

## **ACCELERATING CHANGE WORKSHOP 2.**

### **SUCCESSFUL SUMMER CROPPING.**

#### **Introduction.**

#### **Literature:**

- Riverine plains
- Alluvial and aeolian
- Mapped by Smith (1945), Johnson (1950), Churchward & Flint (1956).
- Butler (1973) map.
- MIL Map

#### **Soils:**

1. Red Brown Earths:
  - Deep phase – deep topsoil
  - Shallow phase – shallow topsoil.
2. Transitional Red Brown Earths – the in-between soil type. Shallow topsoils over clays.
3. Cracking Clays:
  - Lighter phases
  - Heavier phases
4. Sands. Occur in conjunction with prior stream traces.

#### **Agenda - Four key areas for discussion at each site:**

1. Soil types, variability & impact on production.
  - Regional variability
  - Within paddock
  - Within irrigation bay.
2. Soil texture and available water.
  - Horizons
  - Depths
  - Textures
  - Impedances
  - Effective Root Zone Depth
  - Available Water Content.
3. Soil amelioration and preparation for summer cropping.
4. Summer crop nutrition.

## SOIL TESTING FOR LAND CAPABILITY PARAMETRES.

Land capability parameters providing background information on the quality of soil for agriculture and the likely behaviour and performance include EC, pH, slaking and dispersion. The purpose of the tests and their relativity for providing general basis behind soil condition are included in the table below.

Test Performed	Test Method	Purpose of the Test
Electrical conductivity EC 1:5 & ECe (dS/m)	Rayment and Higginson, 1992. Slavich and Petterson, 1993. Weatherby, 1992.	Soil salinity criteria, changes in soil salt with depth, match plant root growth and depth of soil utilised by the crop with subsoil salinity, surface and profile drainage status, zones of maximum clay content.
Soil pH (water)	Rayment and Higginson, 1992.	Soil pH, acidity and/or alkalinity, soil growing conditions
Slaking class	Australian Standards, 1980	Assess soil behaviour when wetted by rainfall, aggregate stability, identify if the soil has sufficient organic matter to limit breakdown of aggregates and deterioration of soil structure.
Emerson dispersion class	Emerson, 1967; Australian Standards, 1980; Charman (1978); Charman & Murphy (1991).	Assess clay dispersion when wet by rainfall, soil stability to wetting, likely/unlikely presence of sodic soil, likelihood of soil crusting.

Soil test data for land capability parameters is included in the following table.

## MURRAY DAIRY.

JANUARY 2017.

## SOIL TEST RESULTS FOR LAND CAPABILITY ASSESSMENT PARAMETERS.

Sample Number	Site No.	Sample Name	Depth (cm)	EC 1:5 Soil/Water (uS/cm)	EC 1:5 Soil/Water (dS/m)	Texture	Texture Factor	EC 1:5 Soil/Water (dS/m) Sat Ext.	Soil pH (H <sup>2</sup> O)	Slaking Class	Emerson Dispersion Class
1	Site 1	Holm. MD1. A1	0-10	210.0	0.210	SCL	10	2.1	6.30	2	5
2	Site 1	Holm. MD1. B1	10-45	170.0	0.170	MHC	7	1.2	6.90	2	3
3	Site 1	Holm. MD1. B2	45-80	172.2	0.172	MHC	7	1.2	8.05	2	4

4	Site 2	Holm. MD2. A1	0-10	200.0	0.200	KSCL	10	2.0	5.80	2	5
5	Site 2	Holm. MD2. A2	10-23	110.0	0.110	KSCL	10	1.1	6.10	2	2 (2)
6	Site 2	Holm. MD2. A3	23-58	93.4	0.093	KSCL	10	0.9	5.06	2	5
7	Site 2	Holm. MD2. B1	58-90	111.8	0.112	LSC	9	1.0	4.96	2	2 (1)

