MSU Extension and the College of Agriculture and Natural Resources are undergoing significant restructuring to address stakeholder education and information needs and to solve budgetary challenges. MSU dairy Extension and research efforts have been given very high priority in these restructuring efforts.

With these changes, the MSU Dairy Team reaffirms its strong commitment to Michigan’s dairy producers and allied agribusiness professionals to help you achieve your goals and to maintain a competitive advantage. The Michigan Dairy Industry is one of the stalwarts of Michigan’s over $70 billion agriculture sector, a vitally important economic driver for communities all across rural and urban Michigan producing high quality, healthy, and nutritious food products.

Among the changes for MSU Extension is that all staff and faculty are now affiliated with one of four Extension Institutes. Extension Educators and Specialists working with and programming for the dairy industry are primarily in the Agriculture and Agribusiness Institute. This Institute is led by Dr. Wendy Powers, professor and researcher of air quality in the Departments of Animal Science and Agriculture and Biosystems Engineering, and Director of Environmental Stewardship for Animal Agriculture of the college.

MSU Extension Dairy Team membership has changed through retirements and reassignments. Extension Dairy Educators have taken on specializations within dairy production management to further develop and concentrate their expertise and efforts in various subject areas, while still serving dairy producers in a given geographic area. Table 1 on page 2 lists the current Dairy Educators, their location, specialization, and contact information is on page 3 of this issue.

You are encouraged to continue to contact the Extension Dairy Educator for your area by phone or email. They may assist you directly or they may connect you with a colleague with particular specialization to assist you. Your local Extension Dairy Educator is still your most convenient front door for service and education.

Extension Dairy Educators are working closely with campus faculty who are focused in particular specialized subject matter. Together, this team of researchers and Extension Educators will strive to serve your educational and technical information needs. In addition, MSU Extension Educators specializing in other agricultural-related subject areas will have important information for dairy producers. These supporting Educators are listed in Table 2 on page 2.

Michigan dairy producers and agribusiness professionals have an array of resources available from MSU to help...
manage profitable businesses that meet the demand of consumers and neighbors for high quality food, exemplary animal care, and progressive management of the land, water and air natural resources.

Table 1: Michigan State University Extension Dairy Educators.*

<table>
<thead>
<tr>
<th>Educators</th>
<th>Location</th>
<th>Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faith Cullens</td>
<td>St. Johns</td>
<td>Dairy Nutrition</td>
</tr>
<tr>
<td>Phil Durst</td>
<td>Mio</td>
<td>Cattle Health</td>
</tr>
<tr>
<td>Kathy Lee</td>
<td>Lake City</td>
<td>Reproduction &amp; Genetics</td>
</tr>
<tr>
<td>Mike McFadden</td>
<td>Mt. Pleasant</td>
<td>Milk Quality</td>
</tr>
<tr>
<td>Stan Moore</td>
<td>Bellaire</td>
<td>Employee Management</td>
</tr>
<tr>
<td>Roberta Osborne</td>
<td>Coldwater</td>
<td>Environmental Issues</td>
</tr>
<tr>
<td>Craig Thomas</td>
<td>Sandusky</td>
<td>Business Management &amp; Marketing</td>
</tr>
<tr>
<td>Frank Wardynski</td>
<td>Ontonagon</td>
<td>Ruminant Production</td>
</tr>
</tbody>
</table>

*See more contact information on page 3.

Table 2: MSU Extension Educators supporting Michigan's dairy industry and programs statewide.

<table>
<thead>
<tr>
<th>Educators</th>
<th>Specialization</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roger Betz</td>
<td>Business Management</td>
<td>269-781-0784</td>
</tr>
<tr>
<td>Fred Hinkley</td>
<td>Business Management</td>
<td>989-345-0692</td>
</tr>
<tr>
<td>Adam Kantrovich</td>
<td>Business Management</td>
<td>616-994-4580</td>
</tr>
<tr>
<td>Warren Schauer</td>
<td>Business Management</td>
<td>906-786-3032</td>
</tr>
<tr>
<td>Dennis Stein</td>
<td>Business Management</td>
<td>989-672-3870</td>
</tr>
<tr>
<td>Curtis Talley</td>
<td>Business Management</td>
<td>231-873-2129</td>
</tr>
<tr>
<td>Van Varner</td>
<td>Business Management</td>
<td>248-347-0269</td>
</tr>
<tr>
<td>Mary Dunckel</td>
<td>Agricultural Literacy</td>
<td>989-354-9870</td>
</tr>
<tr>
<td>Nancy Thelen</td>
<td>Agricultural Literacy</td>
<td>734-222-3825</td>
</tr>
<tr>
<td>Charles Gould</td>
<td>Manure and Energy</td>
<td>616-846-8250</td>
</tr>
<tr>
<td>Phil Kaatz</td>
<td>Forages</td>
<td>810-667-0341</td>
</tr>
<tr>
<td>Kelly Ewalt</td>
<td>AgrAbility</td>
<td>989-224-5240</td>
</tr>
<tr>
<td>Jerry Lindquist</td>
<td>Grazing</td>
<td>586-774-2428</td>
</tr>
<tr>
<td>Jerry May</td>
<td>Air Quality</td>
<td>989-875-5233</td>
</tr>
<tr>
<td>Natalie Rector</td>
<td>Nutrient Management</td>
<td>269-781-0908</td>
</tr>
<tr>
<td>Jeannine Schweihofer</td>
<td>Meat Quality/Hazard Analysis Critical Control Point</td>
<td>989-269-9949x612</td>
</tr>
<tr>
<td>Marilyn Thelen</td>
<td>Integrated Agricultural Systems</td>
<td>989-224-5240</td>
</tr>
<tr>
<td>Dean Ross</td>
<td>Emergency Management &amp; Farm Safety</td>
<td>517-546-3950</td>
</tr>
</tbody>
</table>

Newly Formed Extension Dairy Advisory Team

The MSU Extension Dairy Team recently formed an Advisory Team of progressive producers and professionals from across the state. These individuals are working to partner with and advise Dairy Extension to better understand and attend to the educational needs of dairy producers and allied professionals across the state.

Advisory Team members represent a large cross-section of the industry. All share a strong commitment to advance the dairy industry and a willingness to be innovative.

Advisory Team members have committed to serve a term on the Team, meet with the Extension campus and field staff twice each year, and contribute in periodic conference calls. Through the regular input by and partnership of this Advisory Team, the MSUE Dairy Team will be able to respond quickly to emerging challenges and educational needs of the dairy industry. The MSU Extension Dairy Team looks forward to working with the Advisory Team to help the Michigan dairy industry advance and grow stronger.

Please feel free to contact any of these Advisory Team members or members of the Extension Team directly.

Table 1: Members of Extension Dairy Advisory Team

<table>
<thead>
<tr>
<th>Member</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeremy Beebe</td>
<td>Whittemore</td>
</tr>
<tr>
<td>Mike Cox</td>
<td>Portland</td>
</tr>
<tr>
<td>Nathan Elzinga</td>
<td>Zeeland</td>
</tr>
<tr>
<td>Luke Haywood</td>
<td>Hastings</td>
</tr>
<tr>
<td>Tim Hood</td>
<td>Paw Paw</td>
</tr>
<tr>
<td>Jim Judge</td>
<td>Mt. Pleasant</td>
</tr>
<tr>
<td>Dana Sue Kirk</td>
<td>St. Johns</td>
</tr>
<tr>
<td>Josh Lehman</td>
<td>West Branch</td>
</tr>
<tr>
<td>Bruce Lewis</td>
<td>Jonesville</td>
</tr>
<tr>
<td>Don Martell</td>
<td>DeWitt</td>
</tr>
<tr>
<td>Amy Martin</td>
<td>LeRoy</td>
</tr>
<tr>
<td>Greg Messing</td>
<td>Bad Axe</td>
</tr>
<tr>
<td>Dwight Nash</td>
<td>Elsie</td>
</tr>
<tr>
<td>Jerry Neyer</td>
<td>Shepherd</td>
</tr>
<tr>
<td>Dr. Karen Peterson</td>
<td>Lakeview</td>
</tr>
<tr>
<td>Jim Reid</td>
<td>Jedd</td>
</tr>
<tr>
<td>Stephanie Schafer</td>
<td>Pewamo</td>
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<tr>
<td>Mitch Smith</td>
<td>Okemos</td>
</tr>
<tr>
<td>Wayne Whitman</td>
<td>Lansing</td>
</tr>
<tr>
<td>Tyler Wilson</td>
<td>Carson City</td>
</tr>
<tr>
<td>Nate Zuiderveen</td>
<td>Falmouth</td>
</tr>
</tbody>
</table>
Introduction
A number of agriculture organizations have been increasing their efforts to educate the public and to reconnect the consumer with the food system to inform and build public trust. In 2009, the first Breakfast on the Farm (BOTF) event was held in Fowler, Michigan (Clinton County). Over 1,500 people attended this free event aimed at educating the public about modern agriculture. Four BOTF events were held in 2010 with over 7,000 in total attendance. Host farms were Steenblik Dairy in Pewamo (Clinton County), Horning Dairy Farm in Manchester (Washtenaw County), Bryant Farm (Isabella County), and Tolan Family Farm in Oscineke (Alpena County). These BOTF events were a collaborative effort between MSU Extension and county Farm Bureau with significant personnel and financial support from various agribusinesses.

