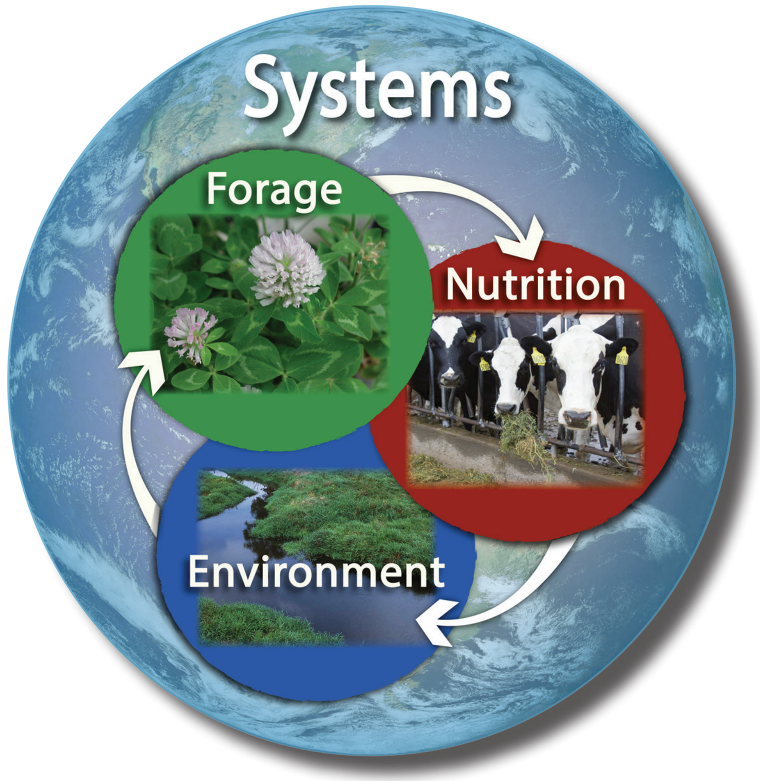
United States Department of Agriculture

U.S. Dairy Forage Research Center

In the News



October to December, 2015

Are we prisoners of the technology moment?

Mark Boggess for *Progressive Forage Grower*

At some point, everyone wonders about the current state of technology in his life, and some conclude that mankind has peaked and will go no further. Charles H. Duell, who was the commissioner of the U.S. Patent Office in 1899, is famously credited with the following quote: "Everything that can be invented has been invented," which, it turns out, he did not actually say – but the point is well taken. Most of us have limited appreciation for the future of technology and how it may impact us. We are prisoners of the moment.

To keep my children a bit more interested in science and technology, I occasionally try to paint a picture of what I consider to be the most impactful technologies looming on the horizon. This summer, as a family, we discussed four technologies specifically: grapheme, quantum computers, room-temperature superconductors and controlled thermonuclear fusion reactors.

Graphene

Graphene is a one-atom layer of carbon with remarkable properties. It is 200 times stronger than steel, pliable, conducts electricity and heat, and is nearly transparent. The potential applications for graphene are extraordinary, from energy storage to water filtration (sea water to potable water) to advanced composites (paints, lubricants, oils, packaging, etc.) and numerous biological engineering applications. Graphene will impact agriculture starting with improved energy systems and sophisticated water filters (possibly even for salt water).

> "So are we at the pinnacle of the genetic revolution in crops and forages, or are we just getting started? That is a difficult question to answer for several reasons – biological, political and socioeconomic."

Quantum computers

Every government and computer engineering lab in the world is working on quantum computing technology because the first to achieve it will have an enormous advantage over the rest of the world – both good and bad.

How will quantum computers be different? Let's say we want to search the entire 37 million books in the Library of Congress for a particular phrase. Today we could use a "supercomputer" to do the job, and in a matter of a few hours, the supercomputer would go through each book very rapidly, page by page and catalog the chosen phrase.

A quantum computer will do the same thing – except it will check every page in every book at exactly the same time, completing the job millions of times faster than even the best supercomputer available today. The future of data analysis will be revolutionized for economic, business, genetic, environmental and other large data mining and applications. Extraordinary advancements will be possible for weather forecasting, crop and animal genetic improvement, astronomy, personalized medicine, travel time and safety, and marketing.

Room-temperature superconductors

Superconductors are materials that conduct electricity with zero resistance. Superconductivity exists today in several forms – unfortunately, all of which function only at extremely cold temperatures. The search is ongoing for superconductors that will function at temperatures above freezing. When realized, these superconductors will revolutionize how electricity is stored and managed. Examples include high-speed trains with magnetic levitation, vastly more effective computers, MRI imaging and medical equipment, improved water filtration systems and the ability to transmit and store energy almost limitlessly.

Controlled thermonuclear fusion reactors

And the holy grail of energy technologies is controlled thermonuclear fusion reactors. Thermonuclear fusion is the process by which two hydrogen atoms are fused, creating helium and releasing vast amounts of energy. However, unlike nuclear fission reactions (think nuclear power plants), fusion does not create a radioactive waste product. We all realize the benefits of nuclear fusion every day because that is exactly what is happening in our sun. If a fusion reactor is built on earth, it would provide a virtually limitless supply of energy without the need for fossil

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fuels and without the production of greenhouse gases or radioactive waste. It would produce extraordinary power without the environmental burden. Imagine the impact on the way we live and farm today.

> "… you might ask, 'What technologies are emerging that may hit a bit closer to home now?' The most significant technologies for forage producers are those relating to the genetic improvement of crops and forages, some of which are already being realized."

Forage technologies

While these technologies are potential game-changers and have the potential to revolutionize the way we live and work, their impact will not be felt in agriculture for many years. Consequently, you might ask, "What technologies are emerging that may hit a bit closer to home now?" The most significant technologies for forage producers are those relating to the genetic improvement of crops and forages, some of which are already being realized.

You are most likely well aware of the impact of genetic technologies such as Roundup Ready corn and alfalfa. Roundup Ready options are growing and have clearly revolutionized agriculture around the world. Other genetic advances include Bt corn and reduced-lignin alfalfa varieties, with more to come.

So are we at the pinnacle of the genetic revolution in crops and forages, or are we just getting started? That is a difficult question to answer for several reasons – biological, political and socioeconomic.

Biologically, with regard to understanding the agronomic relationships between the genetic makeup of a plant (genotype – G), the production environment (E) and the management systems (M) that will be applied, we have much to learn. Most forage plants still do not have a quality genome sequence, and we clearly do not understand the vast majority of the complex relationships between the GEM factors.

Ironically, new varieties, improved production systems and climate change will continue to increase the complexity of these challenges. If we use a scale of 1 to 100, where 100 is a perfect understanding of G x E x M and zero is no understanding, we are at about 5. We do not even know all of the functioning parts for many genetic and physiological systems and are just now determining ways to identify simple breeding parameters, such as individual plant parentage.

The second question may be even more complex. How will we define, develop and defend genetic modification- or GMO-based technologies in the future? And what are the socioeconomic implications associated with these definitions?