8	Site 3	Singleton. MD3. A1	0-12	270.0	0.270	KSL	11	3.0	7.20	2	5
9	Site 3	Singleton. MD3. A2	12-32	70.0	0.070	KSL	11	0.8	6.90	3	2 (1)
10	Site 3	Singleton. MD3. B1	32-64	191.6	0.192	MC (S)	7	1.3	6.84	2	1
11	Site 3	Singleton. MD3. B2	64-85	330.0	0.330	MC (S)	7	2.3	8.32	2	1

12	Site 4	Singleton. MD4. A1	0-10	140.0	0.140	LC (S)	9	1.3	6.80	2	5
13	Site 4	Singleton. MD4. B1	10-23	87.2	0.087	LC (S)	9	0.8	6.35	2	2 (1)
14	Site 4	Singleton. MD4. B2	23-60	70.0	0.070	MHC	7	0.5	6.20	3	1
15	Site 4	Singleton. MD4. B3	60-90	278.0	0.278	MHC	7	1.9	7.69	2	2 (1)

**INTERPRETATION.****SOIL SALINITY - ECe SATURATION EXTRACT.**

	0-2.0 dSm. Low level of soil salinity.
	2.0-4.0 dS/m. Moderate EC. Sensitive species will be effected.
	4.0-6.0 dS/m. Moderate - high EC. Salt tolerant species suited only.
	6.0-10.0 dS/m. High EC.
	10.0-13.0 dS/m. Very high EC.
	>13 dS/m. Extreme EC.

Reference: Rayment &amp; Higginson, 1992; University of Melbourne, 2005.

**TEXTURE FACTORS.**

QLD Dept Env &amp; NRM 'Salinity Management Handbook' (2011).

Soil Description Handbook' Weatherby (1992).

**SOIL PH (WATER).**

Reference: Rayment &amp; Higginson (1992); University of Melbourne (2005).

#### SOIL SLAKING CLASS.

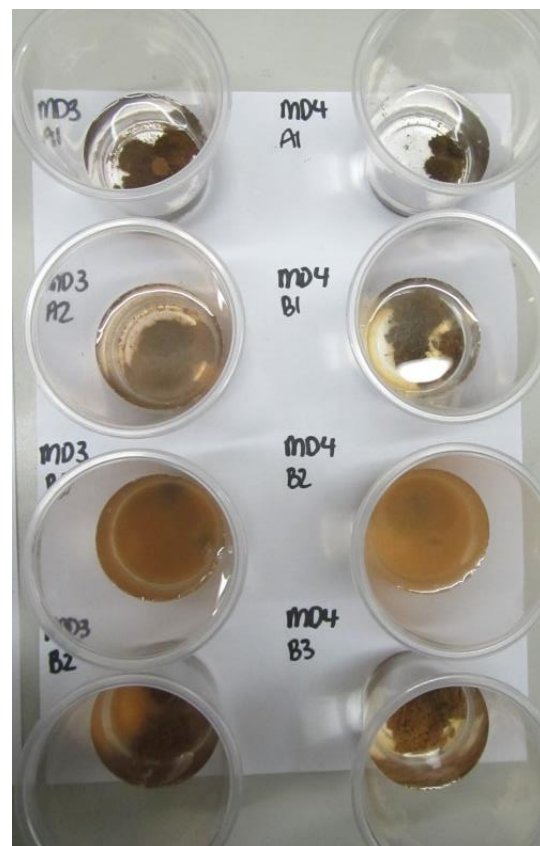
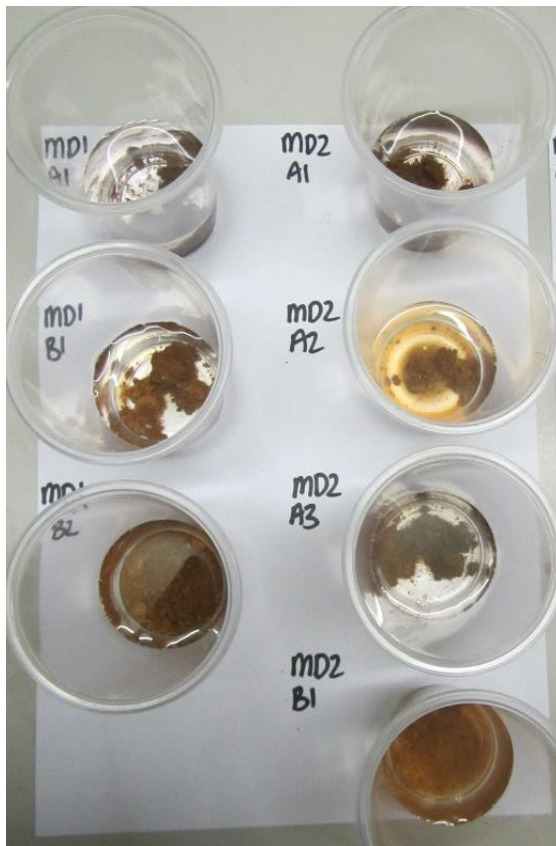
Slaking Class	Interpretation
0	No change
1	Aggregate breaks open but remains intact
2	Aggregate breaks down into smaller aggregates
3	Aggregate breaks down completely into sand grains