Why Are Efforts to Engage the Public Increasing?
In the 2008 Michigan Dairy Industry survey (1,2) high ratings were given to the need to communicate with the public, consumers and legislators about animal agriculture; how animals and the environment are managed; and, the safety of farm produce. Underlying these comments was the concern that consumers receive messages about nutrient value, food safety and how products are produced with regard to the environment and animal management (social conscience) without the background to evaluate the information presented. This is, in part, because they are not familiar with modern farming practices and how food is produced today.

Further, marketing strategies used to differentiate some food products results in food labeling that can be misleading as many consumers may not understand the information or have access to all the facts. As a result, the dairy industry and other food animal industries have been working diligently to increase consumer education efforts. BOTF is one such effort to improve agriculture literacy. It provides the public with an opportunity to learn first-hand about current farming practices, a chance to connect faces to the farm owners, and an occasion to talk with farmers. BOTF has the potential to impact the visitors’ knowledge of how food is produced and inform their impressions about modern farming practices and correct misconceptions.

Purpose of Exit Survey
Exit surveys were conducted on the 3 dairy farms that hosted BOTF in 2010 (Alpena, Clinton and Washtenaw counties). The exit survey was developed to help determine who came to BOTF events, what their impressions were, and what they learned from their visit.

At the exit point of each BOTF event, individuals were invited to complete a survey to provide some feedback on their experience. Table 1 below shows the number of participants estimated by tickets turned-in, meals served and sign-ins along with the number of surveys completed at the 3 locations. Financial support for survey data entry was provided by United Dairy Industry of Michigan.

Table 1: Number of surveys and percentage of participants completing surveys by location.

<table>
<thead>
<tr>
<th>BOTF Location</th>
<th>Competed Surveys</th>
<th>Gate Count*</th>
<th>% Completing Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpena</td>
<td>125</td>
<td>1500</td>
<td>8.3</td>
</tr>
<tr>
<td>Clinton</td>
<td>101</td>
<td>2500</td>
<td>4.0</td>
</tr>
<tr>
<td>Washtenaw</td>
<td>371</td>
<td>2300</td>
<td>16.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>597</td>
<td>6300</td>
<td>9.5</td>
</tr>
</tbody>
</table>

* meal tickets + sign-ins
Are We Reaching People Who Have Not Been on a Farm?
Respondents were asked about the number of times they had previously been on a dairy farm. At the 3 locations, 46% percent had not been on a farm before and 25% percent had been on a farm 1 to 5 times. To determine how connected or familiar visitors may be with modern farming we asked two questions: Where did they grow up? and, Did they have relatives, friends who own/owned a farm? Over the 3 locations, 37% percent grew up in an urban area; 14% grew up in an urban area not near a farm; 11% grew up in a rural area not near a farm; 23% grew up on a farm, and, 18% grew up in a rural area near a farm. Keep in mind that for this question, respondents could check more than one response. For instance, they could check “grew up in urban area” and “on a farm”. When asked if they had relatives or friends who own/owned a farm, 26% indicated they had/have parents who owned/own a farm; 35% grandparents; 19% great-grandparents; 37% percent relatives; 20% no relatives; and 39% friends that own/owned a farm. The distributions by location are similar for Alpena and Washtenaw. A greater percentage (41%) of attendees in Clinton County checked parents own/owned a farm compared with Alpena County at 22% and Washtenaw County at 23%.

Age and Gender
For the 3 locations combined, one-third of the respondents were 36 to 50 years old, one-fourth were 21 to 35, and one-fourth were 51 to 65 years old, leaving 14% over 65. The gender of overall respondents was 36% male and 64% female and was not different by location.

Who Did They Bring to BOTF?
Overall 58% brought their kids, 16% brought grand-kids, 26% brought friends, 6% brought neighbors, 0.8% brought members of youth organizations, and 0.5% brought students. These percentages were similar for all 3 locations. For this question, respondents could check more than one response.

Where Do They Live and Work?
When asked where they currently live, 29% checked urban area, 16% checked urban area near a farm, 12% checked rural area not near a farm, 30% checked rural area near a farm and 14% checked on a farm. Alpena County had a greater percentage from a rural area for both near and not near a farm, while Clinton and Washtenaw Counties had a greater percentage from an urban area near a farm.

Currently, 39% work in a non-ag-related job; 7.9% work in ag-related jobs and a surprising 40% checked the job category “Did not apply.” It is likely many are retired, however, only 14% indicated they were over 65 years. Some may be unemployed and a number are possibly stay-at-home mothers. A category for stay-at-home mothers could be added in future surveys. We also asked if they were currently a family member of a farm owner or a farm employee to which 15% indicated yes. Washtenaw County had over 40% working in non-ag-related jobs, Clinton County had a higher percentage that were either family member of farm owner or farm employee, a farm owner/operator, a dairy farm employee or worked in ag-related jobs with the fewest in non-ag-related jobs. The Clinton County location was a larger farming operation that perhaps attracted farmers and farm employees. Alpena had the greatest number who checked “Did not apply” for the job categories.

How Far Is the Farm from Their Home?
Overall, the farms were on average 32 miles from the respondents’ homes. Alpena County had almost 10% respondents greater than 100 miles from their home. The majority, 57%, that attended in Washtenaw County (approximately 10 miles from Ann Arbor) were within 15 miles, 47% of those visiting Clinton County (approximately 20 miles from Lansing) were within 15 miles, and 19% within 5 miles.

Summary
Are the BOFT events attracting the desired audience? Probably, the best indicator is that 46% percent of respondents had not been on a farm before and 25% percent had been on a farm only 1 to 5 times. In addition, only 23% grew up on a farm while 51% grew up in an urban area. However, we might conclude that they are somewhat “connected” as 37% percent had/have relatives who own/owned a farm and 39% had/have friends that own/owned a farm, while only 20% had/have no relatives that own/owned a farm. It is likely some had both friends and relatives who own/owned a farm. With this in mind, individual producers might consider inviting friends and relatives to their farm. Also, 39% of respondents currently work in non-ag-related job and stay-at-home-mothers may be part of the largest group who indicated that a job “Did not apply.” In addition, 45% live in an urban area and 42% live in a rural area, while only 14% live on a farm. BOTF attracted a greater number of first-time visitors in Washtenaw County and it is likely
Elwood Kirkpatrick Dairy Science Research Endowment: Completed and Ongoing Projects

The Elwood Kirkpatrick Dairy Science Research Endowment began in 2007 to honor the work and support of Mr. Elwood Kirkpatrick for the dairy industry of Michigan and Michigan State University. The Endowment along with partnership support from the Department of Animal Science, Michigan Milk Producers Association, the Clinton E. Meadows Endowment, the College of Agriculture and Natural Resources, and Michigan AgBioResearch (formerly Michigan Agriculture Experiment Station) has partially funded several MSU dairy research projects addressing a wide range of topics. Reported in this issue are summaries of some completed and ongoing projects.

Title: Modeling the Role of Herd Management on the Relationship Between Production and Reproduction of Dairy Cows

Main participants: Robert Tempelman and Nora Bello
Dept. of Animal Science

Objectives of Project
- To investigate the nature of the association between level of milk production and reproductive performance of dairy cows, taking into consideration the within-herd (cow-level) and between-herd (herd-level) effects of this association.
- To evaluate management factors and herd attributes as potential sources of dissimilarity or complexity in the association.

Main Results and Outcomes
We developed and validated cutting edge statistical methods to model the within herd (cow-level) effects jointly with the between-herd (herd-level) relationships between two traits. The methods allowed us to model these relationships as functions of management or herd factors.

Evidence was overwhelming for the complexity in the association between milk production and reproduction applied to data from commercial Michigan dairies. Most notably, inferred relationships were generally quite different and, in some cases, opposite between cow-level versus herd-level components. Intensive management conditions seemed to contribute to a more favorable association in some cases (e.g., estimated herd calving interval decreased by 1.4±0.1 days per 220 lb increase in cumulative milk yield for herds using recombinant bovine somatotropin) or to a partial alleviation of an overall antagonism in others (i.e., improved reproductive performance among herds implementing more frequent milking schemes).

