United States Department of Agriculture

The Year in Review

U.S. Dairy Forage Research Center

Agricultural Research Service

Fiscal Year 2014

October 2013 through September 2014

U.S. Dairy Forage Research Center

Unique in Our Field

The U.S. Dairy Forage Research Center is one of about 90 units in the Agricultural Research Service (ARS) of the U.S. Department of Agriculture (USDA). We're the only USDA-ARS unit with the mission of improving forage use by dairy cattle.

Our Mission

To develop knowledge and tools to enhance sustainable and competitive dairy forage systems that protect the environment, promote animal health, and ensure a safe, healthy food supply.

Web Site

www.ars.usda.gov/mwa/madison/dfrc

Five Locations

The U.S. Dairy Forage Research Center conducts research at five locations in Wisconsin but is managed as one Center. The five locations are:

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

Madison

USDFRC at Prairie du Sac, WI

The research farm consists of 2,006 acres and about 350 cows in milk.

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

Prairie du Sac

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

Marshfield

USDFRC at Stratford, WI

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

USDFRC at Milwaukee, WI

Great Lakes Aquaculture Lab located at the University of Wisconsin-Milwaukee School of Fresh Water Sciences.

600 East Greenfield Ave.
Milwaukee, WI 53204
Phone: (414)382-1767

Stratford

Dairy Forage Research Scientists

Research at the U.S. Dairy Forage Research Center is directed by 18 scientists who manage the personnel and activities in their respective laboratories in Madison, Marshfield and Milwaukee, 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.

Mark Borchardt
Research Microbiologist
Marshfield, WI
(715) 387-4943
mark.borchardt@ars.usda.gov

Geoffrey E. Brink
Research Agronomist
Madison, WI
(608) 890-0052
geoffrey.brink@ars.usda.gov

Michael D. Casler
Research Plant Geneticist
Madison, WI
(608) 890-0065
michael.casler@ars.usda.gov

Wayne K. Coblentz
Research Agronomist/Dairy Scientist
Research Leader, Environmentally Integrated Dairy Management Research Unit
Marshfield, WI
(715) 384-5784
wayne.coblentz@ars.usda.gov

John H. Grabber
Research Agronomist
Madison, WI
(608) 890-0059
john.grabber@ars.usda.gov

Mary Beth Hall
Research Dairy Scientist
Madison, WI
(608) 890-0078
marybeth.hall@ars.usda.gov

Ronald D. Hatfield
Research Plant Physiologist
Research Leader, Cell Wall Biology and Utilization Research Unit
Madison, WI
(608) 890-0062
ronald.hatfield@ars.usda.gov

Bill Jokela
Research Soil Scientist
Marshfield, WI
(715) 384-5954
bill.jokela@ars.usda.gov

Kenneth Kalscheur
Research Dairy Scientist
Madison, WI
(608) 890-0066
kenneth.kalscheur@ars.usda.gov

Richard E. Muck
Agricultural Engineer
Research Leader, Dairy Forage and Aquaculture Research Unit
Madison, WI
(608) 890-0067
richard.muck@ars.usda.gov

J. Mark Powell
Research Soil Scientist
Madison, WI
(608) 890-0070
mark.powell@ars.usda.gov

Heathcliffe Riday
Research Geneticist
Madison, WI
(608) 890-0077
heathcliffe.riday@ars.usda.gov

Michael Sullivan
Research Molecular Geneticist
Madison, WI
(608) 890-0046
michael.sullivan@ars.usda.gov

Peter Vadas
Research Soil Scientist
Madison, WI
(608) 890-0069
peter.vadas@ars.usda.gov

Paul J. Weimer
Research Microbiologist
Madison, WI
(608) 890-0075
paul.weimer@ars.usda.gov

Geoffrey Zanton
Research Dairy Scientist
Madison, WI
(608) 890-0053
geoffrey.zanton@ars.usda.gov

Wayne E. Zeller
Research Chemist
Madison, WI
(608) 890-0071
wayne.zeller@ars.usda.gov

Other Staff

Mark Boggess
Center Director
Madison, WI
(608) 890-

Richard P. Walgenbach
Mgmt. Agronomist/Farm Manager
Prairie du Sac, WI
(608) 643-2438, ext. 223
richard.walgenbach@ars.usda.gov

Lori Bocher
Agricultural Information Spec.
Madison, WI
(608) 890-0079
lori.bocher@ars.usda.gov

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 seven CRIS (Current Research Information System) projects in FY 2014.

More flexible and resilient alfalfa harvest system has no negative impact on milk production of cows.

Alfalfa, the most widely cultivated forage legume worldwide and the fourth most produced crop in the U.S., is typically harvested at early-bud stage to keep total fiber as low as possible. This helps insure high-quality forage with high protein and low fiber; however, it requires multiple harvests on the farm, increasing costs for alfalfa producers. Additionally, these harvests must occur in a relatively narrow window of time (2-3 days) to maintain high-quality alfalfa, which is easily compromised by unfavorable weather conditions.

The USDFRC is studying the potential for an alfalfa harvesting system that separates the leaves from stems. Shown here are leaves.

An alternative harvesting method is being tested that removes the leaves from the stems so they can be stored separately. Alfalfa leaves contain high protein (25-30% dry matter) and low fiber while stems contain high fiber and low protein (7-9% dry matter). When the two alfalfa components are stored separately, they can be recombined in the appropriate ratios to optimize diets for dairy cows.

To validate that such a harvest system would not have an adverse effect milk production, USDFRC scientists conducted a feeding trial comparing silage from: 1) a typical early-bud alfalfa harvest with leaves and stems together; and 2) leaves harvested 4 weeks later at late full-bloom stage. Leaves were then recombined with stems to meet fiber needs of the cow. Subsequent results showed that milk production, milk protein, and milk fat from dairy cows were the same using the two diets. This system will potentially reduce the number of alfalfa harvests and enable producers to better time harvest and alfalfa storage needs, resulting in improved yields, diet quality and forage consistency while significantly decreasing costs associated with alfalfa harvest.

RONALD HATFIELD

New information expands ration options for dairy cows during stressful situations such as drought.

