Implementation of Emerging Technologies in Orchard Production

UC University of California Cooperative Extension

Ali Pourreza

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1. Updates on Botryosphaeria Early Detection Project
2. Virtual Orchard for Precise Pistachio Orchard Management

Pistachio Botryosphaeria Panicle Blight Disease

- A major disease of pistachios in California
- Botryosphaeria caused a significant yield reduction in San Joaquim Valley
- Botryosphaeria has a long latent period
- The earliest symptoms appear in late April to May, if the temperature is warm enough

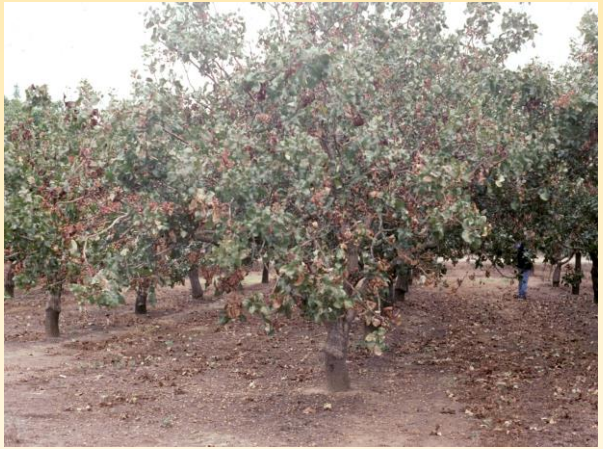


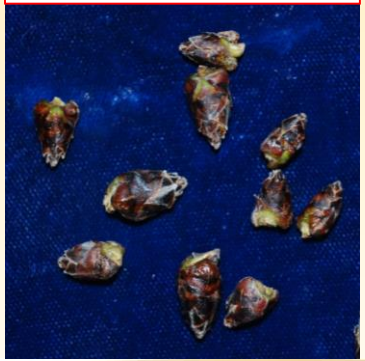
Photo credit: Dr. Themis J. Michailides

BUDMON: Current early detection practice

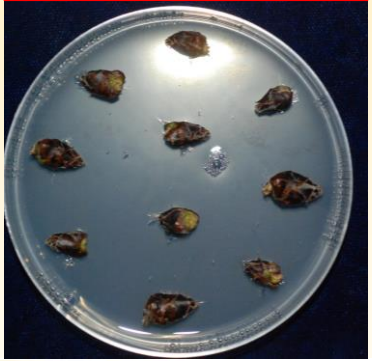
BUDMON technique requires

- Collecting up to 100 buds from random locations throughout the grove
- Processing buds samples using BUDMON (bud monitoring) technique
- BUDMON technique was developed by Dr. Michailides

1st step: Buds at collection



2nd step: After surface sterilization & plating



3rd step: After incubation

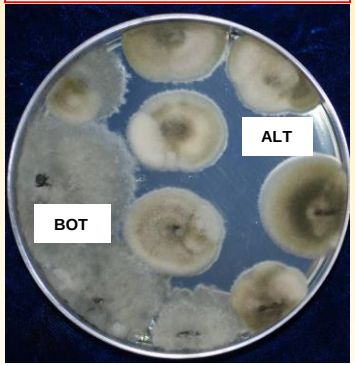
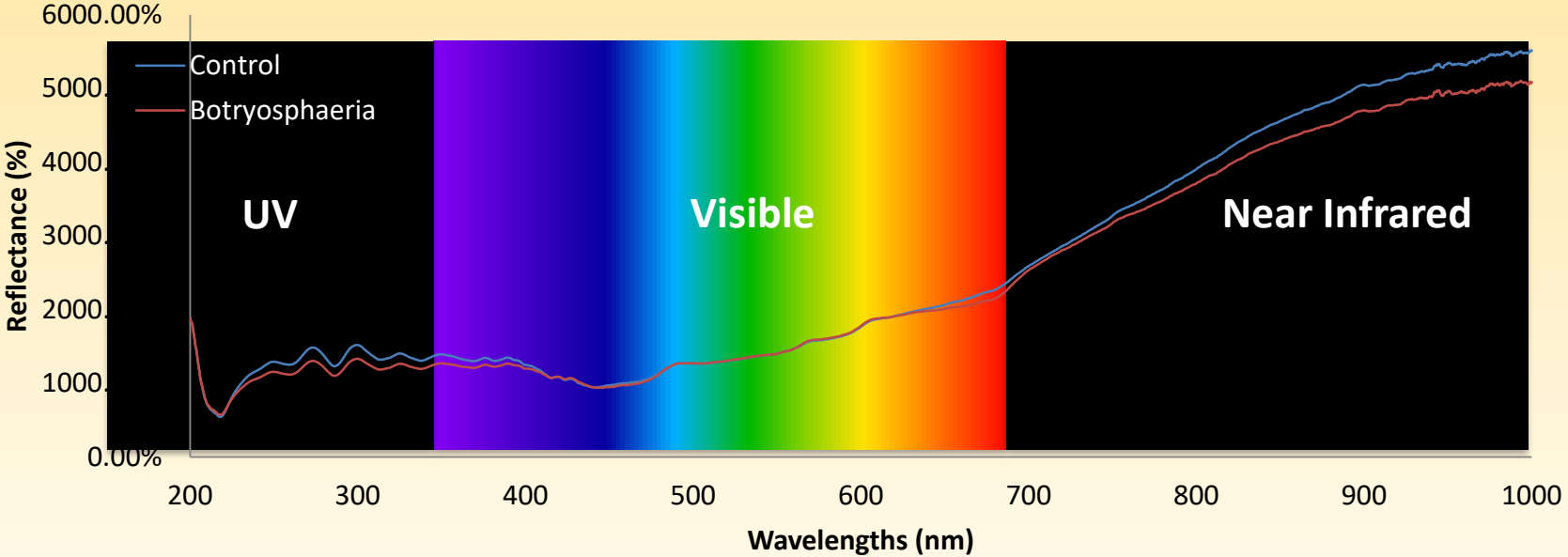


