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Soken Matsuda, Shigeto Kawashima

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Relationship between laser light scattering and physical properties of airborne pollen

Soken Matsuda[a], Shigeto Kawashima[a,*]

[a]Graduate School of Agriculture, Kyoto University, Kyoto 606-8502, Japan

*Corresponding author: Postal address: Graduate School of Agriculture, Kyoto University, Oiwake-cho, Sakyo-ku, Kyoto 606-8502, Japan. Tel.: +81-(0)75-753-6155 ; Fax: +81-(0)75-753-6476. E-mail: sig@kais.kyoto-u.ac.jp

Abstract

Pollinosis (allergy to pollen) causes social and health problems around the world. Monitoring the actual amount of airborne pollen is essential to dealing with this problem. However, as measurements are usually done with the human eye using a microscope, enormous amounts of time and skilled labor are needed. We developed an automatic pollen monitor that uses laser optics to measure pollen more easily. With this method, unique ranges of light scattering intensities for each taxon of pollen, or “extract windows,” are searched and parameters for extracting subject pollen from observed data are clarified. These extract windows are determined using a scatter plot for the forward and side scattering intensities, based on the correlation coefficient between data from the automatic monitor and a Hirst-type sampler. In this paper, we present an analysis of data obtained by Le Réseau National de Surveillance Aérobiologique in Lyon, France in 2013 and by MétéoSuisse in Payerne, Switzerland in 2014 and 2015. Scattering intensities derived from the locations of extract windows for five pollen taxa were compared with physical properties of the pollen grains, clarifying that a positive relationship exists between the size of pollen and the intensity of forward scattering. We also investigated the ratio between side and forward scattering intensity and pollen surface characteristics using frequency analysis, finding a strong relationship between this ratio and the frequency spectrum of pollen surface structures. Larger roughness sizes on the pollen surface showed a clear relationship with the ratio between side and forward scattering intensity.

Graphical Abstract