

Harvard Forest

Long Term Ecological Phenology Project: Spring Protocol



Harvard Forest Schoolyard Ecology Buds, Leaves, and Global Warming

Spring Protocol: Budburst

Revised July 2012-J.O. and P.S.

Objective: Students will record the progression of bud swelling and budburst to monitor the start of the local growing season. The end of the growing season is monitored in the fall for this project. This means if you do this annually, one class will pass on data to be used by next year's class.




What is Budburst exactly? We are defining budburst as the point where the bud scales have opened AND leaves are fully visible. Leaves may be tiny but the entire leaf can be seen. Budburst indicates when the growing season begins and leaves begin making food for the tree.



Data Collection:

- **Begin and end dates:** Spring data collection should begin in early to mid April (before the buds have become very swollen), and continue until all or most buds have burst, and leaves are fully emerged. Ideally, continue until June 1st or as close to the end of the school-year as is feasible for your schedule. Dr. O'Keefe completes his study when all trees in his field site have 75% leaf development (leaves are 75% of their expected final size estimated from measurements taken the previous fall). This is generally in mid to late June.
- **How often to collect data:** Collect data at least once a week during study time. We recommend going out twice a week if possible when the buds are very swollen and budburst appears imminent, as that would pin point budburst more accurately.
- **Observe the specific branch(s) and buds assigned and labeled.** These will be the six buds nearest the branch tip, not counting the terminal (tip) bud. See Section VIII (Site Preparation) in the Study Overview.





“Student Data Sheet-Spring”

Observe and record whether each bud is completely closed (not puffy), or almost ready (puffy or opening with a green leaf tip visible but not unfolded yet), or open (budburst - the emerging leaf is unfolded/whole leaf is visible) by putting a check in the proper category on the data sheet.

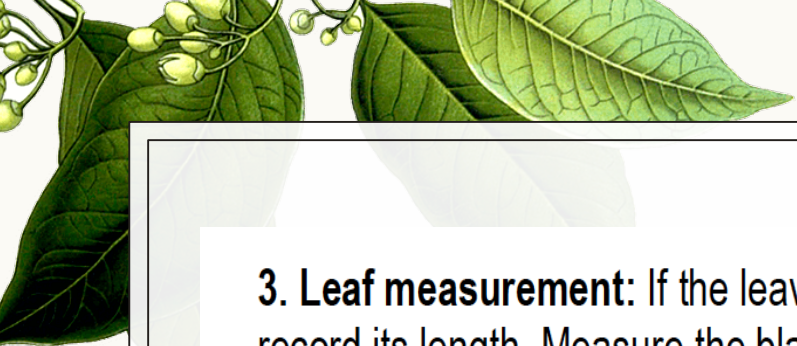
1. Number of buds open: Record on the data sheet how many of the labeled and observed buds (0-6) are closed, puffy, and open. Please refer to photos of buds enclosed in teacher notebook and posted online at:

<http://harvardforest.fas.harvard.edu/museum/data/sy001/budburst-chart.pdf>



to clarify the differences between “puffy”, “open” and “closed”.

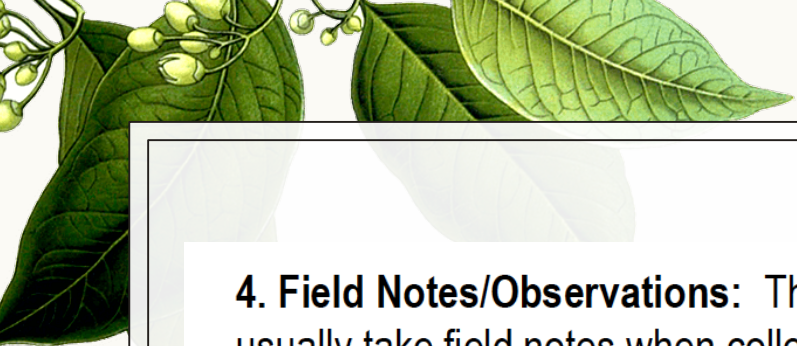
2. “Bud fallen off”-Please note if the bud is no longer on the branch. Place a check mark in appropriate box. If no buds remain on a branch, replace the branch with another branch with live buds. Data from earlier branch should be reported to HF as “NA” (missing).







3. Leaf measurement: If the leaves are fully open, select the largest leaf and record its length. Measure the blade of the leaf only, not including the stem (also called the petiole). Note: If there is more than one leaf growing from each bud, measure the largest leaf only. If the leaf is compound (multiple leaflets are attached to a main leaf stem/petiole), measure from the tip of the entire leaf down to the base of the lowest leaflets where they meet the leaf stem for the leaf length. For width, measure the widest part of the whole leaf-as in the widest pair of leaflets.





4. Field Notes/Observations: This part of data collection is **optional**. Scientists usually take field notes when collecting data. If you choose to include it, record any notes about field conditions – climate (temperature, cloud cover, precipitation), wildlife, what is happening with other plants, moisture, snow, or human activity - that you notice while collecting data. As time allows you may discuss these optional data with students.





**Harvard Forest LTER Schoolyard Program
Buds, Leaves and Global Warming**

Student Data Sheet – Spring

Revised March 2010 by JOK and PS

Names: _____

School: _____ **Date:** _____

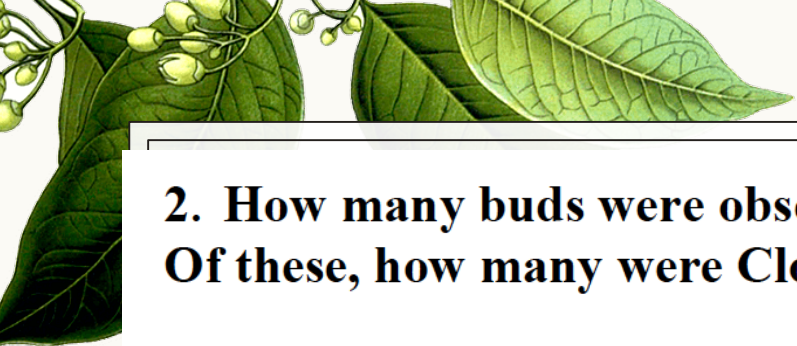
Tree Species: _____

Tree ID (number): _____ **Branch ID (letter):** _____

1. Put a check mark in the correct column below to show the stage of each bud.

	Bud 1	Bud 2	Bud 3	Bud 4	Bud 5	Bud 6
Closed: Bud is closed and not puffy						
Puffy: Bud is swollen or opening with no unfolded leaf						
Open: Bud has opened and whole leaf is visible (budburst)						
Bud Fallen Off						





2. How many buds were observed in all? _____
Of these, how many were Closed? _____ Puffy? _____ Open? _____

3. Look for the open bud with the largest leaf.
Measure the leaf length in centimeters: _____

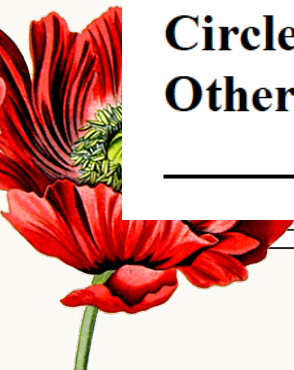
4. Field notes:

Temperature (degrees Celsius): _____

Humidity(%): _____

Circle one: Sunny Cloudy Rainy

Other observations and Notes: _____





Buds, Leaves, and Global Warming
Citizen Science, Schoolyard Ecology

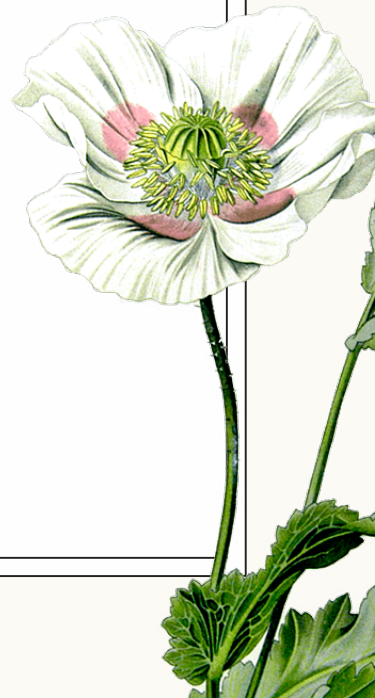
Spring budding

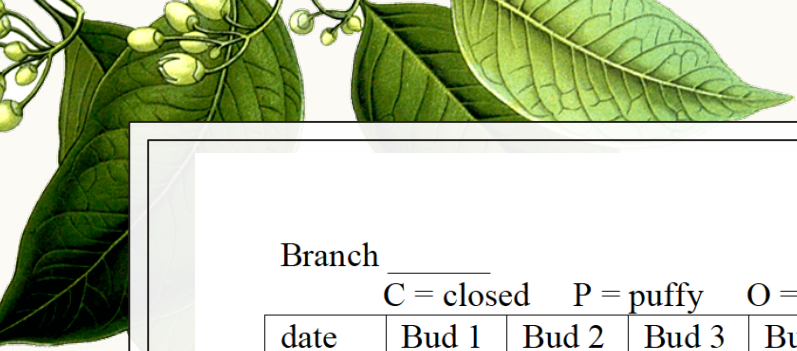
Tree # _____ Tree species _____ Team _____

Branch _____

C = closed P = puffy O = open

date	Bud 1	Bud 2	Bud 3	Bud 4	Bud 5	Bud 6	# buds observed	# buds open	Longest leaf (cm)





Team _____

Branch _____

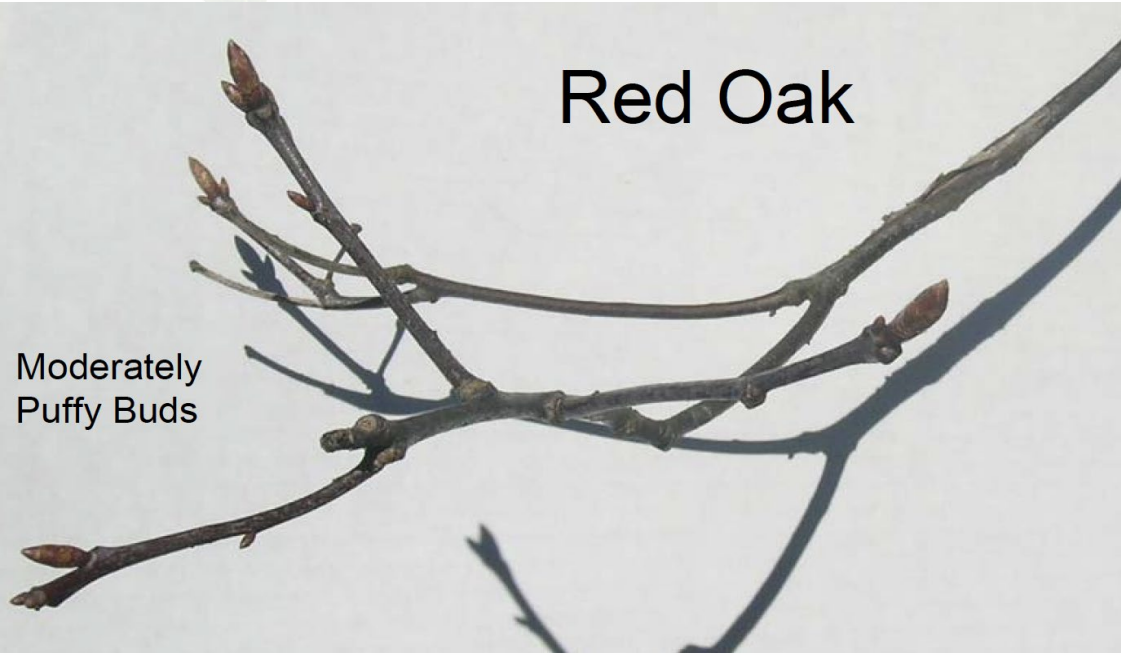
C = closed P = puffy O = open

date	Bud 1	Bud 2	Bud 3	Bud 4	Bud 5	Bud 6	# buds observed	# buds open	Longest leaf (cm)

