

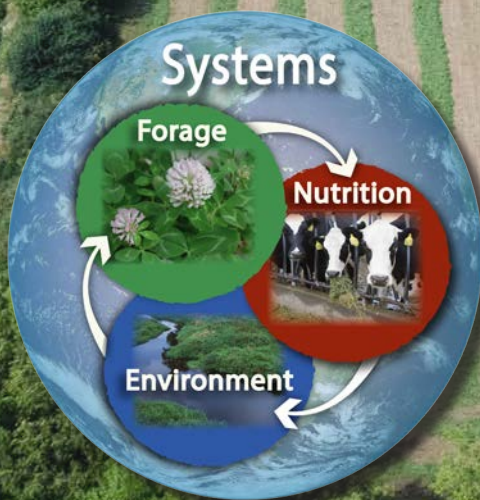


# Year in Review

## U.S. Dairy Forage Research Center

FY 2017, October 2016 through September 2017

*Leading the world in integrated dairy forage systems research.*



U.S. Dairy Forage Research Center  
Madison, Marshfield, and Prairie du Sac, Wisconsin  
United States Department of Agriculture, Agricultural Research Service





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**Leading  
the world in  
integrated dairy  
forage systems  
research.**

**U.S. Dairy  
Forage  
Research  
Center**

Providing dairy industry solutions for food security, environmental sustainability, and economic viability. We build uniquely valuable, science-based research initiatives focused on improving dairy production systems, soil ecology, forage production, forage quality, nutrient management, and ecosystem services.

**Visit the USDFRC Web Site:**

**[www.ars.usda.gov/mwa/madison/dfrc](http://www.ars.usda.gov/mwa/madison/dfrc)**

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# Center Director Foreword

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To our readers:

What a great year we have had here at the USDFRC! Yes, we have certainly had our challenges, but the science and the dedicated people we have all through the Center more than make up for any worries we have about the “business” of ARS. In FY17 we increased our staff with extraordinary scientists in both permanent and temporary scientific support roles. Some of these new faces are introduced later, but suffice to say that I would compare the entire group with any other lab in the world. These are brilliant young scientists and they will make a difference! It will be a joy to watch them make their mark on the dairy and forage industries.

Unfortunately, we also said goodbye to some amazing people in 2017. Bill Jokela, Mark Powell, and Paul Weimer all made extraordinary contributions to the science of dairy. They will be missed! We are also saying goodbye to Lori Bocher who has served a vital role as our Information Specialist for the past 12 years. She, too, will be missed. A special thanks to each of them for their years of dedication to the USDFRC and to ARS.

In 2017, we received a modest increase to our budget. This new funding will provide tremendous opportunity to expand our focus on cover crops and soil ecology. This increase also includes funding for the University of Wisconsin, which will further expand our excellent and on-going collaboration research and outreach opportunities. They are great partners to the USDFRC!

Most importantly, we conducted some amazing science at the USDFRC in FY17! The USDFRC was noticed with impactful papers, new grants, and numerous awards. These results confirm to me that we are doing great work for the dairy and forage industries. It also confirms to me that we are evolving, that we are embracing the value of integration and collaboration, that we are being recognized as leaders, and that we are addressing the complex questions facing our industries. This can all be seen in our new research action plans, in our leadership roles in ARS Grand Challenge and other collaborations, and in our focus on fulfilling our mission: Leading the world in integrated dairy forage systems research.

Lastly, I extend a personal thank you to all of our scientists and our support staff for their hard work and dedication during a very trying year here at the Center. You are all to be commended. Keep up the great work. Thank you also to our industry stakeholders and all of you that support our research programs. We appreciate your support and dedication and look forward to providing you with the information and solutions that you need to make your dairy business successful and sustainable for years to come.

Thanks again and stay tuned! The best is yet to come.

Sincerely,

A handwritten signature in black ink, appearing to read 'Mark Boggess'.

Mark Boggess, Center Director

# Research Accomplishments

The following summaries of research were taken from the 'accomplishments' section of the AD-421 annual reports that the researchers write for each of the five CRIS (Current Research Information System) projects in FY 2017.



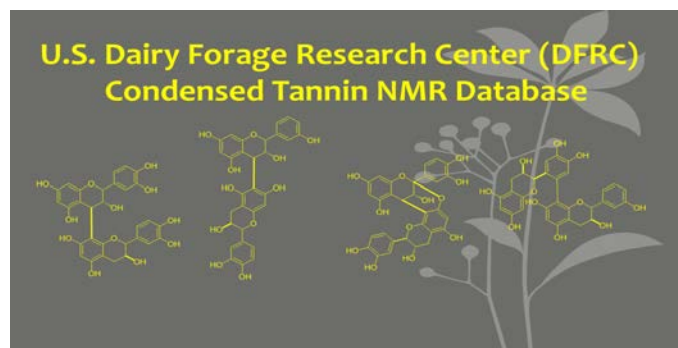
Information from this library is being used to test basic chemical and biochemical relationships between tannins and feedstuff proteins, and to test their effects on microbial populations during the ensiling process and rumen digestion. The library now contains an adequate set of condensed tannin samples to actively investigate these effects, and more samples are being added as research advances.

WAYNE ZELLER

## Completion of comprehensive structural library of purified condensed tannins allows research to advance.

Condensed tannins, natural protein-binding substances found in plants, are being studied for their impact on improving economic and environmental aspects of the on-farm nitrogen cycle. Past research has shown that different tannins impact sectors of the nitrogen cycle to different extents.

In order to evaluate and compare these differences, one must have access to a set of well-characterized condensed tannins in order to draw accurate



conclusions about their influence on nitrogen use, waste production cycles, and volatilization into the atmosphere. USDFRC researchers have succeeded in generating a library of purified condensed tannin samples from forages and other plant materials. The library contains the entire spectrum of composition found in common condensed tannin-containing forages and condensed tannin-containing feed amendments (flavan-3-ol subunit composition, size, and subunit linkages).

## Insertion of a maize gene into alfalfa alters lignin composition.

Improving the digestibility of alfalfa by dairy cattle, which will increase both the economic and environmental sustainability of milk production, is an ongoing research challenge. Compared to alfalfa, grasses have a higher total extent of cell wall degradation and utilization. The general composition of grass lignin is not greatly different from alfalfa composition except for large amounts of a phenolic acid (p-coumarate) linked to grass monolignols. It is thought that the attachment of p-coumarates to lignin could alter its overall structure impacting how the cell wall is digested.

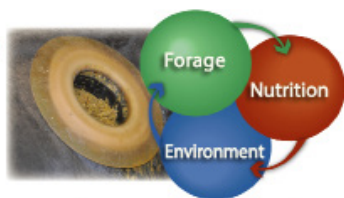
USDFRC Researchers inserted into alfalfa the gene from maize (a grass) that is responsible for the formation of p-coumarate attachment to lignin. Alfalfa stems do not contain p-coumarates normally, but after this genetic transformation, stem cell walls contained levels that were comparable to some cool season grasses (which typically contain significant amounts of p-coumarates but at levels half to one third that of maize). There was a slight shift in lignin composition, but the total lignin did not change.

Even though the genetic transformation increased the p-coumarate content of alfalfa, digestibility by rumen microbes of the transformed alfalfa stems did not change compared to non-transformed control alfalfa. This would suggest that the insertion of the maize gene does alter lignin, but not to a point of over-riding the normal lignification process in alfalfa. Future research will study other methods for improving the digestibility of alfalfa.

RONALD HATFIELD



## UNDERSTANDING RUMEN INTERACTIONS



Determining influence of microbial, feed, and animal factors on efficiency of nutrient utilization and performance in lactating cows.

### New knowledge of hemicellulose fermentations by rumen bacteria will augment rumen fermentation models.

Hemicelluloses are carbohydrates that are the second most abundant components of plant cell walls, but information on which members of the rumen microbial community convert different hemicelluloses to which fermentation products is limited. USDFRC researchers quantified the conversion of 5 different hemicelluloses to different fermentation products by 5 strains of ruminal bacteria, and they used next-generation sequencing to determine the relative importance of these and other bacteria in hemicellulose degradation in mixed cultures from rumen contents that were fed these same hemicellulose substrates.

