2019 AIM Science & Tech Project Results

Ryan Barrett

Research & Agronomy Specialist, Prince Edward Island Potato Board

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AIM Science & Tech Projects

- Subsoiling Ahead of Planter
- Fall Hilling
- Developing Management Zones with Soil Electroconductivity
- Measuring Compaction with Soil Electroconductivity

Subsoiling Ahead of the Planter

- Worked with a couple of growers to look at measuring the impact of deep tillage (ripping).
- Wanted to directly measure the depth of a compaction layer and then do ripping just underneath it to fracture that compaction layer in relatively dry conditions.
- Ripper shanks are more common on potato planters in Western Europe, saving a pass in the field

Subsoiling Ahead of the Planter

- 2 fields in East Prince
- Morgan and I did penetrometer readings to measure compaction levels and also to try and identify the presence/depth of compaction layer (plough pan)
- We then dug some holes to verify the depth of the compaction layer
- Did two strips of deep tillage with the same machine in each field relatively close to each other. Took 10 foot yield samples in strips as well as non-tilled areas immediately next to strips

Subsoiling Ahead of the Planter

Subsoiling Ahead of the Planter

Field A

Field B

Subsoiling Ahead of the Planter

Field A:

- Russet Burbank planted June 1st
- Preceding crop: Brown Mustard
- Depth of Compaction Layer: 12-13 inches

Treatment	Gross Yield Cwt/acre	% smalls	% 10 oz	Specific Gravity	Market Yield Cwt/ac	$/acre
No Ripping	298.0	15.0	20.7	1.071 a	259.2 a	$2905 a
Ripping at 16 inches	333.5	12.2	20.5	**1.079 b**	**306.3 b**	**$3466 b**
Difference	+35.5	-2.8	-0.2	**+0.008**	**+47.1**	**$561**

Subsoiling Ahead of the Planter

Field B:

- Russet Burbank planted June 1st
- Preceding crop: Brown Mustard
- Depth of Compaction Layer: 10 inches

Treatment	Gross Yield Cwt/acre	% smalls	% 10 oz	Specific Gravity	Market Yield Cwt/ac	$/acre
No Ripping	324.3	21.1	1.2	1.075	266.5	$2768
Ripping at 15 inches	320.0	23.7	1.3	1.074	252.0	$2587
Difference	-4.3	+2.6	+0.1	-0.001	-14.5	-$181

- Not significantly different
- We think that we ripped too deep. Operator had a hard time keeping it above 15 inches.

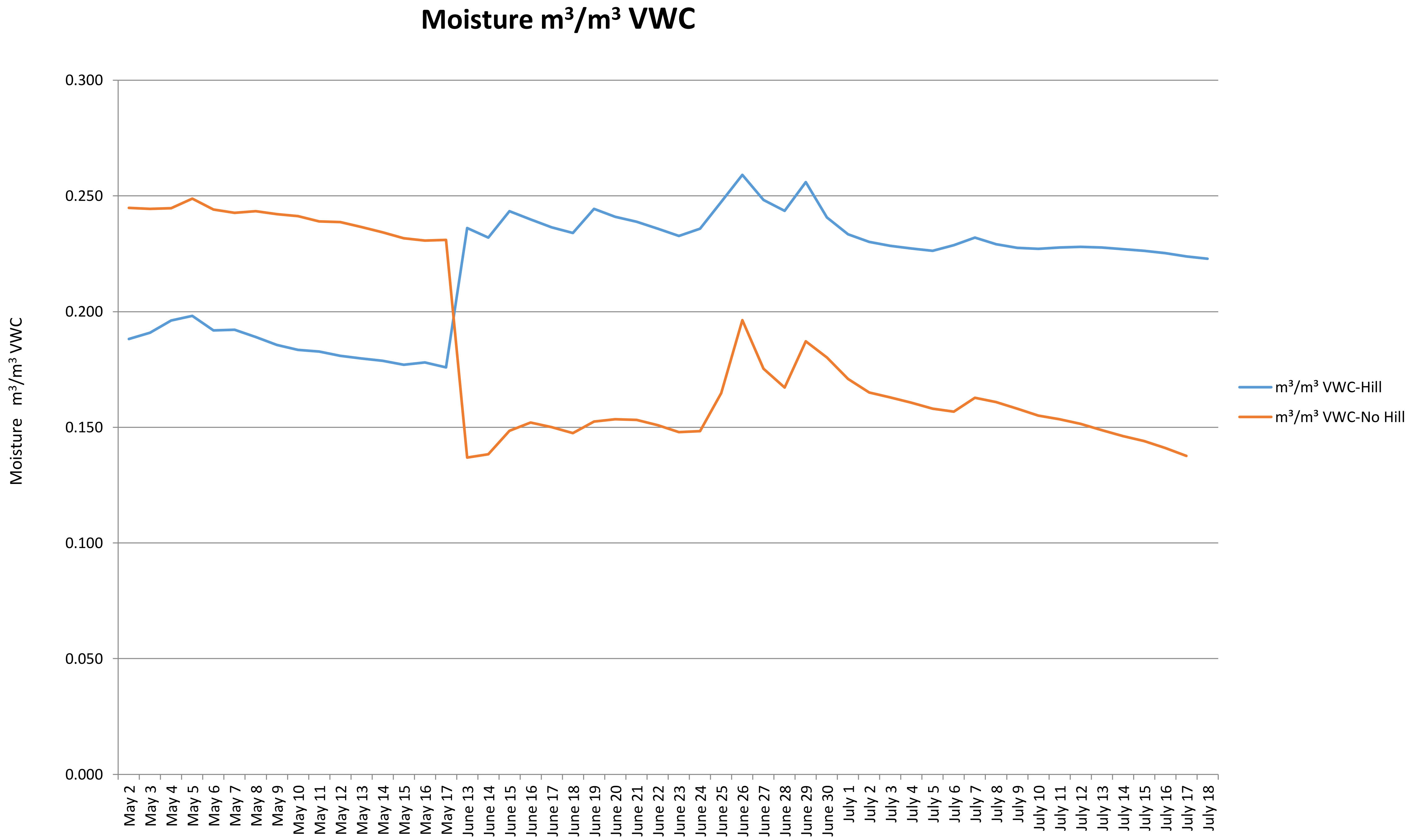
Subsoiling Ahead of the Planter

2020 Plans

- Ripping ahead of the planter – 3-4 fields
- Set some fields up to rip in the summer/early fall to compare against ripping ahead of the planter and no ripping in 2021
- Looking for growers interested in this trial!

Fall Hilling

- Continuation of work begun in the fall of 2017
- Three more fields hilled in the fall of 2018, potatoes in 2019
- Hilling done in early to mid-September with cover crop sown at the same time.
- Planted directly into those hills in the spring without additional tillage pass.


