DEVELOPING MANAGEMENT ZONES FOR SITE SPECIFIC NUTRIENT MANAGEMENT IN POTATO PRODUCTION

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PEI Potato Growers Meeting
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An increase in yield requires precise agricultural inputs – NOT UNIFORM

Complex interactions among soil, topography, climate, cultivation, crop, and agricultural inputs

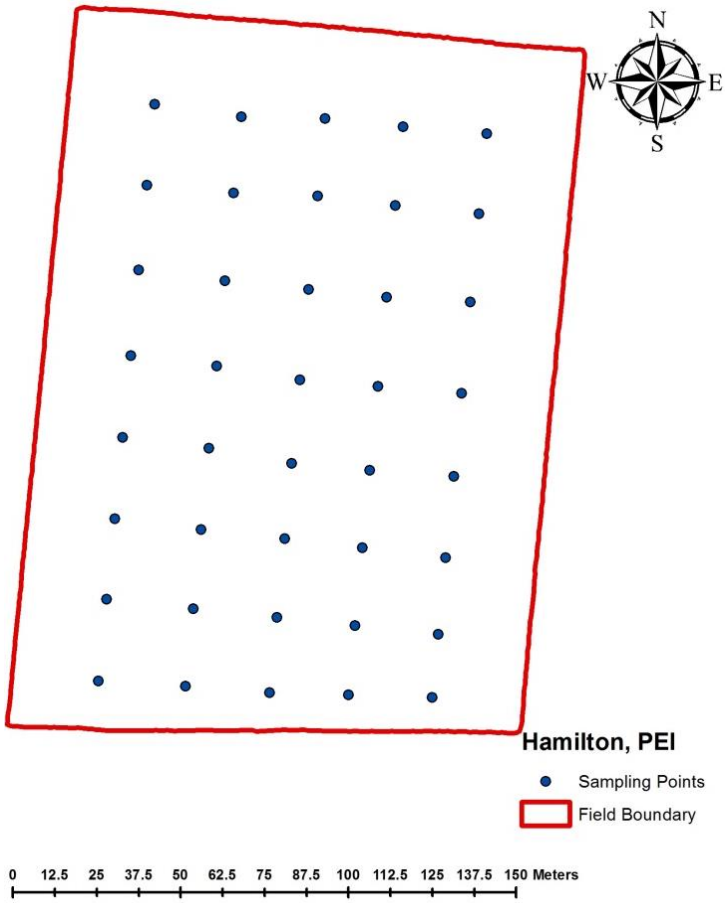
Substantial variability in soil and crop - YIELD VARIABILITY

Management of agricultural inputs based on soil and crop variability - FARM PROFITABILITY and ENVIRONMENTAL PROTECTION

Objectives

- ✓Characterize and quantify variability - soil, crop, topography and yield,
- ✓Identify the significant factors affecting potato productivity,
- ✓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.

