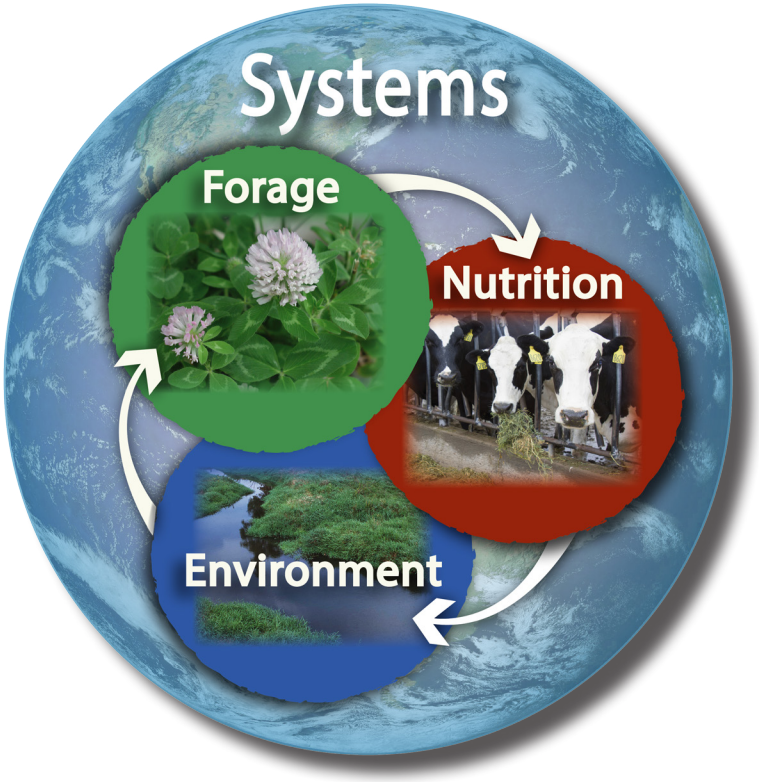
USDA United States Department of Agriculture

Year in Review

U.S. Dairy Forage Research Center

FY 2015, October 2014 through September 2015



Leading the world in dairy forage systems research.

U.S. Dairy Forage Research Center ● Madison, Marshfield and Prairie du Sac, Wisconsin
USDA Agricultural Research Service

Mission Area Communities

These four Mission Area Communities were established in FY2015 as a vehicle for scientists to discuss research needs and challenges from a 'higher elevation' or 'big picture' viewpoint. University of Wisconsin-Madison researchers and other stakeholders are also invited to attend. The meetings are held twice a year. The goals of each community are listed below.

Dairy Forage

Enhance the productivity, efficiency and environmental sustainability of integrated dairy and forage systems through development of improved traditional and novel forages and management strategies that:

- Support multiple uses and provide eco-system services and natural resource conservation;
- Improve dairy cow production, efficiency and well-being;
- Better complement adapted dairy genetics and associated rumen and gut microbiomes;
- Improve the value and utilization of traditional and novel forages;
- Are adaptable to changing biotic and abiotic factors and environmental conditions.

CHAIRMAN: RON HATFIELD
VICE CHAIR: GEOFF BRINK

Dairy Nutrition

Enhance the production capacity, efficiency, product quality and sustainability of dairy systems through better understanding and management of:

- Metabolic demands, developmental and nutritional physiology, nutrient use efficiencies and productive lifetime capacity;
- Relationships between animal genetics/genomics and nutrition;
- Relationships between nutrition, production and rumen and gut microbiomes;
- Interactions between nutrition and animal genetics, rumen and gut microbiomes, and management and environmental factors;
- Improved rations and nutritional regimens featuring traditional and novel forages and feedstuffs;
- Integrated dairy production systems featuring intensive forage production, resource and nutrient conservation practices, and enhanced eco-system services.

CHAIRMAN: KEN KALSCHEUR
VICE CHAIR: MARY BETH HALL

Dairy Environment

Reduce the environmental footprint of the U.S. dairy industry and maximize relevant ecosystem services through research and technology transfer initiatives that address the prominent bio-physical, socio-economic and operational features of dairy production systems (based on costs, benefits and optimized tradeoffs between production, profitability and environmental outcomes). This might include:

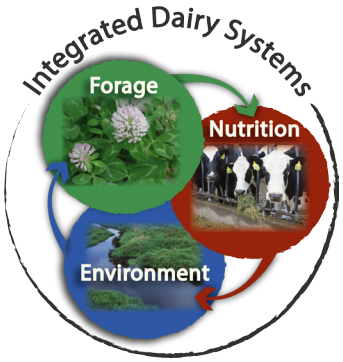
- Conceptual models that depict key transformations of energy, nutrients and other inputs into milk, meat and other outputs of dairy production systems, to identify areas of significant knowledge gaps and improve dairy system efficiency;
- Field, farm, watershed and air-shed computer simulation models to better evaluate the impact of alternative dairy production systems on environmental outcomes;
- A determination of key tradeoffs in carbon, nitrogen, and phosphorus use and loss in the feed/cow/milk/manure/environment continuum;
- Manure treatment and land application methods that reduce the environmental impacts of nutrients, pathogens, and biologically active compounds;

- Cropping systems that increase opportunities for land application of manure which are more environmentally sound; and
- On-farm dairy enterprise management systems to enhance production and reduce emissions, manure nutrient loads and environmental losses from dairy farms.

CHAIRMAN: PETE VADAS
VICE CHAIR: MARK POWELL

Integrated Dairy Systems

Improve the production capacity, efficiency and the economic and environmental sustainability of diverse, integrated dairy production systems through the development and/or parameterizing of:



- Comprehensive biophysical models that address the complex farm-scale and inter-farm interactions between forage, animal, management, logistic and environmental factors;
- Integrated forage production systems for intensive dairy production that promote increased dairy production, efficiency, and economic viability while improving eco-system services;
- Regionally adapted farm-scale and industry-based dairy and forage management systems that improve the economic and environmental sustainability of the dairy and forage industries.
- Optimize the integration of forage crop, animal and environmental factors and management practices at the farm scale.
- Determine how dairy farms best fit in the physical and economic landscape and how their interaction can be optimized to promote improved production, efficiency and ecosystem services.
- Develop analytical tools and identify the most relevant production, management and environmental factors and metrics for use in dairy production systems and related models.

CHAIRMAN: WAYNE COBLENTZ
VICE CHAIR: GEOFF BRINK

U.S. Dairy Forage Research Center

Leading the world in integrated dairy forage systems research.

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.

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 even CRIS (Current Research Information System) projects in FY 2015.

Forage characteristics that alter feed utilization, manure characteristics and environmental impacts of dairy production.

Research shows need for more uniform terms and measures of nitrogen use efficiency in agricultural production.

