Soil Health for Vine Variation Management
NLP-03-01-5g

GILLAMII CENTRE
SOUTHCOAST
NATURAL RESOURCE MANAGEMENT INC
Sustainable Agriculture in Practice

Australian Government

National Landcare Programme

Acknowledgements

Alkoomi wines, Stratus Imaging, Precision Agronomics, Southern Soil Incentives, South Coast NRM, Gillamii Centre and Ben Johnston Intripid Winemakers.

1. Project Aim

The main aims and objectives of this trial are to monitor the outcomes on soil health and variability by the application of different treatments to the soil under vine after analysis with EM38, NDVI imaging and Radiometrics.

2. Project Design

The vineyard site chosen is the Alkoomi Vineyard 10 km west of the Frankland Town site along the Wingebellup Road. This vineyard was established in 1974 and has now grown in size to a 105 ha vineyard. The two blocks chosen for analysis for this trial were block 3 and block 6, with treatments done on Block 3.

Block 3 had a section three rows wide as control, one section three rows wide which has composted grape marc applied to the surface under vine, a section three row wide where composted marc was trenched into the ground at the root zone, and a section three row wide with mycorrhizae trenched in the ground. Soil moisture monitoring equipment was installed in this section with the aim of ascertaining if any increase in soil moisture retention is achieved by the use of grape marc as mulch.

Soil testing and analysis using EM38, NDVI imaging and Radiometrics was completed followed by soil moisture meter installation. Detailed soil testing also took place to enable base line nutrient levels, soil carbon and C:N ratios, as well as other soil nutrient parameters to be established. All soil applications were made after soil analysis and initial soil testing is completed.

3. Site Treatments

Block 3 had a control, treatment of composted grape marc applied to the surface under vine, treatment of composted marc was trenched into the ground at the root zone, and a treatment of mycorrhizae trenched in the ground. All treatments began 35m south of the Northern Strainer.

Treatment Outline

	Treatment	
Treatment 1	Mulch – using marc	• Approximately 10cm in height. • Directly under the vines. • Applied in April.

Treatment 2	Control	
Treatment 3	Trenched Marc	• 400mm deep trench • 300mm from trunk (machinery restriction) • Applied in April •
Treatment 4	Mycorrhyza	• Shallow trench – 200mm deep. • Applied September.

4. Results

4.1 Soil Analysis table pre-treatment

- The highlights in the soil analysis table: results the first thing we noticed is that the variability is highlighted by the difference in clay content and changeability throughout the depth. The variation on PH is significant.

Code	Depth	Colour	Gravel	Texture	Phosphorus Colwell	Potassium Colwell	Organic Carbon	Conductivity	pH (CaCl2)	pH (H2O)	PBI	MIR% Clay	MIR% Sand	MIR% Silt
			%		mg/Kg	mg/Kg	%	dS/m	pH	pH		%	%	%
AK 2	0-10	GR	0	1.5	27	23	1.75	0.041	6.0	6.7	19.7	7.80	82.00	10.20
AK 3	0-10	DKGR	5	1.5	157	79	3.74	0.086	6.5	7.2	83.8	11.20	84.10	4.70
AK 2	0-30	LTGR	0	1.0	6	< 15		0.016	5.0	6.1		0.80	90.60	8.60
AK 3	10-30	GRBR	15-20	2.0	39	26		0.019	5.6	6.7		6.50	83.20	10.30
AK 2	30-50	LTGR	0	1.5				< 0.010	5.2	6.3		0.10	88.70	11.20
AK 3	30-50	GRBR	15-20	2.0				0.016	5.4	6.5		8.30	76.80	14.90

2017

	High
	Deficient
	Good

Foliar Status

Nutrient	N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	Bo
Block 3	0.66	0.46	2.15	1.67	0.89	0.17	21.17	12.11	14.79	37.53	43.94