Reference: Australian Standards (1980).

#### SOIL DISPERSION CLASS.

Emerson Class	Interpretation
1	Slaking, complete dispersion
2	Slaking, partial dispersion
3	Slaking, slight dispersion after remoulding and immersing in water
4	Slaking, nil dispersion, carbonate or gypsum present
5	Slaking, carbonate or gypsum absent, remould, reshake, dispersion
6	Slaking, carbonate or gypsum absent, remould, reshake, non-dispersive
7	No slaking, swelling, nil dispersion
8	No slaking, swelling
	Orange: Dispersive soil.

Reference: Emerson (1967), Australian Standards (1980).



## SOIL TEST SPREADSHEET – COMPREHENSIVE SOIL TEST RESULTS.

MURRAY DAIRY WORKSHOP 2.

JANUARY 2017.

COMPREHENSIVE SOIL TEST RESULTS.

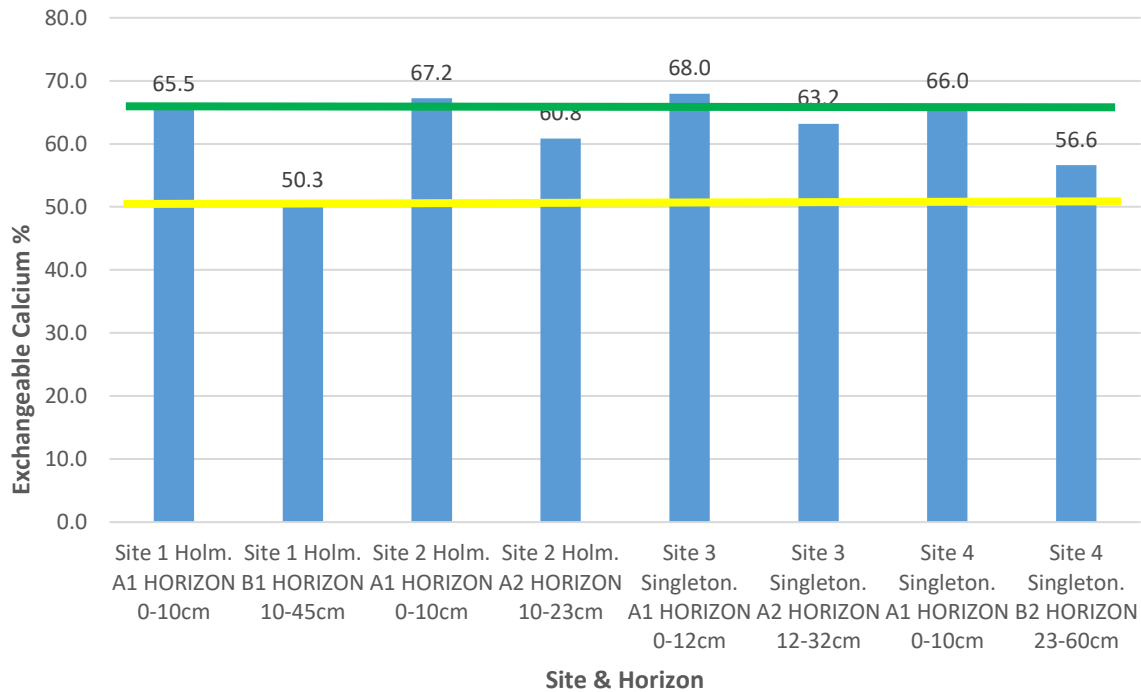
Sample Name	Units	Site 1. Holm.	Site 1. Holm.	Site 2. Holm.	Site 2. Holm.	Site 3. Singleton.	Site 3. Singleton.	Site 4. Singleton.	Site 4. Singleton.
		A1 Horizon.	B1 Horizon.	A1 Horizon.	A2 Horizon.	A1 Horizon.	A2 Horizon.	A1 Horizon.	B1 Horizon.
Soil pH	Water	6.3	6.9	5.8	6.1	7.2	6.9	6.8	6.2
Soil pH	CaCl <sub>2</sub>	5.8	6.2	5.3	5.4	6.7	5.9	6.3	5.4
Conductivity	dS/m <sup>-1</sup>	0.210	0.170	0.200	0.110	0.270	0.070	0.23	0.11
Conductivity	EC Sat Ext.	1.3	1.1	1.2	0.7	2.2	0.4	1.4	0.7
