Fall 2012

The effect of dirt on inhibition of light absorption in Musa leaves

Lorelle Knight  
*Pepperdine University*

Alexis Carrington  
*Pepperdine University*

Angela French  
*Pepperdine University*

Roxanne Barker  
*Pepperdine University*

Follow this and additional works at:  
https://digitalcommons.pepperdine.edu/sturesearch

Part of the *Plant Biology Commons*

**Recommended Citation**

https://digitalcommons.pepperdine.edu/sturesearch/48

This Research Poster is brought to you for free and open access by the Undergraduate Student Research at Pepperdine Digital Commons. It has been accepted for inclusion in Featured Research by an authorized administrator of Pepperdine Digital Commons. For more information, please contact  
Katrina.Gallardo@pepperdine.edu, anna.speth@pepperdine.edu.
The effect of dirt on inhibition of light absorption in *Musa* leaves

Lorelle Knight, Alexis Carrington, Angela French, Roxanne Barker
Pepperdine University, Malibu, CA 90263

**Abstract**

Dirt can be transported by wind, human activity and many other factors. It was hypothesized that dirt particles collected on leaves will decrease leaf reflectance and thus make the leaf less healthy. The rationale for this is that the more dirt present on the leaf, the more inhibited photons will be in reaching leaf pigments. The leaf will therefore be less healthy as it will be less able to perform photosynthesis. To test this hypothesis, eight leaf samples with varying amounts of dirt present, were collected from the plant, Musa. A Unispec spectrophotometer was used to test the reflectance of the leaves and from the collected data the NDVI was found. A Dirt Index was created as a second form of measuring the reflectance by a leaf. A Leaf Area Meter was used to measure the area of each of the eight samples. The data was then normalized taking into the account the amount of dirt on each sample and the area of each sample. The data coincided with the hypothesis. The dirt index and NDVI were both correlated with the amount of dirt on the leaf yet the NDVI had better accounted variance. The T-tests of both the DI and NDVI verified the hypothesis that leaves with greater amounts of dirt had lower reflectance.

**Introduction**

Regardless of a leaf’s location on dry land, it is destined to acquire dirt. Dirt buildup on a leaf will impact its ability to thrive in multiple manners, but perhaps the most significant is the inhibition of light absorbance that the built-up dirt causes. As more and more dirt accumulates on a leaf, more light cannot reach the leaf’s photoreceptors, i.e. the light needed for the leaf to do photosynthesis is blocked. Therefore, we have hypothesized the following: The more dirt accumulated on a leaf, the less light the leaf will absorb. Leaves in areas prone to high levels of dirt in the air will appear less healthy than those that live where the air is cleaner. This is in part because the dirt accumulates on the leaf and decreases light absorption, decreasing photosynthetic efficiency.

To test this, we used the NDVI, the Normalized Difference Vegetation Index, to measure and show the leaf’s reflectance of light and how this is impacted by dirt. According to Styloński et. al, “NDVI are often offered as a rapid non-destructive and cost effective means of estimating plant carbon gain over varied special and temporal scales. These indices have been correlated with net primary production and in some instances with photosynthetic rates.” Therefore, we would expect a greener, less dirty plant to have a higher NDVI level. Additionally, we selected a range of light wavelength in which the most light was reflected and used this to create what we coined the “Dirt Index,” an index that indicates how dirt levels are directly correlated to light reflectance levels.

**Methods**

The Unispec Spectral Analysis System was used to determine the NDVI and DI of each individual 4x4 inch square of Musa leaf. The leaves were then rinsed and the runoff was collected and dried, and the amount of dirt left after the water had been evaporated was weighed. This number was divided by the area of the leaf (found by the Leaf Area Meter) and the new NDVI and DIs were calculated on the clean leaf for comparison. The “dirty” and “clean” NDVIs and DIs were then compared.

**Results**

The North American Vegetation Index measures the vegetation present, therefore the amount of light it reflects.

**Discussion**

Our findings correlated with our hypothesis. Specifically, our “Dirt Index” (DI) positively correlated with the amount of dirt calculated on the dirty leaves, shown through the 50% accounted variance through the linear regression. The NDVI had a positive correlation with the amount of dirt on the leaf as well, yet there was a better-accounted variance (76.1%). Our DI correlated with the standard NDVI that is commonly used in this field. This was a positive outcome for our experiment and also illustrates the consistency of the light absorbance varying in the dirty and clean leaves. The NDVI had a higher accounted variance than our “Direct Index” (by about 35%); this additionally illustrates that the NDVI is more accurate at detecting the amount of light that leaves reflect. This accounted variance obtained shows how the NDVI can be obtained (as shown in Fig. 1) from a vast mass of plants to a very small plant and still obtain accurate results. The T-tests of the DI and NDVI confirmed our hypothesis as well; the reflectance was greater in clean leaves than in the dirty leaves and both the indices obtained this. This also agreed with our second hypothesis (how a leaf will appear less healthy if it accumulates more dirt). This second hypothesis was additionally supported by the fact that, upon inspection, dirtier Musa leaves were observed to appear more curled and less rigid (more unhealthy) than cleaner Musa leaves.

Previous experiments performed, such as Rasoul Sharif’s, acquired the same results. Sharif determined that one of the physiological effects of dust accumulation has is on photosynthesis, especially under summer conditions of high ambient air temperatures. This is a significant factor correlates to the environment conditions our plant grew in, since there was no rain for months before we performed our experiment. The lack of rain and human activity near the plants caused the accumulation of dirt on the plants. This serves to support our prediction that leaves exposed to much dirt due to human activity, such as construction or landscaping, will show impairment (from what would be ideal) with regards to light absorption. Methods of decreasing this effect must be further explored.

**Conclusion**

The light reflectance was affected as the amount of dirt on the leaf increased.

- The Dirt Index and the NDVI positively correlated with the amount of dirt calculated on the dirty leaves.
- When compared, the NDVI and the Dirty Index displayed the same correlations. Yet, then NDVI had a better result.

**Acknowledgements**

This research was funded by National Science Division of Pepperdine University.

**Work Cited**


image provided by: www.ccpo.ods.edu

**Figure 1**

![Figure 1](image1.png)

**Figure 2**

![Figure 2](image2.png)

**Figure 3**

![Figure 3](image3.png)

**Figure 4**

![Figure 4](image4.png)

**Figure 5**

![Figure 5](image5.png)

**Figure 6**

![Figure 6](image6.png)