FARM REPORT

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FROM THE PRESIDENT'S DESK: FIBER AND STARCH

As you all know, for a few years now Miner Institute has been working on how to optimize both forage particle size and digestibility. We've focused on simply integrating physically effective NDF and undigested NDF at 240 hours of in vitro fermentation (uNDF240). This value – termed physically effective uNDF240 (peuNDF240) - can be calculated as physical effectiveness factor (pef; % of particles retained on 1.18-mm screen when dry sieved) multiplied by uNDF240, or perhaps more accurately over a wide range of diets, as a direct in vitro measure of uNDF240 on the pef fraction of particles. The most recent study, conducted by graduate student Katie Smith, has looked at how peuNDF240 interacts with starch.

Our research to date suggests that when forage fiber digestibility is lower than desired, a finer forage particle size will enhance dry matter intake and energy-corrected milk production. The improved lactational performance appears to be associated with less eating time and a more desirable rumen fermentation and fiber turnover for cows fed higher uNDF240 diet with finer chop length.

A database of multiple trials done at the Institute found strong negative relationships between uNDF240 and dry matter intake and energy-corrected milk yield. The relationship between peuNDF240 and intake and milk production was even stronger. The diets in this data base were primarily based on corn silage and haycrop silage with some chopped hay and straw. Importantly, there were no alfalfa diets or diets with larger amounts of non-forage fiber sources.

A 2019 report by Rock River Labs using 59 commercial dairy herds assessed the influence of corn silage uNDF measured at 30 and 240 h with NIR on herd dry matter intake and energy-corrected milk yield. A negative relationship between uNDF240 of the corn silage component of the total mixed ration and dry matter intake was observed, as well as a negative relationship between silage uNDF240 and milk. Overall, these researchers concluded that a 1-unit increase in uNDF240 was associated with a 0.60 lb/d reduction in dry matter intake and a 1.3 lb/d reduction in energy-corrected milk yield. In our study, as dietary uNDF240 increased by 1 percentage unit, intake and milk were reduced by 0.83 and 1.2 lb/d, respectively, and so the agreement between the two studies was quite good. In the future, we intend to define the relationships between uNDF240, peuNDF240, and dry matter intake and milk yield for a wider range of diets and management scenarios on commercial dairy farms.

Our most recent work assessed the relationship between dietary peuNDF240

See **FIBER**, Page 4

IMPACTS OF TILE DRAINAGE ON FIELD-SCALE NUTRIENT LOSSES, YEAR 2

The role of tile drainage in runoff-driven nutrient losses from cropland continues to be a hot topic in New York, Vermont, and many other agricultural regions. This isn't without reason as in some cases, especially in flat landscapes, a large proportion of the nutrient losses from these fields may be occurring in tile drainage flows. However, a key point that can get lost in the concern over the impacts of tile drainage is that, if we could snap our fingers and instantly remove all tile drainage from our fields, the problem would not immediately be resolved. Setting aside the agronomic consequences resulting from a reduction in subsurface drainage capacity, the rain and snow that ends up in the fields still has to find a way out of the field and therefore, we would typically see an increase in surface runoff.

For such a common practice with tremendous benefits to crop production, there have been relatively few studies that have directly compared the impacts that altering the primary pathway of runoff from the surface to the subsurface will have on phosphorus (P) losses. Research has provided insight into some of the changes that will occur when tile drainage is installed. First, it is common to see a 10-25% increase in runoff volume due to the enhanced drainage capacity, with the majority typically occurring as tile flow. A positive result of this reduction in surface runoff is that it's common to see substantial reductions in the rate of erosion. Soils have a strong ability to bind P and when we can reduce soil erosion, we can also reduce the losses of P that is attached to those soil particles.

We also know that tile drainage water tends to have significantly lower concentrations of P than surface runoff, though this can vary depending on soil type, timing of applied P, and historical rates of P application. However, two important questions remain: 1) Does the increase in total runoff negate the benefit of the lower P concentrations in the runoff and 2) Even if total P losses are reduced, by allowing runoff to percolate downward through the soil before reaching the tile line, are we increasing losses of dissolved reactive P (DRP), the P form that is immediately available for algal growth?