Chloride	ppm	15	13	<10	<10	60	14	29	16
Organic Carbon	%	1.4	0.5	1.4	0.7	1.3	0.6	2.1	0.9
Nitrate Nitrogen	mg/kg	62.0	42.0	73.0	31.0	78.0	7.0	29	18
Ammonium Nitrogen	mg/kg	4	3	3	1	2	<1	3	1
Colwell P	mg/kg	43	8	55	14	170	14	260	62
Phosphorus Buffer Index		95	110	88	79	66	44	130	96
Phos Env Risk		46	23	23	15	33	22	2	0.6
Sulphate Sulphur	mg/kg	14.5	19.3	11.9	12	9.7	5.4	58	23
CEC	cmol/kg	9.50	9.70	8.00	7.30	6.60	3.40	14.4	7.8
Exc. Calcium	cmol/kg	3.9	8.4	2.9	3.8	1.7	1.3	9.5	4.4
Exc. Magnesium	cmol/kg	0.17	0.29	0.09	0.10	0.38	0.37	2.9	2.6
Exc. Sodium	cmol/kg	0.80	0.91	0.89	0.89	1.10	0.31	0.36	0.35
Exc. Potassium	cmol/kg	310	350	350	350	420	120	1.6	0.44
Aluminium KCl	cmol/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aluminium Saturation	%	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Calcium Sum of Cations	%	66	50	67	61	68	63	66	56
Magnesium Sum of Cations	%	27	43	25	31	17	25	20	34
Sodium Sum of Cations	%	1.2	1.5	0.8	0.8	3.9	6.8	2.5	4.5
Potassium Sum of Cations	%	5.5	4.7	7.4	7.4	11.0	5.7	11.0	5.6
Ca:Mg Ratio		2.4	1.2	2.8	1.9	3.9	2.6	3.3	1.7
Zinc	ppm	0.8	0.1	1.6	0.3	4.7	0.3	5.0	0.7
Copper	ppm	1.8	1.7	1.8	1.4	1.2	1.0	2.8	2.3
Iron	ppm	69	33	110	52	84	38	180	130
Manganese	ppm	37	19	35	27	12	19	27	67
Boron	ppm	1.3	2.0	1.0	1.2	1.1	0.8	1.7	1.3