Whereas nitrogen is generally recognized as the most important nutrient required for productive agriculture, its widespread and sometimes excessive use over many years has impaired soil, water, and air quality at local, regional and global scales. Given the increasing scrutiny of linkages between agricultural nitrogen use and environmental degradation, an important question is, "What nitrogen use terms and calculations could be most effective in enhancing nitrogen use management, production and environmental outcomes on the farm?" USDFRC scientists have shown that two standard terms and calculations currently in use, 'nitrogen balance' and 'nitrogen surplus,' are not effective in this regard because they do not provide meaningful, quantitative information on relationships between nitrogen inputs (feed, fertilizer and manure) and outputs (milk and crops); and they do not provide a better understanding of the differences between actual nitrogen use efficiency (NUE) obtained by producers and potential NUE determined under experimental conditions.

More rigorous, uniform determinations of nitrogen use efficiency (NUE) are needed and being developed.

Discontinued use of the terms nitrogen balance and nitrogen surplus, and more rigorous, uniform determinations of nitrogen use efficiency, would permit development of educational tools that clearly convey the importance of nitrogen use efficiency to producers, nutrition consultants, crop advisors, milk processors, and policy makers. Fortunately, much of the information needed to calculate NUE for livestock and crops is already available, and improved NUE metrics are being developed.

J. MARK POWELL

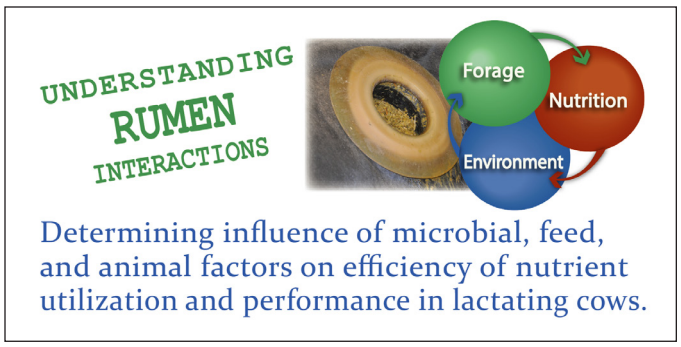
Reducing nitrogen use without reducing productivity and profitability of dairy farm systems.

Balancing nitrogen use in dairy production systems is a huge challenge with significant economic and environmental consequences. For example, if too much protein nitrogen is fed, profits decline and the excess nitrogen is excreted in manure and ends up in the atmosphere, in surface water runoff, or leached to groundwater; if too little protein is fed, milk production, feed efficiency and profits may decline.

To give producers guidelines for dealing with this balancing act, USDFRC scientists developed a computer simulation to examine the various tradeoffs with nitrogen use on farms. The results show that: 1) as animal stocking rate increases (more cows per acre), feed imports increase which leads to increased manure nitrogen excretion and nitrogen loss to the environment; 2) although fertilizer nitrogen reductions of up to 20% may reduce corn silage protein content, this practice should not impact long-term corn yield and it reduces nitrate and nitrous oxide losses by 13% to 38% -- a big environmental gain for a relatively small cost; and 3) dietary protein can be reduced on many dairy farms with no decline in milk production, but a 15% to 43% reduction in ammonia and nitrous oxide emissions may be obtained.

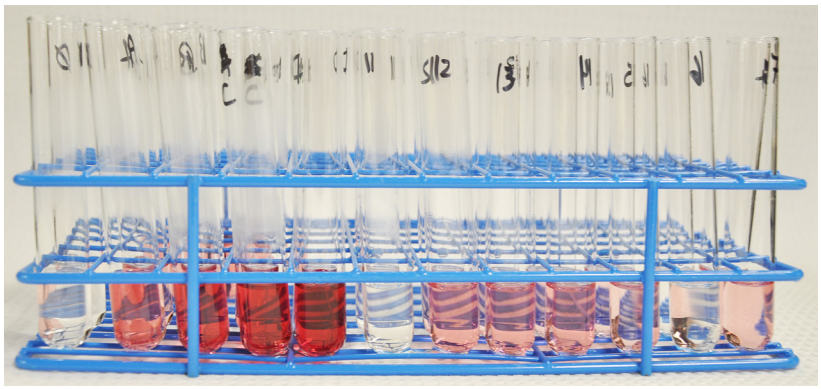
These findings give dairy producers a greater understanding of the balance between nitrogen use and loss, as well as methods they can use to improve nitrogen use efficiency, enhance profits, and reduce environmental nitrogen loss from their farms.

J. MARK POWELL



New dairy dietary starch method will benefit livestock producers and consumers.

Accurate information on feed composition is essential for formulating healthy diets for cows and for informing consumers about the nutritional qualities of the animal feeds and pet foods they purchase. In particular, starch is a carbohydrate in feeds that helps meet an animal's energy requirements, but it also can cause health disorders if overfed. Consumers and field nutritionists need reliable starch values to better evaluate and develop animal feeds and pet foods.



Researchers have improved and standardized an assay for analyzing the starch content of feedstuffs. The Association of Official Analytical Chemists International gave it First Action approval as AOAC Official Method 2014.10.

A USDFRC scientist tested and refined a recently improved starch assay to make it more reliable and consistent. She then directed a collaborative study with 14 state, commercial, and research feed analysis laboratories to fully test the method. The further improved method was found to be sufficiently precise and reliable across a range of diverse feedstuffs that an expert review panel appointed by the Association of Official Analytical Chemists International gave it First Action approval as AOAC Official Method 2014.10. It can now be used for animal feed and pet food labeling to provide producers and consumers with information needed to best feed their animals. This same method is also used by commercial feed analysis laboratories to analyze the starch content of feedstocks and ingredients used by field nutritionists to formulate rations for livestock.

MARY BETH HALL

Findings force rethinking of how researchers evaluate responses of cows to diets.

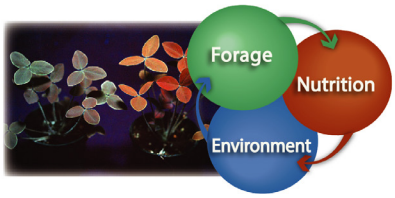
The rumen is incredibly important when describing how cattle, sheep, goats, or other ruminants respond to diets. This "fermentation compartment" contains microbes that digest fiber and other carbohydrates, build and break down proteins, and that are the source of much of a ruminant's energy and protein supply. Understanding how feeds, commercial products, and feeding management affect rumen function is key to understanding how to make the rumen work effectively to enhance animal efficiency and production. For at least 70 years, researchers measured changes in the concentrations of microbial products in rumen liquid as a way to track the fermentation process in the animal and make inferences about the effects of dietary treatments.

USDFRC scientists and collaborators at Purdue University and ADM Research demonstrated that evaluating rumen concentrations alone can be misleading because the volume of rumen liquid can differ greatly among animals and dietary treatments; consequently, similar rumen concentrations in different volumes can actually represent grossly different amounts of fermentation product, which will not be detected by measurement of concentrations. A more correct, but still imperfect measure for microbial products is concentration multiplied by the liquid volume to give a mass of product.

This research clearly establishes the need for development of accurate methods for evaluating rumen fermentation in the animal. It also calls into question the validity of previous research conclusions based on ruminal concentrations about the effects of diets and treatments on rumen fermentation. A reevaluation of the research and possibly a repeat of studies may be in order to determine the actual effects of treatments in the rumen as we seek ways to modify rumen function in order to enhance food production, efficient use of feed resources, and farm profitability.

