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Effect Of Soil Compaction on Water Use Efficiency of Watermelon

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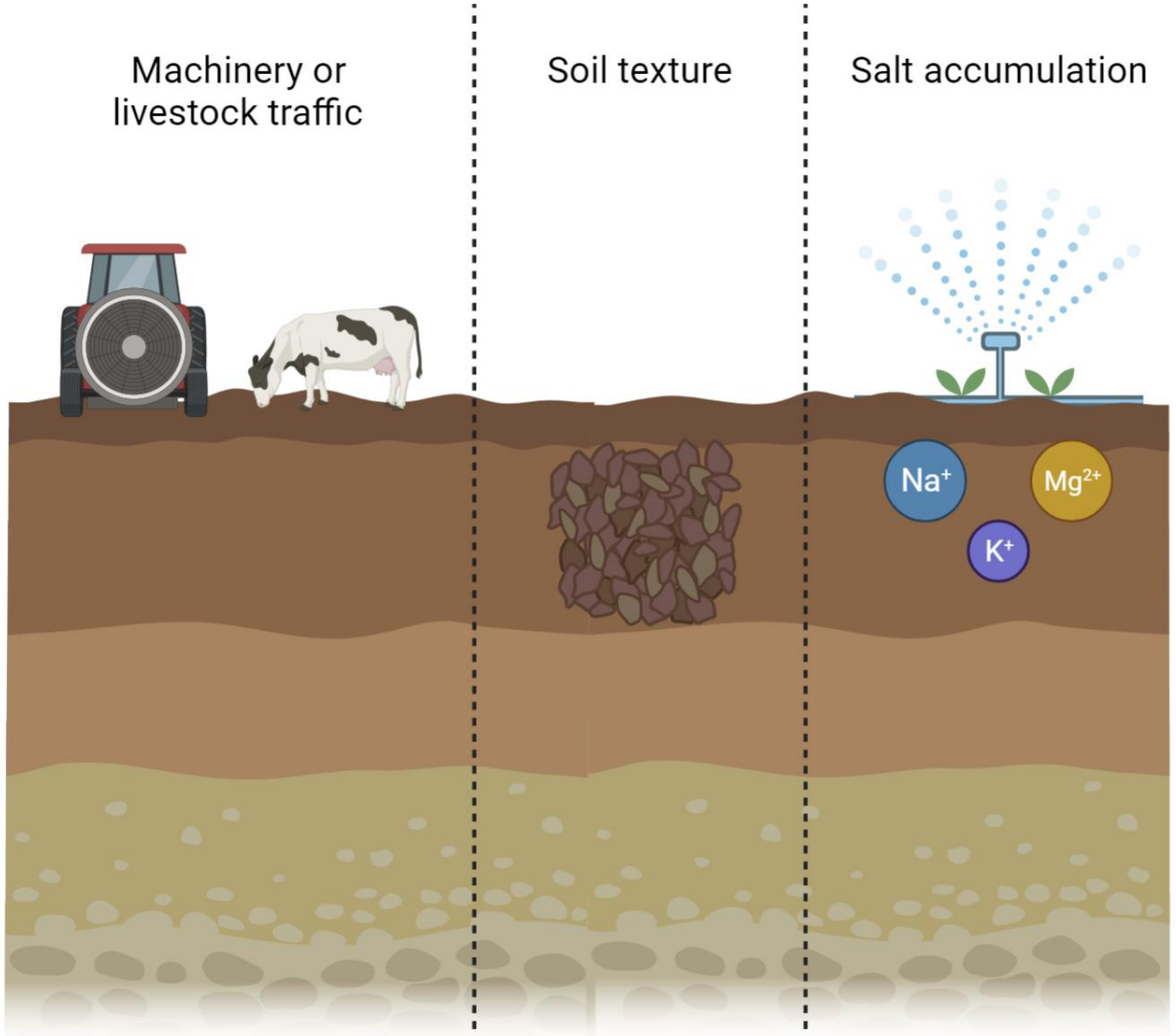
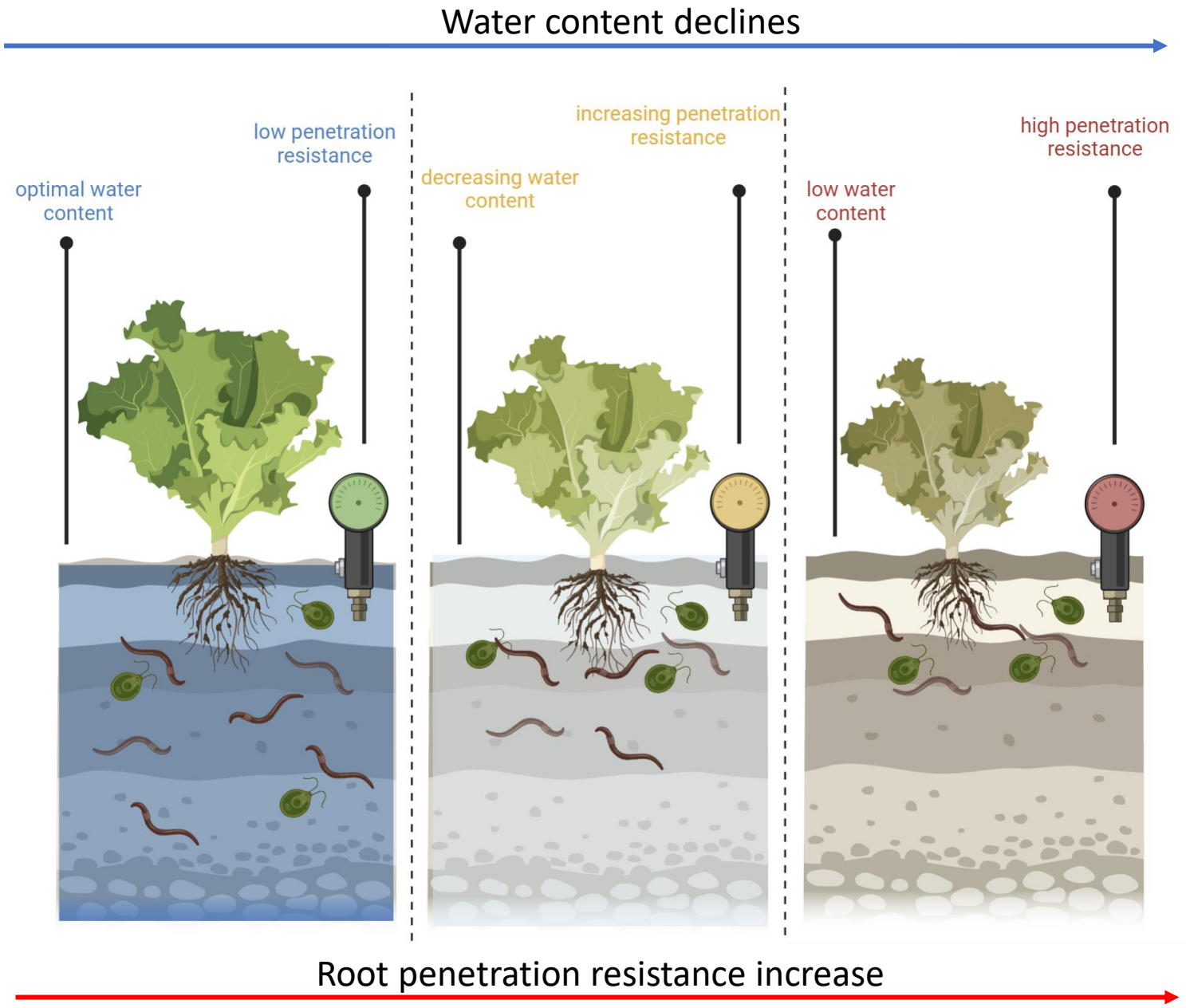
Soil compaction—consolidation

- Machinery traffic
- Soil texture
  - High clay content;
  - bulk density

Salt accumulation

  - Ca, Mg, Na, etc.