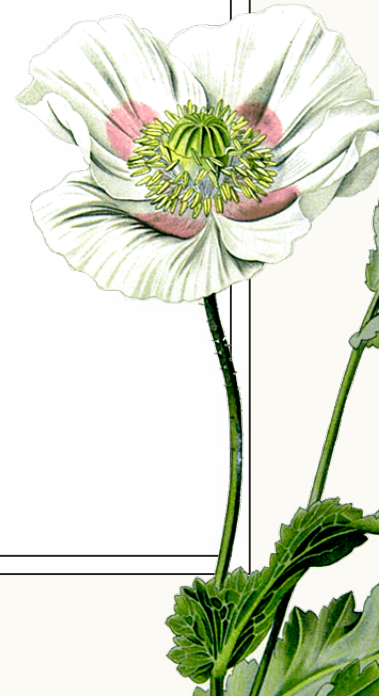


Examples of Observations: Buds Closed, Puffy or Open

Red Oak



Moderately
Puffy Buds



Red Oak

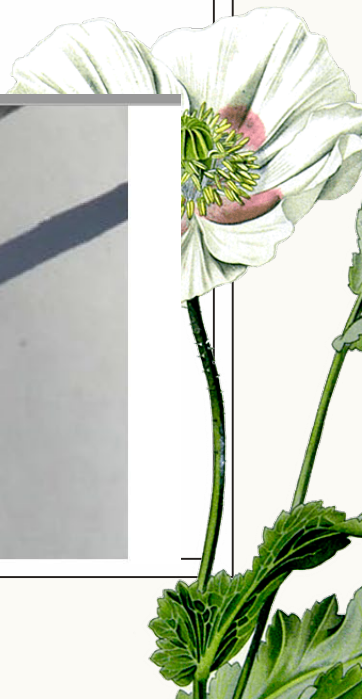
Moderately Puffy



White Ash

White Ash

Slightly puffy buds



White Ash



Yellow Birch-Mixed-some open and some puffy

Yellow Birch



Yellow Birch-Mixed-some open and some puffy







Red Maple



Red Maple

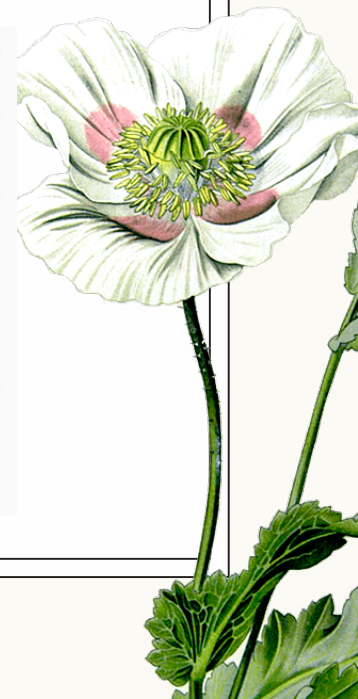
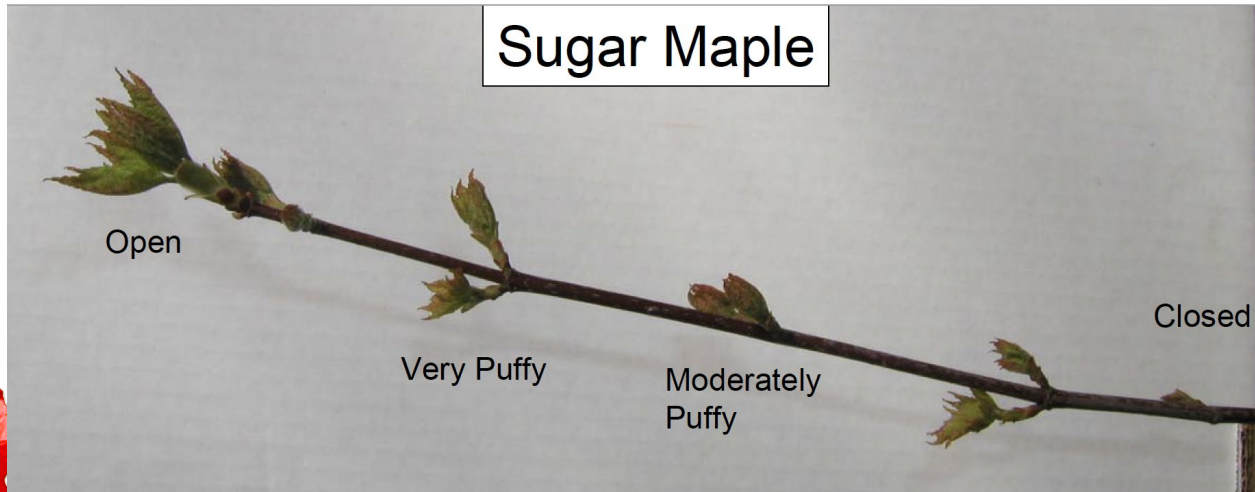


Very puffy

Red Maple



Sugar Maple



Sugar Maple

Very puffy



American Beech



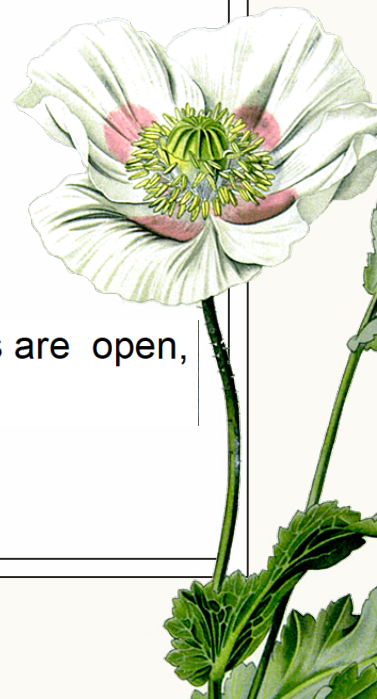
American Beech-Slightly-moderately puffy buds



American Beech



Beech-Some buds are open,
Others very puffy



Guess the stage of these buds

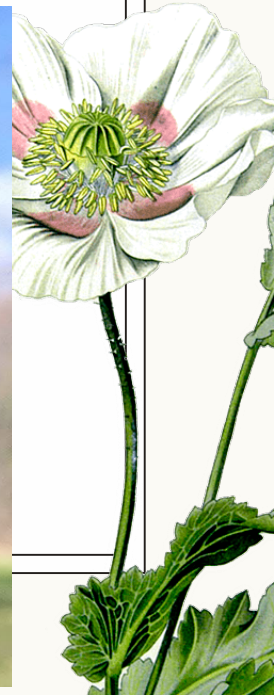




**Guess the
stage of these buds**



Guess the stage of these buds



Guess the the stage of these buds





March 21, 2020

Dr. M. observed all all nine trees. Observed tagged branches and all buds were closed.

No photos





March 28, 2020

Dr. M. observed all all nine trees. Observed tagged branches and all buds were closed.

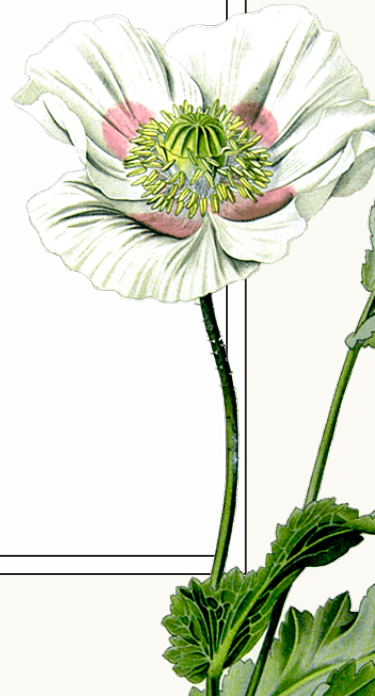
No photos





April 4.2020; 4.4

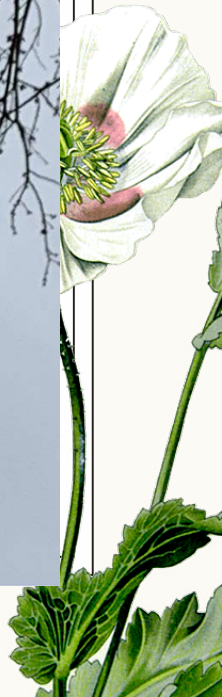
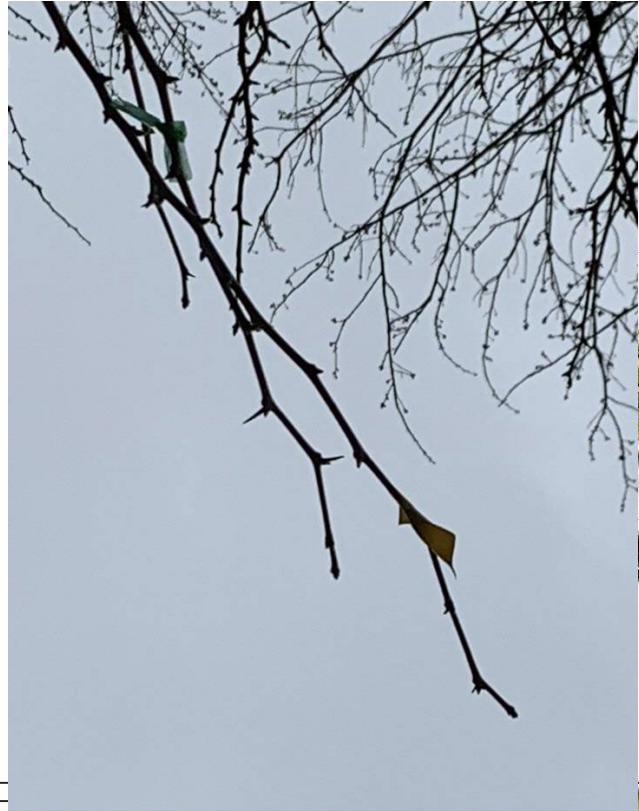
Only able to photo 2 of the branches on each of the nine trees



