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Crop Soil News

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"It is the crops that feed the cows that make the milk which creates the money."

Advanced Ag Systems
Research, Education, Consulting

Nutrient Enhanced BMR Forage Sorghum

Hypothesis Proven True:
BMR Sorghum with Management and Genetics can rival Corn Silage

The hypothesis we first broached in 2020 SARE research grant (Jan 2021 click to see) supporting the use of male sterile BMR sorghum with **nutrient enhance harvest**, has been validated by our Sorghum Check-Off repeated replicated research. Normal sorghum will have fertilized seeds at the top of the plant. The nutrients formed by photosynthesis after seed fertilization are preferentially moved to the seed sink much like a corn plant moves nutrients to the kernel on the ear. The difference is that the seeds of sorghum quickly get very hard and are not digested in the rumen. Their small size makes any processing difficult without destroying the forage effective fiber and turning the crop into soup. Additional research found that breaking the seed does little to increase the digestibility and the broken seed's nutrition is lost out of the back of the cow. Adding insult to injury, having several pounds of seed at the top of an 8 to 12 foot stalk is a setup for lodging. Multiple times in my research we had a high yielding crop that was completely lodged before reaching harvest maturity.

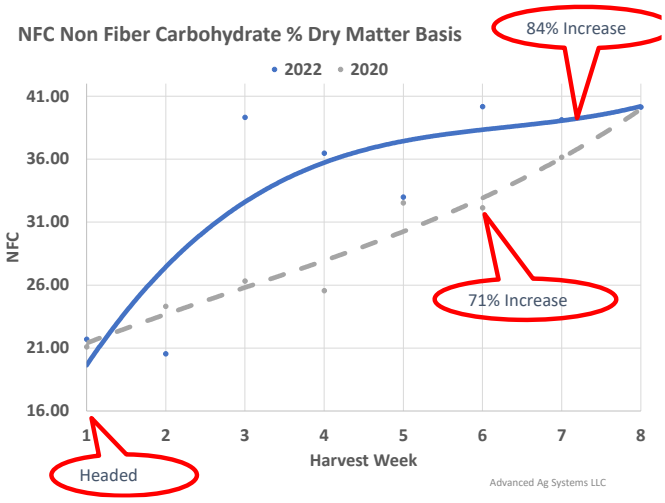
The hypothesis of our research is to utilize a **male sterile** BMR forage sorghum. Much like a beef steer, the plant does not have a nutrient sink in the seed head. Thus, with delayed harvest, all the photosynthetic material is accumulated in the forage portion where it was formed. There is no fertilized seed to accept it. We clearly measured this phenomena occurring in both 2020 and 2022 research trials.

Dr. Eckelkamp of Dairy Science at the University of Tennessee was key to getting the trial established and helped with the weekly sampling.

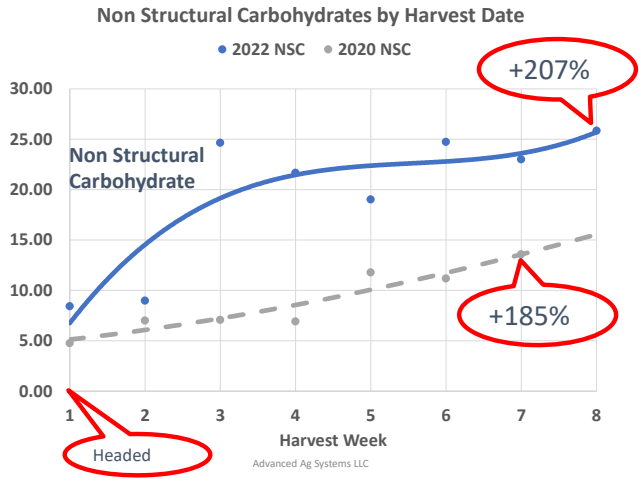
In each trial, Male Sterile BMR forage sorghum was grown in narrow rows. Starting at heading, six replicate samples were taken each week. Each sample consisted of a single full plant chopped (to avoid subsample bias), inoculated with SiloSolve MC, vacuum sealed, and fermented for 21 days before being sent for analysis. Sampling went 6 weeks in 2020, and 8 weeks in 2022. Farmers had traditionally waited until a week after heading for sorghum and then chopped. They then complained about the wetness of the forage and the lack of energy compared to corn silage. This harvest delay for the sorghum was to match what occurs in corn silage where it tassels and then chopped 8 weeks later. This allows both crops to be compared on an equal playing field. The result was a **huge increase in enhanced nutrition** as the digestible components accumulated in the forage cells.