	Runoff	DRP	Total P	TSS	Total N
	in/yr	----------lbs/ac/yr----------			
Tiled Field	8.79	0.018	0.187	130.22	12.95
Untiled Field	7.56	0.010	0.230	178.21	5.33

Funding from the Northern New York Agricultural Development Program from 2016-present provided the opportunity for Miner Institute to begin investigating these questions at the field scale with the establishment of an edge-of-field monitoring project on two adjacent fields in Keeseville, NY. The fields are very similar with respect to size, slope, soil type, cropping history, and current management, with the exception that one was tile-drained (35 ft lateral spacing, 4 ft depth) two years prior to the start of monitoring. Both fields are managed for corn silage with tillage-incorporated spring manure applications, starter fertilizer at planting, and a fallow period from corn harvest until spring planting. Surface runoff and tile drainage flows from the tile-drained field (TD) and surface runoff from the non-tiled field (UD) are continuously measured and sampled year-round, allowing annual estimates of sediment, P, and nitrogen (N) losses. The two-year average of annual runoff, DRP, total P, total N, and total suspended solids (TSS; an estimate of erosion) from 2018 and 2019 are shown in the table.

As expected, we saw a modest increase in total runoff from TD. While surface runoff continued to play an important role in the water balance of TD, representing 47% of the total runoff, it was reduced 45% relative to UD. As would be expected, the elevated rate of surface runoff in UD lead to 37% greater sediment loss than in TD. Event-based sediment losses were highly correlated with total P losses and the reduction in erosion from TD appears to have led to an overall reduction in total P losses compared to UD. Despite lower total P loss from TD, there was an increase in DRP lost, however, at 0.018 lbs/ac/yr, these losses are extremely low and the average concentrations (flow-weighted mean) from both fields were similar to the levels found in healthy lakes and streams. While the tile drainage has thus far had neutral (year 1) to modestly positive (year 2) impacts on P losses, it has clearly increased the rate of N losses. This is not unexpected as research over the years has demonstrated this tradeoff and it is crucial to recognize that additional conservation practices should be enacted to help mitigate these losses. The majority of N losses from these fields in both 2018 and 2019 occurred in October and November; planting a cover crop following corn harvest is a great way to capture residual N in the soil following the growing season and provide soil cover to further reduce the risk of erosion. Late fall corn harvests can complicate efforts to seed cover crops early enough to see growth before the cold sets in, but harvest is likely to come earlier than usual this year in the Lake Champlain Basin due to an early planting season and dry summer. This makes it a great year to try seeding a cover crop in at least a test field or two to see how it works for your operation.

— Laura Klaiber
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LACTO IPSO FACTO: FROM SILAGE TO SOUR BEERS

Recently, I've been learning quite a bit about the diversity and capability of the lactic acid bacteria (LAB). As a microbiologist and former beer scientist, I definitely appreciate the versatility of the LAB species. In the beer industry LAB are used in fermentation and barrel conditioning processes to create sour and "wild" beers (such as lambics, gose, and Berliner Weisse styles). Therefore, it should be no surprise that an article in Applied and Environmental Microbiology on the use of LAB in sour beer production caught my eye this month. As I read, I began to draw a number of parallels between the properties that lactic acid bacteria (particularly the Lactobacillus spp.) lend to sour beers for their tart profile, and those initiated during the silage fermentation process to preserve quality of forages. In Latin, "ipso facto" means "by the fact itself" or "as an inevitable result". When it comes to fermentation, use of lactos – ipso facto – brings favorable (and flavorful!) results.

