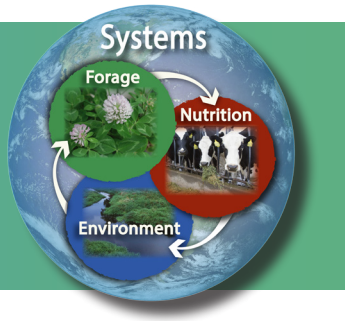
USDA
United States Department of Agriculture

Research Scientists & Projects

U.S. Dairy Forage Research Center

USDA Agricultural Research Service

Madison, Marshfield & Prairie du Sac, WI



Dairy Forage Scientists

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

Geoffrey E. Brink

Research Leader, Agronomist

Madison

Phone: (608) 890-0052
E-mail: geoffrey.brink@ars.usda.gov

BS: Agronomy, Penn State University
MS: Agronomy, University of Minnesota
PhD: Agronomy, University of Minnesota

Overall Research Goal

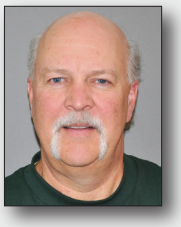
Grazing management to improve the productivity, utilization, nutritive value, and persistence of temperate pastures.

Current Projects

04 Growth of grazing heifers
05 Impact of grazing management
06 Annual grasses in dairy systems

Project descriptions pages 6-10.

Michael D. Casler



Research Plant Geneticist

Madison

Phone: (608) 890-0065
E-mail: michael.casler@ars.usda.gov

BS: Agronomy, University of Illinois
MS: Plant Breeding/Genetics, University of Minnesota
PhD: Plant Breeding/Genetics, University of Minnesota

Overall Research Goal

Improving perennial grasses for management-intensive rotational grazing systems. Also improving the yield of switchgrass to make it a more sustainable feedstock for bioenergy production.

Current Projects

04 Growth of grazing heifers
10 Meadow fescue breeding program
11 Non-flowering orchardgrass breeding program
15 Switchgrass breeding for biomass yield

John H. Grabber

Research Agronomist

Madison

Phone: (608) 890-0059
E-Mail: john.grabber@ars.usda.gov

BS: Agronomy, University of Connecticut
MS: Plant Science, University of Connecticut
PhD: Agronomy, Pennsylvania State University

Overall Research Goal

Improving forage plants and forage-based cropping systems for enhanced profitability and sustainability in dairy production systems.

Current Projects

01 Interseeding alfalfa with silage corn
13 Protecting protein in alfalfa using condensed tannins
14 Improved methods for characterizing tannins and forage quality
28 Impact of tannins on soil and subsequent crops

Leading the world in integrated dairy forage systems research.

Ronald D. Hatfield

Research Leader, Plant Physiologist

Madison

Phone: (608) 890-0062
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BS: Secondary Ed. (Science), Kansas State University
MS: Botany-Plant Physiology, Iowa State University
PhD: Botany-Plant Physiology, Iowa State University

Overall Research Goal

Increasing the utilization of forages, with an emphasis on alfalfa, in dairy production systems in an effort to improve environ- mental and economic sustainability.

Current Projects

02 Separating alfalfa leaves from stems at harvest
12 Protecting protein in alfalfa using PPO/o-diphenols

Project descriptions pages 6-10.

Heathcliffe Riday

Research Geneticist

Madison

Phone: (608) 890-0077
E-Mail: heathcliffe.riday@ars.usda.gov

BS: Conservation Biology, Brigham Young University
MS: Agronomy-Plant Breeding, Iowa State University
PhD: Agronomy-Plant Breeding, Iowa State University

Overall Research Goal

Improving forage legumes for hay, silage, and grazed pasture systems with enhanced value for dairy production, profitability and sustainability.