Dairy cows are typically fed diets based on forages (grass, alfalfa, corn silage, etc.) that are supplemented with corn grain and soybean meal. However, drought in 2012 reduced forage supplies and quality and drastically raised feed prices for both forages and grain supplements. Consequently, many dairy farmers were forced to find alternative ingredients to maintain competitive production levels and manage ration costs. Existing recommendations for formulating dairy cow diets did not address replacing some of the forage with alternative ingredients and all of the corn and soy with byproduct feeds.

USDFRC scientists and collaborators at Cornell University evaluated lactating dairy cow performance on low-forage diets with less expensive byproduct feeds used instead of the typical grains. High-producing (79 lbs/day), late-lactation cows were used in the study and produced milk yields equivalent to conventional high-forage diets. The down side to the alternative diets, as compared to conventional forage diets, was that the cows consumed more of the ration per unit of milk produced, and so were less efficient in converting feed into milk. The daily cost of feeding them was also higher. This research demonstrated that when conventional ingredients are limited, dairy farmers can effectively use forage substitutes and byproduct feeds in the short term and still maintain milk production.

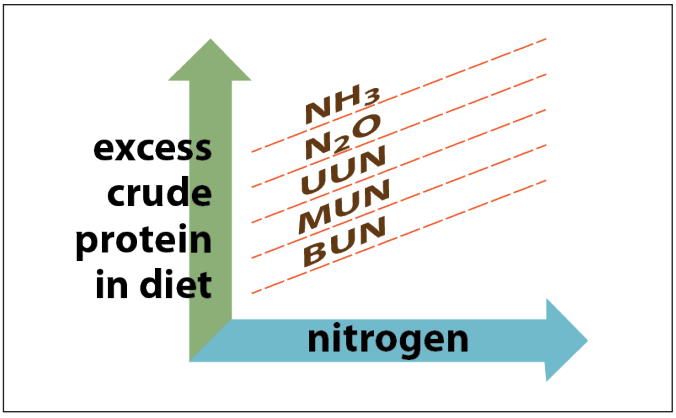
MARY BETH HALL

Old tool finds new use in reducing nitrogen emissions from dairy farms.

Milk urea nitrogen (MUN), a common measurement used to monitor feed efficiency in dairy herds, also can be used to help reduce nitrogen emissions from dairy farms. Ammonia emissions combine with other atmospheric compounds to form particles which can be hazardous to human health. They also produce acidity and nitrogen that can be detrimental to natural ecosystem health. The urea in dairy cow urine is the principal source of ammonia emissions from dairy farms. Urinary urea also contributes to emissions of nitrous oxide, the most potent greenhouse gas emitted from agriculture. Many dairy cows are still fed rations unbalanced for energy and protein, and the excess nitrogen is excreted in urine as urea.

USDFRC scientists studied the relationships between the amount of dietary crude protein fed to lactating cows, urea in milk and urine, and nitrogen emissions from dairy farms. Results show a highly correlated relationship; with each 1 unit decrease in MUN (when MUN is in the range of 16 to 10), there was an associated daily decrease in urinary urea of 16.6 g/cow, which decreases ammonia and nitrous oxide emissions from manure by 7 to 12%. Monitoring MUN on dairy farms can now be used to optimize crude protein use in cow rations which will reduce feed costs, reduce excretion of urea in urine and decrease nitrogen emissions from dairy farms.

J. MARK POWELL



Research has shown that, as excess protein is fed in the dairy cattle diet, there is a proportional increase in the amount of nitrogen in the blood, milk and urine (BUN, MUN, UUN) and subsequently an increase in ammonia and nitrous oxide being emitted from the farm. Therefore MUN, a common measurement already in use on dairy farms, can also be used to help reduce gaseous emissions.

Research identifies areas to target for reducing phosphorus loss on dairy farms.

Phosphorus loss in runoff from dairy farms can pollute local waters, but it is difficult to know what areas on farms are responsible for the most loss and consequently should be managed differently. USDFRC scientists monitored phosphorus runoff from cattle pastures for two years and extensively surveyed four pasture-based dairy farms. Runoff results and farm management and topographical information were used to parameterize advanced computer models to quantify annual phosphorus loss from all areas on the farms. At the whole-farm level, annual phosphorus loss was low due to permanently vegetated pastures or hay fields; rates of erosion were also low. However, some areas had significant phosphorus loss, including corn and hay fields with exposed soil and higher erosion potential (45-75% of total farm phosphorus loss). Barnyards and outdoor lots with high erosion and manure accumulation also had increased rates of phosphorus loss (5-30% of total farm phosphorus loss). This proof-of-concept research demonstrated that producer surveys and new advanced models can quickly and reliably estimate phosphorus loss in runoff from all areas on a dairy farm and identify areas in the greatest need of alternative management.

The Annual Phosphorus Loss Estimator was developed at the USDFRC and is being used in many applications.

PETER VADAS

New data improves computer model for estimating whole-farm phosphorus loss from dairy farms.

Nutrient loss in runoff from dairy farms can pollute local waters, but there is little information in the United States about how much nutrient loss comes from pastures grazed by beef and dairy cattle. USDFRC scientists, in collaboration with the University of Wisconsin, monitored runoff and nutrient loss from eight beef and dairy pastures for two years to develop accurate parameters for use in modeling. Annual precipitation runoff from the pastures varied from 3 to 10%, but sediment loss was very low due to well-established vegetation. Annual nutrient loss in runoff was also low, averaging less than 1

pound per acre of phosphorus and 2.5 pounds per acre of nitrogen. The scientists used the runoff data to update and validate the Annual Phosphorus Loss Estimator (APLE) computer model which predicts annual phosphorus loss in runoff from cropland and pastures. These results further improved the accuracy of the APLE model to estimate whole-farm phosphorus loss from dairy production systems and helped identify the most effective and economical on-farm practices to reduce phosphorus loss from grazed pastures.

PETER VADAS

In northern climates, fall-grown oat can extend the grazing season.

Dairy producers in northern climates often need to extend the grazing season, or they may need emergency fall forage when it is in short supply due to drought or other conditions. USDFRC and University of Wisconsin researchers conducted a two-year grazing study with pregnant dairy replacement heifers to assess fall-grown oat as a possibility for meeting this fall-forage need. Results confirmed that fall-grown oat should be managed as stockpiled forage for deferred grazing. Good utilization of fall-oat forage can be accomplished by efficient, one-time removal of standing forage using a single 'lead' wire (electric fence) advanced daily to prevent waste. Generally, concentrations of protein and energy for fall-oat pasture exceeded requirements for dairy heifers weighing 1000 to 1200 lbs. In this study, grazing heifers exhibited comparable performance to heifers maintained on a blended control diet within a confinement operation. This production system offers an additional effective tool for extending the grazing season into late November within northern climates.

