Green-down Study Results in Relation with Water Availability at Kents Hill School

Global Environmental Learning

Chelsea Gaiero

Andrew Deaett

November 8, 2021

Introduction:

At Kents Hill School in Readfield, ME we conducted a green-down study to observe the rate at which trees green-down and lose their leaves. We used a broad procedure created by GLOBE, and then applied it to trees we have here on campus. After observing the environment surrounding our green-down study, we pondered if precipitation affects the rate at which leaves change colors (green-down). The research question that is being tested and asked is if the location of a green-down site in terms of amount of precipitation will affect the rate at which leaves change colors. Using the data collected from our green-down study here at Kents Hill School, as well as monthly precipitation data provided by NOAA, we will observe if the two have any significant correlation, leading us to our answer.

In order to have a full understanding of how water affects trees, it is important to provide some background on the topic. Water typically enters the tree's roots through the process of osmosis. Osmosis is the spontaneous diffusion of water through a semipermeable membrane. Dissolved nutrients within the water then travel through the bark and into the leaves. These nutrients are used to support the process of photosynthesis which is when an organism uses light energy to synthesize foods from CO2 and H2O. Typically on a hot day a tree will consume or use more water than it would on a warm day or a cold day. There are a lot of factors that work

alongside water availability and precipitation that affects the rate at which a tree greens-down (“Tree Hugger”).

Hypothesis:

The less amount of precipitation, the faster the leaves will change colors and then fall off. (dependent on the species but I am mostly referring to those around us.)

Materials

- GLOBE database for data collection
- GLOBE green-down protocol
- Green-down Research Project and Methods and Materials sheet
- Flagging tape
- Sharpie
- Tree classification guide
- NOAA precipitation data
- GLOBE Plant Color Classification Sheet
- Field journal
- 6x16 column data table (example below)

Tree Shrub & Grass Green-Down

Date	Leaf 1	Leaf 2	Leaf 3	Leaf 4	Data Entry (if entered on GLOBE)
10/9	Color identification “5GY 4/8”	“5GY 4/8”	“5GY 4/8”	“5GY 4/8”	✔
10/11	“2.5Y 8/12”	“2.5Y 8/12”	“2.5Y 8/12”		✔
10/14					✔

10/18					✔
10/22					✔

Methods:

Identify a tree to then conduct a GLOBE Green-down study on. Then, follow the GLOBE green-down protocol which explains how to set up a green-down study. Collect metadata in a field journal and create a table like the one shown above. This table will be used throughout data collection to write down the date of the day data was collected, which leaf's data is being collected and if the data has been uploaded to the GLOBE database. Collecting data as frequently as possible will really strengthen your findings because leaves can change colors at rapid rates. One should collect data every day if possible, or every other day.

After collecting data from the GLOBE green-down study it is possible to ask questions as to why trees green-down the way they do. It could be temperature, humidity, sunlight, but in this study we are identifying if precipitation impacts the rate at which trees green-down. In order to find the answer, precipitation data was required. Unfortunately that is not a form of data that is collected at Kents Hill School which makes it difficult to see the direct relationship between the two variables. Fortunately there is data on NOAA which allows us to see precipitation data in Winthrop, ME which is a neighboring town. Using this data one can try to identify the correlation between precipitation in inches and the rate at which leaves green-down. This can be altered depending on your location. Using the NOAA monthly summaries website, one can locate a nearby location for precipitation data and then use that data to identify the relationship between precipitation and trees' green-down process (Team).

Results:

September 2021 - Precipitation amount (in)

Location 1: 172-160 Main St, Winthrop, ME 04364

Lat: 44.307 Long: -69.970

Precipitation (in): 4.1-6.0 (in)

Location 2: 164 Turkey Ln, Winthrop, ME 04364

Lat: 44.305 Long: -70.003

Precipitation (in): 4.1-6.0 (in)

October 2021 - Precipitation amount (in)