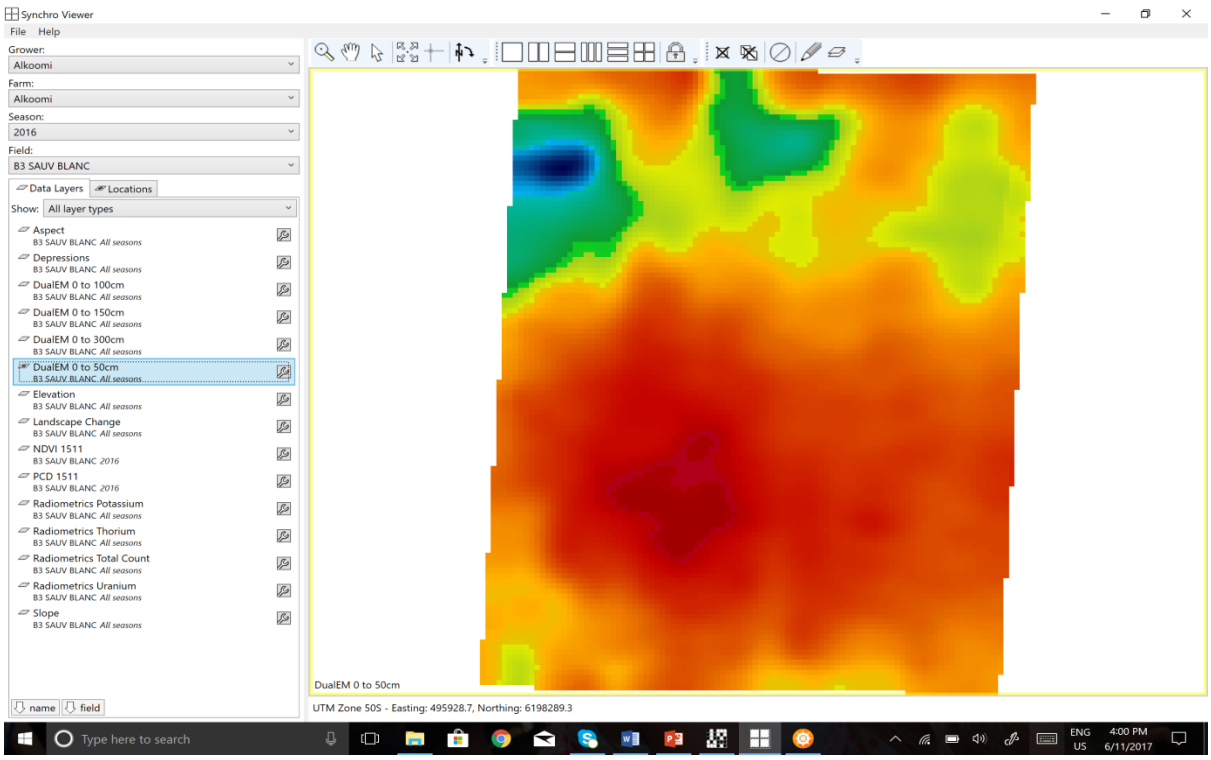
Soil Status

Nutrient	pH	EC	Org. C	N	P	K	Ca	Mg	S	Av Fe	Av Mn	Av Zn	Av Cu	Bo
B3 SB														
0 - 10	6.7	0.041	1.75		27	23			12.6					
0 - 30	6.1	0.016			6	15			5.9					

30 - 50	6.3	0.01												
Block 3	7	0.046	0.98	0	50	55	984	91.2	4.7	22.78	0.68	1.99	5.06	0.45

4.2 EM 38

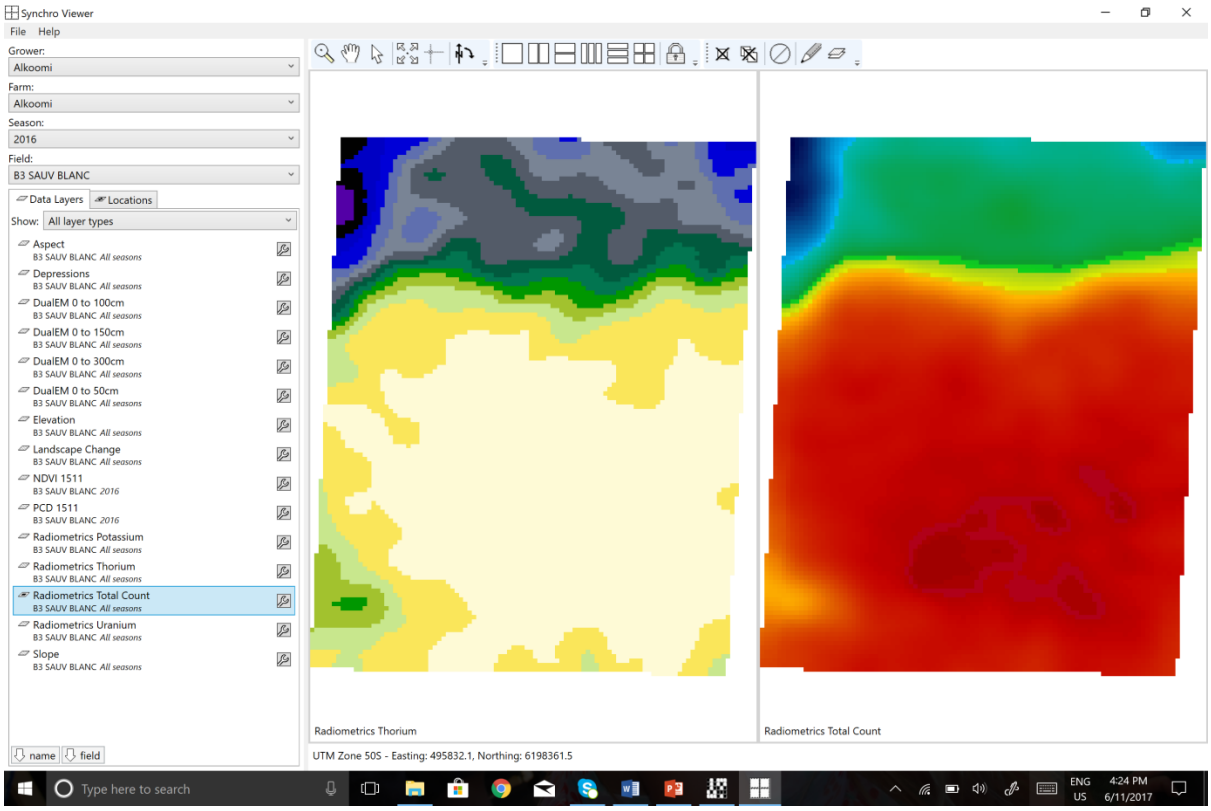
- Please include some dot points to explain EM38 results
- The below EM38 diagram shows us highlights the moisture or salt content indicated through the green and blue, which saves you walking around the vineyard digging holes, this is indicative of variation. From a farmers perspective a EM38 picks up areas that need further testing or an introduction of gamma readings.
-