Current Projects

07 Red clover breeding program
08 Other forage legumes
09 Developing improved techniques for plant breeding

Michael Sullivan

Research Molecular Geneticist

Madison

Phone: (608) 890-0046
E-Mail: michael.sullivan@ars.usda.gov

BS: BSChem, BS Molecular Biology and Biochemistry, Purdue University
PhD: Cell & Molecular Biology, Univ. of Wis.– Madison

Overall Research Goal

Designing forage plants with increased protein protection for enhanced profitability and sustainability in dairy production systems

Current Projects

12 Protecting protein in alfalfa using PPO/o-diphenols
13 Protecting protein in alfalfa using condensed tannins

Wayne E. Zeller

Research Chemist

Madison

Phone: (608) 890-0071
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BA: Biology, Chemistry, Mathematics, Westmar College
PhD: Chemistry, University of Nebraska-Lincoln

Overall Research Goal

Improving nitrogen use efficiency in dairy forage systems by investigating the use of condensed tannins in forages or dairy cattle feed.

Current Projects

13 Protecting protein in alfalfa using condensed tannins
14 Improved methods for characterizing tannins and forage quality

Leading the world in integrated dairy forage systems research.

Dairy Nutrition and Dairy Forage Scientist

Wayne K. Coblentz

Research Leader,* *Dairy Scientist
and ***Agronomist***

Marshfield

Phone: (715) 384-5784
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BA: Chemistry, Western Maryland College
MS: Dairy Science, Pennsylvania State University
PhD: Forage Agronomy, Kansas State University

Overall Research Goal

Investigating the use of traditional and alternative (cereal-grain) forages: 1) in diets for dairy heifers or lactating cows; 2) to open opportunities for land application of manure; 3) to provide ground cover and improve the efficiency of nutrient capture, thereby reducing environmental risk.

Current Projects

03 Retention of dry matter and nutrients in hay and silage
04 Growth of grazing heifers
18 Fiber digestibility of triticale
24 Management of dairy heifers
26 Assessing new sand versus recycled products of manure separation as bedding for lactating cows

Project descriptions pages 6-10.

Dairy Nutrition Scientists

Mission: Enhance the production capacity, efficiency, product quality, and sustainability of dairy systems through better understanding and management of the factors and relationships affecting dairy cattle nutrition.

Mary Beth Hall

Dairy Scientist

Madison

Phone: (608) 890-0078
E-Mail: marybeth.hall@ars.usda.gov

BS: Animal Science, Cornell University
MS: Animal Science, Virginia Tech
PhD: Animal Science, Cornell University

Overall Research Goal

Identifying the impact of protein by carbohydrate interactions on microbial and animal production performance in lactating dairy cows.

Current Projects

21 How changes in the balance of carbohydrates and protein affect rumen microbial production of nutrients
20 RDP, RUP, and different sources of carbohydrate

Kenneth Kalscheur

Research Animal Scientist

Madison

Phone: (608) 890-0066
E-Mail: kenneth.kalscheur@ars.usda.gov

BS: Dairy Science, University of Wisconsin-Madison
MS: Animal Sciences, University of Maryland
PhD: Animal Sciences, University of Maryland

Overall Research Goal

Improving fiber digestion and nutrient utilization in high-producing cows; identifying how forage quality affects feed conversion efficiency and ruminal digestion.

Current Projects

06 Annual grasses in dairy systems
16 Comparing canola meal and soybean meal as primary protein sources in dairy cow diets
17 Using sudangrass to replace a portion of corn silage in dairy cow diets
19 Effect of forage fiber digestibility and dietary starch in lactating dairy cow diets

Leading the world in integrated dairy forage systems research.

Wenli Li

Research Animal Geneticist

Madison

Phone: (608) 890-0056
E-Mail: wenli.li@ars.usda.gov

BS: Biology, Yunnan University, China
MS: Plant Developmental Biology, University of Georgia
PhD: Population Genomics, Indiana University

Overall Research Goal

To identify genetic/genomic determinants of dairy feed efficiency and production using a high-throughput sequencing- based strategy.