Location 1: 172-160 Main St, Winthrop, ME 04364

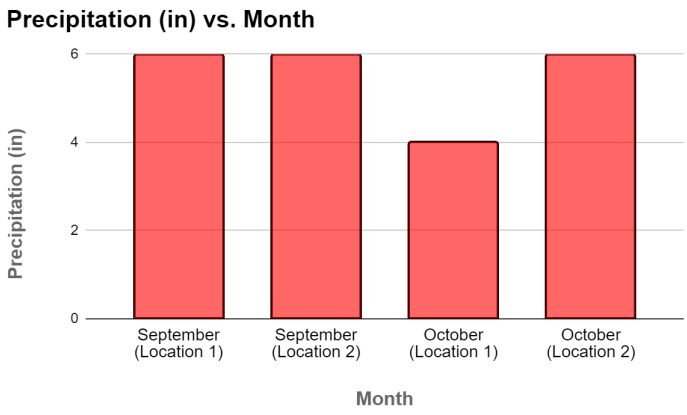
Lat: 44.307 Long: -69.970

Precipitation (in): 3.1-4.0 (in)

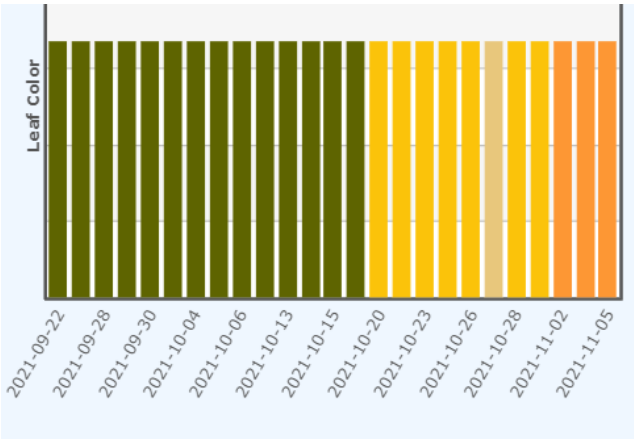
Location 2: 164 Turkey Ln, Winthrop, ME 04364

Lat: 44.305 Long: -70.003

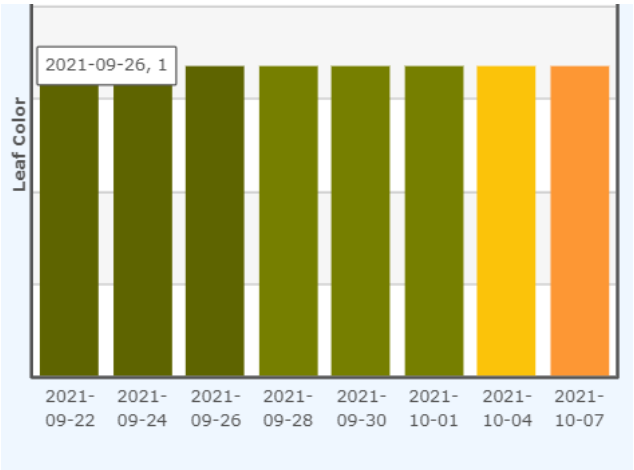
Precipitation (in): 4.1-6.0 (in)



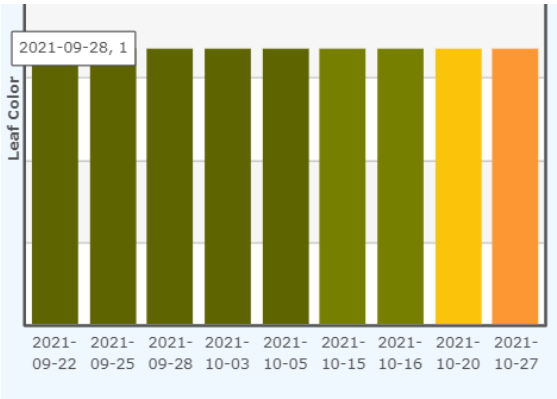
This graph shows the amount of precipitation in inches vs the month at each location.



This graph shows the change in leaf color from the beginning of a green-down study (9-22-2021) and the end of the green-down study (11-05-2021) for the "Fagus Grandifolia" tree at Kents Hill School in Readfield, ME, 04349.



This graph shows the change in leaf color from the beginning of a green-down study (9-22-2021) and the end of the green-down study (10-07-2021) for "Paper Birch #1" tree at Kents Hill School in Readfield, ME, 04349.



