Brix Level in Your Forage: What Does It Mean?

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 (on a percent by weight basis). Forages are composed of many soluble and nonsoluble 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 day and year samples were collected, maturity, and segment of the forage sampled. For example, in a drought situation, plants tend 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.

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 prism to measure the refractive index of sap collected from a grass or legume.

Figure 1. (a) Spectrometers. (b) A representative grass sample. (c) Preparing a sample. (d) Sap collection. (e) Brix estimation. (Photos courtesy of Josh White)

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The optical Brix meter is one in which a drop of the sample of solution is placed on a prism and the result is observed through an eyepiece. This device needs 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 achieve a critical angle. Usually an optical meter contains a thermometer to correct the temperature to 68 degrees Fahrenheit. The digital meter has an internal light source (usually LED) in the prism, and when a sample is dropped in the well, the light does 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.

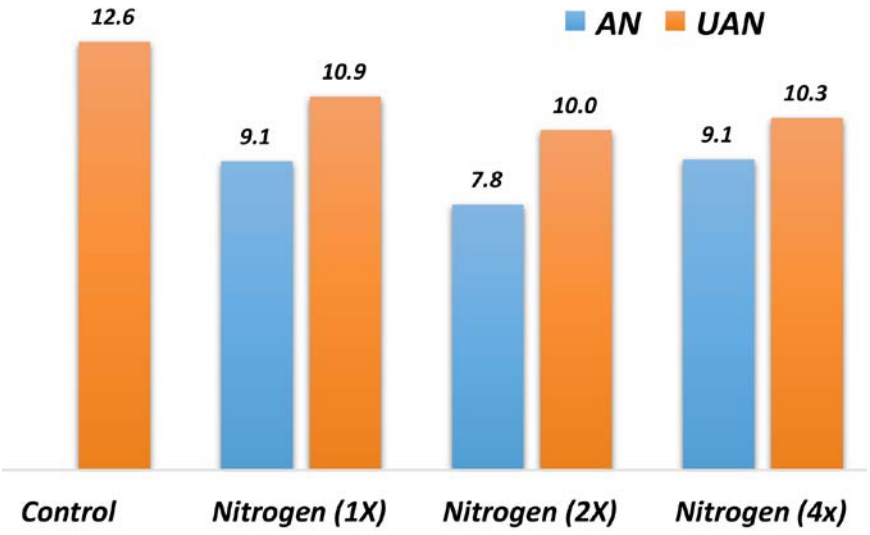

Figure 2. Brix levels in annual ryegrass treated with two nitrogen sources. (Lemus et al., 2012.)
AN = ammonium nitrate, 34%; UAN = urea ammonium nitrate, 32%
1X = single application of 50 lb N ac^{-1}; 2X = two applications of 50 lb N ac^{-1}; 4X = four applications of 25 lb N ac^{-1}

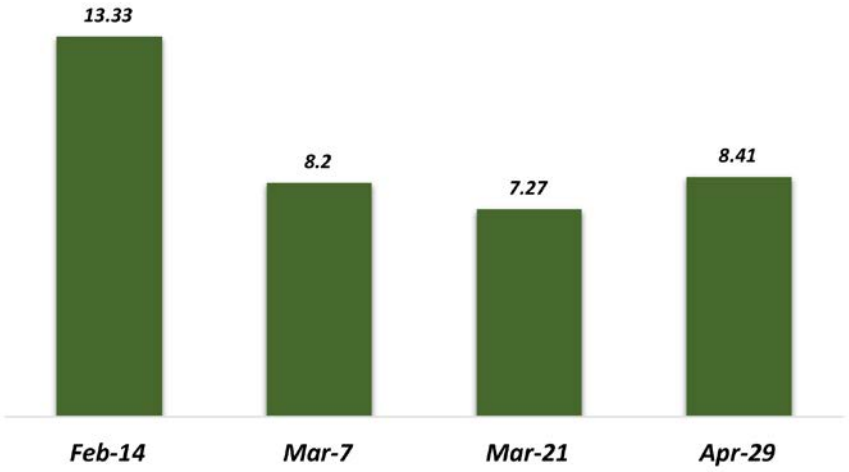

Figure 3. Brix distribution in annual ryegrass throughout the growing season. (Lemus et al., 2012.)