INTERPRETATION:

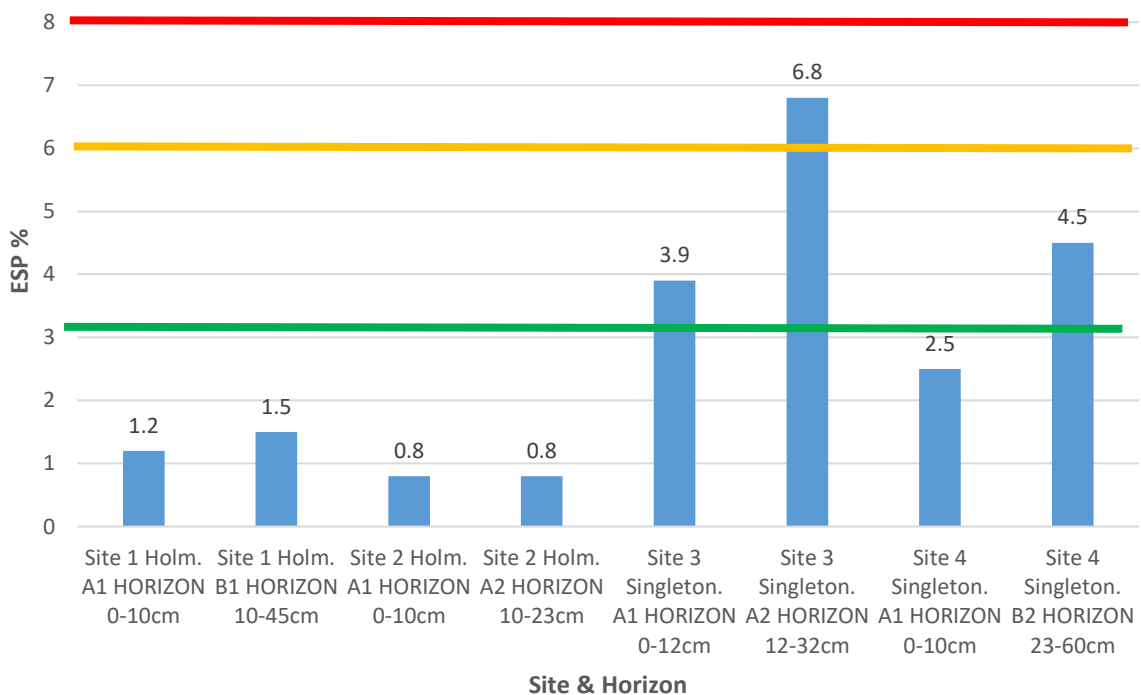
	Very High
	Slightly High
	Acceptable
	Slightly Low
	Low
	Very Low-Deficient.