The data showed that different strains of rumen bacteria exhibit specialization in the use of different types of hemicelluloses from feedstuffs, and that the ability of these strains to carry out these fermentations in complex microbial communities is not predicted by their activity in pure culture. The data, combined with the large amount of microbial community composition data that is emerging from next-generation sequencing of the rumen microbial community, will be useful to nutritionists in modeling the rumen fermentation in animals fed forage-based diets.

PAUL WEIMER

### Study shows that changes in ruminal microbial compositions in vitro do not reflect what happens in the rumen.

In an effort to predict the production potential of individual feedstuffs, in vitro methods using microbes taken from a cow's rumen are widely used to assess the digestibility of feedstuffs and the formation of fermentation products, such as volatile fatty acids (VFA), used by the host animal for energy and for production of milk and other animal

products. Such methods are considered to reflect, with reasonable accuracy, the outcomes that these microbes have on digestion. However, the degree to which the microbial community composition in vitro resembles that in the rumen is unknown, and there is almost no information on how the in vitro community changes over time.

USDFRC researchers attempted to find out by maintaining an in vitro ruminal microbial community over an extended time. They maintained mixed cultures of the ruminal community, fed a mixture of switchgrass and distillers grains, by transfer at 3-4 day intervals over 2.5 years. This long-term cultivation resulted in major, though gradual, changes in bacterial community composition which is in contrast to the relatively steady composition of bacterial communities in the actual rumen. In addition, they noticed a gradual decrease of ~25% of VFA production and a shift towards higher production of the VFA propionate (a less desired fermentation product).

However, parallel enrichment cultures fed a secondary energy source were able to maintain VFA production and retain the VFA acetate (a desired out-



come) as the primary fermentation product, due to a dramatically different bacterial community composition. The data will be useful to scientists seeking to model ruminal fermentation for improved feed efficiency and for potential use of mixed ruminal microbial communities for industrial VFA production, which requires consistent long-term stability of microbial community performance.

PAUL WEIMER

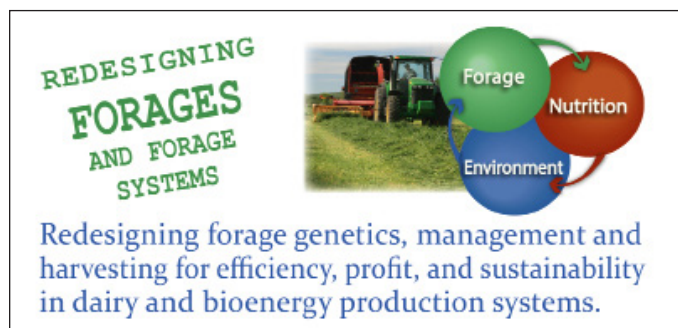
### New on-farm approach for formulating diets supports cow health and performance.

The rumen contains microbes that ferment much of the fiber and carbohydrates which provide nutrients to the cow. Rumination by the cow supplies buffer to the rumen to balance the fermentation, thus preventing the rumen from becoming too acid

and making the cow ill. Rumination is affected by the size and rate of fermentation of feed particles. Imbalances in the types of carbohydrates, how rapidly they ferment, and the particle size of the diet can result in too acid a rumen.

In collaboration with university researchers, a USDFRC researcher used the results of 60 research studies to develop equations that can be used to make diet formulation recommendations about the particle size needed in the diets to maintain healthy rumen conditions under different feeding situations. They are currently working on a user-friendly system, such as an app, for use on the farm. Diet particle size would be measured on farm using a device already available for the purpose. Healthy dairy cows are more productive and efficient. While helping to keep cows healthy through a healthy diet, the new recommendations will also help to make better use of farm resources, with potential for less environmental impact.

MARY BETH HALL



### Useful DNA markers for switchgrass breeding identified and mapped.

USDFRC researchers have identified and mapped several potentially valuable DNA markers to the switchgrass reference genome. These markers are located within key genes in the flowering and lignin pathways and have been linked to critical variation in flowering time and lignin concentration of switchgrass biomass – two crucial traits for increasing the biomass potential of switchgrass. These DNA markers can be easily evaluated and scored on large numbers of individuals in a switchgrass breeding program, allowing switchgrass breeders to evaluate plants for flowering time and lignin concentration without conducting field or laboratory evaluations. These results will aid switchgrass breeders in creating more efficient breeding strategies to speed the rate of development of biomass-type switchgrass varieties.

MICHAEL CASLER



### Research leads to major change in manure management on pasture legumes.

Legumes such as red clover and alfalfa play a critical role in improving pasture quality, and they can increase livestock performance 25 to 50% compared to pastures consisting of only grasses. USDFRC researchers discovered that spreading manure on pastures, a typical practice, reduces forage legume productivity and pasture quality; and the fertilizer value of the manure does not increase pasture productivity as commonly believed. Delaying manure application to pastures until third or fourth year after seeding legumes will significantly improve their contribution to pastures.

GEOFFREY BRINK

### More accurate mating models will accelerate gains in forage legume breeding programs.

Modeling forage legume seed fertility allows forage legume breeders to better manage inbreeding in their breeding programs. USDFRC researchers created a more accurate model for forage legume seed fertility distribution and showed that the shape of this fertility distribution was linked with environmental stress during seed production. This new model will allow forage breeding programs to accelerate gains for biomass yield, an important trait to improve.

HEATHCLIFFE RIDAY

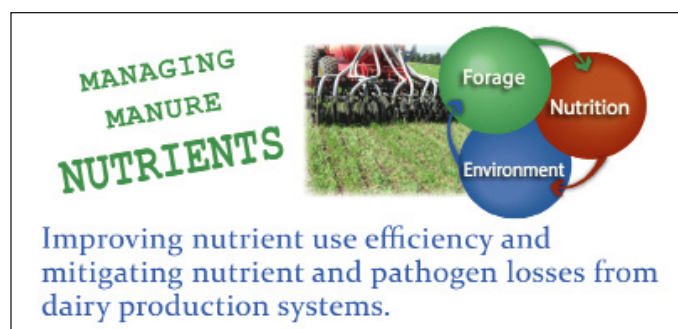
### Modifying lignin with caffeic acid derivatives to improve utilization of biomass & forage crops.

Plant cell walls in crops are potentially an abundant source of carbohydrates for ruminant livestock and biofuel production, but their utilization is restricted because they are enmeshed in a vital structural component known as lignin. USDFRC researchers are testing ways to modify lignin formation in plants to improve cell wall carbohydrate digestion.



In this study, they artificially lignified cell walls from corn with normal precursors plus a wide variety of phenolic compounds that are naturally produced by plants, but not normal components of lignin. Lignins that were formed in part with caffeic acid derivatives, such as dicaffeoyl quinate or clovamide, improved the ruminal and enzymatic digestibility of cell wall carbohydrates by up to 30% compared to conventional lignin formed with normal precursors. These results suggest some caffeic acid derivatives would be promising genetic engineering targets for modifying lignin in forage and biomass crops.

JOHN GRABBER



### Commonly used computer models underestimate nitrous oxide from agricultural fields.

Computer models are increasingly used to help find ways to reduce greenhouse gas emissions from farms, including nitrous oxide from soil. These models need to be tested and compared to make sure they are reliable. USDFRC researchers tested three models (DayCent, DNDC, and EPIC) and found that they varied widely in how they simulated soil processes controlling nitrous oxide emissions, including microbial respiration, denitrification, and soil nitrogen availability. In addition, the models underpredicted emissions when measured emissions were high. The research shows that there are limits to how well the models can be used for policy or management recommendations for soil nitrous oxide and that scientists need to work together to improve the models; and it shows what variables need to be measured in field experiments to allow better testing and improvement of models.

PETER VADAS

### Optimizing manure anaerobic digestion for pathogen control.

Anaerobic digestion of manure is used on dairy farms to produce energy. The process also can de-

stroy zoonotic pathogens that infect both livestock and humans. Digestion is often paired with manure separation on large dairy farms where separated solids are used as cattle bedding.

The extent of pathogen destruction in digesters is not well-characterized, and the distribution of pathogens in solid and liquid fractions of separated manure is not known.



USDFRC researchers studied seven manure digesters with separators and determined that pathogen destruction is suboptimal and highly variable among farms and seasons. Surviving pathogens ultimately end up in the liquid fraction of separated manure, which can result in human exposure during land-application. This research shows livestock producers that they must optimize the performance of their digesters to maximize public health benefits. Fortunately, optimization also is likely to improve biogas yields during digestion, which in turn improves the economic viability of digesters.