Perhaps the most significant result in our study was the remarkable complexity in the relationship between milk production and reproduction across herds, even after accounting for known management factors as recorded by DHIA. Understanding the multi-dimensional levels of differences in the associations between milk production and reproductive performance are expected to have direct implications for tailoring dairy management programs that optimize overall dairy cow performance in current production systems.

Take-home Messages
Overall, our research shows that the “one-size-fits-all” idea is overly simplistic to describe the nature of the association between milk production and reproductive performance of dairy cows. Instead, this association is not the same at different levels. That is, the relationship between milk production and reproduction is such that the delicate intricacies of a cow’s physiology do not necessarily mirror the mechanisms of management at the herd-level in which the individual cow resides. Management practices and herd attributes are potential contributors to the dissimilarity in the nature, as well as the magnitude, of the link between milk yield and reproductive performance.

These results have implications for devising management strategies that jointly could optimize milk production and reproduction of dairy cows. Also, subtle differences in the results were apparent when analyzing long-term versus short-term measures of milk production and reproduction. That is, the mechanisms that underlie performance measures spanning a whole lactation (i.e., cumulative milk yield at 305-d or calving interval) may differ from the mechanisms at work for short-term performance indicators corresponding to a specific point in time (i.e., daily milk yield and pregnancy outcome to first postpartum AI service). For example, our results showed that individual cows with greater lactation yields had longer calving intervals, but herd calving intervals were either shorter or unaffected among herds with highest cumulative 305-d yields.

Continued on page 6
Title: National Air Emissions Monitoring Study

Main Participant: Wendy Powers
Dept. of Animal Science

The National Air Emissions Monitoring Study (NAEMS) is now complete and the scientists have submitted their data and reports to EPA to interpret. EPA will use a subcontractor for this work and there is considerable interest in ensuring that EPA considers outside input in the process. A unified approach to estimating emissions from livestock operations around the country is needed. EPA is expected to develop emissions estimates based on the results from the NAEMS.

Through funding obtained by the E. Kirkpatrick Endowment Fund, Michigan State University Extension and research staff were engaged in a process to address the topic of collection, measurement and reporting of data that contribute to emissions estimates. The specific objective of the project was to help move the development of a nationally recognized standard that estimates emissions from livestock operations. Such an air quality emissions standard might parallel the current American Society of Agriculture and Biological Engineers (ASABE) Manure Production Characteristics Standard D384.2 that is widely used to estimate nutrient volumes and excretions based on dietary inputs.

To kick off the project, a meeting was held February 16, 2010 at the EPA location in Research Triangle Park, NC focusing on emission factors from Annual Feeding Operations (AFOs). Air emissions can be expressed in a number of different ways - based on number of animals and units of product produced.

In addition, the most appropriate emission factor for different parts of a farm system (housing, storage, land application) may vary. Further consideration of how air emissions are expressed is needed in order to determine what the appropriate emission factors are for the various components of a farm system. An approach to estimating farm emissions may be as simple as a single emission factor multiplied by a farm-specific variable, something more complex that considers multiple emission factors and farm-specific variable combinations, or an approach that provides for use of either of the previous options.

Further discussion of the topic took place locally in Michigan. In addition, the USDA Ag Air Quality Task Force took up the topic and hosted a meeting at EPA in Research Triangle Park, NC September 27, 2010. As was the goal of the project supported by the E. Kirkpatrick Endowment Fund, the topic was discussed and debated by scientists and industry representatives from around the country. Topics at the meeting included reports from groups tasked with considering how to report emissions units, measurement protocol and standardization, and reporting of mitigation effects. One of the recommendations from the organizing group was to continue to develop the reports as an ASABE Technical Reference. More information about this meeting and the presentations can be obtained from http://www.airquality.nrcs.usda.gov/aaqtf/Documents/index.html.

The project funded by the E. Kirkpatrick Endowment Fund has concluded, however; the work to identify the best means of reporting air emissions continues.

Modeling the Role of Herd Management...

Continued from page 5

Conversely, herds with greater milk yields at the time of first insemination had impaired reproductive performance, but within such herds, cows with higher daily milk yields were not any more or less likely to become pregnant to first postpartum insemination than lower yielding herdmates. Clearly, the joint consideration of cow and herd components of the association between milk production and reproduction behave differently on a whole-lactation basis compared with a point in time (short-term). Adjusting management recommendations to each short- and long-term scenario undoubtedly add an extra layer of complexity to the challenge of jointly optimizing milk yield and reproductive performance of dairy cows.

A more comprehensive appreciation for complexity of levels and sources of different factors that affect the association between milk production and reproductive performance may make it possible to suggest management practices to jointly optimize milk production and reproductive efficiency. However, we recognize that, by its own nature, this complexity inferred for the milk production-reproduction association complicates the formulation of general management recommendations. Further, more research undoubtedly can help to clarify what these recommendations may be in specific circumstances, particularly given that significant complexity in these associations remains across herds, even after adjusting for known management factors.
Title: Combination of Borax and Condensed Quebracho Tannins to Treat Stored Dairy Manure for Reduction of Hydrogen Sulfide and Ammonia Emissions

Main Participants: Principal Investigators: Melvin Yokoyama1 and Terence Whitehead1, Co-Investigators: Kristen Seymour1, Susan Hengemuehle1, Cheryl Spence2, Robert von Bernuth3, Michael Cotta2 and Robert Kreft1

Institutions: 1Dept. of Animal Science, MSU; 2National Center for Agricultural Utilization Research, Bioenergy Unit, USDA, ARS, Peoria, IL; 3College of Agriculture and Natural Resources, MSU.

Objectives of Project

- To treat stored dairy manure with different combinations of borax and condensed quebracho tannins in laboratory incubations to determine their effectiveness in reducing hydrogen sulfide and ammonia emissions.
- To quantify the total and sulfate reducing bacterial populations in the treated dairy manure by molecular genetic analyses.

Hydrogen sulfide is a toxic gas that is produced by sulfate reducing bacteria during the storage of livestock manure under anaerobic conditions. Hydrogen sulfide emissions have been rising due to intensive livestock production, posing a risk to both farmers and their livestock. The US Environmental Protection Agency (EPA) is considering regulating hydrogen sulfide emissions along with other greenhouse gas emissions from concentrated animal feeding operations.

Previous research we conducted demonstrated that borax is highly effective in reducing hydrogen sulfide emissions from stored swine manure. Other research conducted by the Bioenergy Unit, United States Department of Agriculture, Agricultural Research Service (USDA, ARS) has demonstrated that condensed quebracho tannins will also inhibit hydrogen sulfide emissions from stored swine manure.

Both borax and tannins were effective in inhibiting hydrogen sulfide and ammonia emissions from stored dairy manure. Borax was found to be more effective than tannins in inhibiting hydrogen sulfide emissions at lower treatment concentrations (Table 1 below). Tannins were found to be more effective than borax in inhibiting ammonia emissions at lower treatment concentrations. The effects of the borax and tannins are not additive, but complementary. Molecular genetic analyses indicate that tannins reduce the total microbial population of dairy manure and that the sulfate-reducing bacteria population of dairy manure differ from that of stored swine manure.

Adding a combination of borax and tannins to stored dairy manure may reduce the hazard of hydrogen sulfide toxicity to farmers and animals and ensure that dairy farms are in compliance with possible future federal regulations on gaseous emissions, while maintaining environmental sustainability. Follow up studies on farms are needed to confirm this treatment benefit, which might also reduce the contribution of greenhouse gas emissions from stored dairy manure to global warming. The data generated is being considered for a patent disclosure submission.

