

# *Epipremnum aureum* (Alismatales: Araceae) (Bunting) Root Growth in College Station Tap Water Versus Purified Water

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**Abstract:** Plant owners living in the Bryan/College Station area have observed a lack of growth and wilting of their potted plants after being watered with College Station water. Contaminants in College Station tap water, such as trihalomethanes (TTHMs) and Haloacetic acids, may influence plant growth. Two six-inch-long pieces of *Epipremnum aureum* (Alismatales: Araceae) golden pothos were cut from a mother plant to be used in the experiment, where the root growth was measured over 22 days with one cutting in purified water and one in tap water. An unpaired t-test determined an insignificant p-value ( $p=0.8807$ ). These results indicate that root growth in store bought water and sink water was not statistically significant, demonstrating to plant owners in the College Station area that watering their plants with tap water does not have a statistical effect on its growth.

*Key words: Golden pothos, sodium, root growth, Epipremnum aureum*

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Many college students living in the Bryan/College Station area noticed that their potted plants were not growing normally and often appeared wilted even after being watered with College Station water. The horticulture building on the Texas A&M campus warns students that tap water must be distilled before they will use it to water plants in their building. College Station tap water, although in compliance with federal drinking water standards, does contain many contaminants (EWGCS 2021).

An older study conducted blatantly stated that although College Station has a sufficient quantity of groundwater available, the quality is very poor. This paper warns against watering ornamental plants and shrubs with said water (Turner 1938). Although more recent studies do not overtly state the lack of quality in College Station water, there are some concerning contaminants still present.

The legal limits for tap water contaminants have not been updated since 2000 – meaning that any emerging contaminants since then are not being regulated (EWG 2021). The contaminants in College Station tap water may influence plant growth. To test this, this experiment will compare the root growth of two propagated pieces of *Epipremnum aureum* (Alismatales: Araceae) golden pothos in College Station tap water and Hill Country Fare purified drinking water (H.E.B., San Antonio, TX). Golden pothos are easy to propagate and a mother plant was available to take cuttings from for the experiment.

According to a 2021 collection of data, College Station water contains over 20 contaminants, with 9 exceeding the EWG's (Environmental Working Group) health guidelines. These chemicals include trihalomethanes (TTHMs) and Haloacetic acids, which can both have a potential side

effect of cancer. The TTHMs include chloroform, bromodichloromethane, dibromochloromethane and bromoform, all of which are formed during the water treatment process with chloring and other disinfectants. Trihalomethanes are found to be 160X above the EWG's health guidelines, and there are no legal limitations for these contaminants. These TTHMs can be filtered out of water via activated carbon filters or through reverse osmosis (EWGCS 2021).

Haloacetic acids are also formed as side effects from disinfectants and chlorine being used to treat water. Five of these acids do have governmental regulation with the legal limit being 60ppb. Although these are found in College Station tap water at 2.34 ppb, the EWG recommends a health guideline of under 0.1ppb, making these over 23X the EWG's recommended legal limit. The regulated and unregulated Haloacetic acids together are over 123X the EWG's health guideline. Haloacetic acids can also be removed from water with activated carbon filters or reverse osmosis (EWGCS 2021).

Water quality has an immense effect on plant health and wellness. Contaminated water can cause side effects such as slow growth and gradual death of a plant. High salt content can be detrimental to plant health, interfering with water and nutrient uptake in the roots (UMassAmherst 2023). According to a Culligan water report in 2023, the Total Dissolved Solids (TDS) contained in College Station water is about 550 ppm – with 250 ppm of that being dissolved sodium. The sodium contained in College Station water is naturally occurring and can only be removed via reverse osmosis – not a carbon filter (BCSCulligan 2023).

There is no federal regulation on salt content in water, but the EPA (Environmental Protection Agency) has reported that 76% of

U.S. drinking water contains only 100 or less ppm of sodium. The EPA also has recommended that sodium levels in drinking water should be less than 250 ppm (ODHS 1998). This indicates that the 250 ppm of sodium in College Stations tap water is on the higher side of nationwide water sodium content, and right at the EPA's recommended content.