TUCKER BURCH

### Dairy manure and human wastewater both contaminate groundwater in NE Wisconsin.

Groundwater quality in the dolomite aquifer in northeast Wisconsin has become a contentious issue as dairy farms and suburban development expand. The aquifer is highly vulnerable because the bedrock is extensively fractured and top soil over the bedrock is often shallow. A key question is if contamination of household wells is from land-applied dairy manure or human septic systems.

Measuring microorganisms that are found only in cattle manure or only in human wastewater, USDFRC researchers learned that of 131 sampled wells in northeast Wisconsin, 40 wells had evidence of cattle manure contamination, 29 with human wastewater contamination, and 7 wells with both. Although wastes from both cattle and people contribute to aquifer contamination, the worst contamination is the result of dairy manure applied inappropriately on shallow soil above bedrock fractures or before a heavy rainfall event. This important research provides local producers and policy makers with information on what sources of contamination are important to target for improved water quality.

MARK BORCHARDT



## Study shows magnitude of legacy phosphorus challenges for water quality goals.

Watersheds throughout the world have a buildup of phosphorus in agricultural soils and stream and lake sediments that can contribute to eutrophication of surface waters for many years into the future. The influence of this “legacy” phosphorus on water quality needs to be assessed to form realistic goals for farm practices and policy.

USDFRC researchers, along with university collaborators, used computer models to quantify the influence of legacy phosphorus on water quality in the Yahara Watershed of southern Wisconsin. Results show there would need to be 70% less phosphorus in soils and 99% less phosphorus in stream sediments to have 48% less phosphorus reach the Yahara lakes, but even these reductions would not be enough to achieve consistently clear lakes. This study gives policy makers and producers specific information on how much phosphorus in soils and sediments will have to be reduced if desired water quality is to be achieved.

PETER VADAS



Farmland in the Yahara River watershed of Dane County, WI.

producers in the Upper Midwest for successful production of fall oats for cattle feed.

WAYNE COBLENTZ

## An oxygen-limiting barrier does not improve storage of round-bale silage for cattle feed.

Baling silage and preserving it by wrapping it in plastic has become popular for forage preservation. However, farmers need basic bale management information for successful storage as feed. USDFRC researchers evaluated the effects of minimizing

plastic wrap, using a plastic with an oxygen-limiting barrier, and extending storage times on fermentation and cow nutritional value of alfalfa bales. Generally, these different management practices did not have an important impact on bale fermentation and nutritional value.

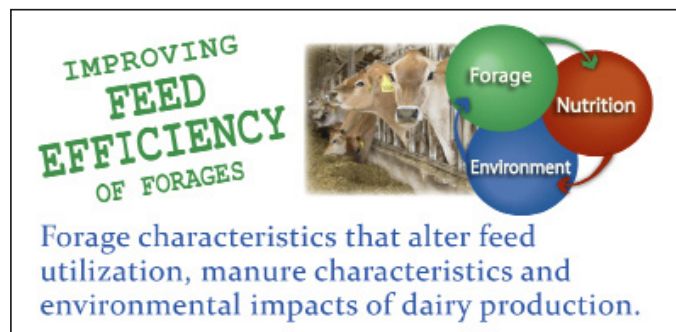
Four layers of plastic is acceptable for bale storage integrity, but plastic with an oxygen barrier does not appear to improve bale quality. This research helps cattle producers minimize their costs and still have successful storage of high quality silage bales.

WAYNE COBLENTZ

## Agronomic management is established for fall oat forages.

Fall-grown oats is a promising option for dairy producers for harvest as silage or to extend the grazing season. However, farmers need basic agronomic management information for successful production. USDFRC researchers examined the effect of seeding rate and oat cultivar on yield, potential for lodging, and the effect of nitrogen fertilizer on yield and cow nutritional value.

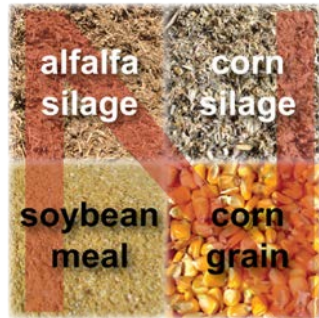
Increasing fall seeding rates beyond traditional rates for spring oats will not consistently improve yields, and may increase the likelihood of lodging. Differences in nutritional value are determined by the maturity rates of the oat cultivars. Cow nutritional value may decrease slightly with more nitrogen fertilizer, but not enough to offset the advantages of greater yield from more fertilizer. This research gives important information to dairy



## Nitrogen use efficiencies to grow feed, produce milk, and recycle manure vary with dairy cow.

The role of nitrogen (N) in dairy systems is multi-faceted with N contributing to protein in milk and meat, but also to N pollution in waterways. To better understand and improve the efficiency of N utilization in dairy systems, USDFRC researchers conducted studies to understand how N moves through soil, feed, and the dairy cow.

Results show a wide range in total N assimilated by the cow with the highest amount from cows fed alfalfa silage, followed by corn silage, soybean meal and corn grain. Dietary N in milk was greater from cows fed corn grain and soybean meal than from cows fed alfalfa silage and corn silage. Relative N recovered in feces was greater from cows fed alfalfa silage and corn silage than from cows fed corn grain and soybean meal, and N recovered as fecal undigested dietary N was greatest from cows fed corn grain, followed by alfalfa silage, corn silage and soybean meal.



Over the 2-year field study period, greatest manure N use efficiency (NUE) was measured in plots amended with manure N derived from soybean meal and lowest from corn silage. The greater total N use efficiency for soybean meal and alfalfa silage over corn grain and corn silage may be attributed to differences between biologically-fixed-N versus inorganic fertilizer NUE to grow dietary components. These results demonstrate the variation in NUE and N cycling between forages and between manure and inorganic N sources.

More research is needed to better understand these differences. To exploit the positive aspects of NUE and N cycling in the soil, forages, and the cow cropping, dairy systems should encourage a balance among corn, alfalfa and soybeans. These steps will enhance NUE in feed/forage and milk production, and in manure N recycling; and will also capture many of the long-term N cycling benefits associated with corn-legume rotations.

J. MARK POWELL

### Canola meal can replace soybean meal in diets of early lactation dairy cows.

Canola meal is a high protein, higher fiber by-product produced from the canola oil industry. It had been shown to be an excellent feed for mid- to late-lactation dairy cows, with an ideal amino acid profile that may be a better match to the amino acid requirement of the lactating dairy cow. But it had not been evaluated in early lactation when cows are producing the most milk and have the greatest nutrient needs.

USDFRC researchers conducted a study to evaluate the inclusion of canola meal as a replacement for

soybean meal on performance, nutrient utilization, and gas emissions of early lactation dairy cows. They found that cows fed canola meal-based diets produced 9.8 pounds/day more milk than cows fed soybean meal-based diets. Part of the response was because of a 1.8 pounds/day increased intake, but the remaining response is under further investigation. In addition, cows fed canola meal-based diets tended to have greater feed efficiency (the conversion of feed to milk) than cows fed soybean meal based diets.

Methane emissions expressed per unit of intake did not differ between diets, but ammonia emissions tended to be higher for cows fed high protein (18% CP) compared to low protein diets (16%). Results suggest that milk production and feed efficiency can be improved in early lactation with the inclusion of canola meal, thus giving dairy producers the confidence to use this protein supplement.

KENNETH KALSCHEUR

### Rearing dairy heifers on pasture has advantages over confinement rearing.

Replacement dairy heifers are routinely raised in confinement, but raising them on pasture could have animal performance advantages. USDFRC researchers compared growth and first-lactation milk production of Holstein dairy heifers reared on pasture or in confinement. Dairy calves were



rotationally grazed on cool-season, grass-legume pastures for two grazing seasons or fed a total

mixed ration in confinement pens. Pasture heifers were also fed a commercial calf-starter mix during the season. All heifers were fed the same TMR during the winter.

As expected, heifers reared on pastures gained weight more slowly than those in confinement during both grazing seasons, but weight of all heifers was similar at freshening. Heifers reared on pasture produced more milk than those in confinement, had lower milk somatic cell count, and had similar feed efficiency throughout lactation. These findings give dairy producers the confidence to raise heifers on pasture knowing that the slower rate of gain is offset by greater benefits.