Over the weekly harvest timeframe, the cellular sugar and starch level, the Non Fiber Carbohydrates NFC, and Non Structural Carbohydrates NSC increase significantly after heading. The question was how long after heading? Most think that sorghum needs to be harvested at boot stage or immediately after heading to optimize the nutrient content. Our research has found that this is completely false for quality forage. Our multiyear replicated research found that **8 weeks after heading** is needed to have the digestible components build to that of corn silage.

When comparing the data for the two crops the end total energy result is nearly the same but how they get there is very different. Corn silage has digestible fiber in the stover and **almost half or more of the dry matter energy comes from the ear**, and the large amount of starch it contains. BMR male sterile forage sorghum with the 8 week enhanced nutrition has **all the energy stored in digestible fiber and forage cell contents.** Yes, it increased the starch in the cells 45% to nearly 10%, but this is much lower than the 40% corn silage contains. Processing is NOT needed to release this starch energy. As you see below, the other energy contents of the sorghum that are actually moved to the grain in fertilized genetics, are many times higher than that of corn silage in the forage. A **critical point** for both nutritionist and farmer is that ***Sorghum is NOT Corn Silage***. When replacing one with the other the ration needs to be rebalanced and a high forage diet is strongly suggested (1% NDF by body weight).



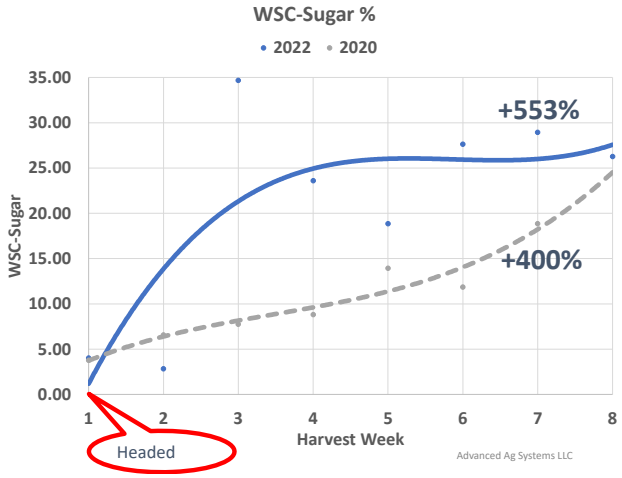
The harvest delay for enhanced nutrition enormously changes the energy levels of the sorghum when comparing to corn silage. The analytical results bear this out. During this time frame the **NDF dropped 20%** as more of the dry matter was digestible cell contents, and the **NDF digestibility increased 13% to equal or exceed corn silage**.



The Non Fiber Carbohydrates, NFC, increased 84% in 8 weeks (see top graph at right). This is equal to corn silage or slightly lower—but not the whole story.

The Non-Structural Carbohydrates NSC (middle graph at right) increased over 200% from what it was at initial heading. By going 8 weeks (2022) instead of 6 weeks (2020) we nearly doubled the level in the forage.