Clearly, this is a contentious and complicated arena which promises to become even more so with the arrival of new approaches to plant breeding and genetic enhancement. There are many drivers in this discussion, but 9.5 billion souls in 2050 may be the most important of them all. Clearly, there is a lot of work to do, but food security will trump special-interest concerns as long as GMO organisms do not demonstrate any significant negative attributes so feared by many – so far so good in that regard.

The third challenge is funding. Many agronomic commodities are very limited in their ability to fund even minimal levels of genetic and physiological research. Most large companies are much more focused on short-term economic impact, i.e., product development focused on significant short-term economic value, as opposed to long-term focus and investment in the basic research required to achieve maximum technological socioeconomic benefit.

Consequently, to maintain focus and progress in fundamental research, public research dollars are critically important. Unfortunately, these dollars are also quite limited for most forage crops, particularly those not associated with bioenergy production.

So what are some of the emerging genetic technologies that will further revolutionize forage plant breeding? For the sake of brevity, I will simply say that there are many exciting strategies being developed, but the current game-changer is "genome editing."

Genome editing is accomplished most often with a technology known as clustered, regularly interspaced short palindromic repeats (CRISPR), although there are other options. These technologies enable the manipulation of individual genes in an organism without disruption of the larger genome. Consequently, conventional breeding efforts to back-cross a single gene into a population, which may take several generations, can now be accomplished in a single generation without changing the original genetic makeup of the organism.

Think about that. In animals, this technology could easily be applied to correct a genetic deficiency, such as bovine leukocyte adhesion deficiency in Holstein cattle, or to create an exact copy of a genetically superior animal that was polled instead of horned. CRISPR technologies are already being used in human and agronomic applications to expediently and efficiently identify gene functions, model genetic diseases and correct defective genes for therapeutic applications.

CRISPR technologies have further enabled the development of standardized, general methods for inducing targeted deletions, insertions and precise genome sequence changes in a broad range of organisms, which will also empower a greater scientific understanding of the critical GEM relationships discussed previously.

Interestingly, the GMO versus non-GMO discussion for gene editing is even more intriguing because, in many cases, no foreign DNA, or even DNA from unrelated organisms, is introduced. The question then is: "Has an organism with a simple knockout or the simple transfer of an existing allele actually been genetically modified?"

This question is especially pertinent since many gene edits will be undetectable in the modified organism. And there will also be many applications for agriculture where the introduction of an unrelated gene or allele (foreign DNA) will create tremendous value, which will further complicate the GMO discussion. Clarity is pending, and it remains to be seen how and when these technologies will impact today's farmers and ranchers. Stay tuned. **FG**

Progressive Dairyman, 10-15-15

LETTER TO THE EDITOR

We read R. Tom Bass' article "100-pound herds: What are the secrets to their success?" pg. 6, Midwest edition, published on July 1, 2015, with great interest – and fully support six of his seven observations. However, in secret No. 7, Dr. Bass states, "Large bodies, the large rumens that come with them and the proportionately lower maintenance costs of bigger cows offer several undeniable advantages when elite production is the goal." This statement raised our concern for several reasons.

Comprehensive data compiled by the USDA-ARS Animal Improvement Program, Animal Genomics and Improvement Laboratory for Holstein cattle show a genetic correlation between milk yield and body size of -0.1. Fat and protein are also negatively correlated with body size. These data are virtually identical across dairy breeds and are also essentially unchanged over several decades of industry data evaluation, indicating that increasing body size in Holsteins is not necessary to increase genetic milk yield.

Further data from 5,700 Holstein cows in the USDA-AFRI National Institute of Food and Agriculture project 2011-68004-30340, which is led by Dr. Mike VandeHaar at Michigan State University, also do not support No. 7 in his article. In this analysis, the estimated genetic correlation between metabolic bodyweight and milk yield is 0.06, with a standard error of plus or minus 0.06, which indicates that it is not significantly different from zero. This means selection for larger body size is not necessary to genetically improve high milk production, though we would also contend that net profit is a more suitable goal than high milk production.

More importantly, the genetic correlation between metabolic bodyweight and gross efficiency (defined as the proportion of total energy intake that is devoted to production of milk and formation of body tissue) is -0.28, indicating that cows with a genetic predisposition for larger body size are less efficient in terms of feed utilization. In contrast, the genetic correlation between energy-corrected milk yield and gross efficiency is 0.66, indicating that selection for higher milk yield will increase the gross efficiency of feed utilization.

By comparing the magnitude of these correlations, we can see that selection for higher milk yield should be the primary goal. Selection for larger body size, though commonly practiced by pedigree breeders and A.I. industry sire analysts, is not supported by this research. Consequently, ending the trend toward selection for larger body size should be a priority in the short term, and if and when we achieve this objective, our selection programs should continue to focus on higher milk yield and improved production efficiencies as primary goals, with smaller body size as a secondary goal. New tools are emerging that will allow direct selection for increased feed efficiency, most likely in the form of genomic predicted transmitting abilities for residual feed intake.

Finally, larger and larger cows are exacerbating challenges with practical dairying in many important areas: reduced reproductive fitness, increased injury and lameness, wear and tear on facilities and housing, and increased safety issues for cows and human handlers; all of which combine, making the selection for ever-larger cows clearly an unsustainable practice, particularly for the Holstein breed. Focus must be reapplied to improving the net profit of the dairy industry through simultaneous improvements in production capacity, production efficiencies and reduced environmental impacts. **PD**

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Producers push forage envelope

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Wisconsin grows abundant forage most years, and if farmers are on top of their game, that forage is good quality. Fortunately, cows are good at making milk on the forages they consume.

How much forage can farmers really feed to dairy cows? That was the question addressed by Ken Kalsceur, dairy scientist with the U.S. Dairy Forage Research Center in Madison, during one of the forage seminars at World Dairy Expo. Down the road, he thinks the dairy industry will see cow diets in the range of 70 percent to 75 percent forage.

Ken Kalscheur

Producers are already pushing the envelope, enticing their cows to eat greater percentages of forage.

"Forages are the base upon which nutritionally sound, economically sound and rumen-healthy diets are formulated," Kalscheur said.

Why feed more forage? Kalscheur listed the potential benefits as:

- Higher milk components, particularly percent milk fat
- Improved cow health and lower incidences of acidosis and metabolic disorders. Acidosis occurs when excessive volatile fatty-acid production in the rumen causes cows to go off feed. Adequate forage and fiber greatly stimulate rumination, which buffers acids in the rumen.

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JANE FYKSEN/AGRI-VIEW

Feeding higher levels of forage has been proven to increase income-over-feed costs.

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- More forage in the diet means fewer foot-health problems. Many times when cows develop acidosis, they also develop laminitis. Adequate fiber in the diet greatly reduces both.
- Lower culling rates and increased longevity
- The ability to feed more homegrown forage means less feeding of purchased feeds, saving on the herd feed bill. Forages are an economical source of protein, energy and fiber compared to most concentrates. Legume forage can provide up to 75 percent of the protein needed by lactating dairy cows; corn silage can provide up to 25 percent. Forages are also an important source of energy, especially corn silage, which can provide up to 50 percent of the energy necessary in a cow's diet. Alfalfa silage can provide up to 40 percent. Forages are often the only source of fiber in a cow's diet. That fiber is essential to slow the passage of feed, thereby increasing the amount of nutrients the cow can absorb from her feed.
- Improved income-over-feed costs. With feed as the largest cost on a dairy, forage feeding can contribute substantially to the profitability of the operation.