Table 1: Summary of significant findings in using a combination of Borax and Condensed Quebracho Tannins to treat stored dairy manure for reducing hydrogen sulfide emissions.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Percent Inhibition of Hydrogen Sulfide</th>
<th>Percent Inhibition of Ammonia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trial 1</td>
<td>Trial 2</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.1% Borax</td>
<td>95</td>
<td>86</td>
</tr>
<tr>
<td>0.1% Tannins</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>0.1% Borax + 0.1% Tannins</td>
<td>48</td>
<td>40</td>
</tr>
<tr>
<td>0.1% Borax + 0.2% Tannins</td>
<td>32</td>
<td>37</td>
</tr>
<tr>
<td>0.1% Borax + 0.3% Tannins</td>
<td>15</td>
<td>46</td>
</tr>
<tr>
<td>0.2% Borax + 0.1% Tannins</td>
<td>98</td>
<td>95</td>
</tr>
<tr>
<td>0.2% Borax + 0.2% Tannins</td>
<td>84</td>
<td>42</td>
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<tr>
<td>0.2% Borax + 0.3% Tannins</td>
<td>58</td>
<td>46</td>
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<tr>
<td>0.3% Borax + 0.1% Tannins</td>
<td>99</td>
<td>98</td>
</tr>
<tr>
<td>0.3% Borax + 0.2% Tannins</td>
<td>99</td>
<td>96</td>
</tr>
<tr>
<td>0.3% Borax + 0.3% Tannins</td>
<td>99</td>
<td>80</td>
</tr>
</tbody>
</table>
Title: The Potential Impact of Chronic Mammary Gland Infections during Pregnancy of Dairy Cows on Fertility of Their Daughters

Main participants: James Ireland, Danielle Scheetz, Joe Folger, George Smith, Richard Pursley, and Lou Neuder
Dept. of Animal Science

Objectives of Project
• To identify Holstein dairy cows with 0 to 5 Somatic Cell Count (SCC) measurements >200,000 shortly before and during pregnancy.
• To determine if the variation in number of SCC measurements >200,000 per cow is inversely associated with their daughter’s circulating anti-Müllerian (AMH) concentrations as adults. AMH is a biomarker positively associated with ovary size, number of healthy oocytes in ovaries and ovarian function.

Expected Main Results and Outcomes
Completion of this project will firmly establish whether dairy cows with a high number of SCC measurements >200,000 shortly before and during pregnancy also have daughters with a relatively low serum AMH concentration and correspondingly smaller ovaries, lower number of high quality oocytes and diminished ovarian function compared with their age-matched herdmates. The expected inverse association between number of SCC > 200,000 in dairy cows with AMH concentrations in their daughters implies that a chronic mammary infection/inflammation during pregnancy of a dairy cow has a negative impact on ovarian function and potentially reproductive performance of their daughters.

Main Take-home Messages
The expected inverse association between number of SCC > 200,000 in dairy cows and AMH concentrations in their daughters will impact the dairy industry by showing for the first time that high quality under health care of animals during pregnancy is critical to prevent not only mastitis and other opportunistic infections, but also to improve the maternal environment during pregnancy to enhance embryo development and subsequent ovarian function and fertility in their daughters. However, because this project will be conducted on a single herd, an expanded study using multiple herds will be necessary before any new culling criteria can be reliably recommended to producers.

Data in this figure depict the inverse relationship between number of SCC measurements > 200,000 per cow with AMH concentrations in their 11-12 mo old daughters. N = number of heifers, numbers in parentheses indicate percent of herd.

Figure 1: The inverse relationship between number of SCC measurements > 200,000 per cow with AMH concentrations in their 11-12 mo old daughters.
Title: Improving Milk Fat Production Through the Targeted Feeding of a C16:0-enriched Fat Supplement

Main Participants: Adam Lock and Michael Allen
Dept. of Animal Science

Objectives of Project

- Determine the effect of a C16:0-enriched fat supplement on feed intake, milk yield, milk fat and milk protein production.
- Examine the potential for a C16:0-enriched fat supplement to minimize the response of cows to a dietary-induced milk fat depression challenge using high moisture corn.
- Establish the impact of a C16:0-enriched fat supplement on milk fatty acid composition.

Background and Significance

Milk components and not milk yield, continue to be the principal driver of producer milk prices. The concentration and yield of milk fat is driven by the nutrition of the dairy cow; in particular, low (or reduced) milk fat % and yield is an important economic issue to dairy farms across the U.S. This was highlighted this year with most months in 2010 in the Mideast Federal Order being well below the 10-year average for milk fat %. For example, using September or October 2010 milk pricing information (from Milk Messenger) the change in milk price when milk fat % dropped from 3.8 to 3.4% was equivalent to $0.96/cwt. Therefore, diets that allow for an improvement in milk fat output would potentially be economically advantageous. This study will determine whether a novel fat supplement that is enriched in palmitic acid (C16:0) is a useful tool for maintaining or increasing milk fat production.

Expected Results and Outcomes

This study is examining the impact of a C16:0-enriched fat supplement on feed intake, milk yield, and milk fat and protein production when compared to non-fat supplemented diet. We expect that the C16:0-enriched fat supplement, compared with the control treatment, will increase milk fat output while having no negative effect on milk protein concentration. We anticipate that the supplement will also mitigate a dietary-induced milk fat depression challenge, either by maintaining pre-challenge milk fat yield or lessening the severity of the drop in milk fat content and yield. Results from the proposed study will provide timely information both to farmers and nutritionists for the formulation of diets to maximize milk composition, thereby increasing revenue.
A team of veterinarians, animal scientists and extension educators from Michigan State University are completing a multi-year research study looking at control and prevention of Johne’s Disease (JD) in cattle herds. Over the course of the past 8 years Michigan dairy and beef operations have been a part of a multi-state research project tackling one of the most prevalent animal health issues affecting cattle. Through disease testing and the establishment of proper management protocols, the herds involved in the study were able to effectively manage and reduce the presence of JD.

The Michigan Johne’s Disease Control Demonstration Project is a cooperative program between MSU College of Veterinary Medicine, Michigan Department of Agriculture (MDA), and the United States Department of Agriculture (USDA). This project was part of the larger National Johne’s Disease Control Demonstration Project. The objective of the project was to demonstrate and investigate management factors that are effective in controlling JD. The project goals were to:

- evaluate the effectiveness of Johne’s disease control strategies.
- develop new knowledge about Johne’s disease through field research.
- promote the Michigan Voluntary Johne’s Disease Control Program.
- develop Johne’s disease education resources.

Eight Michigan dairy farms and one beef operation were enrolled in the project. The enrolled herds represented a variety of management systems. Initially, a herd risk assessment was conducted to identify areas in the operation where JD might be transmitted. Subsequently, a JD control program was developed for each individual herd. This plan was developed in cooperation with the herd owner/management, their herd veterinarian, and other appropriate personnel such as MSU Extension Livestock Educators, nutritionists, USDA veterinarians, and veterinarians from MSU. The prevalence of JD in the respective herds was tracked annually through repeated testing. Each herd’s control program was reviewed annually and updated as necessary. Farms participated in the program for 4 to 7 years. Information gathered from this long-term interaction was then incorporated into research and educational efforts.

Several field-based research projects were conducted to develop new knowledge on the control of JD. Results of these projects have been reported at national meetings and published in peer-reviewed publications. General themes for these projects have included:

- Risks and importance of calves shedding *Mycobacterium paratuberculosis* in maternity/close-up facilities
- Development of new management tools to help control Johne’s disease
- Evaluation of different testing strategies
- Utilization of environmental sampling to determine herd prevalence of Johne’s disease in Michigan

Educational objectives were also key to the success of this project. Information from this project has been incorporated into MSU Extension meetings and field days, MSU Extension publications, including the Michigan Dairy Review and the Cattle Call, and veterinary training programs. The project, along with the USDA-sponsored Johne’s Disease Integrated Project (JDIP), led the organization and development of the first annual “New Horizons in Johne’s Disease Control” workshop in April 2008. This industry-focused outreach meeting attracted industry leaders from around the Great Lakes region.

The Michigan Johne’s Control Demonstration Project has made an impact on the future of both the dairy and beef industry. The program has and will continue to educate producers on management decisions that benefit their businesses and promote cattle well-being.

A comprehensive summary of the research and peer-reviewed publications can be found online at http://cvm.msu.edu/johnes, click on “Demo Project”. It is also available by request by contacting Dr. Dan Grooms at 517-432-1494, or groomsd@cvm.msu.edu.
Cash Rents for Farm Land Need a Safety Valve

Dennis Stein, Extension Farm Management Educator

Business Management

Michigan State University Land Value and Rental rate surveys show that average farm land rental rates continue to increase. Some of the rent increases are a function of competition: as farms are getting larger, some are willing to work on smaller margins spread over more acres. Other farms are willing to pay greater and greater land rents as crop sale prices increase.

Chances are that some landlords will be pushing for higher land rents, which makes it more important for farmers to consider the use of safety valve rental agreements to counter the higher risk levels in farming since the spike in crop prices of 2008. With current crop sales prices reaching higher levels, it is expected that input and overhead costs also will increase, using up some of the wider profit margins. Livestock producers need to secure the land base that is vital for the production of feed and forages along with the opportunity for the spreading of manure, a valued resource of livestock operations. Understanding the value of an acre of forages like alfalfa, on a real basis to the farm, can help some dairy farmers better compete with cash crop farmers eager to take over their rented land. Dairy farmers must look beyond what they have been able to rent land for in the past and consider what a crop’s value is to the dairy when setting rents.