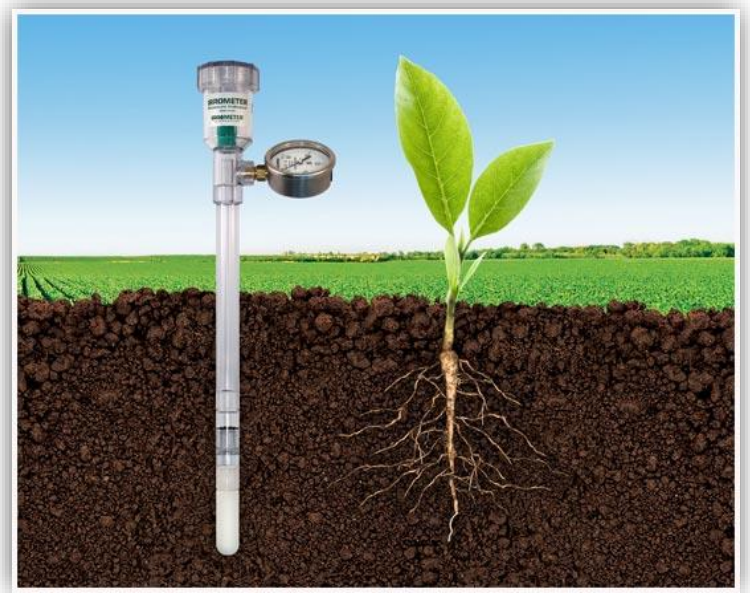


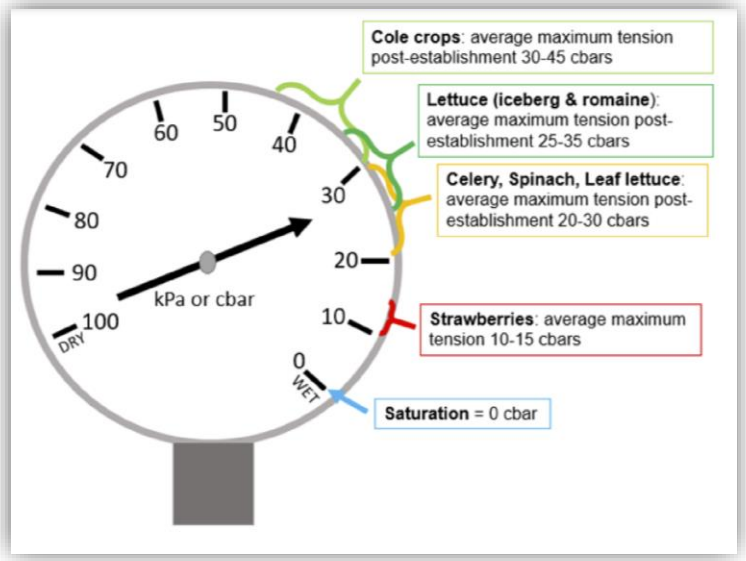

Water content declines
optimal water content
low penetration resistance
decreasing water content
increasing penetration resistance
low water content
high penetration resistance
Root penetration resistance increase

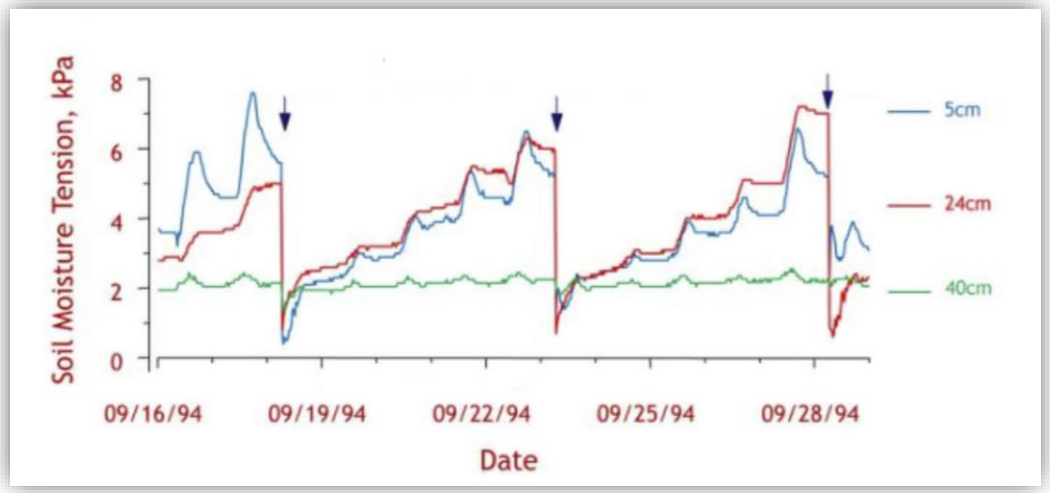
Vegetable crop	effective rooting depth[1] at crop maturity	Irrigation criteria: average soil moisture tension in root zone: establishment	post-establishment	recommended tensiometer depths
	inches	---------- cbars ----------		inches
Artichokes				
annual	12 to 18	20 to 30	30 to 45	8 and 18
perennial	18 to 24	--	40 to 50	12 and 24
Asparagus	24 to 36	20 to 30	45 to 60	12 and 24
Carrots	12 to 18	15 to 25	25 to 35	8 and 18
Celery	12 to 18	15 to 25	20 to 30	8 and 18
Cole				
broccoli	18 to 24	20 to 30	30 to 45	12 and 24
cauliflower	18 to 24	20 to 30	30 to 45	12 and 24
cabbage (red and green)	18 to 24	20 to 30	30 to 45	12 and 24
brussels sprouts	18 to 24	20 to 30	30 to 45	12 and 24
Lettuce				
iceberg	12 to 18	15 to 25	25 to 35	8 and 18
romaine	12 to 18	15 to 25	25 to 35	8 and 18
leaf	8 to 12	15 to 25	20 to 30	8 and 18
spring mix	8	15 to 20	20 to 30	8
Bell pepper (drip)	12 to 18	15 to 25	25 to 35	8 and 18
Spinach				
bunch	12	15 to 20	20 to 30	8 and 18
baby and teen	8	15 to 20	20 to 30	6 to 8
Fresh market tomato (drip)	18 to 24	20 to 30	45 to 60	8 and 18

1. typical depths that contain 80% of roots in a deep, uniform, well drain soil profile

Table 1. Effective rooting depth, recommended maximum soil moisture tension, and tensiometer depths for coastal vegetables.