Field Size and Sampling Location



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

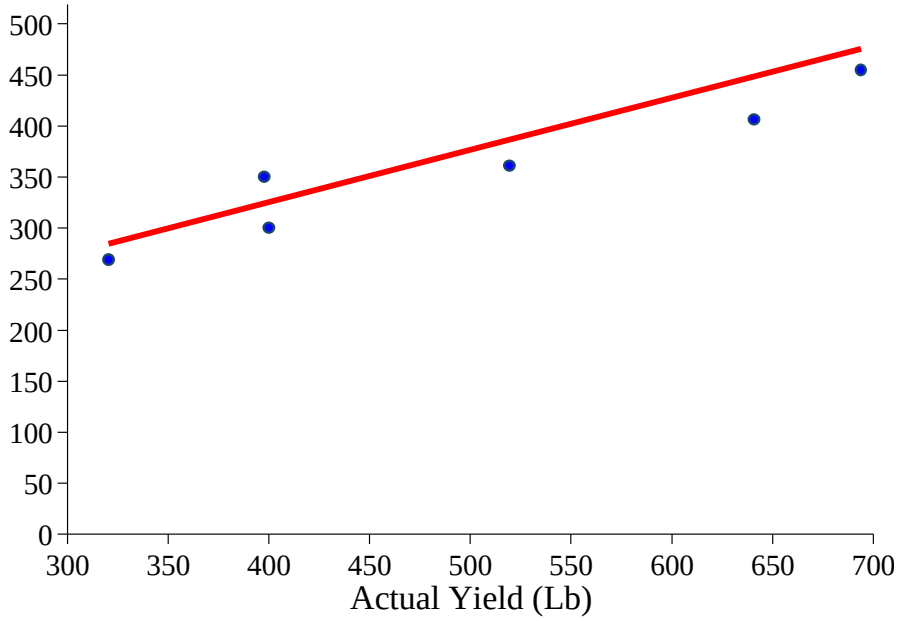
Data Collection

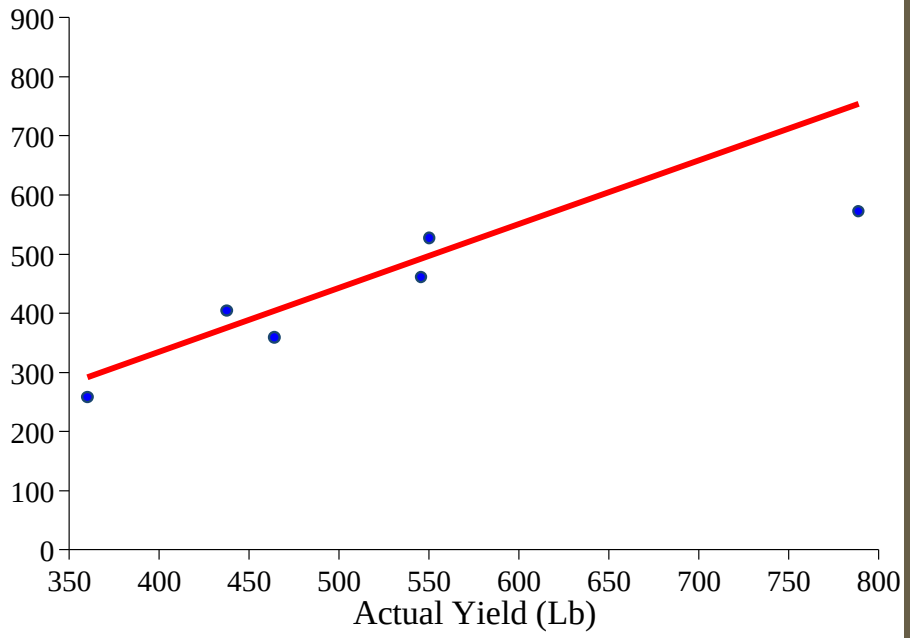
Data Collection

Data Collection

Yield Monitoring

Yield Monitoring





Centreville NB

$R^2 = 0.66$

RMSE = 147 lbs

Mean = 378 lbs

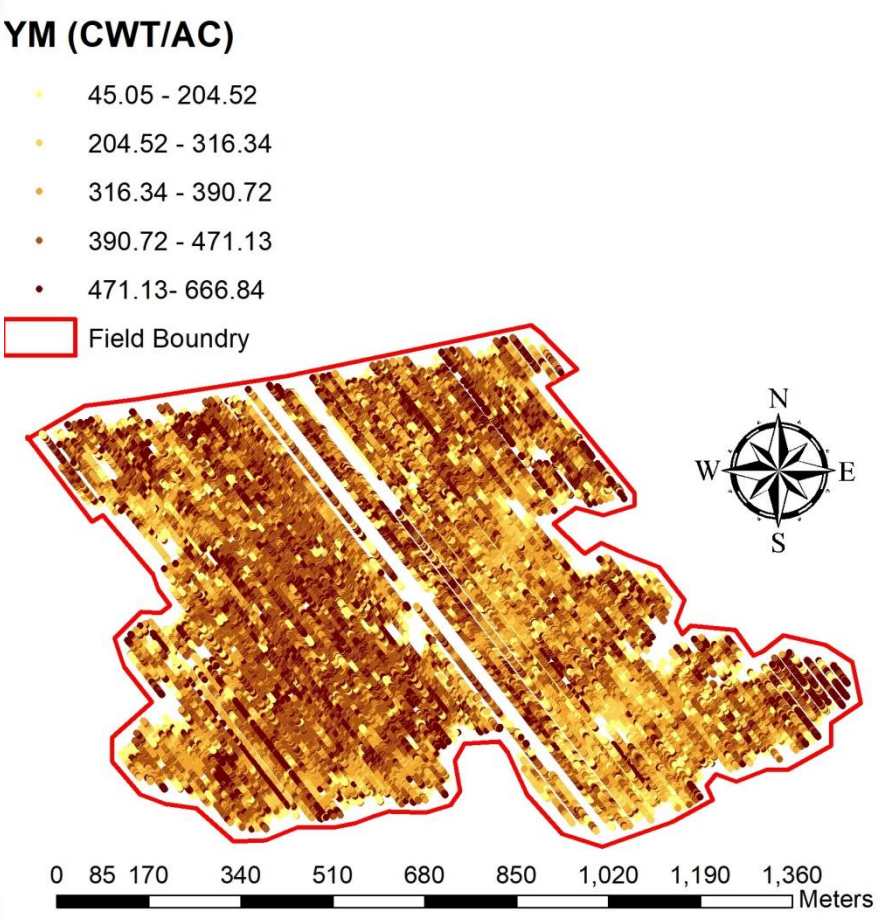
Grandfalls NB

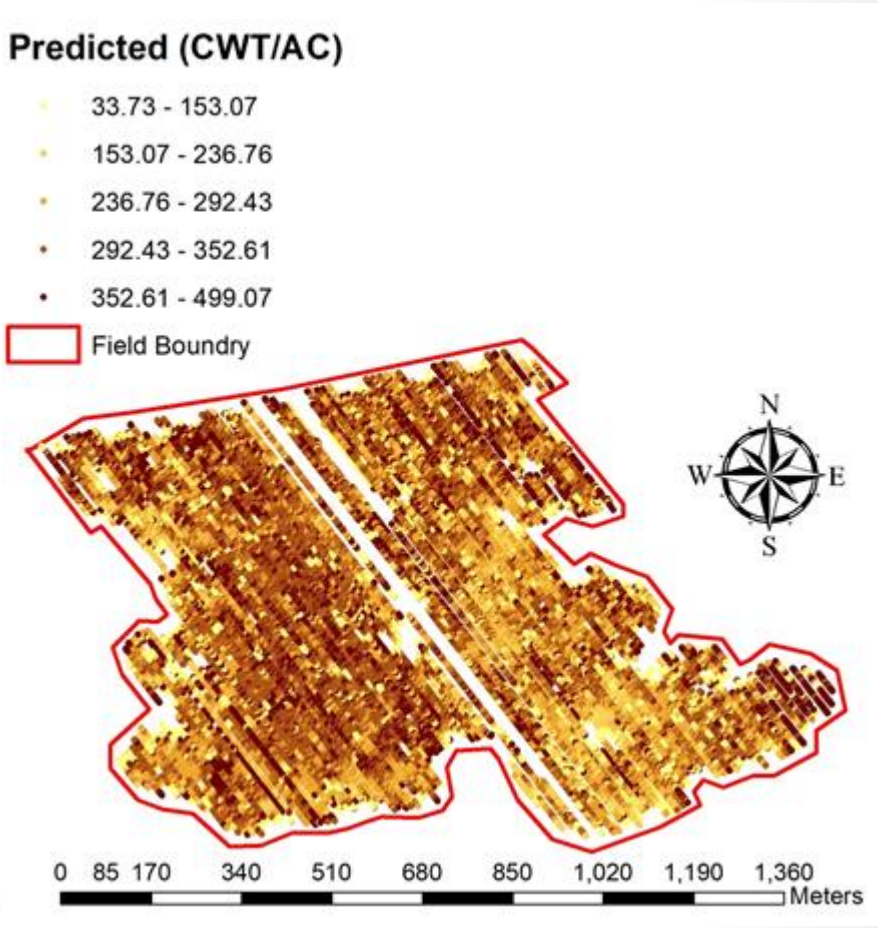
$R^2 = 0.63$

RMSE = 127.29 lbs

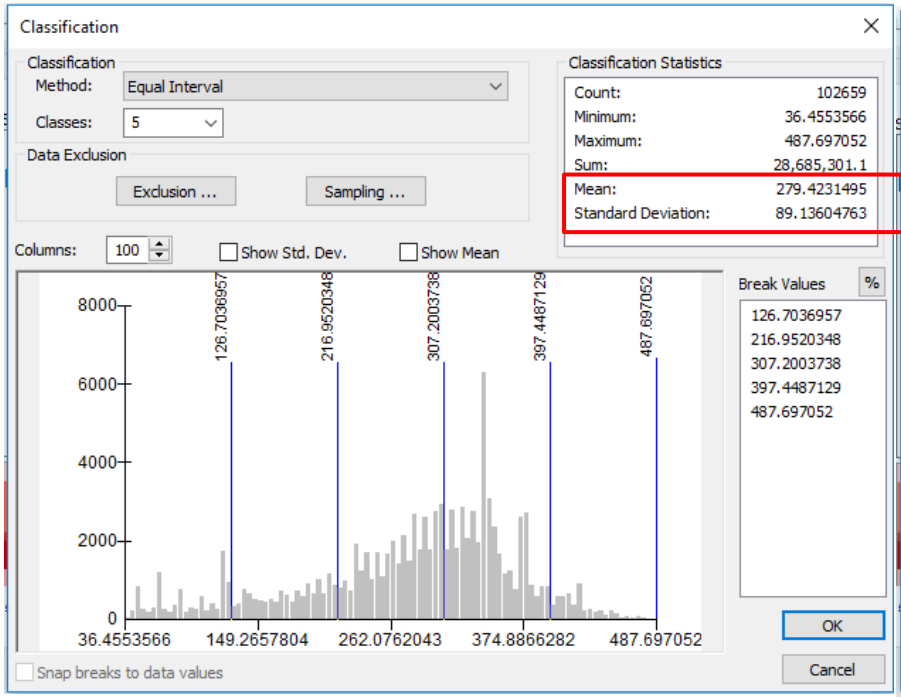
Mean = 547.80 lbs

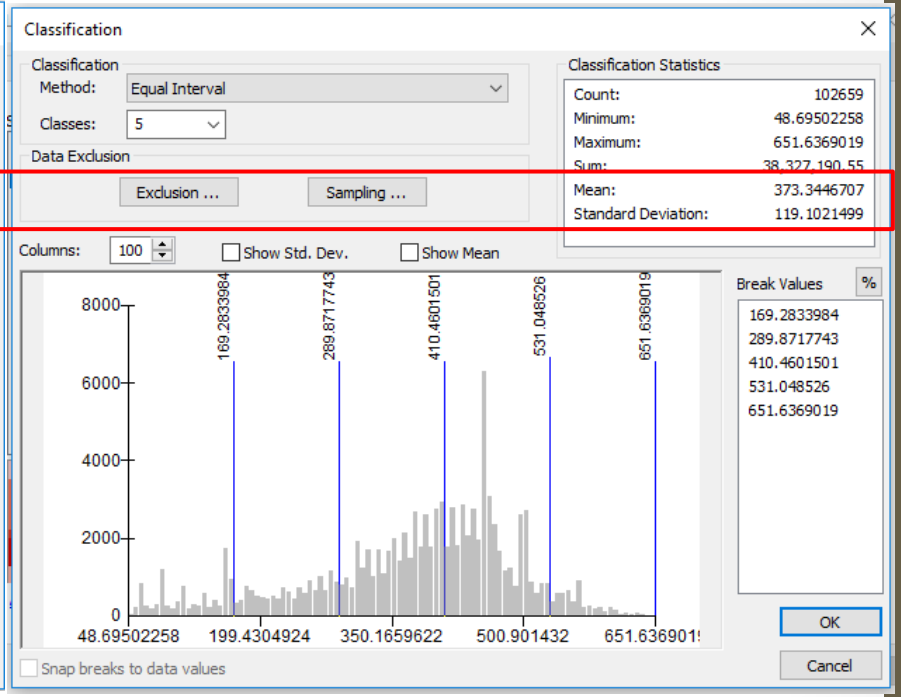
Yield Monitor Mapping – Lindsay NB





Yield Monitor Mapping

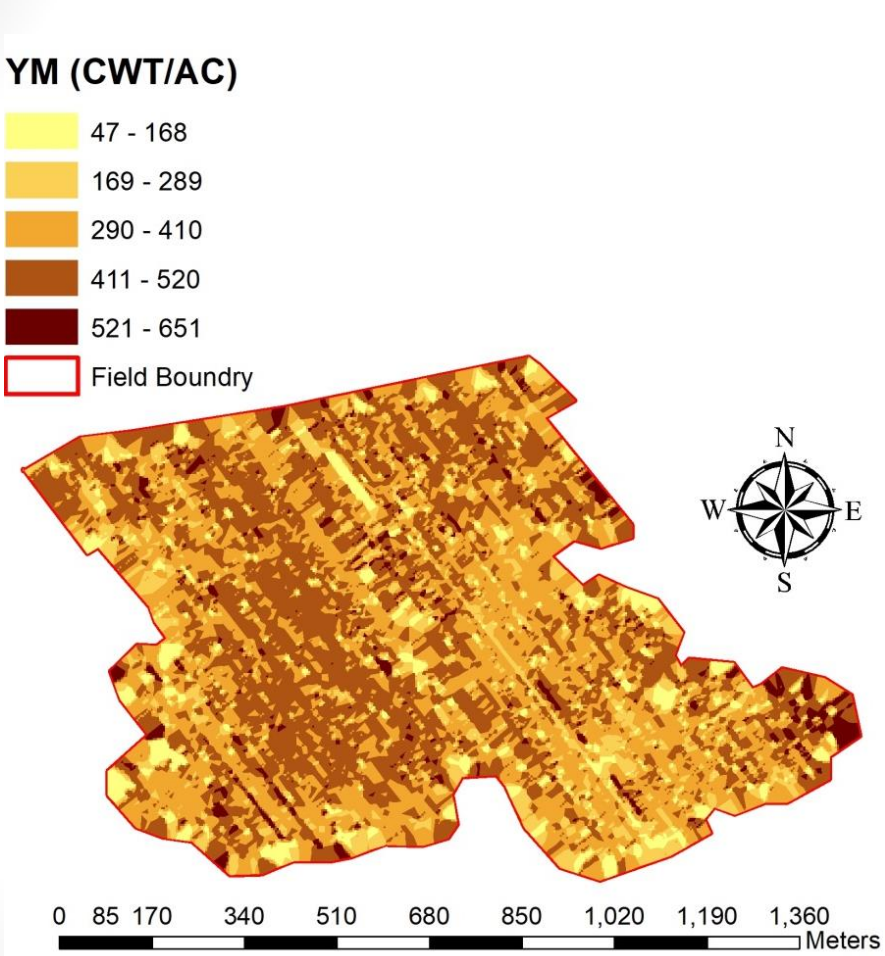


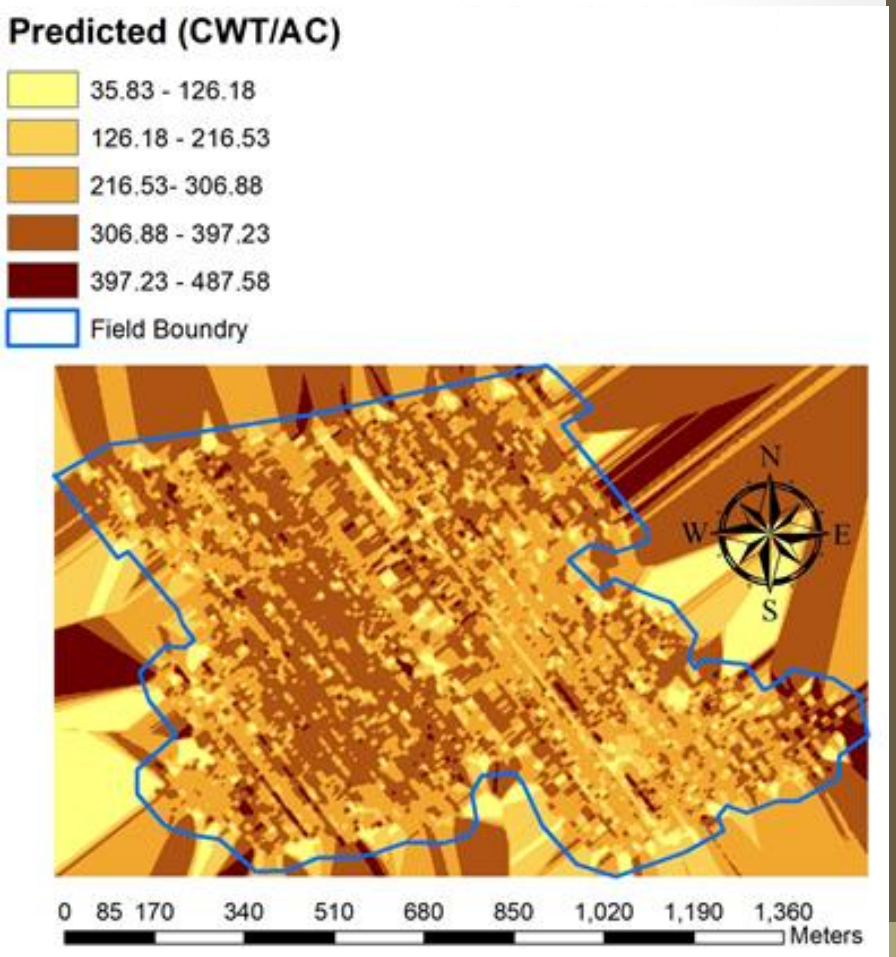


Predicted

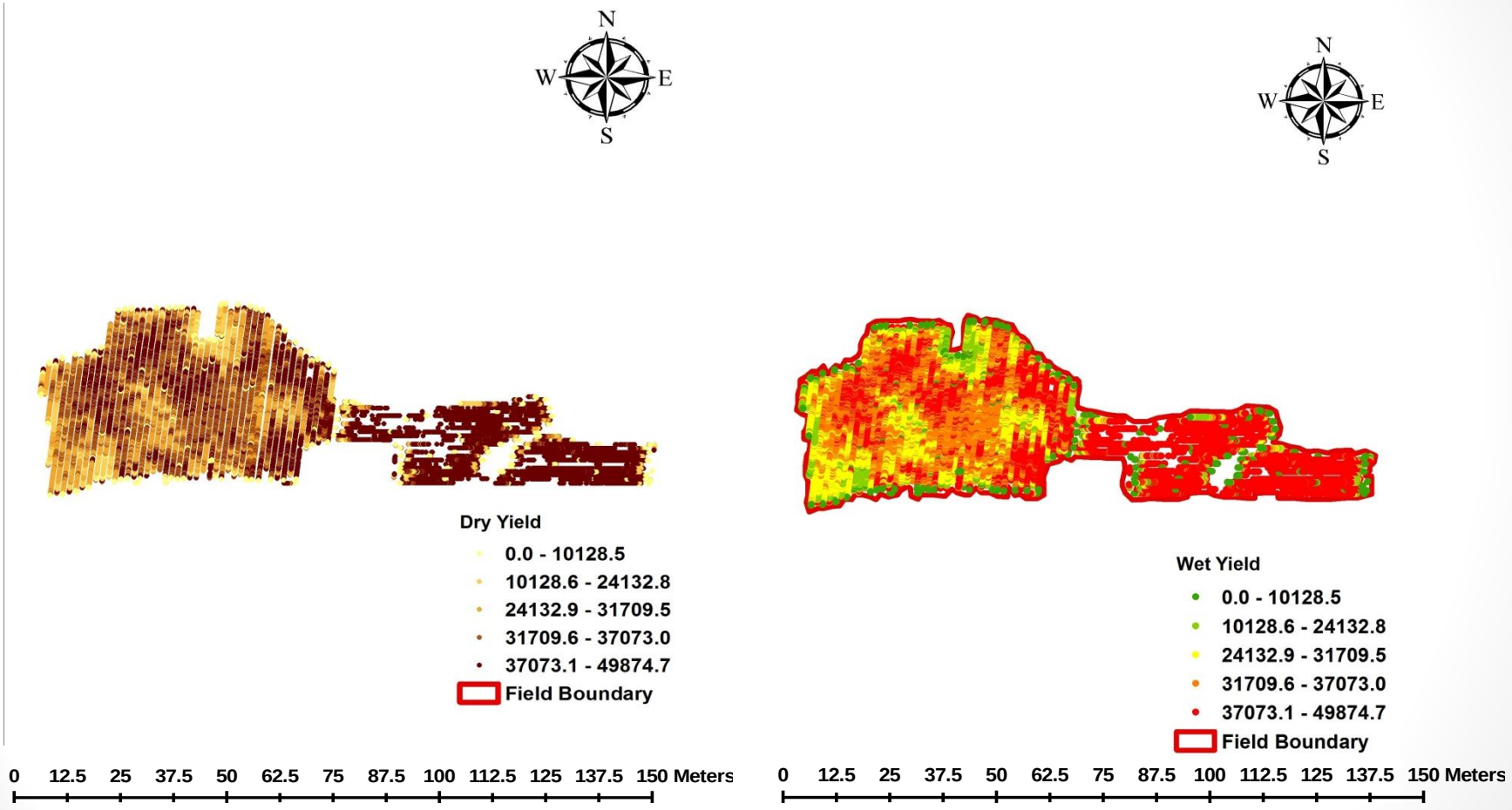
Actual YM

Yield Monitor Mapping





Dry and Wet Yield - Hamilton



Summary of Statistics - Hamilton

Sampling 1, Hamilton PEI

Parameters	Mean	C.V
HCP (mS m^{-1})	7.69	33.91
PRP (mS m^{-1})	5.56	41.21
Moisture Content (%)	20.08	19.60
Slope	1.60	36.78
Potash (ppm)	112.58	27.92
Calcium(ppm)	707.90	11.68
Magnesium (ppm)	76.50	15.36
Boron (ppm)	0.25	23.97
Copper (ppm)	1.55	24.01
Zinc (ppm)	1.13	22.39
Sulfur (ppm)	20.55	11.34
Manganese (ppm)	33.48	17.18
Iron (ppm)	168.32	12.02
Sodium(ppm)	22.25	14.02
Aluminium (ppm)	1574.20	3.38
Lime Index	6.79	1.27
% P/A	13.02	13.14
CEC (meq/100g)	7.20	12.66
Total % Base Saturation	64.97	16.04

CVs < 15% - Least Variable
CVs 15 – 35% - Moderately Variable
CV> 35% Highly Variable

