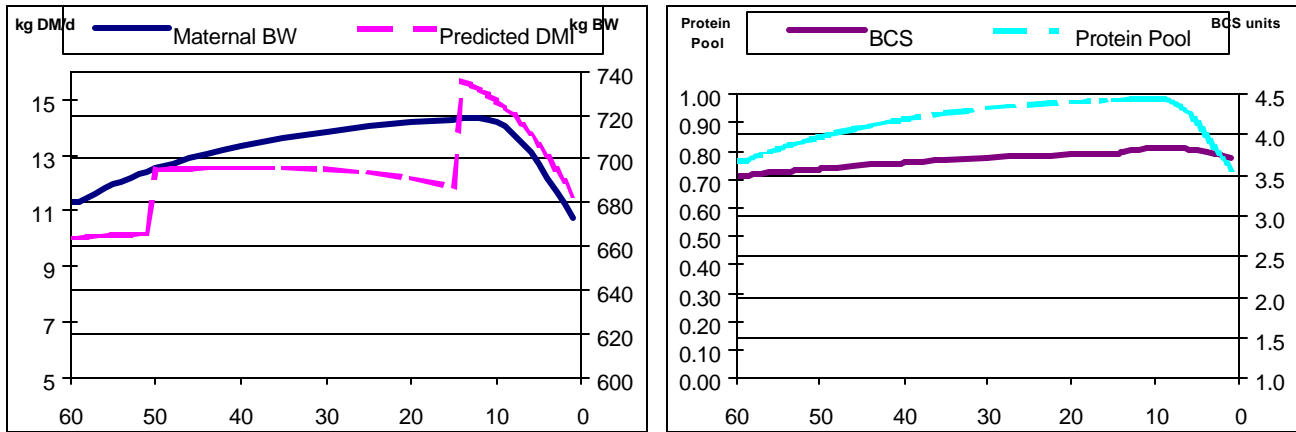
Once this information has been defined, model simulations can be run and examined. For the purposes of illustration, case studies of four possible combinations of diets (from Table 3) will be

examined utilizing common animal (from Table 1) and ingredient (from Table 2) input considerations. These cases will be:

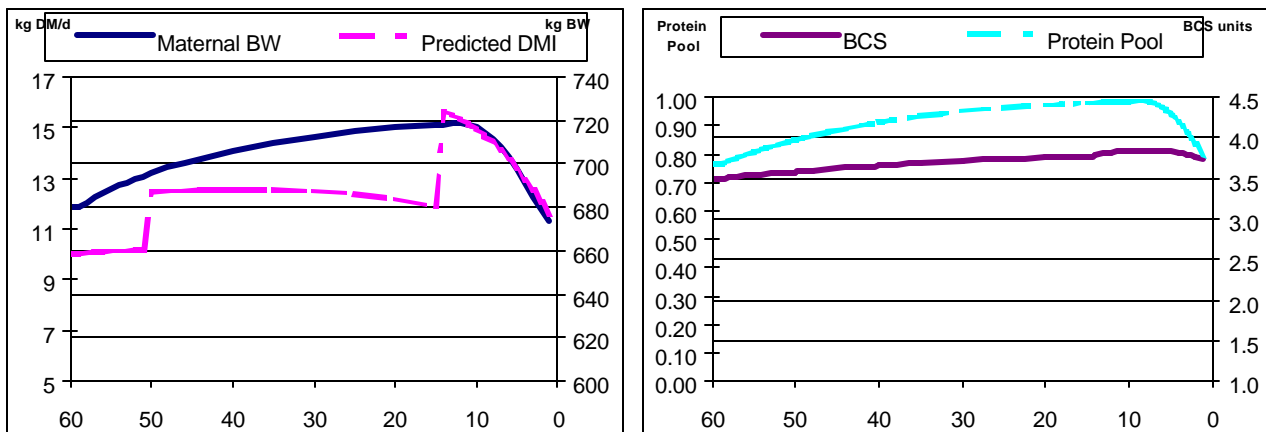
Diet ID	Diet Description	Case 1	Case 2	Case 3	Case 4
1	Just Dry	60	60	-	-
2	Far off	50	50	60	60
3	Lo CP close up	14	-	-	-
4	Hi CP close up	-	14	14	-

The predicted outputs are shown below for:

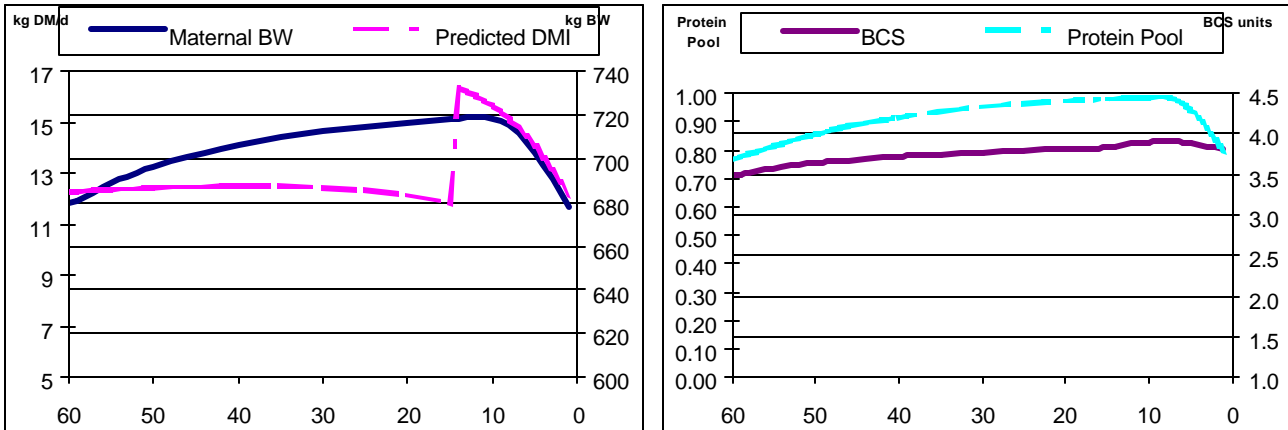
### Case 1:



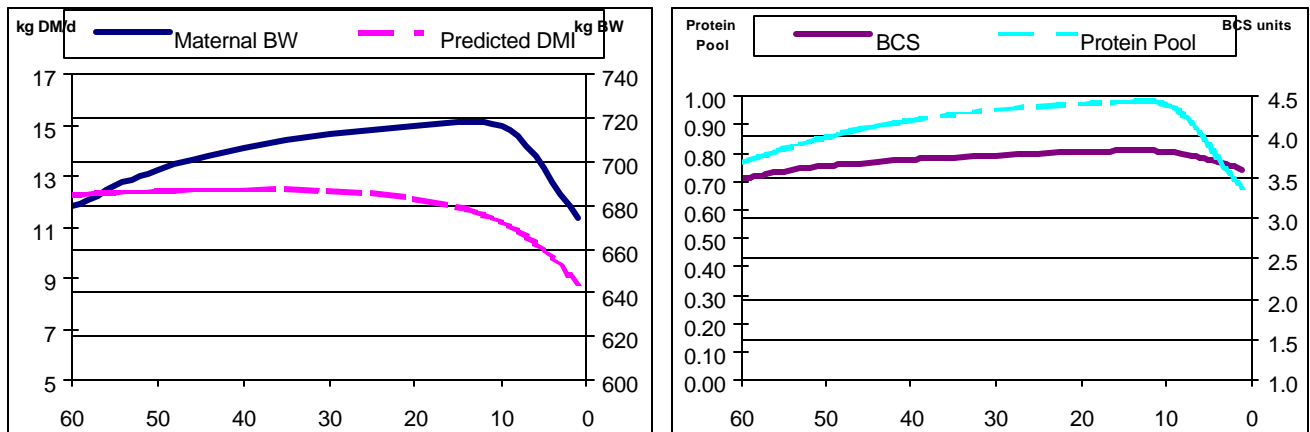
### Case 2:



### Case 3:



### Case 4:



### COMMENTS ON THE CASES

In general, cows increase in BW and deposit fat (represented by BCS) and protein to their labile pools as they progress through the far off and mid dry phases, but mobilize body fat and protein in the close up phase. Dry matter intake is related to both diet (increasing sharply from the just dry to far off ration and again from the far off to the close up ration) and time prepartum (tending to decline as cows approach calving).

*Case 1 vs. Case 2 (i.e., increasing the CP of the close up ration from 12 to 14% of DM)*

Increasing the protein level of the close up ration from 12% to 14% of DM would only be modeled to have a modest effect on the final BCS (3.72 to 3.75) and status of the labile protein pool (74 to 80%). Thus the expectation for an improvement in productive performance in the subsequent lactation would be for only a modest improvement in milk and milk component production. This is consistent with findings from a field study utilizing these rations (Robinson et al. 2000).

