

# Summary of: Utilization of single-image normalized difference vegetation index (SI-NDVI) for early plant stress detection

Key findings and quantitative results:

- **SI-NDVI Analysis**: - **Method**: Single-image normalized difference vegetation index (SI-NDVI) compares leaf reflectance in visible and near-infrared light spectrums. - **Equation**:  $SI-NDVI = (NIR - Blue) / (NIR + Blue)$  - **Comparison**: Blue light reflectance is used instead of red light reflectance to represent the normalizing portion of the visible light spectrum.
- **Stress Detection**: - **Salt Stress**: - **Detection**: SI-NDVI analysis detected salt stress in *Arabidopsis thaliana* seedlings within 15 minutes of salt application. - **Quantitative**: Color changes in false color images were observed, leading to a decrease in the number of pixels with high color index values. - **Statistical**: Significant difference calculated by Student's t-test at 60 h.
- **Ammonium Nitrate Stress**: - **Detection**: SI-NDVI analysis detected ammonium nitrate stress in *Eruca sativa* plants within 6 hours of high concentration application. - **Quantitative**: Color changes in false color images were observed, leading to a decrease in the number of pixels with high color index values. - **Statistical**: Significant difference calculated by Student's t-test at 60 h.
- **Cost Efficiency**: - **Software**: Open-source software for SI-NDVI analysis is used, reducing the cost associated with proprietary software. - **Implementation**: The system requires only one camera and completely free, open-source software, making it user-friendly.
- **Practical Applications**: - **Indoor Farming**: SI-NDVI analysis is suitable for indoor farming environments, where traditional NDVI methods are not ideal. - **Cost Savings**: Lower cost compared to hyper-spectral imaging, as the system uses a single camera and open-source software.
- **Comparison to Traditional Methods**: - **NDVI**: Requires two sensors for NDVI analysis, making it technically challenging to align optical sensors. - **SI-NDVI**: Requires only one camera, making it easier to implement and align optical sensors.
- **Additional Findings**: - **Color Index Values**: Color index values range from -1.0 to 1.0, with increments of 0.0078125. - **Graphs**: Quantitative analysis of color index values over time to track plant health changes. - **Visual Detection**: Early visual detection of stress before visible changes in plant appearance.
- **Future Research**: - **Characterization**: Future research should focus on characterizing SI-NDVI phenotypes for additional plant stressors, species, and growth mediums. - **Practical Concerns**: Addressing practical concerns associated with deploying the SI-NDVI method in real-world controlled crop cultivation efforts.