Moisture m³/m³ VWC
Moisture m³/m³ VWC
0.300
0.250
0.200
0.150
0.100
0.050
0.000
May 2
May 3
May 4
May 5
May 6
May 7
May 8
May 9
May 10
May 11
May 12
May 13
May 14
May 15
May 16
May 17
June 13
June 14
June 15
June 16
June 17
June 18
June 19
June 20
June 21
June 22
June 23
June 24
June 25
June 26
June 27
June 28
June 29
June 30
July 1
July 2
July 3
July 4
July 5
July 6
July 7
July 8
July 9
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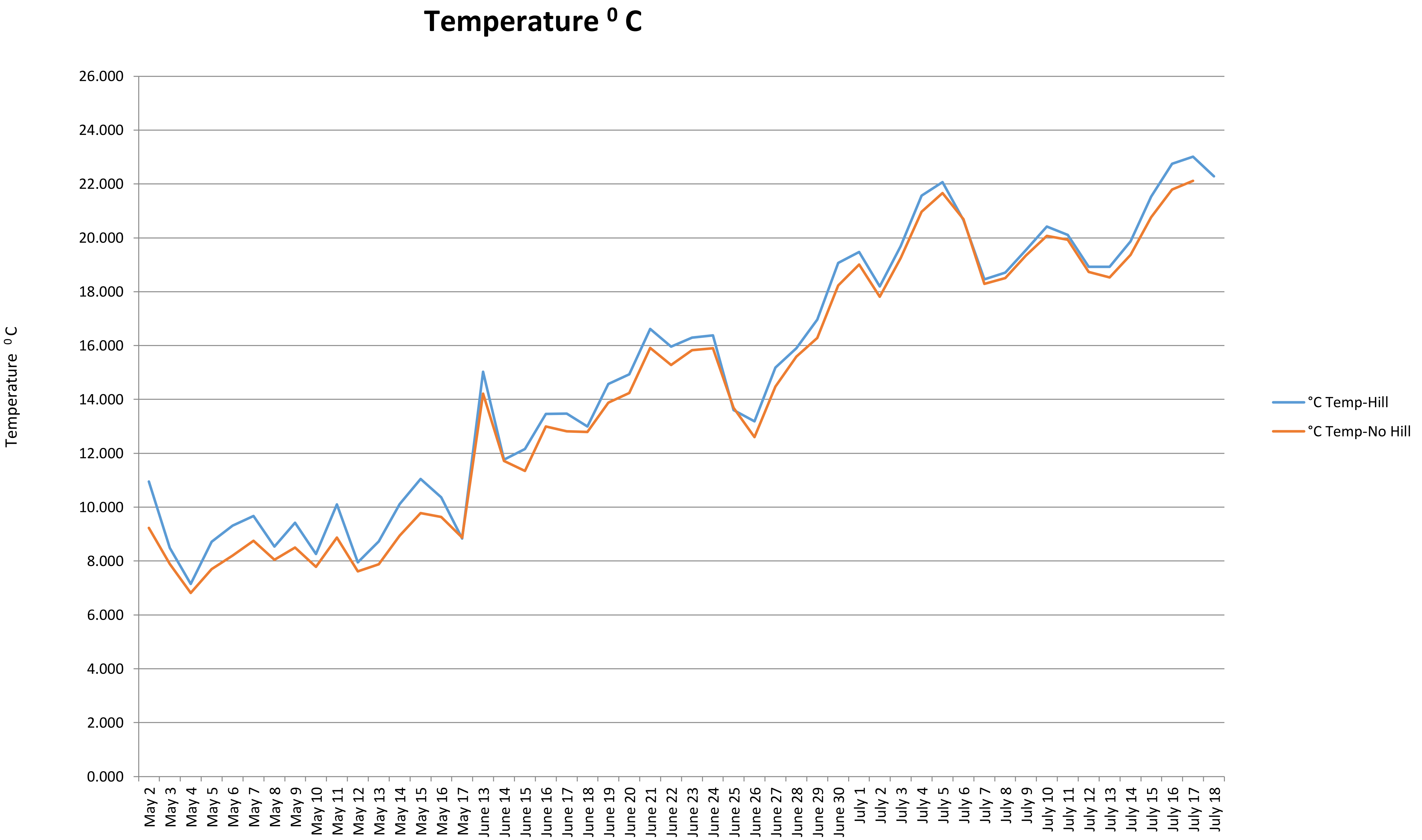
July 11
July 12
July 13
July 14
July 15
July 16
July 17
July 18
m³/m³ VWC-Hill
m³/m³ VWC-No Hill


Temperature 0 C
Temperature 0 C
26.000
24.000
22.000
20.000
18.000
16.000
14.000
12.000
10.000
8.000
6.000
4.000
2.000
0.000
°C Temp-Hill
°C Temp-No Hill
May 2
May 3
May 4
May 5
May 6
May 7
May 8
May 9
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May 11
May 12
May 13
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May 15
May 16
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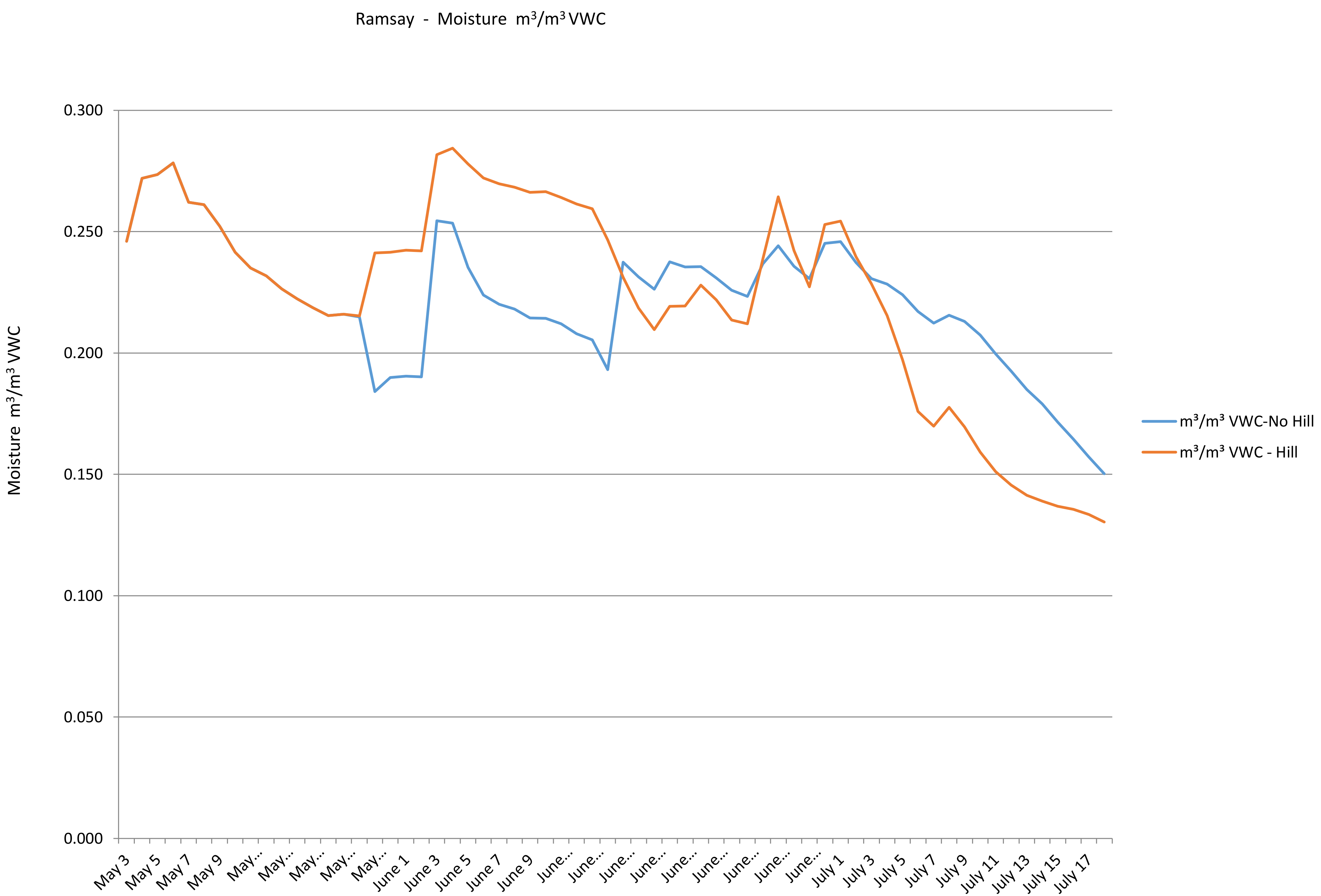
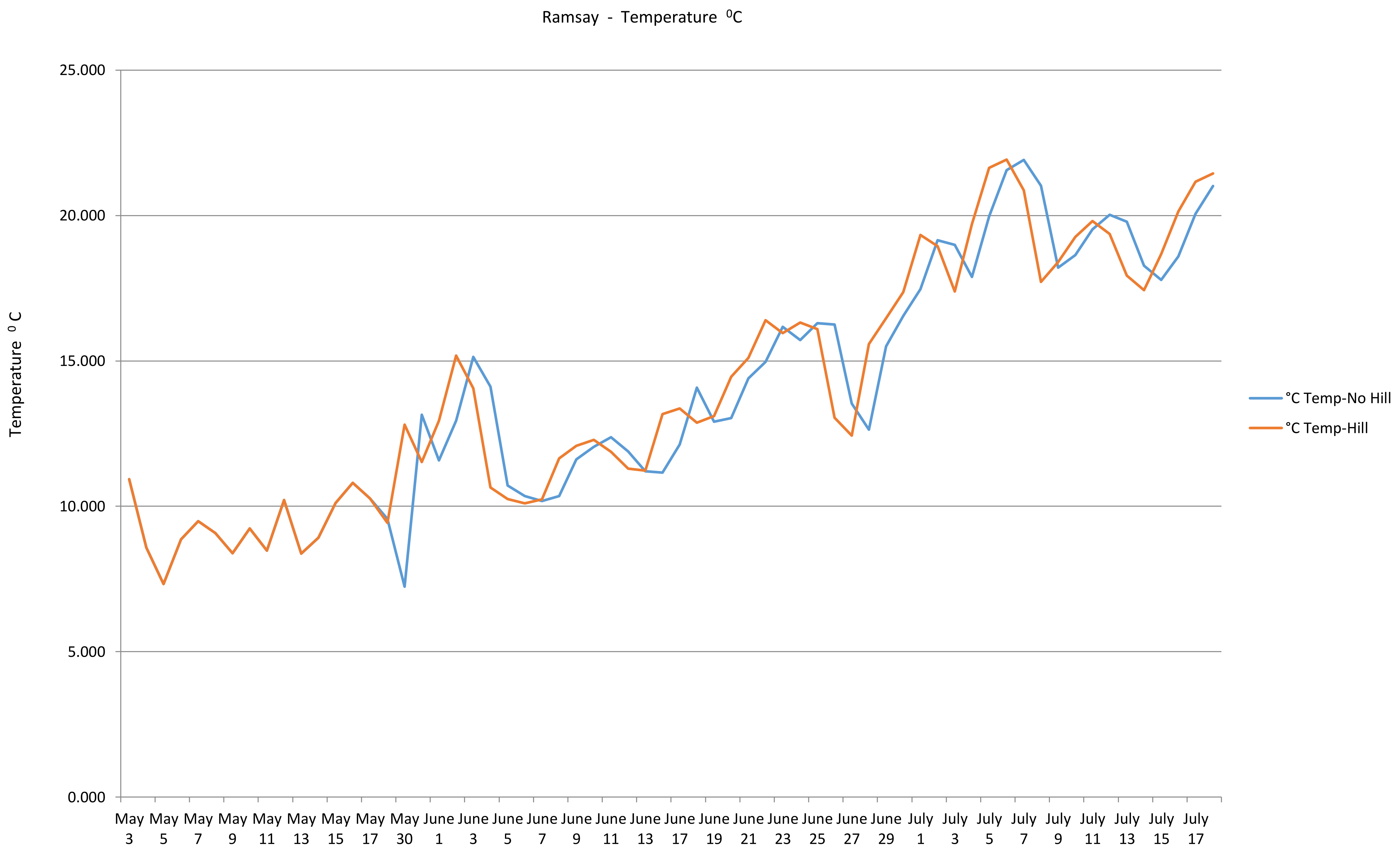
July 17
July 18



