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Do Multiflora Rose Stems Grow Back Stronger at the Huston-Brumbaugh Nature Center

Featured scientist: Breanne Welsh, University of Mount Union
Collaborating scientist: Dr. Al-Zube, University of Mount Union

Research Background:

Breanne Welsh, a student researcher at the University of Mount Union, teamed up with Dr. Loay Al-Zube to investigate a question that could help control an invasive plant species: **Does mowing or spraying multiflora rose make it grow back stronger?**

Multiflora rose is a thorny shrub that spreads aggressively across forests, fields, and roadsides in the Eastern U.S. It's tough to get rid of—and Breanne wanted to know if common control methods like mowing or spraying make the plant harder to manage.

In this study, Breanne collected multiflora rose stems from three different conditions:

- **Before mowing**
- **After mowing**
- **After pesticide spraying**

She dried the stems and tested their strength using a **3-point bending test**—a method engineers use to measure how stiff or flexible materials are. The test involved placing each stem on two supports and pressing down in the middle to see how much force it could take before bending.

Using a machine called an **Instron testing machine** (Figure 1), Breanne measured the **bending elastic modulus**—a number that tells us how stiff the stem is. The higher the number, the stronger the stem.

Figure 1: Instron testing machine

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Guiding Questions

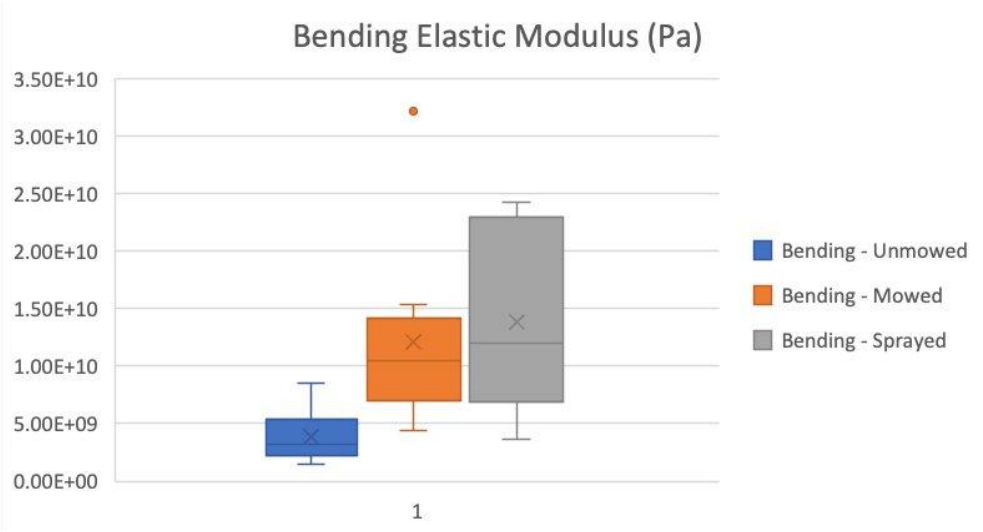
1. What was the main question Breanne was trying to answer?

2. Why is it important to study the strength of multiflora rose stems?

3. What does a higher elastic modulus tell us about a stem?

The Data: What did Breanna find?

Multiflora Rose Treatment	Average Elastic Modulus	Standard Deviation
Unmowed	3.82×10^9	2.08×10^9
Mowed	1.21×10^{10}	7.44×10^9
Sprayed	1.39×10^{10}	7.45×10^9



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- The bar graph shows the average elastic modulus (a measure of stem strength) for multiflora rose stems under three conditions: Unmowed; Mowed; Sprayed
- Each bar represents how stiff the stems were on average. The taller the bar, the stronger the stems
- The line in the middle of the bar represents the mean

4. Which treatment group had the highest average elastic modulus? What does this tell you about the strength of those stems?

5. **Compare the mowed and unmowed stem groups**. What differences do you notice in their average elastic modulus? Why might this be important?