MARY BETH HALL

BASIC FORAGE RESEARCH



Removing limitations to the efficient utilization of alfalfa and other forages in dairy production, new bioproducts, and bioenergy.

Larger tannins are more effective in binding protein and improving nitrogen use efficiency on farms.

Condensed tannins contained in common forages can improve nitrogen use efficiency on dairy farms by: 1) decreasing protein degradation during the ensiling process, 2) decreasing rapid protein degradation in the rumen, and 3) decreasing production of ammonia, an indirect source of nitrous oxide, the most potent greenhouse gas emitted from agriculture. All of the effects are attributed to the ability of condensed tannins to bind to protein and prevent inefficient degradation.

Birdsfoot trefoil is a forage that naturally contains condensed tannins.

USDFRC scientists along with collaborators at the University of Reading, used their previously developed tannin purification and characterization techniques to conclusively show that larger-sized condensed tannins more efficiently bind and precipitate protein than do smaller tannins. The composition of tannins is also important, but not as much as the overall size.

These findings are critical in determining which soluble condensed tannins in forages are most effective in preventing protein degradation and reducing ammonia production; and they will lead to further research that will help producers determine how to best utilize forages in dairy cow rations in order to maximize nitrogen use efficiency, reduce costs, improve performance, and lessen the environmental footprint of the dairy industry.

WAYNE ZELLER

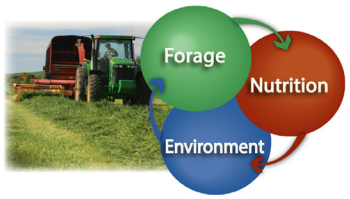
Changing the building blocks for forage cell walls increases digestibility.

Grasses frequently have a lower digestibility compared to other forages such as alfalfa due to a strong cross-linked structure in grass cell walls. A major component of the cross-linking in grass cell walls is a phenolic compound called ferulic acid which produces ferulates. Ferulates in the cell wall become attached to lignin. This creates a cross-linked network that reduces grass digestibility in dairy cows and other ruminants.

USDFRC scientists found a way to change the composition of the cell wall components in grasses, resulting in decreased ferulate attachments, fewer cross-linkages, and improved digestibility. Using modern genetic engineering tools, forage grasses could be modified in a way to increase digestibility without inhibiting yield. Such increased digestibility has both economic and environmental benefits to U.S. dairy producers with the potential to save $350 million in feed costs and reduce the amount of manure produced by about 2.8 million tons.

RONALD HATFIELD, MICHAEL SULLIVAN

REDESIGNING FORAGES AND FORAGE SYSTEMS



Redesigning forage genetics, management and harvesting for efficiency, profit, and sustainability in dairy and bioenergy production systems.

High quality grass variety released for grazing systems.

Livestock producers who use management intensive grazing systems need improved grass varieties that are more long lived in the pasture and of higher quality for growth and milk production. USDFRC scientists developed and released Hidden Valley meadow fescue to the public. This grass variety represents a significant improvement in forage quality over typical pasture forage varieties, as measured by

Hidden Valley meadow fescue represents a significant improvement in forage quality over typical pasture forage varieties

increased fiber digestibility, combined with superior cold tolerance to survive throughout the humid temperate regions of the eastern U.S. and Canada. Seed was produced and distributed as requested to seed companies for further seed multiplication and commercialization. This variety is expected to fill a significant demand for a cold-tolerant, drought-tolerant, and high-quality grass for management intensive grazing systems in the North Central and Northeastern U.S.

MICHAEL CASLER

Plant bioengineering targets for enhancing biofuel production from biomass crops.

Cell walls in plants are the world's most abundant source of carbohydrates for fermentation into biofuels. Prior to fermentation, these carbohydrates must be liberated from lignin in cell walls by harsh and costly chemical pretreatments. In laboratory studies, USDFRC scientists working with collaborators at the University of Wisconsin-Madison, found that lignin formed in part with natural plant anti-oxidants improved the production of fermentable sugars from cell walls following mild alkaline pretreatments. These results provide compelling evidence that genetic engineering of plants to form lignin that includes these anti-oxidants could significantly reduce the cost of producing biofuels from biomass crops.

JOHN GRABBER

Newly released red clover variety has improved persistence and yield.

In an effort to improve the protein content and quality of forage fed to dairy cattle, producers often grow a legume such as red clover with grass. However, improved red clover varieties are needed with better yield and persistence for both pasture and hay or silage uses. USDFRC scientists recently released an improved variety of red clover, FF 9615, which was commercially available through forage seed vendors in 2015. This variety has significantly improved persistence and yield and is expected to improve red clover productivity in the cool-humid regions of the U.S.

HEATHCLIFFE RIDAY

FF 9615 red clover (outlined in yellow) as seen in the third year of a variety trial, showing superior persistence compared to the other varieties. The good-looking plants to the right are an experimental variety currently being developed by Riday.

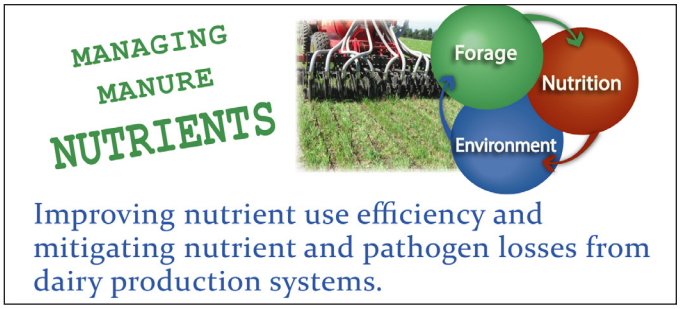
Interseeding alfalfa in corn to reduce soil erosion and phosphorus runoff, and to boost forage yields.

Producers looking to maximize the economic and environmental sustainability of their farms often utilize crop rotations where corn and cover crops are followed by several years of alfalfa production. Unfortunately, farm profitability in this system is constrained by the cost of growing cover crops with corn and by the low yield of alfalfa during its first production year. Alternatively, alfalfa interseeded into corn could provide groundcover during corn silage production and jumpstart alfalfa forage production the subsequent year, but this system has been unworkable to date because competition between the co-planted crops often leads to stand failure of alfalfa.

Recent field studies by USDFRC scientists identified prohexadione-calcium as an effective plant growth regulator for doubling the survival of alfalfa interseeded into a corn silage crop as a dual-purpose cover and forage crop. Following corn silage harvest in the fall, interseeded alfalfa reduced runoff of water and phosphorus by up to 60% and soil erosion by up to 80% from cropland and doubled first year yields of alfalfa compared to the conventional system where alfalfa was spring seeded after corn. Ongoing work is needed to maximize the reliability and profitability of this production system across diverse production systems and environmental conditions.

JOHN GRABBER

The potential of interseeding to jumpstart alfalfa production is illustrated in this photo, which was taken during the first year of alfalfa production. Alfalfa interseeded into corn the previous year is ready for harvest in late May/early June (left), whereas alfalfa spring-seeded in April is still getting established (right). First year dry matter yields of interseeded alfalfa averaged 5 tons per acre compared to only 2.4 tons per acre for spring seeded alfalfa.



