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Ice Nuclei from Birch Trees

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While the importance of heterogeneous ice nucleation in the atmosphere is known, we still know very little about the substances triggering these freezing events. Recent findings support the theory that biological ice nuclei (IN) exhibit the ability to play an important role in these processes. Huffman et al. (2013) showed a burst of biological IN over woodlands triggered by rain events. Birch pollen are known to release a high number of efficient IN if incubated in water (Pummer et al. 2012). Therefore birches are of interest in our research on this topic.
Plants native to the timberline, such as birch trees, have to cope with very cold climatic conditions, rendering freezing avoidance impossible. These plants trigger freezing in their extracellular spaces to control the freezing process and avoid intracellular freezing, which would have lethal consequences. The plants hereby try to freeze at a temperature well above homogeneous freezing temperatures but still at temperatures low enough to not be effected by brief night frosts. To achieve this, IN are an important tool.
The specific objective of our work was to study the potential sources and distribution of IN in birch trees. We collected leaves, fruit, bark, and trunk cores from a series of mature birch trees in Tyrol, Austria at different altitudes and sampling sites. We also collected samples from a birch tree in an urban park in Vienna, Austria. Our data show a sampling site dependence and the distribution of IN throughout the tree. Our data suggest that leaves, bark, and wood of birch can function as a source of IN, which are easily extracted with water. The IN are therefore not restricted to pollen. Hence, the amount of IN, which can be released from birch trees, is tremendous and has been underrated so far. Future work aims to elucidate the nature, contribution, and potential ecological roles of IN from birch trees in different habitats.

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