Can forecasts of the start of the spring season improve allergy and asthma symptom management?

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Abstract

Allergic respiratory disease affects millions of Americans, resulting in billions in medical expenses and lost productivity annually. Information regarding when pollen concentrations are increasing across the country is limited, diminishing the ability of health care professionals and individuals suffering from allergies and asthma to anticipate and manage their symptoms. The USA National Phenology Network, a science and monitoring network that collects, stores, and shares data and information products regarding the timing of seasonal events from across the country, offers a series of map and short-term forecast products that indicate the start of biological activity in the spring, based mainly on temperature conditions. In this study, we evaluate the potential for the Spring Indices to indicate the timing of the start and peak of airborne pollen concentrations by plant taxa, and by extension, their utility for predicting timing of increases in airborne allergenic pollen concentrations. We compared daily pollen counts collected at National Allergy Bureau (NAB) pollen counting stations across the country to the day of year the two Spring Indices – the Leaf Index and the Bloom Index – were met at those locations. In general, the Bloom Index exhibited stronger relationships with the timing of peaks in airborne pollen among the 36 plant taxa evaluated. This is likely because the Bloom Index occurs later in the season, closer to the timing of pollen peaks. However, relationships for the Leaf Index also demonstrate coherence (adj R2; ~ 0.5 +/- 0.15 [SD]). Relationships were generally strongest for Morus (mulberry), Populus (poplar), Fraxinus (ash), and Salix (willow), though the taxa best predicted by the Spring Indices varied by site. Strength of relationships did not vary appreciably across geography. Overall, the Spring Indices provide insight into seasonal pollen dynamics and have the potential to enhance springtime allergy management.

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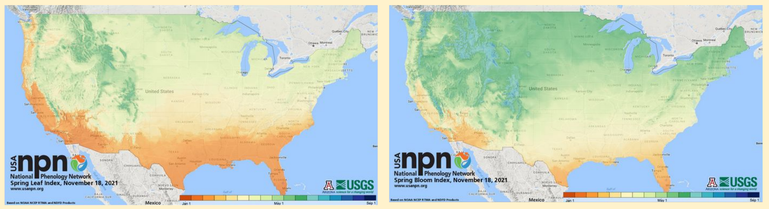
Aim

Information regarding when pollen concentrations are increasing across the U.S. in spring is limited, diminishing the ability of health care professionals and individuals suffering from allergies and asthma to anticipate and manage their symptoms.



Learn more about the Extended Spring Indices and the data products available on the USA-NPN website.

The USA National Phenology Network (USA-NPN) offers short-term forecasts of conditions associated with the start of biological activity in the spring. The Leaf Index represents activity among plant taxa active earliest in the season; the Bloom Index occurs four to six weeks later and represents the timing of activity in species active later in the season.

We evaluated the potential of the USA-NPN's Spring Leaf and Bloom Indices to to indicate the timing of the start and peak of airborne pollen concentrations by plant taxa.

Methods

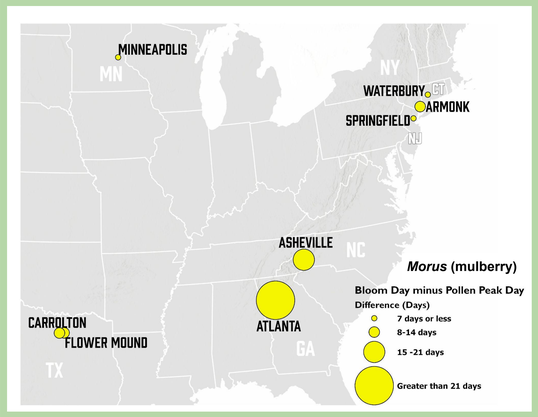
We compared the day of year the Leaf and Bloom Indices were met with the day of year the start and the peak of pollen concentrations for individual plant taxa were observed at 8 National Allergy Bureau pollen counting stations across the country.

For most stations*taxa comparisons, n = 12 years. We used pearson's correlation tests to undertake four sets of comparisons for each site*taxa: Leaf Index vs Pollen Onset, Leaf Index vs Pollen Peak, Bloom Index vs Pollen Onset, and Bloom Onset vs Pollen Peak. We excluded station*taxa comparisons where the index did not precede the pollen event.

Key Findings

- The Leaf Index demonstrated greater performance in predicting pollen peaks (significant models in 27% of site*taxon tests) than pollen onsets (significant models in 19% of site*taxon tests)
- The Bloom Index performed well at predicting pollen onsets in 38% of site*taxon tests and 34% of pollen peak tests
- The Leaf Index precedes Pollen Onset by 21 (±12) days (mean±SD) and Pollen Peak by 23d (±16d) days for taxa exhibiting significant relationships
- The Bloom Index precedes Pollen Onset by 8 (±6) days and Pollen Peak by 34 (±15) days for taxa exhibiting significant relationships
- The Leaf Index is especially useful for predicting pollen activity in *Fraxinus* (ash), *Liquidambar* (sweetgum), *Morus* (mulberry), and *Quercus* (oak)
- The Leaf Index demonstrated especially strong performance for predicting pollen onset and peak in Minneapolis, MN; the Leaf Index also predicted pollen peak for several taxa in Flower Mound, TX and Armonk, NY

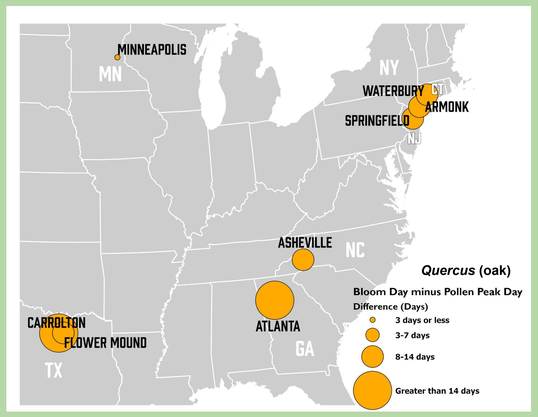
*Summary of pearson's R correlations between the timing of Leaf and Bloom Indices and the timing of start and peak of pollen in various taxa at eight NAB stations. Site*taxa tests demonstrating significant results are depicted by open circles; circle size reflects the number of days between the day of year the index is met and the day of year of the pollen event. Dots indicate tests where p>0.05.*



Average difference in days between the bloom day and the pollen peak day for each of the NAB stations examined.

Circle size reflects the number of days between the day of year the index is met and the day of year of the pollen event. Only sites with a significant relationship (p<0.05) mapped.

The number of days between the Bloom Index and peak pollen counts in *Morus* and *Quercus* varies spatially. Longer durations tend to occur in more southern locations.



Practical application and next steps

The USA-NPN's Leaf and Bloom Indices demonstrate promising performance for indicating the start and peak of pollen in several taxa at locations across the country. In many cases, the Index precedes the pollen event by multiple weeks, demonstrating that these indices can be used to anticipate when allergenic pollen will be highly concentrated at a particular location.

We plan to extend these comparisons to additional National Allergy Bureau pollen counting stations across the United States in the coming months.

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