Proposed Projects

Identify molecular mechanisms in dairy cattle that are associated with feed efficiency, milk quantity and quality, and nutrient utilization.

Study the interplay between dairy cattle genomic factors and rumen microbial diversity.

Paul J. Weimer

Research Microbiologist

Madison

Phone: (608) 890-0075
E-Mail: paul.weimer@ars.usda.gov

BS: Biology, Carroll College
MS: Bacteriology, University of Wisconsin-Madison
PhD: Bacteriology, University of Wisconsin-Madison

Overall Research Goal

Understanding microbial population dynamics and microbial degradation of fiber in the rumen in order to improve feed efficiency and milk production in dairy cows.

Current Projects

Project descriptions pages 6-10.

Geoffrey Zanton

Research Animal Scientist

Madison

Phone: (608) 890-0053
E-mail: geoffrey.zanton@ars.usda.gov

BS: Animal Science, University of Wisconsin-Madison
PhD: Dairy & Animal Science, Penn State University

Overall Research Goal

Increasing the nutritional efficiency of protein utilization in the lactating dairy cow.

Current Projects

USDFRC Mission: 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.

Leading the world in integrated dairy forage systems research.

Dairy Environment Scientists

Mission: Reduce the environmental footprint of the US dairy industry and maximize relevant ecosystem services through research and technology transfer initiatives addressing the prominent bio-physical, socio-economic, and operational features of dairy production systems.

Mark Borchardt

Research Microbiologist

Marshfield

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BS: Horticulture, University of Wisconsin-Madison
PhD: Aquatic Ecology, University of Vermont
Post-Doc: Aquatic Ecology, Philadelphia Academy of Natural Sciences

Overall Research Goal

Investigating the fate, transport, and health effects of waterborne agricultural zoonotic pathogens.

Current Projects

31 Airborne pathogens from dairy manure irrigation
32 Degree and sources of groundwater contamination in the karst regions of eastern Wisconsin
26 Assessing new sand versus recycled products of manure separation as bedding for lactating cows

Project descriptions pages 6-10.

Tucker Burch

Research Agricultural Engineer

Marshfield

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BS: Civil Engineering, Marquette University
PhD: Civil Engineering, University of Minnesota

Overall Research Goals

Microbiological issues related to manure management, and reducing costs/optimizing the value of manure.

Current Projects

31 Airborne pathogens from dairy manure irrigation
32 Degree and sources of groundwater contamination in the karst regions of eastern Wisconsin

J. Mark Powell

Research Soil Scientist

Madison

Phone: (608) 890-0070
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BS: Plant Science, Clemson University
MPS: Int'l Agriculture/Soil Fertility, Cornell University
PhD: Agronomy, Texas A & M University

Overall Research Goal

Interdisciplinary research in soil, crop and animal science using an agroecological approach to understand wholefarm nutrient cycling and to develop integrated production systems that sustain natural resources and profitable livestock production.

Current Projects

27 Understanding the dynamics between crops, cows, and recycling manure nutrients
28 Impact of tannins on soil and subsequent crops
30 Reducing nutrient losses from outdoor cattle lots

Peter Vadas

Research Soil Scientist

Madison

Phone: (608) 890-0069
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BS: Crop/Soil Environmental Science, Virginia Tech
MS: Soil Science, University of Delaware
PhD: Soil Science, University of Delaware

Overall Research Goals

Combining experiments and computer modeling to assess nutrient cycling and environmental impacts of agricultural systems, and integrating biophysical and economic analysis to assess farm scale tradeoffs and sustainability.