*Case 2 vs. Case 3 (i.e., deleting the just dry ration)*

Eliminating the just dry ration/group would not be modeled to have any impact on the BCS or protein pool at the end of the dry period. This is primarily because the period of feeding of the just dry ration is during a time of very low dietary protein needs which are due to protein influx to the metabolizable protein pool from the resorption of milk and mammary tissue.

*Case 3 vs. Case 4 (i.e., deleting the just dry and close up rations)*

Eliminating the close up ration would have a substantial modeled negative impact on both the BCS (3.80 vs. 3.68) and status of the protein pool (80 vs. 68%) at the end of the dry period. This would be a result of both the lower DM intake during the close up period as well as the lower protein level (11%) of the far off ration (which is now fed through calving) vs. that of the close up ration (14% of DM). These projected changes in BCS and the labile protein pool would be expected to result in a substantial improvement in production of the cows in the subsequent lactation, which is consistent with finding from a study utilizing these diets (Robinson et al. 2000).

These cases are merely examples. Other examples in which diets and/or animal input data are changed will lead to different conclusions.

## **CONCLUSIONS**

The dry period of dairy cows can be broadly divided into three phases (just dry, mid dry and close up) that are characterized by periods of very low, moderate and high absolute dietary needs for protein and energy. These protein and energy needs can be predicted and modeled based upon their uses for specific metabolic functions. Such a model has the potential to simulate the changes, and absolute levels, of parameters such as DM intake, body condition score (i.e., labile energy reserves), labile protein reserves and maternal body weight in order to assess the status of the cows at the end of the dry period. These values can in turn be used to predict, only qualitatively at this time, expectations of productive performance in the next lactation.

This project is ongoing and expectations are that a practical model for use on commercial dairies will be ready within 12 to 18 months.

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## **RESEARCH HIGHLIGHTS**

The Research Highlights are summaries of various projects that are currently in progress within the Department of Animal Science. This is not an exhaustive list of research activities, but the Highlights provide a view of the diversity of research topics that are being investigated with the objective of serving the dairy and livestock industries in California. If you should wish further information on a project, you may contact the investigator.

# Cooling Cows With High Volume Low Speed (HVLS) Fans

Tom Shultz  
Dairy Advisor, Tulare County  
UC Cooperative Extension

**Introduction.** Dairy cow performance is reduced by summer heat stress. This problem can be associated with an elevated cow respiration rate and Temperature-Humidity Index (THI) in both milk barn wash/holding pens and feeding/rest areas. Low Volume High Speed (LVHS) fans have been used to alleviate the stress. High Volume Low Speed (HVLS) fans are an option which uses comparatively less electrical energy than LVHS fans. The objectives of this study were to determine if HVLS fans could help animal performance while using less electrical power.

**Methods.** Afternoon individual cow respiration rates were randomly counted in the wash/holding pen among 100 cows/pen in three consecutive pens. Counts were made from the time wash pen sprinklers were turned off until cows entered milking stalls. Observations were made on the third day of a three consecutive day period, with HVLS fans on or off, between May 15<sup>th</sup> and September 15<sup>th</sup>. Corresponding period bulk tank milk was recorded. Automated data loggers were used to record temperature and humidity for THI determination.

**Results.** As the THI increased, cow respiration rates increased faster ( $P < .01$ ) with fans off than when on. This increase in respiration rate with the fans off correlated negatively (-0.78) with milk yield, while the effect was minimal (-0.09) with fans on. Regression analysis showed with THI\* stress factors of 80 and 90 there were respective drops in milk yield of 0.3 and 0.6 gallons/cow daily when fans were off as compared to fans on. Two overhead HVLS fans, each with eight 10 ft. blades, were used for this study and used 0.88 kwh/hour used. For adequate cooling, this size pen would require ten 36-inch LVHS fans at 0.54 kwh/fan/hour used. Electrical power savings with HVLS fans was 84%.

A similar ratio of one HVLS to five LVHS fans/area is being compared in two side-by-side free stall barns. Cow activities in these barns are being used as an indicator of cow response under an equal management situation. Preliminary results from two months of averaged observations are listed below and will be combined with a continued study next summer.