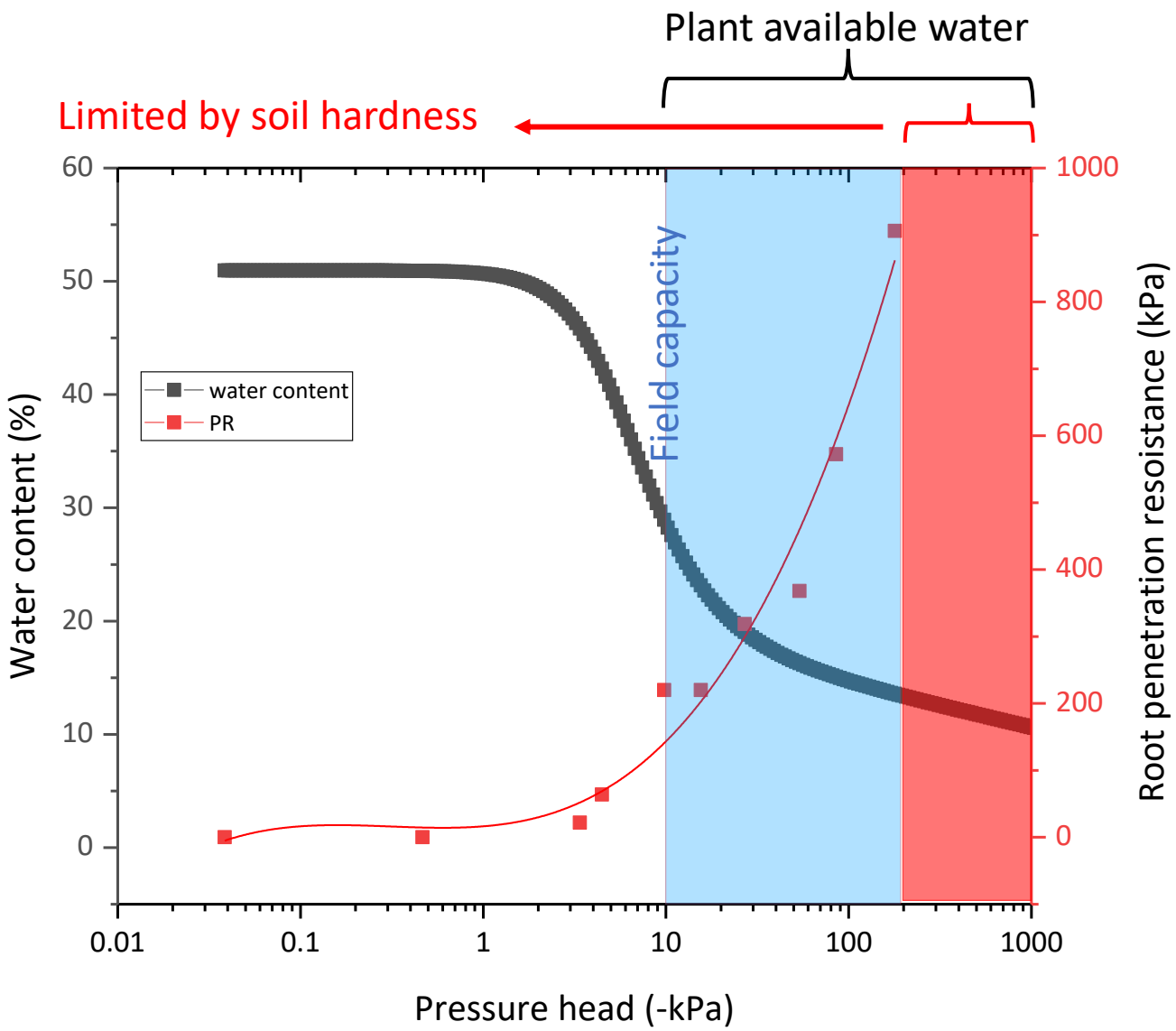






Water stress

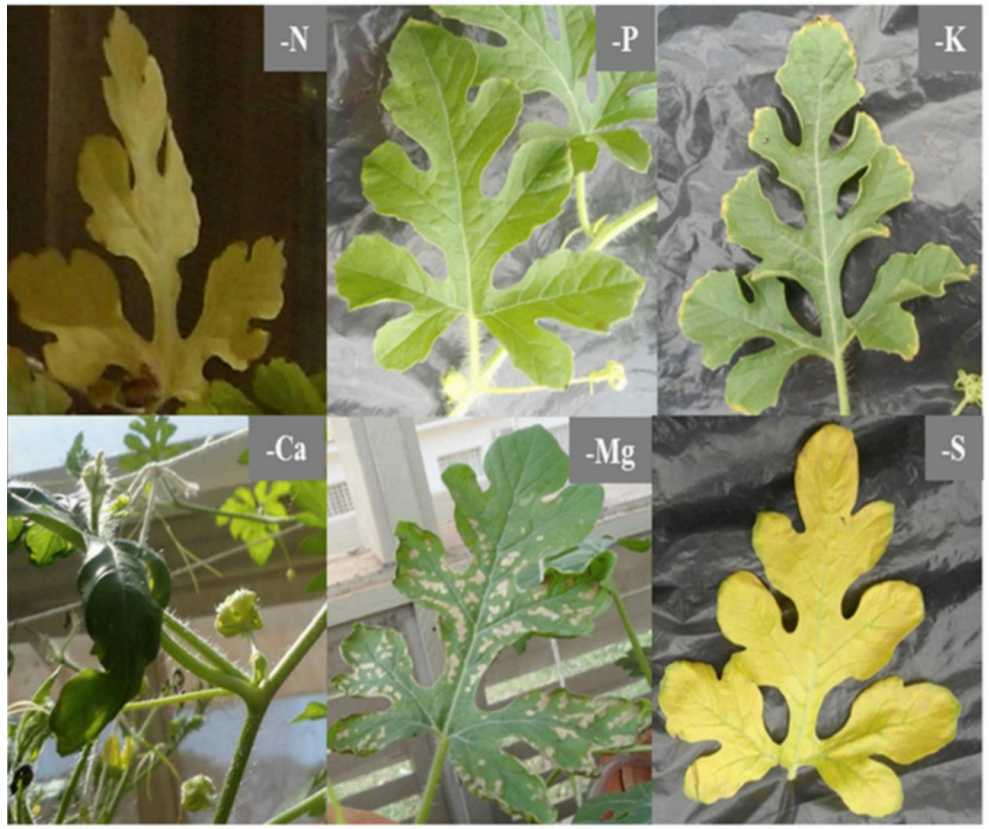
- Reduced available water content
- Reduced water uptake area
- Limits root extension
  - PR > ~1000kPa
- Inhibits root extension
  - PR > ~2000kPa