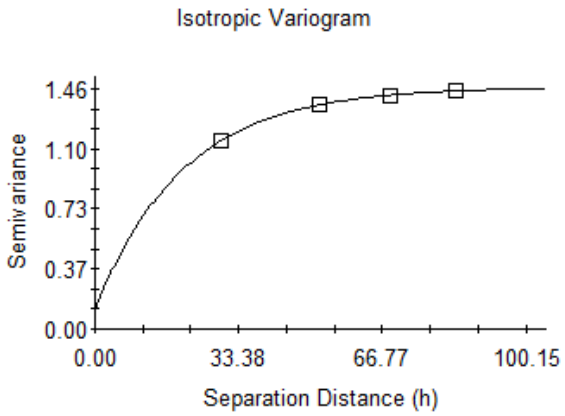
Summary Statistics - Hamilton

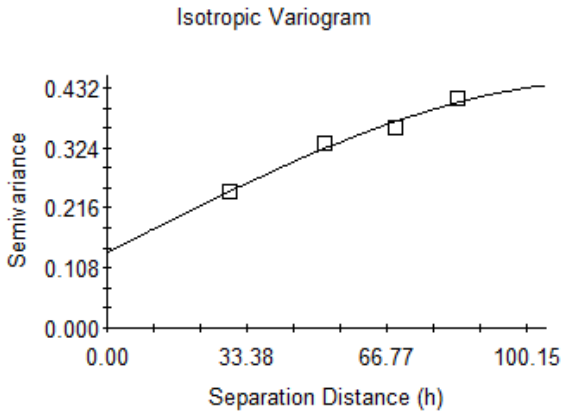
Sampling 3, Hamilton PEI		
Variable	**Mean**	**C.V**
HCP (mS m^{-1})	6.99	25.06
PRP(mS m^{-1})	5.67	23.73
MC	12.06	27.52
NDVI	0.85	6.44
Organic Matter (%)	2.89	13.38
pH	5.16	4.07
Phosphate (ppm)	757.6	23.35
Potash (ppm)	372.00	40.85
Calcium (ppm)	876.50	14.80
Magnesium (ppm)	147.20	29.21
Boron (ppm)	0.30	22.65
Copper (ppm)	1.60	21.17
Zinc ((ppm)	1.77	22.39
Sulfur (ppm)	84.00	51.12
Manganese (ppm)	57.27	21.91
Iron (ppm)	201.97	11.40
Sodium (ppm)	22.45	11.09
Aluminium (ppm)	1591.10	2.89
Lime Index	6.44	1.86
% P/AI	21.40	22.14
CEC (meq/100g)	13.50	10.74
Total % Base Saturation	50.10	17.34

Leaf Tissue Analysis

Leaf Analysis (results reported on a dry matter basis)	
Nitrate – N %	2.04
Phosphorus %	0.13
Potassium %	5.69
Calcium %	1.77
Magnesium %	1.06
Boron (ppm)	28.60
Copper (ppm)	<0.01
Zinc (ppm)	31.00

Semivariogram - Hamilton





PRP

Slope

Calculates spatial variability in terms of distance (in meters).

Geostatistical Analysis - Hamilton

Sampling 1, Hamilton PEI

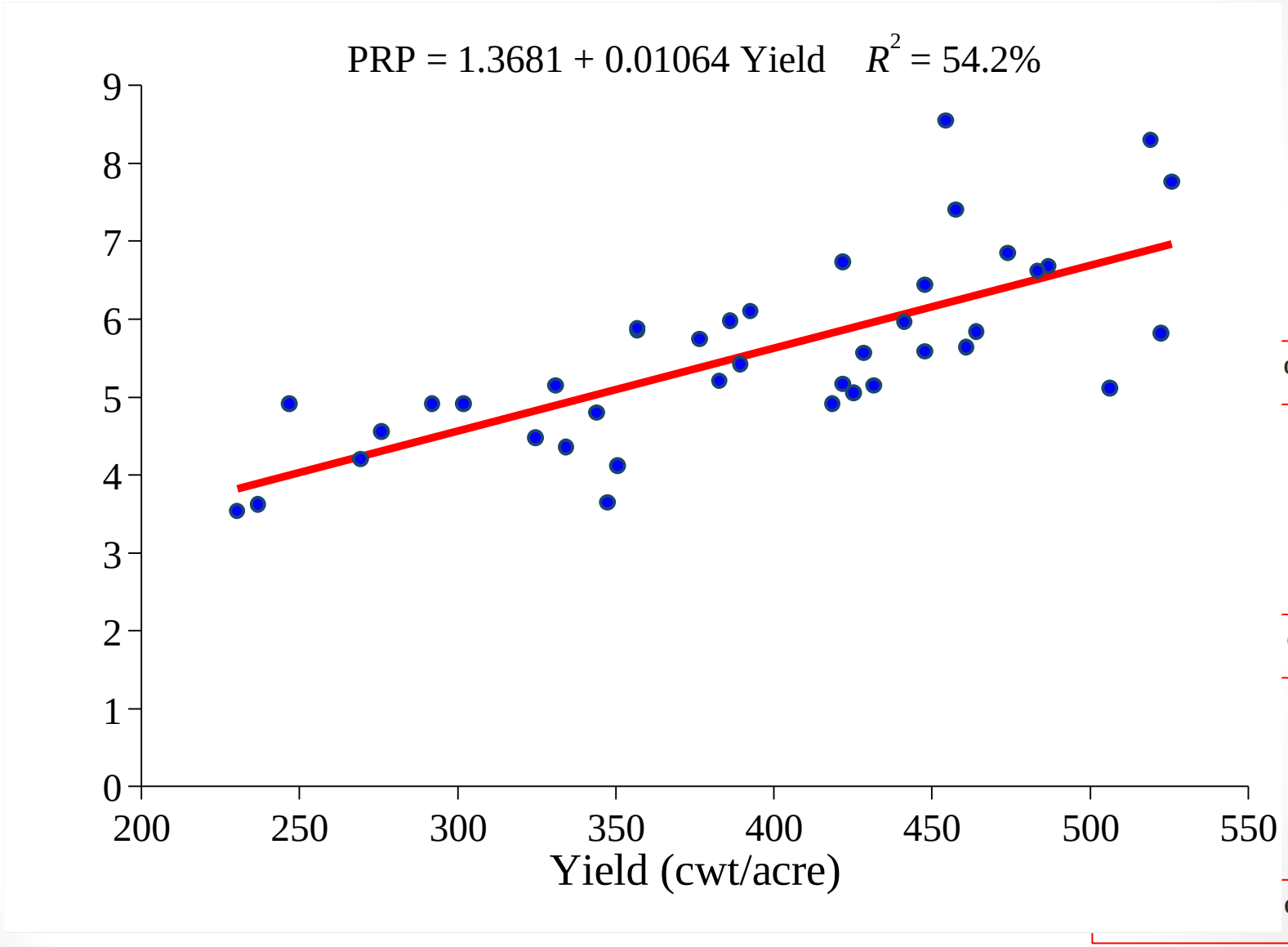
Parameters	Range (m)
HCP (mS m^{-1})	40.90
PRP (mS m^{-1})	31.80
Moisture Content	21.80
Slope	120.30
Organic Matter (%)	29.30
pH	35.00
Yield (cwt/acre)	39.70
Phosphate (ppm)	31.00
Potash (ppm)	62.70
Copper (ppm)	38.40
Zinc (ppm)	185.10
Sulfur (ppm)	29.30
Manganese (ppm)	137.00
Iron (ppm)	29.30
Sodium (ppm)	40.90
Aluminium (ppm)	51.60
Lime Index	107.40
% P/AI	102.60
CEC (meq/100g)	157.10
Total % Base Saturation	57.90

Spatial variability is 1/3 of the range of variability.

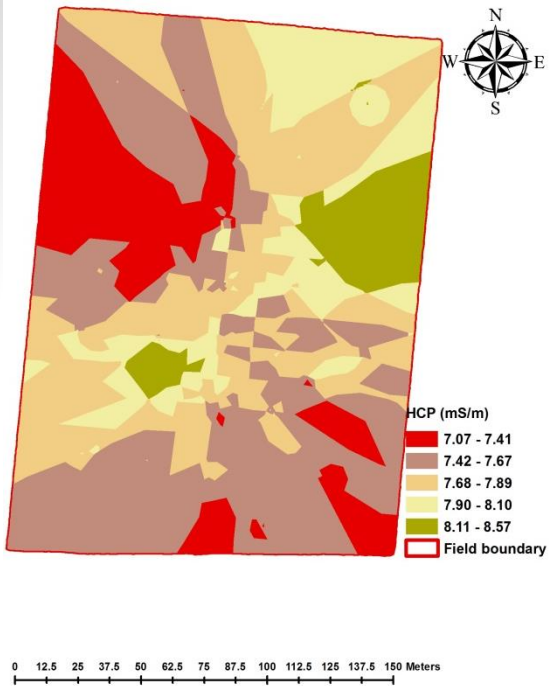
Geostatistical Analysis - Hamilton

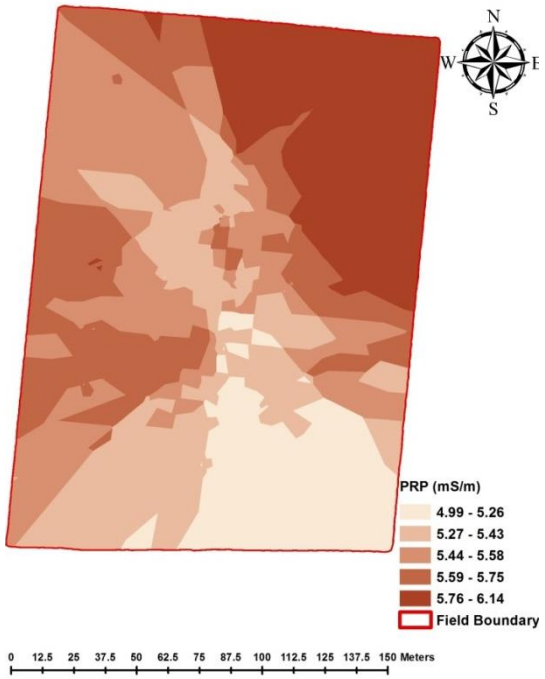
Sampling 3, Hamilton PEI	
Parameters	**Range (m)**
HCP (mS m^{-1})	64.20
PRP (mS m^{-1})	46.80
Moisture Content	29.30
Slope	35.60
Organic Matter (%)	31.20
pH	45.60
Phosphate (ppm)	185.00
Potash (ppm)	19.20
Calcium (ppm)	38.10
Magnesium (ppm)	37.80
Boron (ppm)	72.00
Copper (ppm)	74.20
Zinc (ppm)	43.50
Sulfur (ppm)	29.30
Manganese (ppm)	49.80
Iron (ppm)	175.30
Sodium (ppm)	83.71
Aluminium (ppm)	133.37
Lime Index	44.20
% P/AI	50.70
CEC (meq/100g)	180.65
Total % Base Saturation	83.71