There are other good reasons to key in on forages:

- Forages stimulate cud-chewing and rumination, which improve the cow's appetite.
- They're good for the soil. With deep roots and permanent ground cover, perennial forages help hold soil in place. They also increase soil organic matter, and legumes add nitrogen to the soil.
- Perennial forages also help protect the farm environment, because they reduce surface-water runoff and leaching of nutrients. They demand less fertilizer, and they cover the soil year-round.

Kalscheur said there are potential challenges that farmers looking to feed more forages will face. They will need to plan ahead in terms of their operations' capacity to harvest and store forage. More frequent forage analysis and ration adjustments will be needed; attention to detail is crucial when forages are fed to cows.

Further, if forage quality is not sufficient, farmers will face more problems with lower intake, lower milk production and reduced profitability, when higher amounts of forage are in the diet.

JANE FYKSEN/AGRI-VIEW

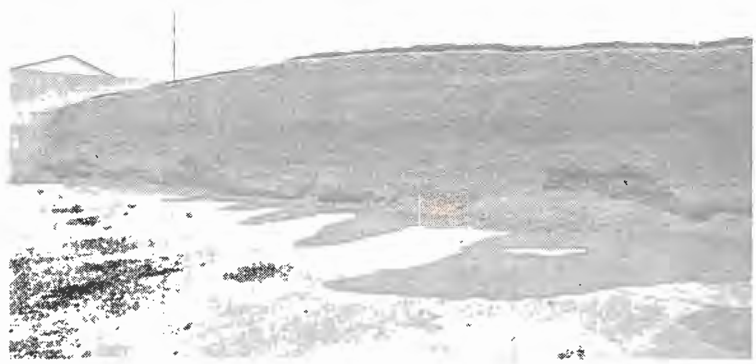
Forage is the backbone of a grazing operation. Cows are designed to eat forages, so it makes sense to feed more if a farmer can, according to Ken Kalsceur, dairy scientist with the U.S. Dairy Forage Research Center.

Looking at examples of high-forage diets fed by six farms in the northeast United States, Kalscheur said, "There is no exact way to do this." Forage as a percent of ration dry matter ranged from 62 percent all the way up to 75 percent in the study. Ration starch was in the 24 percent to 27 percent range. Crude protein ranged from 15.5 percent to 18.3 percent. Kalscheur noted that herds are moving to lower crude protein quite well.

While traditional recommendations on ration neutral detergent fiber fall in the 27-percent to 28-percent range, these herds were all above 30 percent, with one as high as 34.4 percent.

This study also measured forage neutral detergent fiber as a percent of bodyweight. The herds ranged from 0.9 percent to 1.1 percent. "We want the diet at least 0.9 percent," Kalscheur said, emphasizing that if forage neutral detergent fiber is too high, it limits intake.

"There's no specific recipe," Kalscheur said, highlighting the fact that the herds were feeding various percentages of forages. One herd fed 66 percent corn silage as a percent of forage dry matter and 34 percent alfalfa silage. Another was feeding 34 percent corn silage with 65 percent legume-grass forage. A third was feeding 56 percent corn silage, 29 percent alfalfa silage and 15 percent legume-grass silage. A fourth fed 60 percent corn silage and 40 percent legume-grass forage. A fifth fed 61 percent corn silage and 39 percent grass silage.



As producers increase the amount of forages they're growing and feeding, it becomes more important to closely manage the forage inventory, both for quantity needed and consistency of feed.

The sixth herd fed 56 percent corn silage, 40 percent alfalfa silage and 4 percent grass silage. Kalscheur remarked that grass silage is more common in the Northeast than it is in Wisconsin.

Cows in these herds were milking from 76 pounds to 105 pounds a day, with milk fat percentage running from 3.6 to 4.3.

"It's about putting up good-quality forages of whatever type they are," he said.

He cited work at South Dakota State University, where he'd been prior to coming to Wisconsin. Researchers there increased forage from 42 percent to 66 percent of the diet. Researchers basically saw no production differences from increasing the level of forage in the diet. Again, he said it's possible to feed cows a wide range of forage-to-concentrate rations without jeopardizing milk.

Where they saw a difference, however, was in improved feed efficiency by providing those cows with more forage. They saw a linear increase in energy-corrected milk over dry matter intake as the forage level rose from 42 percent to 66 percent. Milk fat also rose in similar fashion.

Feed cost moved in the opposite direction. It went from \$6.23 per cow per day at 42 percent forage fed to \$5.49 per cow per day at 66 percent forage in the diet. Income-over-feed costs – based on a 10-year rolling average of the cost of feed – was as follows: 42 percent forage, \$6.73; 50 percent forage, \$7.21; 58 percent forage,

$7.72; and 66 percent forage, $7.52. Kalscheur said it's possible to decrease the cost of the diet with more forage.

Kalscheur said that during the last decade there's been a strong trend to push more forage to cows. He said the dairy industry should want to continue that push. In fact, he noted, herds component-feeding instead of utilizing a total mixed ration will get the same type of feed-efficiency boost from more forage as total-mixed-ration herds do.

How far can dairy farmers take this? Up to 75 percent forage, Kalscheur said, noting he's heard of some farms with total mixed rations going to cutting edge with 80 percent. Of course, there are also farms out there that are 100 percent forage. They're called grazing herds, he said. And their feed costs are very low.

Driving factors determining forage consumption are: Forage quality or neutral detergent fiber concentration, forage digestion rate, rate of passage, particle size and palatability. When pushing more forage intake, the rate of passage goes up. Ultimately farmers want cows to eat more, but they also want as complete a digestion in the rumen as possible. It's a balancing act.

If digestibility is poor, rate of digestion is reduced, rate of passage is reduced and intake is reduced because of rumen fill. Milk production goes down.

Kalscheur concluded with these considerations for feeding higher forage diets:

- Strive for consistent quality with minimal variation. As forages increase in the diet, consistency is king. Slight variations in forage quality from silo to silo or field to field will have a greater impact on milk production.
- Monitor the forage inventory and plan ahead to make sure the farm can harvest or source the amount of forage desired as feed.
- Frequently analyze forages including particle size and digestibility. Adjust the diet more often than normal.
- Fine-tune feeding management, including silage-face management, aerobic stability, palatability and feed delivery.
- Monitor total mixed ration mixer management. A ration with more forage is bulkier, creating the need for more mixes per day or the need for a bigger mixer.

Wrap up quality baleage

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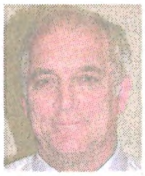
Most of the methods for making conventional chopped-silage apply to baled silage, otherwise known as baleage. However, there are differences, especially when it comes to moisture management and fermentation rate.

Wayne Coblentz, agronomist and dairy scientist with the U.S. Dairy Forage Research Center in Marshfield, took the stage at World Dairy Expo's forage seminars earlier this month in Madison. He shared tips for making high-quality baleage.