No studies were found on the effect that tap water versus bottled water had on plant root growth, but there were studies found comparing the mineral contents of the two types of water. According to a 2004 study, mineral levels in tap water varied across the United States, but that Texas did have some of the highest levels compared to the other states in the study. Central Texas water contained an average of 43 ppm of Calcium, 15 ppm of Magnesium, and 132 ppm of sodium (Azoulay et al. 2001). As specified by a propagation study in 2006, groundwater used for propagation should contain less than 120 ppm Calcium, 24 ppm Magnesium, and 50 ppm sodium. The amount of sodium in Central Texas Drinking water is 82 ppm over this recommended content, which could contribute to the observations made by many College Station residents about their plant health (Chen and Stamps, 2006).

In contrast, H.E.B. Hill Country Fare purified drinking water, which was used in the experiment as the bottled water, contains no Calcium, no Magnesium, and no Sodium. These differences in mineral contents likely influence plant growth, and this study aims to show whether this difference is statistically significant.

## **Materials and Methods**

**Experimental Set Up.** Two six-inch-long pieces of golden pothos were cut from a mother plant to be used in the experiment. A

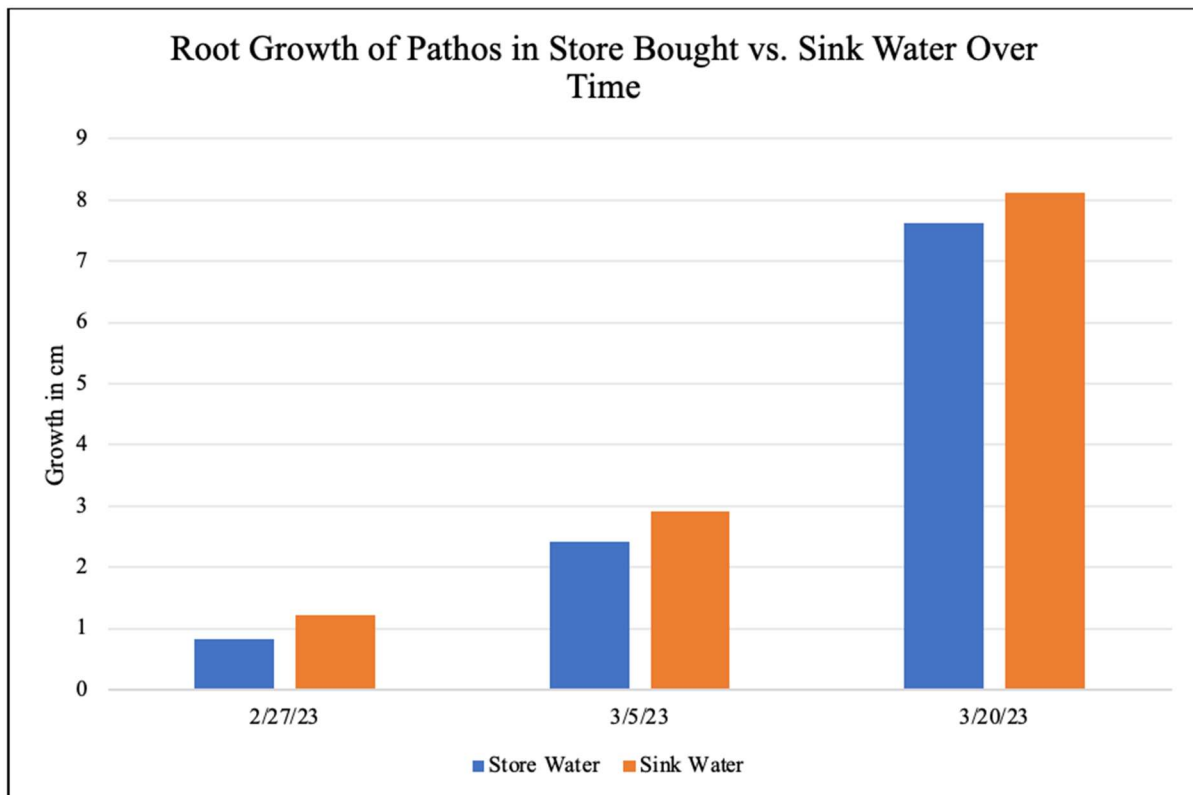
16 oz mason jar (Ball, Broomfield, CO) was filled with 200 ml of Hill Country Fare Purified Drinking Water (H.E.B., San Antonio, TX). One of the cuttings was placed inside, taking care to have the bottom of the cutting submerged in water. The same procedure was conducted for the College Station tap water (City water, College Station, TX). Both labeled mason jars were placed on an indoor windowsill that got bright indirect light during day hours.

