

# Can we use a portable NIR (near infra-red) scanner and machine learning (AI) to quantify soil microbiology in avocado orchards?

Dra. Maria Manjarrez  
Director  
R&D

Dr. Ash Martin  
Director  
Business

Dr Ta Nguyen  
Lab Manager



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# Microbiology Laboratories Australia

## Soil (Micro)Biology Analyses

- Focussed on outcomes
- Advanced techniques
- Extensive range
- Continual R&D



# The Problem when testing soil biology:

- Limited by delivery times
- Expensive
- Destructive
- Replication

## MICROBE WISE

### Key Microbe Groups

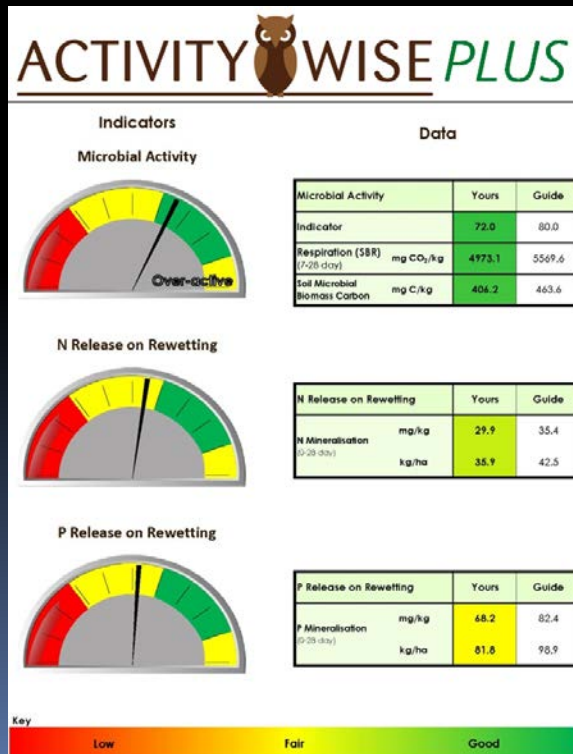
Group	Biomass (mg/kg)	
	Yours	Guide
Total microorganisms	12.3	50.0
Total bacteria	4.4	15.0
Total fungi	7.4	33.8
<b>Bacteria</b>		
Pseudomonas	0.303	1.000
Actinomycetes	0.995	1.000
Gram positive	3.588	11.250
Gram negative	0.848	3.750
Methane oxidisers	0.271	0.500
Sulphur reducers	0.001	< 0.005
True anaerobes	0.040	< 0.005
<b>Eukaryotes</b>		
Protozoa	0.448	1.250
Mycorrhizal fungi (including VAM)	1.177	10.000

Useful indicators	Yours		Guide
	Yours	Guide	
Microbial diversity	107.2	80.0	
Fungi : Bacteria	1.7	2.3	
Bacterial stress	0.6	< 0.5	

Nutrients held in microbes	Concentration (mg/kg)	
	Yours	Guide
Nitrogen (N)	0.980	3.450
Phosphorus (P)	0.368	1.500
Potassium (K)	0.123	0.500
Sulphur (S)	0.123	0.500
Calcium (Ca)	0.061	0.250
Magnesium (Mg)	0.061	0.250
Carbon (C)	5.771	22.688

Key \*BDL = Below Detectable Limit (0.001 mg/kg)