WAYNE COBLENTZ

Fall-grown oat forages can provide another high-energy option for dairy cattle diets.

Fall-grown oat forages that undergo winter-hardening in response to cold temperatures during the late-elongation or early-boot stages of growth typically exhibit abnormally high concentrations of water-soluble carbohydrates (sugars). This phenomenon, where the forage plant produces more energy late in the plant's life, is highly unusual among forages and suggests that fall-grown oat forages can be utilized to extend the grazing season, or to produce a high-energy, late-season silage crop in northern latitudes. Previous trials with grazing dairy heifers have shown that fall-grown oat is effective at extending the grazing season, and maintaining weight gains as heifers transition from fall to winter weather conditions.

In order to evaluate how lactating dairy cattle might perform on fall-grown oat, USDFRC and University of Wisconsin scientists estimated rumen fermentation using in-vitro gas production. Fermentation was accelerated early in the process, specifically in response to this large pool of rapidly fermentable carbohydrates. While unique in-vitro fermentation characteristics of these forages were observed, production trials with lactating cows are needed to determine how to use these forages most efficiently in dairy diets. The high-sugar oat forages evaluated in this study had energy densities comparable to corn silage, a very common forage in northern climates. It may be possible to replace some corn silage in dairy diets with fall-oat forage, thus providing more options for cropping rotations in dairy enterprises.

WAYNE COBLENTZ

Fall-grown oats can be utilized to extend the grazing season or to produce a high-energy, late-season silage crop in northern latitudes.

Delaying harvest of Eastern gamagrass improves yield without affecting plant persistence.

Eastern gamagrass (a perennial warm-season grass) may be an effective alternative to chopped straw within the blended diets of dairy heifers and cows. Extension materials discussing appropriate fall management of eastern gamagrass often recommend avoiding harvest within six weeks of first frost. However, single-harvest yields of dry matter have not peaked by mid-August in northern climates because of inadequate accumulation of growing degree days.

USDFRC scientists evaluated dry matter yields, plant persistence, and nutritive value across four production years for eastern gamagrass harvested at 15-day intervals between August 1 and November 1. Yields of dry matter were increased by 31% on September 15 compared to August 1. Most importantly, there was no evidence that plant persistence was affected negatively by delaying harvest dates. Results of this study will give producers confidence to delay harvests of eastern gamagrass to increase yield because they know that this management practice will not affect plant persistence.

WAYNE COBLENTZ

Research shows that farmers have choices when selecting companion crop and manure management systems for no-till silage corn.

The production of silage corn with companion crops (e.g. cover crops or living mulches) is widely recommended for reducing soil and fertilizer nutrient losses and for maintaining or improving crop yields, nutrient cycling, and soil quality. Manure is a common natural fertilizer for silage corn production.

USDFRC researchers evaluated the agronomic and environmental performance of five companion crop systems for corn amended with manure during a four-year study in south central Wisconsin. Overall, researchers found that no companion crop or manure management system was clearly superior in all attributes related to forage production, nitrate leaching potential, runoff, and soil quality. The study will, however, enable producers to better tailor companion crop and manure management practices to meet feed production needs and to enhance the environment by limiting losses of soil and nutrients from cropland.

Researchers evaluated the agronomic and environmental performance of five companion crop systems for corn amended with manure.

JOHN GRABBER, BILL JOKELA

Rapid method for characterizing tannins will help determine how they can be used to improve nitrogen use efficiency on dairy farms.

Condensed tannins, a component in many plants including some forages, have been shown to improve nitrogen use efficiency at different steps in milk production including silage production, rumen efficiency, and manure chemistry. A more comprehensive understanding of how condensed tannins work in these processes will enable farmers to develop farm/feed management processes, leading to both economic and environmental benefits. Due to the complex chemical structure of condensed tannins, it is often difficult to characterize them fully. Chemical methods currently available are cumbersome and time-consuming.

USDFRC scientists have developed a rapid method based on nuclear magnetic resonance spectroscopic analysis. This method can determine the chemical components that make up individual tannins, the ratio of the components in the tannins, and the size of the individual purified tannins. This information is critical in the accurate characterization of tannins as they are used in protein precipitation, protein degradation, and enzyme inhibition studies. The method can be used not only in dairy-related research and production, but in any discipline or industry where tannins have an important function.

WAYNE ZELLER

Improved methods for isolating condensed tannins of high purity will aid researchers seeking to improve nitrogen use efficiency.

Condensed tannins contained in common forages can improve nitrogen use efficiency in the milk production system by: 1) decreasing protein degradation during the ensiling process, 2) decreasing rapid protein degradation in the rumen, and 3) inhibiting urease activity to reduce unwanted ammonia production and resulting nitrogen volatilization. A major hurdle in understanding how condensed tannins work is the availability of significant amounts of well-characterized, purified tannins for research. USDFRC researchers have developed methods for the isolation and purification of condensed tannins from several plant materials that are known to contain tannins including grain sorghum, lespedeza, white clover flowers, cocoa powder, big trefoil, birdsfoot trefoil, and grape seeds. The method of purification involves initial extraction of the soluble tannins from the dried, ground plant material with an acetone/water mixture. Extracted

tannins are purified through a sequence of chromatography steps. Examination of the tannin fractions by proton nuclear magnetic resonance spectroscopy allows rapid assessment of the relative purity of the tannin. In this manner, gram quantities of condensed tannins have been isolated and are now available for laboratory investigation. This provides critical materials for understanding how tannins work and, specific to the dairy industry, how they can improve nitrogen use efficiency in forages.

WAYNE ZELLER

USDFRC research clearly demonstrated that selective breeding of legumes that are grown in plots with a grass companion, compared to growing alone, produced better varieties for use in pasture situations.

Legumes being bred for pasture use should be grown with grasses during selection process.