Based on their metabolic pathways, lactic acid bacteria are either classified as homofermentative or heterofermentative. Both produce lactic acid as a fermentation end product after metabolizing available carbohydrates in forages; however, heterofermentative LAB also produce CO_2, ethanol, and acetic acid as byproducts. As a result, heterofermentative LAB are often favored as preservation agents over homofermentative LAB. Several Lactobacillus inoculants on the market are heterofermentative; of the LAB, the Lactobacillus spp. are favored based on their performance, stability, and safe use in both animal and human foods. LAB inoculants lower the pH of the forages to which they are applied through production of organic acids, which helps to control growth of harmful microbial populations such as yeasts and molds. When added to sour beer, LABs initiate the same effect. The pH of the beer is lowered to between 3.0-3.9 (compared to the 4.0-4.5 pH range of most other beers), and the accumulations of organic acids from fermentation are what give sour beers their tart flavors. The production of CO_2 in both fermentation processes are what inhibit aerobic bacteria from proliferating. Because LABs are facultative anaerobes (meaning they are able to grow regardless of the presence of oxygen), they are able to survive and dominate the microbial population in forages. As they are tolerant of ethanol, Lactobacillus strains are highly desirable as microbial inoculants, and so are easily able to dominate sour beer fermentation as well. In fact, when bacterial populations in beer are identified, the majority are Lactobacillus, followed by Pediococcus, Acetobacter, and other acetic acid-producing LABs.

Spontaneous fermentation occurs in both sour beer production as well as in forages, and LAB are added as means to positively enhance this naturally-occurring fermentation. Beer and forages face similar challenges with spontaneous fermentation, which is why assistance from LAB helps to improve their quality. Inconsistencies with fermentation in both can be financially detrimental; for forages, this can result in dry matter loss, decreased palatability, and spoilage. Undesirable flavors or aromas (such as ammonia) created by certain fermentation end products can reduce dry matter intake, while spoiled forages, if fed, can create issues with rumen health and lactation performance. Monetary loss as a result of discarding spoiled forages, decreased performance, or treating cows for digestive upset is generally not favored by a producer. While contamination or spoilage in beer is not likely to cause physical harm to the consumer, it is also financially detrimental to a brewer to have to dump a batch of beer down the drain if fermentation did not go as planned, or if the taste, aroma, and mouthfeel of the beer does not match its expected profile.

To support optimal fermentation capability, it is important to determine compatibility between LAB inoculants and their intended forage. If the LAB inoculant does not play nice in the bunker with the epiphytic (plant surface) bacteria on the forage, fermentation and palatability may be compromised. The aforementioned undesirable flavors, aromas, or presence of mold or spoilage are indicators that fermentation may not have gone as planned. Similarly, wooden barrels used for fermentation of some sour beers also have their own unique microflora based on the age, moisture, and previous content of the barrel. For sour beers that are cooled down in an open vessel (also known as a coolship) after the boiling process, a variable bacterial population can be present after being exposed to the environment. If the bacterial population in the barrel doesn't quite jive with that of the beer that is destined for it, comparably discouraging results are imminent.

Overall, the lactic acid bacteria have proven themselves worthy candidates in a variety of applications. They have long since been used in the dairy and craft beverage industry with satisfying outcomes, and their use only continues to improve as new strains and combinations with other LABs are studied. I could ramble on forever about the capabilities of the lactic acid bacteria, but suddenly I seem to be thirsty...

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ALFALFA: A PERENNIAL IN NAME ONLY

For years I've told farmers: "Alfalfa doesn't die — *you kill it*. You over-mow it, you under-feed it, you cut it in the fall, and you run over it with almost every piece of heavy field equipment on the farm."

Pity the poor alfalfa plant: What it *needs* is to grow free from insects and diseases, mature to full bloom so it can fully replenish root reserves (a full tummy), and then set seed in preparation for the next generation. But what happens? A myriad of insect pests, some (alfalfa weevil for one) invaders from Europe, several root and foliar diseases, and instead of letting alfalfa accumulate enough nutrients you repeatedly mow it at the bud stage. Then you topdress the field, often with manure using ever-larger tractors and spreaders, cracking the alfalfa crown which opens the tap root to disease. The poor thing eventually gives up the ghost, and when it does you say "Gee, I wonder what happened? Alfalfa used to live a lot longer than it does now." Today's alfalfa varieties are more stress-resistant than are older varieties, particularly for disease resistance, so variety selection isn't the problem.

