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Using Multi-Spectral Image Analysis to Quantify Disease Resistance

Jessica Pinder



Pathogens of greenhouse vegetables



Powdery Mildew



Bacterial Canker (*Clavibacter*)



Botrytis cinerea



Pepino Mosaic Virus

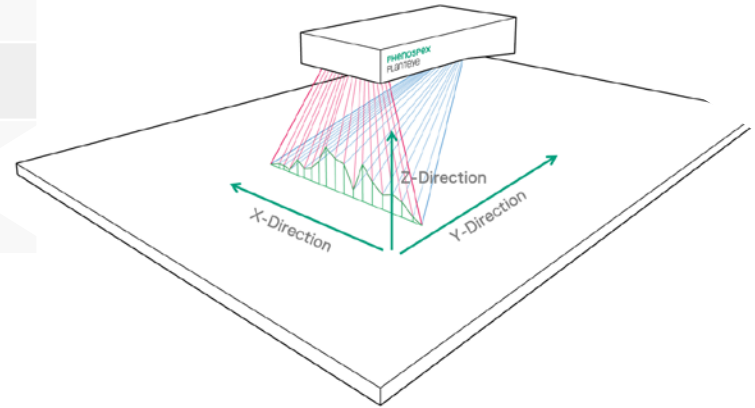


Pythium root rot



Phenospex PlantEye F500

Channel	Wavelength
Red	620 - 645 nm
Green	530 - 540 nm
Blue	460 - 485 nm
Near-Infrared (NIR)	820 - 850 nm



Parameters:

- Plant height
- Leaf area
- Leaf angle
- Light penetrating depth
- Greenness
- Normalized digital Vegetation Index (NDVI)
- Hue

Normalized Digital Vegetation Index (NDVI)