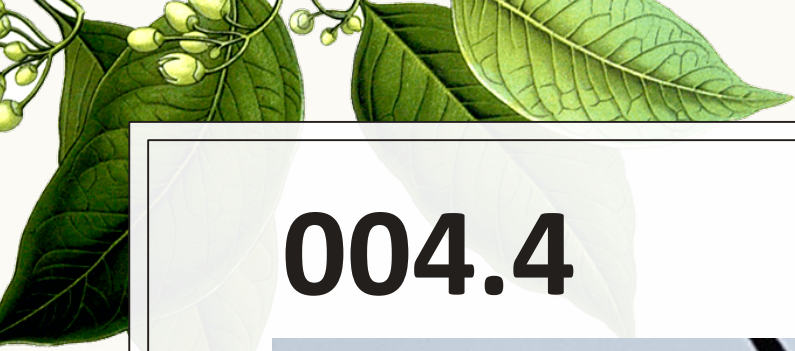
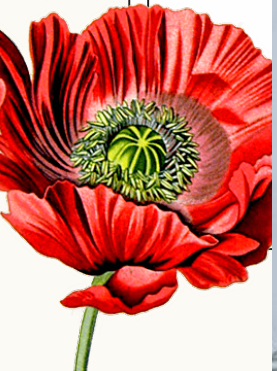



Osage Orange, OO 4.4

OO

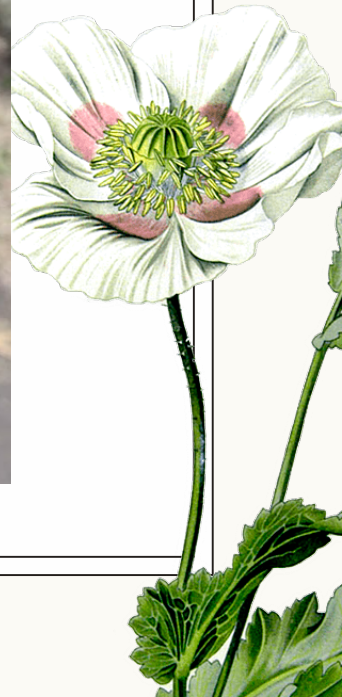


004.4





**Pin oak,
PO 4.4**





PO4.4



White Oak, WO 4.4



wo4.4



English Elm, EL 4.4



EL 4.4



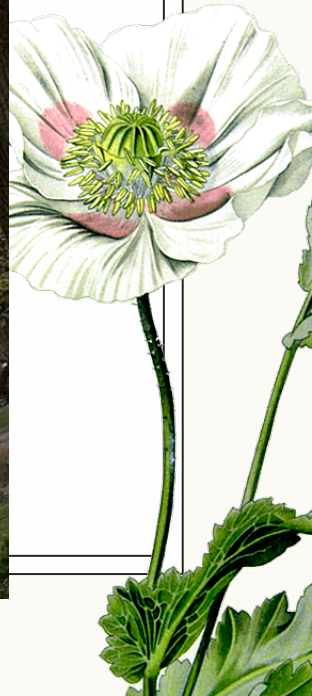
Willow Oak, WK 4.4



WK4.4



Norway Maple, NM 4.4

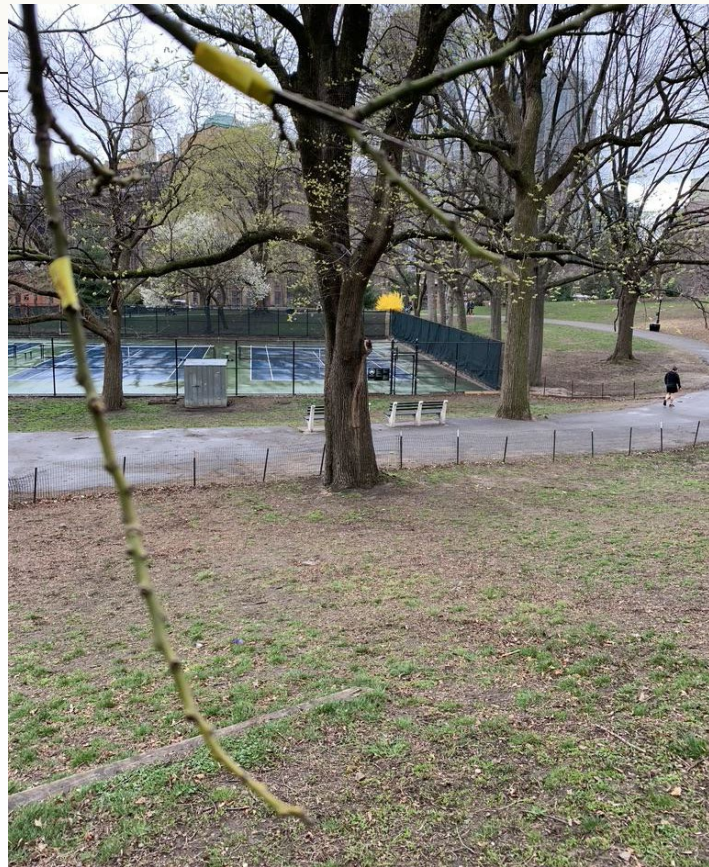


NM4.4





Japanese Pagoda, JP4.4

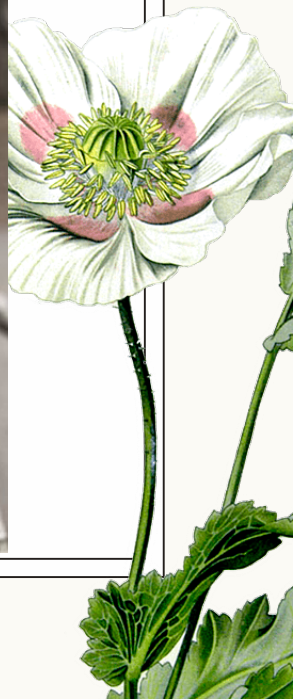


Green Ash, GA 4.4



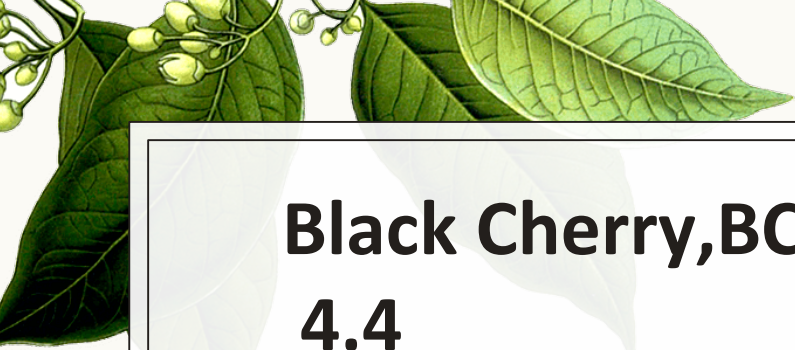


GA 4.4



Black Cherry, BC

4.4





April 11, 2020

Dr. M photographed all nine trees and was able to photograph 4 tagged branches for each tree.