## EXCHANGEABLE CATION DATA IN GRAPHS.

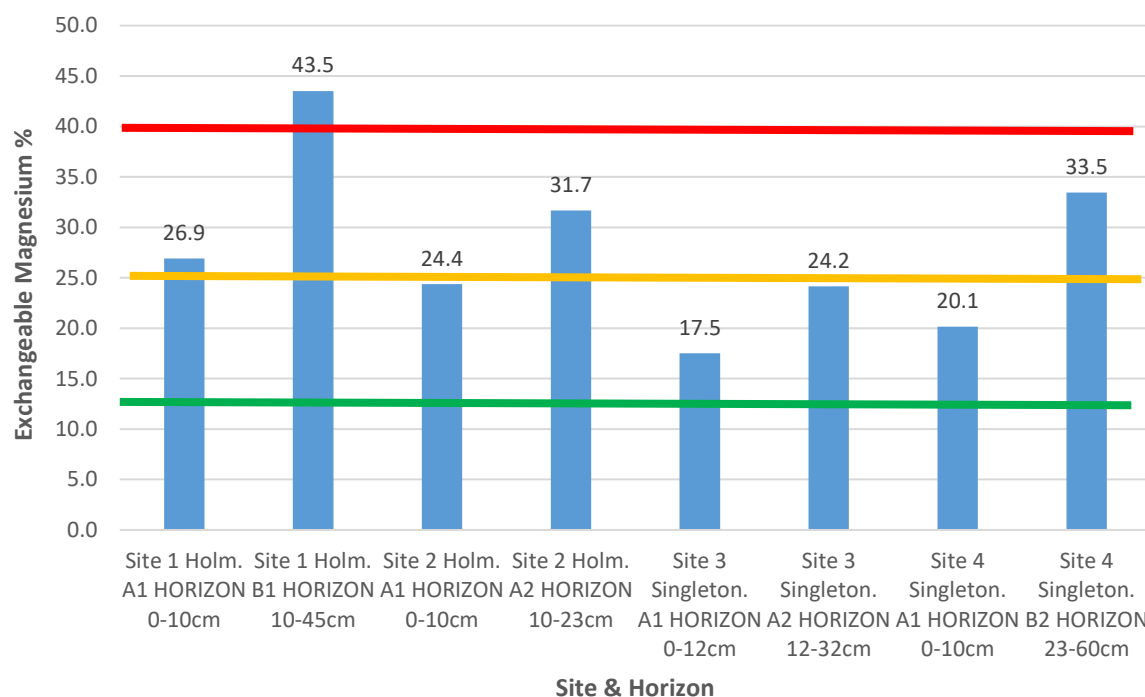
### Murray Dairy Accelerating Change Workshop 2. Exchangeable Calcium Percentage Results.



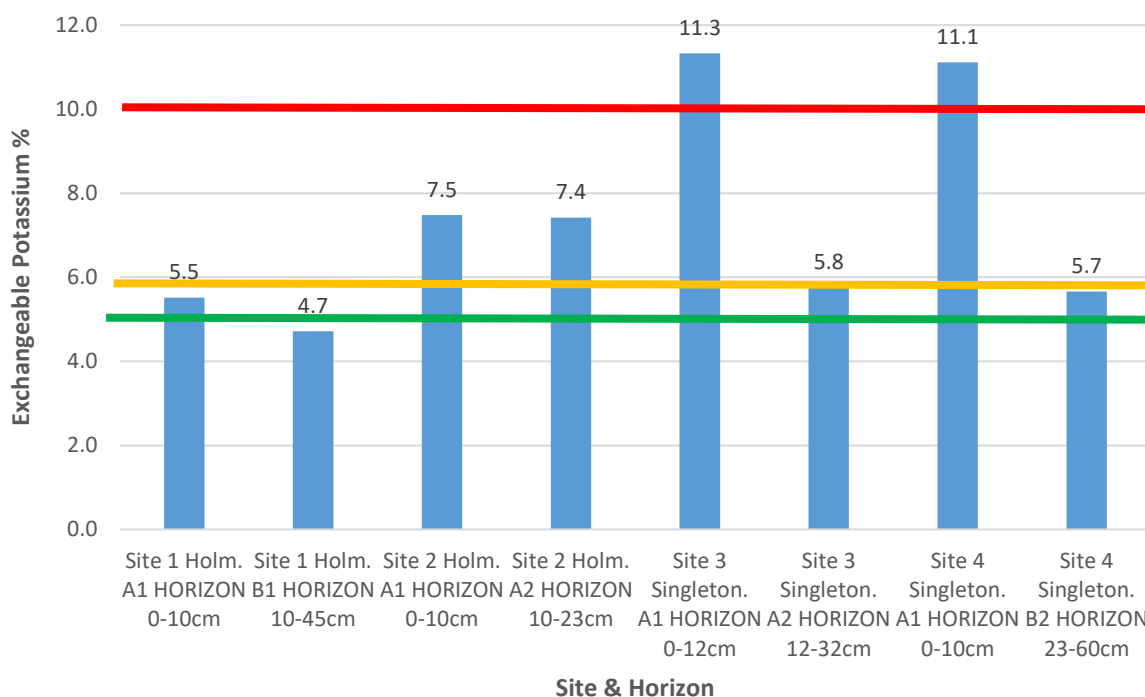
### Murray Dairy Accelerating Change Workshop 2. Exchangeable Sodium Percentage Results.



