

An International Network of Trees

Botanical gardens from around the world investigate the timing of leaf-out, leaf senescence, and fruit ripening

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Each year we witness the seasonal schedules of plants—when they flower, fruit, and unfurl and drop their leaves—in our gardens, parks, and wild areas. The details of these schedules are vitally important to pollinators, herbivores, and frugivores, and to horticulturists, farmers, landscape architects, and ecologists. Even so, we know surprisingly little about the phenology (or life cycle schedules) of most plant species, and even less about how climate change is affecting them. With input from our colleagues in the botanical gardens community like the Arnold Arboretum, we have created an international network to help understand these schedules, how they vary among species, and how they are changing.

Our work is anchored at the Arnold Arboretum's living collection, where the Primack Lab has been studying plant phenology for 15 years. In 2012, we teamed with scientists at botanical gardens in Beijing, Berlin, Munich, Ottawa, Chicago, and Washington, DC, and with Harvard Professor Charles Davis to monitor the dates that leaves emerge, leaves senesce, and fruits ripen for hundreds of woody plant species at these gardens (leaf-out for 1,600 species, leaf senescence for 1,360 species, and fruit ripening for 200 species).

We learned that the timing of leaf-out at the Arnold Arboretum varies by more than two months from species to species. Some honeysuckles and gooseberries leaf out in early April, whereas many rhododendrons and pines do so in early June. Strikingly, species leaf out in virtually the same sequence no matter the year or garden. Shrub leaves tend to appear before those of trees, and deciduous plants tend to leaf out before evergreens.



Amanda Gallinat monitors fruit ripening times at the Arnold Arboretum. Photo by R. Primack.

Evolutionary history plays a role, too—certain groups of related species, like those in the rose family, leaf out earliest, while other groups, such as oaks, leaf out later.

We quickly discovered that the timing of leaf senescence (the process of leaf color change and leaf fall) is much more difficult to determine than leaf-out. A few species, such as chokeberries and honey locusts, consistently lose their leaves in late summer, while some privet and honeysuckle species regularly senesce in November and December. For most species, however, the timing of leaf senescence is inconsistent from year to year and garden to garden. So far, the timing of fruit ripening seems to vary in a fairly consistent matter: certain species, such as shadbushes and some honeysuckles, ripen in the early summer, and other species, such as hollies, ripen in late autumn.

Uncovering these patterns reveals a new richness of natural history at the Arboretum, and helps us understand how plant schedules will be affected by climate change. This fall, take time to observe the timing of leaf senescence among different groups of plants. We invite you to contribute to our efforts to better understand plant life cycles by participating in the Tree Spotters program at the Arnold Arboretum, contributing to a citizen science program in your town, or by making Nature's Notebook observations at your favorite place in nature. 🌿



Richard Primack amid fall foliage in the Maple Collection at the Arnold Arboretum (left, photo by A. Gallinat); *Prunus sargentii* (Sargent cherry) is among the earliest trees to leaf out at the Arnold Arboretum (above, photo by R. Primack).