

# An Initial Assessment of the Frequency of Maple Crop Failure in the U.S.

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Some seasons sometimes produce a bountiful crop of maple syrup. In other years producers are considerably less lucky. Periodic failures of the maple crop happen. Sometimes this affects only isolated operations when massive equipment problems or health issues intervene. Other times the shortfall in production can be more widespread. In years with extensive weather anomalies, crop failure can be extensive, affecting many states across the maple-producing region. These tend to happen in years when the winter and spring are abnormally warm or in years when the weather changes stays cold until late in the spring, then suddenly turns warm and remains that way.

Climate change has shifted the maple season towards a production window that occurs earlier and earlier in the calendar year. In addition, research points to the transition from winter to summer (the spring season) happening more quickly in some areas. Because maple production relies on a relatively small number of good production days, reducing the duration of the sap flow season has the potential to in-

crease the possibility that crop failures might occur.

This study examines the frequency of maple crop failures over the past few decades in an attempt to understand how a changing climate might impact maple production. We used data from the U.S.D.A. National Agricultural Statistics Service (NASS). Crop failure was defined as years in which syrup yield (gal/tap) in a given year was 20% lower than the two seasons immediately before and the two seasons following the year being examined. This approach reduced the influence of growth in the number of taps over time. Because yield data is available starting in 2001, it resulted in an evaluation of the seasons from 2003-2021 (19 seasons). States included in the analysis included: CT, MA, ME, NH, OH, PA, VT, and WI. Collection of yield data for CT, MA, and OH ended in 2018, so analysis for those states covers the years 2003-2016 (14 seasons).

The frequency of maple crop failure for each state is shown in Figure 1. Over all states, crop failure occurs at a frequency of 15.1% (about one out of

every 6-7 seasons). ME, NH, PA and VT had the lowest crop failure rate at 10.5% (about one of every 10 seasons). CT and MA experienced crop failure 14.3% (about 1 of 7 years) of the time, and WI 15.8% of the time. NY had a crop failure frequency of 21.1% (about 1 of 5 yrs). OH had the highest crop failure frequency of assessed states with a rate of 28.6% (1 out of every 3 or 4 years). The cause of the differences in failure rates across states are unknown, but may be due simply due to natural variation, low sample size, the level of technology adoption, or something else.

The average loss in maple syrup production for each state in years of crop failure is depicted in Figure 2. Overall, the average loss in failure years across all states is 30.5%, nearly 1/3 of a crop. Several states show a tendency for losses in the 20-29.9% range (ME, NH, NY, OH, VT), while other states show higher average crop losses in the 30-39.9% range (CT, MA, PA) or even above 40% (WI). The reason(s) for different failure rates are unknown, but might simply be due to the short timeframe over which this analysis was completed. Examinations over a longer time frame would likely be more informative.

When we look at when crop failures have occurred (Figure 3), we see that early in this time-series (2003-2012) crop failures were common in at least one of the states, occurring in 7 out of 12 years, with multi-state (regional) failures occurring in 3 of those years. In 2007, ME, NY, PA and WI were all

affected. In 2010, CT, MA, NY, OH and PA all experienced crop failure. The widespread heatwave of 2012 resulted in crop failures across the maple production region, with CT, NH, NY, OH, VT, and WI all affected.

From 2013-2021 (9 seasons), crop failure was seen only twice (2016 and 2021). The 2016 failure involved only OH. The 2021 failure was more extensive, with NH, VT, and NY all experiencing significant drops in syrup production.

While OH appears to suffer from a higher frequency of maple crop failure, a lack of data from more southern regions (IN, KY, NH, TN, VA, WV) precludes the ability to determine whether crop failure is more common in those areas peripheral to the dominant maple producing states.

The fact that crop failure frequency appears to be LESS common than in the past is interesting. While we might expect that climate change would result in more uncertainty about when to tap and might produce warmer prolonged temperature periods earlier in the season, that doesn't appear to be the case, at least over the short period of investigation in this study. It is possible that heightened awareness and flexibility on the part of maple producers on when to tap along with improved application of technology (better spout/drop sanitation, better vacuum) has managed to offset any reductions in yield.