Ramsay - Moisture m3/m3 VWC
Moisture m3/m3 VWC
0.300
0.250
0.200
0.150
0.100
0.050
0.000
May 3
May 5
May 7
May 9
May...
May...
May...
May...
May...
June 1
June 3
June 5
June 7
June 9
June...
June...
June...
June...
June...
June...
June...
June...
June...
July 1
July 3
July 5
July 7
July 9
July 11
July 13
July 15
July 17
m3/m3 VWC-No Hill
m3/m3 VWC - Hill



Ramsay - Temperature °C
Temperature °C
25.000
20.000
15.000
10.000
5.000
0.000
May 3
May 5
May 7
May 9
May 11
May 13
May 15
May 17
May 30
June 1
June 3
June 5
June 7
June 9
June 11
June 13
June 17
June 19
June 21
June 23
June 25
June 27
June 29
July 1
July 3
July 5
July 7
July 9
July 11
July 13
July 15
July 17
°C Temp-No Hill
°C Temp-Hill

Summary Data from 2018 Fall Hilling Trials

Site 1: Russet Burbank (both sides cover crop)

Treatment	Total Yield (cwt)	% Total Defects	% Smalls	% 10 oz	Gravity	Pay Yield (cwt)	Payout/acre
Fall Hilled	333	7	25	16	1.085	251	2740
Spring Hilled	337	9	28	16	1.084	236	2518
difference	**-4**	**-2**	**-3**	**0**	**0.001**	**15**	**222**

Site 2: Prospect (both sides cover crop)

Treatment	Total Yield (cwt)	% Total Defects	% Smalls	% 10 oz	Gravity	Pay Yield (cwt)	Payout/acre
Fall Hilled	349	18	7	1	1.096	277	2922
Spring Hilled	351	24	8	6	1.093	257	2719
difference	**-2**	**-6**	**-1**	**-5**	**0.003**	**20**	**203**

Site 3: Ranger Russet (cover on fall hilled only)

Treatment	Total Yield (cwt)	% Total Defects	% Smalls	% 10 oz	Gravity	Pay Yield (cwt)	Payout/acre
Fall Hilled	336	21	16	14	1.094	238	2632
Spring Hilled	366	24	24	6	1.093	227	2555
difference	**-30**	**-3**	**-8**	**8**	**0.001**	**11**	**77**

Fall Hilling: 2019 Results

- Two fields of Russet Burbank, fall hilled vs spring hilled (both with cover in fall)

Treatment	Gross Yield Cwt/acre	% smalls	% 10 oz	Specific Gravity	Market Yield Cwt/ac	$/acre
A: Fall Hilled	354.0	12.8	18.1	1.079	322.5	$3677
A: Spring Hill	328.2	13.6	13.0	1.080	290.1	$3239

Treatment	Gross Yield Cwt/acre	% smalls	% 10 oz	Specific Gravity	Market Yield Cwt/ac	$/acre
B: Fall Hilled	314.5	23.0	7.5	1.083	247.8	$2747
B: Spring Hill	315.3	18.8	9.8	1.083	264.0	$3003

Fall Hilling: 2019 Results

- Prospects, including subsoiled treatment

Fall Hilling: 2019 Results

- Prospects, including subsoiled treatment

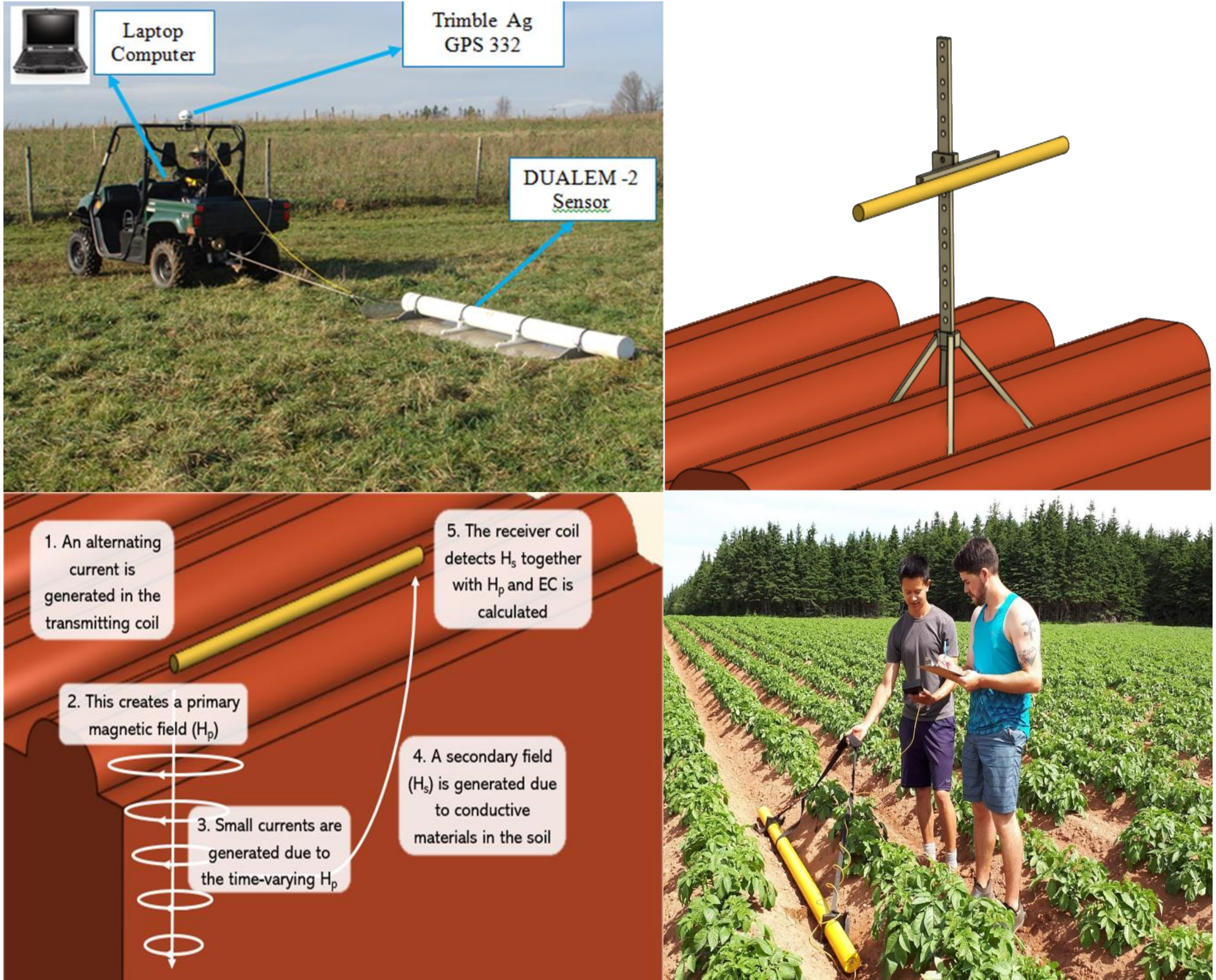
Treatment	Gross Yield Cwt/acre	% smalls	% 10 oz	Specific Gravity	Market Yield Cwt/ac	$/acre
Fall Hilled	297.7	8.3	24.3	1.089	280.7 a	$3359 a
Fall Hilled + Subsoiled	284.3	3.8	24.8	1.089	267.2 ab	$3091 ab
Spring Hilled	269.2	5.8	24.2	1.087	235.9 b	$2756 b

Fall Hilling: Results

- **Numerically positive at 5 out of 6 fields.** Statistically significant at 2 out of 6 at $p = 0.05$
- Does not appear to have negative impact on yield and would allow getting significant tillage, cover crop work done early, shortening amount of work in the spring
- With use of "freshening tool" and hill subsoiling, might have even greater impact.