Wayne Coblentz

Moisture management is critical, according to Coblentz. Generally, baled-silage techniques will accommodate drier forages, less than 50 percent moisture, better than relatively wet ones, greater than 50 percent, said Coblentz. In other words, drier material is more forgiving than wetter material.

"Fermentation may occur at a slower rate for baled silage because forages are ensiled on a whole-plant basis, and the forage is

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Baleage

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usually drier than chopped silage," he said.

"As a result, producers should diligently address other management details, such as maximizing bale density, applying plastic wrap promptly and properly and protecting the wrapped product until feeding," Coblentz said.

Baleage has been gaining popularity, especially with smaller dairies. Not only does it provide harvesting flexibility but the ability to bale silage also enables a farmer to better manage feed inventory. The producer can also sell any hay-crop silage made because it's easier to transport.

Coblentz prefaced his talk by stating that a machine-shed of expensive equipment won't turn poor-quality harvested forage into high-quality packaged feed. It is crucial farmers manage for quality start to finish with baleage just as with other silage.

Why choose baleage over hay? "Well-made baled silage will often exhibit better quality-characteristics than corresponding hays," Coblentz said. "That's because there's less leaf loss with legume baleage."

Less wilting time is required, which is a definite benefit when the weather is somewhat-less-than-cooperative, he said. There's also less risk-exposure to potential rain damage.

Further, there's little or no spontaneous heating with baleage and no weathering of the feed after baling like there is when round bales of hay are stored outdoors, as they are on many farms, according to Coblentz.

Baleage is suitable for either wetter hay – 25 percent to 50 percent moisture – or haylage – 50 percent to 70 percent moisture.

How does baled silage compare to haylage? Baled silage may be less dense than chopped silage, which also may restrict the availability of sugars to lactic-acid bacteria. Lower bale density and a greater ratio of surface area to forage dry matter potentially makes baled silage more susceptible to entrapment and/or penetration by oxygen.

Finally, baled silage should be put up at a moisture content that's 5 to 20 percentage units lower than for chopped forages. This alone will restrict fermentation, according to Coblentz.

The goal in preserving silage – be it baled-and-wrapped or chopped and bagged or placed in a bunker – is to establish anaerobic conditions, i.e. no oxygen, as soon as possible. Trapped oxygen in baled silage is removed through respiration of still-functioning plant cells.

Sealing quickly prevents air from re-entering, thereby preventing decay, losses in dry matter and energy and possibly production of toxic products. The goal is to stabilize the baleage by lowering the pH and maintaining anaerobic conditions.

Lactic-acid bacteria are the targeted desirable microorganisms that consume plant sugars to produce lactic acid, which Coblentz called the good silage acid of fermentation. Clostridia and enterobacteria are the undesirables, he said.

Well-preserved silage is characterized by reduced pH, greater lactic-acid concentration, and reduced ammonia concentration compared with silage that did not ferment well. Water-soluble carbohydrates are the primary fermentation substrate. Ensiling is more efficient with greater water-soluble carbohydrates.

Don't wrap baled silage and forget about it until it's needed for feeding. Maintaining the integrity of the plastic requires regular inspection and repair.

Research revealed that alfalfa, with less water-soluble carbohydrates, or sugars, than ryegrass, didn't achieve as low a pH during fermentation.

Fermentation will differ depending on the forage crop being wrapped. He compared the water-soluble carbohydrates, i.e. amounts of sugars, for selected forage crops. Water-soluble carbohydrates as a percent of dry matter are as follows: Corn silage, 10 to 20 percent; forage sorghum, 10 to 20 percent; sudan, sorghum-sudan and millet, 10 to 15 percent; rye, oats, wheat and triticale, 8 to 12 percent; ryegrass, 8 to 12 percent; and alfalfa, 4 to 7 percent.

He also pointed to research that showed that water-soluble carbohydrates in fall-grown oats are affected by the amount of nitrogen fertilizer applied. Basically, the more nitrogen applied, the more water-soluble carbohydrates are suppressed.

Rain also reduces water-soluble carbohydrates, along with starch. And the more rain the worse it is.

Coblentz said that generally baled silage should be packaged at 45 percent to 55 percent moisture, with the average for the whole field or group of bales at about 50 percent. Production of silage fermentation acids is positively associated with moisture concentration.

Moisture recommendations for chopped silage are greater than 70 percent. As a result baled-silage fermentation is inherently restricted, resulting in a slower fermentation and a greater, less-acidic, final pH.

Colbentz said clostridial fermentations produce some nasty end products that restrict intake, such as butyric acid and ammonia. Some characteristics of high-risk forages for clostridial fermentation are: High-moisture concentration; direct-cut forages; immature, rapidly growing forages; high contamination wet dirt, manure or both; low sugar; high buffering capacity or the forage crops inherently resistant to pH change; high protein; leguminous; and non-homogenous forages, i.e. baled silage. The best prevention is to wilt the forage prior to ensiling. As such, baled silage is generally at low risk, Coblentz said.

As for sealing baleage, lack of bale uniformity will create air pockets in line-wrapped bales. Thus the goal is to have as straight a top-line to the row of sealed bales as possible. Use ultra-violet-resistant plastic and patch holes with appropriate tape, i.e. not duct tape.

Wrap as quickly as possible after baling – within two hours is ideal. Use at least four layers of plastic and at least six for longer-term storage. Coblentz said those are bare minimums.

Storage-site selection and maintenance are also important. Isolate wrapped silage from cattle, pets and vermin so as not to puncture the plastic.

A cutter on the front of the baler is also recommended for greater packing density. What makes baled silage more susceptible to undesirable clostridial fermentation than chopped silage is when particle size isn't adequately reduced.

Coblentz concluded that he'd wait at least 90 days before testing the feed value of baled silage. He estimated it takes about 90 days for a full fermentation.

Overcoming Seed Dormancy in Switchgrass

Switchgrass has been a primary focus of efforts to develop perennial crops for bioenergy. Low dormancy is critical to stand establishment, but we know little about how selection and breeding have improved germination and reduced dormancy in switchgrass cultivars compared with wild populations.

In the November–December 2015 issue of *Crop Science*, researchers report on switchgrass germination in a population-level study involving a diverse group of cultivars and wild populations. The team's growth chamber experiment quantified variation in seed mass and its association with germination across populations. The group also tested a common seed treatment (cold-moist stratification) for improving germination.

Cultivars showed greater germination than most wild populations. However, germination of wild populations varied by more than an order of magnitude. Wild populations with large seeds showed greater germination. Cold-moist stratification substantially improved germination and increased germination of nearly all populations.

Breeding and selection, or even seed multiplication, passively eliminates non-germinated seeds, and the current study suggests this has led to large reductions in dormancy of switchgrass. Deliberate selection for larger seeds is another strategy for enhancing germination, especially during integration of wild populations into breeding programs. Continued selection and breeding, and seed multiplication, should overcome dormancy in switchgrass. For switchgrass populations with persistent dormancy, practitioners can cold-moist stratify seeds to increase germination.

Overall, dormancy should not be a major barrier to developing switchgrass as a biomass crop.