	LVHS Barn		HVLS Barn	
	AI Pen	Bull Pen	AI Pen	Bull Pen
Cows	287	298	292	291
Milk, lbs/cow	91	81	93	91
Days in Milk	103	234	77	207
Barn °F, Afternoon	87		89	
THI*, Afternoon	76		77	
Barn °F, Evening	83		84	
THI*, Evening	75		76	
Eating, %	19	17	22	17
Laying, %	38	41	41	40
Standing, %	31	31	24	27

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\*THI = Temperature-Humidity Index: Stress Factor 72-79 Mild; 80-89 Moderate; 90-98 Severe.

Acknowledgments to Southern California Edison and engineer Paul Williams for project support.

# Close-up dry period protein supplementation influences milk, fat and protein yields of multiparous Holstein dairy cows in the first half of their next lactation

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<sup>2</sup>Institute of Grassland and Environmental Research, Plas Gogerddan, Aberystwyth SY23 3EB, UK

**Introduction** Considerable effort has recently been directed to better defining protein requirements of dry dairy cows. Early efforts (Moorby *et al.*, 1996) suggested substantial increases in milk and milk protein yield of multiparous cows to a small amount of a high undegradable dietary protein (UDP) supplement in the late dry period. Recent studies have not consistently supported these findings. The objective of this experiment was to define the impact of supplementation of a high UDP supplement in the late dry period of multiparous dairy cows on production of milk and its components.

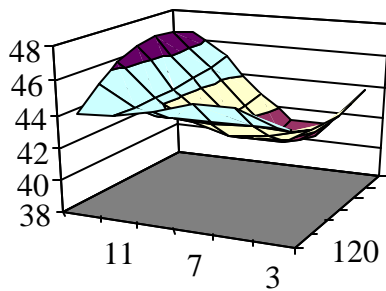
**Material and methods** A close-up dry period ration, based on maize silage (0.17 of dry matter, DM), lucerne hay cubes (0.24), oat hay (0.25), barley (0.16) and maize grains (0.16), was limit fed at 12.1 kg DM/d. Diets were: D<sub>0</sub>, no supplement; D<sub>1</sub>, with 1.1 kg/d of a UDP supplement; and D<sub>2</sub>, with 2.3 kg/d of the supplement, comprising rumen-protected rapeseed meal (0.6), dried distillers grains (0.2), blood meal (0.1), feather meal (0.05), and maize gluten meal (0.05). Final crude protein (CP) contents of the diets (P) were 118, 148 and 178 g/kg DM. Milk, protein and fat yields of 121 multiparous Holstein cows, each offered one of the dry period diets for up to 16 d (n = 47, 40 and 34 for D<sub>0</sub>, D<sub>1</sub> and D<sub>2</sub>), were measured monthly for the first 150 d of lactation. Following calving, all cows received the same complete diet formulated to contain 177 g CP/kg DM and 320 g neutral detergent fibre/kg DM. Cows were allocated to one of four groups based upon time close-up (T) for statistical analysis (1-4, 5-8, 9-12 and 13-16 d). Yields of milk, protein and fat for each cow during the first 150 d of lactation were used to calculate a mean for each treatment group. Data were analysed by multiple regression with a maximum model of:  $y = \text{constant} + P + P^2 + T + T^2 + T^3 + T^4 + P \times T + P \times T^2 + P \times T^3 + P \times T^4 + P^2 \times T + P^2 \times T^2 + P^2 \times T^3 + P^2 \times T^4$ , with removal of terms until the best fit regression was achieved.

**Results** Milk, milk fat and milk protein yield were influenced, albeit in different ways, by increasing the level of diet UDP supplementation and increasing the time that cows received the supplement (Table 1). Shapes of the modelled responses are in Figures 1 to 3. Milk yield was greatest for cows offered diet D<sub>0</sub> for shorter periods of time or D<sub>1</sub> or D<sub>2</sub> for longer periods of time. Milk protein yield tended to be greatest for cows offered diet D<sub>1</sub> for longer periods of time. Both milk and milk protein yields appeared to be depressed when cows on any diet were fed the protein supplement for approximately 5 to 7 d, although the extent of the depression in milk was greater in cows offered more protein supplement. Similarly, milk fat yield tended to be lower for cows supplemented for intermediate periods of time.