We are seeing that very good lands continue to command higher rents, while the poor, low productivity lands stay the same. Renters are looking for land that has the potential to take advantage of new technologies in seed selection and vigor, tillage, fertilization, and weed or pest control. The best land has corn yields well above 150 bushels per acre, has good soil structure, is well drained with a newer tile drainage system, and has well-balanced soil fertility already established. Good crop rotation practices help to maintain the soil’s health and productivity for future crops.

Rents generally are increasing with some of the move being supported by higher grain prices. Because of the continued volatility in the grain markets, farmers can and should consider alternative types of rental agreements, such as variable rate, flexible rent, or shares to reduce some of the risks.

Cash Rental Price Hikes
Cash rents have trended upward in the last couple of years (Table 1). Michigan State University Extension (MSUE) and USDA National Agricultural Statistics Service (NASS) surveys show that the base rental rates range from $50 to $160 per acre. This suggests that in some locations the rental rate is still in the $30 per acre range, while in other parts of the state, it is not uncommon to see rents in the +$200 per acre range.

<table>
<thead>
<tr>
<th>MSU Farm Land Values and Rental Survey</th>
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<tbody>
<tr>
<td>Land Prices, per acre</td>
</tr>
<tr>
<td>Tiled</td>
</tr>
<tr>
<td>2007</td>
</tr>
<tr>
<td>2008</td>
</tr>
<tr>
<td>2009</td>
</tr>
</tbody>
</table>

Flex Rent
Converting to a flex rent is a way to share the risks and rewards. Your formula can promise the base cash rent price, which is often paid in advance, with a possible bonus at harvest, which is based on the gross value (yield times price) of the crop. Flex rent landlords may receive much higher rents, possibly better than some of the highest cash rents in the area. In the case of a revenue disaster, the renter is obligated to pay only the base cash rate.

The comfort level of accepting risk tends to exert impact on the flex rent decision, as some landlords prefer guaranteed, set cash rent. The preference for cash rent is not uncommon, as landowners look to eliminate uncertainty and risk.

Fixed Bushel Rent
A fixed bushel agreement with landlords is an alternative to the share crop arrangement. The rent payment is a set number of bushels of
Rents for Farm Land...  

Continued from Page 11  
grain per acre to the landlord (for example, a corn rent might be 40 bushels of corn per acre). The bushel rent is delivered to the local elevator in the landlord's name, which means the landowner has the opportunity and responsibility to market the grain.

When the corn sale price is high, rental income to the landowner increases; in lower price years, rental income goes down. The marketing ability of the landowner could significantly affect eventual income.

Multiple Choice Flex Leases  
Some flex agreements offer a fixed price per bushel multiplied by the average corn yield for that field (for example, $1 times the average yield -- 150 bushels per acre in the Saginaw Valley of Michigan -- produces a cash rent of $150 per acre).

Flex leases also can be based on crop prices only. For example, the lease payment could be based on the price of corn in the Chicago futures market measured on the same day every month for a set number of months.

If the average corn price is $3 per bushel, the farmer pays $100 per acre in cash rent; $4 per bushel, the cash rent is $150 per acre; $5 per bushel, produces a cash rent of $200 per acre. Be clear on when the crop price is set, so there is no confusion. In this formula a yield factor may need to apply to cover a disaster crop yield.

Another common type of variable cash rent sets a minimum rent with a bonus payment at certain production or price benchmarks. Those arrangements have a good chance to pay out this year, because production appears to set record highs in many parts of the state and crop prices have increased significantly since July.

If trends continue, the price index that sets the rent for 2011 will likely be higher than the prices that would have set the rent for 2010. A year ago, crop prices were not as high as they are now, which may have resulted in slightly conservative rents.

To understand and calculate the variables in a flex lease or see sample flex rent leases, go to the web site: http://www.msu.edu/user/steind; click on “Land Rent and Purchase Information”. You also can find simple crop budget templates to help in calculating and estimating a reasonable land rental value and keep your crop farming operations profitable. In addition, you can find a simple landlord check list and worksheet to cover some of the bases before going out to meet with your landlord.

For more information, email author at steind@anr.msu.edu. Other useful sources include Michigan State University Department of Agricultural, Food, and Resource Economics, Reports No. 634, 636 and 638 by Eric Wittenberg and Stephen Harsh.
Sustainable Agriculture, Social Responsibility & Dairy Farming*

Vera Bitsch  
Dept. of Agricultural, Food & Resource Economics

Sustainable agriculture has been discussed a lot during this last decade; so has corporate social responsibility (CSR) in the corporate world. The concepts of sustainability and social responsibility often are used interchangeably, although some authors associate different approaches with each. Also, sustainability is used as a potential justification of the need for CSR (see Porter and Kramer, 2006).

Meaning of Sustainable Agriculture  
The Committee on Twenty-First Century Systems Agriculture (2010) defines sustainable agriculture as progress with respect to four goals:  
1. producing enough to satisfy human needs  
2. enhancing environmental quality and protecting the natural resource base  
3. being profitable  
4. increasing the quality of life for farmers, farm workers, and society as a whole.

Accordingly, sustainability is not an end state, but continuous striving for a wide range of improvements to the current state. While some of these improvements may support each other, others will involve trade-offs. To underline this multi-dimensional view, sustainability is framed along the triple bottom line of economic, social, and environmental performance or, in other words, profit, people, and planet.

Similarly, CSR is a concept where businesses take responsibility for their impacts on the environment and the society, in which they are embedded, beyond their economic impacts. A large number of organizations have emerged that purport to measure CSR performance in the corporate world. However, as Porter and Kramer (2006) pointed out, many ratings are neither consistently defined and measured, nor reliable or verifiable. As CSR has reached the agri-food sector, this situation is now impacting the food supply chain from farms through processing to the retail level (Genier, Stamp, and Pfitzer, 2008).

Martin (2002) suggested that firms, or in our case, farms, can engage with sustainability issues on different levels. Acknowledging the civil foundations of the society they are embedded in, most firms will choose to comply with laws and regulations. An additional step in compliance is the acceptance of norms and customs, as expected by the wider society. Innovations and sustainable development are more likely to occur beyond the compliance levels, at the frontier of production.

Martin distinguishes between the strategic frontier and the structural frontier. At the strategic frontier, sustainability objectives are complementary, meaning an increase in social and environmental sustainability contributes also to economic goals. Once more and more farms operate at the strategic frontier, it is not enough to become more efficient and trade-offs will set in. At the structural frontier, sustainability objectives are competing with each other, meaning an increase in social or environmental sustainability results in reduced economic performance. Therefore, farms and farms will need to make difficult choices, where to position themselves.

Sustainability and Profitability  
To economically survive as a private business, farmers have to make sure that their enterprise stays profitable in the long term. Similarly, on a dairy farm, tending to cows and ensuring their health and well-being is part of good agricultural practice for most farmers.

In addition, for many farmers taking care of the land, ensuring environmentally sound practices, and preventing wastefulness in the use of resources, such as fossil fuels, have been part of their farm management ritual since the beginning.

For others, becoming good stewards of the environment and paying attention to the welfare of farm animals has become another requirement in how they go about farming, in recent years. There are the constant demands of animal care, the seasonal peaks of crop planting and harvesting to manage, family to take care of, plus other community responsibilities requiring attention. So how would farmers be able to focus also on the social aspects of sustainable production and responsibility in a broader sense?

While prominent in Europe, the social aspects of sustainability have
long taken a back seat in the U.S. debate. However, this is changing. More and more civil movements are including the term “fair” in their description of a sustainable food supply. Large food retailers, such as SYSCO, have introduced codes of ethics for their suppliers; others, such as Wal-Mart, are experimenting with such requirements and developing reporting guidelines.

**Sustainability & Farm Management**

Social sustainability often is broadly defined to include community impacts, general human rights, social justice, and labor rights and treatment (Bitsch, 2010).

For mid-size and larger dairy operations, the labor management aspects of social sustainability will be a key issue. Beyond the basics of a thorough knowledge of and compliance with all applicable laws and regulations, what will be the benchmarks of sustainable labor management? The answer is, we do not know, yet. But farm owners and their employees need to get involved in that discussion and not leave the decision to advocacy groups, retailers, and consumers alone.

Currently, different measurement, standardization, and certification initiatives for labor and human resource management are underway. An example in the fruit and vegetable supply chain is the Stewardship Index for Specialty Crops (SISC), developing sustainability benchmarks with multi-stakeholder involvement (http://www.stewardshipindex.org/). This author is currently serving as a coordinator for the SISC human resource metrics workgroup. Although a multiplicity of engaged groups are participating in the workgroup, more employee and more farmer involvement would be beneficial to developing a balanced measurement approach.