Poor Fair Good

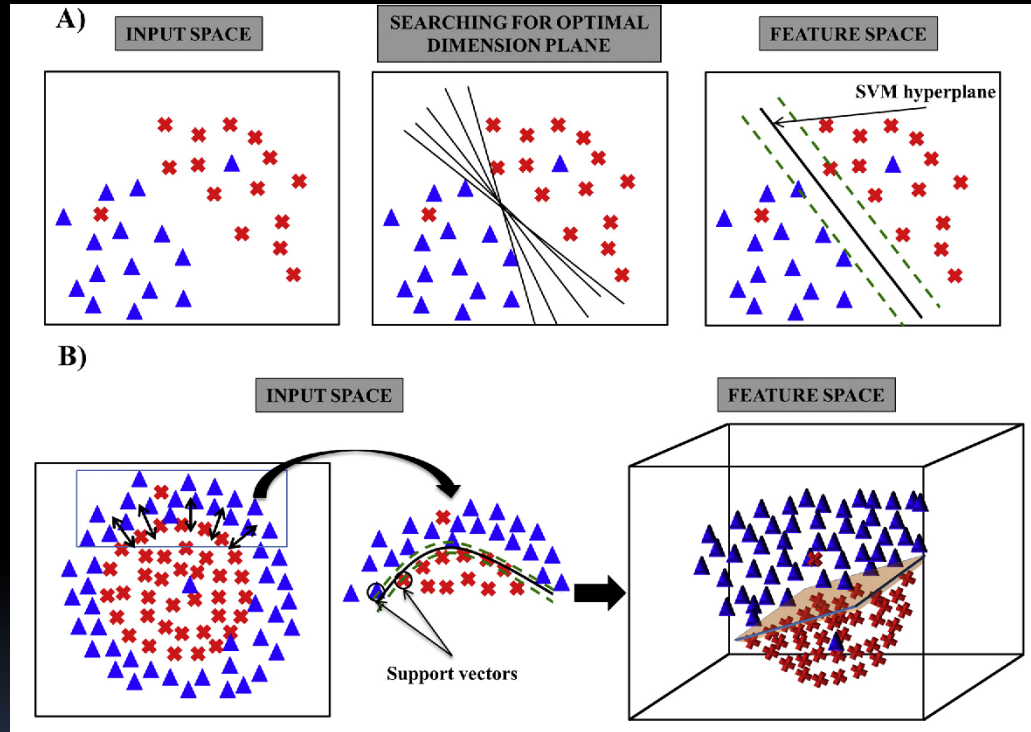


# *In situ* Proximal soil sensing and machine learning: Portable scanners

- Compact, not so expensive, robust and suitable for new technologies
- Compatible with data acquisition and transfer to user: PC, Tablet or phone
- Machine learning = math modelling/stat fitting