GEOFFREY BRINK



# Staff Changes in FY 2017

## November, 2016

**Alison Duff** joined the USDFRC in a newly created position as an Ecologist at the Prairie du Sac farm. Duff is a native of Bottineau County, ND, where her family farms 2,000 acres. In 2002 she earned a BS in Ecology, Evolution, and Behavior from the University of Minnesota. An MS in Land Resources and a PhD in Environment and Resources were earned from the University of Wisconsin-Madison in 2006 and 2014.



Duff

**Derek Bickhart** joined the USDFRC in November as an Animal Geneticist/Microbiologist. A native of New Jersey, he received a BS in 2004 from Fairfield University (CT), and an MS and PhD in Genetics and Genomics from the University of Connecticut in 2008 and 2010. Bickhart previously worked for ARS at the Bovine Functional Genomics Laboratory and the Animal Genomics and Improvement Laboratory, both in Beltsville, MD.



Bickhart



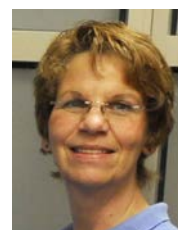
In memory of Dr. Jane Marita.

**Jane Marita** retired after 15 years at the USDFRC working in Ron Hatfield's lab. Jane was a Category 3 PhD scientist who was a major contributor to helping USDFRC scientists understand forage cell wall chemistry and biochemistry as it relates to utilization by dairy cows. In her last 4 years at the Center, Jane organized a biweekly "Feds Feed Families" brat fry that raised money and food for local food pantries. Jane always provided help to anyone who needed an extra hand. Sadly, Jane died from ALS on February 3, 2017.



Betzold

**Shan Betzold**, a UW employee, was hired as the dairy herd manager at the Prairie du Sac farm in November. A native of Amery, WI, he grew up on a farm and received an MBA from the University of Guelph. Before coming to the USDFRC, Shan managed large dairy farms in Russia and South Dakota. Prior to that he owned a 150-cow dairy in Emerald, WI, with his wife Nancy, a previous herd manager at the USDFRC.



Hensler

**Dorene Hensler**, a Secretary at the USDFRC since 2006, left Madison for a job as a Program Specialist, providing support for grants and agreements, with the U.S. Forest Service at the Stanislaus National Forest Headquarters in Sonora, CA.

## December, 2016

**Adam Wallenfang** began as Tucker Burch's biological science technician at the Marshfield location in December. Adam grew up in Peoria, IL, and received a BS in Integrative Biology from the University of Illinois in Urbana-Champaign. He then earned an MS in Molecular Microbiology from the University of Texas Southwestern Medical Center. Prior to joining the USDFRC team, Adam worked as an ARS technician in Peoria, IL, Fargo, ND, and Beltsville, MD.



Wallenfang

Also in December, **Laura Cersosimo** joined the USDFRC as an ORISE Postdoctoral Participant in the Zanton lab. A native of Massachusetts, she received a BS in Animal Science from the University of Connecticut and a PhD in Animal, Nutrition, and Food Sciences from the University of Vermont.



Cersosimo

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## January, 2017

**Kevin Panke-Buisse** began his duties as an Animal Geneticist/Microbiologist in January. A native of Wisconsin, Kevin received a BA in biology from Carthage College in 2010 and a PhD in Horticulture from Cornell University in 2015. At Cornell he focused on harnessing microbial diversity to modulate complex plant host and soil interactions. At the USDFRC Kevin is incorporating novel methods of microbial selection and manipulation to better understand microbiome-agroecosystem interactions. Specifically, he is focusing on the assembly of functional microbiomes to improve silage for dairy nutrition and to reduce waste and the environmental impact of dairy systems.



Panke-Buisse

Also in January, **Lisa Kucek** came to the USDFRC as a Postdoctoral Research Associate in the Riday lab. She is manager of the Legume Cover Crop Breeding Project which is creating regionally adapted varieties of legumes for use as cover crops in organic agricultural production. Kucek is a native of Missouri with a BS in Environmental Science from the University of Minnesota and a PhD in Plant Breeding and Genetics from Cornell University. Prior work includes two years with agricultural extension organizations in Ecuador, Cuba, and Mexico; and four years with the USDA-NRCS in Washington State.



Kucek

## March, 2017

**Kristin McElligott** joined the USDFRC in March as Soil Ecologist/ORISE Postdoctoral Research Fellow. She is assisting in the development of the FarmLab soil and ecological monitoring program and developing a carbon budget for the USDFRC research farm at Prairie du Sac. A native of Wisconsin, Kristin received a BS in Conservation and Environmental Sciences from the University of Wisconsin-Milwaukee; an MS in Forest Soils and Bioenergy Systems from the University of Idaho; and a PhD in Soil Biogeochemistry from Virginia Tech.



McElligott

## April, 2017

**Anthony Johnson**, a biological science technician in Michael Casler's lab since 2015, left the USDFRC to join the U.S. Army Corps of Engineers in Trail, OR. He will work as a natural resource specialist, restoring habitat in the Rogue River Basin Project.



Johnson

## May, 2017

**J. Mark Powell**, who came to the USDFRC in 1997 as a post-doctoral researcher and was named a Research Soil Scientist in 2000, retired in May. Internationally recognized as an authority on nutrient cycling and the environmental impacts of mixed crop-livestock systems, he led interdisciplinary studies on phosphorus management for commercial dairy farms; investigated how dietary forage and crude protein feed supplements affect soil characteristics, soil fertility, and nitrogen loss; and assessed how different factors in dairy production systems affect ammonia emissions. He helped create questionnaires and survey tools used to obtain information about nutrient management and related issues on dairy farms, and used this information to develop a nutrient use efficiency model; as a result of this work, the United Nations Food and Agricultural Organization asked him to lead a new global program on nutrient use efficiency in animal food chains.



Powell

## June, 2017

**Amelie Fischer** came to the USDFRC in June to work as a postdoctoral research associate in the Kalscheur lab. She grew up on a Holstein dairy farm in Alsace, France. She received a BS and MS in animal science and agronomy at Agrocampus-Oest in Rennes, France. For her PhD at the same university she focused on individual differences and



Fischer



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finding ways to estimate feed efficiency in dairy cows. As a post-doc at the USDFRC, she will continue to work on feed efficiency in dairy cows with a focus on the effects of changing diets.

## September, 2017

**Paul Weimer**, Research Microbiologist, retired after 30 years with the USDFRC. Internationally known as an expert on rumen microbiology, he and research collaborators were the first to use several cutting-edge molecular marker techniques to survey ruminal bacterial communities and demonstrate their association with milk fat depression, which highlighted the individuality of bovine microbiomes and their roles in milk production. Taking the ruminant animal as a model, he also proposed a consolidated bioprocessing system for converting biomass into hydrocarbons and hydrogen gas without chemical pretreatment. And he constructed a new continuous culture system for growing microorganisms and used it to determine key growth and fermentation parameters for important microbes in the rumen; this system is now used in other laboratories around the world.



Weimer

**Lori Ward Bocher**, Agricultural Information Specialist, retired after 12 years with the Center. Her position was created in 2005 in an effort to better position the USDFRC as the flagship dairy forage research institution in the U.S. She was instrumental in implementing new outreach programs, such as the FFA Dairy Forage Quiz at World Dairy Expo and the Scientist for a Day program at the USDFRC farm. She created publications and web site content to explain Center research for a general audience. And she helped plan and execute many events and meetings, always with the goal of creating information with a targeted message for each individual audience.



Bocher

# Technology Transfer in FY 2017

Each year the Agricultural Research Service compiles a list of technology transfer activities – ways that ARS research and technology is being transferred to and used by the public. These are the activities that were reported by the U.S. Dairy Forage Research Center.

## Research Results Being Implemented

On June 7, **Wayne Zeller** made public the “U.S. Dairy Forage Research Center (USDFRC) condensed tannin NMR database” by publishing an article of the same name in the *Journal of Agricultural and Food Chemistry*. The article described the database and told researchers how to obtain free access to it.

**Michael Casler** participated in an interview to be used for a CenUSA web-based video on the CenUSA web site. He spoke about advances in switchgrass breeding. CenUSA is a USDA National Institute of Food and Agriculture (NIFA) sponsored research project investigating the creation of a Midwestern sustainable biofuels and bioproducts system.