Management Zones with Soil EC

- Third year of trials in 2019, four fields from west to east
- Can we use soil electroconductivity to create management zones (MZs) in order to potentially manage fields on a site-specific basis
  - VR fertility (N, K, Mg)
  - VR manure application (targeting low soil OM)
  - VR seed spacing (tighter spacing in best ground)
- Assessing soil EC data along side NDVI, soil test data and yields to validate if it’s a valuable tool here in PEI


Laptop Computer
Trimble Ag GPS 332
DUALEM -2 Sensor
1. An alternating current is generated in the transmitting coil
2. This creates a primary magnetic field (H_p)
3. Small currents are generated due to the time-varying H_p
4. A secondary field (H_s) is generated due to conductive materials in the soil
5. The receiver coil detects H_s together with H_p and EC is calculated

Objectives

- ✓Characterize and quantify variability - soil, crop, topography and yield,
- ✓Identify the significant factors affecting potato productivity,
- ✓Calibrate yield monitoring system testify its potential to be used as factor to develop MZs,
- ✓Sensors for an accurate prediction of the attributes of interest explaining significant variability
- ✓Develop MZs for site-specific application of agricultural input – Ensure economic and environmental sustainability.

PARAMETERS - DETERMINED

Soil Sampling/Analysis

Ph
EC
Lime Index
Moisture Content
Soil Chemical Properties
SOM
(P, K, Ca, Mg, Cu, B, Zn, Al, Mn, Na, CEC, Fe,..)