Adapted from Eckberg, J.O., M.D. Casler, G.A. Johnson, L.L. Seefeldt, K.E. Blaedow, and R.D. Shaw. 2015. Switchgrass population and cold-moist stratification mediate germination. Crop Sci. 55(6). View the full article online at http://dx.doi.org/doi:10.2135/cropsci2015.02.0124

Left: Emerging radicle and coleoptile of a germinating switchgrass seed. **Right:** Non-germinating seeds were tested for viability (dormancy) using tetrazolium which stains live embryonic tissue pink-red. *Photos taken by Karen Blaedow.*

By Sarah Hill

Yes, You Can Feed Cows While Saving the Environment

A lot of times, dairy producers focus separately on what goes in at the front end of the cow, how much milk is produced, and how to deal with the manure that comes out the back end. But feed, milk production, manure and environmental impacts are inexorably linked.

Dr. J. Mark Powell, a research scientist with the U.S. Dairy Forage Research Center (USDFRC, USDA Agricultural Research Service), has studied the impact of dairy cow nutrition on manure. His research found that the two main factors influencing manure are energy and protein.

What's Happening Inside the Cow

"When we feed a dairy cow, we're feeding the microbes in her rumen," says Powell. "These microbes make everything happen."

When rumen microbes are fed a balanced diet for energy and protein, it provides the microbes energy to grow.

"Balanced diets are really important," says Powell.

However, not just any old protein will do – the protein's degradability and amino acid composition is important.

"You also want to evaluate the contribution of the protein to meeting the rumen degradable protein needs and how this amino acid composition of the rumen undegradable protein complements the microbial protein," says Powell.

Powell notes that under the best conditions, most balanced diets result in about 30-35% of the protein fed to dairy cows ending up in the milk.

"That's the best that dairy producers can do, based on the biology of the dairy cow," he says. "Most of the remaining 65-70% of feed protein comes out in the manure."

However, Powell says that many dairy cows are being fed rations not properly balanced for protein which, consequently, do not efficiently optimize nitrogen utilization.

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How Do Cows' Diets Affect the Environment?

All that manure being produced has the potential to be damaging to the environment, if not handled correctly. There are three major elements of concern: nitrogen, phosphorus and carbon. Let's dig into those a little further:

Nitrogen – Can be very complex to deal with, according to Powell, and can be found in both gas and solid forms. Ammonia and nitrous oxide are the major nitrogen gases that come from manure. Ammonium and nitrate are the forms of nitrogen that are available to plants.

When more protein is fed than the cow needs, nitrogen is excreted mostly as urea in urine.

"Urea in urine is a major source of reactive nitrogen on a dairy farm," says Powell.

When plants don't take up nitrogen, it can leach into groundwater. Nitrogen denitrifies when deprived of oxygen in soil, forming nitrous oxide, the most potent greenhouse gas (GHG). "It has about 300 times the global warming potential than carbon dioxide," Powell adds.

"When ammonia combines with particulates in the atmosphere, that haze can be bad for people with respiratory problems, or it can obscure visibility, etc."

That ammonia can then come back down to the ground in dust and rain, which can fall anywhere. This added nitrogen enhances grass growth in natural ecosystems, making them more prone to fire.

Phosphorus – Is primarily found in cow manure, but not urine, according to Powell. While phosphorus is an important plant nutrient, it can cause problems when applied excessively to soil surfaces if it runs off into lakes and/or streams. If it reaches a waterway, it feeds the algae, causing algae growth, which, in turn, depletes oxygen and reduces water quality.

"As farmers apply manure, soil phosphorus can build up, which then creates the potential for the excess to run off. Manure can add a lot of phosphorus to

the system and must be managed properly," Powell says.

Research at USDFRC and University of Wisconsin-Madison has determined that dietary phosphorus is linked directly to phosphorus runoff.

"The supplemental mineral phosphorus just wasn't needed in many cases," says Powell. "The animals weren't benefitting from it. When we eliminate unnecessary supplemental phosphorus from the cows' diets, which many dairymen have done, we reduce the amount of phosphorus in manure, and lessen the potential for phosphorus runoff."

It's a chain effect from there, according to Powell. Less phosphorus in manure means less phosphorus in the soil and water.

"Now, nutritionists are doing a pretty good job working with dairy farmers to feed only the necessary amounts of phosphorus," Powell says.

Carbon – Some carbon leaving the dairy is found in the form of methane gas, which has two sources.

The main source is methane, which comes from the cows themselves (burps). This is called "enteric methane" and it is created as a fermentation byproduct from the cow's diet.

The second methane source is created when manure is put in storage and the carbon in the manure continues breaking down, forming methane.

"If a dairy producer has an anaerobic digester, they can capture that gas and either use the energy or sell it," says Powell.

The stable carbon in manure contributes to carbon storage in the soil, which

mitigates climate change because that carbon is not being released as carbon dioxide into the atmosphere.

"When you talk about carbon in regards to feeding cows, you usually talk about the digestibility of the diet fed," says Powell.

Diets that are easily digestible by rumen microbes are balanced in fiber and starch, so the cow gets all the energy she needs while still maintaining healthy rumen function. Carbon from fiber and non-fiber carbohydrates helps the microbes utilize rumen degradable protein and produce milk.

"If you do it that way, you'll still maintain a carbon mixture in manure, reducing methane in manure storage while keeping carbon in the soil after manure application," says Powell.

How To Feed Cows Without Harming the Environment

According to Powell, a large part of the answer lies in grouping milking cows based on needs and feeding balanced diets to those groups.

"In our research, we found that half of Wisconsin dairy farmers weren't grouping cows and were just feeding one diet to every milking cow," says Powell. "That's where a lot of the inefficiencies come from."

To reduce nitrogen losses, Powell recommends feeding cows a diet balanced with energy (C) and protein (N), based on accurate dietary requirements.

Another feeding strategy being researched at the USDFRC and elsewhere is to include more condensed tannins in the diet, either from forages or supplements. Tannins are natural protein-binding substances found in some forages such as birdsfoot trefoil and sainfoin. In addition, there are efforts to bioengineer alfalfa to produce a tannin, Powell says.

"Forage tannins or commercial tannin products added to diets of dairy cows can reduce urea excretion in urine and inhibit the enzyme urease, which is responsible for the conversion of urea to ammonia," Powell says.

Scientists at the USDFRC and the University of Wisconsin-Madison have found that tannin-containing diets reduce ammonia loss from dairy barn floors and from soils after manure slurry application. Other studies have or will examine whether condensed tannins can enhance nitrogen utilization in crop rotations.

Managing Manure Nutrients

"Changes in manure chemistry will have positive effects on the environmental footprint of dairying, but how you manage manure is even more important," Powell emphasizes. One recom-

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mended practice is to collect as much manure as possible and properly store and land apply it.

When cows in a stanchion barn are turned out, manure hot spots can accumulate in outside lots. This manure should be collected whenever possible.

With freestall barns, manure collection is happening continuously. Manure and urine are always mixed, which results in more ammonia being lost.

In manure storage, it's better to let a crust form to reduce ammonia and methane losses.

Powell also suggests that spring manure application is ideal.