On August 16, **Wayne Zeller** was co-author on an article that describes a method of purifying condensed tannins. “Facile Purification of Milligram to Gram Quantities of Condensed Tannins According to Mean Degree of Polymerization and Flavan-3-ol Subunit Composition” appeared in the *Journal of Agricultural and Food Chemistry* as an open access article.

During FY 2017, **Peter Vadas** collaborated with the Soils Science Department at the University of Wisconsin-Madison to code his Annual Phosphorus Loss Estimator (APLE) for cattle lots so it can be incorporated into user-friendly software to be made publically available.

## Special Recognition

In December 2016, **Heathcliffe Riday** completed a 3-year term as an Associate Editor for *Crop Science*. In January of 2016 he received a Citation of Excellence related to his service for the same journal.



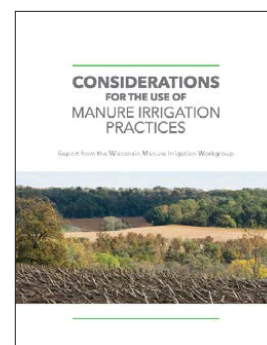
On January 25, **Michael Casler** received the Medalion Award from the American Forage and Grasslands Council for his “Outstanding contributions to AFGC and the forage industry.” The award was

presented at the AFGC Annual Conference in Roanoke, VA. Michael was awarded AFGC’s highest honor not only for his prolific research and publication record, but for mentoring numerous plant breeding and genetics graduate students, providing research experience to undergraduate students not typically majoring in agricultural sciences, and assisting colleagues with statistical analysis of a wide range of experiments. His dedication to mentoring activities has contributed to the career advancement of countless individuals.

On January 26, **Lori Bocher** received the 2016 Outstanding Service Award from the Midwest Forage Association (MFA) at their annual meeting in Wisconsin Dells, WI. The award was given in recognition of her being a contributing editor to the MFA’s *Forage Focus* publication for almost a decade, coordinating a USDFRC article for each issue along with providing cover photos and research updates.



On June 26, **Mark Borchardt** and **Tucker Burch** learned that a book they co-authored, “Considerations for the Use of Manure Irrigation Practices,” received an Educational Aids Blue Ribbon from the American Society of Agricultural and Biological Engineers (ASABE). Their contribution included the chapter, “Airborne Pathogens from Dairy Manure Aerial Irrigation and the Human Health Risk,”



Report on manure irrigation.

which was based on their extensive, largest-of-its-kind, field sampling for airborne microorganisms during 23 manure irrigation events.

On August 8, **J. Mark Powell** received notification that a *Journal of Dairy Science* article for which he was a co-author was among the 100 most highly cited papers published in the JDS since the beginning of 2014. The January 2015 article was titled, “Performance, digestion, nitrogen balance, and emission of manure ammonia, enteric methane, and carbon



dioxide in lactating cows fed diets with varying alfalfa silage-to-corn silage ratios.”

On August 17, **Paul Weimer** received notice that his article, “Transient changes in milk production efficiency and bacterial community composition resulting from near-total exchange of ruminal contents between high- and low-efficiency Holstein cows,” was selected as an “Editor’s Choice” by the Journal of Dairy Science for the September 2017 issue. As such, the article was featured prominently on the journal’s homepage, and it was freely accessible to all.

## Collaborative Research Activities

On October 17-19, 2016, the USDFRC hosted a meeting of the ARS Dairy Agroecosystems Work Group (DAWG). The meeting included a tour of the USDFRC research farm, DAWG task group reports, and updates on research being conducted at the 5 ARS locations participating in DAWG (Kimberly, ID, St. Paul, MN, Bushland, TX, Madison, WI, and University Park, PA). **Peter Vadas** organized the event, and the following from USDFRC participated: **Mark Boggess, Tucker Burch, Wayne Coblenz, John Grabber, Ken Kalscheur, J. Mark Powell, and Kristan Reed.**

On November 10-11, 2016, **J. Mark Powell** attended the Global Research Alliance/Croplands Research Group meeting, including a joint session with the GRA/Integrated Research Group, in Phoenix, AZ. Participants focused on aligning their work with



the new GRA Strategic Plan for 2016-2020 and with GRA flagship projects. The GRA, with 46 member countries, is focused on research, development and extension of technologies and practices that will help deliver ways to grow more food (and more climate-resilient food systems) without growing greenhouse gas emissions.

On February 14 and 15, **J. Mark Powell** worked with co-authors at Dairy Management Inc., Rosemont, IL to complete the draft manuscript, “Sustainable Forage and Grain Crop Production for the US Dairy Industry.” This manuscript is part of the Dairy 2050 series.

On April 10-11, **J. Mark Powell** represented the USDA ARS as the host of an international meeting he organized. The 2-day 9th annual meeting of the Global Research Alliance (GRA) on Agricultural Greenhouse Gases – Livestock Research Group (LRG) was held in Washington, D.C., with the highest attendance ever for the event. The core meeting was followed with a day’s field trip to USDA-ARS Beltsville Agricultural Research Station (BARC) and the National Arboretum. The meeting was attended by 60 participants from 28 countries, including high-level representation from the United Nations Food and Agriculture Organization in Rome, the United Nations Environment in Paris, The World Bank, and other global and regional research agencies.

On May 22, **Kenneth Kalscheur, Mary Beth Hall, and Geoffrey Zanton** hosted a group of 6 dairy industry representatives from Germany to discuss recent advances and best management practices in dairy cattle nutrition. The purpose of their visit was to compare and contrast the U.S. and German/European markets regarding dairy nutrition past, present, and future. They also toured the USDFRC research farm in Prairie du Sac, WI.

## Advice and Consulting

On October 3, **Mark Borchardt** assisted the State of Washington Department of Health with manure irrigation questions and data related to his research.

On October 24, **Mark Borchardt** advised staff members of EPA Region 5 on the Kewaunee County groundwater study.

On October 26, **Mark Borchardt** gave a tour of his water quality lab in Marshfield, WI, and advised attorneys from Midwest Environmental Advocates on microbial source tracking.

On December 16, **Mark Borchardt** advised Diamond V feed company employees and Peninsula Pride dairy producers on a study design to evaluate the effects of their feed products on pathogen levels in dairy cattle manure.

On May 22-24, **Mark Borchardt** was invited to the Centers for Disease Control and Prevention in Atlanta, GA, to participate in a structured expert judgment to estimate the number of illnesses in the U.S. that are from food-borne and water-borne transmission.





On July 12-13, **Mary Beth Hall** taught a class (two half days) on the analysis of starch in feed samples to 6 science technicians and graduate students at the USDFRC in Madison, WI.

On August 17, **Alison Duff** delivered a presentation,

“FarmLab: Integrated agroecosystem research to inform policy and practice,” to 8 policy makers at the state “agency heads” meeting which is attended by leadership from two Wisconsin Departments (Agriculture, Trade and Consumer Protection, and Natural Resources); two University of Wisconsin-Madison entities (UW-Extension, UW College of Agricultural and Life Sciences); and three USDA agencies (NRCS, FSA, and ARS).

During FY 2017, **Mary Beth Hall** was contacted by and worked with a major feed analysis laboratory to help verify the accuracy of their analyses for dietary starch. This work included sending them samples, analyzing their samples, and working with them to verify that the protocols and reagents they were using were appropriate to the assays.

During FY 2017, **Mary Beth Hall** was contacted by and worked with the Association of American Feed Control Officials (responsible for the regulatory side of feed labels) in an effort to provide information to the industry on known challenges in the analysis of fructans in animal feeds. The AAFCO is working to find an appropriate method of analysis which would allow feed labeling for fructans, and it has requested Hall’s expert advice.

During FY 2017, **Mary Beth Hall** consulted with several people across the world on issues related to starch degradability in vitro, starch analysis, carbohydrate analysis and use in dairy cattle, manure evaluation, and more.

## Presentations, October to December, 2016

On October 4, 2016, **Mary Beth Hall** presented a seminar, “What manure evaluation can tell us about cows and rations,” to 65 producers, industry reps, and ag media reps at the Dairy Forage Seminar Stage of World Dairy Expo in Madison, WI.

On October 16, **Geoffrey Brink** led a pasture walk with 25 participants on a farm in, Canton, MN.