## Murray Dairy Accelerating Change Workshop 2. Exchangeable Magnesium Percentage Results.



## Murray Dairy Accelerating Change Workshop 2. Exchangeable Potassium Percentage Results.





## SITE 1. MAL HOLM.

### Soil Profile Photographs:



**Soil Type:** Red-Brown Earth / Transitional Red Brown Earth. Duplex soil.

### Soil Profile Description:

Horizon	Depth (cm)	Texture	Structure	Presence of Lime	Plant Root Score /10	Available Water at 200 kPa soil (Sat) mm.	Profile Notes.
A <sub>1</sub>	0-10	Sandy Clay-Loam	Mod sub-angular, mod organic matter.	Nil	7/10	7.8	Tilled multiple times, soil slaked and consolidated from irrigation and rainfall.
B <sub>1</sub>	10-45	Medium-Heavy Clay	Moderate angular-blocky, strong cracking when dry.	Nil	2/10	23.1	High shrink swell capacity, reservoir for water.
B <sub>2</sub>	45-80+	Medium-Heavy Clay	Weak angular-blocky structure.	Mod-High	0/10	3.3	Roots 5-10cm max into this horizon, layer sets the depth of the root system.

### Summary Table:

Parameter	Measurement & Description.
Effective Root Zone Depth (cm)	45cm, 50cm max.
Available Water Content (mm) at 40 kPa soil suction	34.2 mm.
Irrigation interval at 6mm/day:	5.7 days

### Key soil factors impacting available soil water and yield:

1. Shallow topsoil depth.
2. Low organic matter in the surface horizon.
3. Heavy clay subsoil textures.
4. Dispersive subsoil, non-sodic.
5. Low AWC from medium and heavy clay soils.
6. Alkaline and calcareous subsoil with calcium carbonate (lime).



## SITE 2. MAL HOLM.

### Soil Profile Photographs:



**Soil Type:** Red-Brown Earth – Deep Phase. Duplex soil.

### Soil Profile Description:

Horizon	Depth (cm)	Texture	Structure	Presence of Lime	Plant Root Score /10	Available Water at 200 kPa soil (Sat) mm.	Profile Notes.
A <sub>1</sub>	0-10	Coarse Sandy Clay-Loam	Mod sub-angular, mod organic matter.	Nil	8/10	7.8	Tilled multiple times, soil slaked and consolidated from irrigation and rainfall.
A <sub>2</sub>	10-23	Coarse Sandy Clay-Loam	Mod sub-angular, low organic matter.	Nil	5/10	10.14	High shrink swell capacity, reservoir for water.
A <sub>3</sub>	23-58	Coarse Sandy Clay-Loam	Mod sub-angular, few plant roots only.	Nil	3/10	19.5	High shrink swell capacity, reservoir for water.
B <sub>1</sub>	58-90+	Light Sandy Clay	Weak angular-blocky to massive structure.	Nil	0/10	0	No plant roots, layer sets the depth of the root system.