# Machine learning = modelling



# Soil Microbiology essentials: largely different groups



Hongos

Gram Positivas (+)

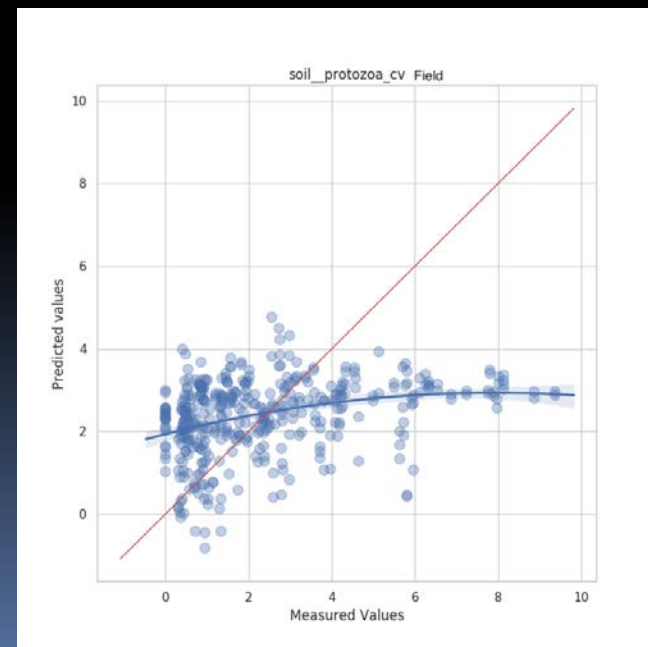
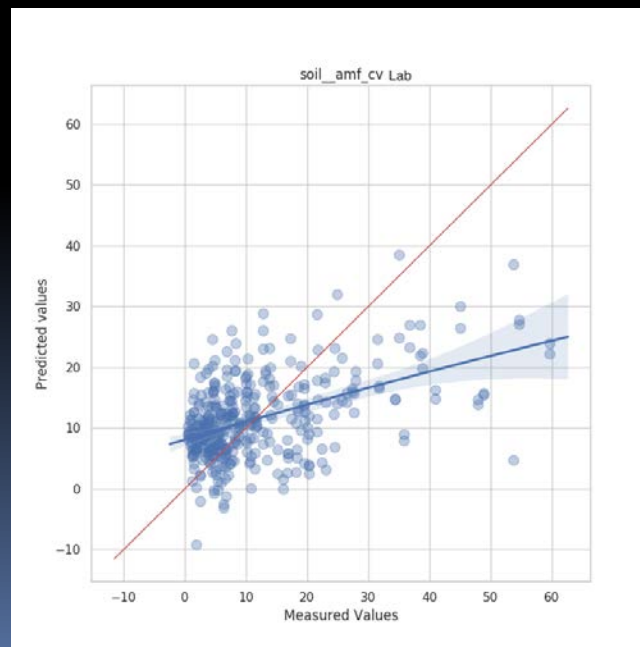
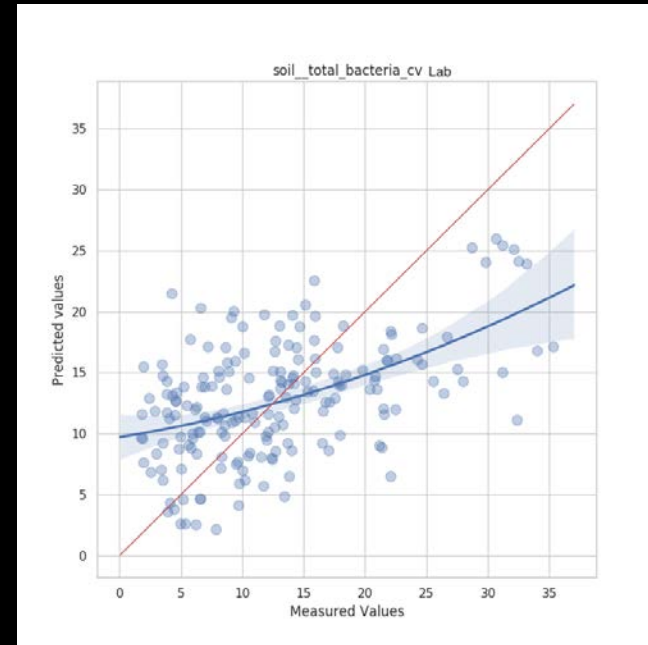
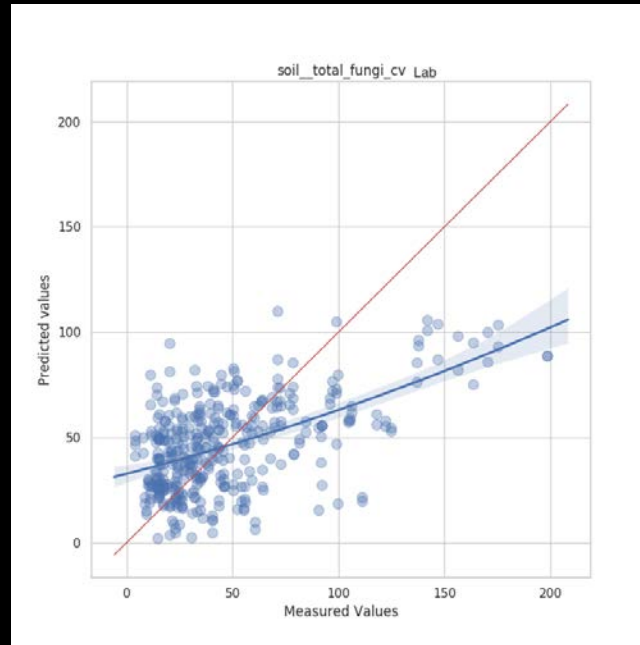