4.3 Radiometrics

- Upon further investigation using Gamma (Radiometric) readings below, soil variation was identified.
- The colour coding highlights different isotopes indicative of soil type and gravels.
- We were then able to accurately map where the variation starts and ends, and what soil type to expect.

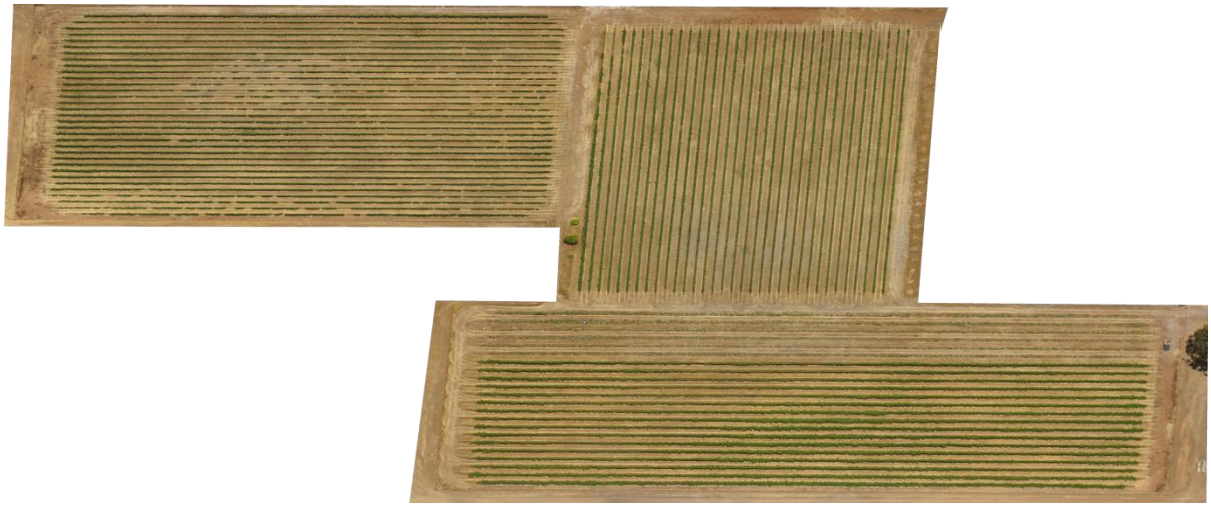
- The white through to yellow measured low thorium levels indicative of sandy soil at the grey, violet is showing heavy clay soil. On the right is total isotope measure quantities which further highlights the differential