Nutrient deficiency

Reduced nutrient scavenge

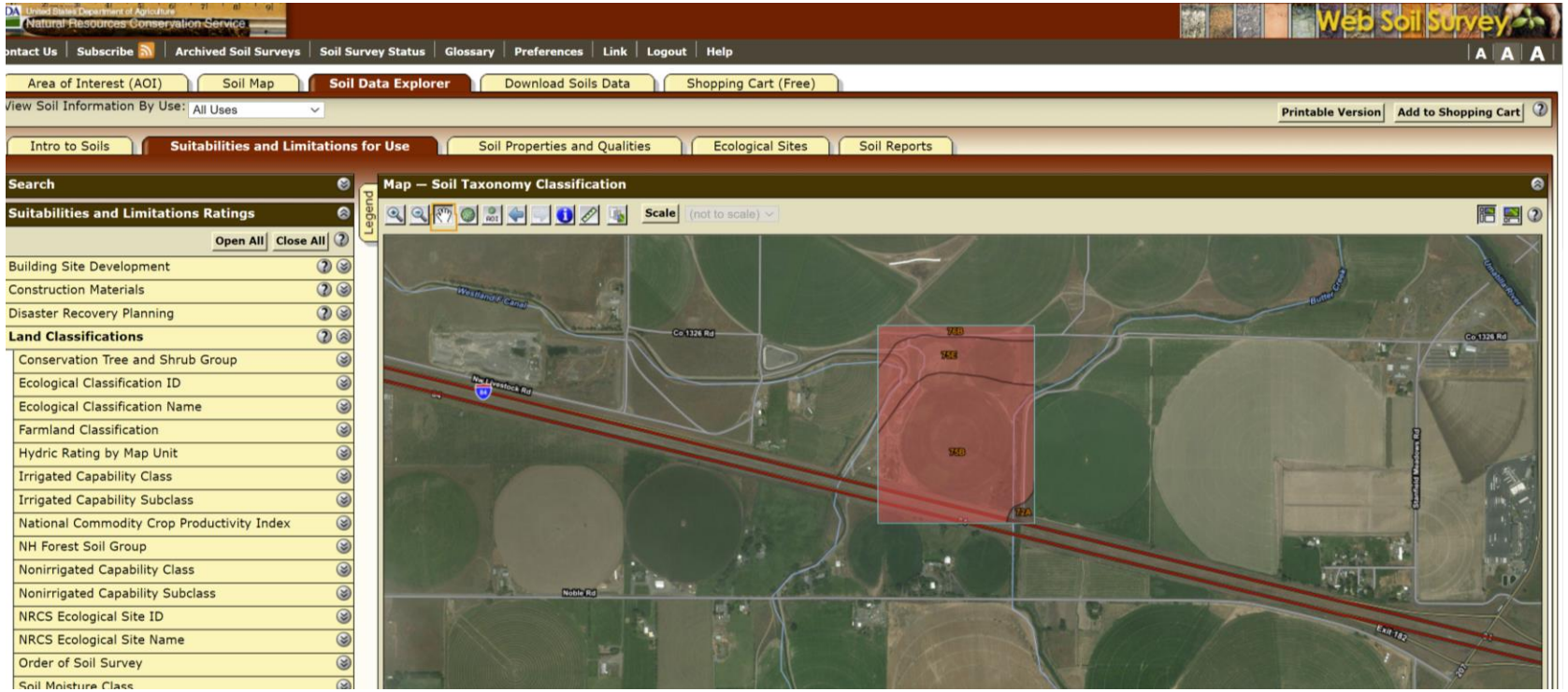
- Immobile nutrients
  - K, and P
- P-deficiency
  - Small leaves
  - Darks, dull green color
  - Abortion of female flowers
  - Small fruit; fruit deformation
- K-deficiency
  - Wavy young leaves
  - Leaf scorch (necrotic margins)
  - Small fruit



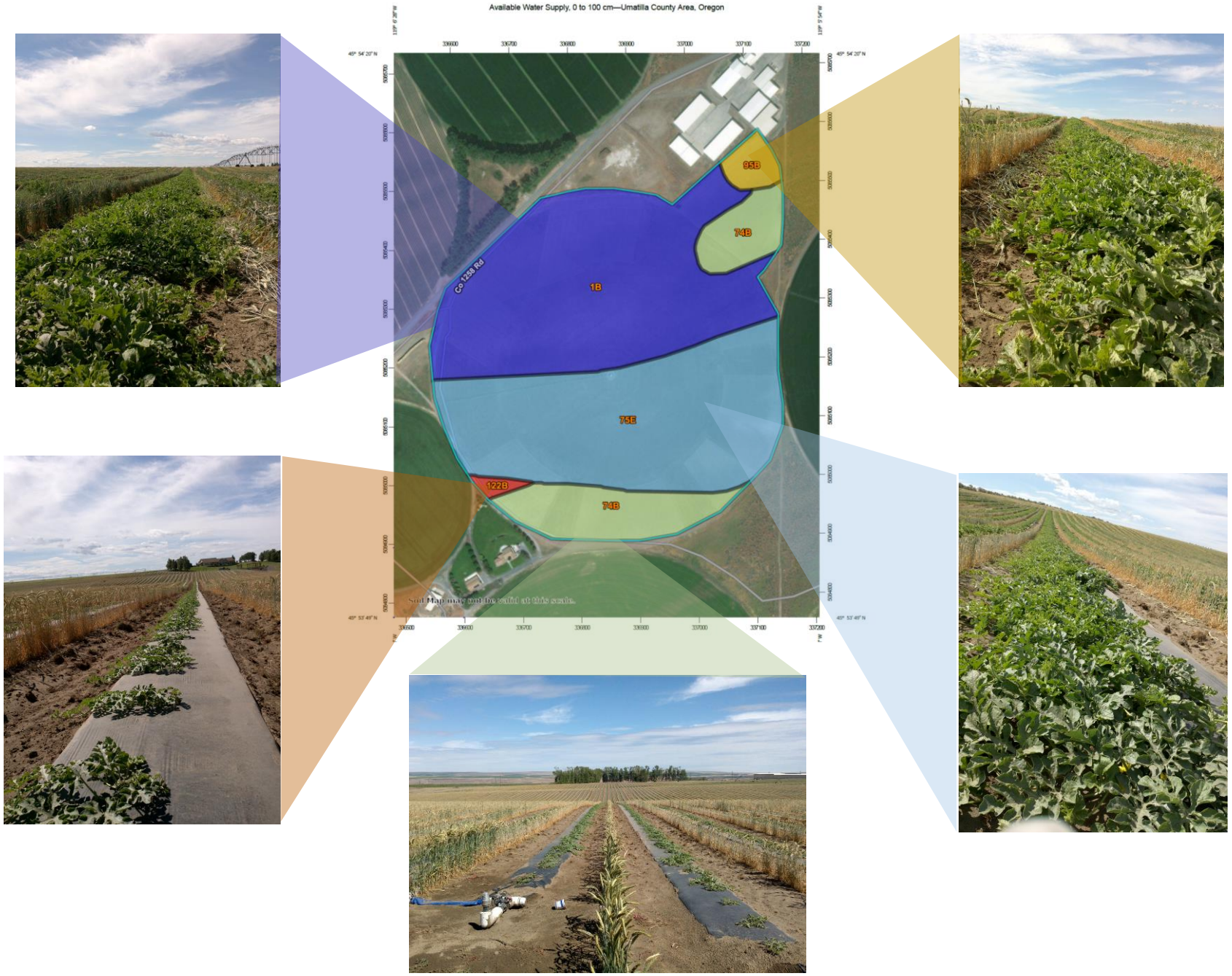
Experimental fields

Soil survey (SSURGO database)