Current Projects

27 Understanding the dynamics between crops, cows, and recycling manure nutrients
29 Winter manure runoff study
30 Reducing nutrient losses from outdoor cattle lots

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Related Research Projects

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USDA Agricultural Research Service

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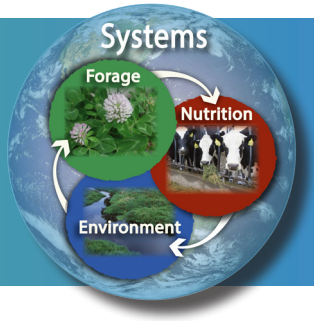

Dairy Forage Projects

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

Forage Management, Harvest, and Storage

01 Interseeding alfalfa with silage corn.

This is a long-term project to develop a system for corn/alfalfa rotations in which alfalfa is established by interseeding into silage corn to jump start it into full forage production the following year. Our previous research identified a growth regulator that can be used to enhance alfalfa survival during its establishment in corn. Now, with collaborators in MI and PA, we are evaluating alfalfa varieties to see which work best in this system. We are also evaluating herbicide options for weed control, refining nitrogen fertilizer management, identifying optimal planting and harvest times, and assessing soil conservation and water quality benefits.

John Grabber

02 Separating alfalfa leaves from stems at harvest.

Harvesting alfalfa is a balancing act between quality and yield due to differences in leaves and stems. Harvest practices to minimize total fiber (before stems get too mature) require cutting the alfalfa frequently (every 4-5 weeks), adding cost and the challenge of having good weather for frequent harvests. With collaborators at the University of Wisconsin-Madison, we are developing a system that harvests alfalfa leaves separately from stems and creates two component streams: One that is protein-rich (leaves) and one that is fiber-rich (stems).

Currently we are measuring the forage quality of ensiled alfalfa leaves, stems, and the whole plant harvested during an entire growing season (3 cuttings) at 3 different stages of maturity (bud stage, early bloom, and >50% bloom). We are also building the next generation prototype harvester that will enable us to make more harvest-time adjustments.

Ron Hatfield

03 Retention of dry matter/nutrients in hay/silage.

We are wrapping up studies with baled silages that have evaluated: 1) effects of delays in wrapping on baled silage fermentation and quality; 2) the use of oxygen limiting barrier plastics; 3) how many layers of plastic are needed for adequate preservation of baled silage; and 4) preservatives for large hay packages.

Wayne Coblentz

Grazing Management

04 Growth of grazing heifers.

The first year of a 2-year study at Marshfield, WI, to measure the growth of dairy heifers grazing orchardgrass and Hidden Valley meadow fescue, an improved variety previously developed at the USDFRC, under a management intensive rotational grazing system.

Geoff Brink, Wayne Coblentz, Michael Casler

05 Impact of grazing management.

The third year of a 3-year study assessing the impact of forage maturity and stocking density on soil health and on legume persistence and productivity. Legumes included in the grazing study are alfalfa, white clover, red clover, and birdsfoot trefoil.

Geoff Brink

06 Annual grasses in dairy systems.

The first year of a 2-year study to evaluate various warm season annual grasses and their response to harvest management. Grasses being evaluated are sudangrass, millet, and a sorghum-sudangrass hybrid. As part of this study, we have already evaluated the substitution value of sudangrass for corn silage in dairy cow rations.

Geoff Brink, Ken Kalscheur

Improving Pasture Grasses and Legumes

Grazing places unique stresses on pasture plants, and, due to limited market potential, the large commercial plant breeding companies are not positioned to provide these stresses as part of their selection program. The USDFRC is working to fill this void with its pasture grass and legume breeding programs.

07 Red clover breeding program.

After alfalfa, red clover is the most widely used forage legume in the U.S. because it generally yields more compared to other non-alfalfa forage legumes, and it is the easiest forage legume to establish particularly in mixtures or intercropped with other forages or crops. Previously we developed a new variety, FF 9615, which became commercially available through forage seed vendors in 2015. This variety has significantly improved persistence and yield. We continue to breed for improved persistence, fall growth, and yield. And we are developing a red cover variety that is resistant to the commonly used broadleaf herbicide, 2, 4-D; the goal is to give grazing-based producers an opportunity for weed control that does not kill the red clover in their grass-legume mixed pastures.

Heathcliffe Riday

Leading the world in integrated dairy forage systems research.