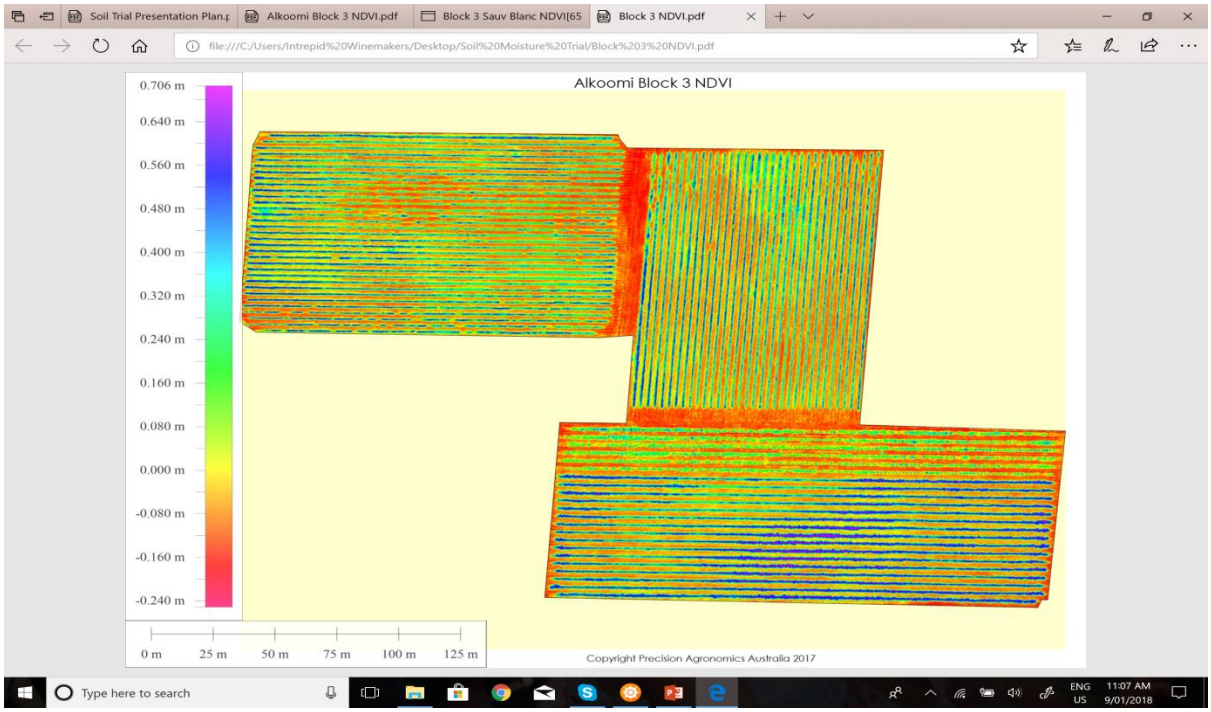
4.3 NDVI images

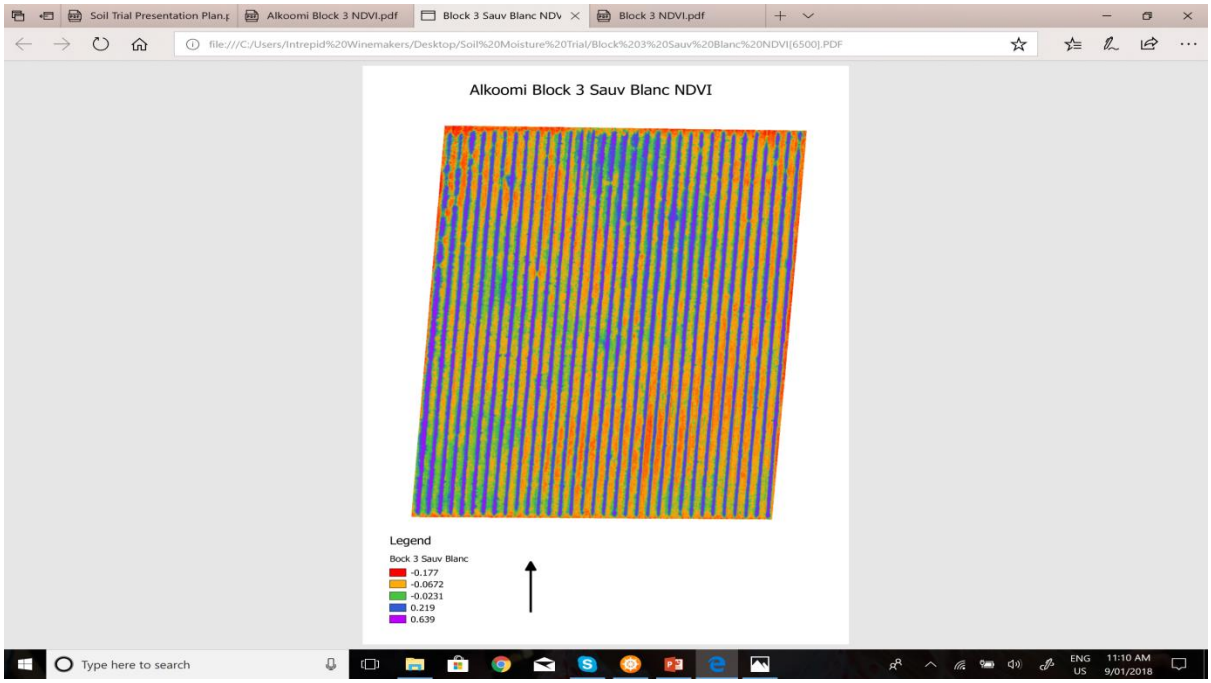
- Below NDVI results show vigour in the canopy growth, the first two images show general growth right across the vineyard in a unblocked image,
- Please add description of each image/figures
-