Osage Orange, OO 4.11



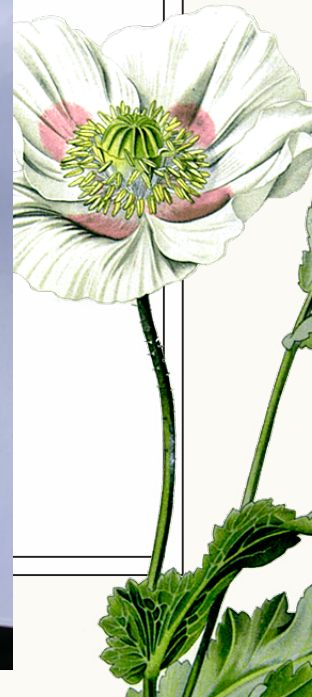
00 4. 11



Pin Oak 4.11



PO 4.11

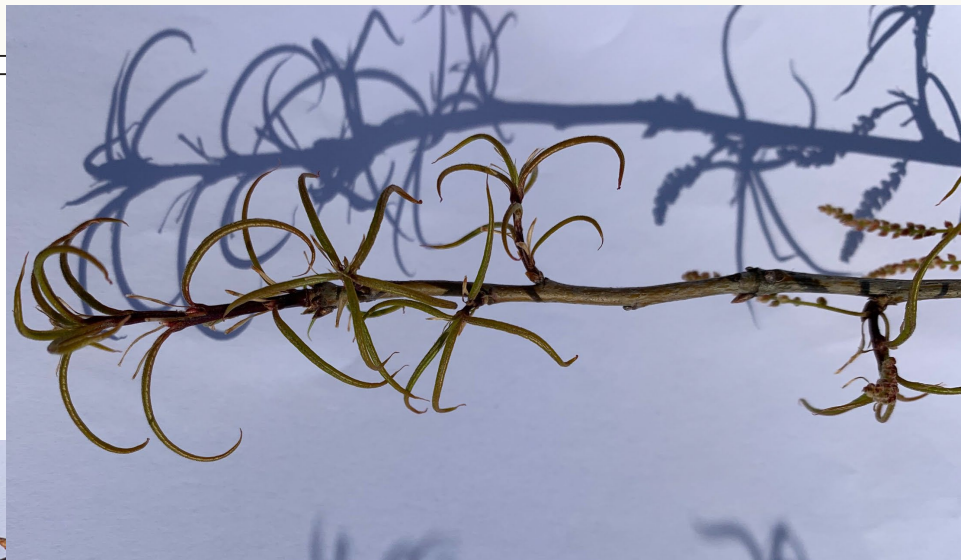


Willow Oak 4. 11

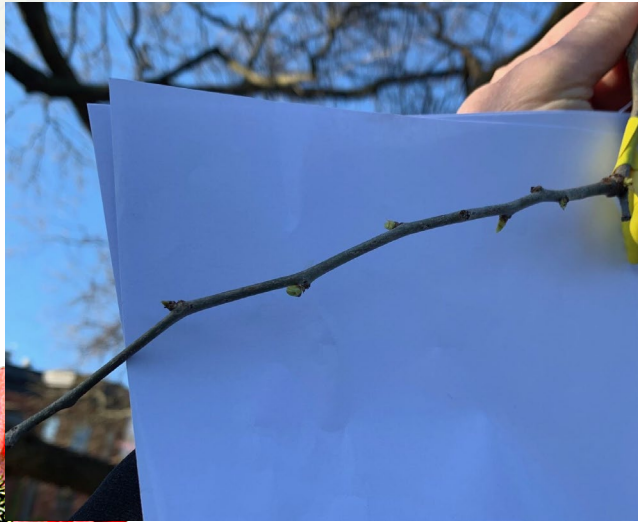




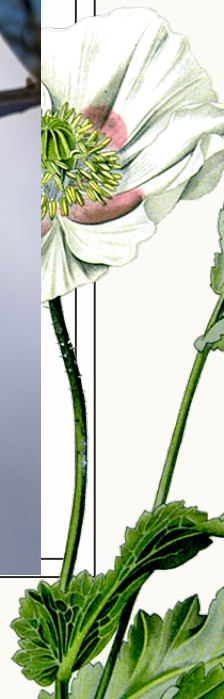
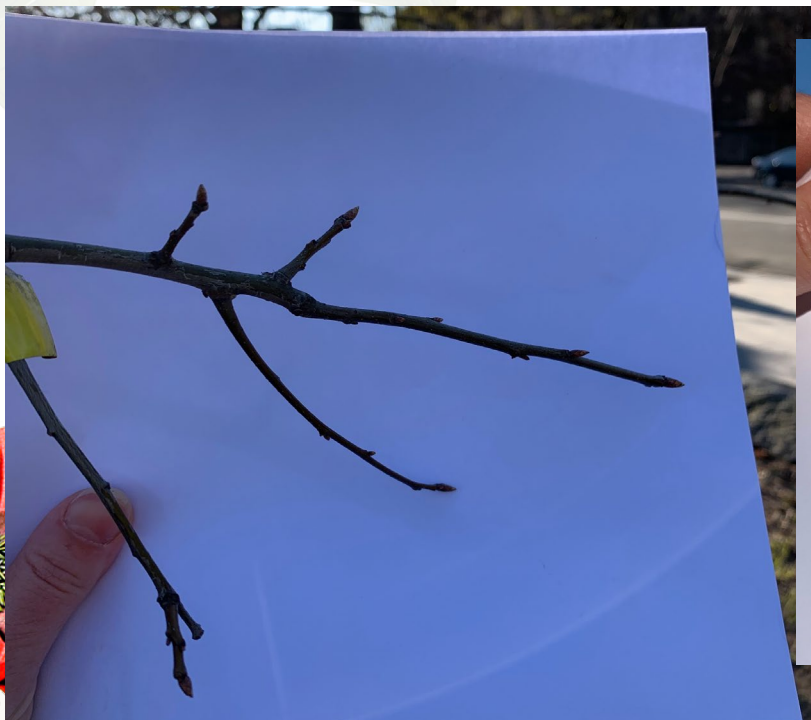
WK 4. 11