08 Other forage legumes.

We are also breeding for improved traits in yellow flowered alfalfa or "falcata" – better yield and uprightness, less fall dormancy; Kura clover – improved establishment and seed yield; birdsfoot trefoil – better yield and ability to grow well with grasses; and hairy vetch – for use as a winter annual in northern climates for green manure, cover crop, and/or forage.

Heathcliffe Riday

09 Developing improved techniques for plant breeding.

We use our extensive breeding programs to test out new breeding methodologies, particularly incorporating DNA markers during breeding to improve breeding efficiency and gains.

Heathcliffe Riday

10 Meadow fescue breeding program.

The goal of this research is to develop cultivars that have acceptable seed production in Oregon, combined with increased forage yield in the northcentral U.S. Meadow fescue is a very popular pasture grass, and our aim is to increase its productivity in pasture situations. Our first release, Hidden Valley, performed well in the northcentral U.S. but failed to produce a sufficient seed crop in Oregon. More recently we have formed a partnership with a seed company and are developing a variety for both seed production and improved pasture traits, with the first cultivar expected for release in 2017 or 2018.

Michael Casler

11 Non-flowering orchardgrass.

The goal of the orchardgrass breeding program is to develop a non-flowering type of orchardgrass to simplify pasture management in the spring when orchardgrass normally flowers profusely; this heavy and early flowering limits pasture management options. We have formed a partnership with a seed company to alternately select for seed production and disease resistance in Oregon and sparse flowering and high forage yield in Wisconsin. We will evaluate these lines again in 2017, but the 2016 results suggest that we may be ready for the first cultivar release in 2018 or 2019.

Michael Casler

Protecting Protein in Alfalfa

12 Using PPO/*o*-diphenol.

Past research at the USDFRC demonstrated that 1) very little protein is degraded in red clover during ensiling and rumen fermentation; 2) that this process is due to an enzyme called polyphenol oxidase (PPO) and an abundance of its substrate, special chemicals called *o*-diphenols that are naturally present in red clover; and 3) the PPO gene can be successfully transferred to alfalfa, the major perennial forage legume crop in the U.S.

We currently are working on ways to introduce a supply of *o*-diphenols since alfalfa does not produce such PPO substrates. We have identified the gene that is responsible for the accumulation of phaselic acid, an *o*-diphenol, in red clover. And we have inserted that gene into alfalfa. But we determined that the process also requires down regulation of an alfalfa gene in order to achieve the desired effect. We are still working on this system, but we are also looking for other genes that would function on their own (that is, without needing to down regulate an alfalfa gene) to cause alfalfa to produce a necessary *o*-diphenol substrate.

In addition, we are trying to gain a better understanding of how the PPO/*o*-diphenol mechanism impacts specific proteases (enzymes that cause protein degradation); if it's more effective knocking out several proteases with one treatment or targeting specific proteases; and if some proteases are a better target than others.

Michael Sullivan, Ron Hatfield

13 Using condensed tannins.

Condensed tannins are natural protein-binding substances present in some forage species; they have been found to protect forage protein from degradation during both silage fermentation and rumen digestion. The goal of our research is to decipher what chemical characteristics and concentrations of condensed tannins will be optimal for improving protein utilization and milk production of dairy cattle.

Because plants produce many different types of condensed tannins, we currently are isolating highly purified tannins with different chemical properties from a variety of forages, foods, and woody plants. These isolated tannins will be evaluated in mini-silo experiments with macerated alfalfa to determine which preparations best protect protein during silage fermentation. We also will be incubating tannins and isolated alfalfa proteins with rumen fluid and with various digestive enzymes to identify what types of condensed tannins best protect protein during ruminal digestion and yet permit extensive digestion of protein and absorption of amino acids in the gastrointestinal tract of cattle. These laboratory experiments will ultimately help to direct plant breeding and genetic engineering efforts to express the most desirable types of condensed tannins in forages.

