Ag Technologies for the Future: Hyperspectral Sensing for Early Disease Detection

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Hyperspectral sensors measure light reflectance more precisely than ever before.
Plant chemistry changes light reflectance

Photosynthesis
CO₂ → carbohydrates
Nitrogen
Leaf Mass per Area (LMA)
Sugars and Starches
Chlorophyll, Pigments
Water
P, K, Ca, Mg

Decomposition
Structural Compounds
Lignin
Cellulose

Defense
Tannins
Phenolics

Slide content from Townsend Lab, UW-Madison
Spectroscopy tells us more about plant pathogen interactions than our eyes can see.
The Gold Lab studies the fundamental and applied science of plant disease sensing to improve early detection & intervention.
Grapevine virus detection with NASA AVIRIS-NG

Romero Galvan et al. accepted

- Airborne imaging spectroscopy facilitates scalable early detection of GLRV – symptomatic and asymptomatic.
- Random forest models accurate from 1m to 5m but perform best at 3m resolution.
- Imaging spectroscopy can supplement ground methods by more strategically deploying mitigation efforts.

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Classification</th>
<th>Random Forest + SMOTE + Smoothing + Unmixing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Test Accuracy</td>
</tr>
<tr>
<td>3m</td>
<td>H vs (Sy + aSy)</td>
<td>85%</td>
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<tr>
<td></td>
<td>H vs Sy</td>
<td>81%</td>
</tr>
<tr>
<td></td>
<td>H vs Sy vs aSy</td>
<td>67%</td>
</tr>
<tr>
<td></td>
<td>H vs aSy</td>
<td>87%</td>
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• Random forest models accurate from 1m to 5m but perform best at 3m resolution.
• Imaging spectroscopy can supplement ground methods by more strategically deploying mitigation efforts.
University of Maryland Selected to Lead NASA's U.S. Agriculture Consortium
Combining AVIRIS-NG with epidemiological modeling to predict and map powdery mildew epidemics

Eller MS Thesis, CSUN
Using Hyperspectral Remote Sensing Techniques to Identify *Vitis vinifera* Powdery Mildew in Napa Valley, California
Cloud-Native, Machine Learning Based Detection

Rubambiza & Romero Galvan et al. accepted
Questions?
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