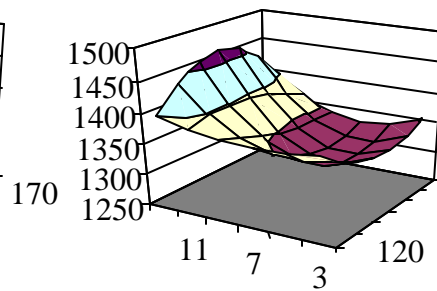
Table 1 Significance and model parameters of multiple regressions (P = diet protein, T = time in close-up group)

	Constant	P	P <sup>2</sup>	T	T <sup>2</sup>	T <sup>3</sup>	T <sup>4</sup>	P×T	P×T <sup>2</sup>	P×T <sup>3</sup>	P×T <sup>4</sup>	P <sup>2</sup> ×T	P <sup>2</sup> ×T <sup>2</sup>	P <sup>2</sup> ×T <sup>3</sup>	P <sup>2</sup> ×T <sup>4</sup>	SE	R <sup>2</sup>	P <sup>†</sup>
Milk	NS	*	-	*	*	-	-	*	*	*	-	+	-	*	-	1.05	0.76	+
Protein	***	-	-	+	+	-	-	+	+	-	-	NS	+	-	-	40.5	0.48	NS
Fat	***	-	-	-	NS	-	-	+	NS	-	-	-	NS	-	-	82.4	0.22	NS

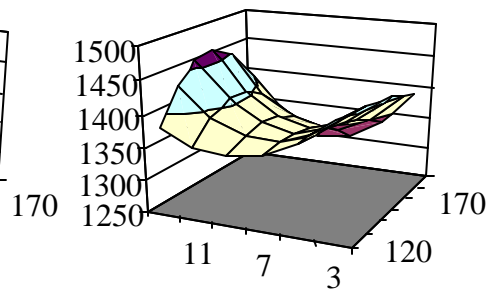
<sup>†</sup>Regression significance; -, excluded from model; NS, not significant but in model; +,  $P < 0.1$ ; \*,  $P < 0.05$ ; \*\*\*,  $P < 0.001$



**Figure 1** Milk production (kg/d)



**Figure 2** Milk protein yield (g/d)



**Figure 3** Milk fat yield (g/d)

All figures: days close-up (3-16 d) by diet crude protein concentration (120-170 g/kg DM)

**Conclusion** The amount of protein supplement fed close to calving, and the length of time that animals received it, both influenced milk and milk component production. While these results are broadly consistent with an earlier study (Robinson *et al.*, 2000), it is evident that relationships between close-up period protein supplementation and production in the next lactation are complex. Experiments are required to define the characteristics of dry cows that influence their potential to respond, and actual response, to dietary protein if prediction of lactation responses are to be accurate.

**Acknowledgements** We are grateful to M. Arana, L. Castelanelli, R. Hinders, T. Graham, the staff of the Castelanelli Brothers Dairy, Lodi, California, and H. Goodby for supplying the Alberta Gold™ Hi-Bypass Canola Pellets.

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# Late gestation protein supplementation influences milk, fat and protein yields of primiparous Holstein dairy cows in the first half of their first lactation

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<sup>2</sup>Department of Animal Science, University of California, Davis 95616, USA

**Introduction** Considerable effort has recently been directed towards better defining protein requirements of dairy cows approaching parturition. Little effort has been directed towards cows entering first lactation, although Van Saun *et al.*, (1993) suggested modest increases in milk protein production to a supplement of high undegradable dietary protein (UDP) in the late dry period. The objective of this study was to define the impact of supplementation of a high UDP protein supplement in the late gestation of cows entering first lactation on production of milk and its components.

