Using Unmanned Aerial Vehicle (UAV) to Identify Metribuzin-tolerant Winter Wheat

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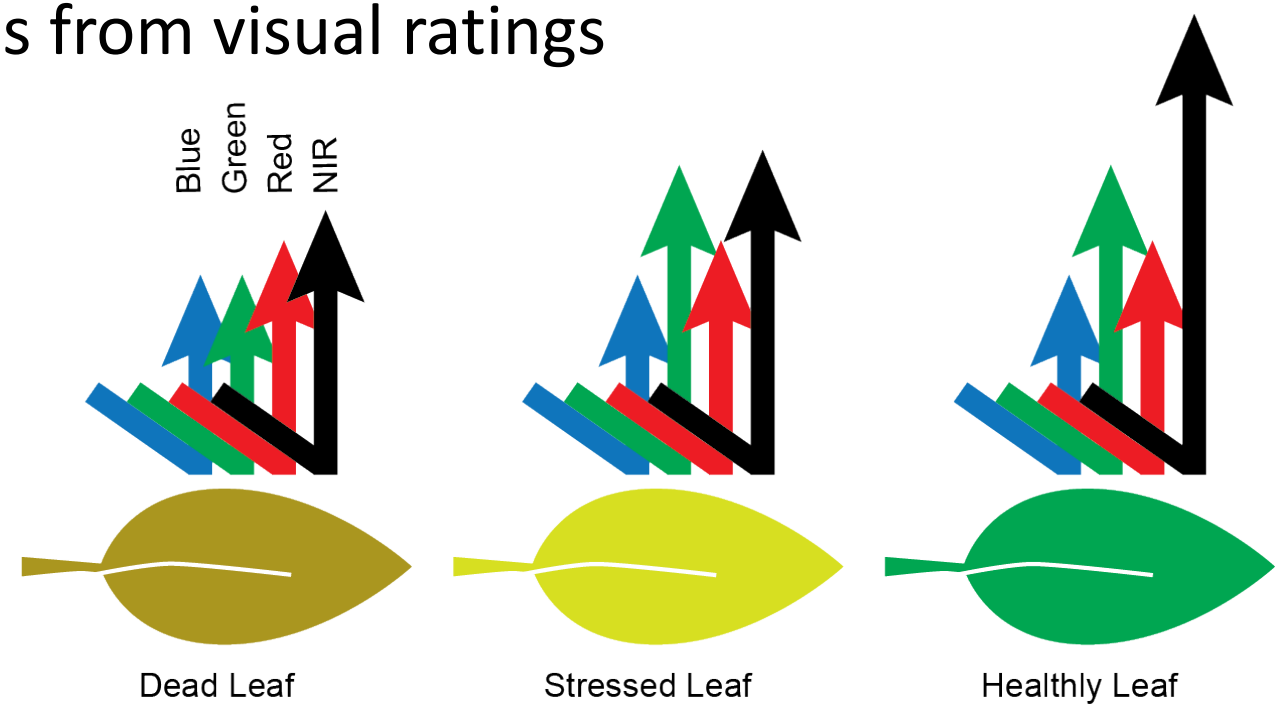
WSU WINTER WHEAT BREEDING
EST. 1894

Metribuzin

- Pre-emergence herbicide (4-8 oz rate)
- Photosystem II Inhibitor
- Higher rate causes injuries to wheat
- Growers use lower rates = not as effective
- Metribuzin Tolerant varieties = higher rates & have better weed control

Unmanned Aerial Vehicle and Spectral Reflectance Indices

- Spectral Reflectance Indices (SRI's) : use wavelengths reflected off a plant's canopy to measure the abundance of a trait
- Eliminate bias from visual ratings