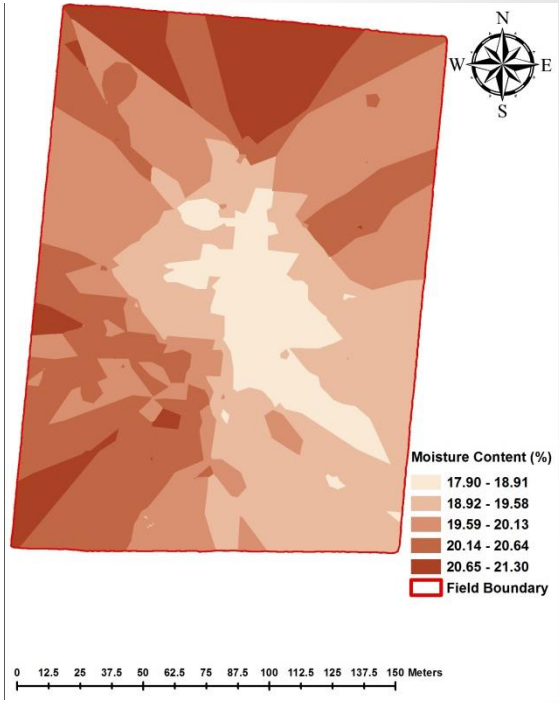
Multiple Regression - Hamilton

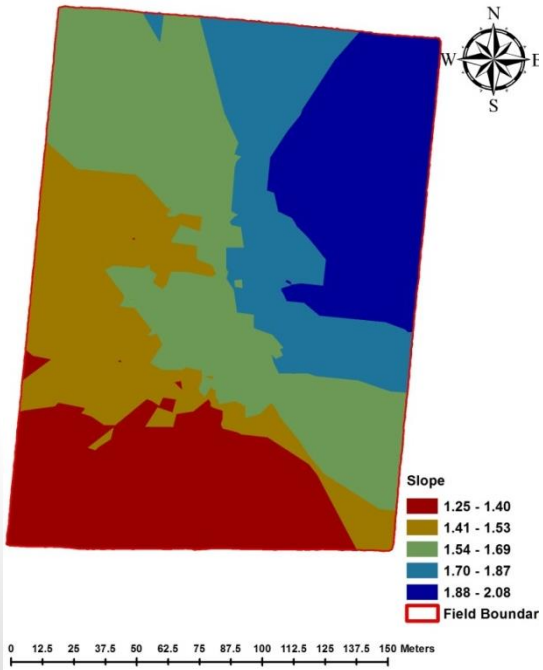


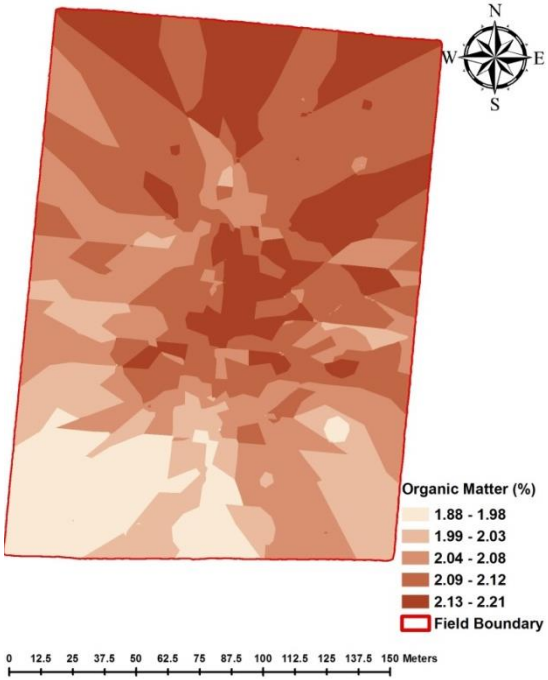
Interpolation and Mapping – Hamilton, PEI

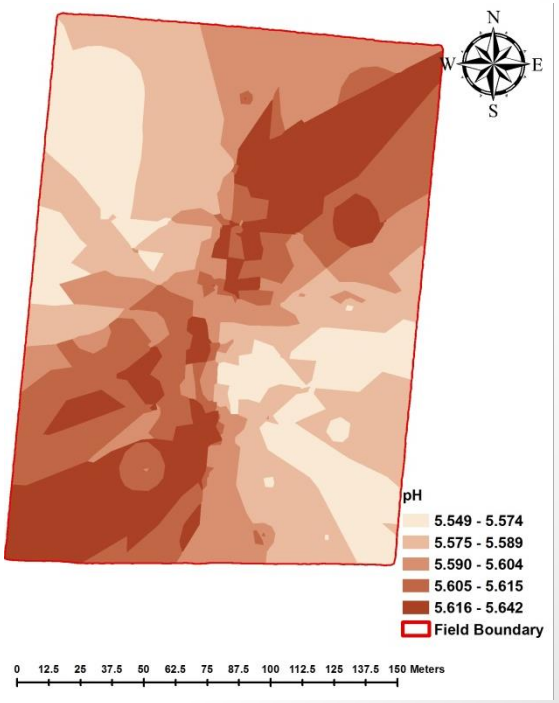












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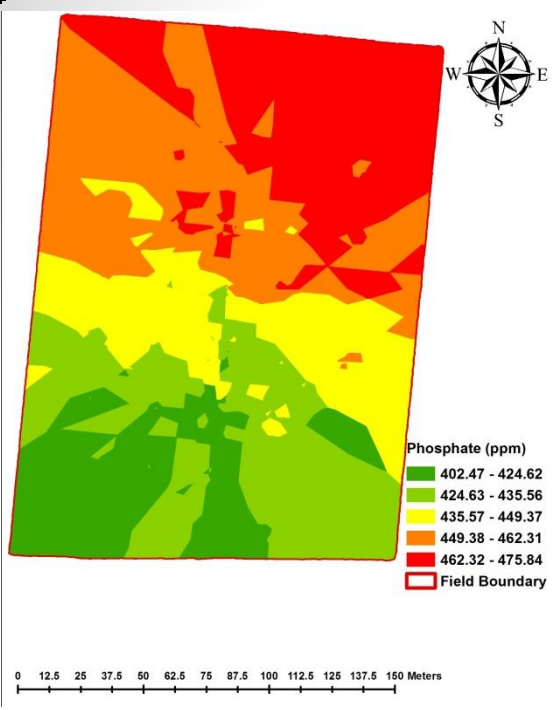
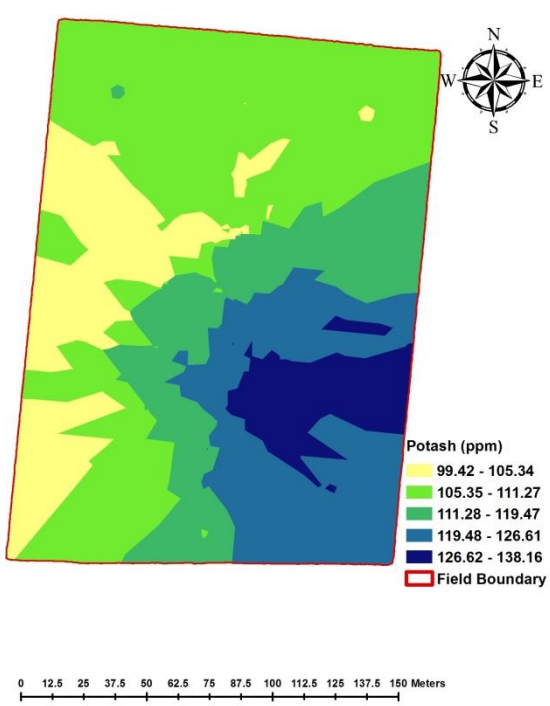
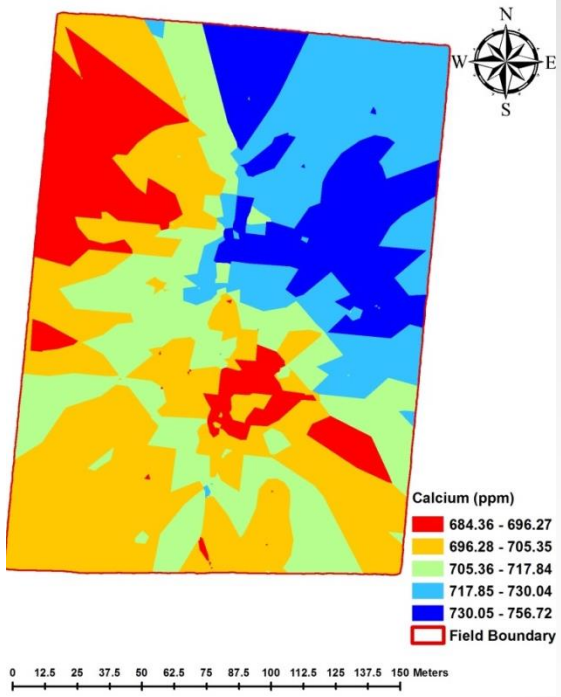
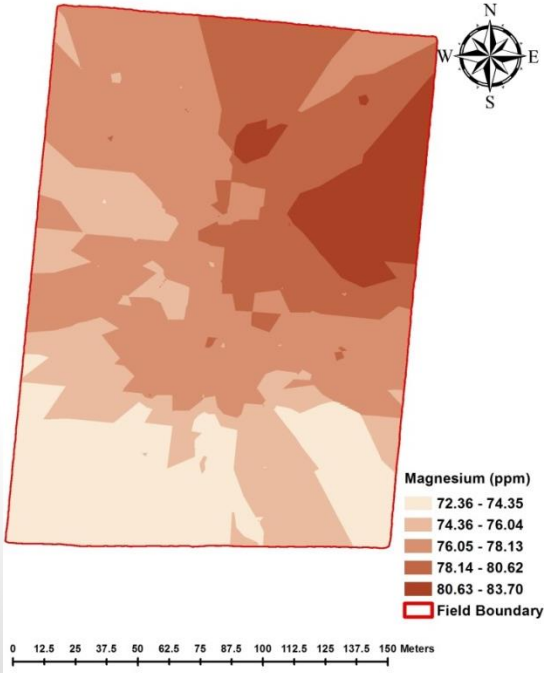
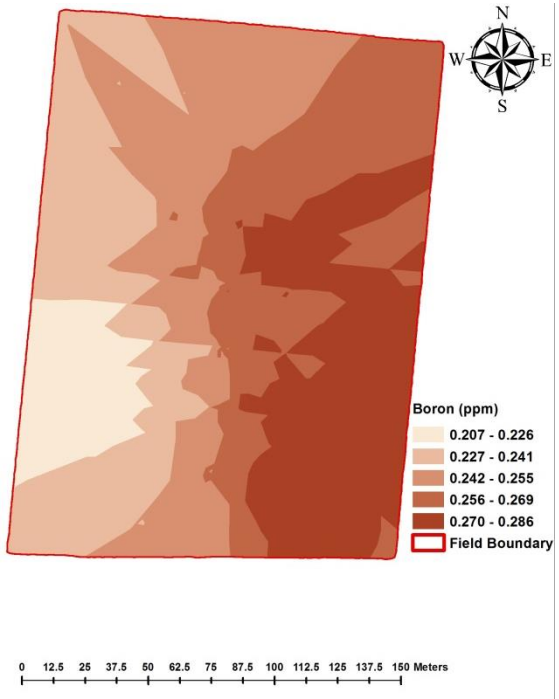
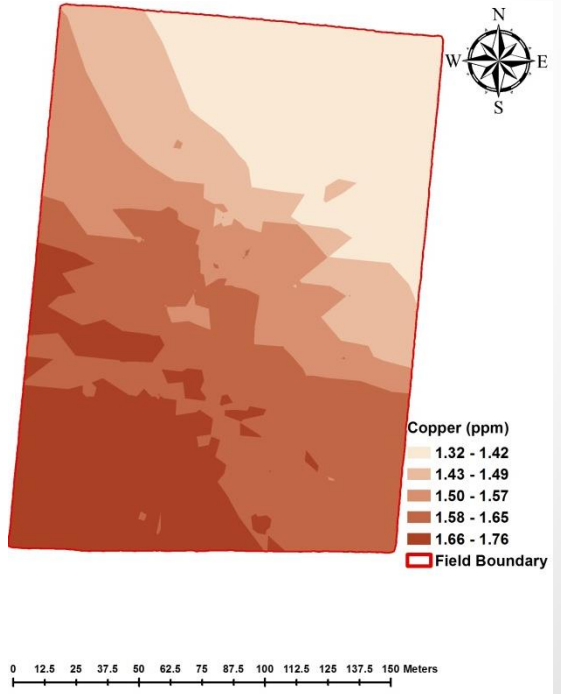