National initiatives like the SISC often lack sufficient participation from the Midwest and Northeast. Agriculture is structured and organized differently in these states than in the main specialty crop producing states, California and Florida. This presents different challenges and opportunities.

**Sustainability, Responsibility and Labor Issues**

Here are some elements that the human resource workgroup has discussed:

- wages and benefits,
- health and safety,
- stable employment and retention,
- compliance with local laws and international conventions, and,
- employee participation in improving workplace conditions.

These elements can be addressed in many different ways and different stakeholder groups interpret them differently. Compared with environmental impacts, which are often quantifiable, labor sustainability and broader social impacts are more difficult to measure. In addition, research on the sustainability impacts of agricultural labor management practices is limited.

Here are some examples of issues deliberated by the workgroup. 1) Should wages and benefits be averaged and reported across all employees or for the lowest paid group? 2) Should a living wage calculation be included as a baseline? 3) Does stable employment mean that the same employees who work on the farm this year have worked for it the previous year or the previous 3 or 5 years? 4) Does employee participation necessarily require union involvement? In addition to these content questions, there are procedural issues to be resolved. When measuring social sustainability, will the farmers report on the metrics based on farm records or will an employee survey or other inputs be needed? Is an external verification of the farm records or farmers’ reporting required?

**What It Means to Dairy Management**

Although the example is from specialty crops production, it matters to dairy farmers. Once a measurement system has been established in one area of agricultural production, processors and retailers will ask their suppliers to adopt it and they will want to apply it broadly. Whether it will be the SISC or a different initiative, the first system to be broadly adopted will set benchmarks for agriculture as a whole. Therefore, where these decisions come out will matter to the sustainability and long-term survival of any farm in America that hires employees.

Farm employers and employees should start thinking about what they believe socially sustainable production, and in particular sustainable labor management, should look like. The more they discuss it with each other, with processors, buyers, consumers, and other stakeholders in the agri-food system, the more likely they are to have a voice in how it will be defined. In addition, the more farmers and farm employees are involved in these decisions, the better for a sustainable agricultural production.

View complete list of references in the web version at http://www.msu.edu/user/mdr/

* An earlier version of this article has been published in the Vegetable Grower News, 2010, October issue.
Several factors hang over the US milk market as 2010 ended: one billion pounds of cheese, booming exports, and expensive feed grain. The first factor reflects a large inventory of cheese that accumulated in the past couple of years with the total stocks exceeding one billion pounds today. In recent years the average value of total natural cheese stocks has been about 800 million pounds so the current value is about 25% above average.

The last time total cheese stocks were this large was back in the massive surpluses of the early 1980’s. At least three things are different now than back then. First, cheese consumption and population have grown so that this surplus is not as large in relative terms. Second, the government held about 70 percent of the cheese stocks three decades ago while it holds less than one percent today. Finally, US dairy exports are much larger than that period with the US perhaps being the low-cost dairy producer today. Still, one billion pounds is a lot of cheese.

Figure 1 below displays the value of US dairy exports monthly from January 2001 through September 2010. Since units are in $1,000 increments, the peak values on the graph are approximately $350 million. The steady increase in values that came to an abrupt end in the economic crisis of 2008 may be back on track as 2010 values are similar to those from 2008. Exports which set records in 2008 may set new record levels in 2010. Through the first nine months of 2010, 280 lb million of cheese were exported. The previous record for an entire year was 290 lb million, so that record will almost certainly fall. Consider that even at the current export rate it would take quite some time to export the existing US cheese surplus.

With holiday orders essentially filled, the Class III price for the coming months weakened recently. The rise of corn prices above $5/bu reflects tight world supplies and volatility in related markets (i.e., oil).

These corn prices are not the shock that they were a couple of years ago but they mean that it is costly to be caught short on feed. 2009 left many dairy farms across the US with little margin of error financially.

In fact, historically we probably would have expected many more herds to liquidate in 2009. However, these seem to be unusual times in the credit market and many herds that might otherwise have been considered up-side down on their loans were not foreclosed.
Thumb H$_2$O Project: Part 1, Importance of Water

Craig Thomas
Extension Dairy Educator, Michigan

Dairy producers spend a great deal of time, effort and money ensuring that dairy cow rations are fine-tuned to the “nth” degree. A few milligrams of this, a few parts per million of that, all to ensure that no stone goes unturned in the quest for the perfect ration. Unfortunately, in the process the most important nutrient of all often goes barely noticed and only lightly considered. What nutrient? Water.

Recall that water weighs 8.35 lb/gal. Even though we normally don’t think in such terms, water by weight, is the largest component of the daily ration for all classes of dairy animals (see Table 1 below). This is particularly true of the milking cow. If you consider her total ration, it will contain somewhere around 50-60 lb of dry matter (DM) per day in the form of what we normally think of as “ration” (carbohydrates, proteins, fats, vitamins, and minerals).

But, just as importantly or even more, the ration also consists of about 42 gallons of drinking water. When you convert the total water consumption to weight the milking cow is consuming around 420 lb of water per day (42 gal. drinking water X 8.35 lb/gal + 120 lb as fed ration X 55% water = 350.7 lb drinking water + 66.0 lb water from feed = 416.7 lb total water intake per day). That means that the dry matter intake we usually focus on accounts for only about 12% of the cow’s total nutrient intake; while water accounts for about 88%. In fact, the water requirement of a lactating dairy cow on a per pound of body weight basis is the highest of any land-based mammal (10).

<table>
<thead>
<tr>
<th>Animals</th>
<th>Water Intake (gal/head/d)$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calves</td>
<td>6-10</td>
</tr>
<tr>
<td>Heifers</td>
<td>10-15</td>
</tr>
<tr>
<td>Dry Cows</td>
<td>20-30</td>
</tr>
<tr>
<td>Milking Cows</td>
<td>35-50</td>
</tr>
</tbody>
</table>

$^1$During periods of heat stress (hot weather) drinking water intake can easily double.

How Much Attention Does Drinking Water Receive on Your Farm?
Drinking water should receive your attention in two regards: 1) water quality (Is your water fit to drink based on its chemical and mineral composition?”), and, 2) water delivery (Are you providing an ample supply of good quality, fresh, clean water to your cattle?).

According to Michigan State University’s Dr. David Beede (1, 2) the most important constituents to evaluate in regards to water quality are: total dissolved solids (TDS), sulfate (SO$_4$), chloride (Cl), iron (Fe), and nitrate-nitrogen (NO$_3$-N).

Total dissolved solids measures the sum of all inorganic matter dissolved in water (9), and is an indicator of the salinity of water (1, 2). Experts usually recommend that TDS levels above 1,000 ppm should be investigated further and potentially be corrected to prevent and/or correct problems like diarrhea and dehydration (4).

If the combined sulfate + chloride content of dairy cattle drinking water is greater than 500 ppm, further testing and evaluation are needed (1, 2). At higher than recommended levels, these minerals may lead to health and production problems. For example, some have observed that high levels of sulfate + chloride cause diarrhea and dehydration in calves, plus increased retained placentas and displaced abomasums in fresh cows (1).

Nitrate-nitrogen levels in cattle drinking water should not exceed 20 ppm (1, 2). High nitrate-nitrogen levels have been associated with long-term reproductive problems in dairy cows, such as higher services per conception, lower first service conception rates, and longer calving intervals (5).

If dairy cattle drinking water contains over 0.3 ppm iron cows may suffer from iron toxicity. Iron in drinking water is in the ferrous state (Fe$^{2+}$) and is soluble, odorless, and easily absorbed in the animal’s gut. However, most dairy rations provide more than adequate iron which is in the less absorbable ferric state (Fe$^{3+}$).

This form of iron is converted in the animal’s gut to ferrous iron (Fe$^{2+}$) and absorbed for use by the ani-
mal’s tissues. When drinking water contains excess ferrous iron (Fe$^{2+}$) this may lead to excess ferric iron (Fe$^{3+}$) in the animal’s tissues causing “oxidative stress” where cell membranes lose integrity. This can lead to increased retained placentas, mastitis, metritis, and a general compromising of the animal’s immune system (2, 4). Problems related to depressed immune function are more likely to show up in transition and fresh cows, reducing peak milk yield.

High iron in drinking water also may depress water intake due to palatability issues although this is not well understood (4). Excess soluble iron (Fe$^{3+}$) in the animal’s gut also reduces absorption of other key minerals like zinc and copper (4). In addition to the problems these various water constituents may cause to cattle health and performance they also may contribute to problems with your farm’s water delivery system (e.g., pumps and pipes) and the effectiveness of pipeline cleaning and sanitizing.