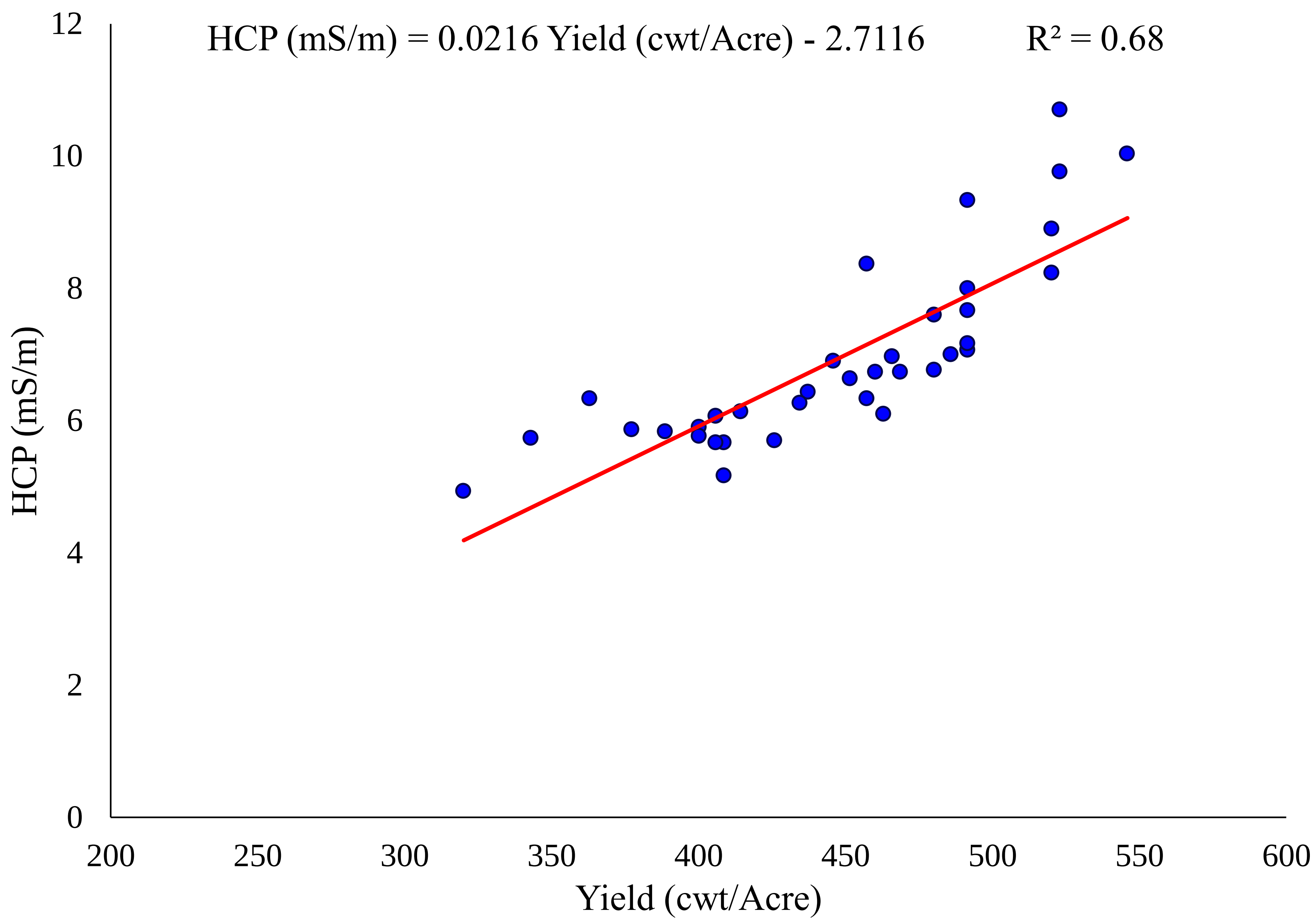
Sensors Data

HCP
PRP
Slope Sensor
NDVI
TDR

Potato Yield

Calibration of yield monitor
Geo-referenced yield collection

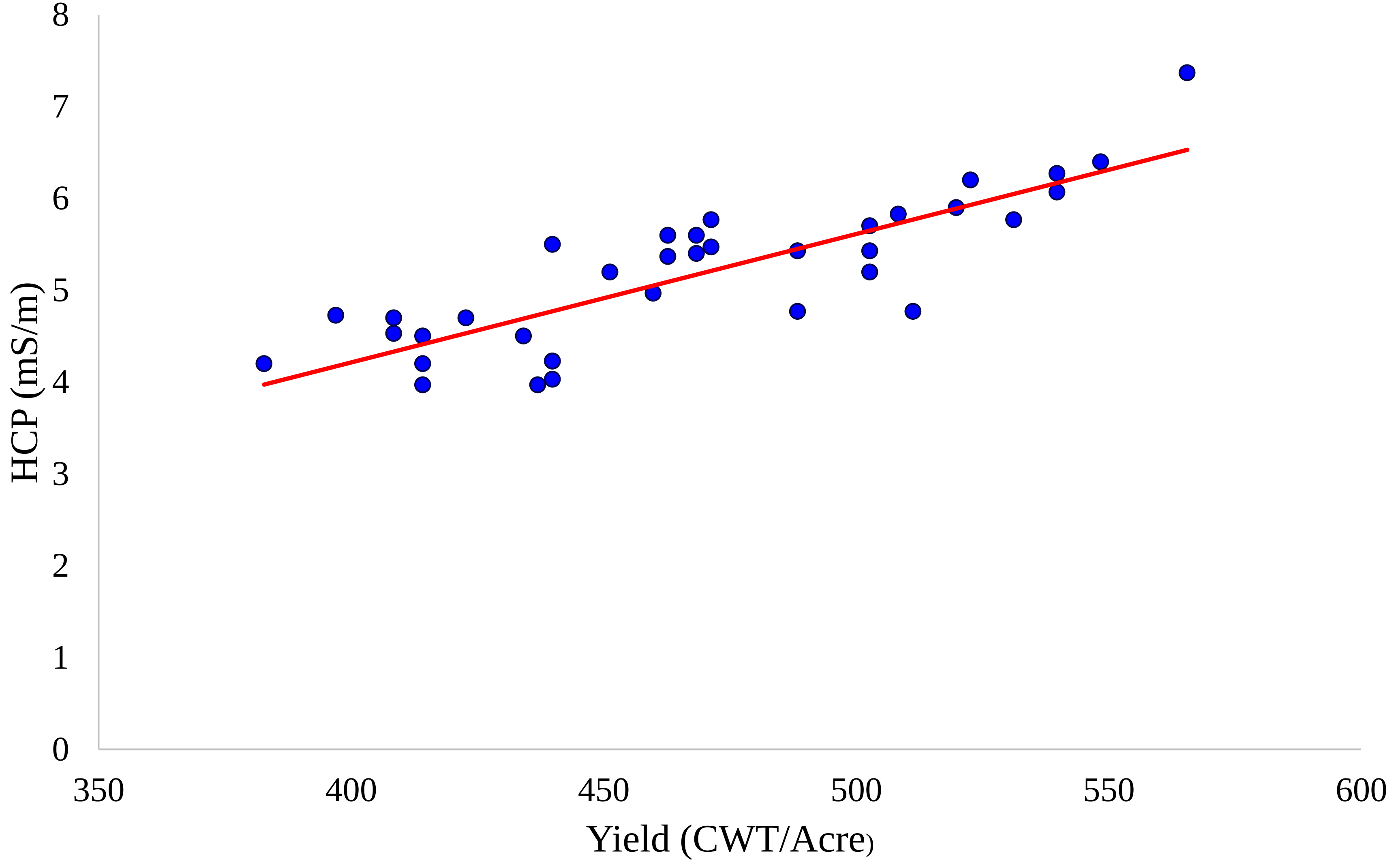
4 Samplings over the growing season



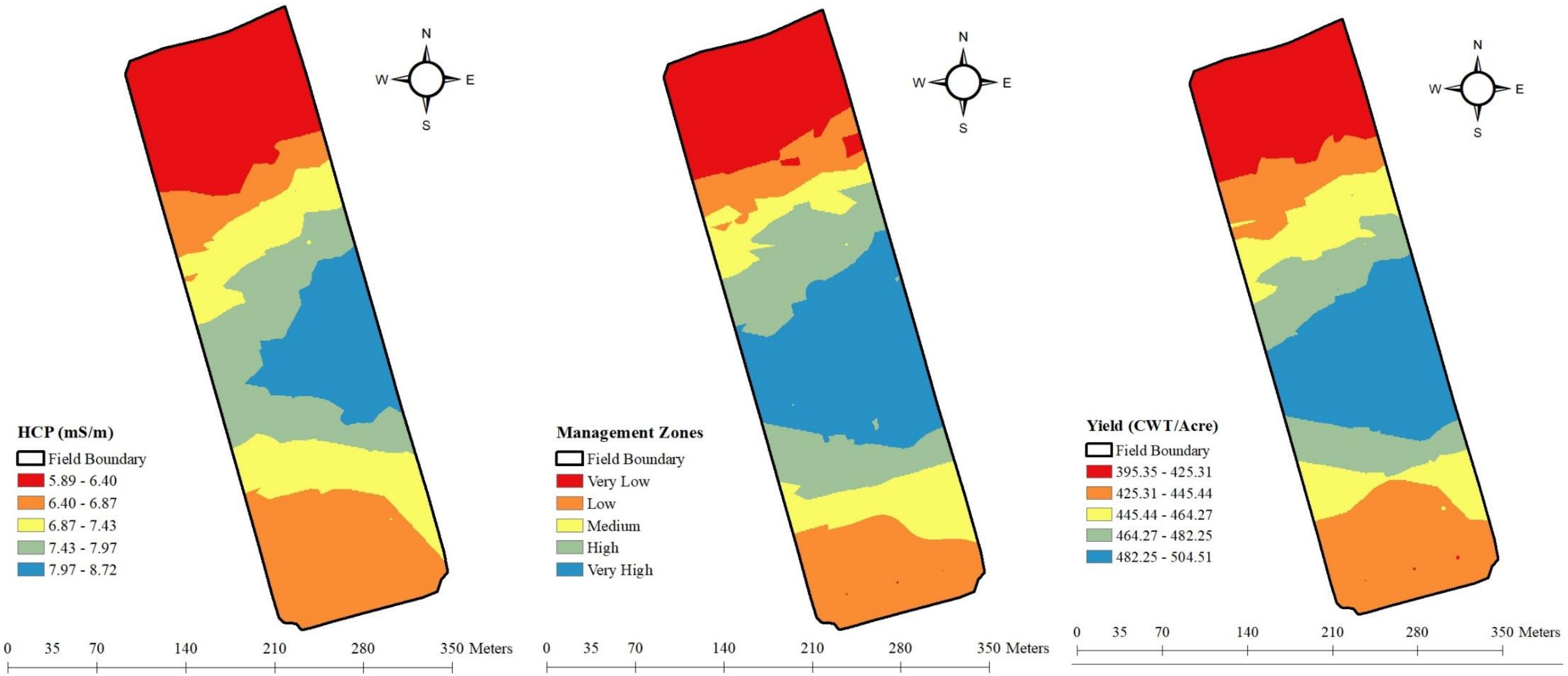
HCP (mS/m) = 0.0216 Yield (cwt/Acre) - 2.7116
R² = 0.68
HCP (mS/m)
Yield (cwt/Acre)
0
2
4
6
8
10
12
200
250
300
350
400
450
500
550
600

Multiple Regression

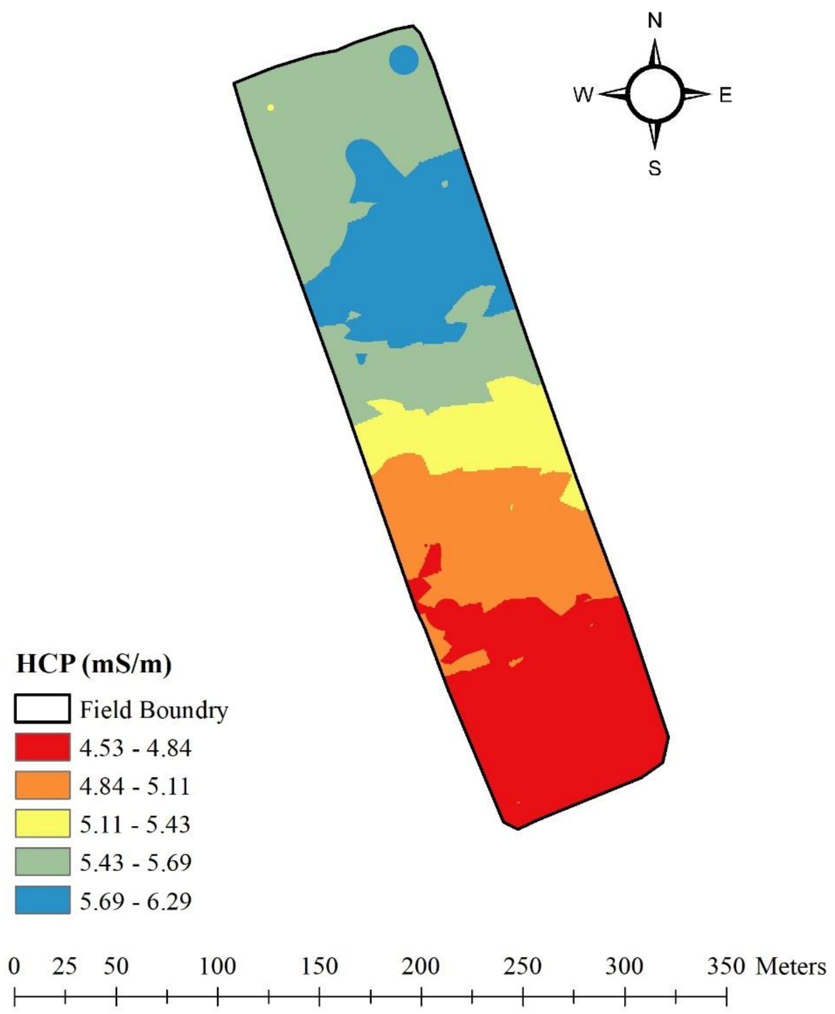
HCP(mS/m) = 204.5+50.77Yield (CWT/Acre)   R2 = 0.69