Cultivar, harvest date, and nitrogen fertilization affect production and quality of fall oat.

Fall-grown oats (planted in the fall, harvested the next summer) provide windows of opportunity for livestock producers to distribute animal manures during the summer months rather than relying solely on spring or fall application strategies that book-end production of corn when wet field conditions and time stress may be considerably more problematic.

USDFRC scientists compared production of fall-grown oat forages fertilized with urea against those fertilized with bedded-pack manure obtained from a dairy-heifer-rearing facility. The bedded-pack manure used in this trial contained wooden shavings as the principal bedding material, and it exhibited no evidence of contributing significantly to fall-forage growth, resulting in apparent nitrogen-use efficiencies that were sometimes negative, thereby suggesting soil nitrogen was immobilized. Generally, the nutritive value of oat forages harvested after receiving bedded-pack manures as soil amendments compared closely to oat forages harvested from unfertilized control plots; however, forages fertilized with urea exhibited consistent growth responses to applications of a much more available nitrogen source for supporting forage growth.

Studies show value to applying dairy slurry to fields immediately after harvest, not after regrowth has started, as shown in this photo.

While adding fall-grown oat to cropping strategies or rotations may provide producers with a good opportunity to apply bedded-pack manure during summer months, producers should not expect bedded-pack manure of this type to increase yields of fall-grown oat within the same production year; any benefits will likely be realized for subsequent crops and years.

WAYNE COBLENTZ

Dairy manure can be applied to alfalfa fields, preferably right after harvest.

Dairy producers frequently ask questions about the risks associated with applying dairy-manure slurry to growing alfalfa. The risks associated with this management option can be physical (smothering), chemical (salt burn), or microbiological resulting from inoculation of silages with clostridial bacteria from the dairy slurry. Clostridial contaminated silages produce undesirable fermentation products, and are consumed poorly by livestock.

To address these questions, USDFRCscientists compared the effects of applying dairy slurry at different stages of alfalfa regrowth. Generally, timing of dairy-slurry application had little effect on silage fermentation products or the nutritive value of the silages. Counts of clostridial bacteria suggest that applications of dairy slurry onto alfalfa stubble are preferred (and least risky) compared to delayed applications on growing alfalfa. Furthermore, crop damage from salt burn, wheel traffic, or smothering is much less likely when dairy slurry is applied immediately after harvest rather than after regrowth has been initiated.

WAYNE COBLENTZ

New scientific method improves study of Clostridia levels in forage.

Clostridia bacteria in ensiled forage can negatively affect fermentation and feed quality, consequently reducing feed efficiency and dairy farm income. USDFRC scientists developed a simple and rapid method for concentrating Clostridia from ensiled alfalfa and quantifying the number of Clostridia by quantitative polymerase chain reaction. The method was effective in recovering 40% of Clostridia and will be useful for researchers working to identify management practices that reduce Clostridia in forage and the risk of undesirable fermentations.

MARK BORCHARDT

Staff Changes in FY 2015

December 2014


Jean Weinbrenner

Jean Weinbrenner, the Administrative Officer for the Madison location of the Agricultural Research Service (including USDFRC), retired after 23 years of service. She rose through the ranks of ARS administration starting as a purchasing agent in 1991. In retirement, she is gardening, reading, taking art classes and raising her golden retreiver at her home and small farm near Dodgeville, WI.

March 2015


Jacob Karlen

Jacob Karlen left to begin a new job with Rock River Laboratory. He started working at the USDFRC in 2004 as a student hourly. After receiving his BS in from the University of Wisconsin-Madison he continued working at the Center. Most recently he provided NIR support for the USDFRC and the NIRS Consortium.

April 2015


Nick Woboril

Nick Wororil, a student employee for five years, left the USDFRC upon receiving his BS from the University of Wisconsin-Madison. Nick worked in Mike Casler's lab, first as part of the summer crew, then as the crew leader for the summer student employees. He also worked as an intermin technican for a short time.

June 2015


Meridith Kruse

Meridith Kruse began working as a technician in Wayne Coblentz's lab at the Environmentally Integrated Dairy Management Research Unit in Marshfield, WI.). She is responsible for laboratory analyses of forages and feedstuffs, as well as maintenance and operation of analytical equipment (gas chromatograph and N analyzer).

July 2015


Terri Gureno

Terri Gureno was named the new Administrative Officer of the ARS Madison location, including the USDFRC. Prior to joining ARS, Terri worked as an Administrative Officer for the Peace Corps in Vanuatu, Fiji and Armenia. A native of Iowa, Terri received a BA in Political Science and French from the University of Iowa and an MS in Public Administration from the University of Oregon.

August 2015

Laurie Reinhardt joined Wayne Zeller's lab as a Physical Science Technician working primarily on the purification and analysis of tannins. A native of New York, she earned a BA in Chemistry from Cornell and a PhD in Organic Chemistry from the UW. Before coming to the USDFRC she worked at the UW's Institute for Enzyme Research.

Technology Transfer in FY 2015

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.

Co-hosted and gave presentations at the Global Farm Platform meeting. GFP is a partnership of scientists in world-leading universities and agricultural research institutions in six continents with a goal of optimizing ruminant livestock production systems. (November 24-26, 2014)

J. MARK POWELL, PETER VADAS

Participated in training workshop for 65 NRCS District Conservationists on the topic, "Legume establishment and persistence in pastures." (February 24, 2015)

GEOFFREY BRINK

Received official approval from the Association of Official Analytical Chemists International (AOAC) for a starch assay, "AOAC Official Method 2014.10 Dietary Starch in Animal Feeds and Pet Food," to be used by feed analysis laboratories. It was also posted on the AOAC web site. (April 30, 2015)

MARY BETH HALL

Created and distributed a computer simulation model, APLE-Lots, to augment the previously created Annual Phosphorus Loss Estimator (APLE) which has gained widespread use among scientists and conservationists working to reduce phosphorus runoff from ag systems. While the original model simulates dissolved and sediment-bound phosphorus loss in surface water from cropped fields and pastures, the new APLE-Lots does the same for phosphorus loss from outdoor cattle lots. (May 2015)

PETER VADAS

Authored an article, "Total volatile fatty acid concentrations are unreliable estimators of treatment effects on ruminal fermentation in vivo," that was selected as an "Editor's Choice" in the ***Journal of Dairy Science***. As such, it is freely accessible to all and was featured prominently on the journal's home page for the month. (June, 2015)

MARY BETH HALL

Conducted an on-line train-the-trainer course, "Baled silage management," to 40 Extension educators at the Virginia Tech County Extension Agent Training webinar. (June 4, 2015)

WAYNE COBLENTZ

An article in the Agronomy Journal was selected to be highlighted in a press release, "Better switchgrass, better biofuel: Looking at multiple traits to increase biofuel production," by the American Society of Agronomy. As such, it was picked up and published in several industry-related magazines and web sites. (June 17, 2015)

MICHAEL CASLER

Reported on U.S.-wide research efforts on greenhouse gas emissions at the Global Research Alliance/ Agricultural Greenhouse Gases/Livestock Research Group annual meeting. (June 22-24, 2015)