a. Varying growth

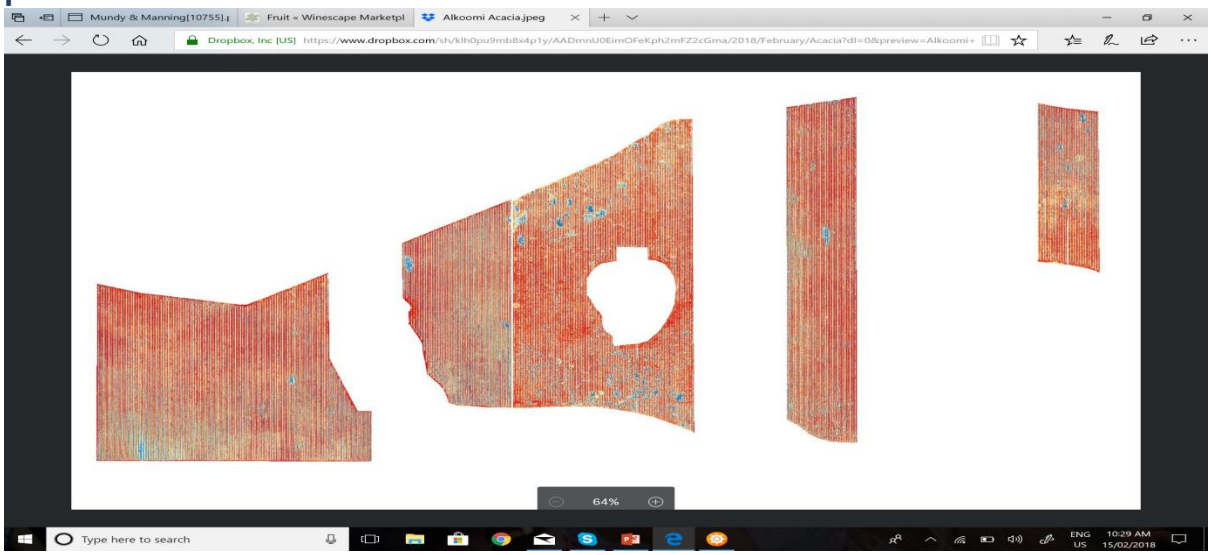


Below shows general vigour across the whole block indicating where there is plant growth, blue indicating strong plant and red less so First image unblocked, second imaged blocked- UN Blocked picks up data points across the whole Vineyard. Blocked for a specific area.