This could in turn lead to increased bacteria counts and buildup within water pipes restricting water flow. For example, high iron levels in water encourage the growth of iron bacteria that plug pipes and coat pumps and other water system components with a slick, rust-colored slime.

How Should You Address Water Quality Issues?

First, you should test your cattle’s drinking water on a quarterly basis for TDS, sulfate, chloride, iron, and nitrate-nitrogen (4). Second, you should check to make sure your dairy facility’s water delivery system meets guidelines for number of waterers, space, location, and cleanliness (details are in Part 3 of this series, to be published later).

A 1-page fact sheet (Three Common Drinking Water Problems on Dairy Farms) providing clues on these issues along with guidelines for taking water samples for analysis and potential certified laboratories that analyze water samples is available by e-mailing your request to thomas.asc@msu.edu or download it from the MSU Extension Dairy Team website (dairyteam.msu.edu -> Nutrition -> Water -> Three Common Drinking Water Problems on Dairy Farms).

Thumb H$_2$O Project

To examine these important water issues even further, I conducted a project called the Thumb H$_2$O Project. This project involved 37 dairy farms in Huron, Sanilac, St. Clair, and Tuscola Counties.

Milking cow drinking water was sampled on each farm and then analyzed using the services of a certified commercial laboratory** (7). The water analysis test used is called the “Livestock Suitability Test” and included sodium (Na), calcium (Ca), magnesium (Mg), pH, nitrate-nitrogen (NO$_3$-N), sulfate (SO$_4$), conductivity, total dissolved solids (TDS), iron (Fe), chloride (Cl), and copper (Cu). In addition, data were collected on these farms from their milking parlors and milking cow housing facilities concerning number of waterers, space, location, and cleanliness.

Water quality issues were found on 27.0% of the farms sampled. Table 2 breaks down these potential water quality issues into five categories. High total dissolved solids were found on 13.5% of farms with TDS levels as high as 3,770 ppm. Sulfate + chloride problems were found on 8.1% of farms with sulfate + chloride levels as high as 2,016 ppm. High iron was found on 10.8% of farms, with levels as high as 0.81 ppm.

### Table 2: Potential drinking water quality issues measured on the 37 farms during the Thumb H$_2$O Project (‘ppm = parts per million).**

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dissolved Solids (TDS), ppm$^1$</td>
<td>609.8</td>
<td>600.8</td>
<td>3,770</td>
<td>114</td>
</tr>
<tr>
<td>Sulfate (SO$_4$) + Chloride (Cl), ppm$^1$</td>
<td>237.1</td>
<td>392.5</td>
<td>2,016</td>
<td>6</td>
</tr>
<tr>
<td>Nitrate-nitrogen (NO$_3$-N), ppm$^1$</td>
<td>0.1</td>
<td>0.3</td>
<td>1.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Iron (Fe), ppm$^1$</td>
<td>0.12</td>
<td>0.17</td>
<td>0.81</td>
<td>0.00</td>
</tr>
<tr>
<td>pH</td>
<td>7.66</td>
<td>0.45</td>
<td>9.48</td>
<td>7.01</td>
</tr>
</tbody>
</table>

None of the farms’ water samples showed elevated levels of nitrate-nitrogen. The highest nitrate-nitrogen level found was only 1.8 ppm. One farm had a high pH (9.48). This was included as a potential water quality problem because EPA water quality guidelines for human consumption suggest that a pH of greater than 8.5 can result in water having a bitter taste, reduce the germicidal effectiveness of chlorine, and is corrosive to pipes. The effect of drinking water pH on animal performance and health has not been well researched.

Continued on page 23
Effect of Exit Alley Blocking Incidences on the Accessibility of the Automatic Milking System

Janice Siegford & Jacquelyn Jacobs  
Dept. of Animal Science

Automatic milking systems, also called robotic milking machines, offer the potential to milk cows more frequently when compared with a conventional parlor system that must rely on hired or family labor. More frequent milking may in turn generate more milk when paired with consistent milking intervals. Robotic milkers also are claimed to reduce the labor needed to milk a herd, which can free up time for other farm management tasks or family and recreational activities. This claim makes robotic milking attractive for farmers looking for relief from a demanding milking routine or hoping to spend less money on labor.

Of course, in order for a robotic milker to achieve more milkings (i.e. and potentially more milk) and reduce labor, the milker must function optimally and efficiently. All robotic milkers rely on cows acting as individuals apart from their herdmates and voluntarily entering the milking stall without encouragement from the farmer. As a result, understanding the interaction among the cows and with their environment is critical to the success of the system.

To accommodate robotic milkers, barns must be built or retrofitted to encourage efficient cow traffic through the robot and to promote normal lying and feeding behavior. A large open area (20 to 24 ft.) at the entrance to the milking stall is recommended in order to give low-ranking cows the ability to avoid dominant cows when they need to be milked. An exit alley with a one-way gate 6ft. or more from the milking stall is also recommended to encourage cows to move away from the robot once they have been milked (1).

When the new free stall barn was built at the Kellogg Biological Station Pasture Dairy Research and Education Center (PDREC), the design included the recommended exit alley and large open area near each robot. However, while collecting data for other projects at PDREC, we noticed that some cows seemed to block the end of the exit alley leading away from the milking stall. These cows would stand with their heads facing the end of the exit alley and appeared to keep cows that had finished milking from exiting the alley (Figure 1 below). Occasionally, this blocking seemed to result in a cow traffic jam, sometimes forcing the milker to stop accepting new cows for milking and causing other cows to wait in Cows normally have access to the milking stall 22 hr/day, with 2 hr of down time dedicated to cleaning the robot. If cows blocking the exit cause the milker to be available for less than the expected 22 hr, cows in herds that are attempting to use the robots at their full capacity could be milked less frequently than would be ideal, for their stage of lactation, production level, or desire to be milked. Ultimately, this could mean that herd milk production will not reach its full potential.

We wondered how often blocking might be occurring, how much of the robot’s time was wasted, whether cows that blocked regularly shared similar characteristics, and whether cows that were blocked were similar to each other but different from blocking cows.
Figure 2: A cow (white arrow) that is blocking the exit to the robot. In this particular case, two cows are stuck in the exit alley, one cow (which has finished milking) is trying to exit the milking stall, and one cow is waiting to access the robot, and two cows are in the entrance alley. Thus, a single cow has effectively prevented three cows from milking and three cows from exiting and moving out of the robot area.

Figure 3: A cow that has hesitated at the end of the exit alley even though no other cows are nearby. We have called these “events hesitations”.

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Prior to our work, little research had examined the behavior of cows in the exit area of robotic milkers. As mentioned earlier, an exit alley with a one-way gate 6ft. or more from the milking stall has been recommended in barns with robotic milkers to allow subordinate cows to move around easily near the exit area (1).

As part of studies examining several types of cow traffic in robotic milking systems, Stefanowska and colleagues (2,3) found indications that exit speed was slowed when other cows were in the exit area. The authors also found that successful milking visits led to quicker exits from the milking stall compared with unsuccessful milking visits. After an unsuccessful visit, 50% of the cows in their study revisited the milker within 30 minutes. Cows in that study also exited the milking stall more quickly if they were given a larger portion of feed concentrate.

In our study, the effects of blocking behavior in a passage (exit alley) between the robotic milker and the holding area were examined. Eighty-four Holstein cows of various parities, stages of lactation, and days in milk (DIM) were divided between 2 pens. Presence or absence of horns, horn positioning and body weight were noted. Cow locations and behaviors in the robotic milker entrance, exit areas, and the adjacent holding area were recorded continuously for 14 days.
“There is enough evidence to suggest that a delicate balance of motivation to enter the robotic milker must be achieved; voluntary approach to the robotic milker is necessary to decrease farm labor, but unproductive visits should be avoided to help promote an efficient system.”

In our study, unsuccessful milking visits resulted in cows hesitating more often when leaving the milking stall (P<0.05); but unsuccessful cows were no more likely to hesitate leaving the exit alley than cows that had successful milking visits. In addition, cows receiving the ‘no-milking’ decision were more likely to immediately circle and re-enter the robotic milker (P<0.001).

Cows exiting the robotic milker were significantly more likely to hesitate (P<0.05) when another cow was located directly at the exit alley gate. However, exiting cows were not more likely to hesitate in the exit alley if the other cow was located elsewhere in the area adjacent to the exit gates (holding area). This suggests that intentional ‘blocking’ of the exit alley may encourage hesitation of the exiting cow, but the presence of a cow in the holding area in general does not seem to slow exiting cows.