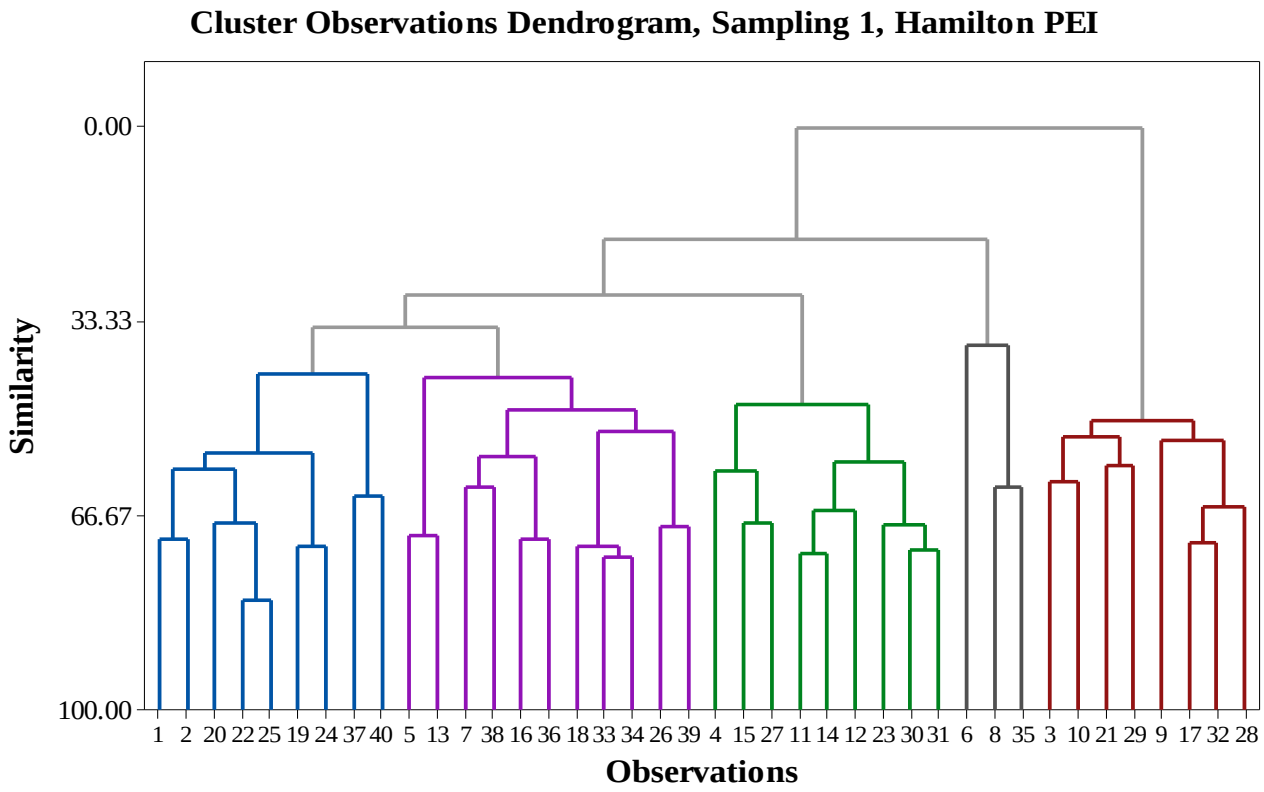






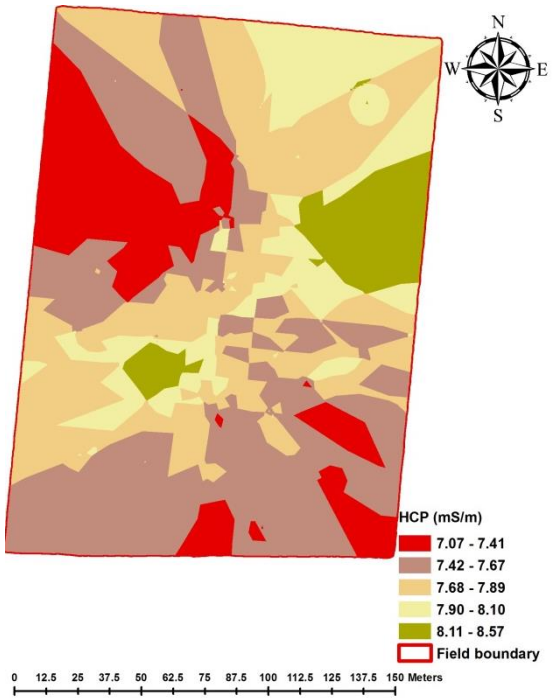


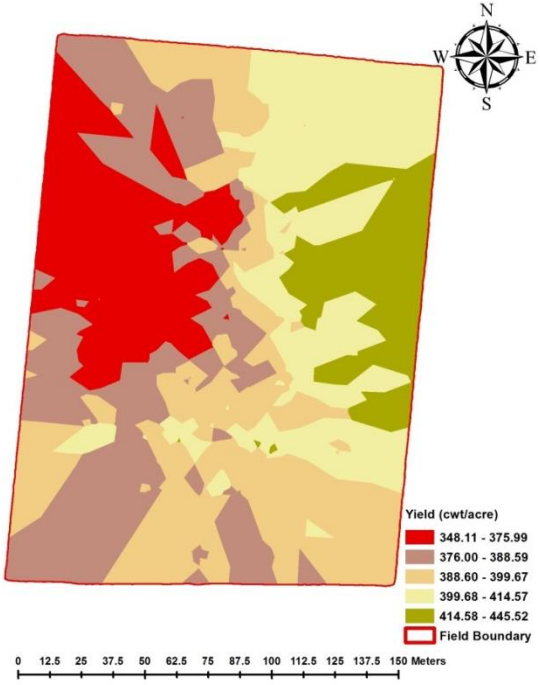
Cluster Analysis, Hamilton



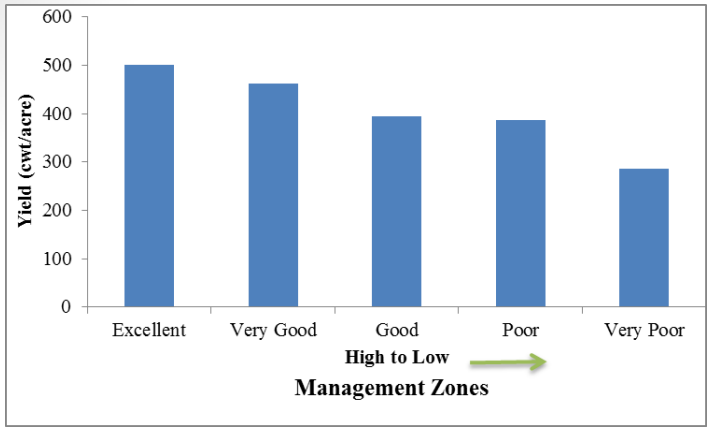
Yield Mean (cwt/acre)
Excellent: Gray 500.80
Very Good: Green 463.00
Good: Blue 394.10
Poor: Purple 387.00
Very Poor: Red 286.40