How to Measure Brix

1. Take random plant samples across the pasture in a Z or W pattern to get a good representation of the average water soluble contents. Take samples between noon and 3 p.m. on a sunny day when plants are photosynthetically active and 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 varies 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 at the top of the plant. Getting a consistent sample that represents the entire plant is very important.
3. Place the sample in a garlic press or other type of press, and squeeze out the plant sap. Make sure the sample does not have excess water and dirt on it, as water especially will influence the Brix reading. Do not take measurements in wet conditions. If the sample is damp, dry the leaves with a paper towel.
4. To make a reading using an optical refractometer, place three to four drops of the liquid sample on the prism surface, close the cover, and point it 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 fields 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, you have 100 pounds of bermudagrass with a Brix reading of 10 percent. This means there would be 200 pounds of crude carbohydrates per ton if the bermudagrass were juiced and dried to 0 percent moisture. By dividing 200 by 2, we find the actual amount of simple sugars is equal to 100 pounds per ton.

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 not a standard level for Brix in forages, quality intervals for Brix measurements in southern forages consumed by beef cattle can range from less than 3 percent (very poor) to 4–7 percent (poor to moderate) to 8–12 percent (good) to more than 13 percent (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 like annual ryegrass usually will have higher Brix levels than warm-season perennial crops like bermudagrass and bahiagrass. This is because cool-season species have

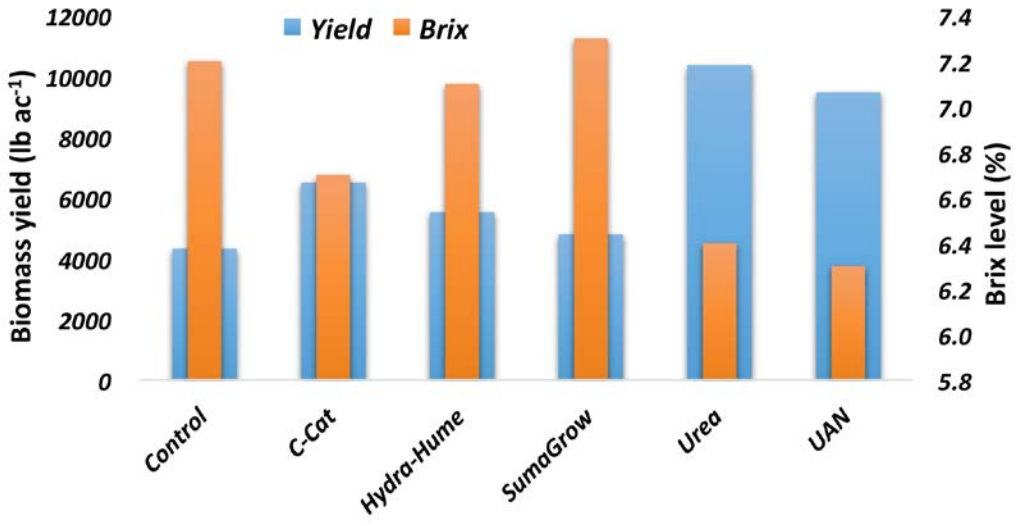

Figure 4. Dilution effect on °Bx levels created by increase in yield with nitrogen application when compared to soil bio-enhancers applied to Sumrall 007 bermudagrass. (Lemus et al., 2013.)

higher moisture and lower fiber levels than warm-season grasses. Additionally, it is more difficult to extract sap from warm-season grasses in the middle of the summer because the plant tissue lacks moisture.

Forage crops with a higher reflective index will have a greater concentration of sugar, protein, and minerals. Crops with higher Brix levels might have an advantage in the fermentation process for silage and baleage. Do not use Brix as a sole variable to estimate forage quality. Although Brix levels have been correlated with taste, palatability, and preference, a forage analysis is the most reliable indicator of the nutritive value of forages. Remember, Brix can be greatly affected by time of year, type of fertilization, time of harvest, and many other environmental factors.

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