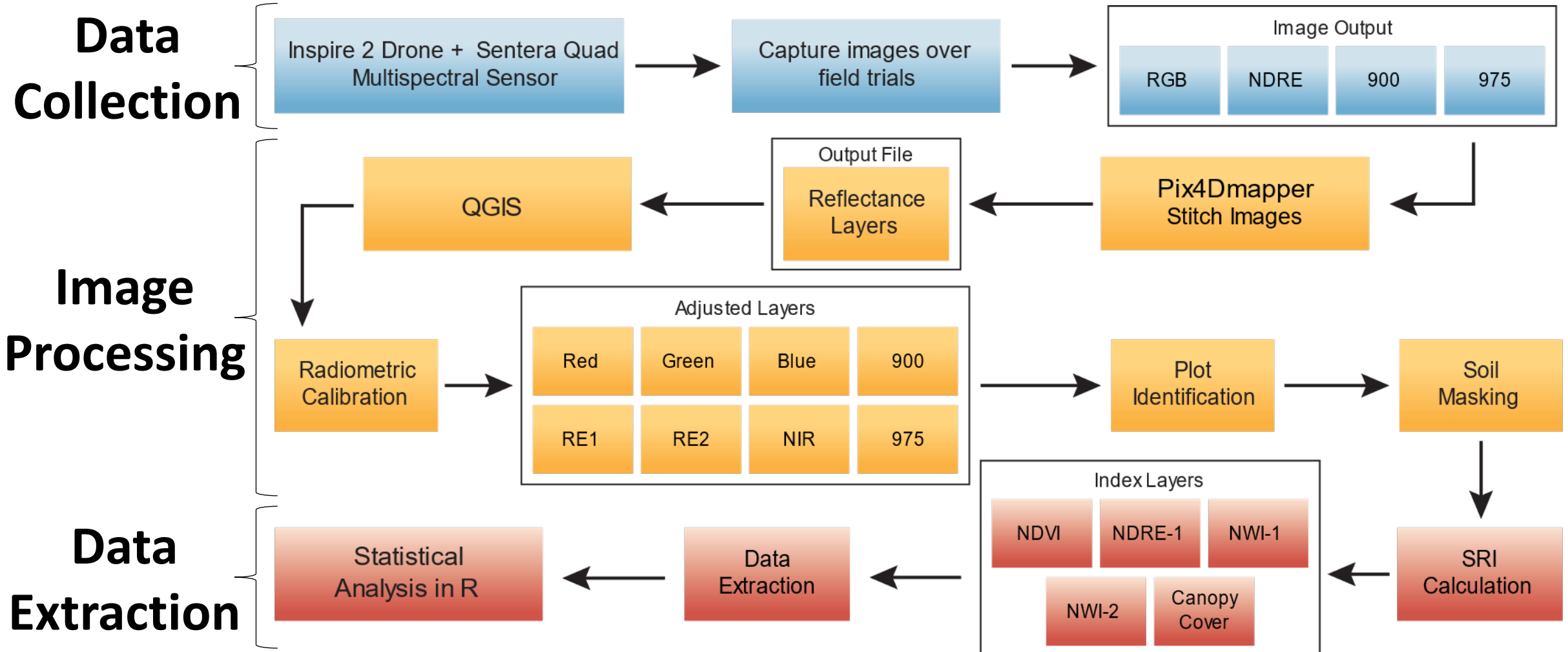


Field Study

- 16 varieties in 2020 and 2021 – Large Plots
- 480 varieties in 2021 – Small Plots
- Treatments: High Rate Metribuzin and Nonsprayed Control