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

Values range from -1 to 1

-1 to -0.1

Water

-0.1 to 0.1

**Barren rock,
sand, snow**

0.2 to 0.4

**Shrubs, grass
lands**

0.5 to 1

**Temperate and
tropical
rainforests**



Experimental 1: Inoculated vs. Non-inoculated

Tomato Powdery Mildew, *Oidium lycopersici*

Treatment	Pathogen	Plants
1	Yes	11
2	No	10

Pathogen: Tomato Powdery Mildew
Oidium lycopersici

Conditions: 25°C, >70% RH

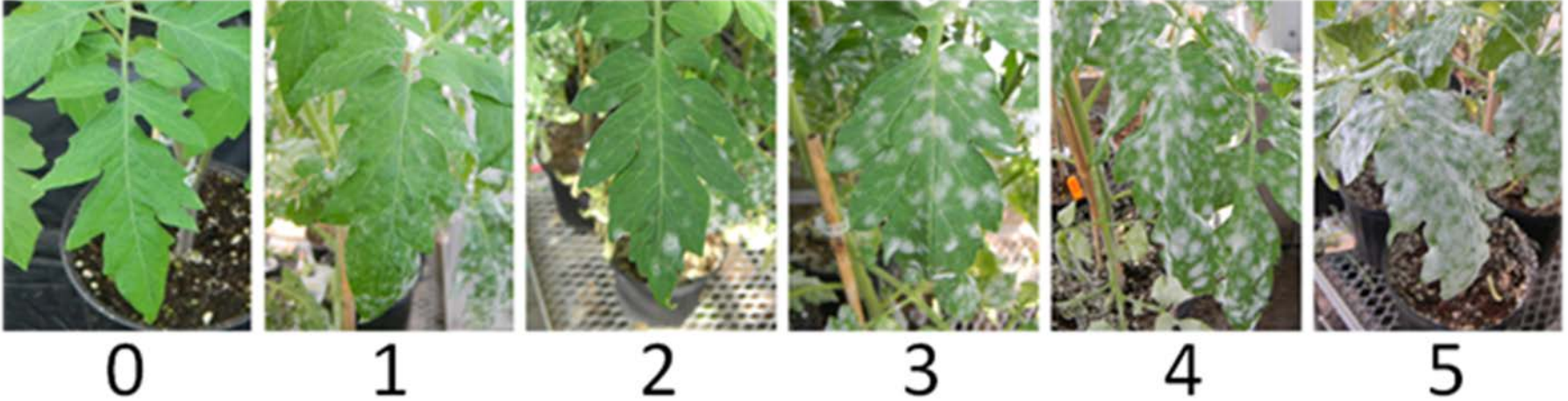
Age of Plants: Four weeks old

Plant Variety: Vendor

Length of Experiment: 13 days



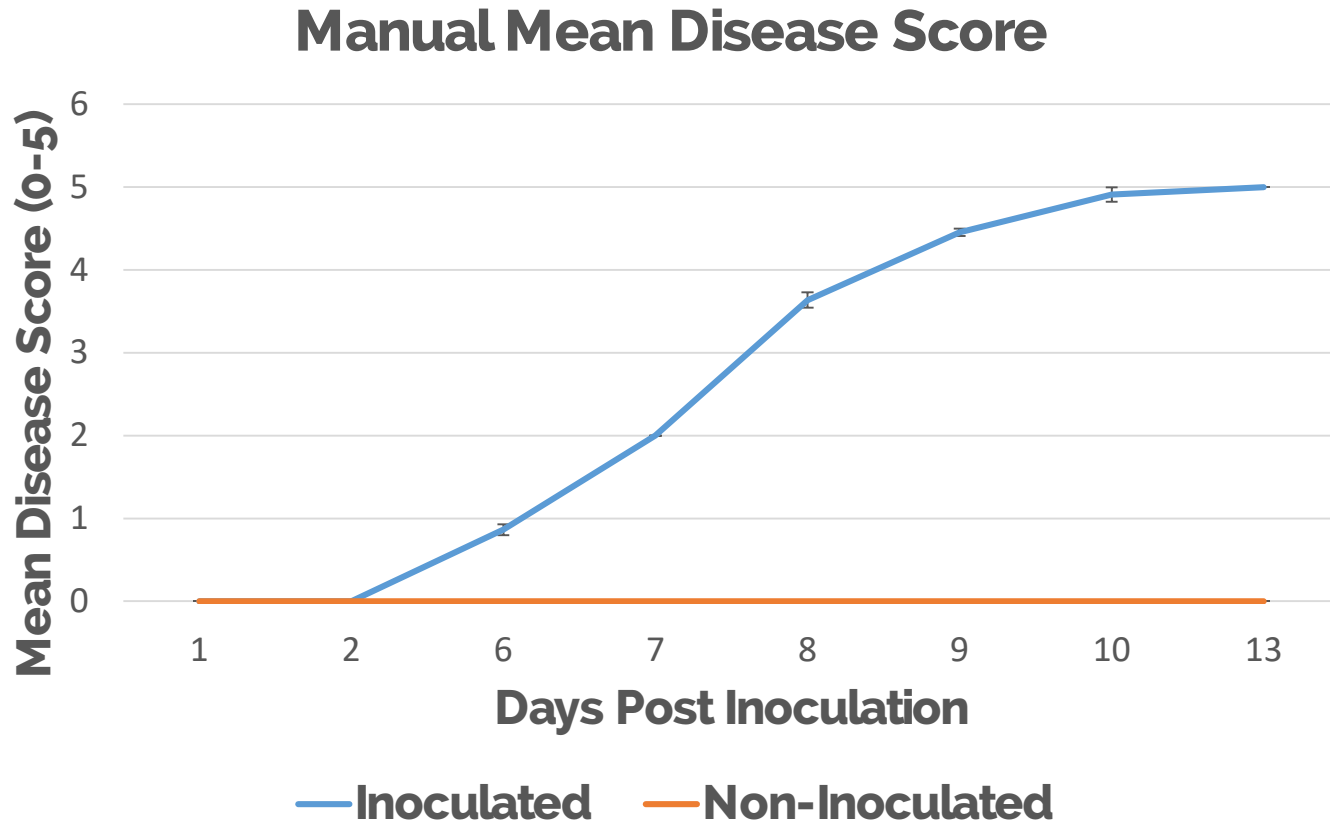
Oidium lycopersici disease severity



- 0 - No powdery mildew infection
- 1 - very light powdery mildew infection
- 2 - mild powdery mildew infection
- 3 - moderate powdery mildew infection
- 4 - heavy powdery mildew infection
- 5 - very heavy powdery mildew infection.