Wayne Zeller, John Grabber, Geoff Zanton, Michael Sullivan

14 Improved methods for characterizing tannins and forage quality.

Methods include an improved HCl-butanol-acetone assay for quantifying concentrations of condensed tannins, and improvement of existing methods (thiolysis/phloroglucinolysis) for the assessment of condensed tannin composition and purity. We are also refining and validating protein degradability assays so that rations for dairy cattle can be properly formulated with tannin containing forages and other feeds.

John Grabber, Wayne Zeller, Geoff Zanton

Other Forage Uses

15 Switchgrass breeding for biomass yield.

The goal of this program is to increase switchgrass biomass production to 10 tons per acre by 2030 in support of perennial and sustainable bioenergy production systems. We have reached the halfway point to that goal with the development of late-flowering switchgrass varieties that flower about 3 to 4 weeks later than local varieties, extending the growing season. The next steps will be: to improve the winter hardiness of later flowering populations that flower about 5-7 weeks after local varieties, i.e. just before killing frost; and to speed the selection process by using genomewide markers and genomic prediction procedures to predict breeding value of superior genotypes.

Michael Casler

Leading the world in integrated dairy forage systems research.

Dairy Nutrition Projects

Mission: Enhance the production capacity, efficiency, product quality and sustainability of dairy systems through better understanding and management of the factors and relationships affecting dairy cattle nutrition.

Alternative Feedstuffs

16 Comparing canola meal and soybean meal as primary protein sources in dairy cow diets.

We have evaluated the replacement of soybean meal with canola meal in diets formulated at either a high protein or low protein concentration on performance of early lactation dairy cows. Cows fed canola meal diets produced 9.9 lbs/d more milk than cows fed soybean meal diets. Feed intake and feed efficiency tended to be greater for cows fed canola meal diets compared to cows fed soybean meal diets. Currently we are evaluating blood parameters from this experiment to provide insight into what amino acids were provided to and used by the mammary gland. We will also characterize dietary effects on the mobilization of body reserves during the transition period. Following these steps, we will continue to investigate and exploit the unique characteristics of canola meal to increase productivity and efficiency of dairy cow systems.

Ken Kalscheur

17 Using sudangrass to replace a portion of corn silage in dairy cow diets.

Finding forages that use less water to grow and are high in digestibility are needed as alternatives to corn silage. We are evaluating changes in dry matter intake, milk production, milk composition, feed efficiency, and nutrient digestibility/excretion when brown midrib sudangrass replaces a portion of corn silage in the diets of high-producing dairy cows.

Ken Kalscheur


Inside rumen. Photo courtesy Chr. Hansen

18 Fiber digestibility of triticale.

In recent years, many producers started using triticale as a cover crop after silage corn is harvested. But little is known about its fiber digestibility, making it more difficult to balance rations for dairy cattle. Currently, we are evaluating the ruminal disappearance kinetics of forage fiber for triticale harvested at different growth stages during spring.

Wayne Coblentz

Rumen Interactions

19 Effect of forage fiber digestibility and dietary starch in lactating dairy cow diets.

1) Corn silage comprises 40 to 70% of the forage DM in the diets of lactating dairy cows, and silage produced from brown midrib (BMR) hybrids contains a reduced lignin concentration and an increased in vitro NDF digestibility when compared to conventional corn silage. 2) Lower starch diets improve rumen health, but they may reduce milk production. We are investigating how differences in fiber digestibility (BMR corn silage vs. conventional corn silage) and dietary starch concentration impact lactation performance and nutrient digestion in an effort to demonstrate how lower starch diets may improve fiber digestion while maintaining high milk production.

Ken Kalscheur

20 RDP, RUP, and different sources of carbohydrate.

The scientific literature shows mixed results for a cow's response to exchanging rumen degradable protein (RDP) with rumen undegradable protein (RUP) in the diet, or for changing the carbohydrate source from starch (corn) to sugar (molasses). Sources of energy such as molasses and ground corn may ferment differently in the rumen and may depend on levels of RDP/RUP. We are trying to determine the effects of these dietary changes on microbial protein synthesis, rumen fermentation, and nitrogen balance in lactating cows. A separate study measured milk production changes with the different diets.

