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Brix values and forage: practical uses and limitations

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Introduction

Before we can discuss the relevance of determining Brix values for forage, let's first discuss what, in fact, a Brix value measures. Degrees Brix (^oBx, named so after German scientist Adolf Brix) is a measure of percent sucrose by mass in a pure water solution. The example to the right outlines the difference between a true Brix value and an approximate Brix value using grass sap as an example of the latter. Brix values can be obtained by measuring the specific gravity, refractive index, or infrared absorption of a solution. In the case of grasses and other forage vegetation, Brix values are obtained by using a device called a refractometer (optical or digital) to measure the refractive index of the sap. While there are limitations to what a Brix value can tell you about your forage, there is also great potential in collecting Brix data for relative seasonal and year-to-year forage comparisons.

Brix measurement example

IN A SUCROSE-ONLY SOLUTION:
A Brix value of 25% means that there are 25 grams of sucrose and 75 grams of water in a 100 gram solution. This is a true Brix value.

IN GRASS SAP:
A Brix value of 25% means that there are 25 grams of *soluble solids* and 75 grams of water in a 100 gram solution. This is an approximate Brix value. Soluble content of grass sap largely includes sugar in various forms (sucrose, glucose, fructose) but may also include other dissolved solids such as minerals, amino acids and lipids.

What knowledge can I gain from Brix values (why measure it)?

-) An approximate measure of dissolved sugars and other nutrients in plant sap.
-) A relative measure of overall quality in forage and pasture health.
-) The potential to assess nutrient/fertilizer uptake.
-) A potential indication of soil health issues suggesting a need for further investigation into soil quality.
-) The ability to compare between different forage vegetation, different forage locations, different

What knowledge will not be gained from Brix values?

-) The breakdown of nutrient levels (e.g. total sugars, protein percentage, measures of different mineral levels) within the plant sap.
-) Details on why forage growth may be poor in some areas.



Relevant Factsheets:

Forage Fact #103: Using Live-stock as Weed Managers
Forage Fact #104: Nutritional Value of Thistle

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For more Forage Facts visit:
www.peaceforage.bc.ca

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What can these tables tell us?

Table 1:

) The vegetables and fruit that we think of as 'sweeter' (e.g. beets, corn, cherry tomatoes, watermelon) were found to have higher average Brix values in this study.
) There is a wide range for Brix values with each fruit and vegetable which can be attributed to the many factors that influence a crop's condition at any given time (see below).

Table 2:

) Different species of pasture vegetation have different ranges of Brix values; more information on Peace region forage Brix values would allow for comparison such as shown in this table.

Table 3:

) Local Brix values from one site in August, and sampling earlier in the year would ensure more sap available.

How can you influence Brix values in your vegetation?

Short-term

- Z Select varieties known to have higher Brix values at maturity
- Z Improve fertility management practices
- Z Alter planting and harvest dates (impact crop maturity at harvest)

Long-term

- Z Improve soil management practices (improve soil health, both biotic and abiotic)

Table 1. Common fruit and vegetable on-farm examples of soluble solids (°Brix) values (OSU extension research project 2011).

Crop	°Brix average	°Brix range	# Observations	# Farms
Beet	7.8	2.8-13.6	26	4
Bean	6.9	2.9-15.7	57	3
Swiss chard	4.6	2.6-6.5	15	2
Cucumber	3.3	2.2-5.4	60	4
Summer squash	4.3	3.5-5.3	43	4
Sweet corn	16.2	9.5-26.5	66	2
Cherry tomato	7.5	4.5-11.7	102	6
Tomato	4.6	2.3-8.2	433	10
Turnip	6.0	4.5-6.9	20	3
Watermelon	10.8	9.0-12.8	66	4
Zucchini	4.0	2.4-6.0	71	5

(Kleinhenz and Bumgarner 2013b)

Table 2. Comparison of common New Zealand pasture vegetation (Novel Ways research project 2008).

Type of vegetation	°Brix range
Ryegrass	4.5-4.7
Cocksfoot	2.0-2.5
Orchard grass	2.0-2.5
Legumes	3.0-4.3
Plantains	3.5-4.5
Other	4.0-4.5

(Balsom and Lynch 2008)

Table 3. Peace River region °Brix for Canada thistle (PRFA research project 2017).

Type of vegetation	°Brix range
Creeping Red Fescue	7-15
Canada Thistle	9-21
Smooth Brome	8-9
Timothy	No Sap
Red Clover	12-18

Samples were take in Aug of leaf

Factors that play a role in Brix values¹

Factors with more direct, immediate impacts on Brix values

-) Variety selection
-) Crop maturity
-) Crop physiology or metabolism
-) Moisture
-) Fertility management

Factors with more indirect and subtle impacts on Brix values

-) Soil and crop nutrient status
-) Environmental light and temperature levels

(Kleinhenz and Bumgarner 2013b)

1 - these factors are referenced as specific to vegetable crops

Brix Value Key Points:

-) Brix values represent an approximate measure of sugar by percent mass in plant sap.
-) Brix values can be seen as a relative measure of quality for forage crops, but do not allow for the specific identification of deficiencies in a crop or in the soil in which it is grown.
-) Collecting Brix values for forage crops and potential forage plants (e.g. Canada thistle) allows for relative comparisons of plant species, locations, seasonal growth stages and year-to year differences.
-) Consistent and frequent Brix value measurement and comparison may allow for better decision making with regards to harvest or grazing time, fertility management, soil health management and overall pasture management.

Want to know more about Brix?: Where To Next?

There is a series of four fact sheets by Kleinhenz and Bumgarner (2013a) published by The Ohio State University, College of Food, Agricultural and Environmental Sciences (HYG-1650 to HYG-1653) that provides more details on measuring Brix and crop management (the focus is vegetables and fruit but the reading provides a great overview of relevant information - see below). There is little peer-reviewed work on forage and Brix values but take a look at some of the referenced websites below to gain a greater perspective on how measuring Brix values in forage might work for you.

-) As this tool is very sensitive to sampling methods. It has limited use for comparisons from field to field in forages over the growing season.
-) Individuals may wish to create a database of local forage Brix values for their farm and forages
-) Compare data for local forages and invasive species with grazing potential.
-) Collect local data regarding fertility management and its affect on Brix values.

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