So what can you do? Not much! You can plant reduced-lignin (HarvXtra) alfalfa varieties, but often you're encouraged by the seed company and perhaps your dairy nutrition consultant to mow these varieties in the bud stage. And while HarvXtra alfalfa mowed in the bud stage is lower in lignin, it hasn't accumulated any more root reserves vs. conventional varieties mowed in the bud stage. Avoid manure application to alfalfa and alfalfa-grass fields? Easy to say, not so easy to do, especially this time of year if your manure storage is full and corn is growing on much of your cropland. Even off-season applications can be a problem: The worst alfalfa crown damage I've ever seen was from a lime-ash application on one of Miner Institute's alfalfa fields when the ground was frozen — no "give" to the soil, so crowns were severely damaged by the lime truck. (And of course it was right on the main road where everyone could see the wheeltrack damage.)

My suggestion: Do all you can to establish a good initial stand, and through manure and fertilizer application (mostly manure if possible) build soil fertility to medium-high or high before seeding. This includes lime application! By doing so you may be able to delay potash topdress for a year or more following establishment, and perhaps no fertilizer P for the life of the stand. I'm convinced that you'll have better establishment and higher yields by increasing soil fertility before seeding than by heavy fertilization during and after stand establishment.

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FIBER, Continued from Page 1

and starch. At lower peuNDF concentrations, moderate levels of starch had negative effects on milk fat and 4% fat-corrected milk production. When peuNDF240 is approximately 4 to 6% of ration dry matter for corn silage-based diets (depending on how peuNDF is measured), and uNDF240 is <7.0% of ration DM, then negative effects of rumen fermentable starch at about 19 to 20% of ration DM may occur. The details can be found online as an abstract presented by Katie Smith at the June virtual ADSA meeting. Just go to the American Dairy Science web site to access the abstract booklet.

As this story unfolds, we plan to better define the interactions between rumen fermentable starch and fiber particle size and digestibility, providing target values to use when formulating rations. Stay tuned for more data – we expect to provide more at this October's Cornell Nutrition Conference.

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SAVE THE DATE: DAIRY DAY IS TUESDAY, DEC. 8, 2020! 10 am - 3 pm

Guest Speaker will be Corey Geiger, Managing Editor of *Hoard's Dairyman*

WHAT A YEAR FOR AN INTERN

I can't believe how quickly time has flown by! I'm wrapping up my year as the Research Intern here at Miner Institute, and can't help but to think back on all that I have learned from the people and farm around me in just one year. After working on research projects here at the Institute, I feel more confident in the resilience of the dairy industry and can't wait to see what my role in the industry will become.

Kristen Gallagher

As for now, I am continuing my education at Michigan State University. I am a New York State girl through and through, but I'm ready and excited to better understand a different philosophy towards dairying and research in a different region of the U.S. I will be working in the labs of Dr. Bradford and Dr. Zhou at Michigan State. I am excited for the work that I'll have the chance to participate in. My Master's will focus on nutritional metabolites and how they relate to cow health, specifically in the transition period. I have always been intrigued by transition cow health. The transition is a starting point that will determine the productivity of the lactation and future lactations. Farmers may often refer to dairy cows as elite athletes, and the start of a race will often determine the outcome. Metabolism and its direct link to cow health and immune function is driven by the way we feed our cows. With my research and studies, I ultimately hope to better understand the interrelated mechanisms that drive energy and protein metabolism in the transition animal, so that farmers can make the best management decisions to support dairy cow productivity and longevity.

I'm very glad to say that I feel prepared to take the next step after my time here at Miner Institute. The staff and friends of Miner have taught me so much during my year here. One of the most important things I will take with me is how to work to read data. The dairy industry is very good at creating data, but may be slower to utilize the information that is pulled from databases. In research, it takes many steps to get the "results" of your experiment, and those steps involve the art of statistics. Even with data that are received on farm, data should be visualized (AKA graphed or charted) before any further steps are taken. When looking at raw data, it's important to validate if the data makes sense in the setting that you pull the data from. For example, is it possible for a cow to consume that much feed when her dry matter intake appears to be very high? I have learned to be critical of data the first (and second) time reading through it. Although I have a lot to learn in the field of statistical analysis, after working here I feel more confident in my ability.

