Maple's Changing Colors

Is climate change already impacting the iconic sugar maple in New Hampshire? A nascent study endeavors to help us learn more.

By Martha Carlson

This past March scientists at the University of New Hampshire awaited the first run of sap as eagerly as sugar maple producers. Together, scientists and sugarmakers want to learn why maple syrup was dark last year. Many of us wonder whether some kind of stress, perhaps a result of climate change, may be involved.

Sugar producers know there are dozens of factors in making good syrup. On a sunny spring day, I bend over a collecting tank and watch clear sap bubble down the blue tubing. A tiny cloud slides over the sun, and I imagine that the sap run stops as if a switch clicked off inside the living wood.

Biochemically, the sugar maple responds to everything in its environment, including much that is less subtle than a passing cloud. The sugar maple, a dominant tree in our forests, can live for 400 years. One of three old grandmother trees in my sugarbush in Sandwich was a sprout in 1690. The maple is resilient against infestations of insects, ice storms, droughts, acid rain, or smog. It rebounds year after year though humans may crush its roots with a heavy skidder, squeeze its canopy in thickets of unthinned forest, and annually bore inch-deep holes around its boll.

Above: *The first syrup run of the season is typically light amber, as in the bottle to the far left, with later runs becoming progressively darker. However, in this study, the dark syrup began at the very start of the 2009 season.* Photo by Nigel Manley.

Sugar maples, like this venerable tree at the Daniel Webster Farm in Franklin, NH, can live for 400 years. A mature sugar maple produces about 40 litres of sap during the four- to six-week sugaring season. Trees are not tapped until they have a diameter of 10 inches at chest-height and the tree is at least 40 years old. If the diameter exceeds 18 inches, the tree can be tapped twice on opposite sides. Photo by Amanda Nickerson.

Members of the New Hampshire Maple Producers Association will continue to collect and boil maple sap samples, grading the finished syrup to see if it is light or dark. Scientists will then look for chemical patterns in the sap that might identify what compounds cause the color of syrup and whether those compounds relate to stress. Photo by Nigel Manley.

But climate change challenges the maple's biochemical wizardry. Rising temperatures, earlier springs, shorter winters, and unusual weather patterns may kill this iconic tree throughout most of its range in the United States, Forest Service models warn.

"Over my dead body," I declared three years ago.

"I'm afraid we'll both be dead by 2100," Dr. Barrett Rock chuckled.

Dr. Rock is a plant pathologist and wood anatomy specialist at UNH. At the Complex Systems Research Center, Dr. Rock and his team compare leaf and needle samples with images of whole forests captured by remote sensing instruments such as Landsat, a high-tech camera that orbits the Earth aboard NASA's Terra satellite, 500 miles above us.

Dr. Rock is exploring how science can see and measure the stress that climate change may bring to the temperate forests of New England. The sugar maple is an ideal specimen for this study: *Acer saccharum* tops the list of species that could succumb to climate change. And sugar maples are one of the only deciduous trees we humans manage in monocultures, large enough plots for Landsat to see from space.

If scientists can learn to identify the signs of stress in a few trees, they may bring that knowledge to interpretations of space imagery. In other words, scientists might be able to track the path of climate change in our forests.

I wanted to join Dr. Rock's team. He and UNH took me on.

The summer of 2008 seemed ideal for a study of climate change in central New Hampshire. The Bearcamp Valley experienced its driest spring on record. Only an inch of rain fell from late April to late June. Then torrential rains fell for six weeks, turning my gardens into a slough of mud, perhaps clogging tiny maple root hairs so they could not absorb water or nutrients.

In June, all 30 trees in my study showed water stress and their dehydration grew worse as the summer progressed. Sixty percent of the trees showed less chlorophyll than a healthy tree should contain. Eighty percent lost their leaves two to four weeks before foliage season.

Curiously the leaves seemed to grow smaller as the season progressed. As large as luncheon plates in June, leaves were the size of tea cup saucers in August. Even more oddly, all of the trees, even the very stressed trees, produced beautiful viable buds in October.

The maples made biochemical choices: they deliberately dropped leaves to concentrate scarce resources on growing excellent buds.

Then March 2009 came. My family and I tapped our sugar maples and boiled down the first harvest of maple syrup. We expected light amber, the champagne delicacy of the first run. But the first syrup graded dark amber. The sap filters were black with gooey nitre. In the collecting tanks, sap as clear as water quickly took on a faint yellowish tinge. Reports began to trickle in from our neighbors: Everyone was getting dark syrup.

Dark syrup is normal at the end of the season. Biochemical compounds that promote growth and others that seal off the tap hole wound all add color and taste to late season syrup. But our dark syrup came at the very start of the season.

"My trees are acting like they're wounded," I thought.

Is it possible that buds, twigs and wood retain the biochemical response to a preceding summer's stress? A dozen members of the New Hampshire Maple Producers Association have volunteered to help answer this question. They will collect samples of sap each day of the run this season. We will boil the samples of sap into syrup, grading it consistently to see if 2010's syrup is light or dark. We will look for chemical patterns in the sap which might identify what compounds cause the color of syrup and whether those compounds relate to stress. I will continue to gather leaves, measuring them for signs of stress that may connect 2010's summer with 2011's syrup. And we will map a dozen New Hampshire sugarbushes and tweak Landsat images to see if we can see the maple sites from space.

Our study may not find any proof that climate change is here yet, among the sugar maples. As one scientist involved in the study cautions, identifying and isolating a compound is difficult, and the study may show patterns configurative of stress without knowing all the compounds. Or there may not be any measureable stress in the leaves this summer. Or stress we find might be caused by poor management, insects or air pollution.

But to measure effects one must start somewhere. The tradition of sugar making is as long-lived as the beloved maples, and sugarmakers are patient.

"The Hunter family has sugared for six generations," Jackie Hunter Rollins of Tuftonboro told her fellow syrup producers last summer. "We'd like to sugar a seventh."

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