This graph shows the change in leaf color from the beginning of a green-down study (9-22-2021) and the end of the green-down study (10-27-2021) for the "Quercus (Moisty Mire)" tree at Kents Hill School in Readfield, ME, 04349.

Results:

Looking at the data collected, one is able to have a rough idea of the connection between precipitation and change of leaf color. Precipitation data shows that in both selected sites in Winthrop, ME the amount of rainfall is between 4.1-6.0 (in). The green down data during the month of September shows that every leaf on the Quercus and Fagus Grandifolia stays at 5GY 4/8 and Paper Birch #1 shows 5GY 4/8 but slightly changed to 5GY 5/10. Looking at October precipitation data shows us that at one site in Winthrop, ME: 172-160 Main St, Winthrop, ME 04364 - there was between 3.1-4.0 (in) of rainfall during the month of October. There is different data at our second site in Winthrop, ME: 164 Turkey Ln, Winthrop, ME 04364 - which was between 4.1-6.0 (in).

Discussion:

After looking at all of the data collected we now look at how the two variables relate. Based on the given data, the less precipitation over the course of a month the faster a leaf will begin its green-down process.

With that, there are factors that alter the results of this study. These two variables are related but it is difficult to know if precipitation really has a major effect on the timeline of a green-down study. There is also a grey area between the location of the two studies. The two locations are roughly 7 miles away. Although this may not change the findings of this study greatly, the data is not 100% reliable. In addition to that, the data program only shows the monthly precipitation data. If data was collected each week or even everyday then we would be able to better understand the relationship between the two variables. A month is such a long span of time, making it difficult if it really affects the rate of which a tree greens down.

Conclusion:

According to the data collected, the less precipitation, the rate at which leaves green-down increases. This is shown throughout the experiment through the data collected. As said before, there are limiting factors which affect this answer. That data collected may not actually show the correlation between the two subjects very well, but it is enough to put together a claim. In order for this to be successful next time, it is important to collect enough data to help show the connection between the two variables. There is still room to fill this knowledge gap by applying better data to this study to obtain a more accurate answer. A potential thing to look at in the future could be comparing try fall months to wet fall months to look at the correlation between the two variables.

References:

Communications, E. S. F. O. of. (n.d.). *Around your world*. Why Leaves Change Color. Retrieved November 8, 2021, from https://www.esf.edu/pubprog/brochure/leaves/leaves.htm.

Evapotranspiration and the Water Cycle. Evapotranspiration and the water cycle. (n.d.). Retrieved November 8, 2021, from https://www.usgs.gov/special-topic/water-science-school/science/evapotranspiration-and-water-cycle?qt-science_center_objects=0#qt-science_center_objects.

Factors influencing autumn leaf color. Factors Influencing Autumn Leaf Color | Harvard Forest. (n.d.). Retrieved November 8, 2021, from https://harvardforest.fas.harvard.edu/leaves/factors.

Globe Science Data Visualization. GLOBE Visualization. (n.d.). Retrieved November 9, 2021, from https://vis.globe.gov/GLOBE/.

Google. (n.d.). *GLOBE Plant Color Guide*. Google. Retrieved December 17, 2021, from https://drive.google.com/drive/folders/1t0zneJclvVChxoc_KvOP-SvZ8SceELWY

Google. (n.d.). *Green-down Materials and Methods*. Google. Retrieved December 17, 2021, from https://drive.google.com/drive/folders/1t0zneJclvVChxoc_KvOP-SvZ8SceELWY

Google. (n.d.). *Tree and Shrub Green-Down Protocol*. Google. Retrieved December 17, 2021, from https://drive.googl`e.com/file/d/15Y7AIJBOz-5qe6Ja3RRNgkuIl4HmIZMt/view

Nix, S. (2021, May 19). *Process for how trees use thousands of gallons of water to grow*. Treehugger. Retrieved December 16, 2021, from https://www.treehugger.com/process-of-using-water-by-trees-1343505

Team, N. C. E. I. G. I. S. (n.d.). *Monthly Precipitation summaries*. National Centers for Environmental Information (NCEI). Retrieved December 17, 2021, from https://www.ncei.noaa.gov/maps/monthly-summaries/