Another very important thing I have learned is how to communicate and be flexible within a complex team. There are so many people involved with the work that comes from Miner Institute. And there are so many things that can go wrong between the cows, feed, technology, weather, and overall luck of the day. The way in which the staff can still accomplish everything they need in a quality manner shows the importance of communication between people and departments. Any farmer knows that there are going to be issues on a dairy with unexpected consequences. Being able to bounce ideas between people, and communicate solutions between all parties that are involved takes organization and respect. I really do believe that this ability is the key reason why the Institute continuously puts out quality research.

And finally, one of the most important things that I learned is that you can learn from anyone. A lot that I learned here didn't necessarily come from someone with a PhD (although they also taught me a lot). Every job that exists at the Institute is critical. Sometimes, we get so wrapped up in our own jobs we forget the roles that everyone else plays. I have learned a lot that I hope to take into the dairy industry just from having conversations and asking about the opinions of the people around me. Miner Institute is a great place to be for anyone who thinks they might be interested in the dairy industry. There is so much to learn here, and so much to learn from the people. Thank you so much to everyone here at the Miner Institute who has made my year so special!

— Kristen Gallagher
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MINER FEEDER TOOLS AVAILABLE

Larry Chase, retired dairy specialist from Cornell University, recently told us that he was getting questions regarding farms in some parts of New York potentially being short of forage this year. He indicated that the Miner Feeder Tools had useful spreadsheets to calculate forage inventories in tower and upright silos as well as feedout rates. They would be of benefit to those folks looking to better characterize and track their forage inventories. So, thank you to Larry for reminding us to mention where these tools may be found. They were created several years ago by Dr. Steve Mooney, now at SUNY-Morrisville, when he was a post-doc at the Institute.

The feeder tools can be found on the Miner Outreach page of our web site (http://whminer.org/outreach/) under "Dairy Management Tools, Miner Feeder Tools".

The most useful tool kit will be Version 2.1 which is available in both English and metric units of measure. These Excel spreadsheets are very user-friendly and easy to use. Check them out if you're looking for some tools to help manage forages on your farm.

THE GREEN MOUNTAIN STATE GOES GREENER

Editorial commentary

On July 1st Vermont became the first state to ban the disposal of food waste in the garbage, AKA the "Food Scrap Ban". Acceptable alternatives include: Composting of food waste and leftover foodstuffs; separating food waste into containers for pickup by trash handlers; or transporting to local food waste drop-offs. Feeding to chickens is among the suggestions as to what Vermonters can do with food waste, but from a previous Farm Report article I think you know my opinion of "backyard" chicken enterprises. Though not mentioned in the ban details, other methods of preventing food from entering the waste stream include a large dog or one or more teenagers. We wish Green Mountain state authorities success in their efforts. This law is well-intentioned: to keep foodstuffs out of landfills. But according to an old English proverb (one often cited by my mother), "The road to Hell is paved with good intentions."

The Bride and I have a large, actively-managed compost area consisting of two sections: The "active" section has new vegetative material added almost daily, while the other section is "cooking" — slowly turning into compost for use in our gardens the following year. Composting weeds, grass clippings, etc.) is simple; composting food waste and table scraps is another matter entirely, though the ban sensibly permits residents who compost food waste to dispose of meat and bones in the garbage. Unless immediately covered by vegetative matter, composted food waste soon begins to smell, attracting flies and bees, and perhaps rodents. We're careful to bury kitchen waste in the active section of our compost pile, but some family members vacationing here are a bit more casual about the process. Recently I found freshly-dumped kitchen waste being visited by scores of bees. Side note to new composters: Sweet corn cobs don't compost worth a darn.

Vermonters who don't compost are instructed to store food waste in containers with tight-fitting lids, delivering the contents to drop-off facilities or curbside food scrap haulers. Trash haulers must offer food scrap collection services to non-residential customers and apartments with four or more units unless another hauler is willing to provide that service. The combination of table scraps + sealed container + summer temperatures should make opening these containers a memorable experience. And unless the container is absolutely airtight, meat waste may become "ground zero" for maggots. Compliance to the Food Scrap Ban is required, but at least at this point Vermont authorities don't intend on searching through residential trash bags looking for food scraps.