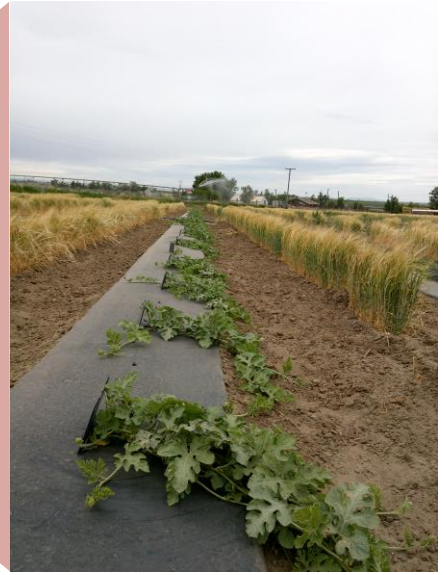
Soil class	*Acreage*	*Percent area*
• **95B**	1977	3%
• **74B**	2269	3.5%
• **1B**	10841	16.7%
• **75E**	1515	3.5%
• **122B**	4186	6.4%
• **75B**	5357.8	8.3%
		41.4 %



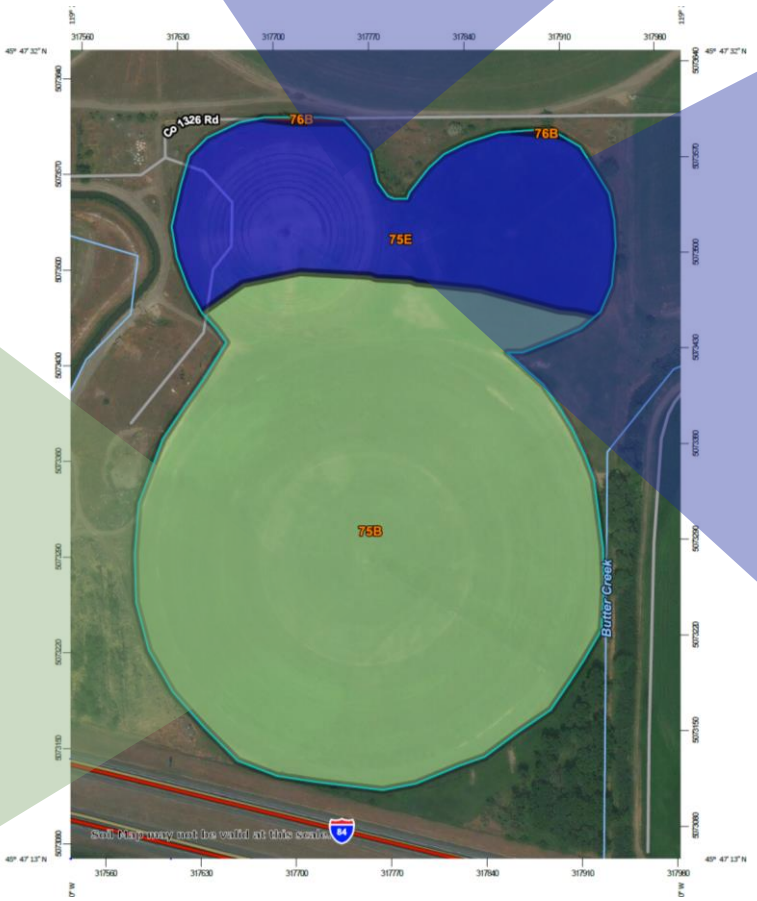
Field #1


Available Water Supply, 0 to 100 cm—Umatilla County Area, Oregon
95B
74B
1B
Co 1258 Rd
75E
122B
74B

Field #2



Field #3


317560
317630
317700
317770
317840
317910
317980
49° 47' 32" N
49° 47' 13" N
5072960
5072920
5072880
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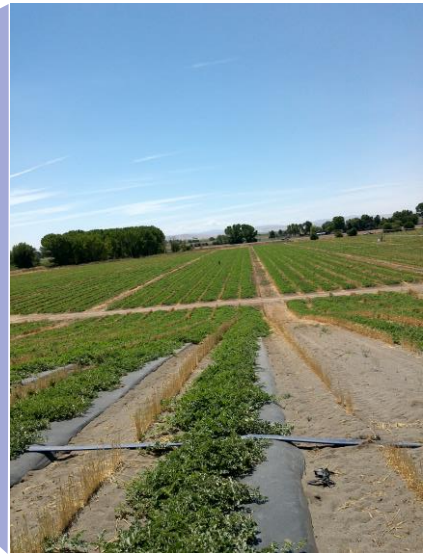
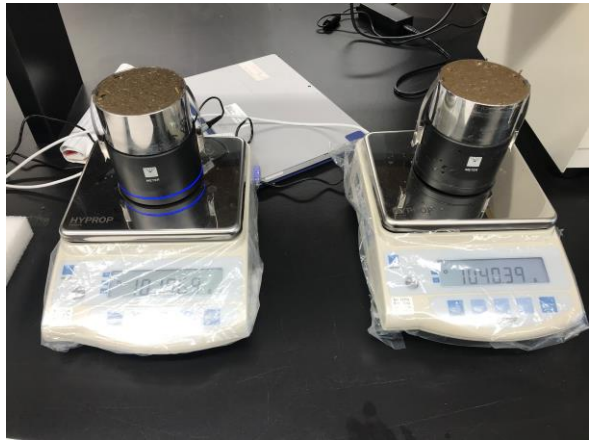
5072800
5072760
5072720
5072680
5072640
5072600
5072560
5072520
5072480
5072440
5072400
5072360
5072320
5072280
5072240
5072200
5072160
5072120
5072080
5072040
5072000
CR 1326 Rd
76B
76B
75E
75B
Butter Creek
64