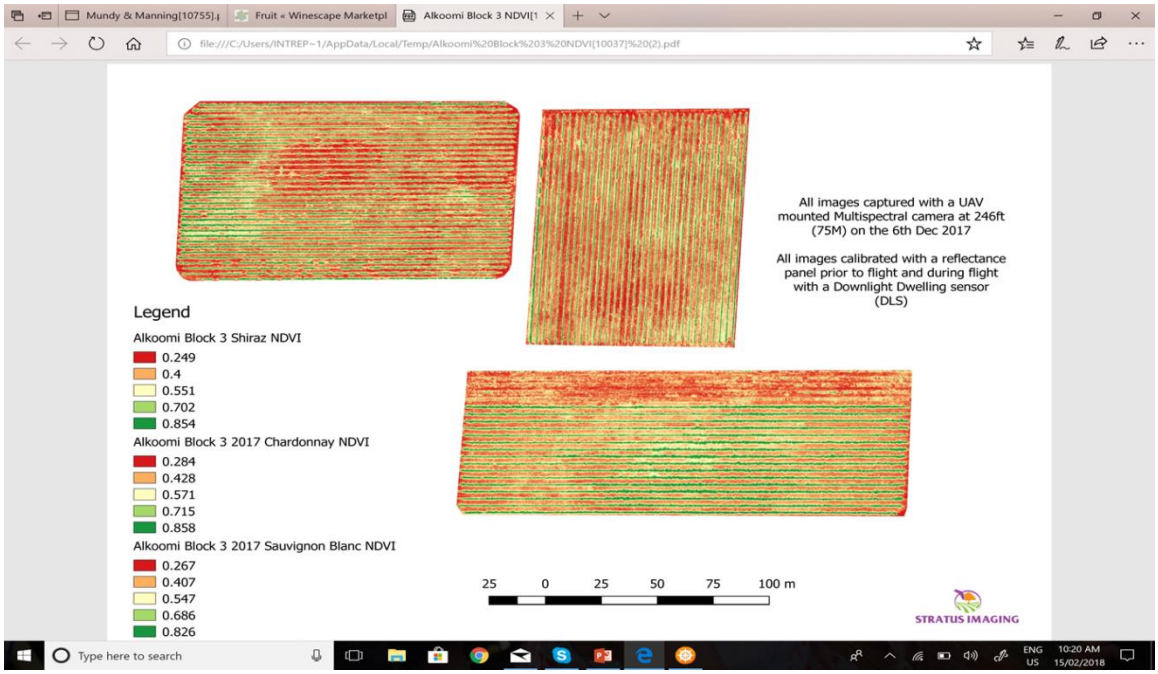




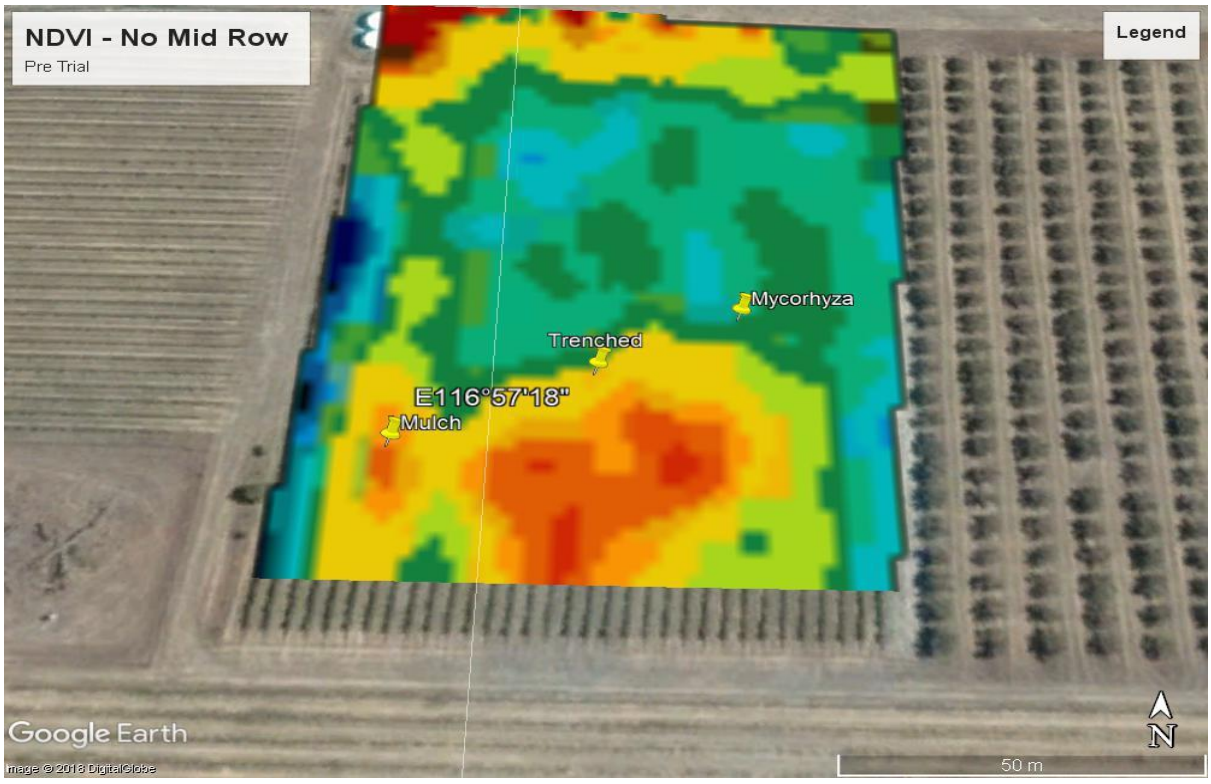
Blue highlights water leaks across the vineyard demonstrated by the blue patches