### Summary Table:

Parameter	Measurement & Description.
Effective Root Zone Depth (cm)	45cm, max 58cm.
Available Water Content (mm) at 40 kPa soil suction	37.4 mm.
Irrigation interval at 6mm/day:	6.2 days

### Key soil factors impacting available soil water and yield:

1. Deep topsoils with subsurface A<sub>2</sub> and A<sub>3</sub> horizons.
2. Low organic matter within subsurface horizons from a lack of root development.
3. Acidic topsoils.
4. Dispersive subsoil, non-sodic.
5. A<sub>2</sub> horizon soil structure.
6. Nutrition management in well drained soils vs clay dominant soils.

## SITE 3. ROB SINGLETON.

### Soil Profile Photographs:



**Soil Type:** Red-Brown Earth – Deep Phase. Duplex soil.

### Soil Profile Description:

Horizon	Depth (cm)	Texture	Structure	Presence of Lime	Plant Root Score /10	Available Water at 200 kPa soil (Sat) mm.	Profile Notes.
A <sub>1</sub>	0-12	Coarse Sandy Loam	Mod sub-angular, mod organic matter.	Nil	8/10	9.36	Minimum tillage, crop utilising water efficiently.
A <sub>2</sub>	12-32	Coarse Sandy Loam	Structure tending massive, roots restricted.	Nil	4/10	15.6	Topsoil not providing efficient delivery of nutrients.
B <sub>1</sub>	32-64	Medium Clay (sandy)	Moderate angular-blocky, strong cracking when dry.	Nil	4/10	21.1	High shrink swell capacity, reservoir for water.
B <sub>2</sub>	64-85+	Medium Clay (sandy)	Weak sub-angular-blocky structure.	Mod-High	0/10	0	No plant roots, layer sets the depth of the root system.

### Summary Table:

Parameter	Measurement & Description.
Effective Root Zone Depth (cm)	65cm
Available Water Content (mm) at 40 kPa soil suction	46 mm.
Irrigation interval at 6mm/day:	7.6 days

### Key soil factors impacting available soil water and yield:

1. Deep topsoils with subsurface A<sub>2</sub> horizons.
2. Moderate to high available water content based on topsoil depth
3. Moderate to high available nutrient, with further improvement possible
4. Low-moderate surface retained organic matter.
5. A<sub>2</sub> horizon soil structure.
6. Dispersive & sodic subsoils.
7. Nutrition management in well drained soils vs clay dominant soils.

## SITE 4. ROB SINGLETON.

Soil Profile Photographs:



**Soil Type:** Grey-Brown Clay – Lighter Phase.

**Soil Profile Description:**

Horizon	Depth (cm)	Texture	Structure	Presence of Lime	Plant Root Score /10	Available Water at 200 kPa soil (Sat) mm.	Profile Notes.
A <sub>1</sub>	0-10	Light Clay (sandy)	Mod sub-angular, mod organic matter.	Nil	8/10	6.6	Minimum tillage, crop utilising water efficiently.
B <sub>1</sub>	10-23	Light-Medium Clay (sandy)	Weak sub angular-blocky, weak cracking.	Nil	4/10	8.58	Topsoil not providing efficient delivery of nutrients.
B <sub>2</sub>	23-60	Medium-Heavy Clay	Moderate angular-blocky, strong cracking.	Nil-Slight	0/10	24.42	High shrink swell capacity, reservoir for water, NO ROOTS YET, high moisture.
B <sub>3</sub>	60-90+	Medium-Heavy Clay	Weak angular-blocky structure.	Mod-High	0/10	0	No plant roots.

**Summary Table:**

Parameter	Measurement & Description.
Effective Root Zone Depth (cm)	60cm
Available Water Content (mm) at 40 kPa soil suction	39.6 mm.
Irrigation interval at 6mm/day:	6.6 days

**Key soil factors impacting available soil water and yield:**

1. Clay dominant horizons, no physical impedance.
2. Lower AWC in comparison to a duplex profile with deep topsoil.
3. Dispersive subsoil, non-sodic.
4. Moderate surface retained organic matter.
5. Poor drainage profile drainage.