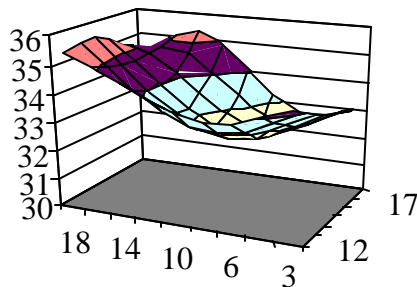
**Material and methods** A close-up dry period ration, based on maize silage (0.17 of dry matter, DM), lucerne hay cubes (0.24), oat hay (0.25), barley (0.16) and maize grains (0.16), was limit fed at 12.1 kg DM/d. Diets were: D<sub>0</sub>, no supplement; D<sub>1</sub>, with 1.1 kg/d of a UDP supplement; and D<sub>2</sub>, with 2.3 kg/d of the supplement, comprising rumen-protected rape seed meal (0.6), dried distillers grains (0.2), blood meal (0.1), feather meal (0.05), and maize gluten meal (0.05). Final crude protein (CP) contents of the diets (P) were 118, 148 and 178 g/kg DM. Milk, protein and fat yields of 192 multiparous Holstein cows, each offered one of the dry period diets for up to 16 d (n = 54, 73 and 65 for D<sub>0</sub>, D<sub>1</sub> and D<sub>2</sub>), were measured monthly for the first 150 d of lactation. Following calving, all cows received the same complete diet formulated to contain 177 g CP/kg DM and 320 g neutral detergent fibre/kg DM. Cows were allocated to one of four groups based upon time close-up (T) for statistical analysis (1-4, 5-8, 9-12, 13-16 and 17-20 d). Yields of milk, protein and fat for each cow during the first 150 d of lactation were used to calculate a mean for each treatment group. Data were analysed by multiple regression with a maximum model of:  $y = \text{constant} + P + P^2 + T + T^2 + T^3 + T^4 + P \times T + P \times T^2 + P \times T^3 + P \times T^4 + P^2 \times T + P^2 \times T^2 + P^2 \times T^3 + P^2 \times T^4$ , removing terms until the best fit regression was achieved.

**Results** Milk, milk fat and milk protein yield were influenced, albeit in different ways, by increasing the level of diet UDP supplementation and increasing the time that cows received the supplement (Table 1). Shapes of the modelled responses are in Figures 1 to 3. Milk yield was greatest for animals offered diet D<sub>0</sub> for longer periods of time and for animals offered diet D<sub>3</sub> for intermediate periods of time, with evidence that cows offered the highest level of protein supplement for the longest period of time had a reduced level of milk production. Milk protein yield showed a similar pattern, without the tendency to higher yields from cows offered D<sub>0</sub> for longer times. Both milk and milk protein yields appeared to be depressed when cows on any treatment were exposed to the close-up diet for approximately 5 to 7 d.

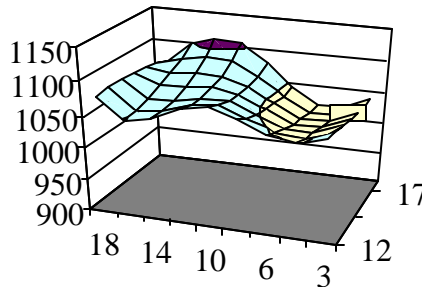
Table 1 Significance and model parameters of multiple regressions (P = diet protein, T = time in close-up group)

	Constant	P	P <sup>2</sup>	T	T <sup>2</sup>	T <sup>3</sup>	T <sup>4</sup>	P×T	P×T <sup>2</sup>	P×T <sup>3</sup>	P×T <sup>4</sup>	P <sup>2</sup> ×T	P <sup>2</sup> ×T <sup>2</sup>	P <sup>2</sup> ×T <sup>3</sup>	P <sup>2</sup> ×T <sup>4</sup>	SE	R <sup>2</sup>	P <sup>†</sup>
Milk	***	-	-	-	*	*	-	-	*	*	-	*	*	*	-	0.73	0.67	*
Protein	***	-	-	*	**	**	**	-	**	**	-	-	**	-	**	13.8	0.76	*
Fat	NS	+	*	*	*	**	**	*	-	**	**	*	**	-	-	24.0	0.84	+

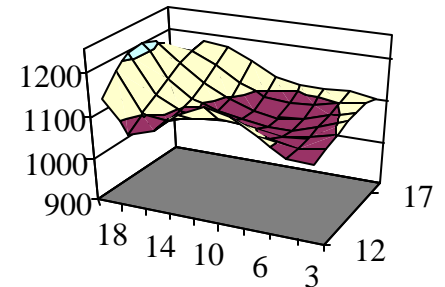
<sup>†</sup>Regression significance; -, excluded; NS, not significant but in model; +,  $P < 0.1$ ; \*,  $P < 0.05$ ; \*\*,  $P < 0.01$ ; \*\*\*,  $P < 0.001$



**Figure 1** Milk production (kg/d)



**Figure 2** Milk protein yield (g/d)



**Figure 3** Milk fat yield (g/d)

All figures: days close-up (3-18 d) by diet crude protein concentration (120-170 g/kgDM)

**Conclusion** Level of feeding of a protein supplement near calving, and the length of time that cows received it, both influenced milk and milk component yield. While these results are broadly consistent with an earlier study (Robinson *et al.*, 2000), it is evident that the optimal combination of level of protein supplement offered, and time of offer, is a complex response that requires further research. Nevertheless, results demonstrate for the first time that performance in the next lactation may be reduced if excess protein supplement is fed to close-up heifers entering first lactation.

