Thermal Imaging as a non-destructive method to detect root rot stress in soft fruit

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Overview

- Why Image
- Discussion of fundamentals of thermal imaging
- Imaging we are doing here
- Automated Image analysis

Why image

- Non invasive/ destructive measurements

- Disease detection and diagnosis

- Monitor progression of symptoms across plant both spatially and temporally

- Can combine with computer vision techniques for automated decision making

Imaging fundamentals

- Many different techniques
- Focus on thermal imaging
- Image = incoming heat * interaction with plant * light interaction with camera
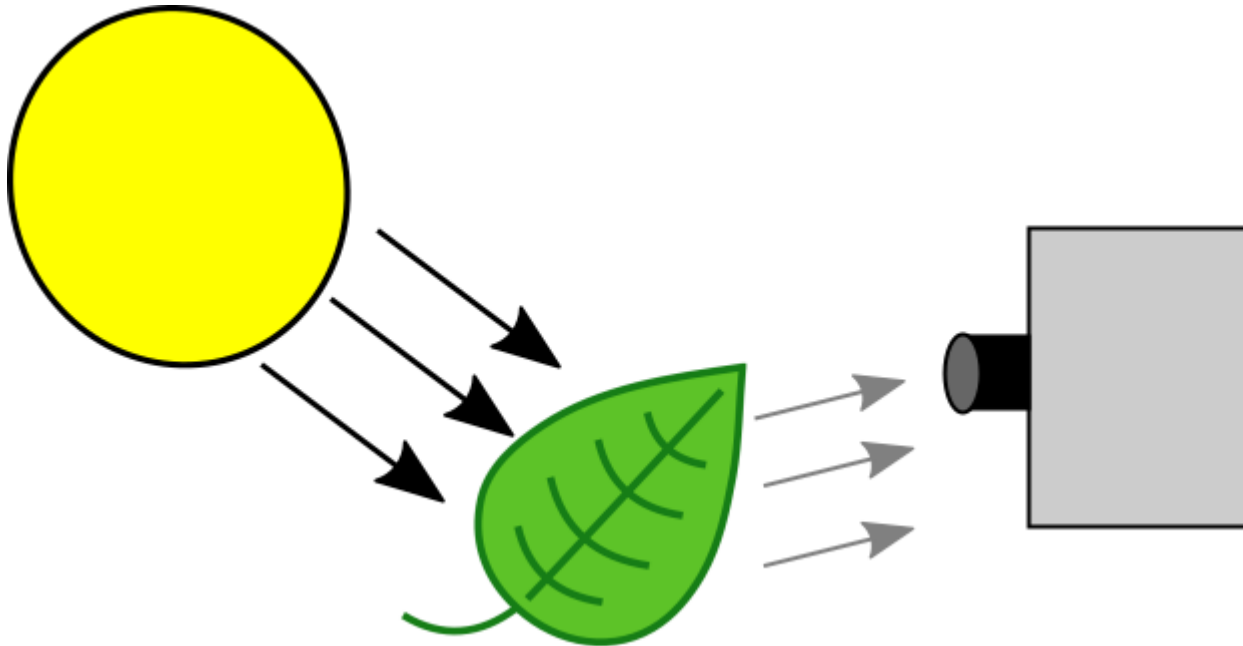
Thermal Imaging

- Everything in the universe emits electromagnetic radiation
- Amount is determined by Boltzmann's law
$$j = \epsilon \sigma T^4$$
- Wavelength is also temperature dependant
- Thermal camera detects radiation with wavelength around 10μm
- Uses intensity to calculate temperature