Methodology

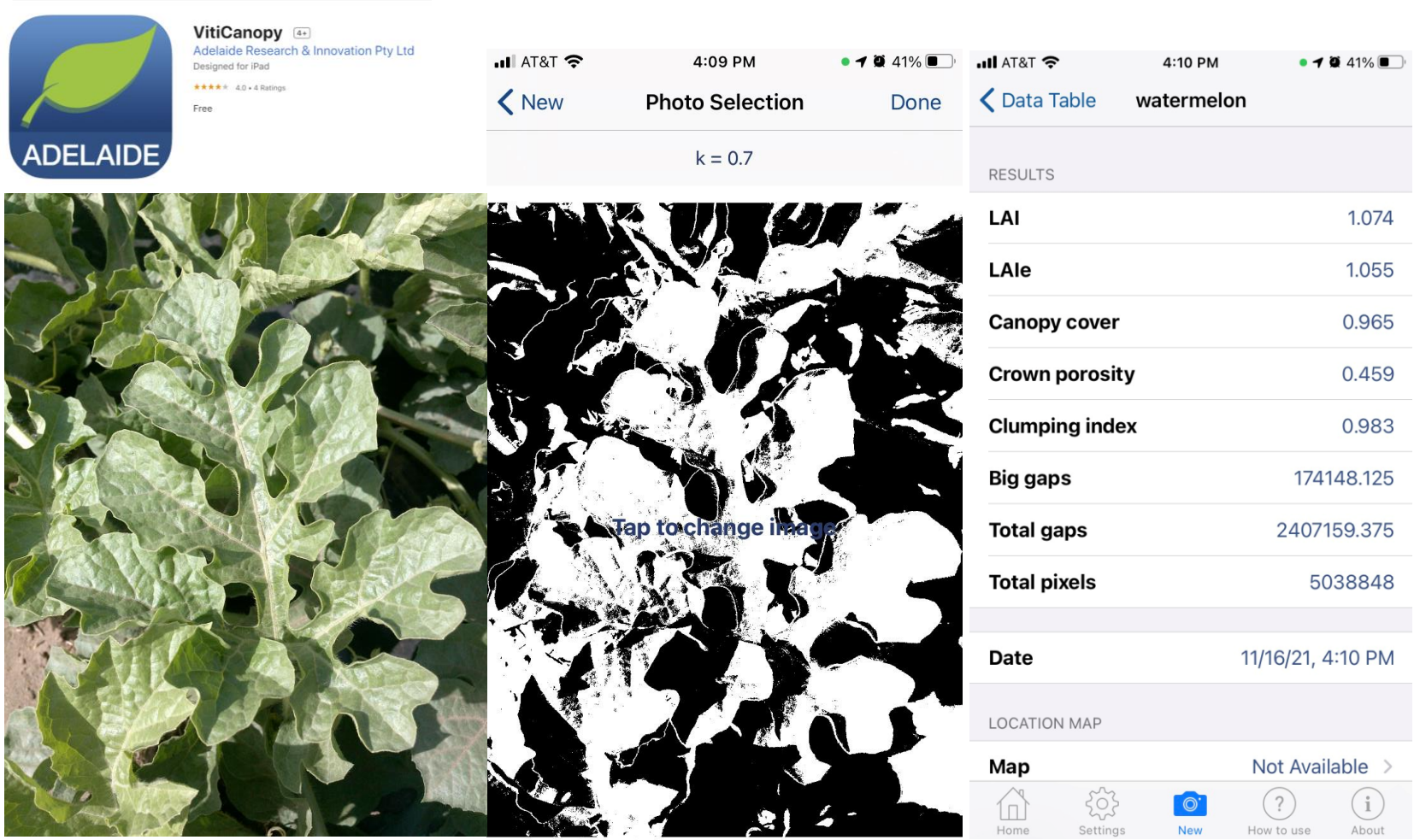
1. Intact soil cores were collected 0-25cm



2. Soil water release curve was obtained

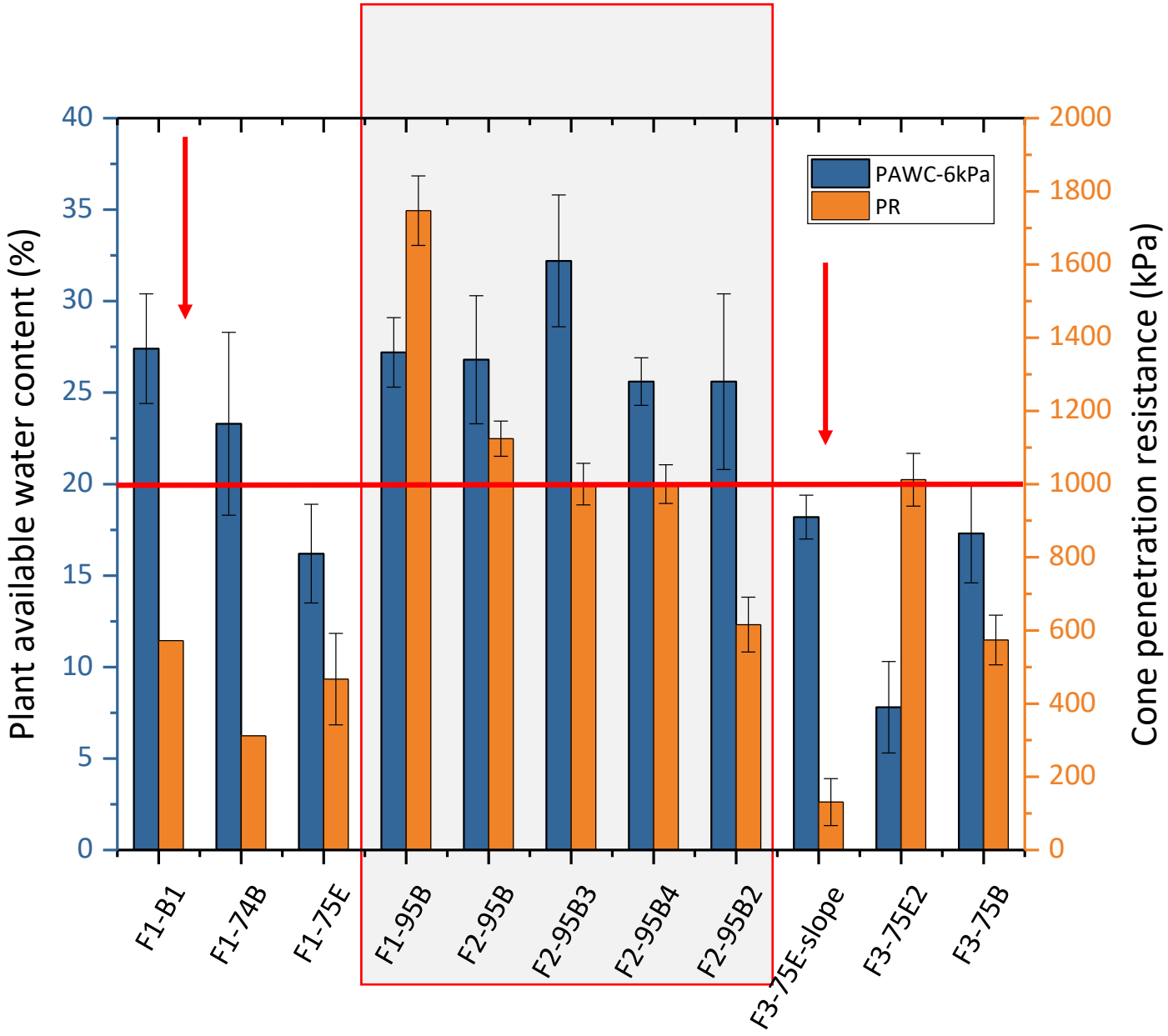
3. Penetration resistance at multiple soil moisture was measured