Grazing-based dairy producers often add forage legumes such as birdsfoot trefoil to grass pastures in order to improve the protein content of the feed. For legume breeders looking for improved varieties for pasture use, USDFRC researchers clearly demonstrated that selective breeding of birdsfoot trefoil that is grown in plots with a grass companion, compared to growing alone, produced better varieties for use in pasture situations. This work provides evidence to other forage legume breeding programs, including alfalfa, that forage legume plants being developed for pastures should be selected with a grass companion when possible to increase selection gains.

HEATHCLIFFE RIDAY

Decreasing the amount of p-coumaric acid in corn cell walls does not change the level of lignin.

Lignin is a compound found in every plant and has been compared to glue that holds things together. It is formed in the cell walls of plants by a chemical reaction that continually adds new units to the growing polymer to form a tough indigestible material. This is like the use of cement to form walls of buildings. The cement is the glue with the sand, gravel, and reinforcing rod being all the other components within the cell wall. Just as there are different types of cement, there are different individual components that make up the lignin. Two plant compounds, p-coumaric acid and sinapyl alcohol, are joined together to become part of the lignin. It is thought this pairing of p-coumaric acid-sinapyl alcohol may help regulate the formation of lignin in grasses.

To test this hypothesis, USDFRC scientists down-regulated the gene controlling coupling of these two components in corn. This resulted in plants with decreased amounts of p-coumaric acid and sinapyl alcohol in the lignin. However, total lignin levels in these corn cell walls were not changed. It would appear that altering the p-coumaric acid-sinapyl alcohol pair does change the composition of lignin; the altered cement still makes a good building. Total growth of the corn does not appear to be changed by altering lignin composition. Altering lignin composition may have other uses, especially if the lignin is being isolated from crop residues for industrial uses. It remains to be determined if such changes in lignin composition have any effects upon cell wall digestibility.

RONALD HATFIELD

A promising bioengineering target for biomass crops is found in epigallocatechin gallate.

Plant cell walls are the world's most abundant source of carbohydrates for fermentation into biofuels. Prior to their fermentation in biofuels, however, these carbohydrates must first be liberated from lignin (indigestible portion of cell wall) by harsh and costly chemical pretreatments. USDFRC scientists are testing ways to modify lignin formation in plants so that it is easier to remove by chemical pretreatments. In this study, they artificially lignified cell walls from corn with normal precursors (i.e. monolignols) plus epigallocatechin gallate, a natural antioxidant found in many plants that is not normally a component of lignin. Incorporation of epigallocatechin gallate into lignin improved the enzymatic release of fermentable sugars from cell walls following a very mild alkaline pretreatment. These results provide compelling evidence that epigallocatechin gallate would be a promising plant genetic engineering target for improving the production of biofuels from biomass crops.

JOHN GRABBER

Best methods for improving efficiency and gains in forage breeding programs are determined.

Progress toward increased forage yield or biomass yield of perennial plants (such as alfalfa, clover, and grasses) has lagged behind the gains made in annual crops for many years. USDFRC researchers compared 14 different breeding methods for their theoretical efficiency to improve the rate of gain for forage or biomass yield. The study concluded that significant improvements can be made to nearly all forage breeding programs by using one or more of the following concepts: field-plot trials that simulate real-world conditions, multiple locations for field trials, and/or DNA markers to supplement field-based data. Just a 5% increase in forage yield derived from improving the efficiency of breeding in one major forage crop, alfalfa, would be worth about $30 per acre or $1,560 million across the U.S.

MICHAEL CASLER

New switchgrass hybrid expands opportunities for growing it as a bioenergy feedstock in northern climates and marginal environments.

Switchgrass is one of the leading candidates for bioenergy feedstock production, especially in marginal environments where field crops either are not profitable or are not sustainable. But many of those marginal lands are in the more northern USDA Hardiness Zones 3 and 4 where switchgrass is not as productive as it is in Hardiness Zones 5 and 6.

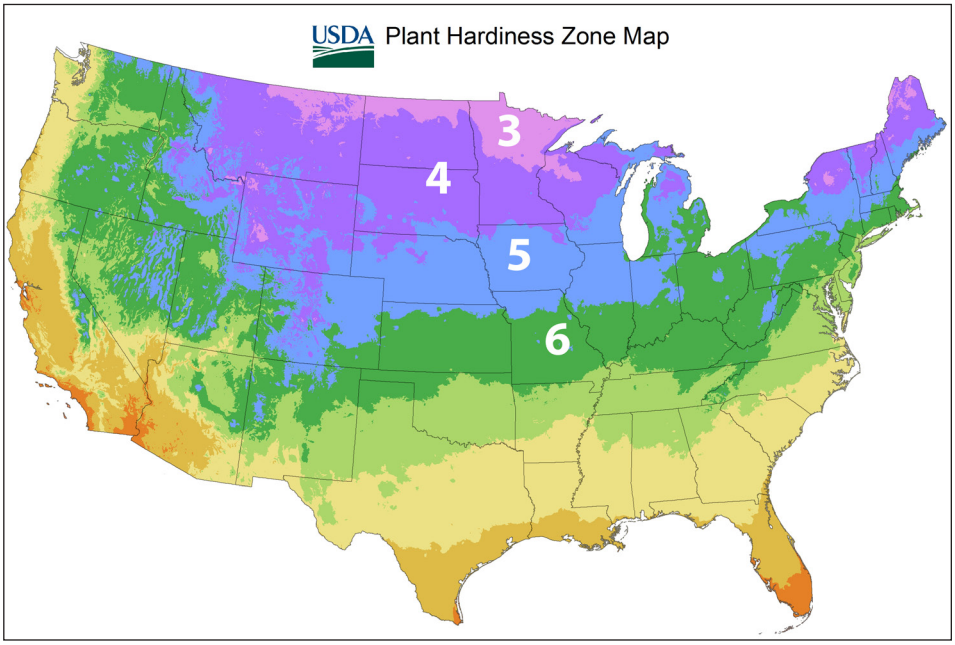
Recent field experiments provided the first demonstration that biomass yields in Zones 3 and 4 can be increased to be similar to those observed in Zones 5 and 6. This was accomplished through directed selection and breeding for high biomass yield and winter survival following harsh winters. The greatest gains in biomass yield, up to a 50% increase, were achieved with hybrid switchgrass that combined high yield of a southern strain with high winter hardiness of a northern strain. This research provides the first documentation of range expansion for high-yielding switchgrass strains into Hardiness Zones 3 and 4.