Geoff Zanton, Mary Beth Hall

Rumen Microbes

21 How changes in the balance of carbohydrates and protein affect rumen microbial production of nutrients.

We are currently conducting a series of in vitro and in vivo studies on how rumen microbes and cow performance respond to changes in degradable protein relative to fermentable carbohydrate. As we change the amount and type of rumen degradable protein given to microbes, we measure how this changes: 1) the amount of microbial protein they produce; 2) the amount and type of organic acids they produce; 3) how much glycogen is produced; and 4) how the carbohydrates differ in their rate of use by the microbes. In lactating dairy cows we measure how dietary changes in degradable protein and carbohydrate type affect: 1) animal lactation performance; 2) feed efficiency; 3) digestibility of the diet; 4) animal behavior that may affect digestion; and 5) ruminal kinetics that affect the nutrient supply to the cow. The answers will help us determine how to better feed lactating cows so that their rumen microbes produce the nutrients that improve performance and efficiency of the cow.

Mary Beth Hall, Paul Weimer

22 Changes in milk production efficiency and ruminal bacterial community composition.

In a recent study, we performed a near total switch of the rumen contents of cows identified as high or low in feed efficiency. The low efficiency cows became more efficient, and the high efficiency cows became less efficient. But the rumen microbial community compositions reverted back to their original states within a week, as did their feed efficiency. With this study we have shown that differences in milk production and feed efficiency are largely due to differences in the cows' rumen microbes. We also know that you can't permanently change the rumen bacterial community composition in cows. Our next study will be to dose newborn calves with known microbial community compositions to see if prescribed microbial communities can be established in dairy cattle.

Paul Weimer

Leading the world in integrated dairy forage systems research.

23 Identifying rumen microbes that efficiently degrade hemicellulose.

Hemicelluloses are a major component of plant biomass, but hemicellulose fermentation in ruminants is not completely understood. In a two-part study we are: 1) taking pure cultures of five rumen microbes that are considered to be good at degrading different hemicelluloses and measuring how well they actually degrade them; and 2) taking rumen fluid with a mixed population of microbes and determining which microbes in the mix are best at degrading these hemicelluloses. We have observed that species that work well at degrading hemicellulose in pure culture are not that effective in a mixed culture, and vice versa; this seems to indicate that there are interactions with other species in mixed culture that determine extent of degradation. Our next step is to identify the bacterial species in mixed culture that cooperate with the hemicellulose degraders in enhancing hemicellulose degradation.

Paul Weimer

Miscellaneous

24 Management of dairy heifers.

Current projects are evaluating the effects of overstocking in heifer growth performance, and sorting behaviors of heifers offered diets with low-energy dilutants.

Wayne Coblentz

25 Analyzing experimental designs.

Among dairy nutritionists and in the scientific literature, there is much debate about change-over experimental designs in which cows receive multiple dietary treatments within one experiment. Many believe that study results could be skewed because the cow is reacting to the change in diet, not the diet itself; but there is very little data to provide a conclusive answer. We have conducted two studies comparing the effect of experimental design (change-over versus continuous) while also looking at different issues related to protein nutrition. So far, these experiments have provided an interesting view of how cows adapt to diet changes, however the impact of experimental design on decisions concerning the cows' responses to diet is still inconclusive.

Geoff Zanton

26 Assessing new sand versus recycled products of manure separation as bedding for lactating cows.

New sand is the industry standard for freestall bedding in lactating dairy cow barns. Other bedding sources, including recycled sand or organic solids from manure separation, are readily available potential alternatives. Organic solids are less abrasive to manure handling equipment; but there is concern about microorganisms growing within these solids that could cause mastitis in lactating cows. We are in the 3rd year of a 4-year study to compare the different bedding systems by measuring stall and cow cleanliness, cow comfort and locomotion scores, somatic cell count and incidence of mastitis, the survival and transfer of pathogens, and labor and economics.