Leaf Area Index (LAI)

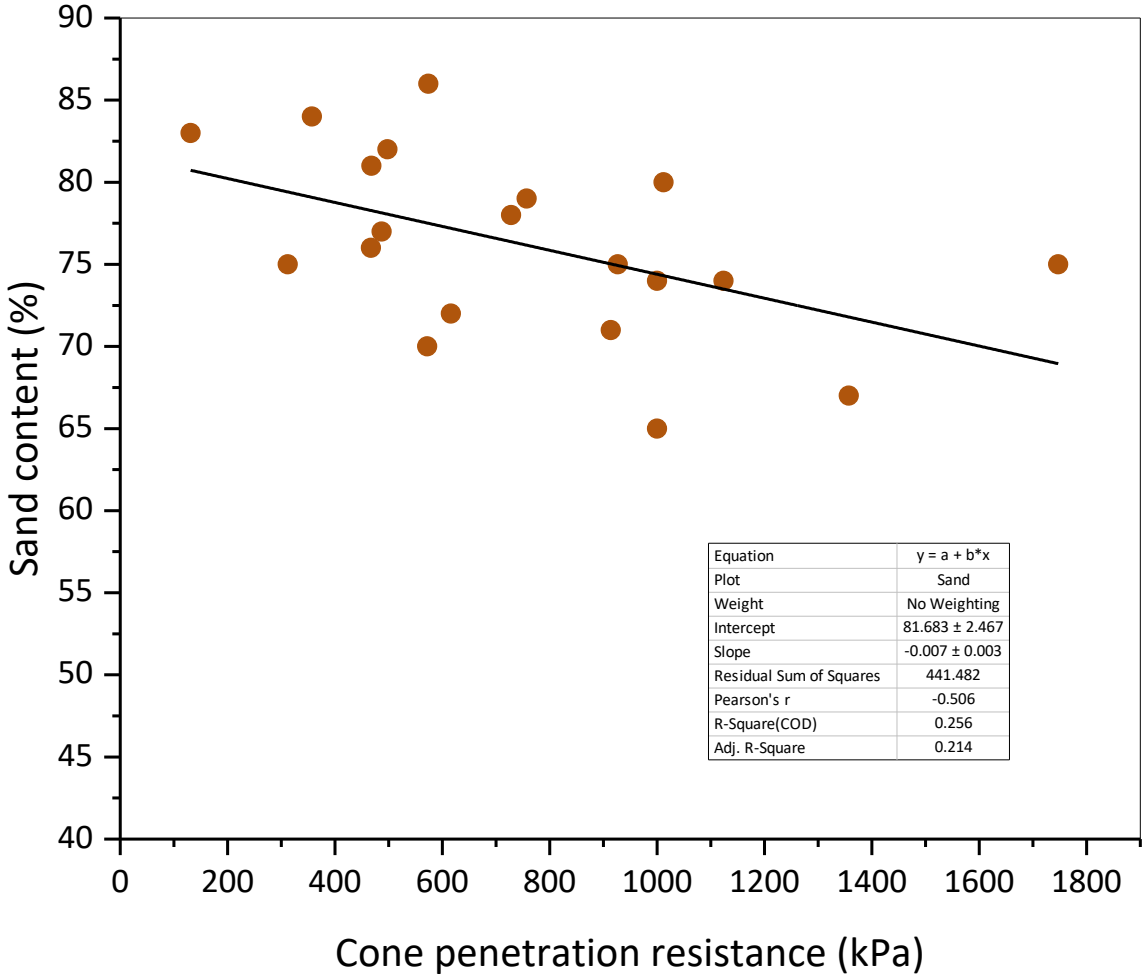


Results

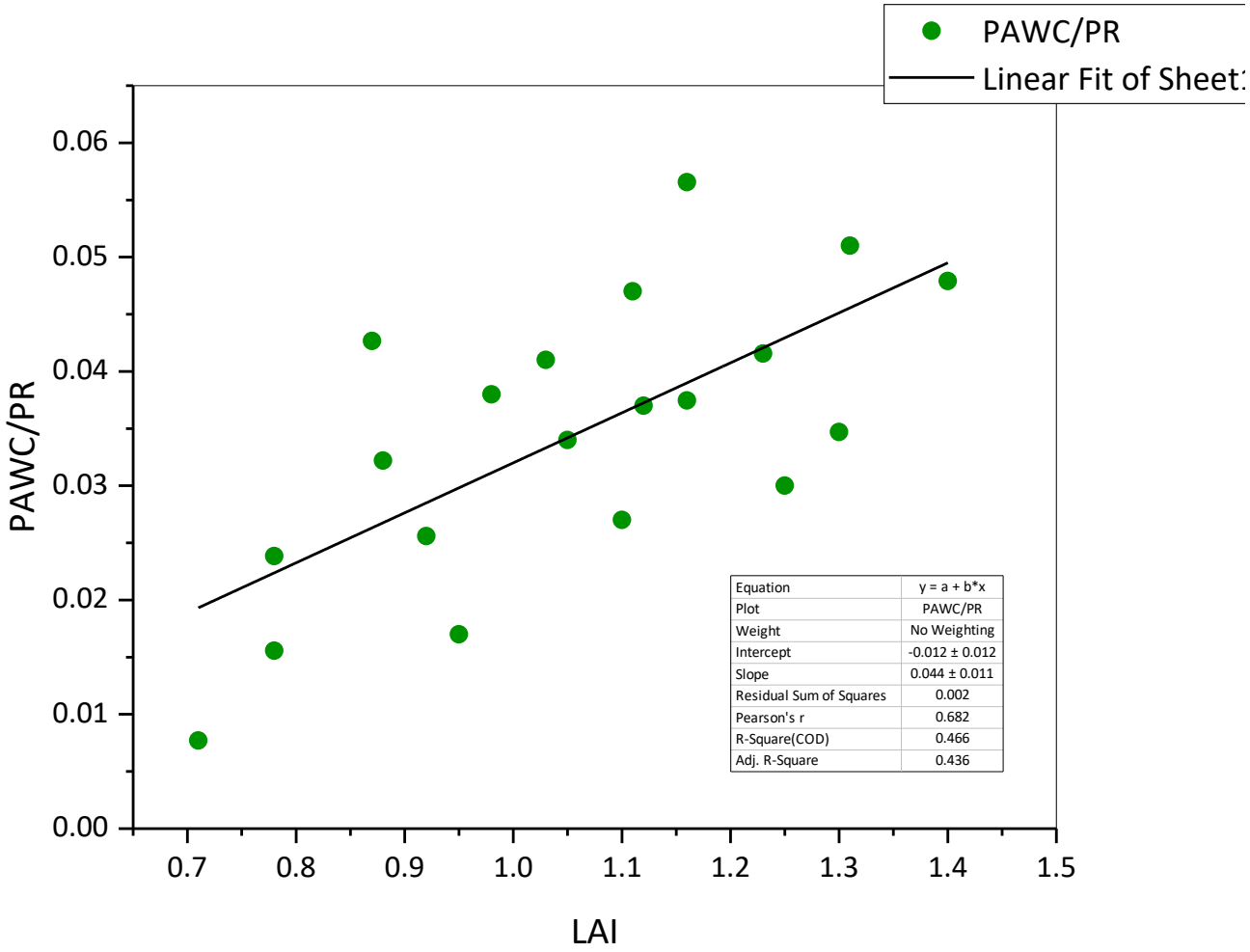
- Available water/PR is low in **95B** soil class
- **B1** and **74B** soil classes were outstanding
- Slope reduces *root penetration resistance*, but also reduces *plant available water holding capacity* (PAWC)