J. MARK POWELL

Entered into a license agreement with a seed company to produce and distribute a new variety of red clover, FF 9615, that was developed through a CRADA. (July 2015)

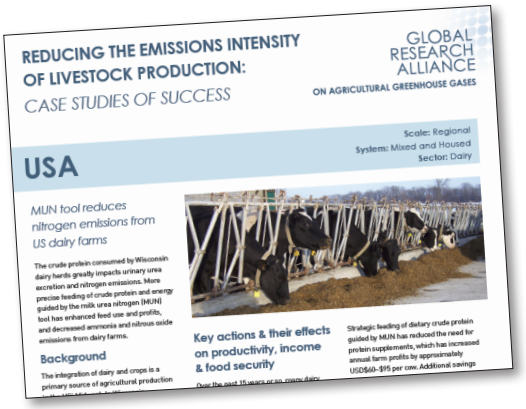
HEATHCLIFFE RIDAY

Hosted a group of 25 scientists from CenUSA and gave presentations on four different research projects at the research farm. CenUSA Bioenergy is a USDA-NIFA sponsored research project investigating the creation of a Midwestern sustainable biofuel and bioproduct systems. (July 28, 2015)

MICHAEL CASLER, PETER VADAS, J. MARK POWELL, JOHN GRABBER

Wrote a case study, "MUN tool reduces nitrogen emissions from U.S. dairy farms," to be used as an educational tool for the Global Research Alliance on Agricultural Greenhouse Gases: Reducing the emissions of livestock production. (September 2015)

J. MARK POWELL


REDUCING THE EMISSIONS INTENSITY OF LIVESTOCK PRODUCTION:
CASE STUDIES OF SUCCESS
GLOBAL RESEARCH ALLIANCE
ON AGRICULTURAL GREENHOUSE GASES
USA
Scale: Regional
System: Mixed and Housed
Sector: Dairy
MUN tool reduces nitrogen emissions from US dairy farms
Background
Key actions & their effects on productivity, income & food security

Trained three graduate students and one professor in microbiology lab techniques including the construction and operation of anaerobic continuous culture systems, preparing culture media for anaerobic bacteria, enrichment and isolation of bacteria in pure culture, and DNA isolation from ruminal contents. (throughout the year)

PAUL WEIMER

Presented two lectures and demonstrated anaerobic culture techniques to students in the Ruminant Nutritional Physiology I class at the University of Wisconsin-Madison.

PAUL WEIMER

Presentations

Presented an invited talk to about 50 faculty, students and producers at the Latin American Conference on Agricultural Production Systems and Greenhouse Gasses in Osorno, Chile. (October 3, 2014).

PAUL WEIMER

"Management of feed, cows and manure in grazing-based dairy production systems" presented to 100 researchers, Extension educators and producers at the Wisconsin Soils Summit. (October 31, 2014)

J. MARK POWELL

"Greenhouse gas emissions and mitigation from dairy farms," presented to 150 crop consultants, Extension educators and researchers at the Northeast Region Certified Crop Advisor Conference. (December 4, 2014)

J. MARK POWELL

Presented information on genomic selection in switchgrass to about 45 scientists at the International Plant and Animal Genome XXIII Conference. (January 10, 2015)

MICHAEL CASLER

American Forage & Grassland Council

"Factors that affect baled silage-fermentation," presented to about 65 forage producers and Extension educators at the American Forage and Grassland Council annual meeting. (January 13, 2015)

WAYNE COBLENTZ

"Measures of nitrogen use efficiency and environmental impacts of dairy production systems," "Effects of manure on legume productivity and persistence," and "Low-disturbance manure application methods in a corn silage-rye cover crop system" presented to 300 crop consultants, animal nutritionists, fertilizer dealers, researchers, Extension educators and producers at the Wisconsin Crop Management Conference. (January 14, 2015)

J. MARK POWELL, GEOFFREY BINK, BILL JOKELA

"Application of dairy slurry on alfalfa fields" presented to about 250 producers and manure applicators at a joint symposium of the Midwest Forage Association, the Wisconsin Custom Operators, and the Professional Nutrient Applicators Association of Wisconsin. (January 21, 2015)

WAYNE COBLENTZ

Presented information on the "Role of models and indexes for phosphorus management" to more than 200 people at the State of the Science of Phosphorus Symposium. The symposium was organized for policy makers, farmers, conservationists, scientists and journalists in the Chesapeake Bay area with the goal of presenting the latest science on phosphorus in the environment. (January 30, 2015)

PETER VADAS

"Making hay in cool, wet conditions" presented to about 250 producers and Extension educators at the Utah Hay and Forage Symposium. (January 29-30, 2015)

WAYNE COBLENTZ

Gave two presentations to about 600 producers at the Northern Indiana Grazing Conference. Topics were "Keeping pastures productive and nutritious through management" and "Nitrogen and manure: How they affect the pasture." (February 6-7, 2015)

GEOFFREY BRINK

"The rations we feed dairy cattle impact manure chemistry and nutrient dynamics in soil, water and air," presented to 200 crop consultants, animal nutritionists, state and federal agents, Extension educators and producers at the Midwest Manure Summit. (February 24, 2015)

J. MARK POWELL

"What do today's forage analyses really tell us" presented to 500 producers, industry reps, Extension educators, and university faculty at the Western Dairy Management Conference. (March 3, 2015)

MARY BETH HALL

Presented two talks on the chemistry of condensed tannins to about 80 chemists at the American Chemical Society national meeting. (March 26-28, 2014)

WAYNE ZELLER

"Best practices for using coproducts in dairy diets" presented to about 300 ethanol industry personnel, animal nutritionists and researchers at the Distillers Grains Symposium. (May 13, 2015)

KEN KALSCHEUR

"Environmental implication of crude protein content of lactating cow rations" presented to 200 dairy nutritionists, researchers, Extension educators and producers at the 29th Discover Conference on Food Animal Agriculture. (May 28, 2015)

J. MARK POWELL

AMERICAN SOCIETY FOR MICROBIOLOGY

Presented research findings on "human enteric pathogens and bovine fecal markers in non-disinfected drinking water from community and non-community wells" to about 100 research scientists and microbiologists at the general meeting of the American Society of Microbiology. (June 1, 2015)

MARK BORCHARDT

ADSA® - ASAS JOINT ANNUAL MEETING July 12–16, ORLANDO, FLORIDA

Gave two presentations to 300 nutritionists, researchers, and Extension educators at the Joint Annual Meeting of the American Dairy Science Association and American Society of Animal Science, titled "Time required for adaptation of protein metabolism" and "Divergent fermentation patterns of grass fructan, inulin, and glucose." (July 20, 2015)

GEOFFREY ZANTON, MARY BETH HALL

"The development of sustainable perennial bioenergy crops" presented to 100 producers and Extension educators at the Agronomy/Soils Field Day sponsored by the University of Wisconsin Agricultural Research Stations. (August 19, 2015)

MICHAEL CASLER

Gave a presentation to about 150 researchers at the Phytochemical Society of North America, titled "Engineering alfalfa to accumulate useful caffeic acid derivatives and characterization of hydroxycinnamoyl-CoA tranferases from legumes." (September 10, 2015)