The photosynthesis increased the **sugar levels over 550%** with mean level at 8th week of harvest of **26% of dry matter**. This was not a fluke as in the 2020 research which only went 6 weeks after heading, increased 400% to 18.85% of the dry matter. Nutritionists have known that sugar plays a big role in the rumen digestion and support of the microbes and fungi critical to breaking forage down. Unfortunately, if very much sugar is just dumped into the ration as molasses or other sugar type, there is a very good chase of tipping the rumen into acidosis. This has multiple negative impacts on the animals health and on the components in the milk that the farm is paid for. The sugars in this sorghum are in a very different package as they are contained in each individual



plant cell. As the cells are individually ruptured by fungi (which need sugar to do their job), the sugars are slowly and steadily released in the rumen. This slow release coupled with our findings that a **one inch length of cut with NO processing** is best for this crop means you have the effective fiber, peNDF, needed for optimum rumen function without the explosion of added sugar tipping the rumen into acidosis. The longer pieces (but still short for maximum intake) assure full extent of digestion before flushing out of the rumen. The longer length of cut and no processing has been proven to have a major impact on reducing or eliminating leachate from the silo.

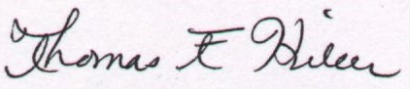
As a crop that is all forage and no grain, the potential that we had in 2020 and earlier male sterile work was that at harvest, crude protein should be 11%. Both sites in 2022 were over 11% CP at heading. As the plant laid down more highly digestible dry matter, the protein levels decreased because of insufficient nitrogen in the plant at the end of the season. We have received a NYFVI grant funding to study nitrogen and sulfur rates on male sterile BMR sorghum looking at the yield curve response and the crude protein economic curve response. Our previous work with winter forage had found that these two curves are very different. It also appears that a heavy manure application with immediate incorporation may supply that late season nitrogen from its organic matter breakdown.

We found that the crop is very wet shortly after heading. By allowing the crop to continue photosynthesizing after heading the **crop dry matter increased 55 to 65% over the 6-8 week period**, with final dry matter over 30%. Thus, like corn silage, the crop looked the same but kept increasing yield as the dry matter increased. Much of the increase was in stalk size which assisted the standability if the crop was planted at correct seeding rate. Our research found that utilizing the **proper homolactic bacteria inoculant** allowed compete fermentation even with this very wet forage, with no butyric and Clostridia formation. By delaying harvest 8 weeks, you avoid harvesting, hauling, and storing a very large volume of liquid for the small amount of dry matter nutrients that earlier harvest causes.

Caution: when we analyzed this crop at Cumberland Valley Analytical Lab, we worked with the staff and Dr. Larry Chase of Cornell to develop extra steps to get an accurate measurement of digestible components. The levels were far outside the algorithms for the NIR+ sugar and starch analysis. CVAS developed a sequence to separate the starch and sugar and wet chemistry measure sugar and then the residual starch. With sugar levels over 26% of dry matter, this is a critical step for accurate energy measurement. Without this extra step, we have had both farmers and nutritionists report that the cows milked much better than the forage analysis said they should.

This is not a slam dunk crop. You can screw it up. Having your crop next to or downwind of headed sorghum, sorghum-Sudan or Sudan will fertilize the male sterile and **void the nutrient enhancement** we are working for. Winter forage allelopathy can hurt the stand unless light tillage is used to break it up. Planting to early in cold soil will wipe it out or delay heading. This was a problem for us at our trial in the cold spot of Willsboro, NY. Fortunately, Dan Gard of S&W Seeds came through and harvested a field for us in Pennsylvania. Drilling more than **8 lbs. of seed**/acre will assure it is all lodged flat when you harvest. Season length is determined backwards: when do you harvest, back up 8 weeks and that is when it should be heading so select a variety and plant date to achieve that point. South of the Mason Dixon line we have the additional issue of needing a variety that heads out late enough in the fall. If it heads to early (as our one stand did) it will increase nutrition for 5 weeks and then start sending up heads from the lateral shoots. This completely ruins potential nutrient enhancement as the energy is used to produce heads and lignin.

Sincerely,



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