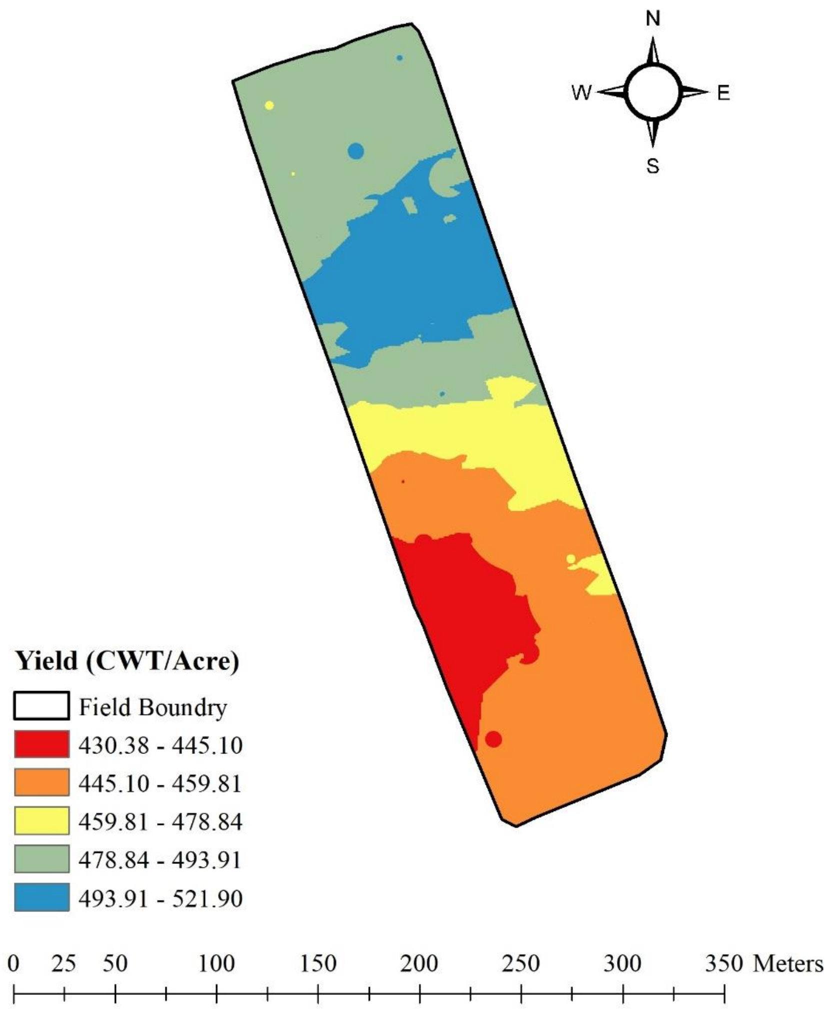


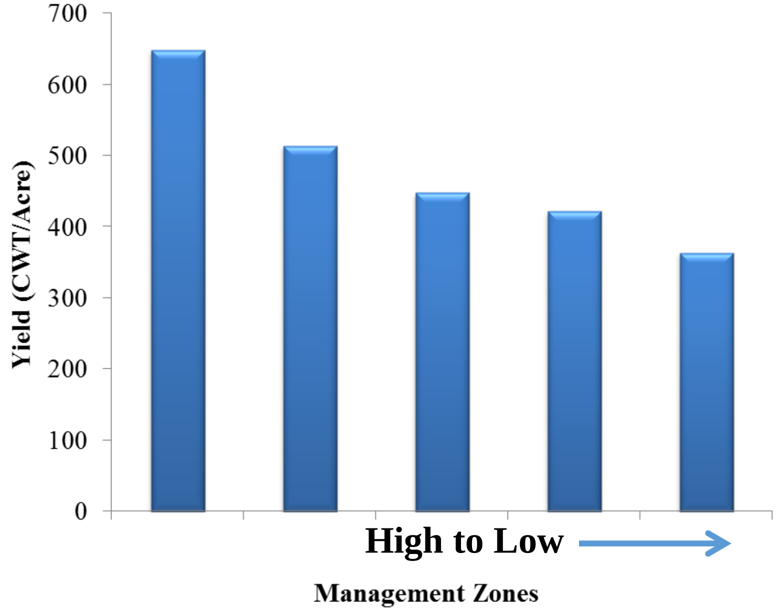
Management Zones - Bedeque

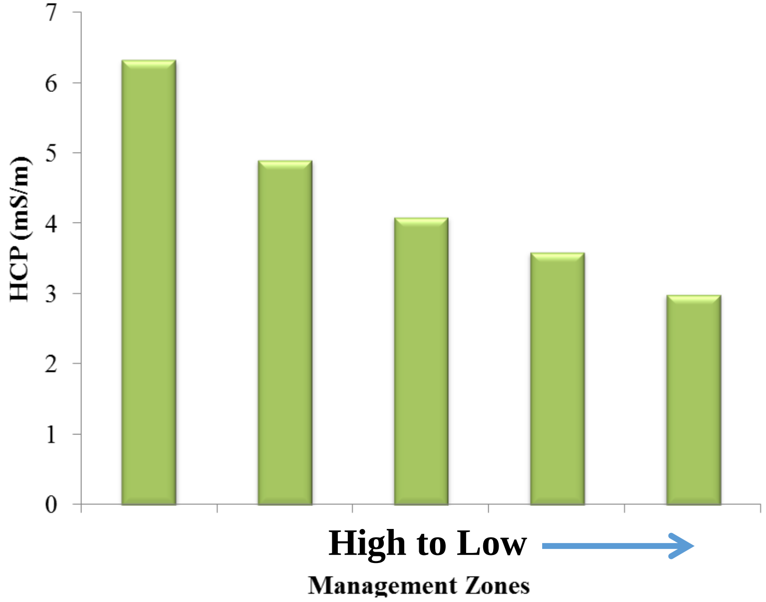


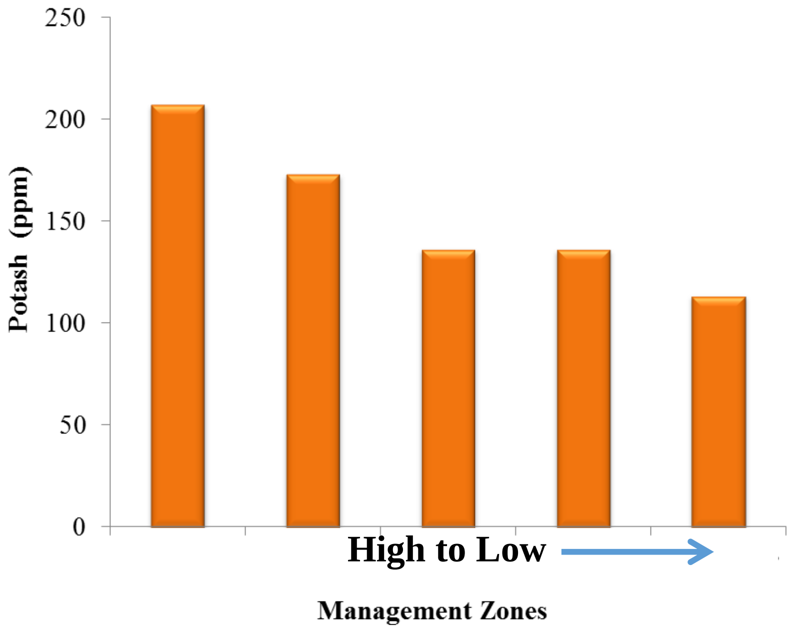
Management Zones -Souris

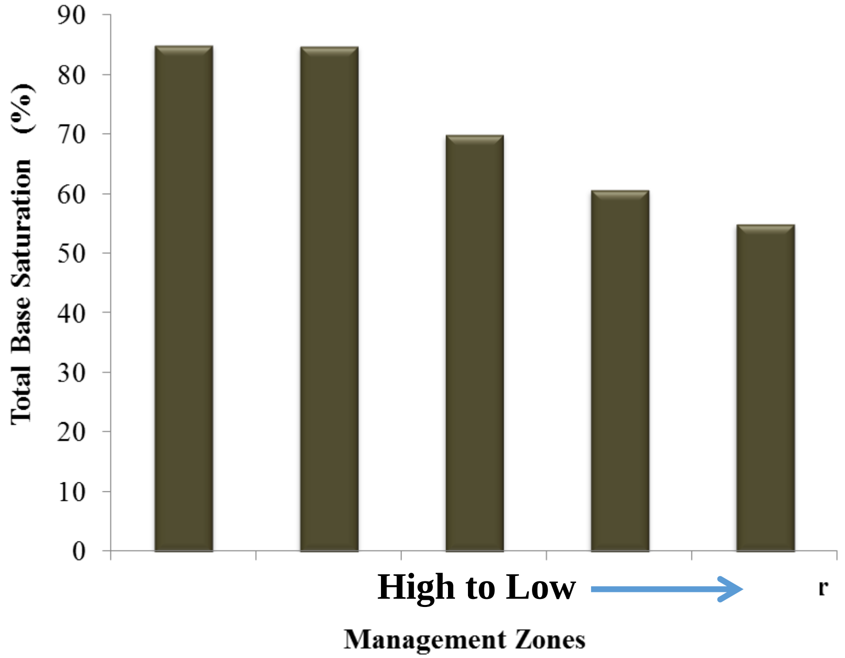




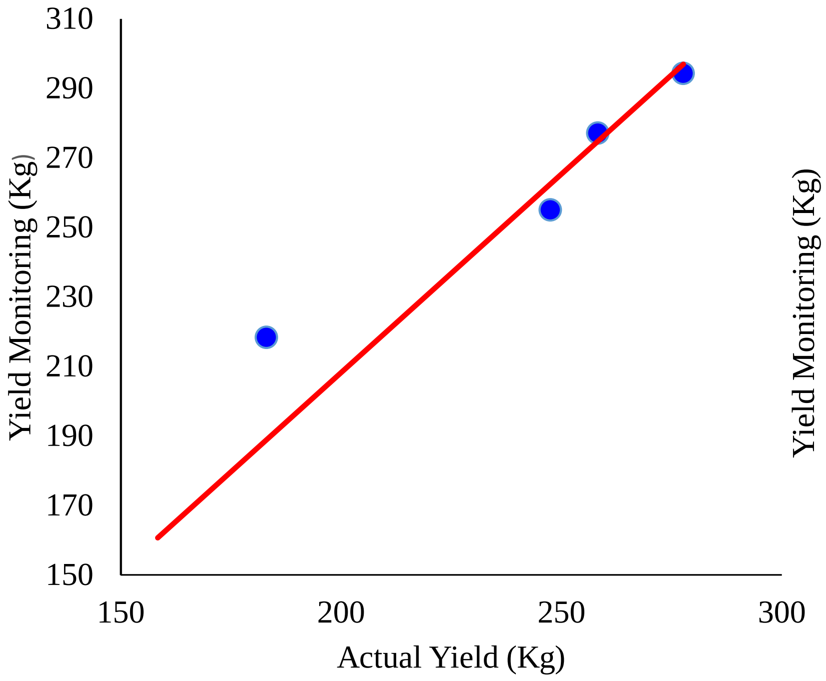

Yield (CWT/Acre)
700
600
500
400
300
200
100
0
High to Low
Management Zones

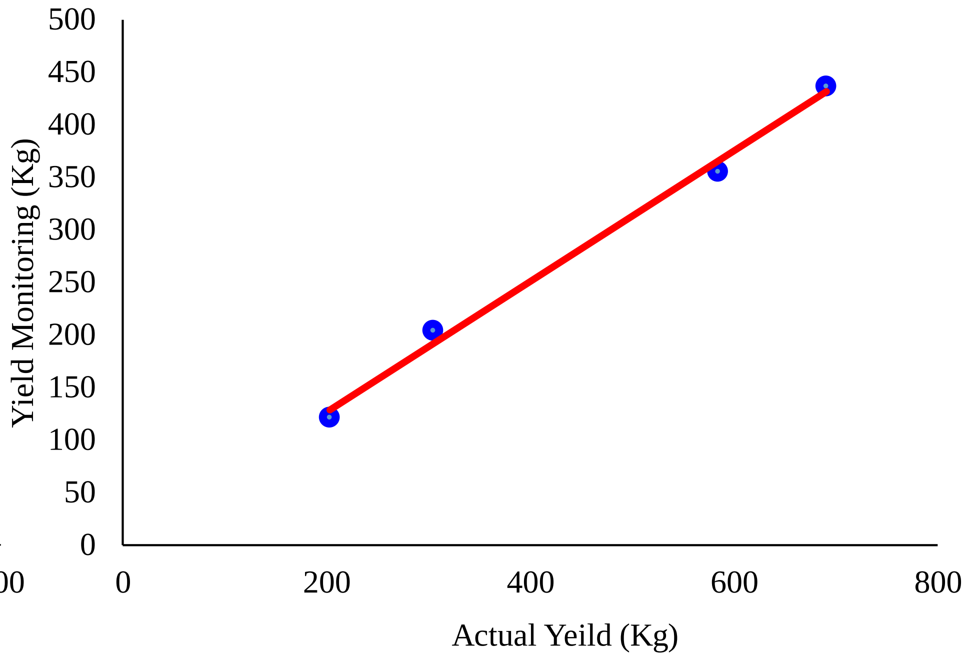