MICHAEL SULLIVAN

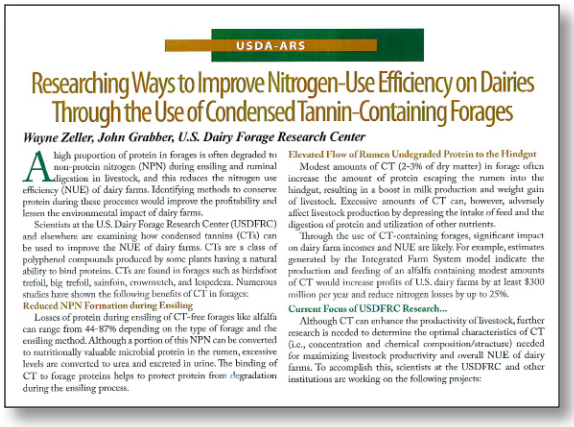
Gave two presentations to plant researchers at the 31st International EUCARPIA Symposium: Breeding in a World of Scarcity. Talks were titled, "Breeding nursery tissue collection for possible genomic analysis" and "Testing a pollen-parent fecundity distribution model on seed-parent fecundity distributions in bee-pollinated forage legume polycrosses." EUCARPIA is the European Association for Research on Plant Breeding. (September 14-17, 2015)

HEATHCLIFFE RIDAY

Provided expert insights on the use of nutrient budgets as a farm management tool at the Environmental Defense Fund workshop, "Improving Nitrogen Management in Agricultural Landscapes." (September 30, 2015)

J. MARK POWELL

Trade Journal and Association Publications


USDA-ARS

Researching Ways to Improve Nitrogen-Use Efficiency on Dairies Through the Use of Condensed Tannin-Containing Forages

Wayne Zeller, John Grabber, U.S. Dairy Forage Research Center

A high proportion of protein in forages is often degraded to non-protein nitrogen (NPN) during ensiling and ruminal digestion in livestock, and this reduces the nitrogen use efficiency (NUE) of dairy farms. Identifying methods to conserve protein during these processes would improve the profitability and lessen the environmental impact of dairy farms.

Scientists at the U.S. Dairy Forage Research Center (USDFRC) and elsewhere are examining how condensed tannins (CTs) can be used to improve the NUE of dairy farms. CTs are a class of polyphenol compounds produced by some plants having a natural ability to bind proteins. CTs are found in forages such as birdsfoot trefoil, big trefoil, sainfoin, crownvetch, and lespedeza. Numerous studies have shown the following benefits of CT in forages:

Reduced NPN Formation during Ensiling

Losses of protein during ensiling of CT-free forages like alfalfa can range from 44-87% depending on the type of forage and the ensiling method. Although a portion of this NPN can be converted to nutritionally valuable microbial protein in the rumen, excessive levels are converted to urea and excreted in urine. The binding of CT to forage proteins helps to protect protein from degradation during the ensiling process.

Elevated Flow of Rumen Undegraded Protein to the Hindgut

Modest amounts of CT (2-3% of dry matter) in forage often increase the amount of protein escaping the rumen into the hindgut, resulting in a boost in milk production and weight gain of livestock. Excessive amounts of CT can, however, adversely affect livestock production by depressing the intake of feed and the digestion of protein and utilization of other nutrients.

Through the use of CT-containing forages, significant impact on dairy farm incomes and NUE are likely. For example, estimates generated by the Integrated Farm System model indicate the production and feeding of an alfalfa containing modest amounts of CT would increase profits of U.S. dairy farms by at least $300 million per year and reduce nitrogen losses by up to 25%.

Current Focus of USDFRC Research...

Although CT can enhance the productivity of livestock, further research is needed to determine the optimal characteristics of CT (i.e., concentration and chemical composition/structure) needed for maximizing livestock productivity and overall NUE of dairy farms. To accomplish this, scientists at the USDFRC and other institutions are working on the following projects:

"Improving NUE on dairies through the use of condensed-tannin containing forages," for ***Forage Focus***, a publication of the Midwest Forage Association. (December 1, 2014)

WAYNE ZELLER, JOHN GRABBER

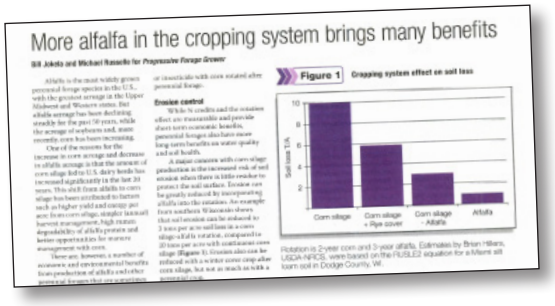
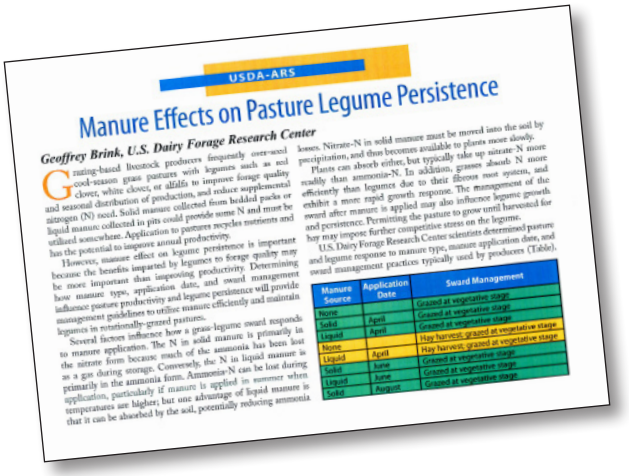

More alfalfa in the cropping system brings many benefits

Figure 1 Cropping system effect on soil loss

"More alfalfa in the cropping system brings many benefits," for ***Progressive Forage Grower***, a trade journal. (February 1, 2015)

BILL JOKELA



USDA-ARS

Manure Effects on Pasture Legume Persistence

Geoffrey Brink, U.S. Dairy Forage Research Center

Grazing-based livestock producers frequently over-seed cool-season grass pastures with legumes such as red clover, white clover, or alfalfa to improve forage quality and seasonal distribution of production, and reduce supplemental nitrogen (N) need. Solid manure collected from bedded packs or liquid manure collected in pits could provide some N and must be utilized somewhere. Application to pastures recycles nutrients and has the potential to improve annual productivity.

However, manure effect on legume persistence is important because the benefits imparted by legumes to forage quality may be more important than improving productivity. Determining how manure type, application date, and sward management influence pasture productivity and legume persistence will provide management guidelines to utilize manure efficiently and maintain legumes in rotationally-grazed pastures.

Several factors influence how a grass-legume sward responds to manure application. The N in solid manure is primarily in the nitrate form because much of the ammonia has been lost as a gas during storage. Conversely, the N in liquid manure is primarily in the ammonia form. Ammonia-N can be lost during application, particularly if manure is applied in summer when temperatures are higher, but one advantage of liquid manure is that it can be absorbed by the soil, potentially reducing ammonia losses. Nitrate-N in solid manure must be moved into the soil by precipitation, and thus becomes available to plants more slowly.