Photo credit:
Dr. Themis J. Michailides

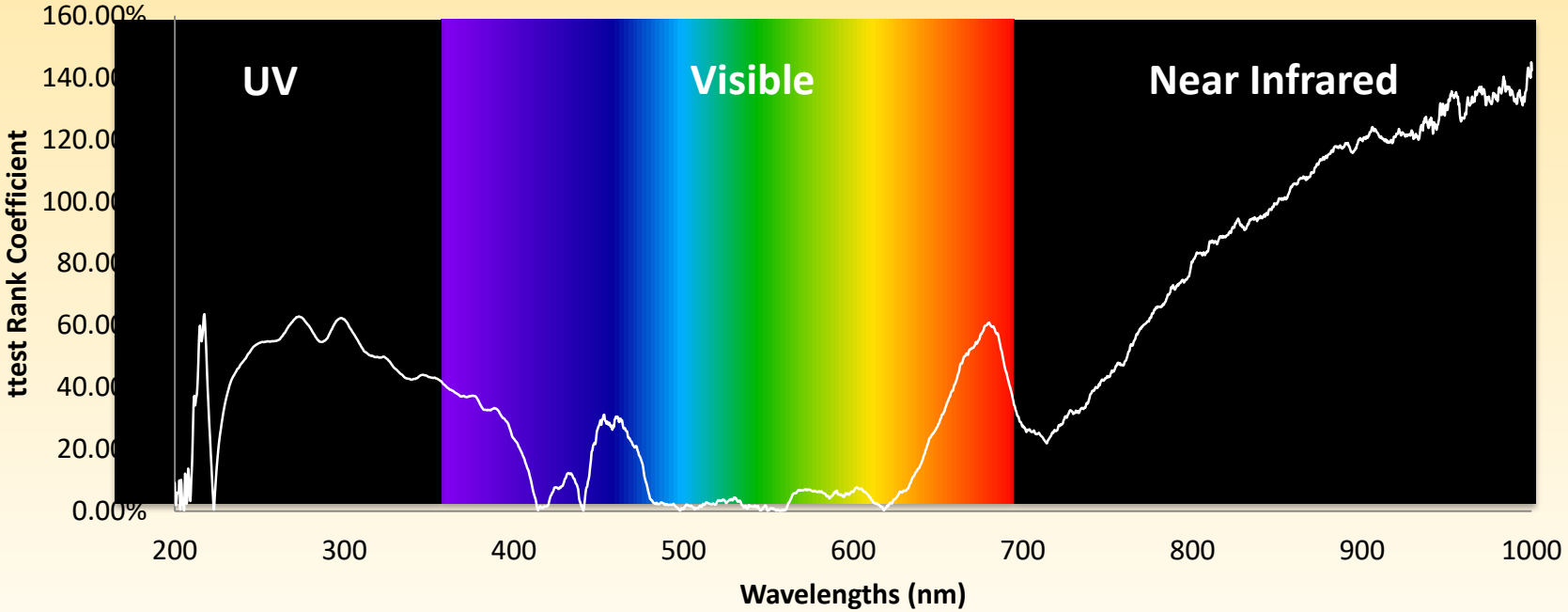
Early detection using optical sensing

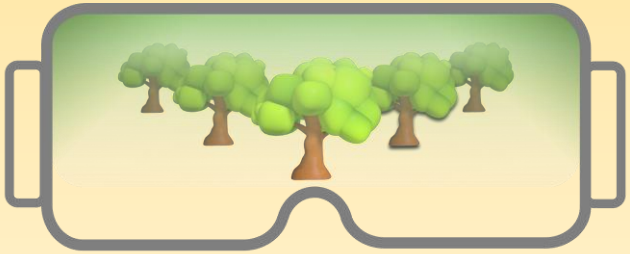
- 280 buds samples were collected
- Spectral measurement of buds was conducted in UV – Visible – Near Infrared bands (200-1000 nm)
- Preliminarily spectral analysis was conducted to investigate the relevant bands for Botryosphaeria detection