On October 28, 2016, **John Grabber** presented “Alfalfa interseeded into corn as a dual-purpose cover

and forage crop” to about 50 faculty, staff and students at Penn State University, State College, PA.

On October 31, 2016, **John Grabber** presented “Alfalfa interseeded into corn as a dual-purpose cover and forage crop” to 8 faculty, staff and students at Cornell University, Ithaca, NY.

On November 1, **Mark Borchardt** gave a presentation to Wisconsin DNR leadership, including Secretary Stepp, on the Kewaunee County groundwater study.

On November 7, **Michael Casler** presented “It’s just grass, isn’t it?” to 80 scientists and educators at the Crop Science Society of America annual meeting in Phoenix, AZ. Casler was the invited speaker for the Calvin Sperling Memorial Biodiversity Lectureship.

On November 10, 2016, **Geoffrey Zanton** gave 2 presentations at the Penn State Nutrition Workshop in Grantville, PA. “Balancing rations to optimize milk components” was presented at the general session to more than 400 consulting nutritionists and industry professionals; and “Amino acid nutrition beyond methionine and lysine for milk protein” was given at a workshop for 70 attendees.

On November 9, 2016, **Peter Vadas** gave a presentation, “Quantifying the Impact of Seasonal and Short-term Manure Application Decisions on Phosphorus Loss in Surface Runoff,” to about 40 researchers, educators and students at the Soil Science Society of America annual meeting in Phoenix, AZ.

## Presentations, January to March, 2017

On January 11, **John Grabber** presented “Establishing alfalfa in silage corn” at the Wisconsin Agribusiness Classic in Madison, WI. At the same meeting, **J. Mark Powell** presented “Nitrogen cycling on Wisconsin dairy farms.”

On January 12, **Wayne Coblenz** presented “Hay preservatives and cutting management for maximum quality” to 60 producers and industry reps at the Southwest Hay and Forage Conference in Ruidoso, NM.

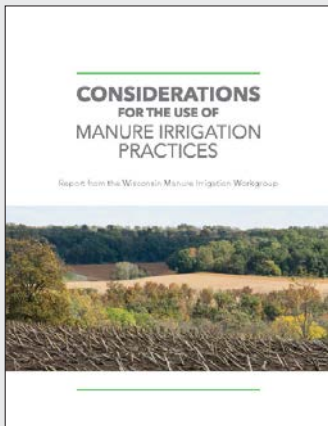


On January 23, **Geoffrey Brink** presented, “Nitrogen source and application effects on pasture productivity, legume persistence, and forage nutritive value,” to 64 producers at the American Forage and Grassland Council annual conference in Roanoke, VA.

## High Demand for Information on Manure Irrigation and Water Quality Studies

USDFRC Marshfield scientists conducted two studies that garnered a lot of attention this past year. The first, “Airborne pathogens from dairy manure aerial irrigation and the human health risk,” was completed in 2016 and was included in “Considerations for the Use of Manure Irrigation Practices: Report from the Wisconsin Manure Irrigation Workgroup,” University of Wisconsin-Extension and UW-Madison College of Agricultural and Life Sciences. **Mark Borchardt** and **Tucker Burch** served on this workgroup.

The second, “Dairy Manure and Human Wastewater Contamination in the Dolomite Aquifer in Northeastern Wisconsin” (**Mark Borchardt** and **Susan Spencer**), was completed in 2017 and led to a related report, “Assessing Groundwater Quality in Kewaunee County.” Here is a synopsis of activities related to these two studies.



On January 11, **Mark Borchardt's** presentation, “Aerial irrigation of dairy manure and risk of microbial infections,” was given by Becky Larson to about 125 producers and industry reps at the Wisconsin Agribusiness Classic in Madison, WI. Borchardt was unable to attend the meeting due to a snow storm.

On February 22, **Tucker Burch** presented “Assessment of human health risk due to airborne pathogens during spray irrigation of dairy manure” to about 100 dairy producers and industry reps at the Midwest Manure Summit in Green Bay, WI.

At the same meeting, **Mark Borchardt** presented “Dairy manure and human Wastewater contamination in the dolomite aquifer in Northeastern Wisconsin.”

On April 7, **Mark Borchardt** was interviewed by reporters from WLUK TV from Green Bay, WI. The reporters traveled to Borchardt's water quality lab at Marshfield for an extensive interview on the Kewaunee County groundwater study.

On April 25, **Mark Borchardt** gave a presentation on the Kewaunee County groundwater study results to 10 leaders of the Wisconsin Department of Natural Resources, including Secretary Stepp.

On April 27, **Mark Borchardt** presented, “Dairy Manure and Human Wastewater Contamination in the Dolomite Aquifer in Northeastern Wisconsin” to about 15 citizens at a meeting of the groundwater committee of the Wood County Board of Supervisors in Nekoosa, WI.

On May 6, **Mark Borchardt** presented, “When ‘It’ Hits the Fan: Groundwater Quality and Public Health in Wisconsin,” to about 60 citizens at the League of Women voters Upper River Region annual meeting in LaCrosse, WI.

On May 17, **Mark Borchardt** presented, “Extensive Fecal Contamination in the Fractured Dolomite Aquifer in Northeast Wisconsin,” to 200 researchers, students, and water quality experts from around the world at the University of North Carolina Water Microbiology Conference in Chapel Hill, NC.

On May 30, **Mark Borchardt** presented, “Sources of Fecal Contamination in the Dolomite Aquifer in Northeastern Wisconsin,” to approximately 200 students, researchers, Iowa state legislators and NGOs involved with water quality at the “Karst, Water Quality, and Livestock: Finding Balance for a Sensitive Geography” conference at Luther College in Decorah, IA.

On June 7, **Mark Borchardt** presented, “Assessing Groundwater Quality in Kewaunee County,” a report on a recent groundwater study, to 250 interested and passionate citizens at the County Expo Center in Luxemburg, WI. At this event he also participated in multiple television news interviews.

Upon the release of the above report, **Mark Borchardt** was interviewed by writers from the Center for Investigative Journalism, WisPolitics, and Milwaukee Public Radio. He also gave several television interviews.

On June 23, **Mark Borchardt** presented, “Assessing Groundwater Quality in Kewaunee County,” to 12 dairy producers at a board meeting of the Professional Dairy Producers of Wisconsin.



Mark Borchardt speaking on water quality issues in Kewaunee County. Photo credit: Coburn Dukehart, Wisconsin Center for Investigative Journalism



On January 24-25, **Wayne Coblenz** participated in Symposium '17 Hosted by the Midwest Forage Association, the Wisconsin Custom Operators, and the Professional Nutrient Applicators Association of Wisconsin in Wisconsin Dells, WI. He gave a presentation, "Making the most of your baleage," bale size and preservative rate for large round bales of alfalfa hay," to 70 producers and custom operators.

On February 6, **Geoffrey Zanton** gave a presentation, "Opportunities and challenges of applying recent advances in dairy cattle nutrition to beef cattle nutrition," to about 40 industry professionals, educators, students, and researchers at the American Society of Animal Science Southern Section meeting in Franklin, TN.

On February 9, **Wayne Coblenz** gave two presentations at the Alabama Farmer's Federation Commodity Organizational Meeting. He presented "Forage Management" to 15 producers at the dairy producers commodity group, and "Post-harvest Hay Management" to 40 producers at the hay and forage growers commodity group.

On February 23, **Mark Powell** gave a guest lecture, "Feed and herd management impacts on nutrient cycles of dairy farms," to 40 students of University of Wisconsin School for Beginning Dairy & Livestock Farmers in Madison, WI.

On March 8, **Wayne Coblenz** gave a presentation at a UW Extension "Raising quality dairy heifers" conference in Kimberly, WI. His talk, "Heifer stocking density and performance," reached a total of 50 dairy producers.

On March 14, **Paul Weimer** presented "Host specificity of the rumen microbial community and its relation to feed efficiency" to researchers and educators at the Midwest Section meeting of the American Dairy Science Association in Omaha, NE.

## Presentations, April to June, 2017

On April 7, **Wayne Zeller** presented "U.S. Dairy Forage Research Center (DFRC) condensed tannin NMR database" to 50 students and researchers at the 253rd national meeting of the American Chemical Society in San Francisco, CA.

On April 12, **Alison Duff** presented "What does an ecologist do for Dairy Forage?" to 16 members of the Sauk Prairie Optimists Club in Prairie du Sac, WI. The talk was part of a series about activities within the former Badger Army Ammunition Plant where the USDFRC research farm is located.