HCP (mS/m)
7
6
5
4
3
2
1
0
High to Low
Management Zones


Potash (ppm)
250
200
150
100
50
0
High to Low
Management Zones


Total Base Saturation (%)
90
80
70
60
50
40
30
20
10
0
High to Low
r
Management Zones

Yield Monitoring 2019





Field 1
$R^2 = 0.91$

RMSE = 18.1 Kg

Mean = 236 Kg

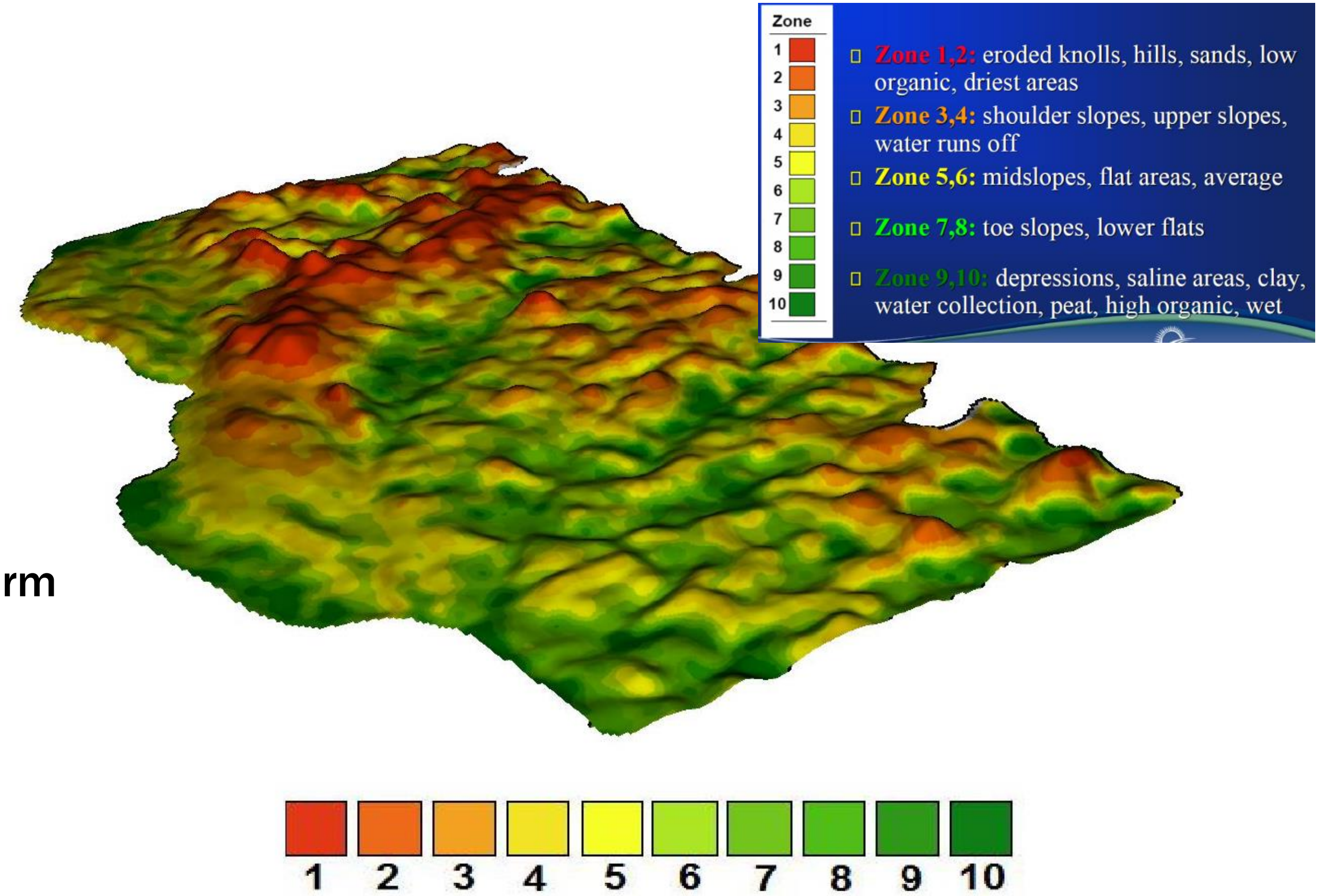
Field 2
$R^2 = 0.92$

RMSE = 20.1 Kg

Mean = 446.2 Kg

SWAT Maps (Soil, Water and Topography)