MICHAEL CASLER

Having one simple method for concentrating multiple types of waterborne pathogens would be advantageous for assessing pathogen levels in water and the associated health risk.

Current methods tend to be specific for a particular pathogen group and the required equipment can be complicated and expensive. USDFRC Researchers developed glass wool filters that are effective for concentrating the many types of waterborne viral and bacterial pathogens typically associated with dairy manure. The filters work even with highly turbid water like that found in runoff from cultivated agricultural fields. The filters are inexpensive and easily constructed in any laboratory. The filters are currently employed in automated edge-of-field samplers to measure pathogens in a field runoff study. This method is useful to researchers and water quality professionals working to reduce pathogen inputs into the nation's waterways.

MARK BORCHARDT



Research shows that, through directed selection and breeding for high biomass yield and winter survival, biomass yields of switchgrass grown in Hardiness Zones 3 and 4 can be increased to be similar to those observed in Zones 5 and 6. One significance of this is that Zones 3 and 4 have more marginal land that is suited to growing biomass crops.

Fishmeal-free diets compare well to fishmeal diets in aquaculture systems, are more competitive and sustainable.

Incorporation of alternative protein (non fishmeal) sources into aquaculture feed is essential to increasing the competitiveness and sustainability of aquaculture in the U.S. Because of the high level of palatability, digestibility and essential nutrients fishmeal, is a highly desired ingredient for aquafeeds. Despite its elite status, continued use is prohibitive as 1) it is a global commodity that is from wild capture fisheries, which are highly variable and unsustainable, and 2) the projected need for fishmeal(s) is expected to outstrip demand before the end of this decade. Given this unsustained trajectory, domestic and international organizations continue to call attention to the need for sustainable alternatives to the use of marine fishmeal in aquafeeds.

USDFRC researchers, in collaboration with the University of Wisconsin-Milwaukee, compared the performance of yellow perch fingerlings fed a commercially-available fishmeal-based diet versus a commercially-available fishmeal-free diet in a laboratory and a commercial pond-side recirculating system. The yellow perch for this project were produced, raised to fingerling size, and subsequently fed test diets for approximately 50 days both in the laboratory and on a commercial farm. On the farm, fish fed the fishmeal-based diet grew slightly faster than fish fed the fishmeal-free diet, whereas in the laboratory, both groups grew the same. Composition of fish (crude protein, crude fat, percent moisture, crude fiber and ash) did not vary significantly between experimental sites or by diet. Equivalent performance of yellow perch in this study suggests that this species can be grown on fishmeal-free diets that have more cost-effective, and sustainable, protein sources.

BRIAN SHEPHERD

New understanding of rapid evolutionary changes in virus will aid in efforts to eradicate it from Great Lakes fish populations.

Viral Hemorrhagic Septicemia (VHSv) causes one of the world's most serious finfish diseases, infecting more than 80 commercially- and ecologically-important marine and freshwater species. Over a decade ago, an especially virulent substrain, IVb, first appeared in the Great Lakes, causing massive fish kills in 2005 and 2006. One of the challenges of fighting this virus is that it evolves rapidly, creating new genetic variants that evade fish host recognition and immune responses, and that enable long-time persistence in fish populations which facilitates expansion to new geographic areas.

University of Toledo researchers, in collaboration with USDFRC researchers in Milwaukee, WI compared gene sequences from existing sources and new isolates of the VHSv pathogen to determine their evolutionary diversification. This study is the first documented case of characterizing the rate at which different genes of VHS are evolving. It is an important step in: 1) understanding where the virus is getting worse or spreading; 2) determining how to detect the virus in different fish populations; 3) and aiding in the development of vaccines to combat the spread of VHSv.

BRIAN SHEPHERD

Staff changes in FY 2014

November 2013

Dave Stevenson, who worked in Paul Weimer's lab for 10 years, left due to his appointment expiring. Among Dave's many accomplishments: setting up/operating a molecular microbial ecology lab; developing qPCR primers for many ruminal bacterial species; first application of ARISA to the rumen; and training many students and visiting scientists. He accepted a job as Research Associate in the Department of Bacteriology, UW-Madison.


Dave Stevenson

March 2014

Joseph Hattamer joined the team at the Environmentally Integrated Dairy Management Research Unit (EIDMRU) in Marshfield. He provides maintenance and repair for all systems in the laboratory building, and he does preventive maintenance one day per week at the farm, mostly on the manure system. Joe previously was in the U.S. Army.


Joe Hattamer

Tony Sternweis began working as a Biological Science Technician/Soils for Bill Jokela's lab at the EIDMRU in Marshfield and Stratford. He conducts field, lab, and data work in support of soil and nutrient management research. Prior to taking this job he worked for the UW Marshfield Agricultural Research Station. He also works part-time on his family's dairy farm.


Mark Boggess

May 2014

Mark Boggess became the new Center Director after serving for 5 years as an ARS National Program Leader in Beltsville, MD, in two areas with great relevance to the USDFRC – Food Animal Production and Pasture, Forage and Rangeland Systems. With a PhD in Animal Breeding, he previously worked for the National Pork Board and the University of Idaho Extension.

Andy Kowalkiewicz joined the Center as building manager in Madison where he makes repairs, works with contractors, manages the vehicle fleet, monitors building safety, and much more. Previously he was in the U.S. Army, and he worked in the commercial heating/air conditioning business.


Andy Kowalkiewicz

June 2014

Allyn Spear, a Research Microbiologist, joined the USDFRC aquaculture lab located within the School of Freshwater Sciences in Milwaukee. His research will focus on pathogens of fish with an eye on improving aquaculture in the Great Lakes region. He previously conducted research at the USDA National Animal Disease Center in Ames, IA.


Allyn Spear

June 2014

Kenneth Kalscheur joined the Center as a Research Dairy Scientist. Previously he was a Professor of Dairy Science at South Dakota State University where he received several awards, including the American Dairy Science Association's Foundation Scholar Award in Dairy Production. At the USDFRC his research focuses on improving fiber digestion and overall nutrient utilization in high-producing dairy cows, and identifying how forage quality affects feed conversion efficiency and ruminal digestion.