White Oak 4. 11



WO
4. 11



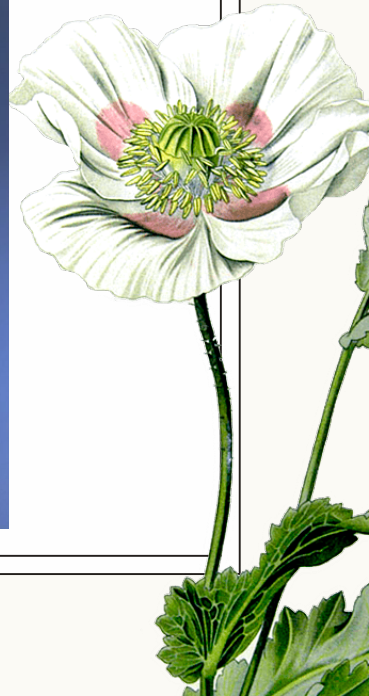
English Elm 4.11



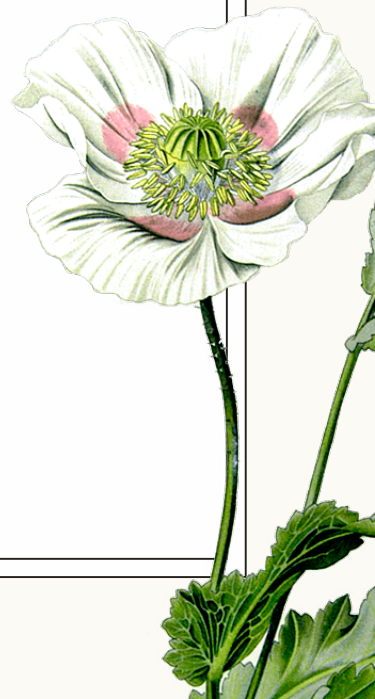
El 4. 11



Japanese Pagoda 4. 11



JP 4. 11

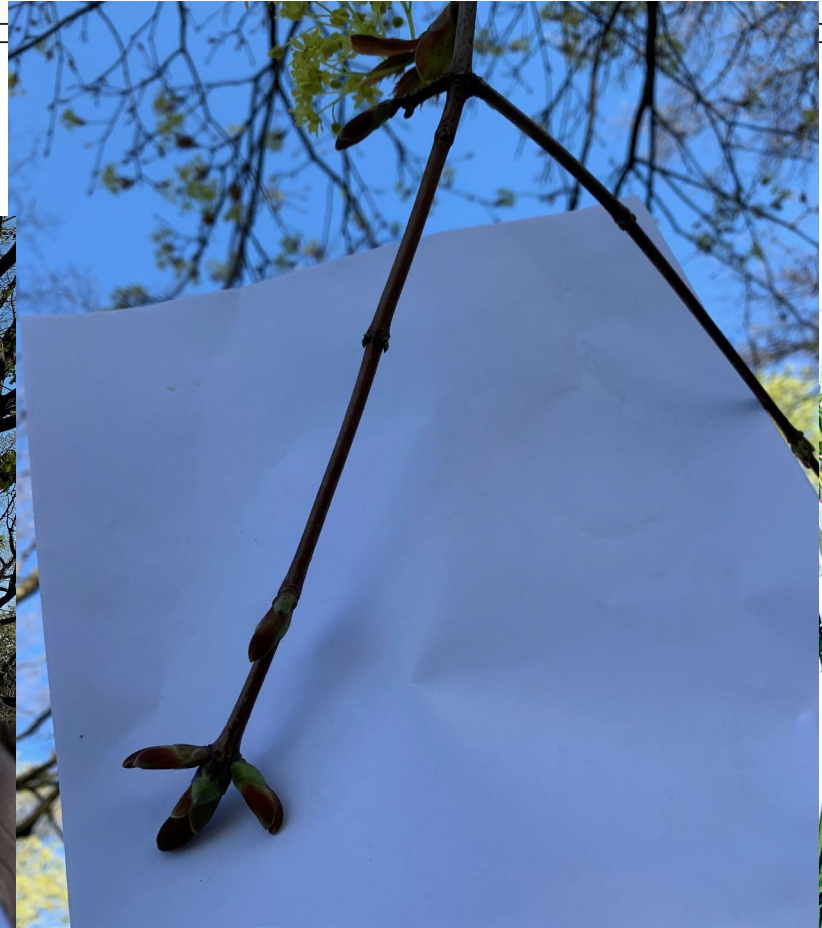


Norway Maple

4.11



NM 4.11



Green Ash

4.11



GA 4.11



Black Cherry 4.11



BC 4.11



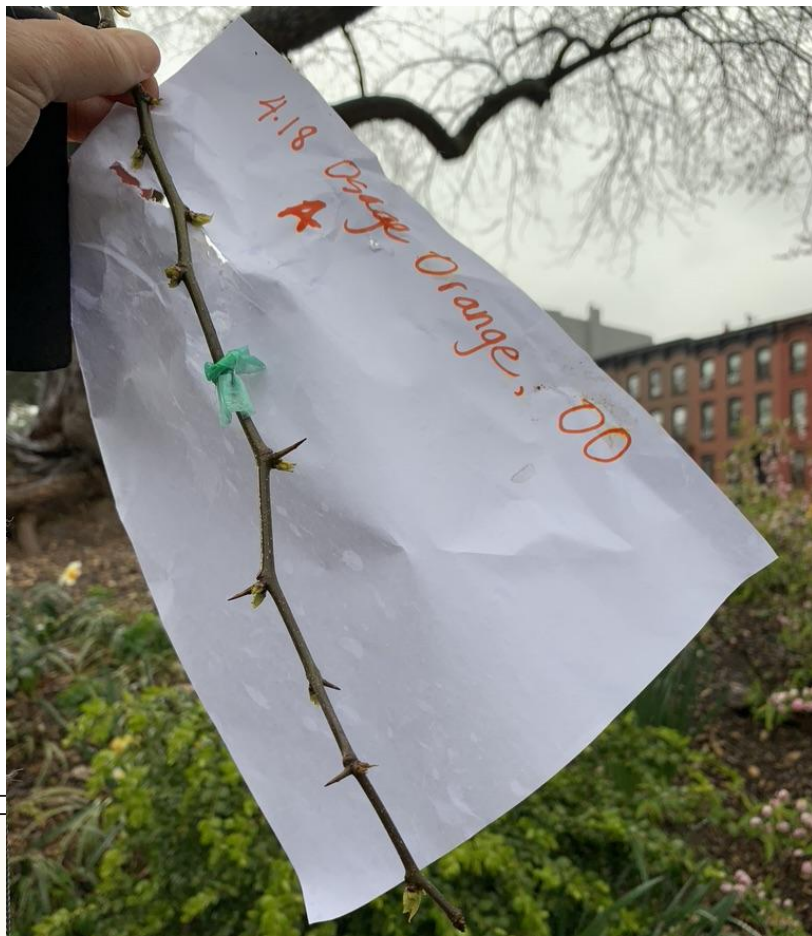
BC 4.11



00 4.18



00 4.18





00 4.18





00 4.18

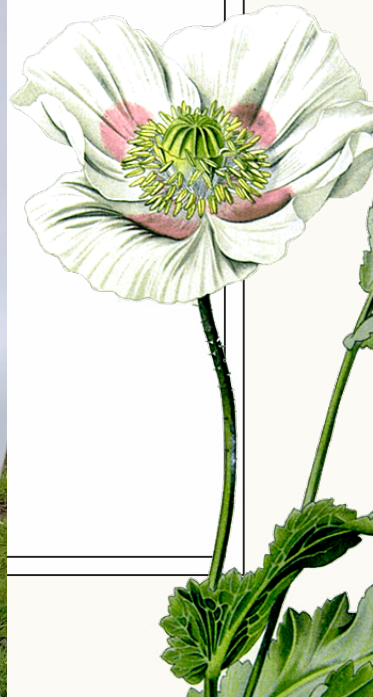


PO 4.18





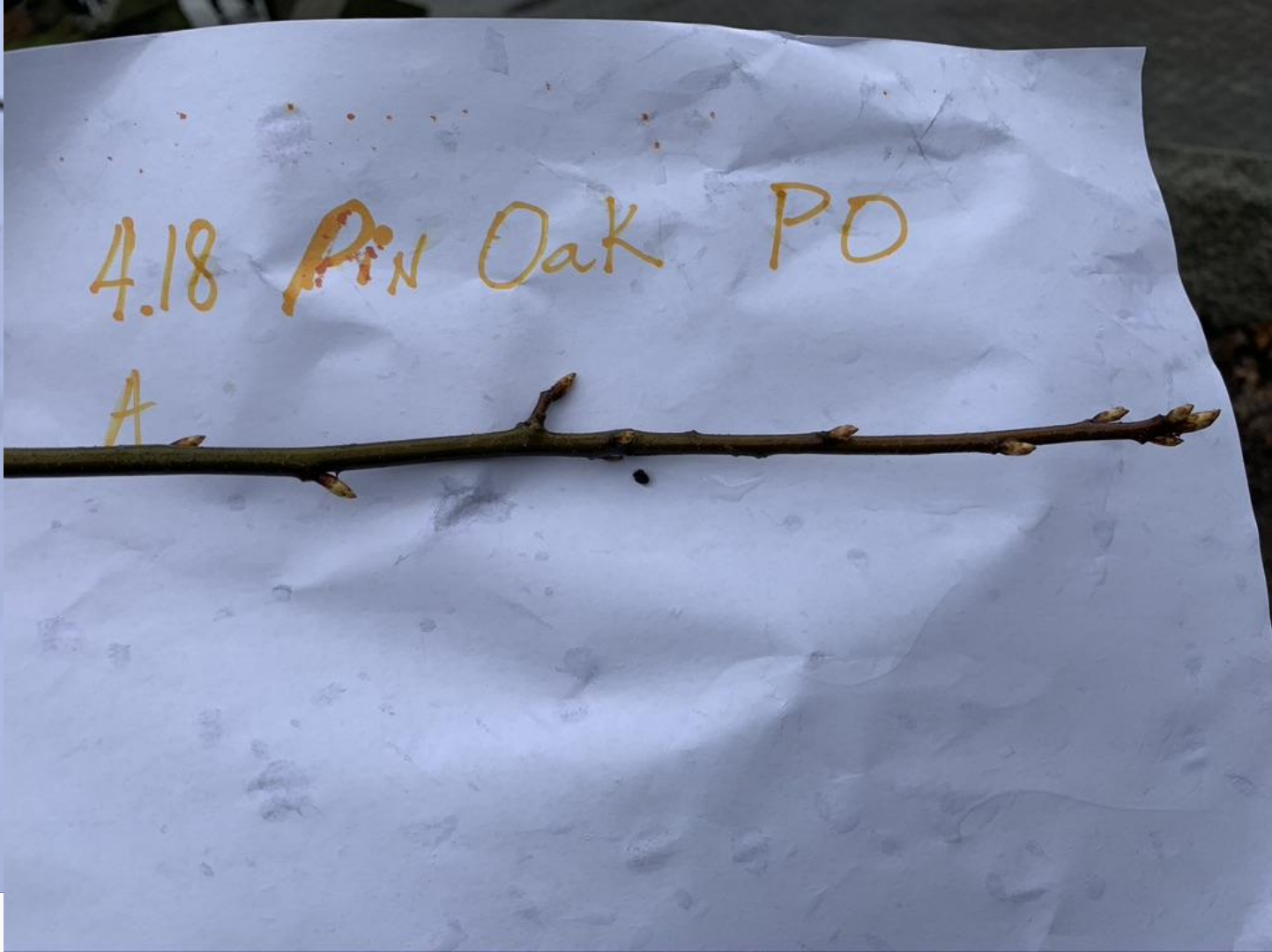
PO 4.18





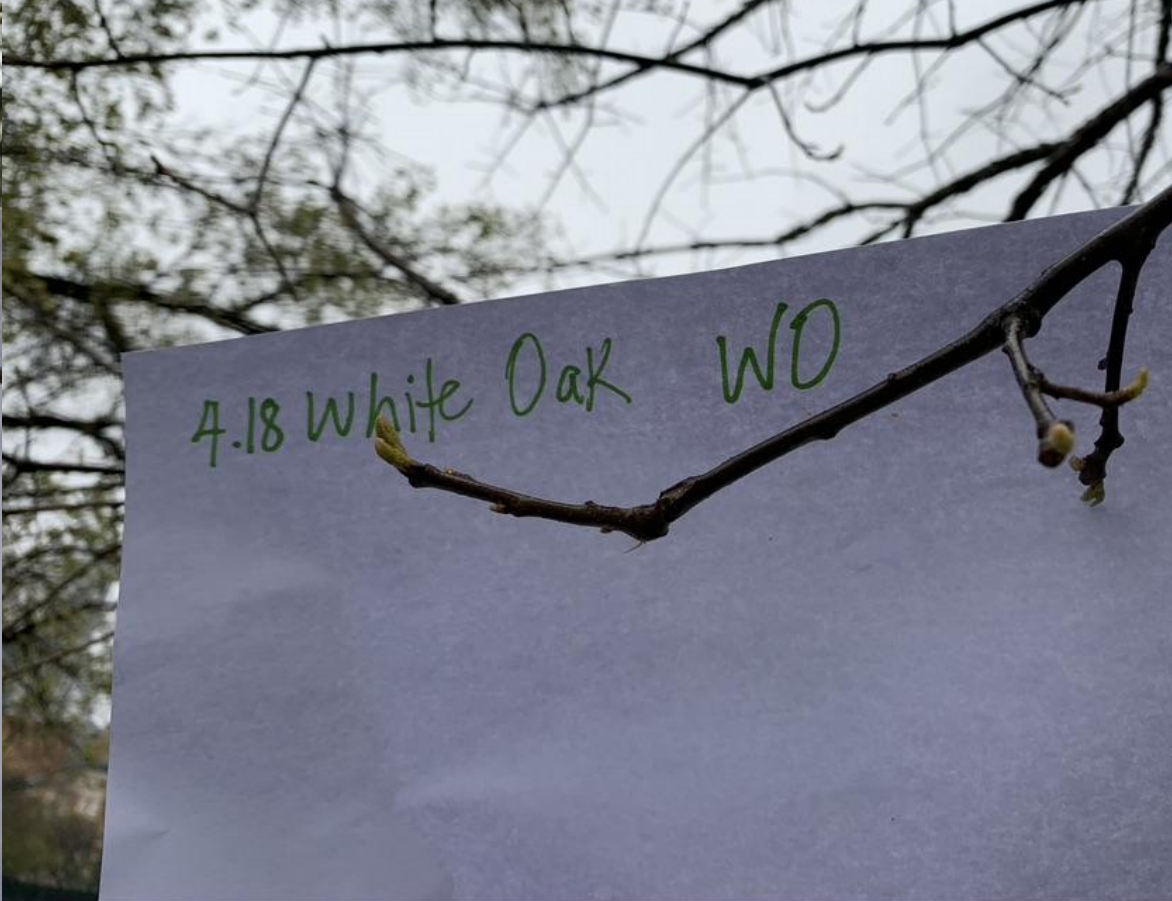
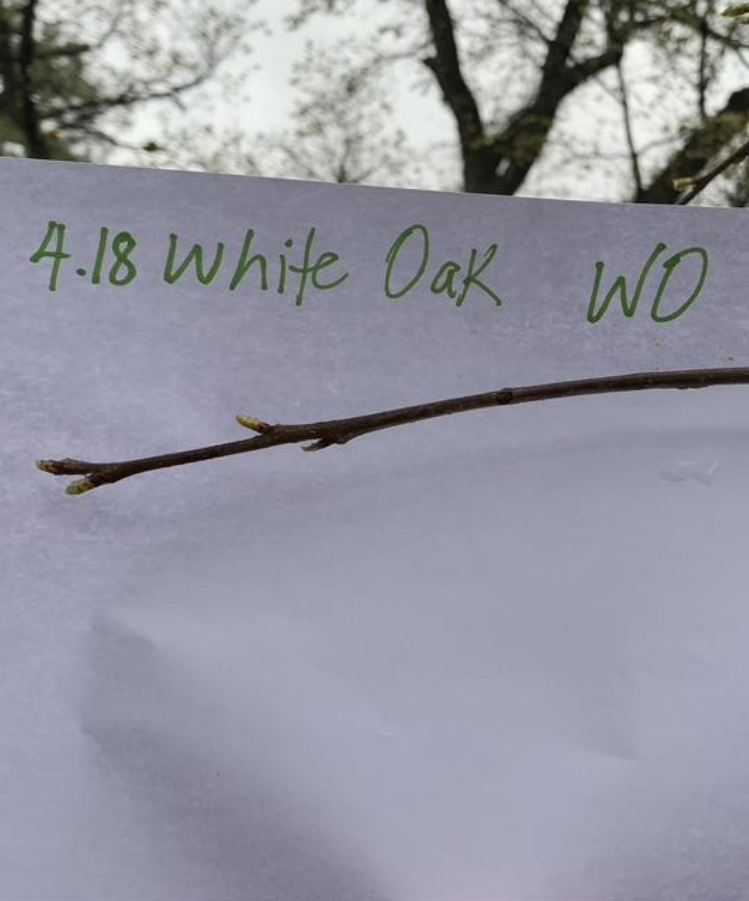
PO 4.18