SWAT Zones are built from Soil, Water and Topography layers collected from Electroconductivity, RTK GPS and/or LiDAR elevation data, and soil sampling



SWAT Zone Map

SWAT Maps:

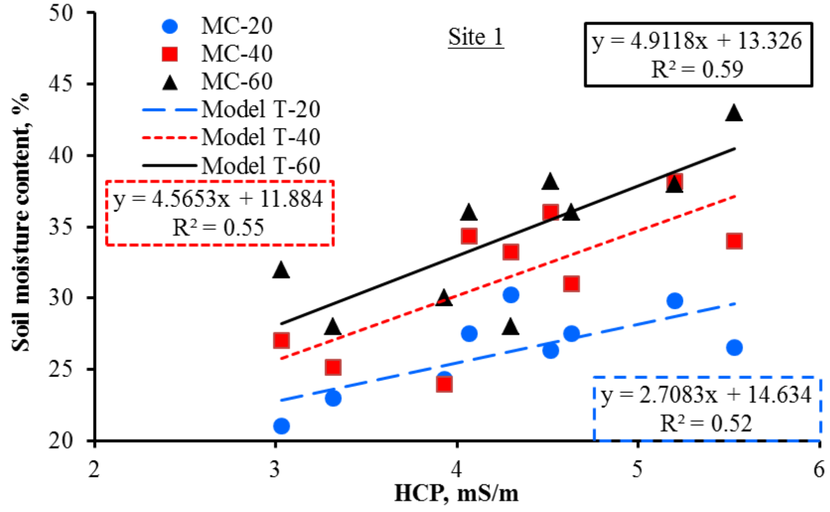
- Zones created from EC + Topography layers
- Zones are soil sampled and ground truthed to confirm accuracy
- Soil sampling requirements vs Grid method are significantly reduced on larger fields
- Potential applications – VR fertility, VR seeding/planting, soil moisture modeling, Compost/Manure application, and more.

Cavendish Agri Services™

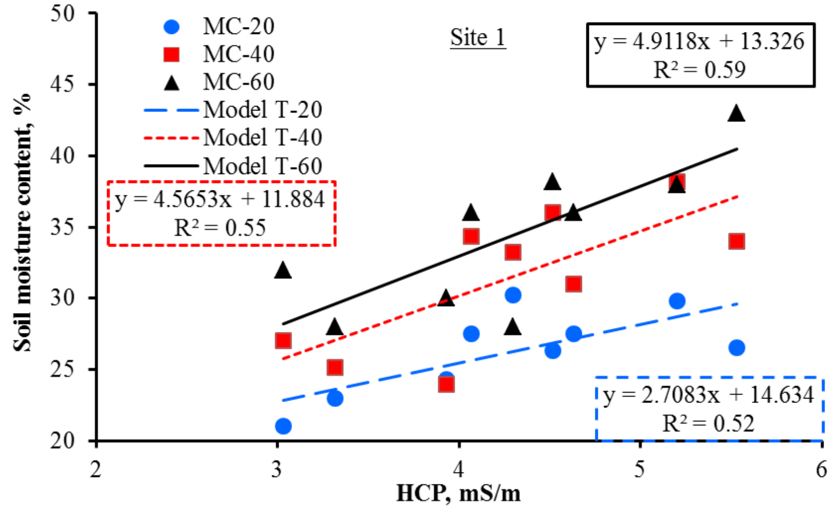
Non-destructive Determination of Soil Compaction

- The readings of electromagnetic inductions (HCP) given by DualEM-II sensor are related to soil properties including soil moisture, temperature, bulk density, and compaction.
- The DualEM-2 has a potential to be used to detect soil compaction.
- Non-destructive estimation of compaction will help to tailor resource management .

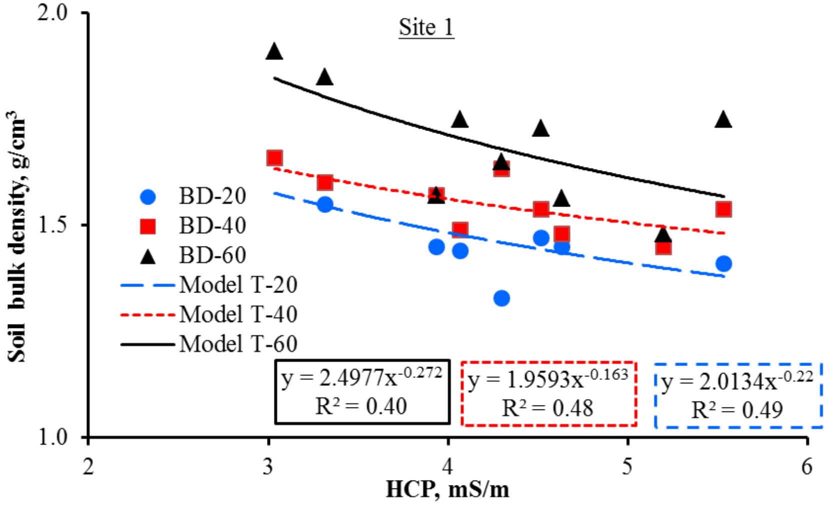
Soil moisture vs HCP (ECa)



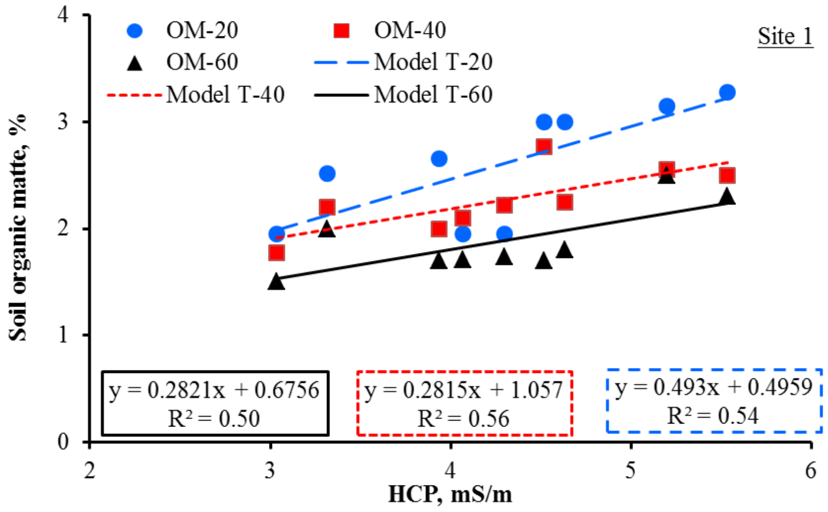
Soil temperature vs HCP (ECa)



Bulk density vs HCP (ECa)



Organic matter vs HCP (ECa)



Conclusions and Recommendations

- The preliminary study had certain limitations namely, the small scale of investigations.

- With the limitation of a small number of sampling points (only 9 at Site 1 and 7 at Site 2), it is hard to make definitive conclusions

- However, from the available data, it is concluded that DualEM-2 sensor has potential to identify depths of layers of subsoil hardpans in agricultural fields.

Conclusions and Recommendations

- It is recommended to conduct a detailed study to investigate the potential of DualEM-II sensor in detecting compaction in potato fields.
- Interpolated mapping can help visualize compaction levels and depths in potato fields to optimize resources (e.g. tillage)
- It is further recommended to acquire the layered response from DualEM-2 sensor for estimation of subsoil hardpans with reduced error and improved prediction accuracy of DualEM-2

2020 Projects:

Subsoiling

- Summer/Fall 2020
- Spring 2021

Living Labs (East Prince/Kensington North/Souris) $$

- Cover Crops before potatoes
- Cover Crops after potatoes
- Full Season Soil-Building Crops

2020 Projects:

ECODA $$

- Comparing brown mustard harvested versus green manure versus check (ie. barley or ryegrass)

Seed Management Trials

- Lower N rates, tighter spacing, GA, etc. to reduce average tuber size and increase tuber numbers

Other Trials/Demonstrations??

Any Questions?

Ryan Barrett

Research & Agronomy Specialist,
PEI Potato Board

Tel: (902) 439-9386

Email: ryan@peipotato.org

@rbarrettPEI