On April 19, **Mary Beth Hall** presented "Sugars in rations for dairy cows" to 200 dairy industry and university professionals and graduate students at the Tri-State Dairy Nutrition Conference (MI, IN, OH) in Fort Wayne, IN.

On May 9, **Mark Borchardt** presented, "Groundwater-borne Infectious Disease in Wisconsin," to about 200 students, faculty, and policy makers at the Water@UW-Madison Symposium on Freshwater Research in Madison, WI.

On May 11, **Mary Beth Hall** presented "Carbohydrates: Measuring them and managing them in dairy rations," to 200 dairy industry representatives, university professionals, and graduate students at the California Animal Nutrition Conference in Fresno, CA.

On May 16, **Tucker Burch** presented a poster, "Agreement between Quantitative Microbial Risk Assessment and Epidemiology at Low Doses during Waterborne Outbreaks of Protozoan Disease," to about 50 researchers and students at the University of North Carolina Water Microbiology Conference in Chapel Hill, NC. The poster described his work to reconcile QMRA with epidemiology – a crucial step required for continued use of QMRA to quantify the environmental and public health impacts of animal agriculture.



On June 20, **John Grabber** gave a presentation, "Update on alfalfa interseeding in silage corn," to 30 forage agronomists and graduate students at the NCCC31 "Ecophysiological Aspects of Forage Management" meeting in Lincoln, NE.

## ADSA Annual Meeting

The USDFRC was well represented at the American Dairy Science Association annual meeting in Pittsburgh, PA. On June 26, **Derek Bickhart** gave an oral presentation, "Discovery of a haplotype affecting fertility in Ayrshire dairy cattle and identification of a putative causal variant." **Paul Weimer** gave an oral presentation, "The influence of forage feeding on the ruminal microbiome of dairy cattle and its implications for dairy production." And on June 27, **Mary Beth Hall** gave an oral presentation, "Sub-

stitution of fall-grown oat forage for corn silage affects lactating dairy cow performance."

On June 26-27, **Wayne Coblenz** gave three poster presentations: "Effects of nitrogen fertilization on the nutritive value of oat forages," "Effects of straw processing and pen stocking density on Holstein dairy heifers: Growth and sorting behaviors," and "Effects of straw processing and pen stocking density on Holstein dairy heifers: Behavior and hygiene."

On June 26, **Kenneth Kalscheur** gave a poster presentation, "Replacing conventional or brown midrib corn silage with brown midrib sudan-grass silage in the diets of lactating dairy cows."

And **Geoffrey Zanton** gave a poster presentation, "Effects of experimental design and protein substitution strategy on production responses to feeding different levels of protein to primiparous dairy cows."



## Presentations, July to September, 2017

On July 11, **Michael Sullivan** presented "Making Caffeic Acid Derivatives in Alfalfa: Challenges to Molecular Approaches for Improving Forage Crops," at the Gordon Research Conference for Plant Metabolic Engineering in Waterville Valley, NH. He also presented a poster, "Identification, gene cloning, and characterization of a BAHD hydroxycinnamoyl transferase capable of producing clovamide and other aromatic amino acid hydroxycinnamoyl amides."

On August 9, **Michael Casler** presented "Directed evolution of adaptive traits" to 65 scientists at the Switchgrass IV Conference at the University of Nebraska, Lincoln.

On August 23, 2017, **Peter Vadas** gave a presentation, "How Does Manure Application Timing Impact Phosphorus Loss in Runoff," to about 40 researchers, extension personnel, and producers at the North American Manure Expo in Arlington, WI.

On August 24, **Wayne Coblenz** gave a presentation, "Baleage made tight, made right," to 220 dairy and forage producers at the Michigan State University Agricultural Innovation Day: Focus on Forages and the Future, in Lake City, MI.

On September 20-22, three USDFRC scientists gave presentations to about 150 researchers, educators

and students at the 33rd Discover Conference, "Integrated Solutions to Fiber Challenges," sponsored by American Dairy Science Association and held in Itasca, IL. **Mary Beth Hall** presented, "What makes fiber effective: What do we need to know?" **Ronald Hatfield** presented, "Basic plant physiology – where fiber comes from." And **Paul Weimer** presented, "Does fiber affect the rumen microbiome? What do we need to know?"

On September 23, **Alison Duff** served as a USDFRC representative for a tour and special event titled, "Explore Badger Day," in Sauk County, WI. The event was coordinated by the Sauk Prairie Conservation Alliance in collaboration with the land owners on the former Badger Army Ammunition Plant. Duff's role was to clarify USDA property boundaries and explain that USDA land is closed to recreational activity; and to discuss the USDFRC mission and research and how they relate to agricultural sustainability and conservation in the context of other projects on the property.

On September 29, **Mary Beth Hall** gave an invited presentation, "Determination of Dietary Starch in Animal Feeds and Pet Food by an Enzymatic-Colormetric Method:2014.10," to 12 scientists at the Association of Official Analytical Chemists Expert Review Panel for Dietary Starches and Fibers at the 131st Annual Meeting & Exposition of the AOAC International. This method was developed at the USDFRC and is now an AOAC Official Method.

## Presentations and Mentoring to Students

On November 30, **Alison Duff** presented a guest lecture, "Conservation in Working Landscapes," to about 25 undergraduate and graduate students for the University of Wisconsin-Madison Conservation Biology course.

On February 21, **Kevin Panke-Buisse** gave a presentation, "Assembly and application of functional microbiomes," to about 50 students at Carthage College in Kenosha, WI.

On February 22, **Paul Weimer** presented a lecture, "The relationship between ruminal microbiome and dairy performance," to students and educators at Stellenbosch University in South Africa.

On April 19, **Geoff Brink** presented an invited lecture, "Improved Forages for Beef Systems," to 40 agriculture students at the University of Wisconsin-River Falls.

On May 4, **Derek Bickhart** and **Kevin Panke-Buisse** mentored a high school junior from Jefferson High



School (WI). The student was working on a class project and wanted to learn more about scientific data analysis and careers in science.

During the summer of 2017, **Kevin Panke-Buisse** mentored an ORISE student intern with a recent bachelor's degree on how to prepare and apply for graduate school. He helped the student choose an institution, find a lab, approach a PI, and strengthen an application. He has since given follow-up advice on a regular basis.

From May 15 to July 11, **Wenli Li** mentored a student intern who is majoring in biology at the University of Wisconsin-Whitewater. The student learned various analytical methods that can be used to identify differentially expressed genes by comparing different experimental conditions, and

he learned about different sequencing technologies currently used in the field of genomics and transcriptomics. This internship was supported by the ARS Midwest Area 2017 Summer Internship Program, and it was named the top-ranked proposal.

On September 6 and 7, **Paul Weimer** presented lectures to students in the Ruminant Nutritional Physiology I class at the University of Wisconsin-Madison. His topics were, "Thermodynamics and the ruminal fermentation" and "Reaction kinetics and the ruminal fermentation."

During FY 2017, **Kenneth Kalscheur** mentored three graduate students: a PhD student from the University of Wisconsin-Madison; an MS student, also from UW-Madison; and a PhD student from South Dakota State University.