Ken Kalscheur

July 2014

Nick Baker, Biological Science Lab Technician in Michael Casler's lab for nine years, left to take a job as the Agriculture Agent for the Rock County (WI) Extension. He worked as a field and greenhouse technician, handling all greenhouse duties and field activities at 6 research locations.


Nick Baker

August 2014

Geoffrey Zanton joined the USDFRC as a Research Dairy Scientist. His research focuses on increasing the nutritional efficiency of protein utilization in the lactating dairy cow. Previously he was the Research & Development Senior Manager of Ruminant Nutrition for Novus International, Inc. in St. Charles, MO.


Geoffrey Zanton

Heather Green, a postdoctoral researcher who worked in Michael Sullivan's lab since August 2010, left the Center when her 4-year appointment expired. Heather was instrumental in understanding how forage plants make phenolic compounds that are useful for plants to resist a number of stresses and that are also part of a natural system of protein protection.


Heather Green

September 2014

Richard Muck retired after 37 years as a research agricultural engineer for ARS, the last 31 of those years at the USDFRC where is research focused on management techniques and technologies to minimize losses from silos, improve the preservation of protein in ensiled crops, and enhance the utilization of silages by dairy cattle. His research resulted in more than 200 articles with 100 being in peer-reviewed journals. He received the Wisconsin Section Career Achievement Award from American Society of Agricultural and Biological Engineers in 2011, and the Pioneer Forage Research Award at the American Dairy Science Association annual meeting in 2015.


Richard Muck

Paul Schatz retired after almost 13 years as a technician, first with John Ralph and then with Wayne Zeller. Previously, Paul served as Director of Organic Laboratories for the Department of Chemistry, UW-Madison. During his tenure, in addition to overseeing the changing of the guard for the Research Chemist position, Paul demonstrated that he is an accomplished bench chemist through the production of several synthetic intermediates and naturally-occurring plant constituents.


Paul Schatz

Technology Transfer Report

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 for FY 2014.

Presentations

Date	Scientist	Event & Location	Title/Topic
10-4-13	Geoffrey Brink	World Dairy Expo Grazing Seminar Madison, WI	Managing pasture after drought or winter damage *(Due to the government furlough, Dr. Brink arranged to have someone else give the talk that he had prepared.)*
10-4-13	Richard Muck	World Dairy Expo Dairy Forage Seminar Madison, WI	Plastic covers and silage density: What's new and basic in making good silage? *(Due to the government furlough, Dr. Muck was not able to give his talk. However, handouts were available, were picked up, and resulted in articles being written for forage magazines.)*
10-4-13	Wayne Coblentz	World Dairy Expo Dairy Forage Seminar Madison, WI	Using propionic acid to preserve more hay *(Due to the government furlough, Dr. Coblentz was not able to give his talk. However, handouts were available, were picked up, and resulted in articles being written for forage magazines.)*
10-30-13	Richard Muck	NE Regional Project NE-1044 Annual Meeting Lexington, KY	Presented various research results
11-2-13	Geoffrey Brink	River Country Grazing Conference Eau Claire, WI	Drought or winter has damaged your pastures – Now what?
11-3-13	Mary Beth Hall	Penn State Dairy Cattle Nutrition Workshop Grantville, PA	Forage digestibility: How to deal with something that makes or breaks rations: Making practical sense of forage analyses
11-4-13	Bill Jokela	ASA-CSSA-SSSA Annual Meeting Tampa, FL *(remote presentation)*	Manure and crop management effects on transport of phosphorus and nitrogen in surface runoff in a corn silage system
11-5-13	Mark Powell	ASA-CSSA-SSSA Annual Meeting Tampa, FL	Nitrogen use efficiency in global dairy production systems
11-8-13	Richard Muck	Industry Extension Forage Advisory Council LaCrosse, WI	New bunker silo technologies
11-14-13	Mark Borchardt	Sam Houston State University Huntsville, TX	Agricultural zoonotic pathogens in the environment and the human health risk
11-19-13	Mark Powell	6th International Nitrogen Conference Kampala, Uganda, Africa	Too little, too much: feed nitrogen use in African and other dairy production systems
11-20-13	Wayne Coblentz	Southwest Wis. Fall Grazing Workshop Dodgeville, WI	Summer-seeded forage oats
12-15-13	Paul Weimer	International Symposium on Microbiology & Biotechnology, Vicosa, Brazil	The relevance of ruminant animals to chemical conversion and biofuels technologies
12-16-13	Paul Weimer	Dartmouth College Hanover, NH	Ruminal consolidated bioprocessing: Fundamentals and applications
12-18-13	Mary Beth Hall	UW Dairy Science faculty and grad students Madison, WI	Homeostasis as a destabilizing force; or How to confound evaluations of rumen function
1-9-14	Wayne Coblentz	Wisconsin Fertilizer Board Madison, WI	Grant proposal presentation