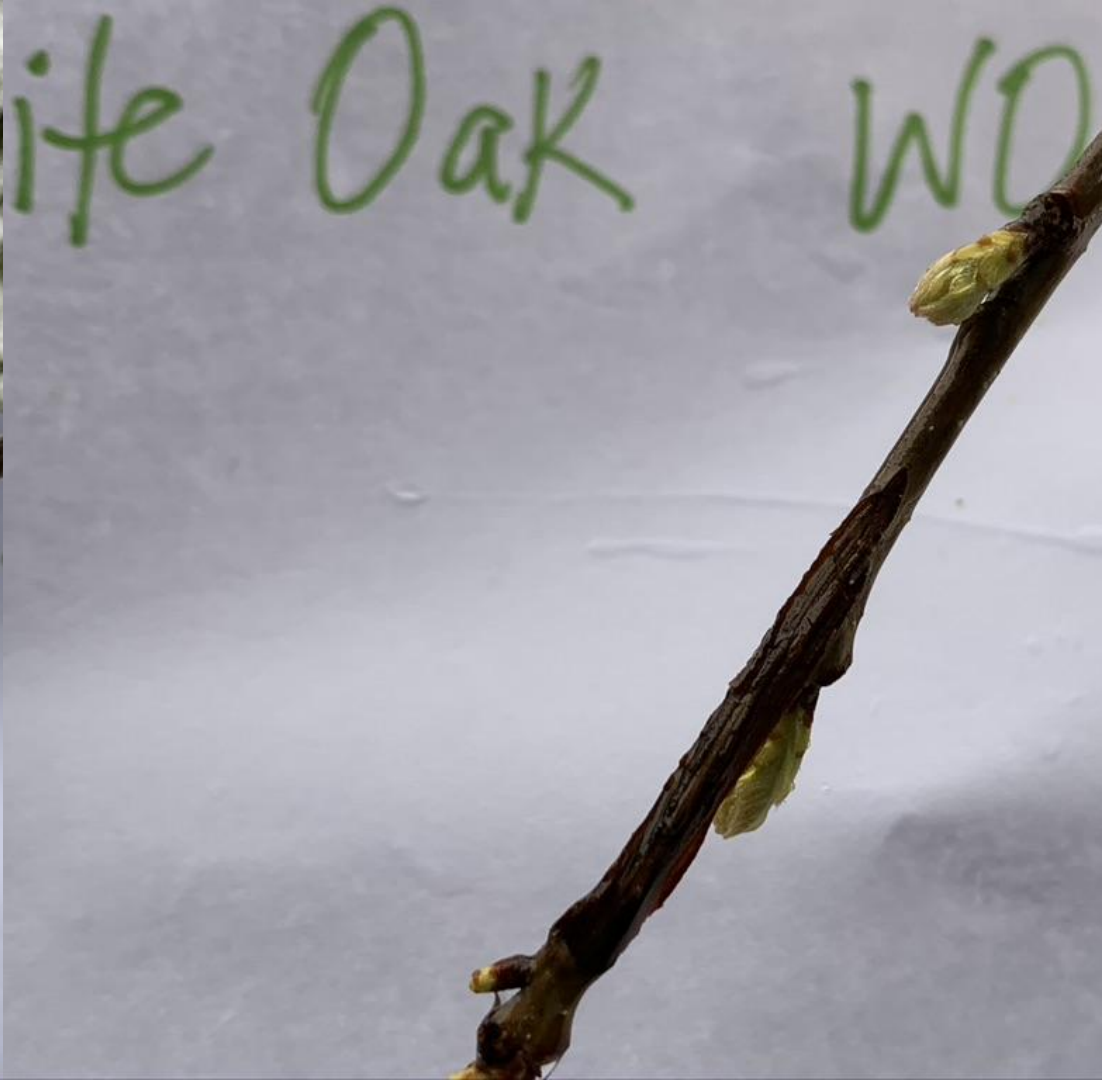
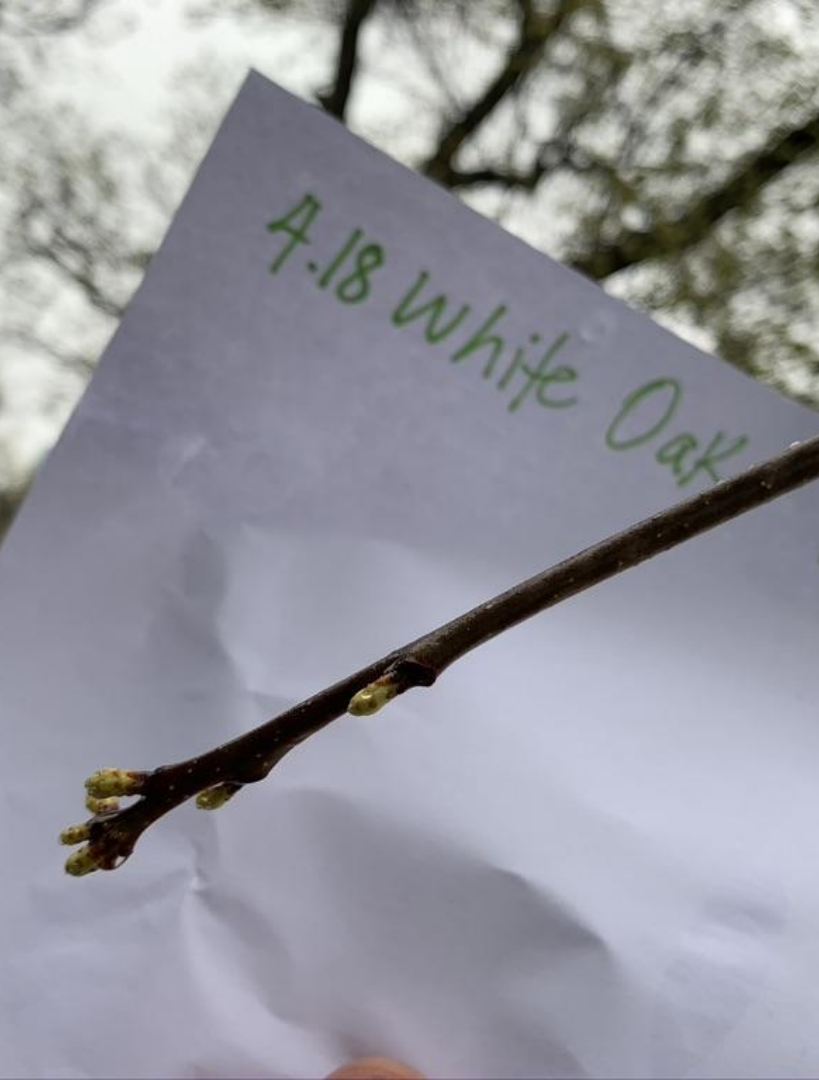




4.18 Pin Oak PO

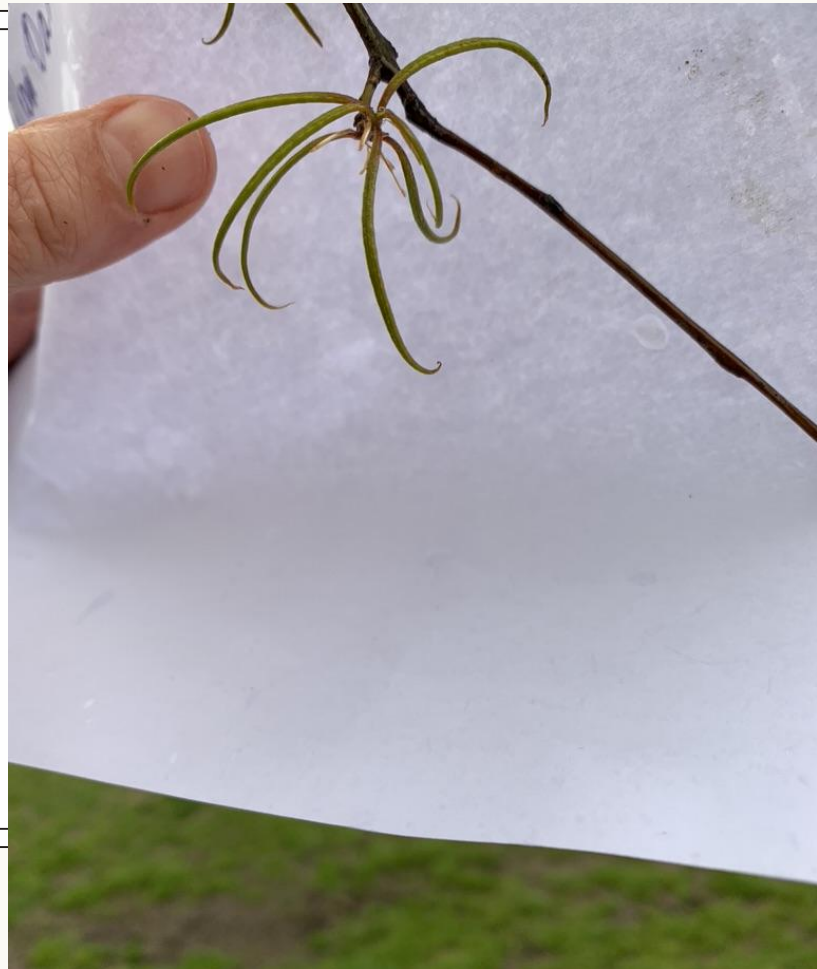
A



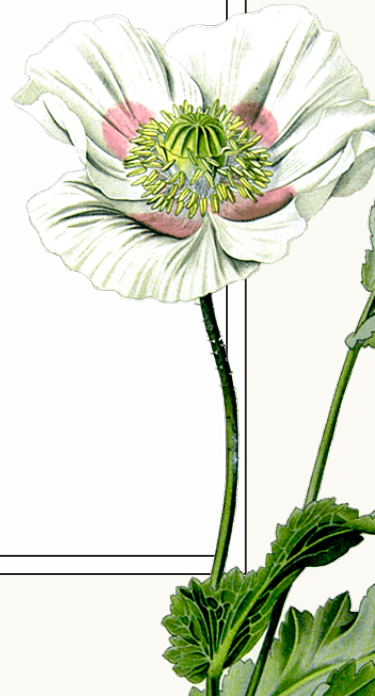
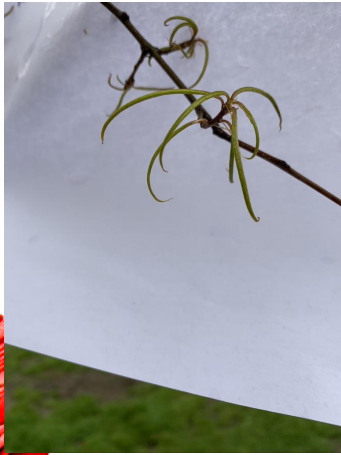