**Acknowledgements** We are grateful to M. Arana, L. Castelanelli, R. Hinders, T. Graham, the staff of Castelanelli Brothers Dairy, Lodi, California, and H. Goodby for supplying the Alberta Gold™ Hi-Bypass Canola Pellets.

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# **Effect of level of cracked Pima cottonseed in the diet of lactating dairy cows on milk yield and plasma gossypol.**

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S.J. Taylor<sup>1</sup>, M.C. Calhoun<sup>2</sup>, B. Baldwin<sup>2</sup>, and S.W. Kuhlmann<sup>2</sup>

<sup>1</sup>University of California, Davis, CA

<sup>2</sup>Texas Agricultural Experiment Station, San Angelo, TX

## **Introduction**

Whole cottonseed is a common ingredient in the diet of lactating dairy cows. Upland cottonseed is the traditional seed used in dairy rations. However, there is an increased availability of Pima cottonseed for feeding. Pima cotton is long staple length cotton, and the acreage grown has been increasing so more Pima cottonseed is available for feeding. Pima cottonseed must be processed, for example cracked, prior to feeding to cattle. Pima cottonseed has been successfully fed to dairy cattle.

Cottonseed contains gossypol. Gossypol occurs throughout the cotton plant as a natural defense mechanism against insect pests. Gossypol exists naturally as a mixture of (+) and (-) stereoisomers. The (-) isomer appears to have the greater biological activity. Gossypol has been associated with anti-nutritional quality affects when consumed by animals. Upland cottonseed in the present study contained 1.3% total gossypol and 0.5% (-) isomer and cracked Pima cottonseed contained 1.7% total gossypol and 0.8% (-) isomer. There are few studies evaluating Upland and Pima cottonseed.

## **Objective**

The objective was to evaluate the feeding value of cracked Pima on production performance and plasma gossypol concentration of lactating cows.

## **Methods**

Lactating Holstein cows were fed one of four diets containing cracked Pima cottonseed to determine its effects on milk yield and plasma gossypol concentration. All diets contained 43% concentrate, 12% cottonseed, and 45% chopped alfalfa hay. The proportion of whole Upland cottonseed to cracked Pima cottonseed varied from 100:0, 66:34, 34:66, and 0:100 (U:P). Primiparous cows (4) were fed the diets in a 4x4 Latin square design. Multiparous cows (3) were fed the diets in a Youden square with five periods. Periods were 35d.

## **Results**

Milk yield (kg/d), milk fat (%), and DM intake (kg/d) were not affected by the inclusion of cracked Pima cottonseed into the diet of either primiparous or multiparous cows. For primiparous cows, milk yield, milk fat, and DM intake were 36.9, 4.2, 28.3; 39.0, 3.9, 28.2; 40.3, 3.7, 29.1; and 38.2, 4.1, 27.8 for the 100:0, 66:34, 66:34, and 0:100 U:P diets,

respectively. Similar data for multiparous cows were 41.9, 3.7, 33.4; 41.5, 3.7, 30.7; 41.5, 3.7, 31.9; and 38.4, 3.9, 29.3, respectively. Upland and cracked Pima cottonseed contained (% of meats DM) 1.3% and 1.7% free gossypol and 0.52% and 0.85% minus (-) isomer, respectively. Gossypol is a natural defense compound in the plant that protects it against pests and diseases, but it can have anti-nutritional quality affects when consumed by animals. Total plasma gossypol concentration significantly increased linearly with increasing proportion of cracked Pima in the diet for primiparous (4.1, 5.8, 6.9, and 8.7  $\mu$ g/ml;  $P < 0.01$ ) and multiparous (4.1, 7.1, 9.5, and 11.7  $\mu$ g/ml;  $P < 0.01$ ) cows. Cracked Pima cottonseed, fed at levels up to 4 kg/d, had no effect on production performance even though plasma gossypol concentrations increased sharply.

## **The Clement and Jeanne Pelissier Undergraduate Scholarship**

Clement “Clem” Pelissier was a Dairy Extension Specialist in the Department of Animal Science for many years. Clem was one of the first researchers to evaluate grain feeding to lactating dairy cows and he was an advocate of maintaining and using accurate records to make wise management decisions. He extended this concept to developing management strategies to improve the reproductive efficiency of cows in California dairy herds. During Clem’s academic career he worked closely with the dairy industry.