Date	Scientist	Event & Location	Title/Topic
1-14-14	Geoffry Brink	American Forage and Grassland Council Memphis, TN	Drying rate differences among three cool-season grasses
1-15-14	John Grabber	Wisconsin Crop Management Conference Madison, WI	Alfalfa, clovers, and grasses as companion crops for silage corn
1-15-14	Bill Jokela	Wisconsin Crop Management Conference Madison, WI	Manure management for corn and alfalfa: benefits and concerns
1-15-14	*Presented by Mark Powell on behalf of* Peter Vadas	Wisconsin Crop Management Conference Madison, WI	Estimating P loss in runoff at the whole-farm scale
1-16-14	Mark Borchardt	Wisconsin Crop Management Conference Madison, WI	From the ground up: Groundwater, surface water, and air as pathogen routes for food contamination
1-22-14	Bill Jokela	Midwest Forage Assn. Symposium '14 Wis. Dells, WI	Manure management for corn and alfalfa: benefits and concerns
1-23-14	Geoffrey Brink	North Central Ohio Dairy Grazing Council Dalton, OH	NDF and NDFD – Why should they matter to you?
2-10-14	Brian Shepherd	Aquaculture America 2014, World Aquaculture Society Meeting, Seattle, WA	Influence of mineral supplementation on growth in yellow perch fed a soy-based diet
2-11-14	Brian Shepherd	Aquaculture America 2014, World Aquaculture Society Meeting, Seattle, WA	Identification of gender in yellow perch using external morphology
2-11-14	Brian Shepherd	Aquaculture America 2014, World Aquaculture Society Meeting, Seattle, WA	Comparative effects of constant versus fluctuating thermal regimens on yellow perch growth, feed conversion and survival
2-13-14	Wayne Coblentz	Waupaca County Forage Council Annual Meeting Manawa, WI	Expanded forage options with fall forage oats
2-18-14	Peter Vadas	USDA Office of Environmental Markets Washington, DC	Refining models for quantifying water quality benefits of animal management for water quality trading
2-26-14	Wayne Coblentz	UW Extension multi-county beef grazing meeting Montello, WI	Fall-grown oats for forage
2-27-14	Wayne Coblentz	Portage County Forage Council Stevens Point, WI	Fall-grown oats for forage
3-6-14	Geoffrey Brink	Heart of Wisconsin Grazing Conference Wausau, WI	Growing cool-season perennial grasses for dairy cattle
3-8-14	Brian Shepherd	Wis. Aquaculture Assn. Meeting Mishicot, WI	Identification of gender in yellow perch using external morphology
3-17-14	John Grabber	Chemistry and Materials for Energy national meeting & exposition of the American Chemical Society, Dallas, TX	Identifying new lignin bioengineering targets for improving biomass and forage utilization: A review of biomimetic studies with maize cell walls
3-28-14	Mark Powell	Wis. Nitrogen Science Summit Madison, WI	Nitrogen use and trade-offs on dairy farms: An illustration of complexity
4-8-14	Richard Muck	2014 Herd Health and Nutrition Conference East Syracuse, NY	Innovations in feed storage technology
4-10-14	Richard Muck	2014 Herd Health and Nutrition Conference West Lebanon, NH	Innovations in feed storage technology

Date	Scientist	Event & Location	Title/Topic
5-8-14	Mark Powell	Penn State University, Advance Topics in Feed Management Extension meeting Lancaster, PA	What dairy cows consume impacts manure chemistry and the environment
5-21-14	Mark Powell	Dairy Asia: Towards Sustainability/Food and Agriculture Organization (FAO) of the UN Bangkok, Thailand	Dairy, natural resources and the environment
5-22-14	Mark Powell	Dairy Asia: Towards Sustainability/Food and Agriculture Organization (FAO) of the UN Bangkok, Thailand	Sustainable dairy feed management
5-30-14	Peter Vadas	UW-Dane County Partnership for the Yahara Lakes Madison, WI	Impact of manure application in different seasons on phosphorus loss in runoff
6-5-14	Wayne Coblentz	UW Team Dairy Marshfield, WI	Overview of USDA-ARS research at Marshfield location
6-17-14	John Grabber	NCCC031 Project Meeting: Ecophysiological aspects of forage management Hickory Corners, MI	Jumpstarting alfalfa production in alfalfa-corn silage rotations
7-2-14	Mark Powell	18th Nitrogen Workshop Lisbon, Portugal	Contribution of dairy ration components to nitrogen in milk, manure, crops and environmental nitrogen loss

Training/Instruction/Editorial Boards/Industry Committees

Date	Scientist	Event & Location	Title/Topic
11-3-13	Mike Casler	Crop Science Society of America workshop Tampa, FL	Organizer/Principal Instructor for Workshop "Beyond Grazing: Statistical Analysis of Perennial Crop Data"
11-18-13 to 11-21-13	Heathcliffe Riday	USDA-ARS St. Paul, MN	Paternity and SSR multiplexing techniques; taught and trained technical personnel
12-3-13 to 12-4-13	Paul Weimer	Federal University of Vicosa Vicosa, Brazil	Gave four lectures on rumen microbiology
12-4-13	Heathcliffe Riday	Alforex (alfalfa seed company) Madison, WI	Paternity and SSR multiplexing techniques; taught and trained technical personnel
12-13-13	Heathcliffe Riday	Pioneer (seed company) Arlington & Madison, WI	Paternity and SSR multiplexing techniques; taught and trained technical personnel
12-31-13	Geoffrey Brink		Ended a 3-year term on the editorial board of Crop Science as the Forage & Grazing Lands Associate Editor
1-14-14	Heathcliffe Riday		Served on National Alfalfa and Miscellaneous Legumes Variety Review Board for the Association of Official Seed Certifying Agencies
2-12-14	Mark Powell	USDA-NRCS Science and Technology Training Library, a Webinar	Feed management for dairy operations to reduce air emissions
2-24-14 to 2-25-14	Mark Powell Bill Jokela	Dairy CAP Project Team meeting at Innovation Center for U.S. Dairy Rosemont, IL	Discuss recent progress on research related to climate change mitigation and adaptation in dairy production systems of the Great Lakes region.
3-3-14	Richard Muck Geoffrey Brink Wayne Coblentz	UW Extension Team Forage Wisconsin Dells, WI	Participated in annual meeting to plan Extension outreach in the area of forages. This includes Team Forage web site, Focus on Forage papers, educational outreach to Extension agents and producers, and current research needs.
May 2014	Mark Powell	Innovation Center for U.S. Dairy, Dairy Marketing, Inc.	Invited to serve on a workgroup that's developing a new version of the Farm Smart model, a decision-support tool that provides dairy producers with their farm's environmental footprint.
5-14-14	Heathcliffe Riday	Barenbrug (grass seed company) Prairie du Sac and Madison, WI	Paternity and SSR multiplexing techniques; taught and trained technical personnel
5-28-14	Mike Casler	Hidden Valley Field Day Viroqua, WI	Public release of Hidden Valley Meadow Fescue which was developed at the USDFRC
5-29-14	Mark Powell	UW-Madison Dairy Research Symposium Madison, WI	On-going environmental research at USDFRC
June 2014	Peter Vadas	Joint project with ARS, the Cow of the Future project (Innovation Center for U.S. Dairy), and The Ohio State University.	An invited review co-authored by Peter Vadas was chosen at the "Featured Article" of the month (June 2014) by the Journal of Dairy Science. Article was titled, "Enteric methane in dairy cattle production: Quantifying the opportunities and impact of reducing emissions."
July 2014	Mary Beth Hall	National Academy of Sciences/National Research Council	Selected to serve on the committee to update the "Nutrient Requirements of Dairy Cattle" report, widely used by all who work in dairy cattle nutrition.