4.18 WK



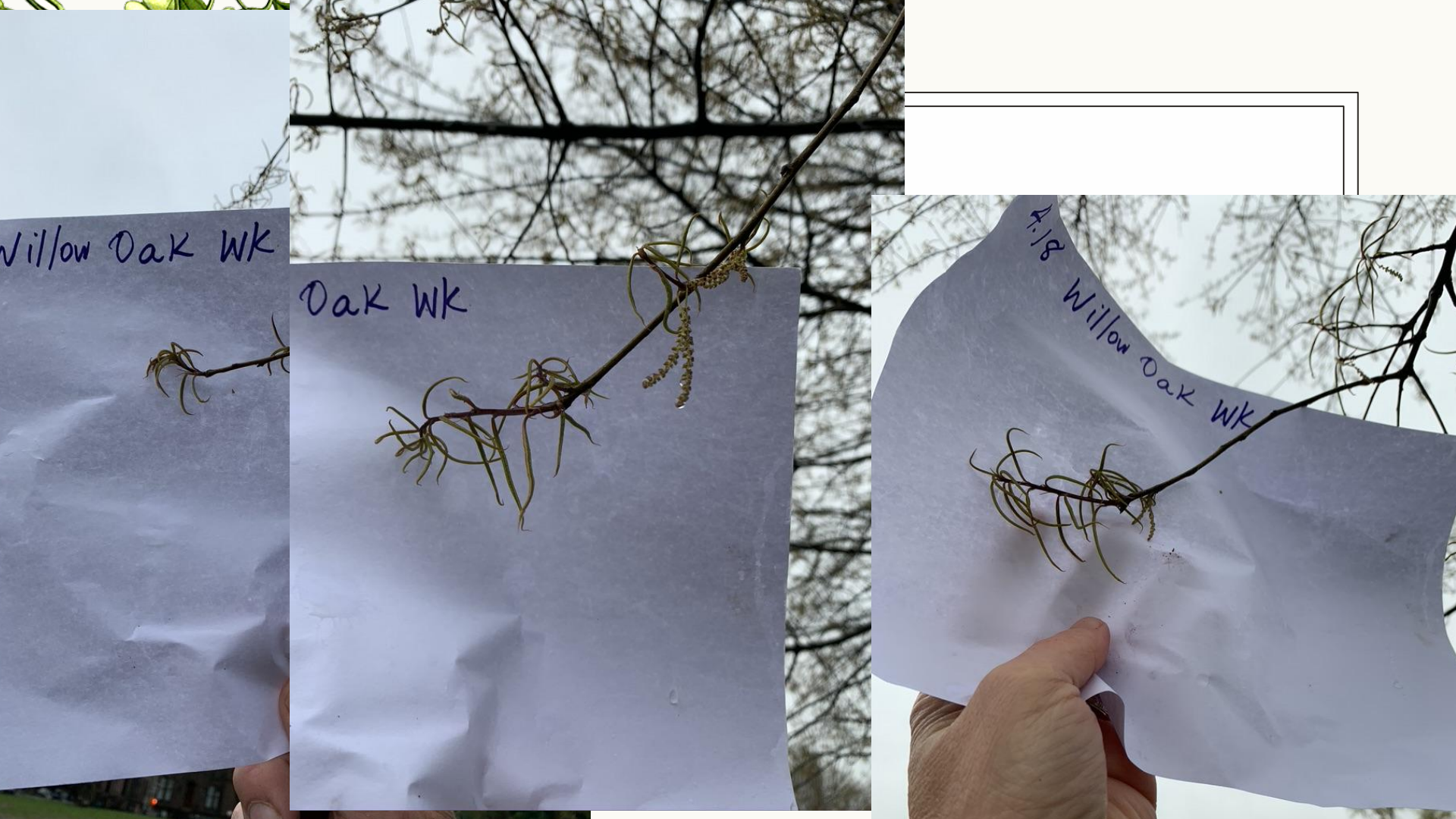
4.18 WK



Willow Dak WK

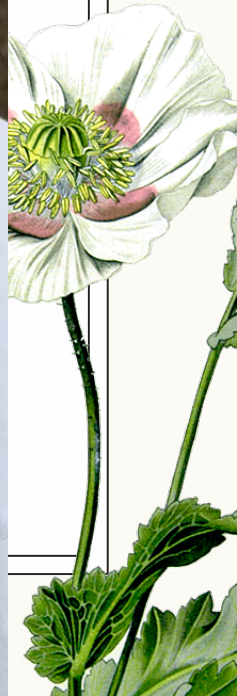
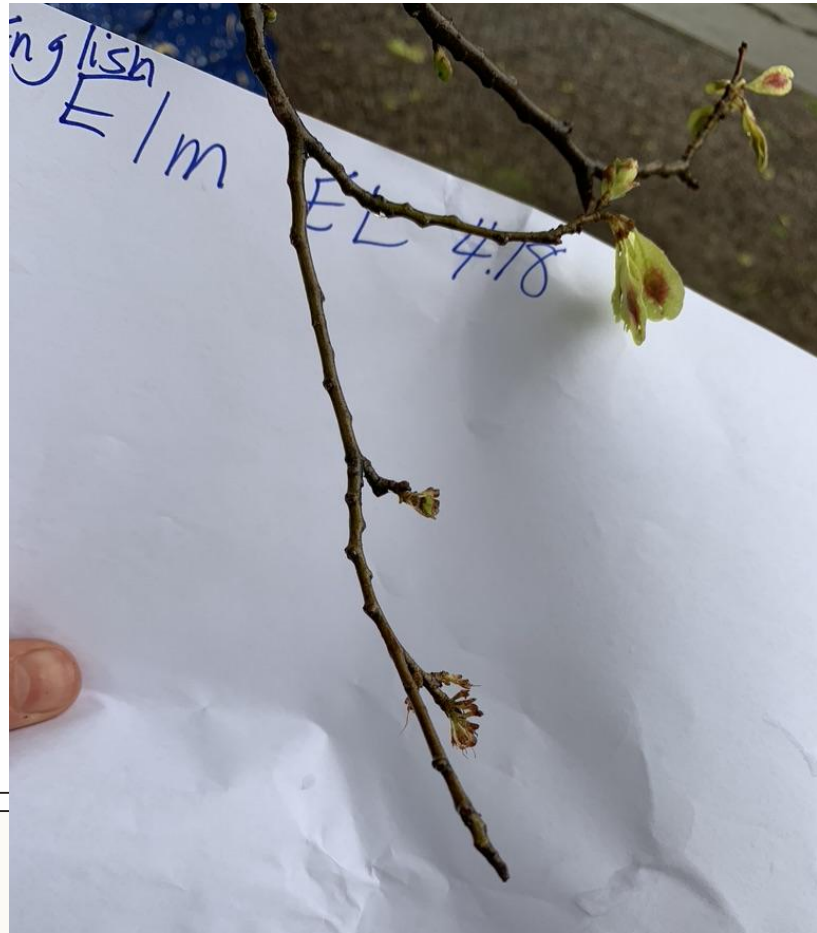
Dak WK

4.18 Willow Dak WK

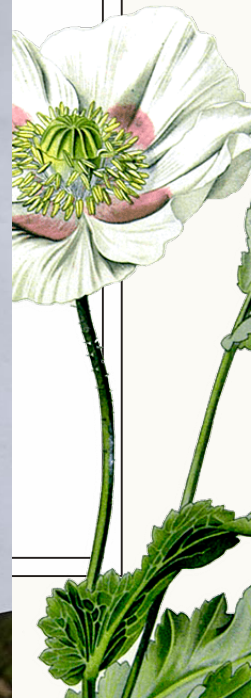
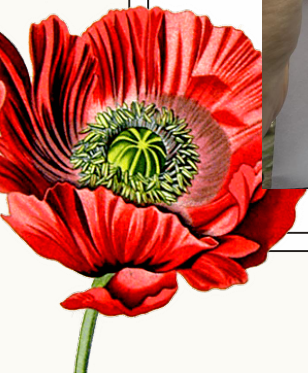
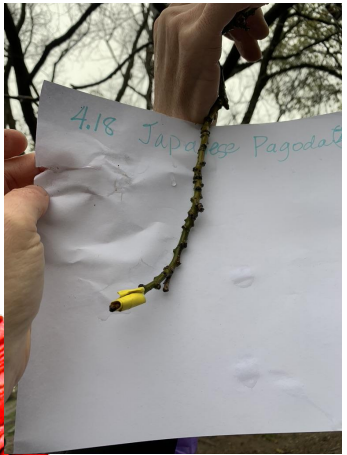
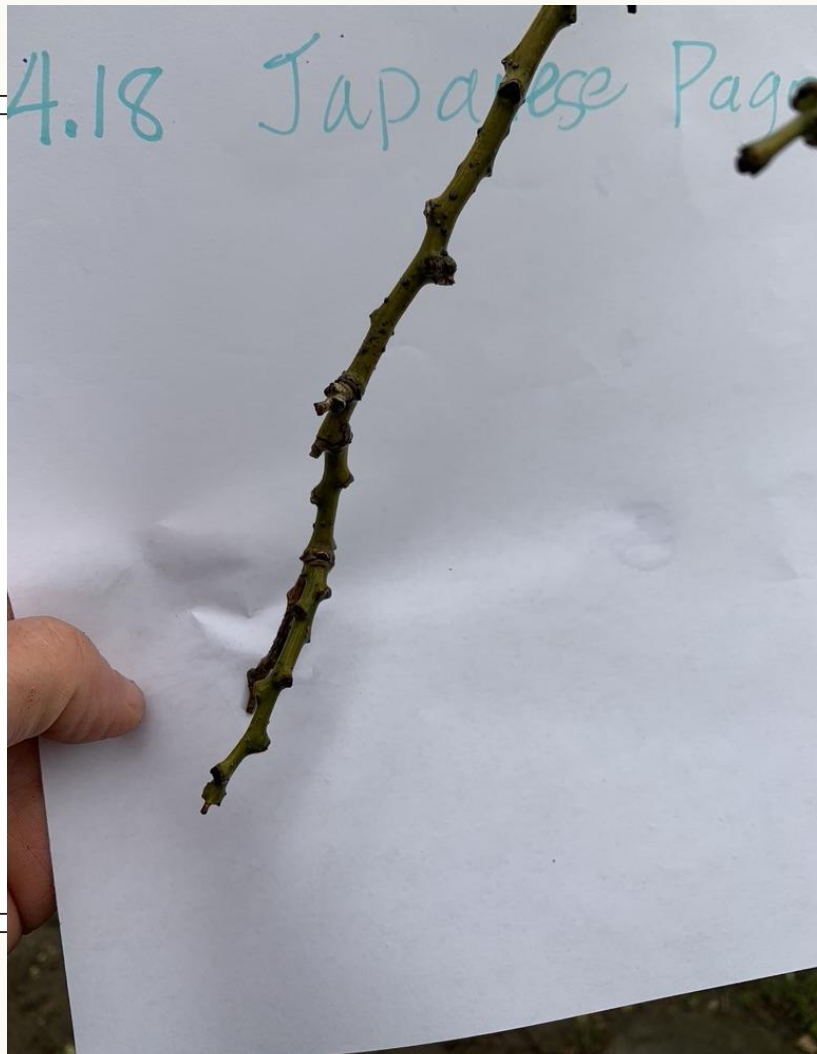




EL 4.18

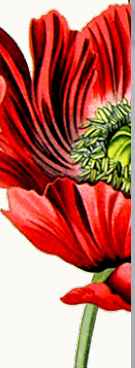
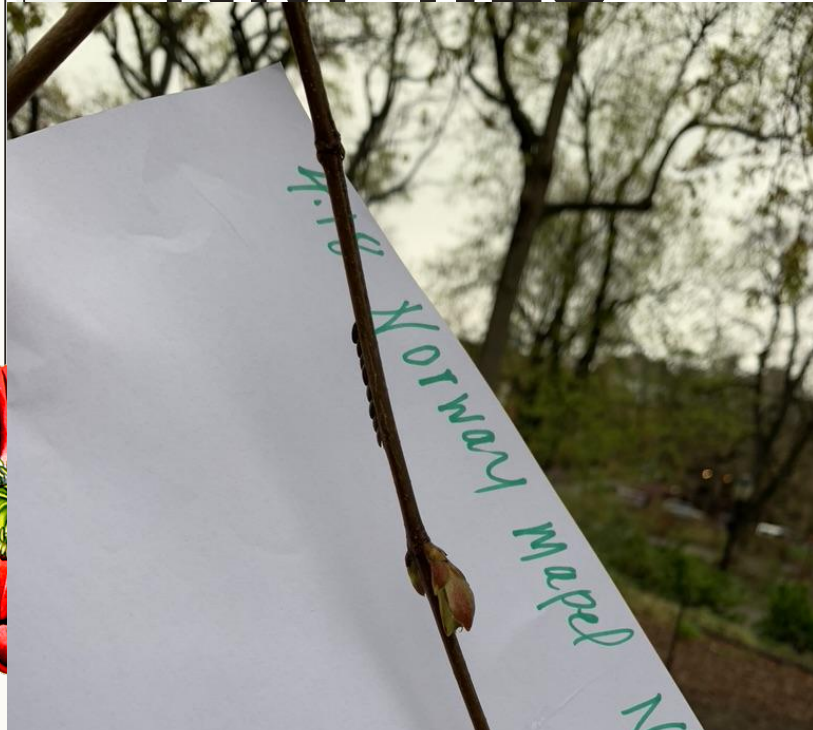