Clem and Jeanne established an endowment in 1996 to provide a scholarship to undergraduate students majoring in animal science with a preference for students demonstrating an interest in dairy cattle.

The recipient for 2000/01 is Jennifer Renner. Jennifer is receiving this award for the second time because of her outstanding contributions to activities related to dairy science. Jennifer was raised on dairy, Renner Ranches, Inc., in Loleta, California. She raised animals and was involved in 4-H and FFA projects. Through 4-H and FFA projects Jennifer showed dairy and beef cattle and sheep at several fairs including the California State Fair and the Junior Grand National Livestock Show. While in high school Jennifer was a member of the National Honor Society, the California Scholarship Federation, 4-H, and Future Farmers of America, and Jennifer was the secretary for the Humboldt-Del Norte FFA Section. Jennifer has been active in numerous extracurricular activities at UC Davis including her involvement with Intersarsity Christian Fellowship, the Block and Bridle undergraduate animal science club, Young Cattlemen’s Association, and Vet Aides. This year Jennifer is Vice President of Block & Bridle, and she was involved in organizing the annual Chili Cook-off, which was a successful event. She is currently the Secretary/Publicity officer for Dairy Club and she was Vice President of the club last year. Jennifer has volunteered to help at the UC Davis Dairy Facility, and she participated in the dairy cattle judging contest of Ag Science Field Day. Her career goal is to become a large animal veterinarian.

Donations in memory of Clem to support the Pelissier Scholarship can be made to the Clement and Jeanne Pelissier Undergraduate Scholarship Fund (checks payable to the U.C. Foundation) or to the Animal Husbandry Memorial Fund in support of department programs and student activities (checks payable to U.C. Regents – Animal Science). Send to the Department of Animal Science, c/o Gary B. Anderson, Chair, One Shields Avenue, University of California, Davis, CA 95616-8521.



## **The Tom Mead Dairy Award Offered by World-Wide Sires, Inc.**

World-Wide Sires, Inc., 5545 Avenida de los Robles, Visalia, CA supports this undergraduate award in memory of Professor Tom Mead. Professor Mead was a member of the Department of Animal Science. He began his career in 1920 at Rutgers and joined the Davis faculty in 1924 bringing with him the Jersey inbreeding experiment from Rutgers which included three sires and 31 cows. His research dealt with genetics, nutrition and management. Professor Mead retired in 1962, and he passed away on December 19, 1971.

World-Wide Sires is the world's largest exporter of U.S. frozen livestock semen. The President is Bill Clark, a UC Davis alumnus. On behalf of the dairy industry within California, World-Wide Sires provides the funds to offer the Tom Mead Dairy Award to a promising young undergraduate that shows interest in the dairy industry.

The 2000/01 recipient of the World-Wide Sires Tom Mead Dairy Award is Carlos Borges.

Carlos Borges is a junior pursuing a B.S. degree in Animal Science. Carlos was raised on dairy, the Borges Dairy, in Tracy, California. Carlos is currently a student resident- manager at the UC Davis Hopkins Facility. Carlos is involved in the day to day operations of the avian facility. He is also involved in the teaching and research activities associated with the facility. Carlos was a student resident-manager at the UC Davis Dairy Teaching & Research Facility in the summer of 2000. Carlos gained many experiences related to the care and management of dairy cattle. He has also contributed significantly to the teaching and outreach activities associated with dairy cattle. Carlos was involved in the preparation of the dairy displays presented at Picnic Day. Carlos is a member of the UC Davis Dairy Club. He has completed an internship at the Dairy Facility involved with vaccination and health programs of the replacement heifers. Carlos can often be found at the Dairy Facility just volunteering his time to help. He is a member of both the Dean's Student Advisory Council and the Biological Undergraduate Scholars Program. Carlos is a member of Ag Ambassadors, which is a group of select students, and he holds the office of Sergeant of Arms. Aggie Ambassadors represent the campus at many functions, they are involved in many programs that educate the general public about agriculture, and they aid with the recruitment of new students for the College of Agricultural and Environmental Sciences. Carlos is an outstanding all-around student.

Carlos' career goal is to obtain a position that is involved with the dairy industry. He is considering either the study of veterinary medicine or becoming a dairy herd-manager. The Department of Animal Science is pleased to present Carlos Borges with the World-Wide Sires - Tom Mead Dairy Award for 2000/01.



## Notes