Forage News

MISSISSIPPI STATE UNIVERSITY EXTENSION SERVICE

Brix Level in Your Forage: What does it mean?

Volume 7, Issue 2

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February 2014

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Brix (°Bx) is a unit of measure that has been traditionally used in the wine, sugar, fruit and honey industries to estimate the sugar (sucrose) or water soluble content (in a percent by weight basis). Forages are composed of many soluble and non-soluble compounds. Water soluble compounds (WSC) could include sugars (sucrose and fructans), oils, minerals, pectins, acids, proteins, lipids, amino acids, tannins, etc. Producers try to use this parameter to estimate energy in forages, but it is important to note that °Bx is not representative of the exact amount of sugar. Brix levels in forage crops could be influenced by many management and environmental factors such as ambient temperature, barometric pressure, soil moisture content, drought, fertilization, crop species, time of the day and the year samples are collected, maturity and segment of the forage sampled, etc. For example, in a drought situation, plants tends to concentrate water soluble carbohydrates in the roots and tissues to survive. On the other hand, nitrogen applications can dilute water soluble carbohydrates since they can be devoted to growth. In a sense, Brix levels can change due to a dilution effect.

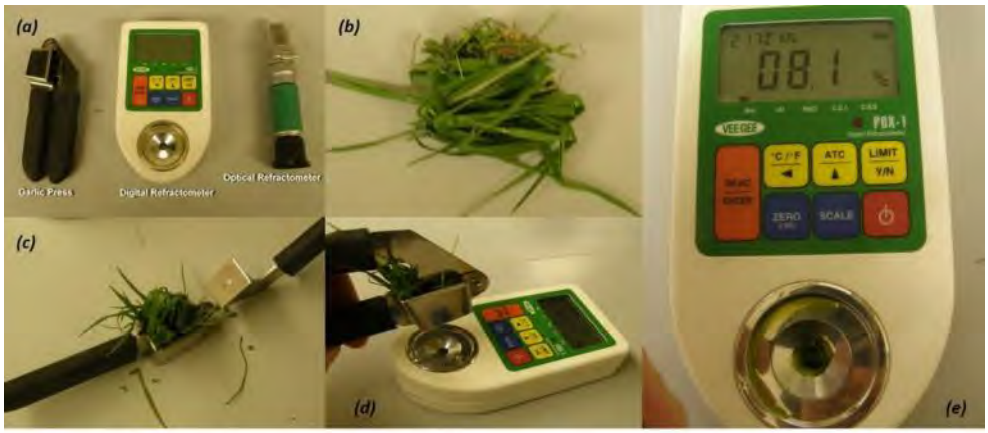

Figure 1. Type of spectrometers (a) (left to right garlic press and digital and optical spectrometers), representative grass sample (b), sample preparation (c), sap collection, and Brix estimation demonstration (d, e). Photos courtesy of Josh White.

Taking Brix measurements requires a garlic press or other type of press and a portable or digital refractometer or Brix meter. The refractometer uses a known refractive index of a glass prim to measure the refractive index of sap collected from a grass or legume. The optical Brix meter is one in which a drop of the sample of solution is dropped on a prism and the result is observed through an eye piece. This device need to be pointed in the direction of the light to make sure that the light is totally reflected into the sample. This will create a reflective index and a critical angle is achieved. Usually an optical meter contains a thermometer to correct the temperature to 68 °F. The digital meter has an internal light source (usually LED) in the prism and when a sample is dropped in the well the light will not penetrate the sample and creates a reflective index. Digital meters are more accurate and easy to calibrate and read. Digital refractometers have the advantage that they automatically correct for temperature variation. Optical refractometers may be slightly less accurate due to human error. This is simply a function of the user making the adjustment so the shadow line falls on the optical scale.

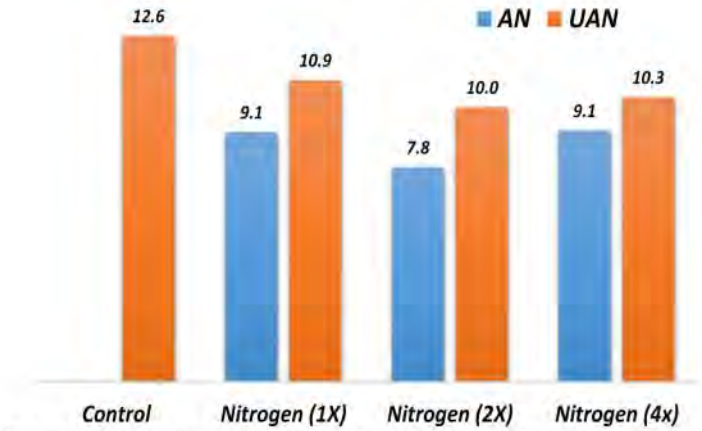

Figure 2. Brix levels in annual ryegrass treated with two nitrogen sources (AN = ammonium nitrate and UAN = urea ammonium nitrate, 32%) at a rate of 0, 1X (single application of 50 lb N ac^{-1}), 2X (two applications of 50 lb N ac^{-1}), and 4x (four applications of 25 lb N ac^{-1}). Lemus et al., 2012.