**Data Collection.** After seven days, the cuttings were taken out of the jars and the roots were measured. This data was recorded, and the water was replaced with 200ml of fresh purified and tap water. After another 7 days, this process was repeated. Fifteen days

later, the final root length data was collected. Root growth data were analyzed using a t-test to determine the statistical significance of collected data.

### Results

Root growth data were collected comparing growth in H.E.B. Hill Country Fare purified drinking water to College Station tap water from the sink. As seen in Figure 1, it is observed that there is more root growth in the golden pothos, *Epipremnum aureum* (Alismatales: Araceae), in sink water than the golden pothos in store water. Figure 1 also shows us that the root growth over the 22 days of the experiment was at a similar rate with both water types.



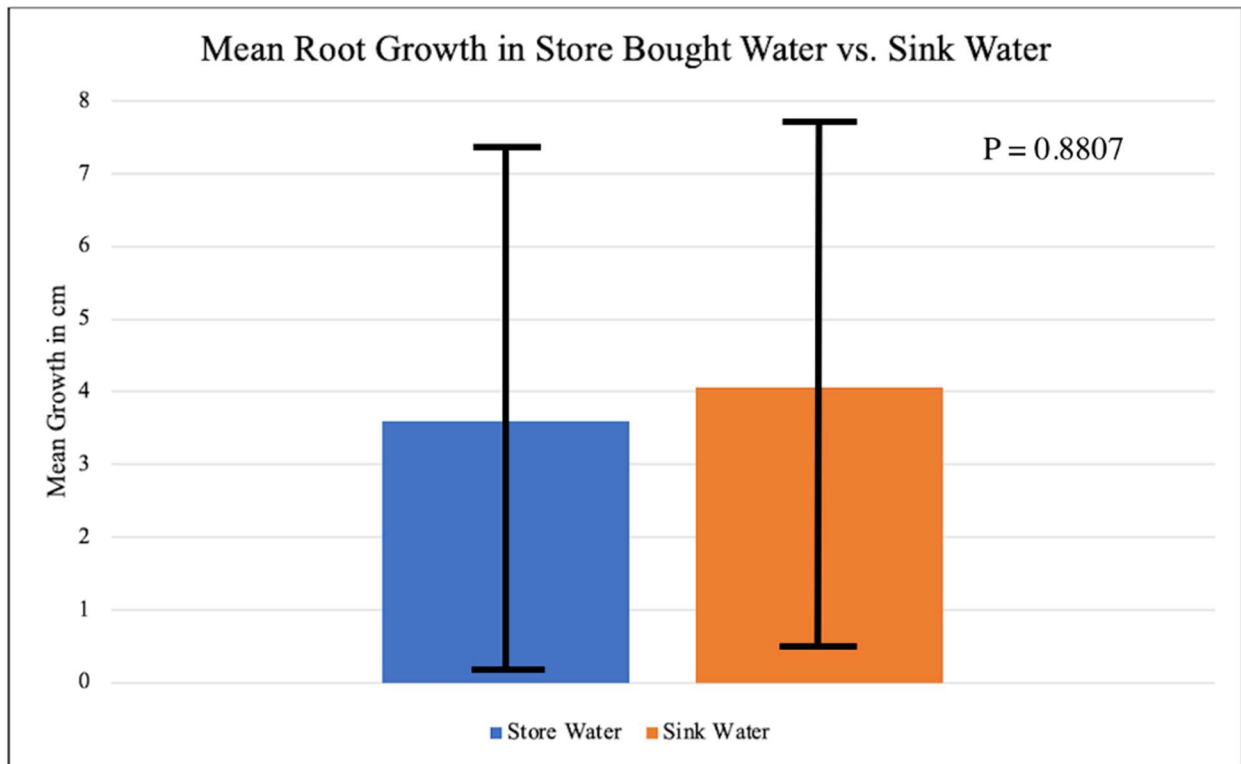
**Fig. 1.** The growth of each pothos root in H.E.B. Hill Country Fare purified drinking water compared to College Station tap water from the sink over 22 days.