6. Why do you think the sprayed stems had a higher elastic modulus than the unmowed ones? What might be happening to the plant after it's sprayed?

7. **Look at the standard deviation values**. Which group had the most variation in stem strength? What does that tell you about consistency in the data?

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Understanding the Elastic Modulus Equation

The elastic modulus is a number that tells us how stiff a material is. In this experiment, it was calculated using this equation:

$$E_{bending} = \frac{a^2 b^2}{3IL}\phi$$

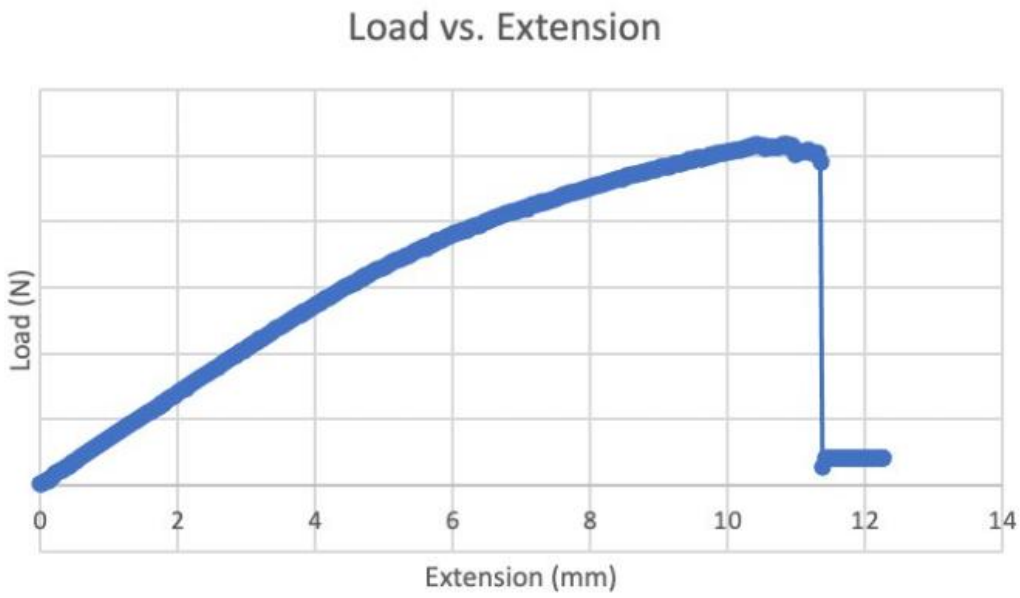
- ***a*** and ***b***: These are dimensions related to the setup of the bending test (such as distances between supports and loading point).
- ***I:*** The **moment of inertia**, which depends on the stem's cross-sectional shape. It tells us how the material's geometry affects bending.
- ***L***: The span length—the distance between the two supports in the test.
- ϕ: A factor that accounts for the slope of the load vs. extension graph (essentially how much force it takes to bend the stem).

How does it work?

- If **a** and **b** are larger, the calculated modulus increases because the setup applies force farther from the center.
- If ***I*** is large (thicker stem), the modulus decreases because the stem naturally resists bending.
- ϕ comes from experimental data—the steeper the slope of the load-extension graph, the stronger the stem.

Line Graph: Load vs. Extension

This graph shows how much **force (load)** was applied to the stem and how much it **bent (extension)** during the test.



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8. What does the x-axis represent in the line graph? What about the y-axis? How do these help you understand what's being measured?

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9. If a stem bends a lot with only a little force, what does that say about its elastic modulus? Would its elastic modulus be high or low? Why?

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Your next steps as a scientist:

10. Science is an ongoing process. What new question(s) should be investigated to build on Breanne's research? How do your questions build on the research that has already been done?

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Citation:

1. **Welsh, B., & Al-Zube, L. (2023).** *Assessing the Mechanical Properties of Multiflora Rose Stems: Bending Elastic Modulus.* Brumbaugh Scholars Program, University of Mount Union, Department of Engineering.