## Popular Press Articles

*Maure looks the way it does for a reason*  
**Agri-View**, Oct. 27, 2016

Based on talk by Mary Beth Hall

*Washed manure reveals clues*

**Agri-View**, Oct. 27, 2016

Based on talk by Mary Beth Hall

*Are you an ecologist?*

**Progressive Forage**, Nov. 15, 2016

Author: Mark Boggess

*Optimizing oats for use as dairy forage*

**Agricultural Research**, Nov. 2016

Based on research by Wayne Coblenz

*Low forage diets work, too*

**Hoard's Dairyman**, Nov. 2016

Based on research by Mary Beth Hall

*Nitrogen fertilization, interseeding alfalfa, rumen microbes and production efficiency, pastures producing more milk*

**Forage Focus**, (Midwest Forage Assn.) Dec. 2016

Authors: Wayne Coblenz, John Grabber, Paul Weimer, and Geoff Brink

*Applying manure impacts pasture yield, composition*

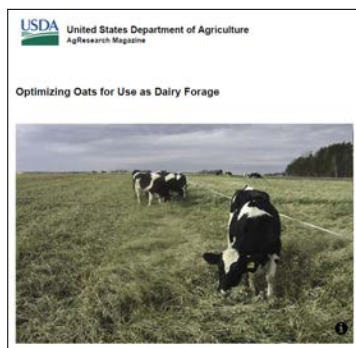
**Hay&Forage Grower**, Jan. 2017

Author: Geoff Brink

*Comparing sudangrass and sorghum-sudangrass in the field and in dairy cow diets*

**Forage Focus**, March 2017

Authors: Geoff Brink, Ken Kalscheur, Lori Bocher



*Utility of alfalfa stemlage for feeding dairy heifers*

**Forage Focus**, March 2017

Authors: Wayne Coblenz, Robin Ogden, Ken Kalscheur, and Ron Hatfield

*Potential for increased use of cereal grain forages*

**Forage Focus**, May 2017

Authors: Wayne Coblenz and Matt Akins (UW)

*Improving legumes for pasture, cover crops, living mulch and green manure*

**Forage Focus**, May 2017

Authors: Heathcliffe Riday, Lisa Kissing Kucek and Lori Bocher

*Sugar has a place in cow rations*

**Hoard's Dairyman Intel**

Based on research by Mary Beth Hall

*Bale wrapping: How late is too late?*

**Progressive Forage**, June 2017

Based on research by Wayne Coblenz

*The most interesting dairy forage farm by far*  
**Forage Focus**, August 2017

Author: Lori Bocher

*Brown midrib sorghum deserves a second look*

**Hoard's Dairyman**, August 2017

Co-author: Kenneth Kalscheur



# Outreach and Events

## World Dairy Expo, 2016

The U.S. Dairy Forage Research Center participated in four technology transfer and outreach efforts at World Dairy Expo in Madison, WI on October 4

to 8; the 2016 show attracted more than 74,500 dairy producers and industry reps from across the U.S. and 102 countries. First, the USDFRC is an organizing partner for the World Forage Analysis Superbowl, an event that encourages farmers to grow high-quality forage for dairy cattle. As such, the Center organized an educational seminar series that attracted more than 435 stakeholders and included USDFRC scientist **Mary Beth Hall** who presented *"It doesn't just happen: What manure evaluation tells us about cows and rations."*



Mary Beth Hall seminar explains manure evaluation.



Second, the Center created an educational display, "50 Years of Forage," to complement World Dairy Expo's 50th anniversary theme.

Third, the USDFRC organized the FFA Dairy Forage Quiz which brought more than 800 FFA students to the USDFRC educational display where they searched for the correct answers to the quiz questions. This event was organized by **Lori Bocher**. Also volunteering were **Meridith Anderson, Mary Becker, Ashley Braun, Geoff Brink, and Jessica Sherman**.

Fourth, **Diane Amundson** created a display, "Reduce, Reuse, Recycle," that highlighted the role dairy



FFA students participate in quiz.



Two students review 50 Years of Forage to see how it was done before they were even born.

cows play in turning waste into milk, fertilizer, and energy; this display was part of tours given to approximately 1,200 4th grade Madison area school children.

## Introducing FarmLab to Community

On June 1, **Alison Duff** hosted a Sauk Prairie Community Meeting in Prairie du Sac, WI, to inform local citizens about, and gather their opinions on, the plans for a FarmLab within the USDFRC research farm. The FarmLab seeks to develop an integrated, whole-farm management and research program that facilitates long-term, quantitative exploration of the agricultural production and other ecosystem service trade-offs associated with land cover and land management practices. Also speaking were **Mark Boggess** and **Kristin McElligott**.



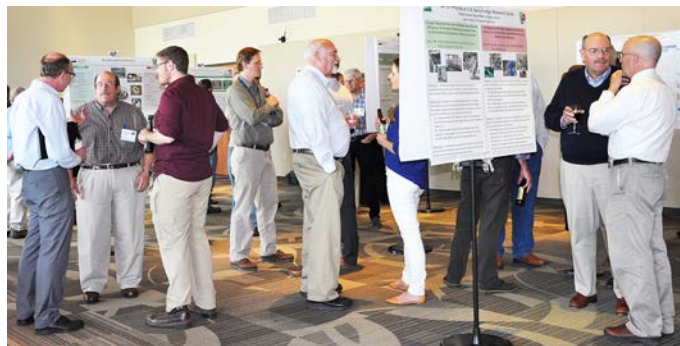
About 20 people attended the community meeting to learn more about the FarmLab being created at the Prairie du Sac research farm.

**Sauk Prairie Community Meeting:**  
Introducing the U.S. Dairy Forage Research Center  
**FarmLab**  
*Research at the intersection of agriculture and conservation.*  
**Thursday, June 1**  
6:00 to 7:30 p.m.  
Ruth Culver Community Library  
540 Water St.  
Prairie du Sac, WI  
  
Sponsored by the  
**U.S. Dairy Forage Research Center**  
USDA Agricultural Research Service

## Stakeholder Conference

On May 11 and 12, the U.S. Dairy Forage Research Center hosted a Research and Industry Stakeholder Conference for about 30 producers, representatives of the dairy and forage industries, along with USDFRC researchers. The purpose of the conference was to share research results and to gather Stakeholder input on industry priorities related to forage improvement and utilization.

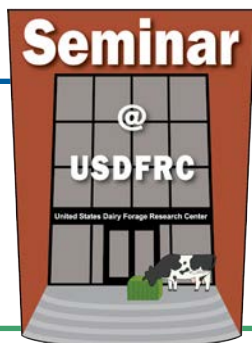
At the meeting a specific topic of interest was addressed via an interactive session which focused on ideas and priorities for future research programs related to forage production for dairy. The stakeholder insights and input have now been used in writing the 5-year research program plan for the ARS National Program 215 – Pasture, Forage and Rangeland Systems.



USDFRC scientists shared their research goals and accomplishments via a poster session with the Stakeholders.



Group discussions on Day 2 focused on ideas and priorities for future research programs related to dairy forage production.



## Seminars@USDFRC

The U.S. Dairy Forage Research Center hosts occasional seminars featuring guest speakers from a wide variety of disciplines to inform about a wide range of issues that affect USDFRC research directly or indirectly. All seminars are open to USDFRC employees, stakeholders, and UW staff and students.

### Frank Mitloehner

January 17, 2017

Professor & Air Quality Extension Specialist, University of California, Davis, CA

*"Understanding the ecological trade-offs in integrated dairy farming systems."*



### Michael Casler

March 29, 2017

Research Plant Geneticist, USDFRC

*"It's just grass, isn't it? The quest for better grasses: What a long, strange trip it's been"*



### J. Mark Powell

March 2, 2017

Research Soil Scientist, USDFRC

*"Dairy manure impacts on soil, water and air: A reflection on 20 years of research"*



### Jo Handelsman

April 6, 2017

Director, Wisconsin Institutes for Discovery, University of Wisconsin-Madison

*"Vision for the Wisconsin Institute for Discovery: Collaborations to Improve Wisconsin and the World"*





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# USDFRC Contact Information

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## Madison



### USDFRC at Madison, WI

Laboratories, greenhouses, engineering lab, and the administrative offices on the west side of the University of Wisconsin-Madison campus.

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Madison, WI 53706  
Phone: (608) 890-0050

## Prairie du Sac



### USDFRC at Prairie du Sac, WI

The research farm consists of 2,200 acres and about 350 cows in milk.

S8822 Sunset Dr. (off of Hwy. 78)  
Prairie du Sac, WI 53578  
Phone: (608) 643-2438

## Marshfield



### USDFRC at Marshfield, WI

The Environmentally Integrated Dairy Management Research Unit (EIDMRU) is researching manure and nutrient management options.

2615 Yellowstone Dr.  
Marshfield, WI 54449  
Phone: (715) 384-9673

## Stratford



### USDFRC at Stratford, WI

Research farm for the EIDMRU. Same contact info as above.

### Web Site

[www.ars.usda.gov/mwa/madison/dfrc](http://www.ars.usda.gov/mwa/madison/dfrc)

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# USDFRC Research Scientists

Research at the U.S. Dairy Forage Research Center is directed by 19 scientists who manage the personnel and activities in their respective laboratories in Madison and Marshfield, and also the research conducted at the farms in Prairie du Sac and Stratford. Three of these scientists are also Research Leaders for their respective management units.

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