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**Introduction:** Environmental stress as with advancing climate change and pollution can affect the plant allergenicity, alter pollen characteristics and influence the occurrence and intensity of allergic respiratory diseases.

**Aim of study:** This study aims to investigate the correlation between pollen data from birch trees grown under different climatic conditions and the molecular composition of the pollen, as well as the skin prick test (SPT) responses in allergic patients. Comprehending the underlying mechanisms may help in the prediction and management of allergic diseases, especially in the context of climate change.

**Materials & Methods:** From 2019 to 2022, birch pollen samples were collected from various locations across Europe. Data on abiotic factors (like air temperature, relative humidity, global solar radiation, air pollution) and biotic factors (tree growth parameters, cherry leaf roll virus infection) was gathered. Standardised pollen extracts were prepared, and correlations were drawn between environmental and tree-specific data, parameters related to allergenicity (total protein content, Bet v 1 content, lipid mediators, lipopolysaccharide (LPS), histamine) the results of the skin prick test (SPT) in terms of wheal-size. Three settings were examined: genetically identical birch trees in international phenological gardens (ROI-1), diverse tree clones in a seed plantation (ROI-2), and trees along an altitudinal gradient, exhibiting different genetic backgrounds and climate conditions (ROI-3).

**Results:** In general, pollen allergenicity was influenced by the genetic background of the trees, with year-to-year variation having an even greater effect. Among the assessed pollen-intrinsic parameters, Bet v 1 and total protein were identified as the strongest predictors of the severity of SPT results. In ROI-1 and ROI-2, wheal size was more strongly correlated with the total protein content than with Bet v 1. In addition, wheal size showed a significant negative correlation with the altitude of the tree location. Finally, we observed a significant positive correlation between Bet v 1 content and the mean temperature of the previous month preceding the onset of flowering.

**Conclusion:** Our results indicate that the allergenic potential of birch pollen varies annually and is influenced by both, the genetic profile

of the tree and the prevalent climatic factors. While Bet v 1 remains the major birch allergen, the allergenicity of birch pollen may depend on various compounds within the pollen matrix, such as histamine and LPS. Birch trees at higher altitudes or in cooler regions produce pollen with lower allergenicity, indicating that trees in warmer climates tend to increase allergenicity due to environmental stress. In the context of climate change, this may imply that adverse health effects for atopic individuals.