"Fall application isn't as good for the crops or the environment," he says. "That manure sits all winter and is prone to runoff and nitrate leaching into the groundwater through the spring."

If manure is applied right before planting, then more ammonium and nitrate stays in the system and more nitrogen is available to plants. ✱

How Much Forage Can We Feed to Dairy Cows?

Kenneth Kalscheur, USDA-ARS, U.S. Dairy Forage Research Center

Dairy cattle are designed to convert forages and high fiber feedstuffs into high quality products. Diets formulated with high amounts of high quality forage can efficiently produce high milk levels. Ultimately, diets need to be formulated to keep the rumen healthy and produce milk efficiently while limiting nutrient waste, all at an economical price to keep the farm profitable.

Why are Forages Important?

Forages in dairy cow diets are required to keep the rumen healthy and fermentation optimal for high milk production. There are many benefits to increasing forage concentration: higher milk components (primarily milk fat percentage), improved cow health resulting from normal rumen function, lower culling rates, increased cow longevity, lower feed purchases, and increased income with homegrown forages. Increased forage consumption is directly related to improved rumen and cow health because it lowers the incidence of acidosis and metabolic disorders resulting in fewer foot problems and longer life.

There are potential challenges for increasing forages in the diet. As with any change in the diet or management practice, one needs to consider what will be affected. First, more high quality forage will be needed over the course of the year, meaning more forage acreage, harvesting, and storage capacity. Second, forage production can be challenging, but it will be important to harvest high quality, highly digestible forages to support high milk production. Since forages will be a greater portion of the ration, slight changes in nutritional concentration will result in significant nutrient supply changes to the cow. Therefore, the farmer or nutritionist will need frequent forage analyses and ration adjustments to account for nutritional changes. Third, if forage quality is not sufficient, cows will decrease feed intake because of lower ruminal digestibility resulting in lower milk production and profitability. Consequently, all of these challenges need to be factored in when deciding whether to increase the forage to be included in the ration.

How much forage can one formulate into high-producing dairy cow rations? Over the past decade, herds successfully increased forages (i.e., grasses, alfalfa, corn silage) from 50% of the diet (on a dry matter basis) to >55%. Today, many Midwest herds use 55-60% forage inclusion. What about even higher inclusion levels and what types of forages can be used to achieve this? Northeast U.S. researchers (Chase and Grant, 2013), summarized diets of six herds that successfully included 62-75% forages. Milk production was 76-105 lbs/cow/day and milk fat percentage was 3.6-4.3. Diet characteristics included:

1) A variety of forages (while all used some corn silage, alfalfa and grass silage were also important, indicating there was no specific recipe as long as the forage is highly digestible).
2) Dietary starch concentration from 24-27%.
3) Dietary crude protein concentration from 15.5-18.3%.
4) Dietary neutral detergent fiber (NDF) from 31-34%.

5) Forage NDF as a % of bodyweight (BW) from 0.9-1.1 (it is important forage NDF, as a BW %, is ≥0.9%; higher is better).

Economic Benefit of Forages

A major reason for increasing forages in diets is that cows can convert higher forage diets to milk more efficiently than lower forage diets, thereby reducing the cost to produce milk. In addition, forages are typically less expensive than purchased grains and concentrates, further enhancing income minus feed costs. For example, South Dakota State University researchers (Schuler et al., 2013) evaluated diets where forages were increased from 42 to 66%. The remaining portion of the diet consisted of grains, concentrates, and by-product feeds. The forage portion consisted of 30% alfalfa haylage and 70% corn silage on a dry matter basis across all four diets. In agreement with previous forage inclusion experiments, dry matter intake (DMI) declined linearly as forage inclusion increased from 42 to 66%. Interestingly, milk production remained the same, averaging 88 lbs/cow/day. Consequently, this has an important impact on feed efficiency, or the conversion of one unit of DMI to one unit of energy-corrected milk produced. Energy-corrected milk is the desired unit of measure to account for any changes in milk fat and protein percentages. In this experiment, because cows consumed less feed on the higher forage diets, but produced similar quantities of energy-corrected milk, the conversion of feed to milk (otherwise known as feed efficiency) increased linearly from 1.36, 1.44, 1.54, and 1.57 for cows fed the 42, 50, 58, and 66% forage diets, respectively.

While improving feed efficiency is highly desirable, this effect is doubly enhanced by the fact that forages are less expensive than concentrate feeds. In this experiment, because energy-corrected milk was similar across diets, milk income was also similar, averaging about $13.14/cow/day. On the other hand, feed costs declined from $6.23 to $5.49/cow/day for cows fed the 42% and 66% forage diets, respectively. Overall, income minus feed costs improved as forage increased in the diets.

Considerations for Feeding Higher Forage Diets

There are many factors that determine forage consumption by the cow. These include forage quality, rate of digestion in the rumen, rate of passage out of the rumen, forage particle size, and forage palatability. If forage digestibility is poor, rate of digestion decreases, rate of passage decreases, intake decreases, and in the end, milk production decreases.

Chase and Grant (2013) suggested the following guidelines for herds considering increasing forages in the dairy ration:

1) Strive for consistent quality with minimal variation. Variation in forage quality will greatly impact milk production.
2) Monitor forage inventory. Consider changes in cropping or feed sourcing program.
3) Allocate the highest and lowest quality forages to the most appropriate groups.
4) Frequently analyze forages (i.e., particle size, digestibility).
5) Adjust rations as needed based on forage analyses.
6) Target feeding management, including silage face management, aerobic stability, palatability, and feed delivery.
7) Monitor TMR mixer management. Ration is bulkier creating the need for more mixes per day or the need for a larger mixer.
8) Make dietary adjustments to higher forage concentration in small increments. Adjust ration and see how cows respond before making dramatic changes in the ration.

Forages are an important part of every dairy cow diet. Higher inclusion levels of lower digestible forages will reduce milk production, whereas higher inclusion of high quality forages in the dairy cow diet will maintain rumen health, improve milk components, and increase income per cow per day minus feed costs. While high forage diets may not fit the management of all dairy farms, it is an excellent option for those dairy farms with land base available to grow their own forages.

Managing Fermentation with Baled Silage

Wayne Coblentz, U.S. Dairy Forage Research Center

Production of baled silage is attractive to many dairy and beef farmers. There are clear advantages over dry hay: 1) less risk of rain damage; 2) better potential to harvest at an earlier or appropriate maturity – shorter window of suitable weather is required to wilt, bale, and wrap; 3) better retention of leaves, especially from legume forages; and 4) greater potential for outside storage since it is wrapped in plastic film. In many cases, existing hay equipment can be used, reducing some of the start-up costs.

General Management Goals

In general, management principles for conventional chopped silage apply to baled silage. The first goal is to start with high-, or appropriate-quality forage for your livestock; however, baled silage is not a corrective measure for storage of poorly managed forage. Once baled, the most important goal is to create an anaerobic (without oxygen) environment where plant sugars convert into fermentation acids (lactic acid is most desirable) by microorganisms adhering to plants at time of ensiling. Production of fermentation acids lowers pH of the forage mass, ideally creating stable fermented silage as long as anaerobic conditions are maintained.