- Visual Ratings : 0-100% Plant Mortality
- Plant Height

Imaging Workflow

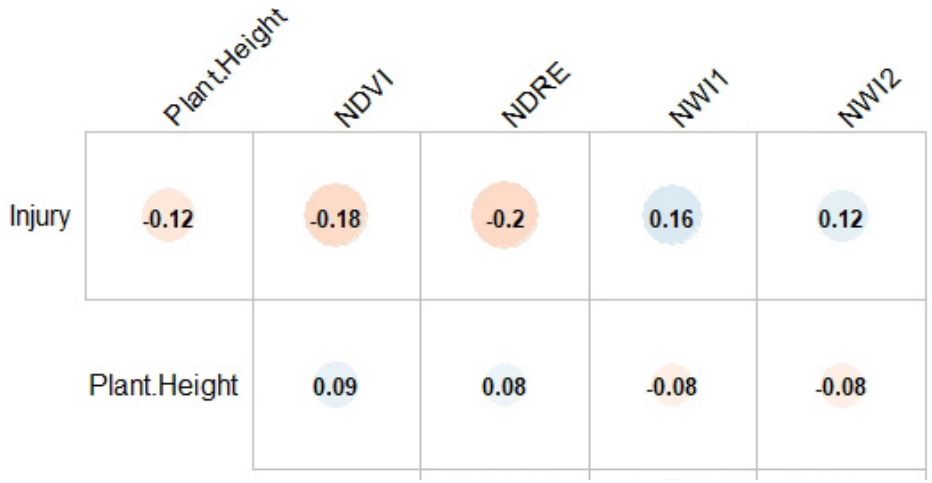


Spectral Reflectance Indices

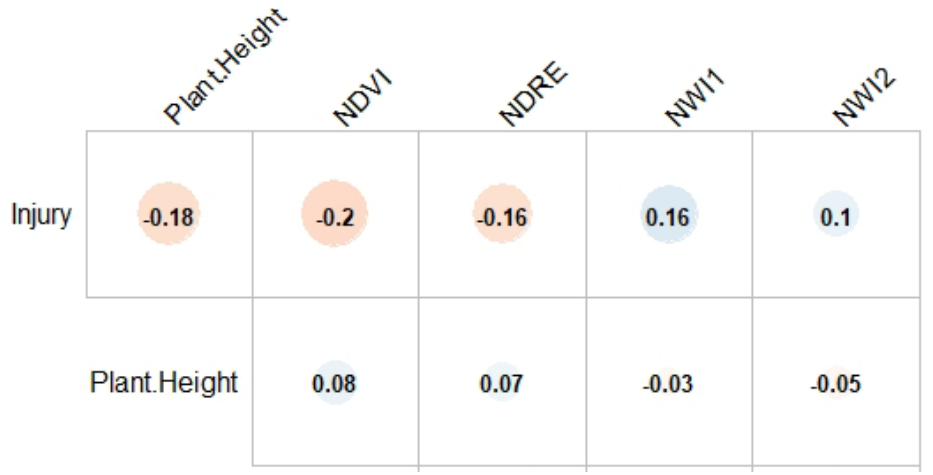
SRI's used in study			
Spectral Reflectance Indices	Abbreviation	**Related Trait**	Equation
Normalized Difference Vegetation Index	NDVI	**Chlorophyll content**	$\frac{NIR - RED}{NIR + RED}$
Normalized Difference Red Edge 1	NDRE	**Chlorophyll content**	$\frac{NIR - RE1}{NIR + RE1}$
Normalized Water Index 1	NWI-1	**Water content**	$\frac{975 - 900}{975 + 900}$
Normalized Water Index 2	NWI-2	**Water content**	$\frac{975 - NIR}{975 + NIR}$
Canopy Cover	--	**% area of leaves**	$\frac{1}{N}\sum_{i=1}^{N} GNDVI_i$

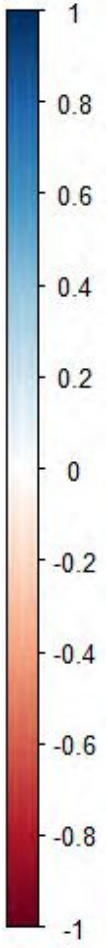
No correlation between the SRIs differences and the Visual Ratings in the Small Plots

April 23, 2021



May 11, 2021





NWI-2 difference has moderately high correlation to the Visual Ratings in the Large Plots

April 30, 2020

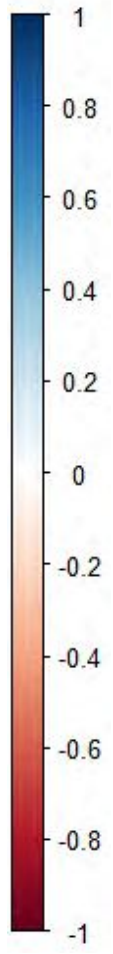
	Plant.Height	NDVI	NDRE	NWI1	NWI2	Canopy
Injury	-0.39	0	-0.05	0.08	0.1	-0.09
Plant.Height	0		0.15	-0.28	-0.08	0.23

April 23, 2021

	Plant.Height	NDVI	NDRE	NWI1	NWI2	Canopy
Injury	-0.22	-0.17	0.05	0.41	0.66	-0.05
Plant.Height		0.12	0.12	-0.38	-0.19	0.01