In addition, days in milk and presence of horns was a predictor for hesitation in the exit alley (P<0.05). More specifically, cows in early lactation with no horns (P<0.001), cows in mid lactation with only a left horn (P<0.05), and all late lactation cows (P<0.05) were more likely to hesitate compared with other combinations of horns and stage of lactation. Cows late in lactation may have less motivation to exit than cows in other stages. Alternatively, cows with no horns or only a left horn may be more subordinate to other cows, and therefore easier to block.

There is enough evidence to suggest that a delicate balance of motivation to enter the robotic milker must be achieved; voluntary approach to the robotic milker is necessary to decrease farm labor, but unnecessary visits should be avoided to help promote an efficient system. It should be noted that these findings are specific to the facility design and cow numbers at the PDREC and may not be able to be generalized to all barns with robotic milkers. Anecdotal reports of cows revisiting robots and blocking and hesitating in exit areas are common, but rarely have been published in the scientific literature.

To determine how universal the problem is, more research should be done using different facility designs. In situations similar to those at PDREC, there may be several solutions to the problem. The first might be to provide feed in external concentrate feeders located in the feed alley of each pen, to encourage the cows to move out of the exit alley and holding areas. Exit alley design also could be improved by using solid, curved sides rather than the straight gated ‘V’ shape currently in use at PDREC. The results of our study can be viewed as a first step into the investigation of efficient cow traffic flow in and around the exit areas of robotic milkers. We are now analyzing additional data to determine if blocking events reduce the number of possible milkings a robot can achieve each day. If this is the case, the production potential of a robotic milking herd could be decreased, especially when robots are being used at full capacity.

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References
Don’t Give Up Your Eyesight

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One of the most common injuries in the workplace is an eye injury. It is estimated that over 2,000 people in the US injure their eyes at work each day. The majority of these injuries result from small particles or slivers impacting or abrading the eye (See http://www.cdc.gov/niosh/topics/eye/). Of these injuries, 90% could have been reduced in severity or avoided altogether through the use of proper eye protection (Also see, http://www.preventblindness.org/safety/worksafe.html).

While we often take our eyesight for granted, in reality it is one of our most precious assets. (Try this experiment today: cover one eye with a gauze and a tape and attempt to work as you would normally for 30 or 40 minutes. It is a guaranteed ‘eye opener’). Yet many farm managers do not encourage or mandate the use of eye protection as a part of daily employment practices.

There are several reasons for this no doubt, some reasonable some selfish. Perhaps the time has come to think about adding eye protection as part of your own work wear and then encourage others on the farm to follow. It is a relatively simple and inexpensive precaution compared with the potential for loss. But the question remains, what types of eye protection are appropriate for agricultural work? Eye protection devices come in different forms such as goggles, face shields, and safety glasses. Each is unique and meets different requirements.

Safety Glasses
The most common cause of eye injury results from flying debris. In agricultural use, eye protection would be useful in almost any situation, from mixing feed to working around harvesting equipment or working in the shop. The simplest first precaution for this is a pair of safety glasses. Safety glasses come in a variety of sizes, shapes, colors and prices. The objective of safety glasses in particular is to stop or deflect those particles before they can impact the eye. Safety eyewear should be marked by the manufacturer with “ANSI Z87.” This indicates that the eyewear meets the requirements set by the National Standards Institute for impact resistance.

Prescription eyeglass wearers should be sure to either use safety glasses which incorporate prescription lenses or safety eyewear that fit over their own glasses, (See http://ohioline.osu.edu/atts/PDF-English/Eye-Protection.pdf). Though most modern prescription eyewear do have impact resistant lenses they are not constructed appropriately to meet the ANSI standards for impact as a unit and can fail if struck by debris.

Safety glasses provide forward impact protection, however they may not provide lateral protection. If lateral protection is required, side shields may be required. These can come as part of the safety glasses or they can be added. When adding or selecting glasses with side shields, be sure they do not interfere with peripheral vision. Safety glasses that are designed to be worn over prescription glasses may be obtained with or without side shields.

Goggles
Goggles are designed to fit snugly around the eyes. They provide protection from all angles and can be a relatively cost-effective way to add protection to your eyes. Keep in mind that some goggles are ANSI Z87 rated and some are not. Be sure to determine if the pair you are considering meet this standard. Many goggles are designed to be worn over prescription eyewear. Many too are coated with an anti-fog solution.

Goggles are available in vented and unvented or splash variations. The unvented or splash variations are designed to be used to protect
against liquids or chemical vapors (For more details, visit http://www.farmsafety.ca/factsheets/tailgate-e/eye-prot-tg.pdf). Be sure that the goggles you choose meet the needs of that particular work situation. Some pesticide or chemical use situations call for a full face respirator for complete protection.

**Face Shields**

Face shields are intended to supplement safety glasses or goggles. These protective devices protect against heat, glare, splashing, dust and flying debris. They are considered secondary protection and are not usually ANSI Z87 certified against impact (Also see, http://www.abe.psu.edu/extension/factsheets/e/E39.pdf). A face shield should always be used when grinding or striking metal with a hammer.

“While we often take our eyesight for granted, in reality it is one of our most precious assets... Many farm managers do not encourage or mandate the use of eye protection as a part of daily employment practices.”

**Special Considerations**

Eye protection is also important when arc welding. Because the eye can be permanently damaged by the brilliance of the welding arc, the eye should always be protected when welding. In most cases a welding helmet is best to use because it combines face protection, eye protection and head protection in one package.

It is recommended that the welding mask be fitted with a number “10” lens when welding at 200 amperes or less. Check your welder’s manual for more information on the lens requirements for the type of welding you are doing. (Also see, http://www.farmsafety.ca/factsheets/tailgate-e/eye-prot-tg.pdf).

Finally, ultraviolet radiation has not only been shown as a causative factor in skin cancer it also has been shown to affect the eye. To help prevent such damage sunglasses or appropriately tinted safety glasses should be worn when working outdoors. The current US standard for sun glasses is ANSI Z80.3-2001, which includes three transmittance categories. According to the ANSI Z80.3-2001 standard, the lens should have a UVB (280 to 315 nm) transmittance of no more than 1% and a UVA (315 to 380 nm) transmittance of no more than 0.3 times the visual light transmittance (http://en.wikipedia.org/wiki/Sunglasses). When purchasing sun glasses or tinted safety glasses be sure they are marked as meeting the ANZI standard Z80.

References

- Workplace Safety and Health topics, Centers for Disease Control website, http://www.cdc.gov/niosh/topics/eye/.
Thumb H₂O Project: Part 1*…

Continued from Page 16

These data clearly indicated that potential water quality issues do exist on nearly one quarter of the farms tested. Every dairy participating in the study was encouraged to perform follow-up water analyses to confirm/deny that the potential water quality issues detected are real and whether water treatment strategies should be sought to correct these problems. MSU Extension encourages all dairy farmers to implement a routine water testing program on their operation and track these analyses over time. Water quality is not something that remains constant, but rather changes as the underlying aquifer changes. Also, some farms on this study sourced cow drinking water from more than one well. Thus, be sure all sources of drinking water for your operation are included in your testing program.

In Part 2 that follows in subsequent issue of MDR, we will discuss what to do if your water analysis indicates your drinking water may have potentially high levels of undesirable constituents.

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** Michigan State University Extension’s mentioning of one laboratory does not constitute recommendation of the laboratory to the exclusion of others.

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7. Midwest Laboratories, Inc. 13611 “B” Street, Omaha, Nebraska 68144-3693; 402-334-7770 (voice); 402-334-9121 (fax); www.midwestlabs.com.


2010 Breakfast…

Continued from page 4

there will be a greater impact with events located near large metropolitan areas, but we also can have significant impact in rural regions where the population is also unconnected with modern farming but may encounter it more often in their daily lives.

It seems that BOTF events provide another mechanism to educate the public. Obviously, part of the attraction is as a family event. Individuals brought their kids (58%) and grand-kids (16%), while 21% brought their friends. But we can also use this effort to learn more about what the public thinks before and after a farm visit, especially from their first visit. We will attempt to address this in a future article as we cover more of our survey results.

We need to keep in mind that our agriculture literacy efforts should involve a dialogue (3,4) with our visitors, not a lecture. Our understanding of what the consumer/public really thinks, wants and why will lead us to better communication about how we manage animals and produce healthy food. Now more than ever we all need to be involved in “telling our story” but not just in supporting media marketing of our products, we need to market ourselves. To do this we need to reconnect with our consumers and the public to rebuild trust in our industry (3,4). Perhaps BOTF along with a number of other industry efforts will help make this happen.

View details of the references in the web version at www.msu.edu/user/mdr/.