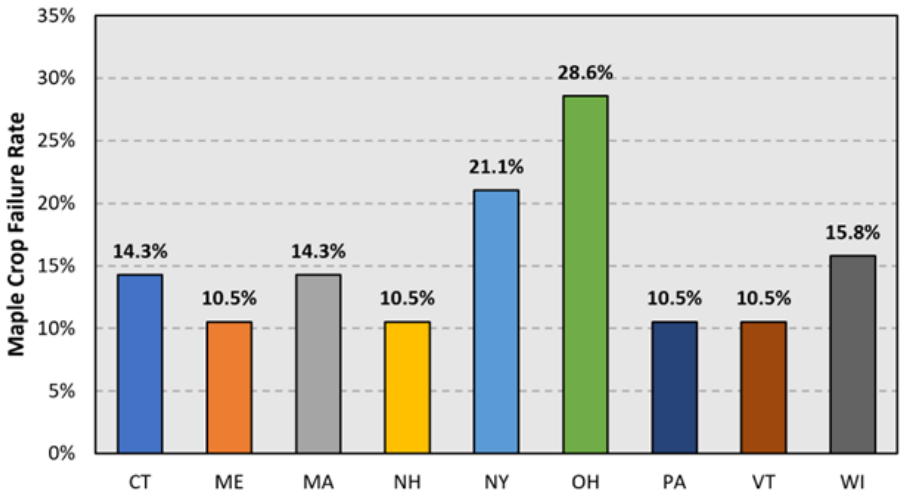


Figure 1. Maple crop failure (> 20% reduction in yield from average of two previous and two post-season yields) by state from 2003-2021. The value above each bar represents the percentage of crop failure. Sample size is 14 years for CT, MA, and OH, and 19 for the remaining states.

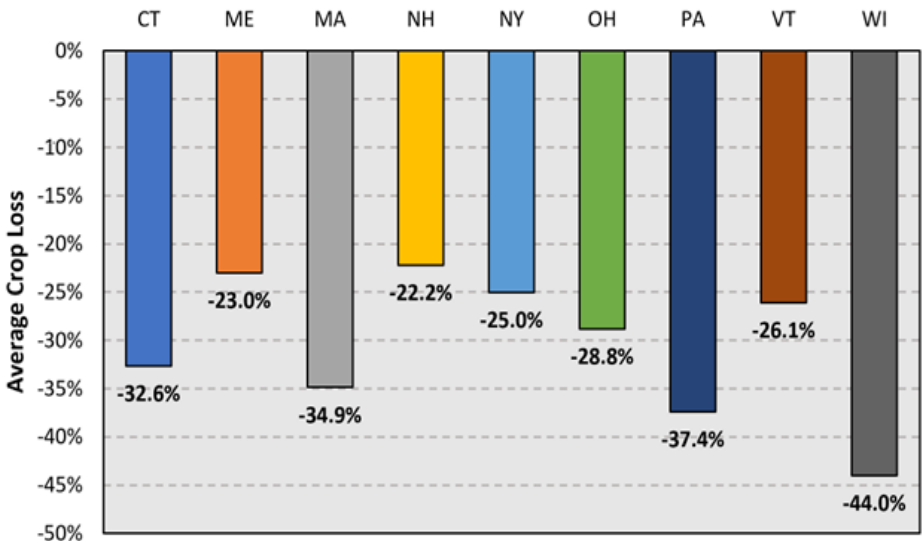


Figure 2. Average crop loss in years with crop failure by state from 2003-2021. The value below each bar represents the amount of average percentage reduction in maple syrup production.

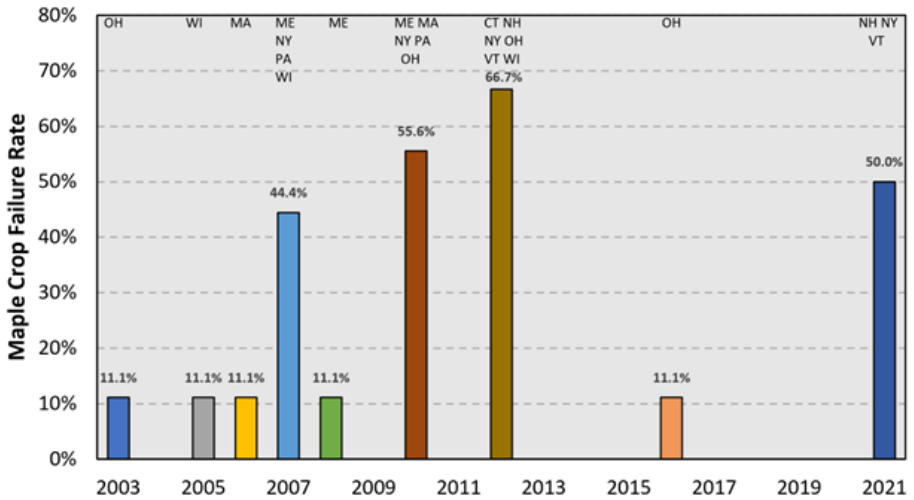


Figure 3. Percentage of states experiencing maple crop failure (> 20% reduction in yield from the average of two previous and two post-season yields) by year from 2003-2021. The value above each bar represents the percentage of crop failure for that year. Initials across the top indicates the state(s) in which failure occurred that year. Sample size is 19 years from 2003-2016 and 14 years from 2017-2021.