Effect of Average Growing Season Temperature on Seedling Germination, Survival and Growth in Jack Pine (*Pinus banksiana* Lamb.)[1]

A. David[2] and E. Humenberger[2]

Abstract

Because jack pine (*Pinus banksiana* Lamb.) is serotinous, it retains multiple years of cones until environmental conditions are favorable for releasing seed. These cones, which contain seed cohorts that developed under a variety of growing seasons, can be accurately aged using bud scale scars on twigs and branches. By calculating the average daily temperature for June through August for the past 15 years in Grand Rapids, Minnesota, and comparing them to the published 30 year average, we identified 3 years that could serve as a warmer (2005), cooler (2008) and control (2013) growing season (range = 3.4 ºC). Cones that could be dated to these 3 years were collected from three mature jack pine, their seeds extracted and sown in a greenhouse. The seedlings were grown with minimal temperature control and minimal, but equal amounts of water to maintain warmer and drier than ambient conditions. Germination rates were scored for each tree/year combination and at the end of the growing season percent survival and height were calculated. Germination rates for the three trees averaged 51.9 percent, 39.1 percent and 48.9 percent across the 3 years with a range for each tree between 10.2 percent and 11.0 percent, suggesting comparable levels of filled seed. Seedling survival under warm greenhouse conditions was 104 percent of control for seedlings from the warm summer of 2005 while seedlings from the cold summer of 2008 survived at 98 percent of control seedlings. A similar trend was observed for seedling height. The warm 2005 seedling cohort grew at 129 percent of the control while seedlings from cold 2008 grew at 98 percent of the average control height. These results suggest that there is an epigenetic effect in jack pine between growing season temperature experienced during seed development and future seedling survival and height growth. Alternatively, differential pollen contribution in warm vs cold years could have contributed to the observed results, but the genetic diversity of seeds from open-pollinated, temperate conifers is remarkably consistent from year to year. Despite being based on a single year of data in an artificial environment, these findings represent the first data that suggest that jack pine, an ecologically and economically important boreal species, possesses some inherent ability to adapt to a warming climate.

[1] A version of this paper was presented at the Gene Conservation of Tree Species – Banking on the Future Workshop, May 16-19, 2016, Chicago, IL.

[2] University of Minnesota, Department of Forest Resources, North Central Research and Outreach Center, 1861 Highway 169 East, Grand Rapids, MN 55744.
Corresponding author: adavid@umn.edu.