Figure 3. Brix distribution in annual ryegrass throughout the growing season. Lemus et al., 2012.

How to measure Brix?

1. When taking measurements, producers should take random plant samples across the pasture to get a good representation of the average water soluble contents. Samples should be taken between noon and 3 pm during a sunny day when plants are photosynthetically active and when bad weather is not expected for the next 24 hours. Take all grass brix measurements using exactly the same methods, at approximately the same time of day.
2. Sugar in the plant will vary from the bottom of the plant to the top. This means that the Brix reading at the bottom of the plant will be higher than the top of the plant. Getting a consistent sample that represent the whole plant is very important.
3. Place the sample in a garlic press or other type of press and squeeze out the plant sap. Care must be taken to make sure the sample does not have excess water and dirt on it, as water especially will influence the brix reading. Measurements should not be taken in wet conditions, and in damp conditions the grass should be dried using a paper towel.
4. To make a reading using an optical refractometer, place 3 to 4 drops of the liquid sample on the prism surface, close the cover and point toward any light source. Focus the eyepiece by turning the ring to the right or left. Locate the point on the graduated scale where the light and dark field meet. Read the percent sucrose (solid content on the scale). If using a digital refractrometer, place the sample in the glass chamber and let it equilibrate and obtain the reading. For example, if you were to have 100 pounds of bermudagrass that has a Brix reading of 10%, it would mean that there would be 200 pounds of crude carbohydrates per ton if the bermudagrass was juiced and dried to 0% moisture. By dividing 10 by 2 it tells us that the actual amount of simple sugars would be equal to 100 pounds.

What do brix measurements of common forages mean?

Summer annuals such as sudangrass, forage sorghums and legumes like alfalfa tend to have higher brix levels than some of the summer perennial grasses grown in Mississippi. Although there is no a standard level for Brix in forages, my rule of thumb is that a Brix measurement in southern forages for beef cattle should be <3 % very poor, 4-7 % poor-moderate, 8-12 % good and >13 % excellent. This is based on brix levels collected from several forage species and management practices at Mississippi State University. Keep in mind that cool-season annual grasses such as annual ryegrass usually will have higher Brix levels than warm-season perennial crops such as bermudagrass and bahiagrass. This is due to the higher moisture and lower fiber levels in the cool-season compares to warm-season grasses. It is more difficult to extract sap from warm-season grasses in the middle of the summer.

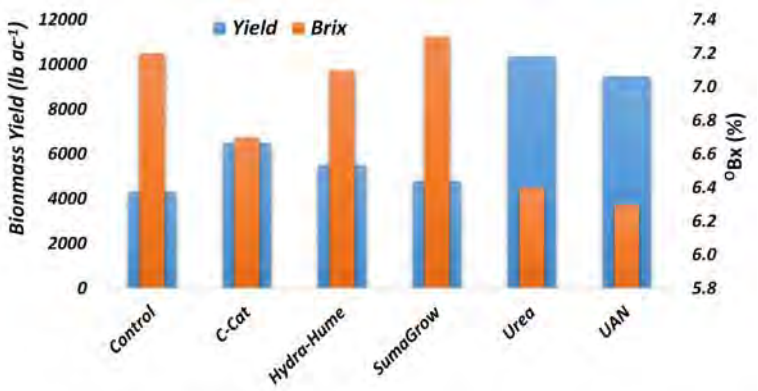

Figure 4. Dilution effect on °Bx levels created by increase in yield with nitrogen application when compared to soil bio-enhancers applied to Sumrall 007 bermudagrass. Lemus et al., 2013.

Forage crops with a higher reflective index will have a higher sugar, protein and mineral content and a greater density. Crops with higher brix levels might give an advantage in fermentation process for silage and baleage. Although Brix levels a have been correlated with taste or palatability and there are claims that cattle will prefer forages with higher sugar content; to truly understand the nutritive value of forages, it requires a forage analysis and then a prescription to change management practices and fertilization. I will not recommend to use Brix as a sole variable to estimate forage quality. Brix could be greatly affected by time of the year, type of fertilization and time of harvest and many other environmental factors.

For upcoming forage related events visit: ***http://forages.pss.msstate.edu/events.html***