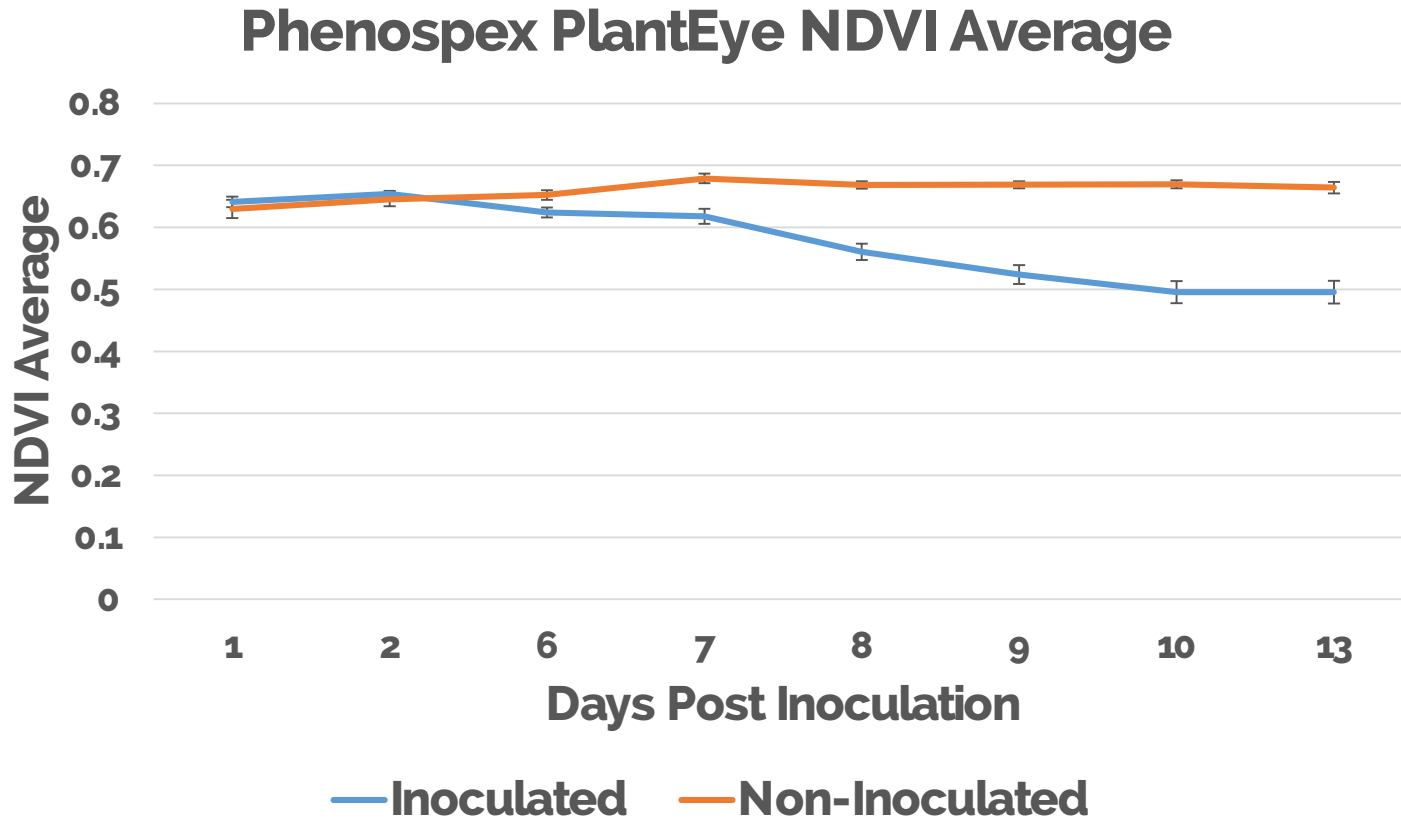
Manual visual scoring of Inoculated vs. Non-inoculated