An unpaired t-test was run to determine statistical significance of the root data. As

represented in Figure 2, the mean for the golden pothos in store water was 3.6, while

the mean for the golden pothos in sink water was 4.067. The t-test determined that the difference in root growth in store bought water and sink water was not statistically significant ( $p=0.8807$ ). The standard deviation (SD) for store water root growth was 3.555 and the SD for sink water root growth was 3.595. With 95% confidence

the population mean for store water root growth is  $3.6 \pm 4.02$ , or between -0.42 and 7.62. The 95% confidence interval for sink water root growth is  $4.067 \pm 4.07$ , or between -0.003 and 8.14, based on only 3 samples.



**Fig. 2.** Mean root growth of golden pothos in store bought water versus College Station sink water. Standard deviation for store water root growth is 3.555 and the standard deviation for sink water is 3.595. The p-value is insignificant ( $p=0.8807$ ).

## Discussion

In this experiment, the root growth data was analyzed with a t-test, and the p value was not significant ( $p=0.8807$ ), indicating that there was not a statistical difference in root growth in store bought water and sink water.

Plants watered by College Station sink water have been observed as being wilted and of repressed growth. College Station tap water contains 200-250 ppm (parts per million) of dissolved salts (BCSCulligan 2023). Water

high in salt can cause poor plant health due to water uptake issues and nutritional imbalances. When an abundance of sodium is present in water, the plants will uptake this instead of other nutrients like calcium, magnesium, or potassium (UWYO 2007). As stated on the label, there is no sodium contained in the store bought H.E.B. Hill Country Fare purified drinking water, but there are high amounts of sodium in central Texas water (Azoulay et al. 2001).

In this experiment, the root growth was examined and analyzed to determine if there was a statistical difference between plants propagated in College Station tap water and plants propagated in store bought water. The results can help other college students in College Station to know what water they can safely water their plants with.

In this experiment, the root growth data was analyzed with a t-test, and the p value was not significant ( $p=0.8807$ ), indicating that there was not a statistical difference in root growth in store bought water and sink water. Although the growth data was not proven significant, this study did have extremely large standard deviations, indicating that there is a large amount of variation in these results. There were a few secondary results found. The first results were that while the main root on the sink water sample was longer than the store water root, the store water did have a second root growth forming, measuring 2.1 cm in length on the last day of data collection. This data was not factored into the t-test and could influence these results.

These results indicate to plant owners in the College Station area that watering their plants with tap water does not have a statistical effect on its growth. Explanations for the observed wilting and lack of plant growth can be explained in many ways. One thing that could have contributed to college students noticing a decline in their plant's health could have been caused by the stress induced on the plants during their move to College Station. Plants can also get stressed out when moving locations, and this can stunt their growth.

Additionally, plants that were used to being in direct sunlight that no longer have access to the same amount of sun can have stunted growth. Leaves in the sun have less chloroplasts, and shade leaves have more chloroplasts. When sun acclimated leaves are placed in low light areas, they must adapt to have shade leaves, which can take a lot of energy from the plant (Relf and Ball 2001). These factors could be what contributed to observed plant health decline, as the water content does not have a statistical effect on plant growth.

One limitation of this study was time allocation and replicate amounts. The experiment was conducted over a 22-day period, and in the future, could be improved with a longer growth period. Additionally, there was only a single replicate of the experiment, with one store bought sample and one tap water sample. These statistics and results could be improved by having multiple replicates of each sample.

Although this data was not statistically significant, this study is a starting place for future research that can be conducted surrounding the quality of water for plants in College Station. Future studies can be conducted with more plant families, and different types of water. For example, College Station water that goes through a reverse osmosis process could possibly be the best water for houseplants, as it removes many toxins and salts from water. Store bought water, while not containing salts, also lacks essential nutrients necessary for plant growth. All these factors could have affected the results of the study and should be investigated in future studies.

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