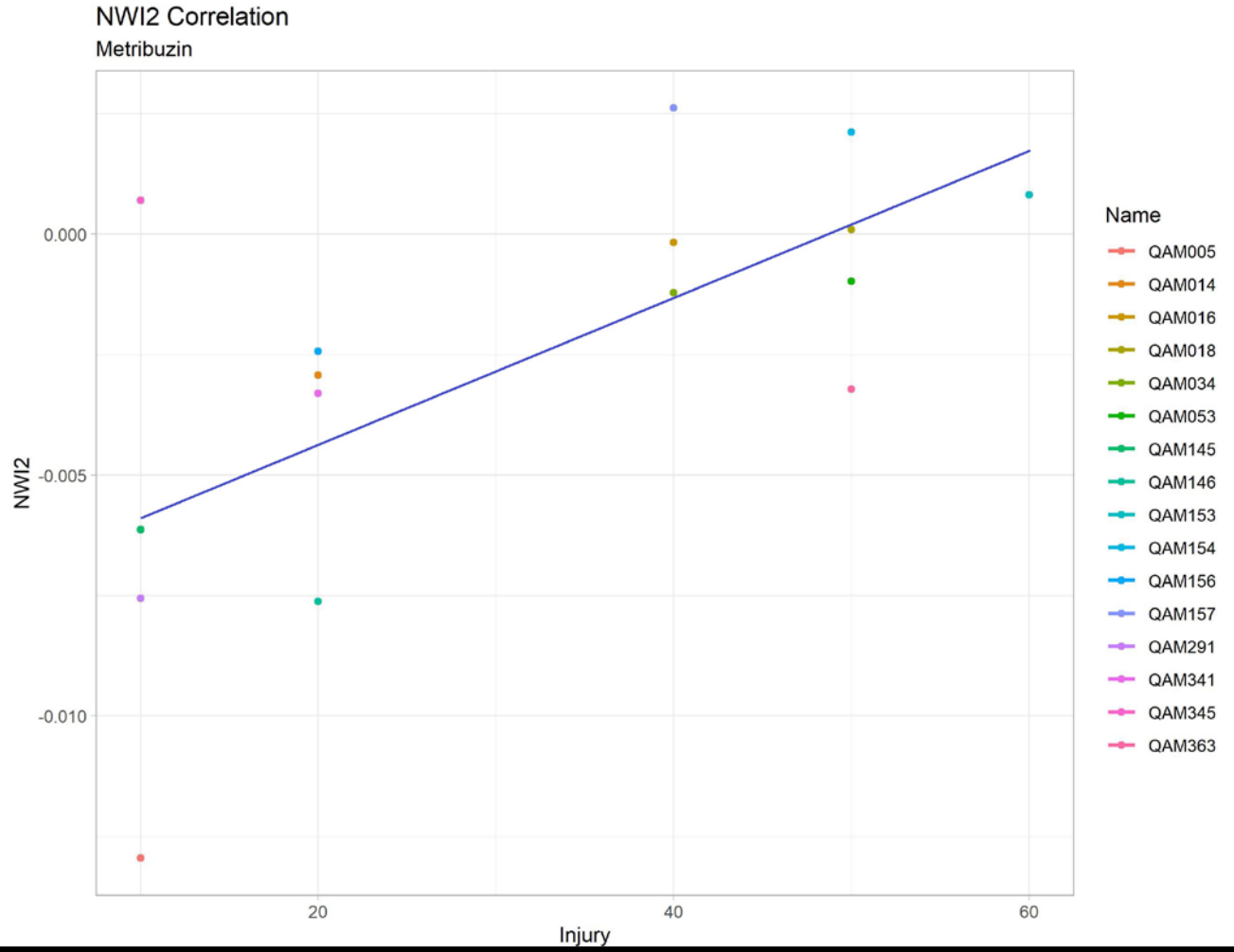
May 11, 2021

	Plant.Height	NDVI	NDRE	NWI1	NWI2	Canopy
Injury	-0.2	-0.04	0.2	0.08	0.28	0.08
Plant.Height		0.07	0.17	-0.05	0.11	-0.27



NWI-2 Correlation

- Negative Difference → Less Injury
  - Tolerant
- Positive Difference → More Injury
  - Susceptible



Future Work

- More Data
- Tolerant Threshold

Acknowledgments

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WASHINGTON STATE UNIVERSITY

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FACT: Research Experience for Undergraduates on Phenomics Big Data Management

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Questions?