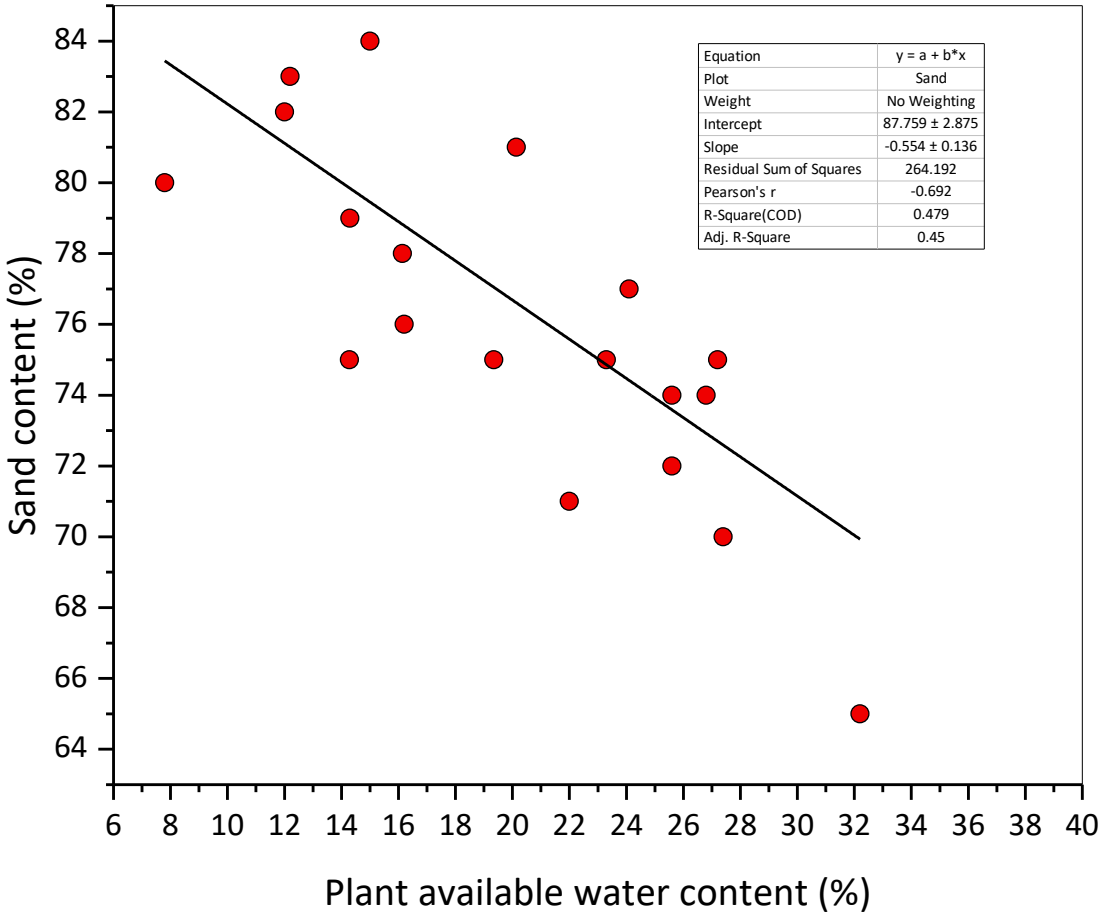
Soil sand content vs. root penetration resistance



Leaf Area Index (LAI) vs. PAWC/PR ratio

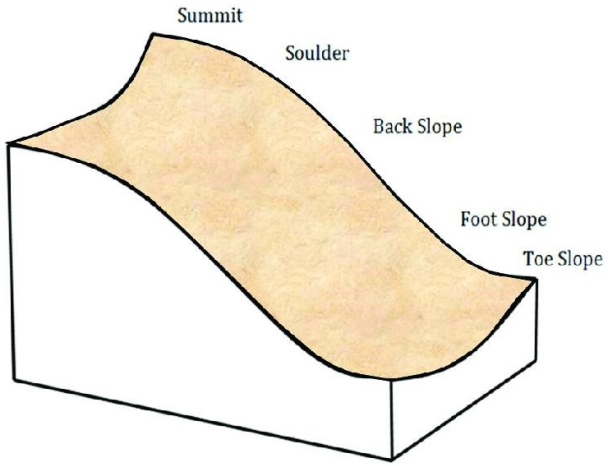


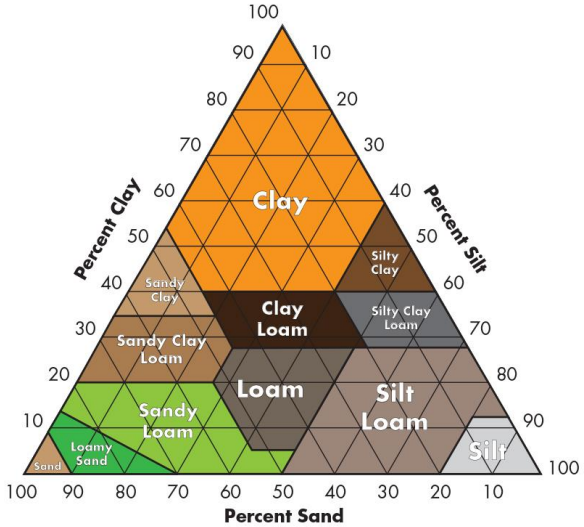
Soil sand content vs. PAWC



Take home message

- The studied soils comprise **41%** of soil types in the Lower Umatilla Basin
- **Soil class 95B** may limit watermelon yielc due to consolidation
- **B1** and **74B** soil classes were outstanding
- In general, **toeslope** alluvial soils show greater PAWC/PR ratio (more favorable) than **shoulder** and **backslope**
- Measure cone penetration resistance along with the soil moisture monitoring
- Soil texture considerably affect the PAWC/PR ratio





Thank you!

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