Wayne Coblentz, Mark Borchardt

USDFRC Mission: 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.

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Dairy Environment Projects

Mission: Reduce the environmental footprint of the US dairy industry and maximize relevant ecosystem services through research and technology transfer initiatives addressing the prominent bio-physical, socio-economic and operational features of dairy production systems.

Tracking N through the whole farm system

Working with collaborators in the ARS Dairy Agroecosystems Working Group (ID, MN, PA, WI), we are conducting research and using on-farm measurements and computer modeling in an effort to improve nitrogen use efficiency and understand how nitrogen moves through cows, crops, soil, water, and the atmosphere. With all of the talk about sustainable agriculture, we want to quantify what needs to be done and how much improvement in nitrogen use efficiency is biologically feasible. Below are two examples.

27 Understanding the dynamics between crops, cows, and recycling manure nutrients.

Research has already shown that changes in dairy cattle diets can reduce nutrient losses; for example, more grain in the diet leads to a decrease in methane emissions from cows. But what impact do dietary changes have on the rest of the whole farm system, such as milk protein, manure nitrogen, and nitrogen transformations in the air, soil and water? We are currently conducting a holistic analysis of nitrogen use, conservation, and loss throughout the cycle of growing crops to feeding cows to applying manure back to the field. This will serve as a benchmark and will help other researchers and dairy cattle nutritionists consider the tradeoffs associated with shifting dairy cattle diets to achieve a particular environmental goal.

J. Mark Powell, Peter Vadas

28 Impact of tannins on soil and subsequent crops.

Research has already shown that condensed tannins can improve nitrogen use efficiency in dairy cows. But do changes in manure chemistry (from feeding tannins) have an impact after manure is applied to the land? We are currently looking at nitrogen dynamics in the soil and nitrogen contributions to subsequent corn crops to see how tannins in the diet ultimately impact nitrogen availability.

John Grabber, J. Mark Powell

29 Winter manure runoff study.

We are now in Year 3 of a 4-year project with the University of Wisconsin-Madison. We know there is a high potential for nutrient loss in runoff from manure that is land applied in the winter. The study aims to more accurately quantify these losses and to improve our understanding of how different variables impact runoff so that there is sufficient scientific data if manure management policy is needed.

Peter Vadas

30 Reducing nutrient losses from outdoor cattle lots.

On many dairy farms, manure that is deposited on unpaved outdoor cattle lots is never collected, and this leads to nutrient losses due to gaseous emissions, leaching, and runoff from the manure. We are currently wrapping up a 4-year trial in which we measured fluxes of carbon dioxide, methane, nitrous oxide, and ammonia from experimental barnyards; bark or sand, with their different absorption and infiltration capacities compared to soil, were added to the barnyards for comparison. Tradeoffs between gas emissions, manure nutrient runoff and leaching, and cow comfort must be more fully assessed before recommending overall beneficial practices for barnyard construction and management.

J. Mark Powell, Peter Vadas

31 Airborne pathogens from dairy manure aerial irrigation and the human health risk.

Land applying manure via irrigation is a growing practice on dairy farms; the practice offers some environmental and economic benefits. But many are concerned about the human health risk due to the potential transport of pathogens, gases, and particulates. We recently completed a study to measure the type and concentration of airborne pathogens found downwind from manure irrigation sites, and to assess the human health risk based on these findings.

Mark Borchardt, Tucker Burch

32 Degree and sources of groundwater contamination in the karst regions of eastern Wisconsin.

Karst is a geological landscape created when water dissolves rocks, often along fractures that can act as conduits to groundwater. We are currently conducting research in Kewaunee County, WI, to determine the level of fecal contamination in household private wells and determine the primary source of contamination, dairy manure or septic systems.

Mark Borchardt, Tucker Burch

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