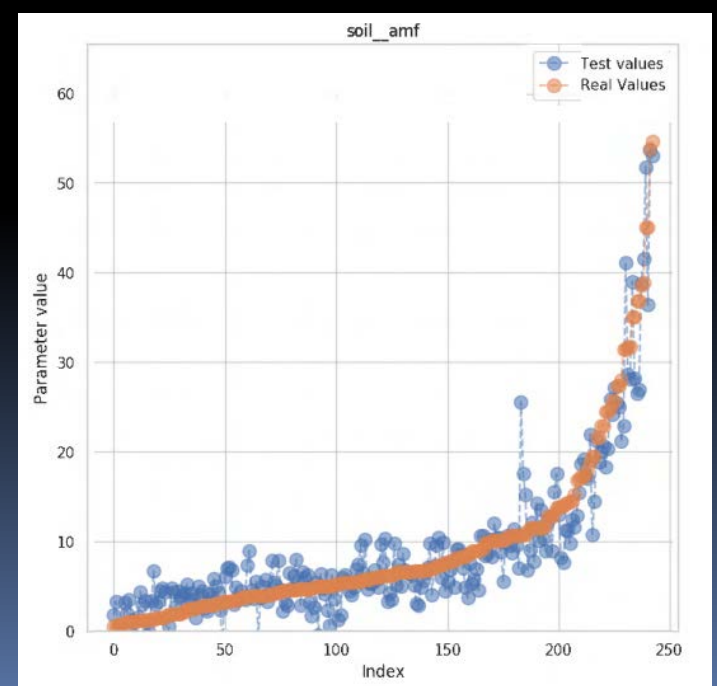
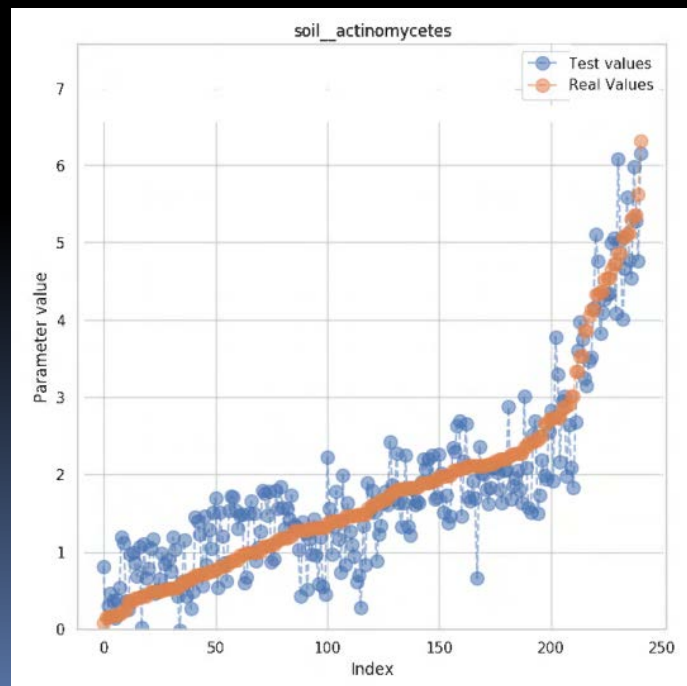
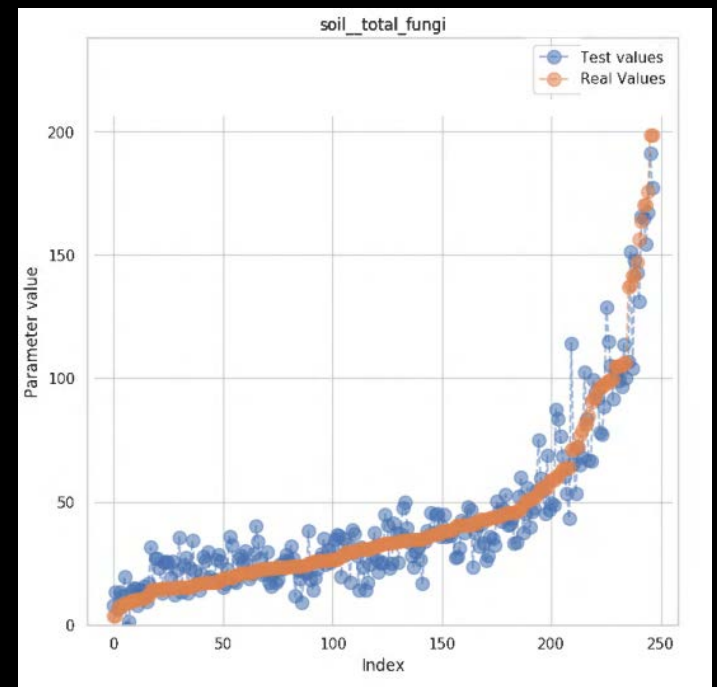
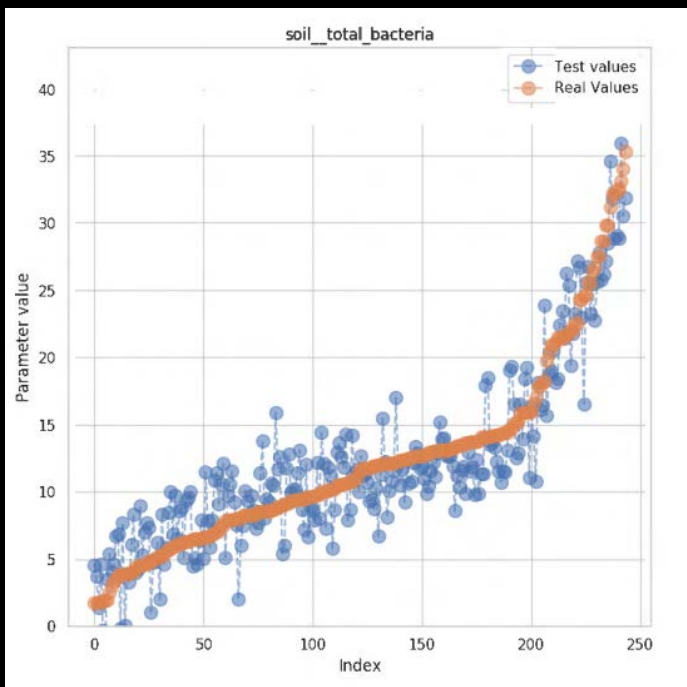
Protozoarios

Gram Negativas (-)



# Measured VS Predicted (ML): $R^2 = 0.87$ to $0.61$





# Can we really use NIR and machine learning in soil microbiology? Yes, as indicator

- Calibration, Calibration, Cal...
- Soils handling: humidity, particle size, etc
- Plastic bag weight (Petri dish?)
- initial calibration of equipment
- Maintenance of equipment
- New modelling software