Thermal Imaging

- Temperature of leaves partially determined by transpiration rate

- Transpiration acts to cool leaves

- Increased temperature is an indication of stomatal closure

IR_4324.jpg   FLIR E50   49036695

DC_4325.jpg
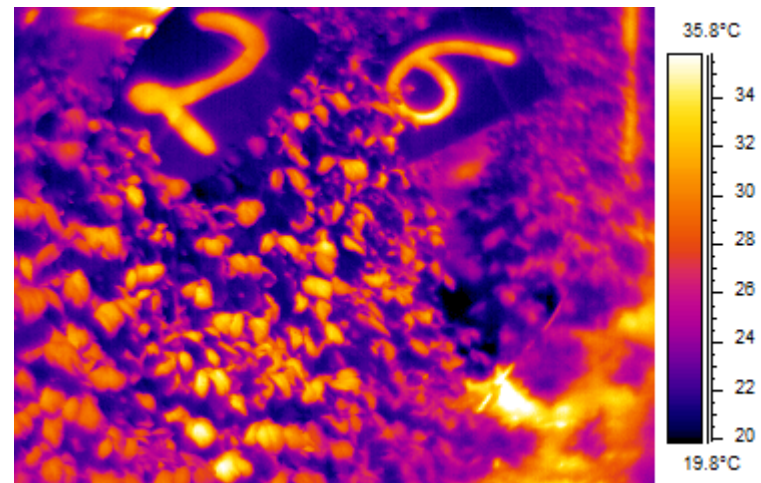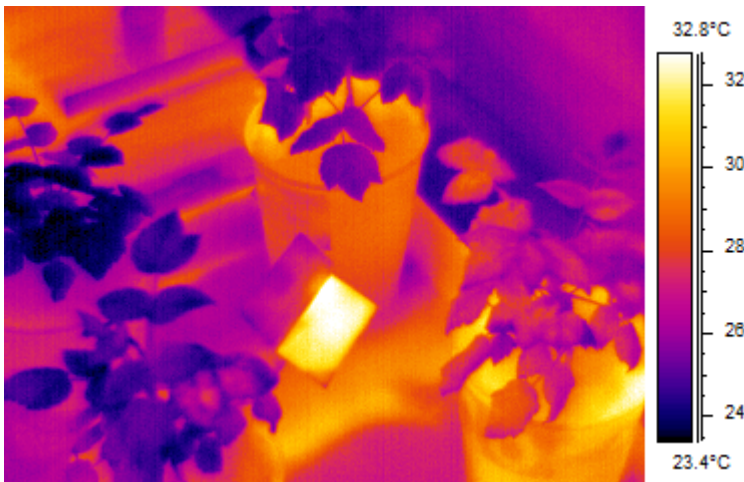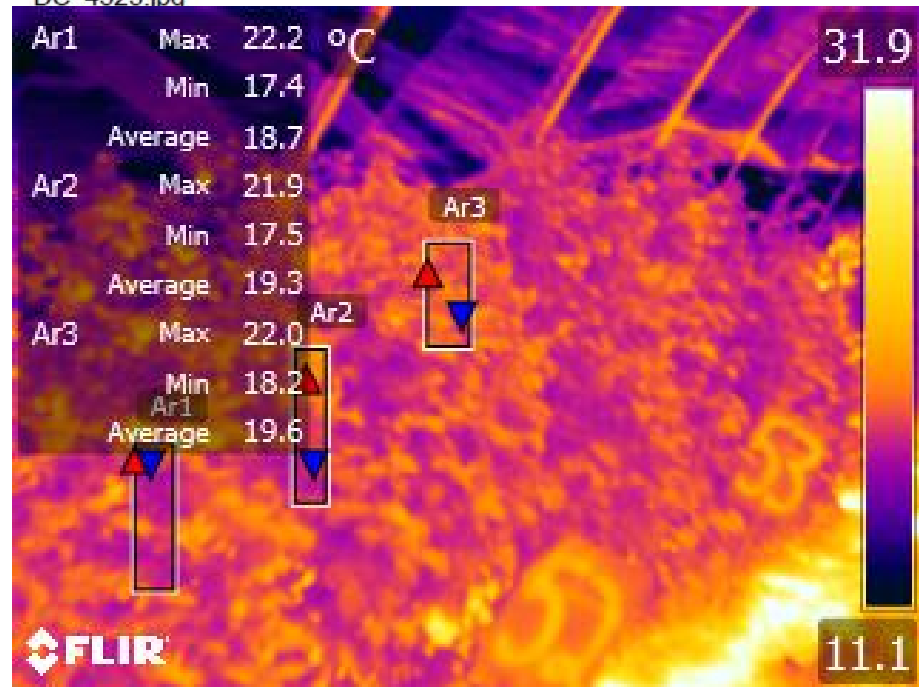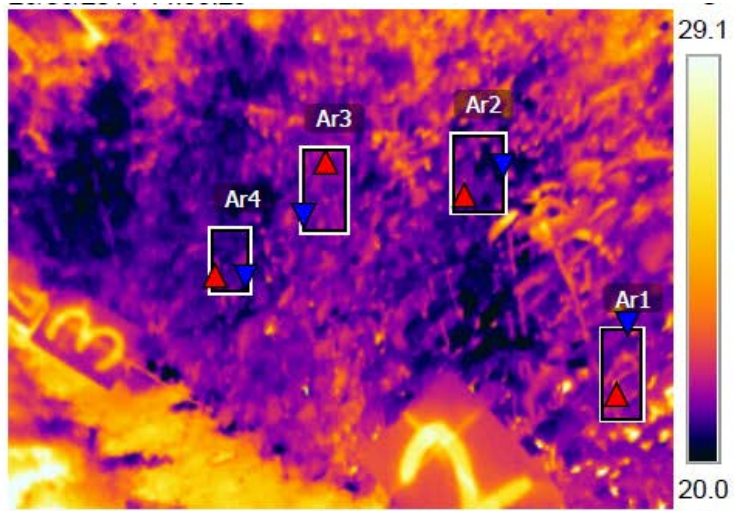
Automated Analysis of Images

- Large amounts of images difficult to manually analyse

- Use computer vision techniques to automate analysis

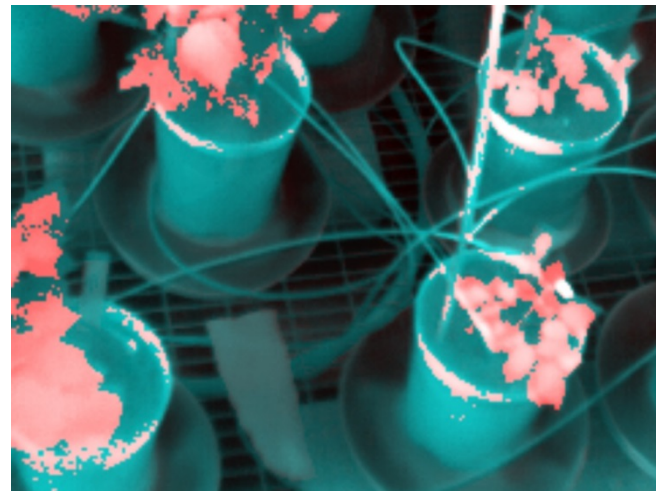- Much easier to do using visible light (RGB) images

Automated Analysis of Images

- Combined RGB and IR images to give 4D image
- Use machine learning technique to segment these images into plant and background

Automated Analysis of Images

- Registration of thermal and visible images needed
- Slight offset of sensors on camera
- Use edge detection

Conclusion

- Thermal imaging is a tool that can be used to measure leaf temperature

- This is can be used as a proxy for stomatal conductance

- Work ongoing aimed at detecting plant response to root rot and vine weevil in field conditions