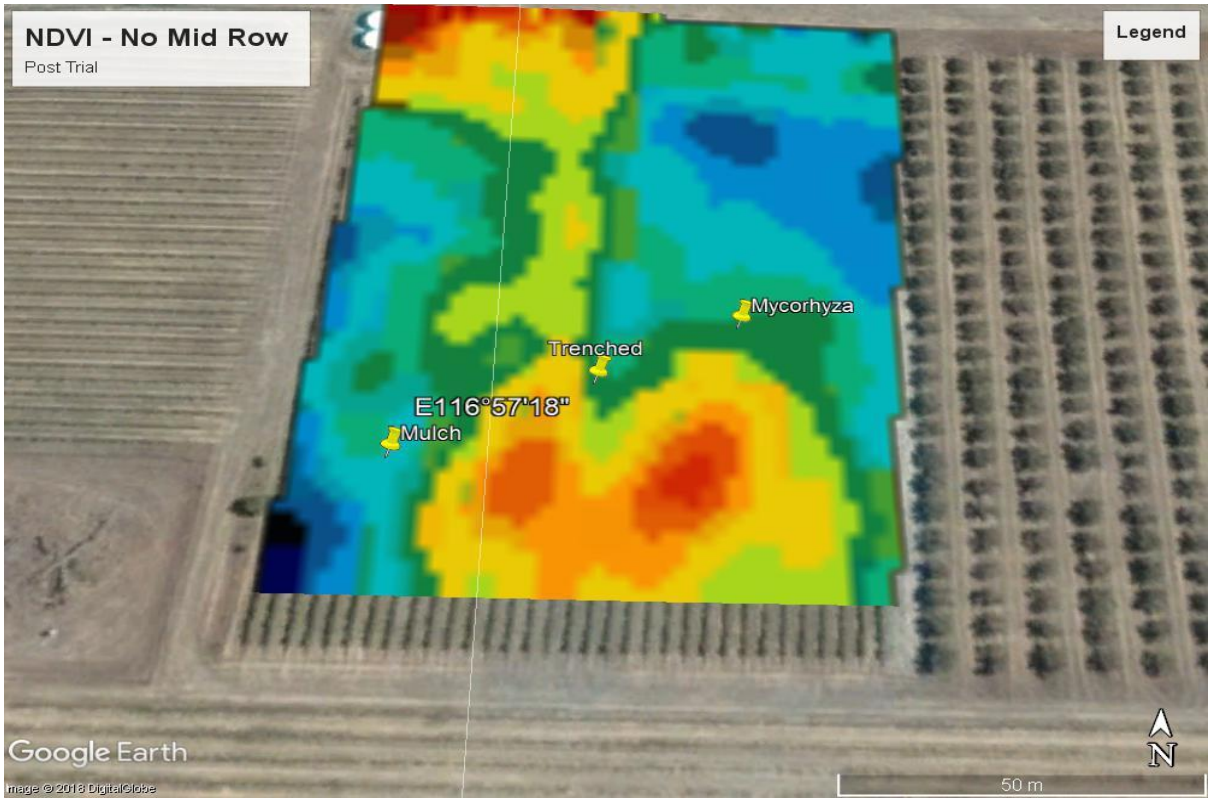
b. Flowering



c. Pre and Post trial



The above NDVI image has been adjusted to take out the midrow and only show true vineyard with no interference midrow from the grass. Useful for sampling and harvesting decisions



4.6 Fruit analysis

- The below table shows the rate of difference ripening between the clay and sandy
- These figures are prior treatments applied showing sandy soil vines ripen quicker assumed to be because of stress. Ripening in this instance describes analytical ripening as opposed to phenological ripening.

		21-Feb	*28-Feb*	*7-Mar*	*8-Mar*	*Daily Change*	*Weekly Change*	*% Difference*	*Ideal (IW)*	*Average*	*Variance*
North	***Baume***	9	10.2	11.4	11	0.17	1.2				
	pH	2.86	2.91	3.06	2.98	0.014	0.1				
	TA	17.5	15.1	9.6	9.66	0.56	3.95				
South	***Baume***	8.6	11	11.7	11	0.22	1.55	29%	0.12	0.13	170%
	pH	2.8	2.98	2.97	2.98	0.012	0.085	-15%		0.004	304%
	TA	17.2	9.66	10.78	9.66	0.46	3.21	-19%	-0.12	0.12	382%

4.7 Shoot count

- The table below indicates shoot counts, identify if the soil variation has a impact on bud burst, in this case minimal with a one shoot per variation across the vineyard

	Mulched		Control		Trenched		Mychorhyza			
North	30		36		29		19		29	
	35		31		30		23		30	
	33	33	35	34	22	27	27	23	30	29
	28		35		27		17		27	
	31		32		24		20		27	
	34		27		35		18		29	
	45		28		34		22		32	
	26		28		28		26		27	
	32		27		37		23		30	
South	23	31	23	29	27	30	20	21	26	28
	31.7		30.2		29.3		21.5			
North	20		24		19		13		19	
	23		21		20		15		20	
	22		23		15		18		20	
	19		23		18		11		18	
	21		21		16		13		18	
	23		18		23		12		19	
	30		19		23		15		22	
	17		19		19		17		18	
	21		18		25		15		20	
South	15		15		18		13		17	
	21		20		20		14			

4.8 Blade analysis

- Please include some dot points to explain blade analysis results
- Blade analysis demonstrated slightly higher levels of nitrogen and prosperous because of the treatments applied for this trial
- The clay soil demonstrated high levels of potassium which leads to the high levels of micronutrients which is indicative of the different fertiliser applied.

