

DATA *Nugget*

A difficult drought

Featured scientist: Trey Sato from the University of Wisconsin-Madison.

Written by Marina Kerekes.

Research Background:

Most people use fossil fuels like natural gas, coal, and oil daily. We use them to generate much of the energy that gets us from place to place, power our homes, and more. Fossil fuels are very efficient at producing energy, but they also come with negative consequences. For example, when burned, they release greenhouse gases like carbon dioxide into our atmosphere. The right balance of greenhouse gasses is needed to keep our planet warm enough to live on. However, because we have burned so many fossil fuels, the earth has gotten too hot too fast, resulting in climate change. Scientists are looking for other ways to fuel our lives with less damage to our environment.

Substituting fossil fuels with **biofuels** is one of these options. Biofuels are fuels made from plants. Unlike fossil fuels, which take millions of years to form, biofuels are renewable. They are made from plants grown and harvested every few years. Using biofuels instead of fossil fuels can be better for our environment because they do not release ancient carbon like burning fossil fuels does. In addition, the plants made into biofuels take in carbon dioxide from the atmosphere as they grow.



Trey examines plated microbes in his lab.

To become biofuels, plants need to go through a series of chemical and physical processes. The sugar stored in plant cells must undergo **fermentation**. In this process, microorganisms, like yeast, transform the sugars into **ethanol** that can be used for fuels. Trey is a scientist at the Great Lakes Bioenergy Center. He is interested in seeing how yeast's ability to transform sugar into fuel is affected by environmental conditions in fields, such as temperature and rainfall.



A plot of switchgrass studied by biofuel researchers.

When there was a major drought in 2012, Trey used the opportunity to study the impacts of drought. The growing season had very high temperatures and very low rainfall. These conditions make it more difficult for plants to grow, including switchgrass, a prairie grass being studied as a potential biofuel source.

Trey knew that drought affects the amount and quality of switchgrass that can be harvested. He wanted to find out if drought also had effects on the ability of yeast to

transform the plants' sugars into ethanol. Stress from droughts is known to cause a build-up of compounds in plant cells that help them survive during drought. Trey thought that these extra compounds might harm the yeast or make it difficult for the yeast to break down the sugars during the fermentation process. Trey and his team predicted that if they fed yeast a sample of switchgrass grown during the 2012 drought, the yeast would struggle to ferment its sugars and produce fewer biofuels as a result.

To test their idea, the team studied two different sets of switchgrass samples that were grown and collected in Wisconsin. One set of switchgrass was grown in 2010 under normal conditions. The other set was grown during the 2012 drought. The team introduced the two samples to yeast in a controlled setting and performed four fermentation tests for each set of switchgrass. They recorded the amount of ethanol produced during each test.



Trey using a pipette to transfer a substance.

Scientific Question: How does drought stress affect the fermentation of switchgrass?

What is the hypothesis? Find the hypothesis in the Research Background and underline it. A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.

Scientific Data:

Use the data below to answer the scientific question:

	Ethanol production (grams/liter)	
	2010 Sample	2012 Sample
Test 1	25.4	24.5
Test 2	30.0	2.4
Test 3	26.4	3.7
Test 4		18.2

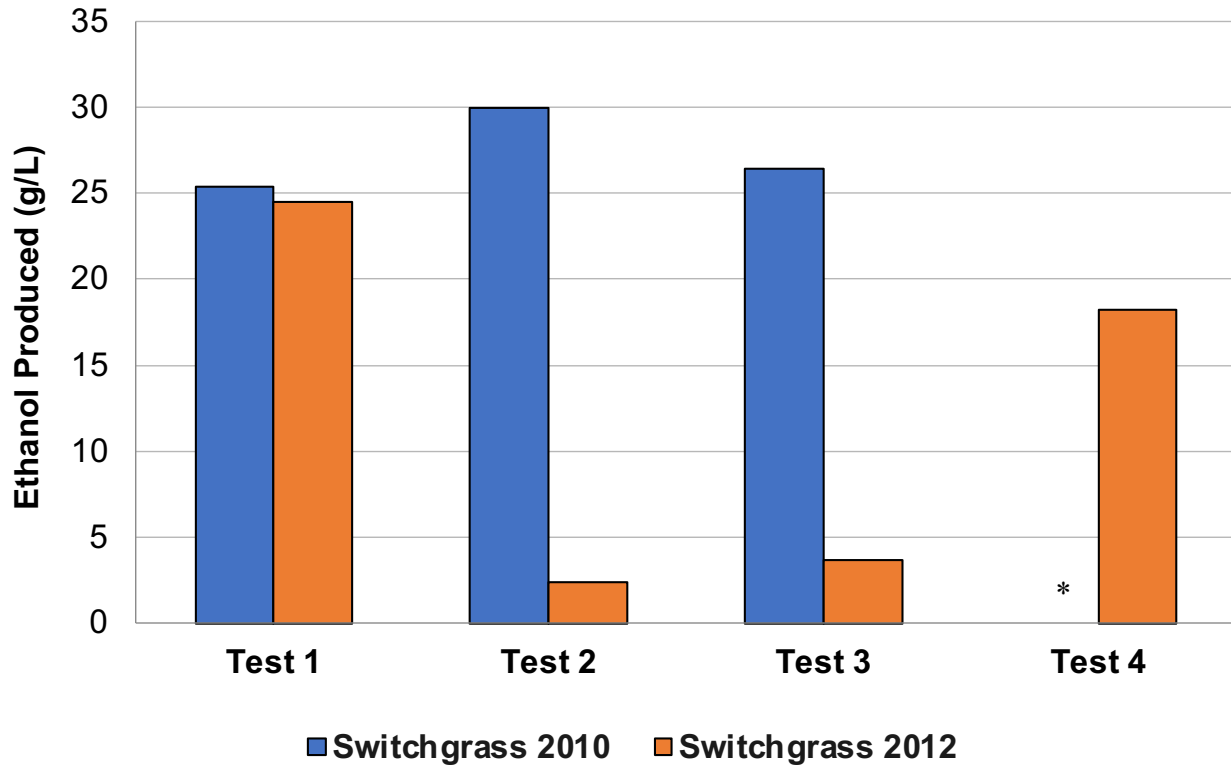
What data will you graph to answer the question?

Independent variable(s): _____

Dependent variable(s): _____

Name_____

Below is a graph of the data: Identify any changes, trends, or differences you see in your graph. Draw arrows pointing out what you see and write one sentence describing what you see next to each arrow.



* Indicates missing data

Interpret the data:

Make a claim that answers the scientific question, how does drought stress affect the fermentation of switchgrass?

What evidence was used to write your claim? Reference specific parts of the table or graph.

Name_____

Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about fermentation and biofuel production.

Did the data support Trey's hypothesis? Use evidence to explain why or why not. If you feel the data are inconclusive, explain why.

Your next steps as a scientist: Science is an ongoing process. What new question(s) should be investigated to build on Trey's research? How do your questions build on the research that has already been done?