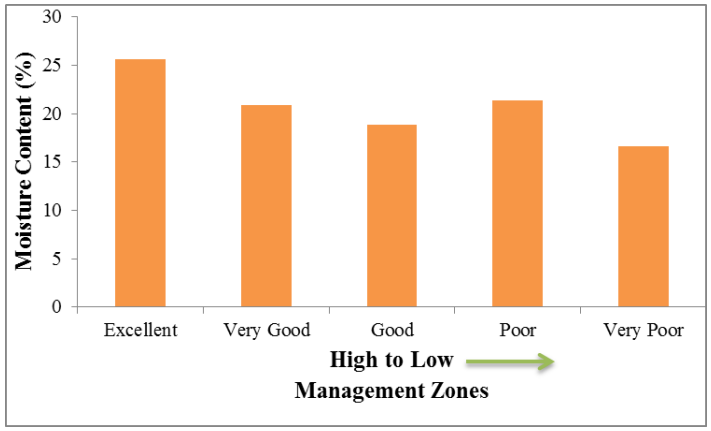
Management Zones – Hamilton, PEI

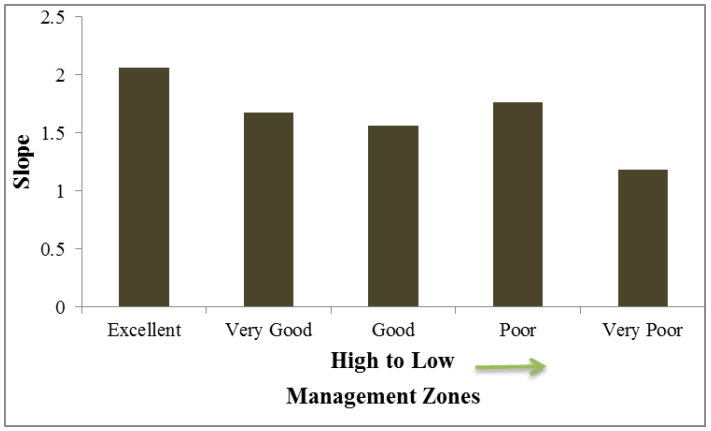


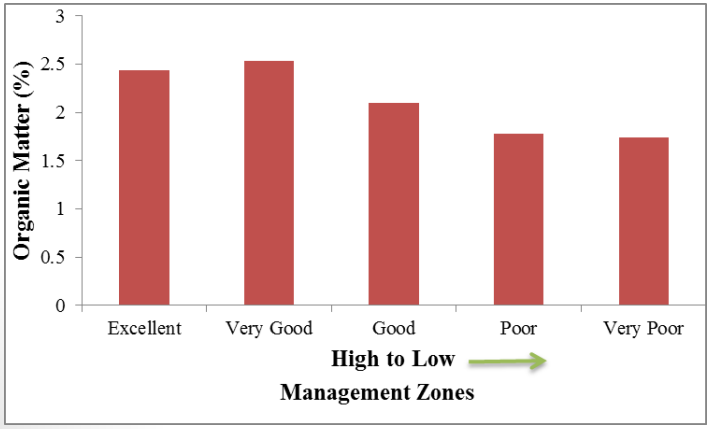


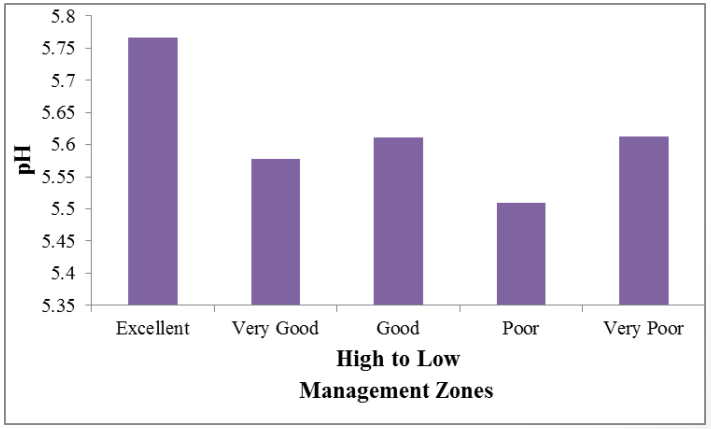
Zonal Analysis – Hamilton, PEI



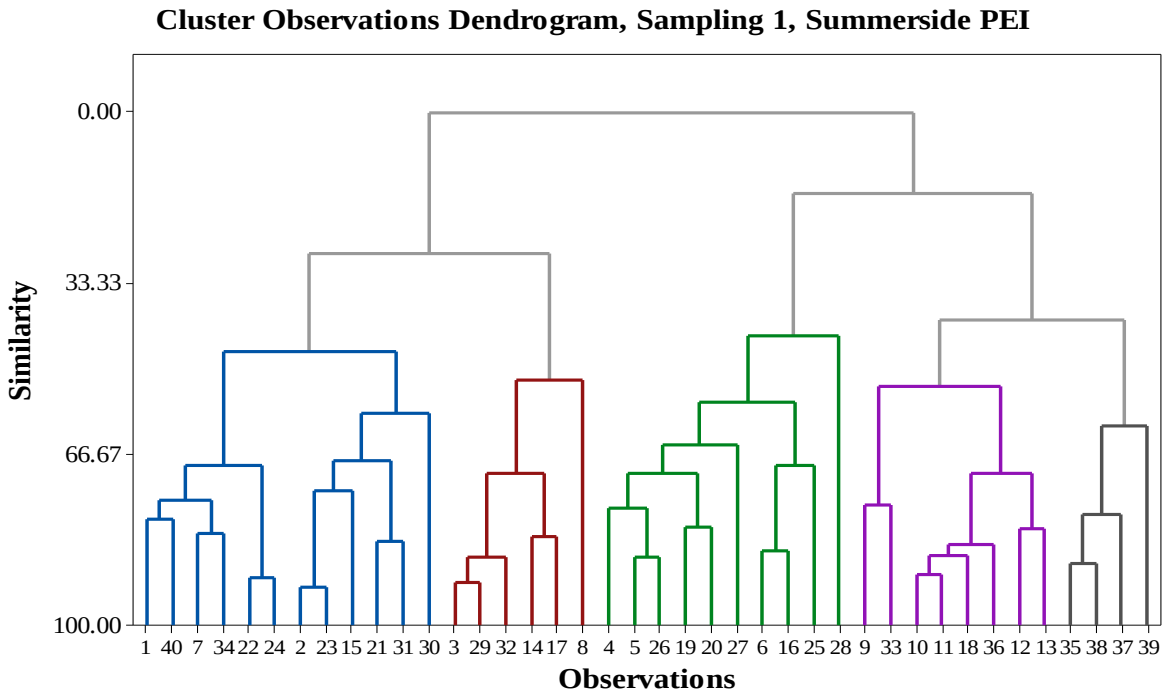






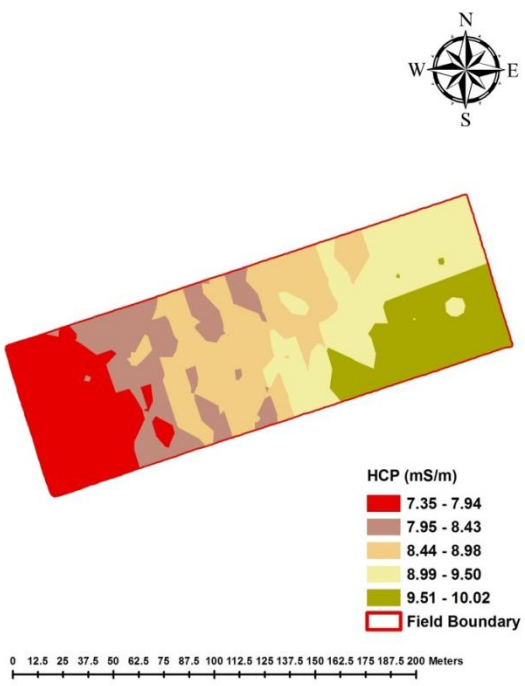


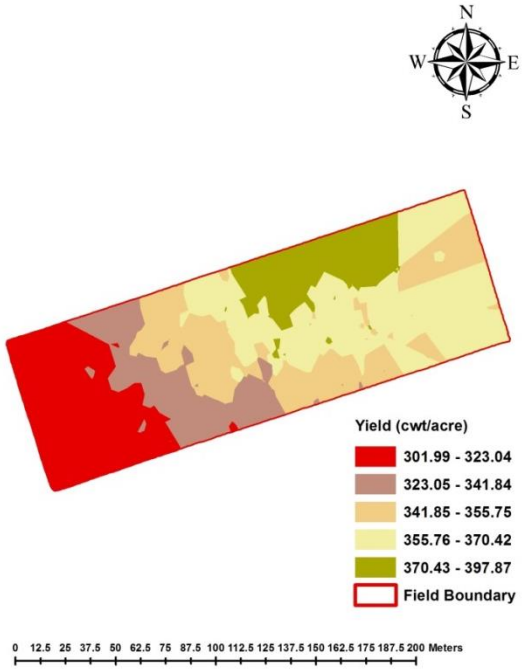
Cluster Dendrogram, Summerside

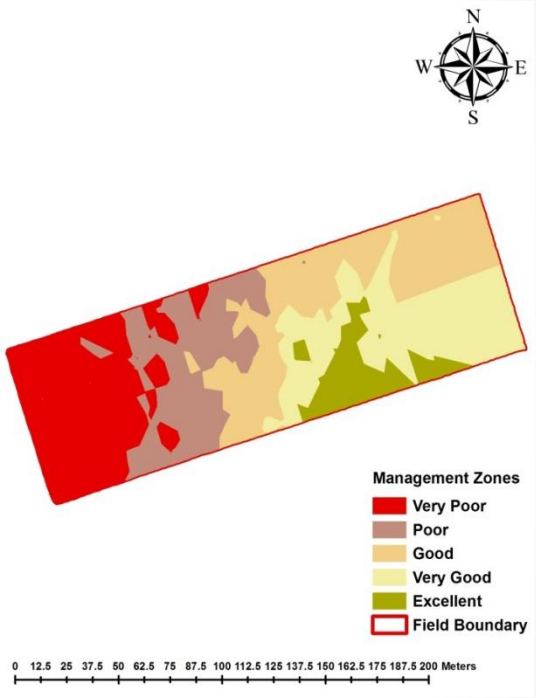