Spectral Signatures



Relevant Wavelengths



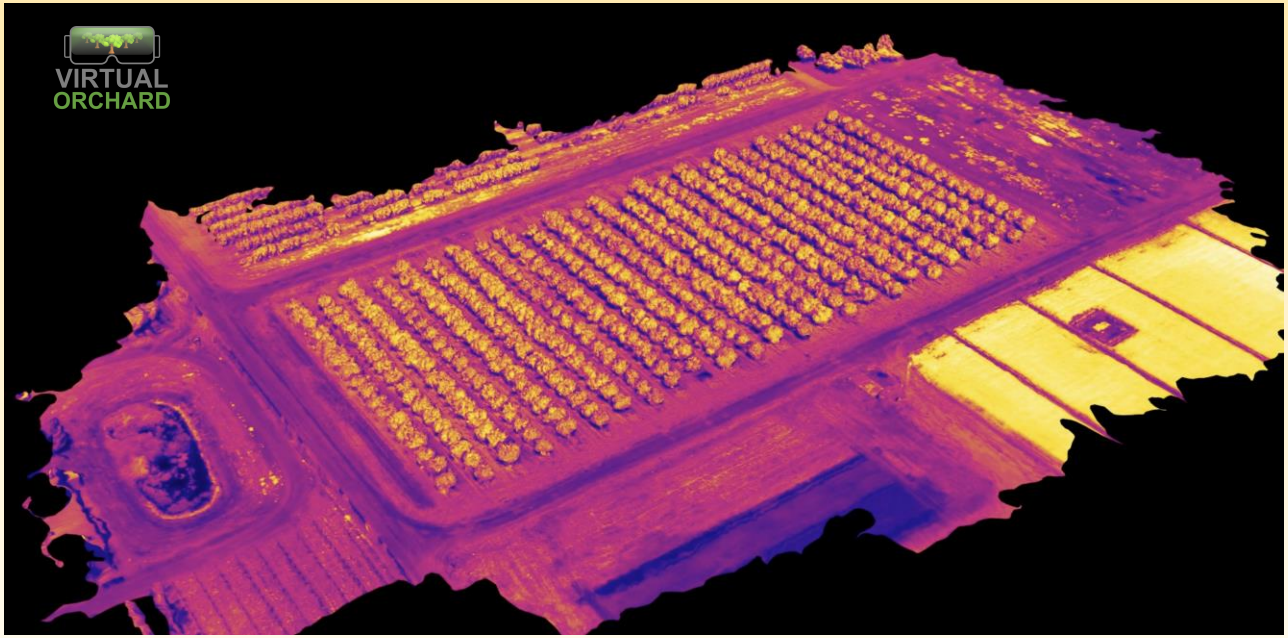


VIRTUAL ORCHARD

- Virtual Orchard is a 3-dimentional reconstruction of orchard
- Virtual Orchard is created by photogrammetry technique using a series of aerial images

Virtual Orchard in Visible Range

Virtual Orchard in Near Infrared



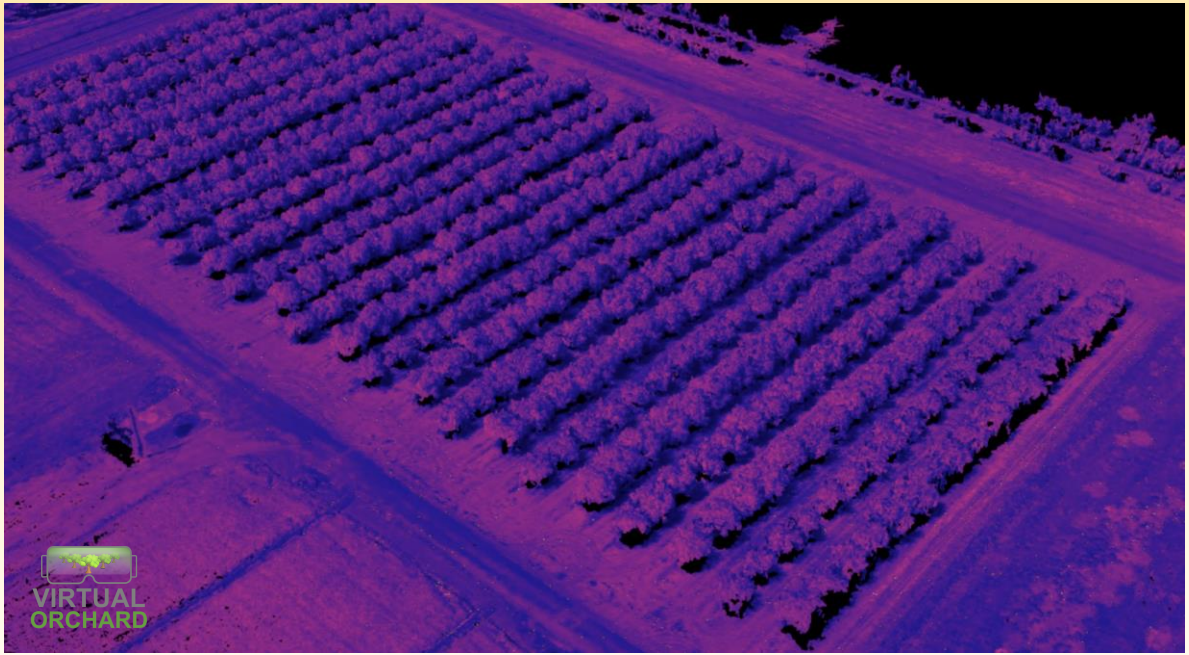
Near infrared (NIR)
Waveband: 770-810 nm
Indicates:

1. Plant Vigor
2. Crop Type

NIR band can be used for normalizing chlorophyll-sensitive bands such as Red

Lower values = Plant under stress

Virtual Orchard in Red Edge



Red Edge
Waveband: 730-740 nm
Indicates:
1. Plant Stress
2. Chlorophyll
3. Nitrogen Content

High Values = Nitrogen Stress

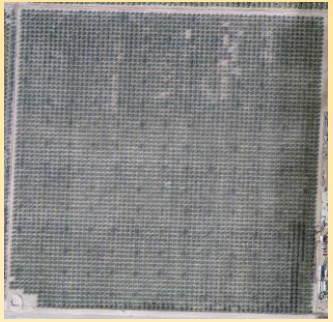
Virtual Orchard can be used to extract:

- Topography
- Canopy volume
- Canopy size
- Terrain 3D area
- Canopy Cover
- Canopy Height
- …

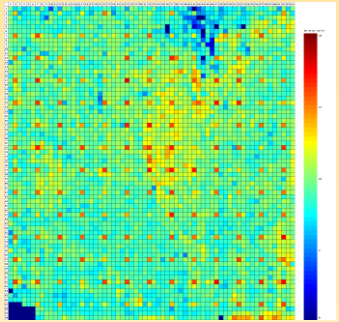
Data maps generated by a

VIRTUAL ORCHARD

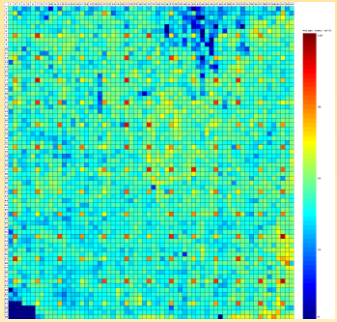
Pistachio



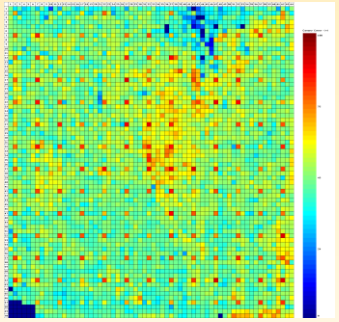
Orthomosaic



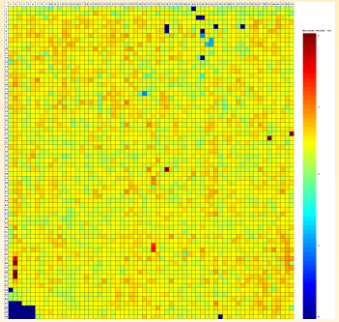
Area



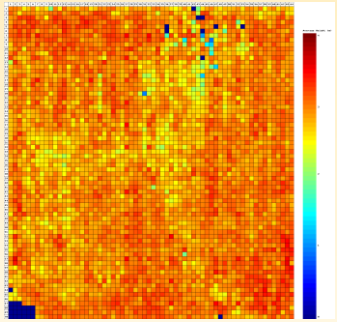
Volume Index



Canopy Cover



Maximum Height



Average Height

Virtual Orchard Applications

The measurements from Virtual Orchard can be further analyzed and interpreted by prediction models to generate useful and timely knowledge about the orchard that will help growers to conduct a better management, improve yield, decrease waste, and maintain the quality of the environment. We will work on three applications for pistachio production:

- Yield Forecasting
- Water Management
- Nutrient Management

These are only a few potential applications of virtual orchard. More research is required to reveal further capabilities of virtual orchard in precise orchard monitoring and management practice.

Thank you for your attention

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