Rapid establishment and continued maintenance of anaerobic conditions are critical because: 1) respiration by active plant cells convert sugars (in presence of oxygen) into carbon dioxide, water, and heat, and must be terminated quickly to prevent sugar losses necessary for fermentation; 2) anaerobic conditions support efficient growth of lactic acid producing bacteria; 3) yeasts and molds cause aerobic deterioration (spoilage) when plastic integrity is compromised; and 4) aerobic deterioration results in dry matter (DM) loss, increased concentrations of fiber components, and decreased energy density. Recommendations for sealing bales are to apply 6-8 layers of plastic within 2-4 hours of baling, if possible.

Moisture Management

Baled silage should be packaged at 45-55% moisture (Shinners, 2003); the average for the whole field, or a group of bales should be ~50%. This recommendation contrasts sharply with normal targets (<70%) for most precision-chopped silages. One reason is related to equipment, particularly safety issues with bale weight and limitations of some balers to package excessively wet forages. Another reason for the reduced moisture recommendation is the potential of clostridial fermentations, depressing voluntary livestock intake and producing undesirable end products (i.e., butyric acid, ammonia). Recent work at the University of Wisconsin Marshfield Agricultural Research Station detected elevated concentrations of undesirable fermentation products when moisture of wrapped alfalfa bales approached 60%. On this basis, 60% should be considered the upper moisture alfalfa threshold, since it is sensitive to clostridial fermentations. Production of silage fermentation acids is positively associated with moisture concentration. As a result, fermentation within baled silages of lower moisture is inherently restricted, resulting in a slower fermentation and a greater (less acidic) final pH (Figure 1).

Plant Factors Affecting Fermentation

All forages are not created equally – this also applies to relative suitability as silage crops. Sugar (referred to as water-soluble carbohydrates, or WSC) is required during silage fermentation to produce lactic acid. Concentrations of WSC in forage plants vary with many factors, including plant species, cultivar within species, growth stage, time of day, climate, drought, frost events, N fertilization, rain damage, and poor/extended wilting conditions. Plant species has a profound effect on WSC concentrations (Table 1), explaining why highly-sugared crops, such as corn (10-20% of DM), are easier to ensile than alfalfa, which typically has moderately low sugar content (4-7% of DM). Common factors depressing WSC concentrations include N fertilization, rain damage, and poor wilting conditions.

Buffering capacity is another plant factor affecting fermentation ease. It can be defined as inherent resistance to pH change within any forage; therefore, highly-buffered forages are naturally more difficult to ensile than less buffered. Specifically, corn is not highly buffered (185 mEq/kg DM; Table 2), but alfalfa and other legumes are. Furthermore, buffering capacity of alfalfa is closely associated with proportions of leaf tissue. As a result, alfalfa ensiled at 1/10 bloom is more heavily buffered (438 mEq/kg DM) than alfalfa harvested at the mid-bloom stage of growth (370 mEq/kg DM), or alfalfa that has been damaged by rainfall events (Coblentz and Muck, 2012).

Other Differences between Baled and Chopped Silages

First, chopped silages have greatly reduced particle length, but baled silage usually is ensiled as long-stem forage. This lack of chopping action within baled silages forces sugars to move, largely by diffusion, from inside the plant to reach lactic acid producing bacteria adhered to the outside of plants. This normally limits the rate and extent of fermentation (Figure 2). In addition, baled silages often are less dense than chopped silages, which may restrict availability of sugars to lactic acid producing bacteria, and further slow fermentation rate. To combat this, farmers should adopt a 10 lbs DM/ft^3 target density threshold when baling. Although operator experience is important in creating dense bales, other management practices, such as reducing tractor/baler ground speed, increasing power take-off (PTO) speed, and creating thinner windrows, also help maintain bale density.

Questions about Inoculants

Research studies evaluating baled silage inoculants are very limited relative to chopped silages; it is difficult to support recommendations with good data. However, for ensiling baled alfalfa, there may be three circumstances especially warranting inoculation with lactic acid producing bacteria. These include alfalfa forages that have: 1) suffered damage from rainfall events during wilting; 2) received dairy slurry or other manures during current growth cycle (Coblentz et al., 2014); or 3) been packaged at 60% moisture threshold at which production of butyric acid may become problematic.

References will appear in archived copy of this article on the MFA website www.midwestforage.org

Figure 1. Fermentation rate for alfalfa ensiled in large-round bales at high (60-65%) or ideal (49-54%) moisture.

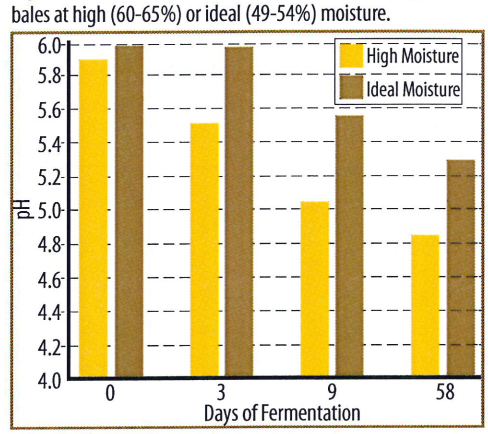
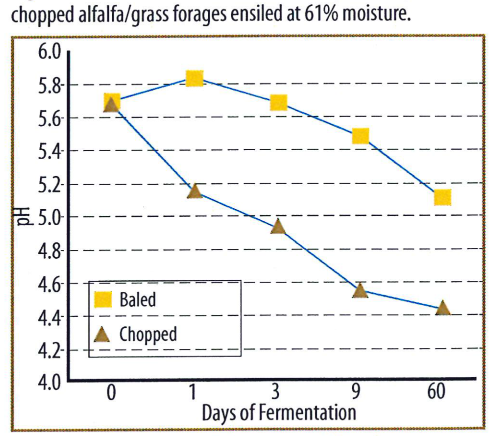


Figure 2. Fermentation rate for baled compared to precision-chopped alfalfa/grass forages ensiled at 61% moisture.



Figures 1 and 2 adapted from Nicholson, et. al., 1991.

Table 1. Concentrations of WSC for selected forage crops expressed as a percentage of DM.

Crop/Species	WSC % of DM
Corn silage	10-20
Forage sorghum	10-20
Sudan, sorghum-sudan, millet	10-15
Rye, oat, wheat, triticale	8-12
Ryegrass	8-12
Alfalfa	4-7
Bermudagrass, stargrass	2-4
Bahiagrass	<5
Limpograss	<5
Perennial peanut	1-4

Source: Adesogan and Newman, 2013

Table 2. Buffering capacities of selected forage crops.

Crop/Species	Range	Mean
	-------mEq/kg DM-------	
Corn silage	149-225	185
Timothy	188-342	265
Fall oat (headed)	300-349	323
Orchardgrass	247-424	335
Red clover	---	350
Fall oat (boot)	360-371	366
Italian ryegrass	265-589	366
Alfalfa (mid-bloom)	313-482	370
Perennial ryegrass	257-558	380
Alfalfa (1/10th bloom)	367-508	438
White clover	---	512

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See 3rd page for USDFRC connection, comments from Dr. Mark Borchardt

One-third of wells in Kewaunee County unsafe for drinking water

Deer Run Dairy LLC near the southern end of Sleepy Hollow Road in Kewaunee County is among many large dairy farms in the county, where a recent study found one-third of the wells exceeded safety standards for drinking water.