		Optimum	*MN*	*CN*	*TN*	*MY.N*	*Ave. N*	*Average*	*Ave. S*	*MS*	*CS*	*TS*	*MY.S*
Nitrogen	%	2.25	1.1	1.4	1.3	1.5	1.3	1.4	1.4	1.4	1.4	1.4	1.3

Phosphorous	%	0.205	0.23	0.22	0.23	0.25	0.2	0.3	0.3	0.34	0.26	0.36	0.32
Potassium	%	1.25	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.5	1.1	1.3	1.3
Calcium	%	2.2	3.4	2.9	3.5	3.1	3.2	3.1	3.0	3.1	3.2	2.9	2.9
Magnesium	%	0.32	0.36	0.74	0.77	0.84	0.68	0.71	0.75	0.38	0.84	0.95	0.82
Sulphur	%	0.275											
Iron	ppm	120	110	98	100	93	100	92	83	79	89	44	120
Manganese	ppm	120	96	98	96	82	93	84	75	89	77	51	84
Zinc	ppm	33	89	91	85	80	86	83	79	95	83	52	85
Copper	ppm	25	550	470	570	490	520	460	400	470	430	210	490
Boron	ppm	30	46	31	29	35	35	41	47	55	46	44	43
Molybdenum	ppm	0.27											

4.9 Weights

- This table measuring bunch weights of the treatment and control both north and south
- The south soil was treated, the table indicated that in the sandy soil of the south there was an increase in all treated sites bunch weights.
- This tables highlights how effective the mulch is through the difference of bunch weights through the soil variation between north and south (north high clay, South high sand content) as shown by the radiometric map.

	Mulched	Control	Trench	Mycorrhyza
North	115	130	134	121
South	106	73	91	106
Difference	9	57	43	15
%	8%	44%	32%	13%
Overall	111	101	113	113

4.10 Estimated Cost: Benefit ratio

- The cost benefits table shows that a increase in bunch weights for mulched and trenched marc balanced the cost of the application rate within the first 12 months.
- The mycrorhyza showed a slight cost benefit.

Bunches	***Mulched***	***Control***	***Trench***	***Mycorrhyza***
North	20	21.4	17.1	18.6
South	14.8	11.2	17.8	12.8
	74%	52%	104%	69%

Weights	(kg/vine)			
North	2.3	2.8	2.3	2.2
South	1.6	0.8	1.6	1.4

Weights	(kg/m)				Average	
North	1.5	1.9	1.5	1.5	1.6	
South	1.0	0.5	1.1	0.9	0.9	56%

Value	($)			
North	$ 2.30	$ 2.78	$ 2.30	$ 2.25
South	$ 1.57	$ 0.82	$ 1.62	$ 1.35

Cost of Product	$ 1,100.00
Distance	1500
	$ 0.73

5. Discussion

1. There appeared to be improvement in bunch size and yield due to all treatments. Mulching had the most and quite significant impact, with a 100% increase in weighs hence value.
2. The trenched trial data appears to be unreliable due to an outlier. But even the mycorrhizae treatment showed 53 cents per metre increase in revenue. However, we need to continually emphasise that this is one season of data, and the results should be treated as indicative and not conclusive.
3. The trial was a live run in an active vineyard where there was a change in vineyard manager during the trial. There were changes in irrigation strategies that may have influenced the trial. But I do feel we mitigated this matter well with the multiple ranges of controls.
4. More lead in time to the trial, as well as a time extension of another 2 or 3 years would help understand the significance of the data collected.

5. It would also be interesting to see how the treatments measured up after 3 years.
6. The trial itself was performed on extreme variation but on 40 year old vines. It would be interesting to apply treatments to 10 year old vines for example, and maybe where the soil variation was less noticeable too see if the treatments could completely mitigate variation or not.
7. There was significant interest in the soil and canopy mapping that the Precision Viticulture provided. In particular, as a tool to providing 'similar' packages of fruit for the wineries.
8. A conversation also started in reference to access to marc/compost. Having access to marc is a luxury that vineyards with wineries associated with them have but not stand alone vineyard operations. There was mention of a co-op to collect/process/distribute the marc.
9. There was concern that the significant change in irrigation strategy may have had an affect on the results. But the control indicated otherwise. Still would like to see more data collected over the following 2 years.
10. Their seemed to be a need to clarify that the marc/compost was not a nutrition addition but a soil amendment. Any improvements in nutrition demonstrated by the trial were due to factors other than direct application of nutrients.
11. According to the trial results, there was a neutral cost benefit ratio due to the increase in weight/yield. However, if the benefits were to follow on in the next two years with no additions expected to be added, there is potential for a positive cost benefit ratio.

Legacy

Alkoomi Vineyard has already engaged in strategic discussions to introduce marc to their soil moisture management program in the sandy blocks.

Project Learnings

1. The size of the trial did not match the available funding. The trials success was due to Alkoomi Vineyards extensive machinery resources and staff.
2. More lead in time and advice could be very useful.
3. Inexperience from the project manager exposed the trial.
4. The mycorrhizae treatment needed to be placed where the Phosphorous Buffer Index was more relevant (higher) to better measure its potential impact.

Attachments