Anna Tran
Junior
Forensic Science

Investigating the Differences in the Elemental Composition of Pollen from Common Houseplants Under Different Growing Conditions Using Laser Induced Breakdown Spectroscopy

Dr. Alyssa Marsico, Ph.D., Forensic Science Department

This summer I chose to investigate if plant material could be identified by its elemental composition using Laser Induced Breakdown Spectroscopy (LIBS) under different growing conditions. I specifically wanted to see if the species of orchids had a unique set of elements in comparison to a peace lily or anthuriums. If they did, if and how would they change if exposed to different growing conditions? This is important because linking a sample of pollen or a leaf to one specific person or location could establish a link between a scene, suspect and victim, which would help with crime reconstruction (Kunz, 2017). If LIBS can be used to narrow plants down based on their chemical make-up, it can be a more efficient method because sample preparation and analysis is quick. The plants used for this experiment were peace lilies, anthuriums and orchids because they are the most common houseplants. The conditions tested included the location of the plant itself and the addition of fertilizer. At the start of the project, the plants were moved to different locations. Samples were taken from the plants in the forms of pollen samples and leaf samples. After a few weeks, fertilizer was added to certain plants. Two different fertilizers, 20-20-20 and 10-30-20, were utilized. Every sample collected from the plants were analyzed using LIBS to compare their elemental profiles over time and under different conditions. Instrument parameters changed over time to ensure the best signal for each element was observed.

In my research, I discovered that the spectra contained the elements carbon, magnesium, calcium, sodium, hydrogen, potassium, oxygen, nitrogen, and barium. One of the elements, barium, I thought was exclusive to anthuriums, but I found with the adjustment of parameters, that it could be found in orchids as well. Based on my research, either barium is nonexistent in peace lilies, or the concentration was too low to be detected. As for the changes in environment, we were successful in being able to distinguish plants if they were fertilized, by looking at levels of potassium and nitrogen. In terms of location, there wasn't much of a difference besides possibly the increase in sodium found in the plants that were placed farther from the school. This was due to the increase of stress because of the drastic change of location (Kunz, 2017). LIBS is an efficient instrument for plant analysis when determining elemental composition, which could narrow down the type of plant an unknown leaf or pollen sample came from. While this does not indicate a specific plant type or even one specific plant, it is a quick way to narrow down the type of plant and the condition it was in at the time it lost either the leaf or pollen sample. The only drawback to LIBS is the issue of homogeneity throughout the samples. The intensity of specific elements in the one sample would vary based on location it was taken from on the plant. However, trends that were observed were consistent regardless of the intensity of the elements. Further research could include locations that are much further away as well as a longer exposure time to this new location in order to determine if the plant's elemental profile could change over time based on location.

Citations

Kunz, J. N.; Voronine, D. V.; Lee, H. W. H.; Sokolov, A. V.; Scully, M. O. Rapid Detection of Drought Stress in Plants Using Femtosecond Laser-Induced Breakdown Spectroscopy. *Optics Express* **2017**, *25* (7), 7251.