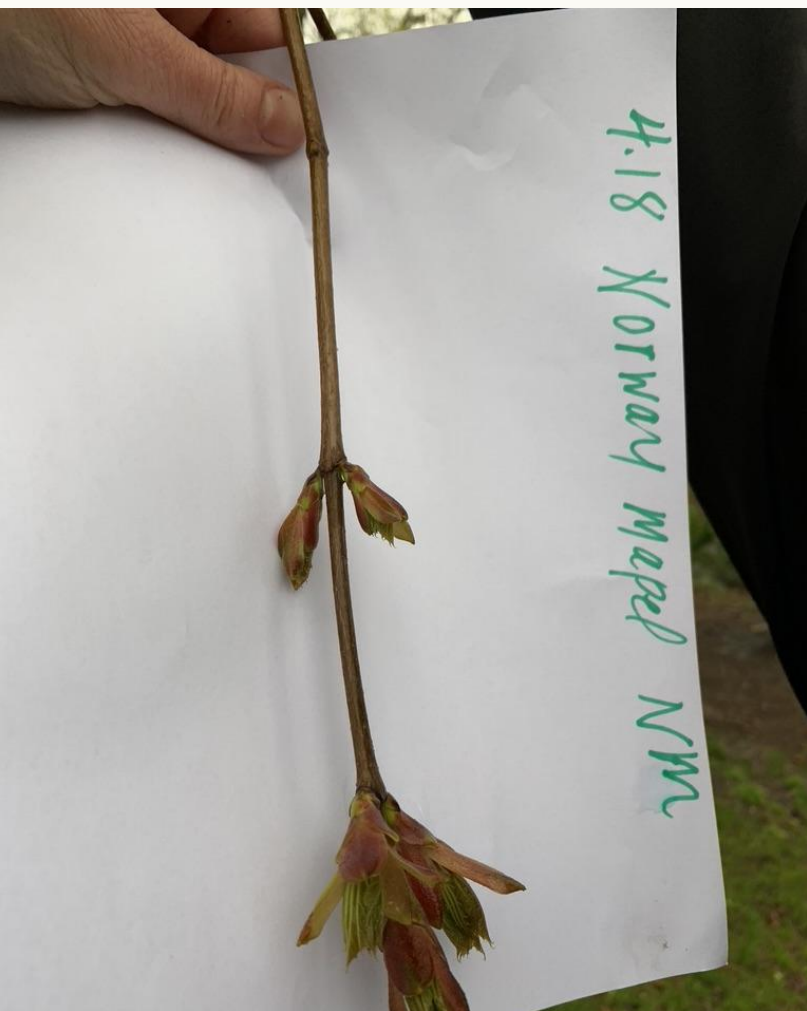
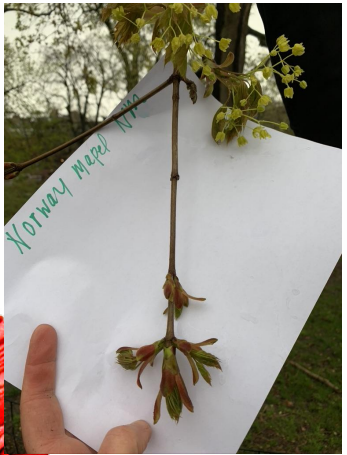


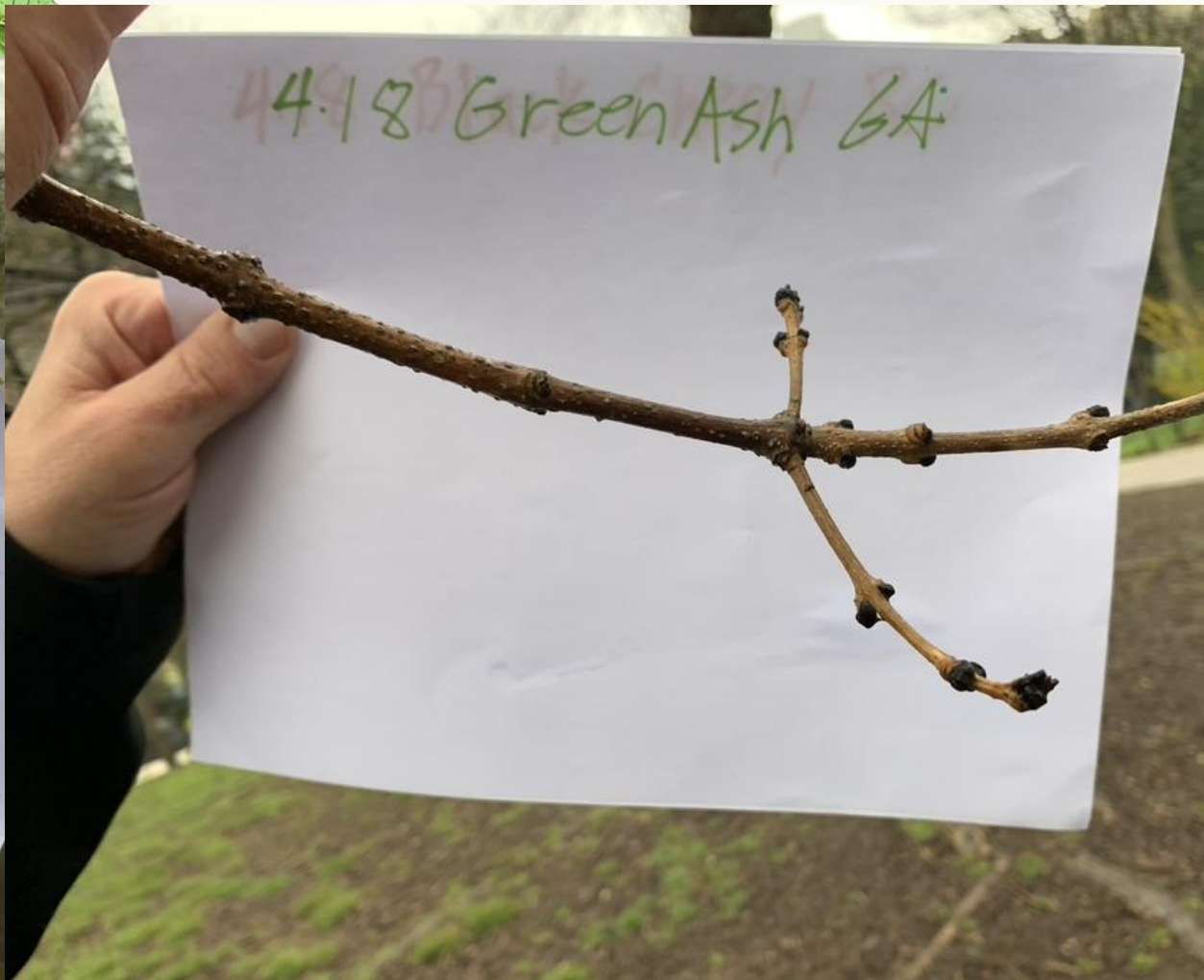
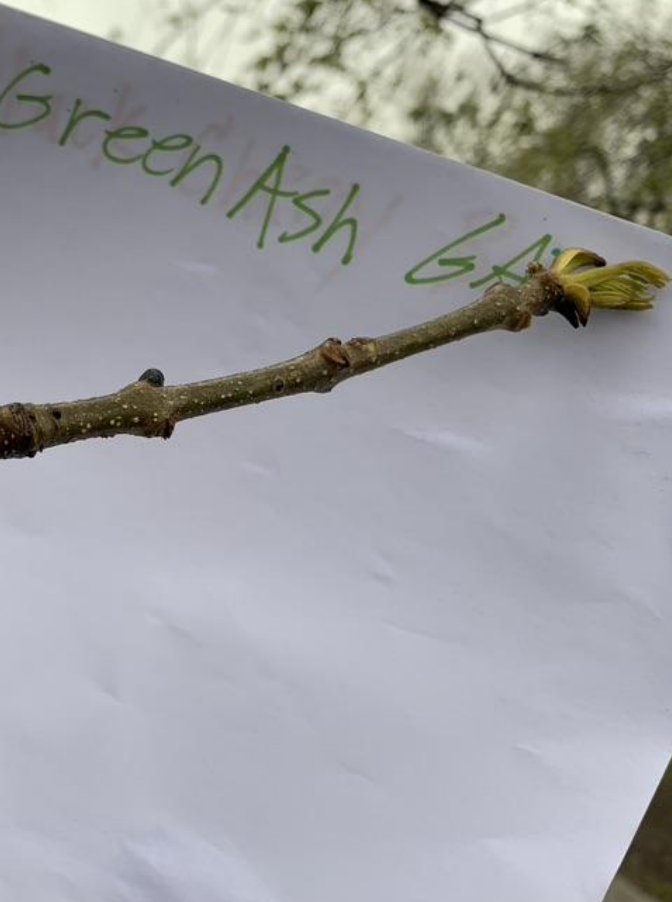


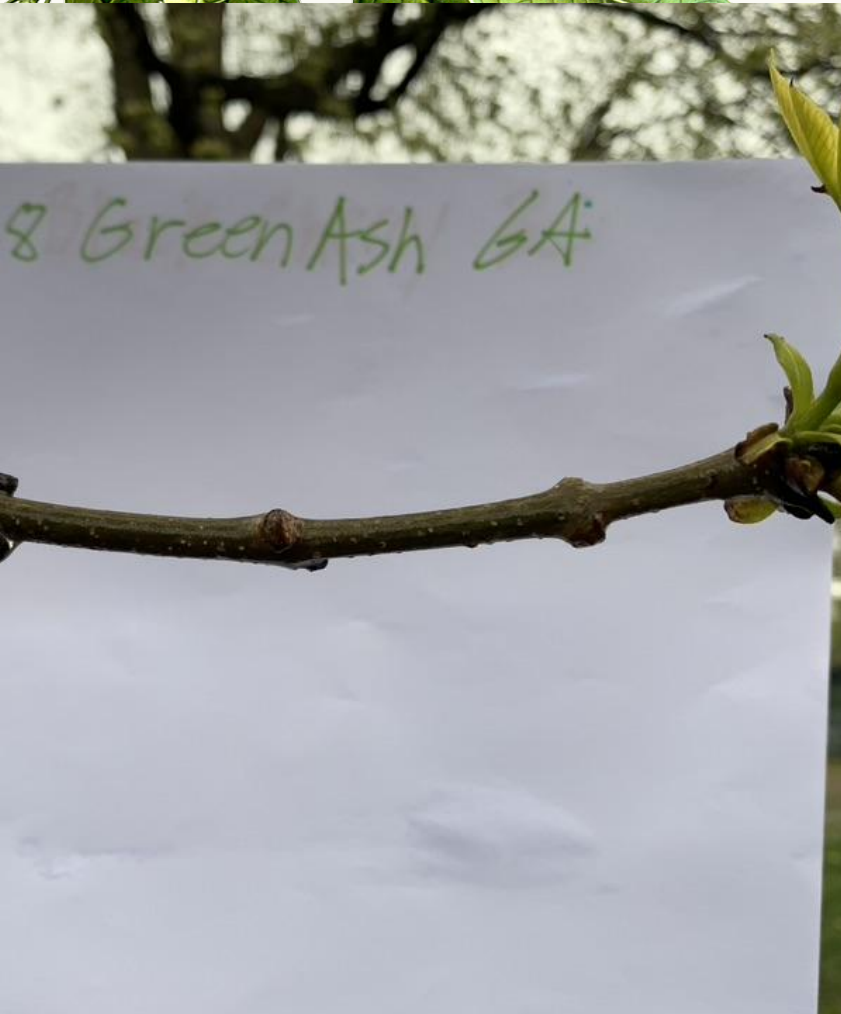


NM 4.18











BC 4.18