Plants can absorb either, but typically take up nitrate N more readily than ammonia-N. In addition, grasses absorb N more efficiently than legumes due to their fibrous root system, and exhibit a more rapid growth response. The management of the sward after manure is applied may also influence legume growth and persistence. Permitting the pasture to grow until harvested for hay may impose further competitive stress on the legume.

U.S. Dairy Forage Research Center scientists determined pasture and legume response to manure type, manure application date, and sward management practices typically used by producers (Table).

Manure Source	Application Date	Sward Management
None		Grazed at vegetative stage
Solid	April	Grazed at vegetative stage
Liquid	April	Grazed at vegetative stage
None		Hay harvest, grazed at vegetative stage
Liquid	April	Hay harvest, grazed at vegetative stage
Solid	June	Grazed at vegetative stage
Liquid	June	Grazed at vegetative stage
Solid	August	Grazed at vegetative stage

"Manure effects on pasture legume persistence," for ***Forage Focus***, a publication of the Midwest Forage Association. (March 1, 2015)

GEOFFREY BRINK

"Low disturbance manure application reduces runoff, maintains residue cover," for ***Forage Focus***, a publication of the Midwest Forage Association. (March 1, 2015)

BILLL JOKELA

"Redesigning forages with condensed tannins," for ***Progressive Forage Grower***, a trade journal. (March 1, 2015)

WAYNE ZELLER, JOHN GRABBER

FORAGE SHOWCASE

HAY TOOLS

Harvesting alfalfa leaves separately from stems

Ronald Hatfield for Progressive Forage Grower

Alfalfa is a high-protein perennial forage with many nutritional and environmental advantages for dairy production. But harvesting it has always been a balancing act between quality and yield due to the differences in leaves and stems. Current harvest practices to minimize total fiber (before the stem gets too mature) require cutting the alfalfa frequently (every four to five weeks). This creates an economic disadvantage to produce a high-quality forage because of the physical and mechanical inputs and the challenge of having enough good weather for the frequent harvests.

There is a need for a harvest management system that requires fewer harvests and extend the harvest window for each harvest but produces the desired amount and quality of forage. At the U.S. Dairy Forage Research Center (USDFRC) USDA Agricultural Research Service in Madison, Wisconsin, along with colleagues at the University of Wisconsin, we're in the early stages of developing a system that harvest alfalfa leaves separately from stems and creates two component streams. One that represents rich (leafy) and one that is fiber-rich (stems).

Such a system would benefit the management, agronomic and feed performance factors of the farm. Previous research at the USDFRC estimated that this strategy could reduce the risk of adverse weather on crop harvest and increase yield by capturing 30 percent of plant material typically left with current harvest practices. And this alternative reduces the frequency at which the crop

Continued Inside

Prototype leaf stripper harvesting alfalfa leaves. The remaining stems were cut and then harvested with a conventional forage harvester.

Photo courtesy of Ronald Hatfield

"Harvesting alfalfa leaves separately from stems," for ***Progressive Forage Grower***, a trade journal. (April 1, 2015)

RONALD HATFIELD

"Harvesting alfalfa leaves separately from stems," for ***Forage Focus***, a publication of the Midwest Forage Association. (May 1, 2015)

RONALD HATFIELD

"Redesigning alfalfa to reduce protein losses," for ***Progressive Forage Grower***, a trade journal. (June 1, 2015)

RONALD HATFIELD

"Dairy slurry application effect on alfalfa silage fermentation, for ***Progressive Forage Grower***, a trade journal. (July 1, 2015)

WAYNE COBLENTZ

"Understand fiber digestibility in the entire ration context," for ***Forage Focus***, a publication of the Midwest Forage Association. (August 1, 2015)

MARY BETH HALL

Outreach and Events

World Dairy Expo, Sept. 30 - Oct. 4, 2014

The USDFRC organized four technology transfer and outreach efforts at World Dairy Expo in Madison, WI. The 2014 show attracted more than 74,000 dairy producers and industry reps from across the U.S. and 94 countries. First, as an organizing partner for the Forage Analysis Superbowl, the Center organized a seminar series that attracted about 300 stakeholders and included USDFRC scientists Wayne Coblentz, John Grabber and Bill Jokela as speakers.

Second, the Center created an educational display, "You don't have to choose between saving the earth and saving money; economic and environmental sustainability go hand in hand."

Jan Pitas reviews quiz answers with two high school FFA students.

Third, the USDFRC organized the FFA Dairy Forage Quiz which brought 525 students to the educational display. This event was organized by Lori Bocher, with Geoff Brink, Ron Hatfield, and Jan Pitas helping.

Fourth, Biological Science Lab Technician Diane Amundson created a display, "Reduce, Reuse, Recycle," that highlighted the role dairy cows play in turning waste into milk, fertilizer and energy; this display was part of tours given to approximately 1,500 4th grade Madison-area school children.

Global Farm Platform Nov. 24-26, 2014

The USDFRC co-hosted (with the University of Wisconsin-Madison) the second meeting of the Global Innovation Initiative (GII) partnership on Global Farm Platforms for Sustainable Ruminant Production. As part of this meeting, Peter Vadas and Mark Powell described sustainable dairy research being conducted at the USDFRC. Also included were discussions on the USDA-funded Sustainable Dairy project of which the USDFRC is a partner.

Ukranian Dairy Association, Dec. 11, 2014

The USDFRC hosted a delegation of 14 Ukrainian dairy farmers and other agricultural representatives

Wayne Coblentz gives a presentation about the use of proprionic acid to preserve more hay.

at both the Center in Madison and the research farm in Prairie du Sac. The visit was arranged by the Food and Agriculture Organization of the United Nations. The Ukrainians learned about how agricultural research is conducted and funded in the U.S. They also visited with researchers about forage challenges and opportunities. Mark Boggess, Rick Walgenbach and Lori Bocher participated.

Martin Luther King Day of Service, January 8

Seven USDFRC employees participated in the Martin Luther King, Jr. Day of Service by volunteering at the Second Harvest Food Bank in Madison, WI. The volunteers repackaged frozen meats to be distributed at food pantries in southern Wisconsin. Participating were Lori Bocher, Geoff Brink, Julie Grogan, Ron Hatfield, Rich Muck, Chris Odt, and Mike Sullivan.

Staff Trip to Marshfield, May 5

About 30 USDFRC employees participated in a field trip to the Environmentally Integrated Dairy Management Research Unit in Marshfield, WI. Marsh-

Wagon tours allowed USDFRC staff to learn more about dairy cattle and field research being conducted at the Marshfield location.

field scientists Mark Borchardt, Wayne Coblentz, and Bill Jokela gave short presentations about their research and a tour of the lab facilities. Then everyone traveled a few miles north to the research farm where barn and field tours were given by USDFRC and University of Wisconsin collaborators.

USDFRC Stakeholder Conference May 12-13

The USDFRC held a Research and Industry Stakeholder Conference in Madison, WI. Twenty-two Stakeholders joined the USDFRC staff for discussions about emerging issues in the dairy and forage industries and how USDFRC research can best address these issues. Each Stakeholder gave a short presentation about the knowledge and experience they bring to the group, and USDFRC scientists gave updates on research initiatives.