Experiment 1



Automated NDVI average of Inoculated vs. Non-inoculated

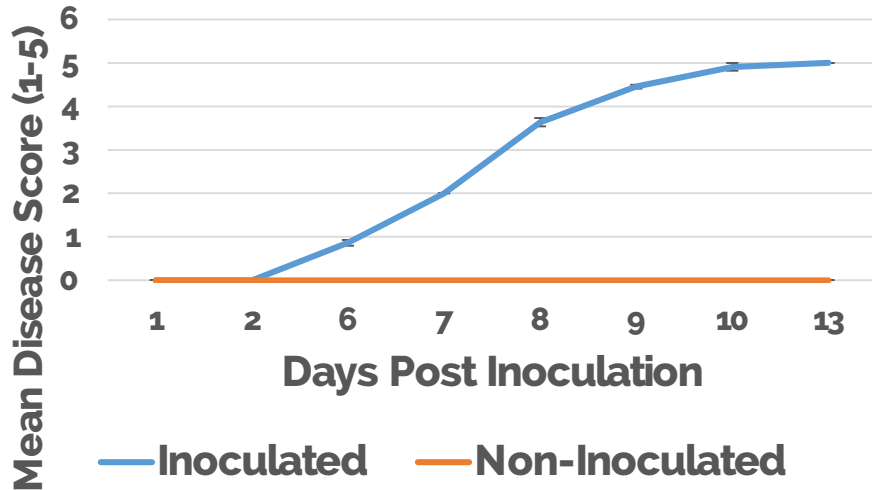
Experiment 1



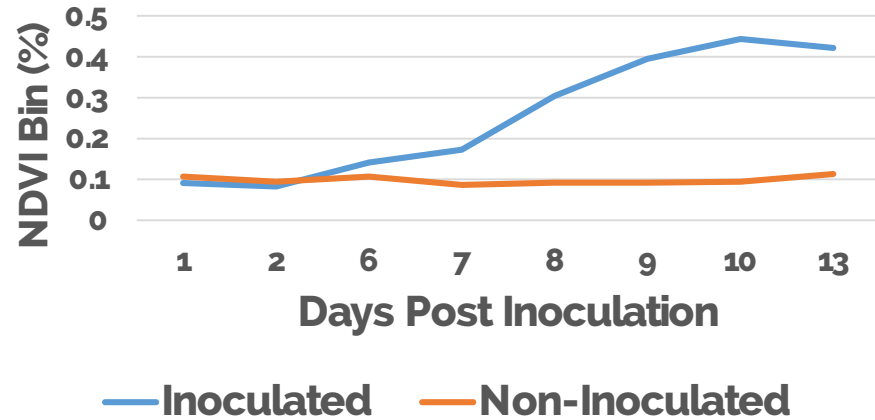
Manual scoring compared to automated NDVI metrics

Experiment 1

Manual Mean Disease Score



Phenospect PlantEye NDVI Metric



Inoculated vs non-inoculated NDVI images

10 days post inoculation

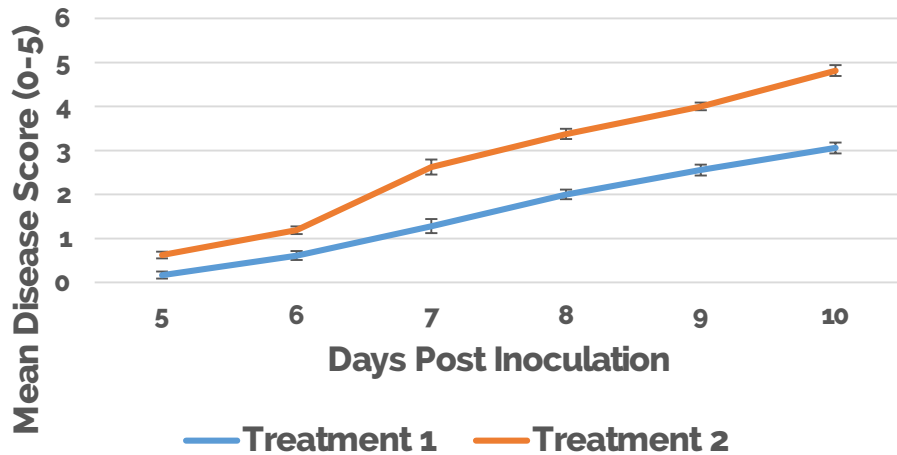


Partial disease resistance detection

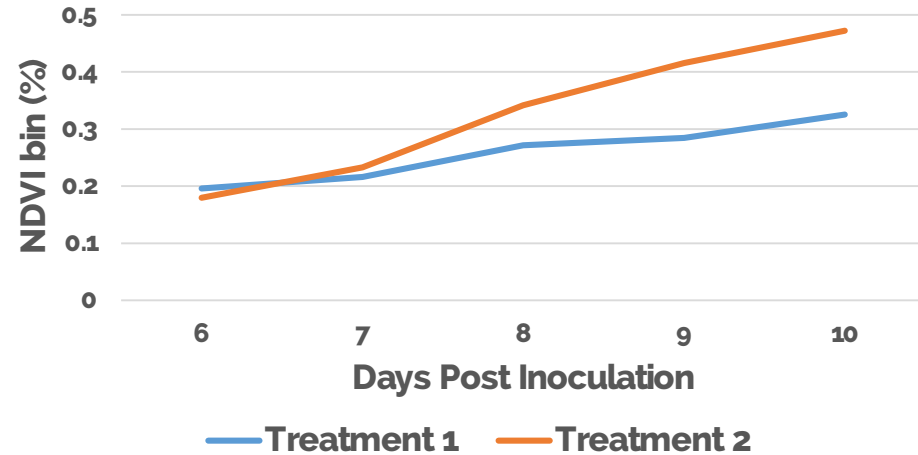
Experiment 2

Treatment	Pathogen	Genotype	Plants
1	Yes	Partial Resistance	9
2	Yes	WT	8

Manual Mean Disease Score



Phenospex PlantEye NDVI metric



Partial resistance vs. susceptible NDVI images

9 days post inoculation



What's next?

- **Continue producing new lines of plants through our trait development program**
- **Different species of crops**
- **Challenge plants with different pathogens**



Thank you

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