By Lee Bergquist of the Journal Sentinel
Dec. 21, 2015

More than one-third of wells in dairy farm-intensive Kewaunee County were found to be unsafe because they failed to meet health standards for drinking water, according to a new study.

Researchers say it's too early to blame cattle as the source of pollution.

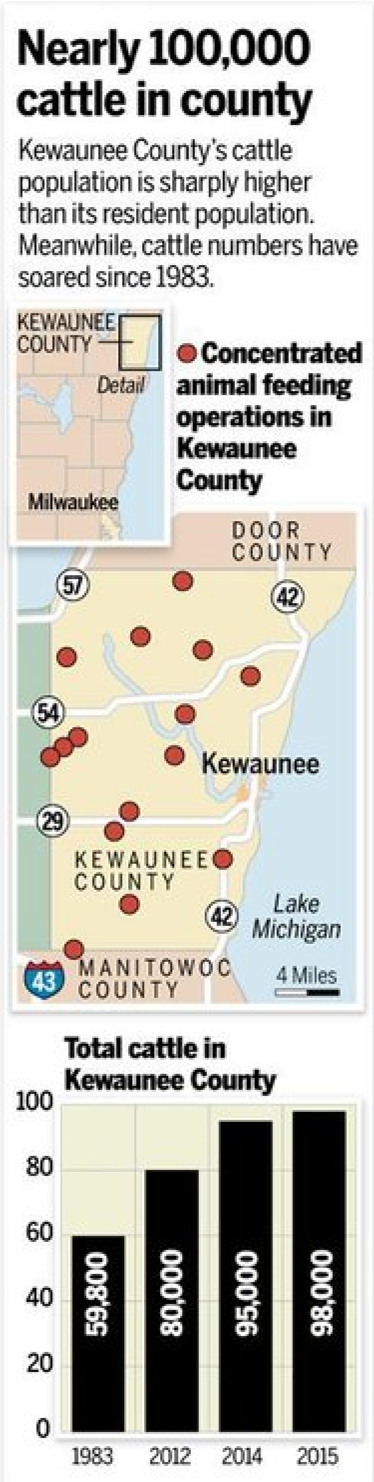
But the findings are significant because the northeastern Wisconsin county — where cows far outnumber people — has become the center of a growing controversy in Wisconsin over manure's role in polluting ground and surface water.

The results are from the first phase of research funded by the Department of Natural Resources to study pollution problems. In Kewaunee County, cattle numbers have grown sharply over two decades, and the amount of manure exceeds the waste generated by the human population of Milwaukee.

Animal waste isn't cleaned by sewage treatment plants, however. Manure is spread on farmland as fertilizer and has long been an accepted practice of replenishing the soil for growing crops.

But manure use in Wisconsin has grown increasingly controversial, especially in areas with large-scale farms and where soil and local geologic conditions make groundwater more vulnerable to pollution. Kewaunee County has 15 large-scale dairy farms, known as CAFOs, or concentrated animal feeding operations, that have 700 or more milking cows per farm.

The county ranks among the highest in the number of CAFOs in the state, according to the DNR.



Sources: Department of Natural Resources, U.S. Department of Agriculture — Journal Sentinel

It also lies in a region where soil depth varies and sometimes is only a few feet above fractured bedrock where bacteria from manure and other pollutants can reach groundwater more easily. Statewide, there are worries about the effect of manure and other nutrients that wash into streams, rivers and lakes and spur algae blooms. In Lake Michigan, animal waste, urban runoff and other sources are ingredients in the annual formation of a dead zone in Green Bay.

In October 2014, six environmental groups petitioned the U.S. Environmental Protection Agency to use its authority to investigate water contamination. Kewaunee farmers opposed the petition, but the EPA responded by saying it would work with the DNR on groundwater issues in the county.

The DNR then brought together different parties this year for discussions and formed a series of work groups aimed at reducing the risk of groundwater contamination. Recommendations are expected to come out early next year.

The agency approved an $80,000 research project, including the well study, that is led by researchers from the U.S. Agriculture Research Service and the University of Wisconsin-Oshkosh. The project will examine the extent and source of groundwater contamination in the county.

In August, Russ Rasmussen, the DNR's top water regulator, told the state Natural Resources Board the system of spreading manure in certain regions isn't adequately protecting drinking water supplies.

Last week, Rasmussen said the DNR will use input from the Kewaunee County work groups to recommend better application methods for sensitive areas. But he stressed the agency prefers a voluntary approach over regulations, which can take several years to implement.

"I do believe that those petitions made the DNR much more serious about the problem here," said Lee Luft, a member of the Kewaunee County Board and chairman of a newly formed county groundwater committee.

The initial well study showed that 34% of 320 wells tested in November — a relatively dry period — did not meet health standards for nitrates and total coliform, both of which can be found in manure but which can come from other sources as well.

Well testing in the county dating back to 2004 has produced similar results, although on average, the latest figures revealed a higher percentage of unsafe wells.

Between 2004 and 2015, 29% of 620 wells in a voluntary testing program by the Kewaunee County Land and Water Conservation Department showed unsafe drinking water.

The agriculture community has raised doubts about the results because owners of the wells volunteered to provide water samples and may have already suspected they had a problem or live near livestock operations or fractured bedrock.

The latest study is different.

"This was a random study and it was done countywide," said Mark A. Borchardt, a microbiologist for the U.S. Department of Agriculture, an expert on pathogens in groundwater and the co-investigator of the project.

Critics of past well reports have blamed leaking septic systems as a possible explanation for wells, but Luft cited county data showing by the end of August 79% of all septic systems had been inspected and were compliant or were coming into compliance.

With so much manure being spread on the landscape, Luft said the results are a sign that manure is the likely source of the tainted wells.

The county's total cattle population is 98,000, which includes dairy cows. That's up 64% from 59,800 cattle in 1983, according to state figures. The number of dairy cows, which produce more manure than calves or heifers, is 45,500, according to the U.S. Agriculture Department.

But Borchardt said, "It's way too premature" to blame cattle.

Borchardt and his colleagues still must pinpoint the various depths of contamination in the groundwater.

The next phase of the study will be more telling, he said. In that, researchers will use DNA fingerprinting to identify whether bacteria in 20 wells comes from cattle or humans. Another phase will use an automated sampling system to monitor the flow of groundwater in real time to measure spikes in bacteria and viruses moving through the groundwater.

In April, Kewaunee County voters approved a groundwater protection ordinance prohibiting manure spreading from Jan. 1 to April 15 on land with 20 feet or less of soil before reaching bedrock.

"It's a step in the right direction," said John Pagel, owner of Pagel's Ponderosa Dairy, the largest dairy farm in Kewaunee County. "It's one more tool for farmers to use."

The state-funded study will also inject more science into the manure debate, said Pagel, who milks more than 4,000 cattle.

"It's additional information to help us understand how serious the problem is," he said.

For now, he said, he wants to see the complete results from the study before he draws any conclusions.