Educational Materials & Ag Media Articles

Date	Scientist	Publication	Title/Topic
2-17-14	Mary Beth Hall	Progressive Dairyman	Protein, carbohydrate interactions in rumen: The balancing act
2-7-14	Neal Martin	Progressive Dairyman	Keeping pace with forage fiber testing options
February 2014	John Grabber	Hay & Forage Grower *(Interviewed for article on DFRC research, not the author.)*	Interseeding with corn jump-starts alfalfa
3-1-14	Richard Muck	Progressive Forage Grower	What's new and basic in making good silage?
March 2014	John Grabber	Forage Focus	Research seeks to improve the establishment and subsequent yield of alfalfa interseeded into silage corn
March 2014	Wayne Coblentz Richard Muck Mark Borchardt Bill Jokela	Forage Focus	To reduce chance of clostridial silage, apply manure to alfalfa stubble
4-1-14	Wayne Coblentz	Progressive Forage Grower	Hay preservation with propionic acid
4-24-14	Ron Hatfield Lori Bocher	Agri-View *(Interviewed for article on DFRC research, not the authors.)*	Forage research impacting dairy bottom line and environment
May 2014	Mark Powell	Forage Focus	Using MUN to reduce nitrogen emissions from dairy farms
May 2014	Wayne Coblentz	Forage Focus	Grazing management for fall-grown oat forages
May/June 2014	Brian Shepherd	Agricultural Research *(Interviewed for article, not the author.)*	Identifying yellow perch gender to improve production
August 2014	Mike Casler	Agricultural Research *(Interviewed for article, not the author.)*	Switchgrass for ethanol: Where it came from – and where it's going
August 2014	Mike Casler	Forage Focus	'Hidden Valley' meadow fescue grass released to public
August 2014	Heathcliffe Riday	Forage Focus	Alfalfa breeders start collaborative program to bring germplasm out of the repository; others invited to join the effort
August 2014	Heathcliffe Riday	Forage Focus	Research underway to develop 2,4-D resistant red clover
September 2014	Wayne Coblentz	Hay & Forage Grower *(Interviewed for article, not the author.)*	Preservative cuts losses in big square bales; Propionic acid is less effective in round bales, study shows
	Wayne Coblentz Richard Muck	Focus on Forage, UW Extension Team Forage	Effects of rain damage on wilting forages
	Wayne Coblentz	Focus on Forage, UW Extension Team Forage	Propionic acid preservatives for hay
	Wayne Coblentz	Focus on Forage, UW Extension Team Forage	Management and production potential for eastern gamagrass in Wisconsin
	Wayne Coblentz	Focus on Forage, UW Extension Team Forage	Forage quality and feeding management for eastern gamagrass in Wisconsin

Outreach

The USDA Agricultural Research Service encourages its employees to reach out to diverse audiences and to help foster the next generation of research scientists. These are the major Outreach, Diversity and Equal Opportunity (ODEO) activities conducted by U.S. Dairy Forage Research Center employees in FY 2014.

World Dairy Expo, October 1-5, 2013

Due to the federal government shutdown and furlough, the USDFRC had a limited presence at the 2013 show. An educational display was set up, but no one was able to staff it. The FFA Dairy Forage Quiz outreach event was planned but had to be conducted by FFA state officers in place of USDFRC employees. At the Dairy Forage Seminar Stage, two of the seven scheduled talks were cancelled because USDFRC scientists were scheduled to give them.

Mary Becker volunteers at the Baraboo Circus Heritage Days.

Sauk County Institute of Leadership, April 10, 2014

The USDFRC hosted the Sauk County Institute of Leadership (SCIL) at its research farm for an educational seminar on Agriculture and Natural Resources. The day-long seminar was one of nine in the SCIL program in which 15 community leaders learn about a variety of local, state, and national issues. Sharing the story of how USDFRC research seeks to improve the environmental and economic sustainability of milk production were: Lori Bocher and Rick Walgenbach.


Two young participants watch a video of rumen microbes as seen under a microscope.

Baraboo Circus Heritage Days, May 17, 2014

Where does milk come from? Hundreds of young people and their adult leaders gained a better idea by viewing a display hosted by the USDFRC at the Baraboo Circus Heritage Days. This annual event attracts more than 1,000 people from southern Wisconsin and neighboring states. The display included fresh feed representing a dairy cow's diet for one day, and the USDFRC employees emphasized how cows take rough feeds, like silage and hay, and convert them into nutritious milk for humans. It also included the many different byproduct feeds that cows consume from the food, fiber and fuel industries, and a video clip of live rumen microbes under a microscope. The display was designed by Diane Amundson and Lori Bocher and staffed by Mary Becker and Lori Bocher.


A Scout leader and her son learn about the different byproduct feeds that are recycled by dairy cattle.

Irish Dairy Board, June 26, 2014

Twelve members of the Irish Dairy Board, a cooperative which markets and sells dairy products on behalf of its members (Irish dairy farmers and dairy processors) visited the Center to learn about dairy forage research in the U.S. Presentations were given by Mark Boggess and Richard Muck.

Members of the Irish Dairy Board included producers and processors.

County Land Conservation & Planning Meeting, July 30, 2014

About 75 land conservation and planning professionals from 11 counties visited the USDFRC research farm in Prairie du Sac in order to learn more about conservation practices on farms. They learned about research at the farm, including work in the air emission chambers and the engineered barnyards. And they learned about field research from Geoffrey Brink and John Grabber.

U.S. State Department Group, August 11, 2014

The USDFRC hosted a group of scientists participating in a U.S. State Department sponsored tour. Mark Boggess, Lori Bocher, Geoff Brink, Wayne Coblentz, Mary Bell Hall, Ron Hatfield, Ken Kalscheur, Mark Powell, and Paul Weimer all spoke to the group about research projects at the USDFRC. The visitors also toured the research farm in Prairie du Sac.

Sauk County Master Gardeners, August 14, 2014

The Master Gardeners met at the research farm in Prairie du Sac. Lori Bocher gave an overview of USDFRC research and the farm. She also conducted a short tour to show some of the land restoration work being conducted on USDFRC land that was once part of the Badger Army Ammunition Plant.

The USDFRC rain garden was one stop on the Master Gardeners tour.