— *E.T.*

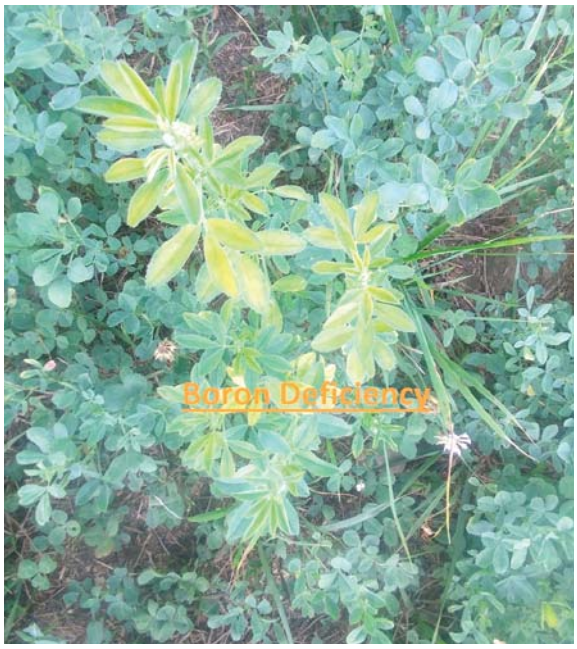
WHY IS MY ALFALFA YELLOW?

Chlorophyll is the dominant pigment in most of our agronomic crops. That's why we like to see a blanket of dark green when we look at a stand of alfalfa/grass. If other colors start to show in a standing crop, then something is going wrong. In the case of alfalfa, it could be any number of things. Here at Miner Institute we've had a fair bit of yellows and reds appearing in our alfalfa.

When most folks see yellowing in their alfalfa, they immediately assume it's potato leafhopper damage (which is often the case), but a number of nutrient deficiencies and diseases can also cause leaves to yellow. It's important to properly identify the cause of the yellowing if you want to treat it or at least prevent the problem in the future. Often the damage has already been done by the time you see the yellow from a distance, so periodic scouting in healthy-looking stands is also very important.

The two major culprits behind our yellow alfalfa at Miner Institute have been potato leafhopper and boron deficiency. While these are two very different problems, the symptoms they cause in alfalfa can look similar from a distance. While they both cause yellowing in leaflets and stunted growth, leafhopper damage (hopper burn) often shows primarily at the end of the leaflet, forming a characteristic yellow V shape. This damage is caused by the piercing-sucking mouthparts that the leafhoppers use to suck the nutrients out of the alfalfa, and damage can occur anywhere on the plant. The insects themselves should also be present near the scene of the crime, so be sure to look for them (a ballcap works for a sweep net in a pinch).

Hopper Burn



Boron Deficiency

In contrast to leafhopper damage, a boron deficiency should affect the entire leaflet with damage concentrated near the top of the plant (the growing points). In addition to yellowing, the leaflets can also develop a red tint that's a good giveaway. Boron is essential to all plants, but alfalfa is particularly sensitive to shortages. Boron is a micronutrient, so it's only needed in very small quantities (there is only about an ounce of B in a ton of alfalfa dry matter). Caution should be used when applying boron, since excessive boron is toxic to plants and problems can occur if your plan to rotate your alfalfa field into corn the following year. Here at the Institute, a few of our fields got boron this spring, some got it the previous spring, and the rest have gone for longer periods without boron. I observed the worst deficiency symptoms in this last group, but even fields where boron was applied this spring showed symptoms in some places. I attribute this to the unusually dry weather that we have been having this season. Since boron is supplied to plants through the decomposition of organic matter, boron availability wains when the uppermost soil layers become dry. An alfalfa taproot can penetrate deep into the soil to find water, but boron may not be available to sustain the plant until more moisture returns. Alkaline soils, coarse textured soils, and soils with low organic matter content can also contribute to boron deficiency, but aside from consistent irrigation, a foliar boron application may be the only way to alleviate symptoms if dry soil is the culprit.

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