Bill Jokela (left) and Dave Taysom discuss the manure analysis poster.

Stakeholders (including those unable to attend) include eight dairy and forage producers from Pennsylvania, Florida, Indiana, Wisconsin, Minnesota, and Idaho; one forage producer from Nebraska; eight dairy industry representatives; ten forage industry reps; and two representing conservation and environmental issues.

Baraboo Circus Heritage Days, May 16

USDFRC employees introduced youth and their parents to the importance of soil at the Baraboo Circus Heritage Days, an event that draws more than 1,000 Boy Scouts and Girl Scouts from Wisconsin and surrounding states. The youth conducted an experiment and visualized how water moves through different types of soil. Several posters emphasized the value and finite amount of soil on earth. Volunteering for the project were Mary Becker, Lori Bocher, Kris Niemann, and Lila Walters.

Lila Walters (left) and Mary Becker help two Boy Scouts with a soils experiment.

Breakfast at the Farm, June 13

More than 2,300 people attended the Sauk County 'Dairy Breakfast on the Farm' that was hosted by the USDFRC Farm near Prairie du Sac, WI. Dairy Breakfasts are a tradition in many Wisconsin counties during June Dairy Month. The meal itself was prepared by a local dairy promotion group, but several USDFRC employees organized educational displays and a self-guided walking tour. Visitors were able to see inside a cow's rumen, view rumen microbes under a microscope, and pet calves. Other displays explained how much and what a cow eats in a day.

Rick Walgenbach and Cindi Birch greeted visitors with smiles.

USDFRC employees who worked at the breakfast were: Diane Amundson, Cindi Birch, Lori Bocher, Mark Boggess, Geoff Brink, Mary Beth Hall, Ron Hatfield, Ken Kalscheur, Bryan Kloosterboer, Josh Nehring, Kris Niemann, Ali Pelletier, Jan Pitas, Rick Walgenbach, Lila Walters, and Geoff Zanton.

Mary Beth Hall (in green) describes a cow's rumen to curious visitors.

Despite the rain, more than 2,300 visited the USDFRC farm.

Students and Teachers, May 27 and July 28

On May 27, Robin Ogden, Marshfield, WI, participated in a special educational event that is organized by the Spencer (WI) FFA Chapter each year. About 115 3rd and 4th graders, 30 junior and senior high agriculture students, and 25 teachers and parents visited the research farm that ARS operates jointly with the University of Wisconsin Marshfield Agricultural Research Station. Her role was to teach everyone about rumens.

Robin Ogden teaches students about rumens.

And on July 28, she gave a similar presentation to a group of 25 teachers and volunteers with the Know & Grow Wisconsin Ag in the Classroom Summer Tour. The tour is designed to give teachers first-hand knowledge and educational resources about Wisconsin agriculture to use in their K-12 classrooms.

CenUSA Tour at Farm, July 28

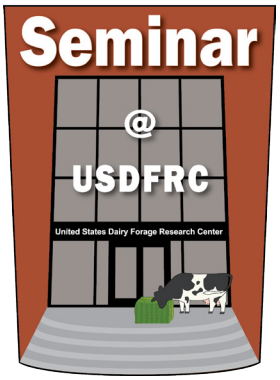
The USDFRC hosted a group from CenUSA at their research farm in Prairie du Sac, WI. CenUSA Bioenergy is a USDA-NIFA sponsored research project investigating the creation of a Midwestern sustainable biofuels and bioproducts system. Participating from the USDFRC were Michael Casler, John Grabber, Kris Niemann, Mark Powell, Peter Vadas, and Rick Walgenbach. The farm tour included stops at air emission chambers for cows; engineered barnyards for runoff research; fields with cover crop research; and nursery plots for legume breeding.

Brazilian Dairy Producers, Sept. 28

Twenty-seven Brazilian dairy producers visted the USDFRC to learn about new technologies and research in the dairy and forage industries. The producers were members of a farm organization, FAESP, that translates to "Agriculture Federation of Sao Paulo State." Mary Beth Hall, Ron Hatfield, and Ken Kalscheur spoke to the group.

Seminars at USDFRC

The U.S. Dairy Forage Research Center conducts two types of seminar series. The 'Lunch and Learn' series features USDFRC employees and graduate students giving updates about their research. The 'Seminar @ USDFRC' series invites 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 Coale

October 17, 2014

Professor of Environmental Science & Technology, Univesity of Maryland

"How science and policy affect each other: The Chesapeake Bay experience"

Jude Capper

November 12, 2014

Livestock Sustainability Consultant

"Moving the dairy industry to 2050 . . . ***sustainably****"*

Michael Lee

November 24, 2014

University of Bristol Veterinary School

"Steps to sustainable livestock: Insight from the recently established Global Farm Platform research network for sustainable ruminant systems."

Dominique Brossard

March 3, 2015

Professor of Life Sciences Communication, University of Wisconsin-Madison

"Sharing your science with the public and policy makers"

Tim Osswald

April 7, 2015

Professor of Mechanical Engineering and Co-Director of the Polymer Engineering Center, University of Wisconsin-Madison

"An overview of additive manufacturing (3D printing)"

Wayne Zeller

February 4, 2015

Research Chemist, USDFRC

"Purification, analysis, and activity of condensed tannins"

John Grabber

March 4, 2015

Research Agronomist, USDFRC

"Challenges in quantifying condensed tannins and their impact on the ruminal degradability of forage protein"

Peter Vadas

April 15, 2015

Research Soil Scientist, USDFRC

"Assessing whole-farm phosphorus loss from grazing-based dairies"

Paul Weimer

May 6, 2015

Research Microbiologist, USDFRC

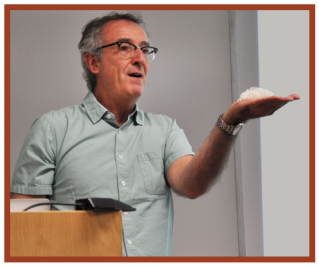
"Megasphaera elsdenii and milk fat depression: A 'good bug' gone bad?"


Frank Coale


Jude Capper


Michael Lee


Dominique Brossard


Timothy Osswald

USDFRC Contact Information

Madison

USDFRC at Madison, WI

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

1925 Linden Dr.
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

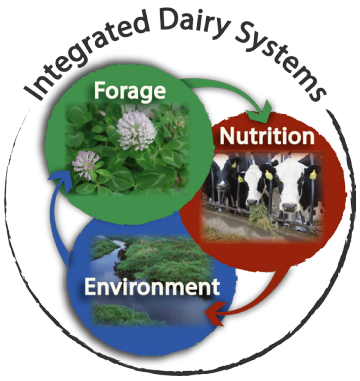
The Environmentally Integrated Dairy Management Research Unit (EIDMRU) is researching manure and nutrient management options.

2615 Yellowstone Dr.
Marshfield, WI 54449
Phone: (715) 387-4609

Stratford

USDFRC at Stratford, WI

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



Leading the world in integrated dairy forage systems research.

Web Site

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 (currently 2 vacancies) 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 (1 vacancy in FY2015).

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