Effects of North Dakota Road Dust on A. thaliana: An Assay of Chlorophyll and Ascorbate Peroxidase

Zent, Monica

In recent years, the "oil boom" in rural Western North Dakota has caused traffic on unpaved gravel roads to increase dramatically. Road dust is known to cause metabolic and oxidative stress to plants because of its chemical and physical properties. The dust can decrease light exposure, which can inhibit the chlorophyll producing enzyme protochlorophyllide oxidoreductase. Metals found in the dust can also increase production of reactive oxygen species (ROS) including hydrogen peroxide. ROS can cause oxidative stress by damaging proteins, nucleic acids, and lipids. Ascorbate peroxidase is the primary hydrogen peroxide scavenger in plant cells. Increased concentrations of hydrogen peroxide up-regulate ascorbate peroxidase (APX). In this experiment, four test groups of A. thaliana were exposed to 0, 2, 4, and 8 grams/square meter of North Dakota road dust daily for four weeks. The oxidative and metabolic stress was quantified by measuring chlorophyll content and ascorbate peroxidase activity. The chlorophyll was extracted with acetone and measured with a spectrophotometer. The APX activity was calculated by measuring the change in concentration over three minutes of its cofactor, ascorbate, using a spectrophotometer. Chlorophyll and APX activity changes were not considered statistically significant when a paired student's t-test was applied to the data. Interestingly, APX activity slightly decreased as dust exposure increased. The knowledge obtained from this experiment can be applied to oil and agriculture industry relations in North Dakota. It can also be applied to agriculture across the globe, especially in developing nations where low-quality diesel and low-efficiency vehicles increase dust deposition.

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