Yield Mean (cwt/acre)
Excellent: Green 453.70
Very Good: Purple 384.10
Good: Blue 285.80
Poor: Red 274.21
Very Poor: Gray 237.70

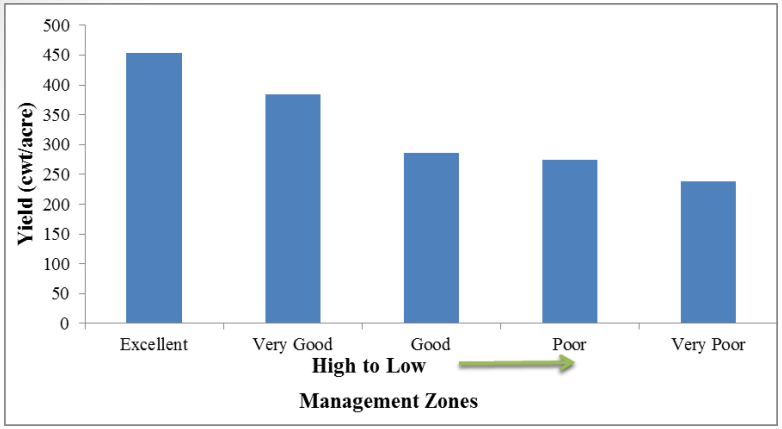
Management Zones - Summerside

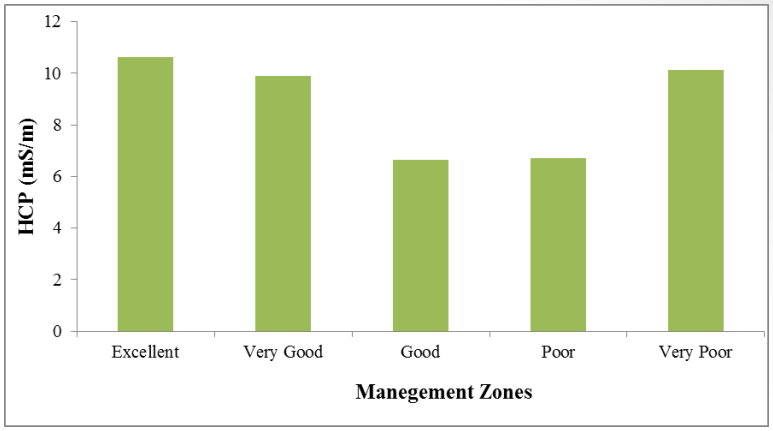


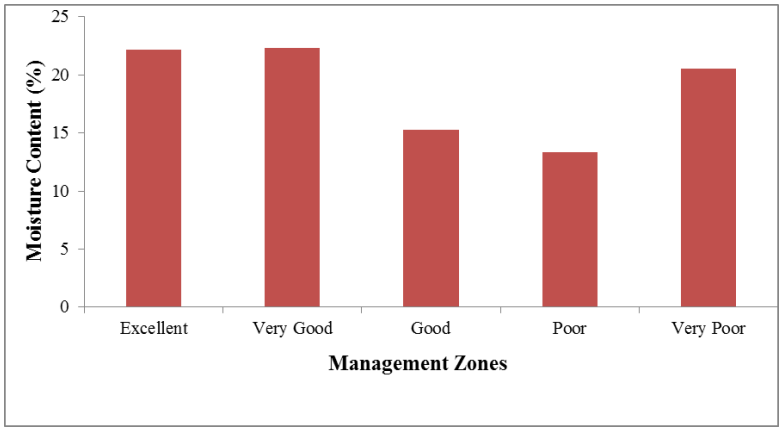


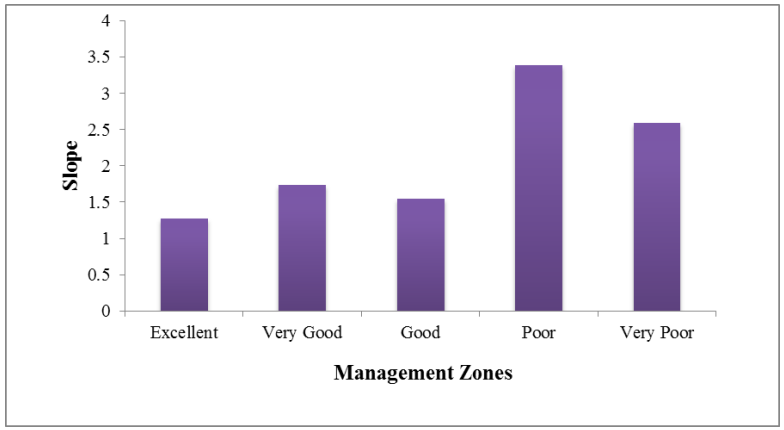


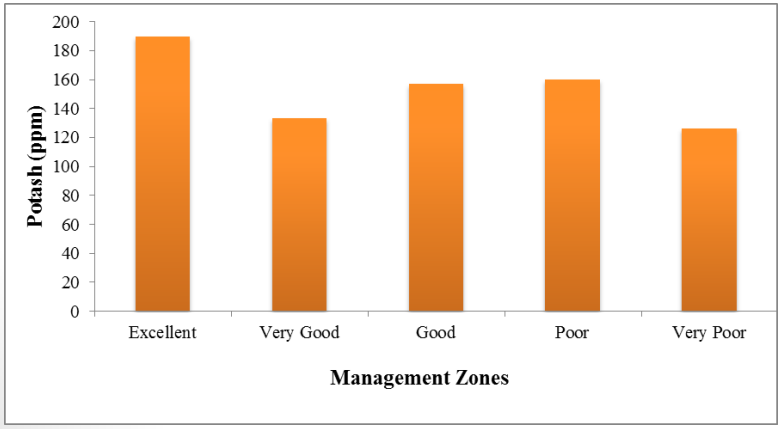
Zonal Analysis – Summerside, PEI

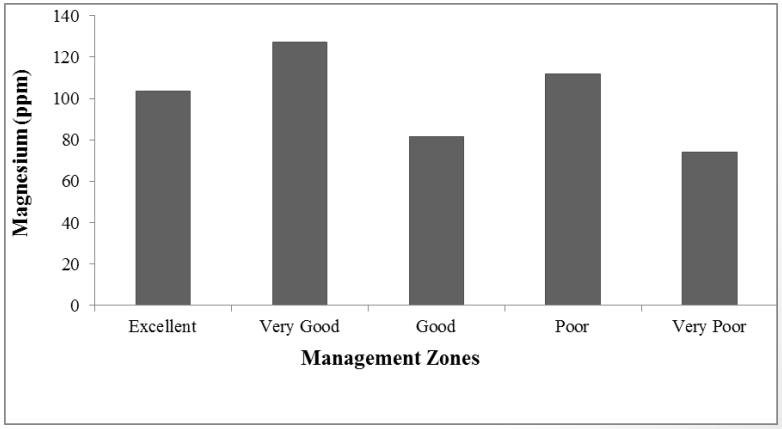




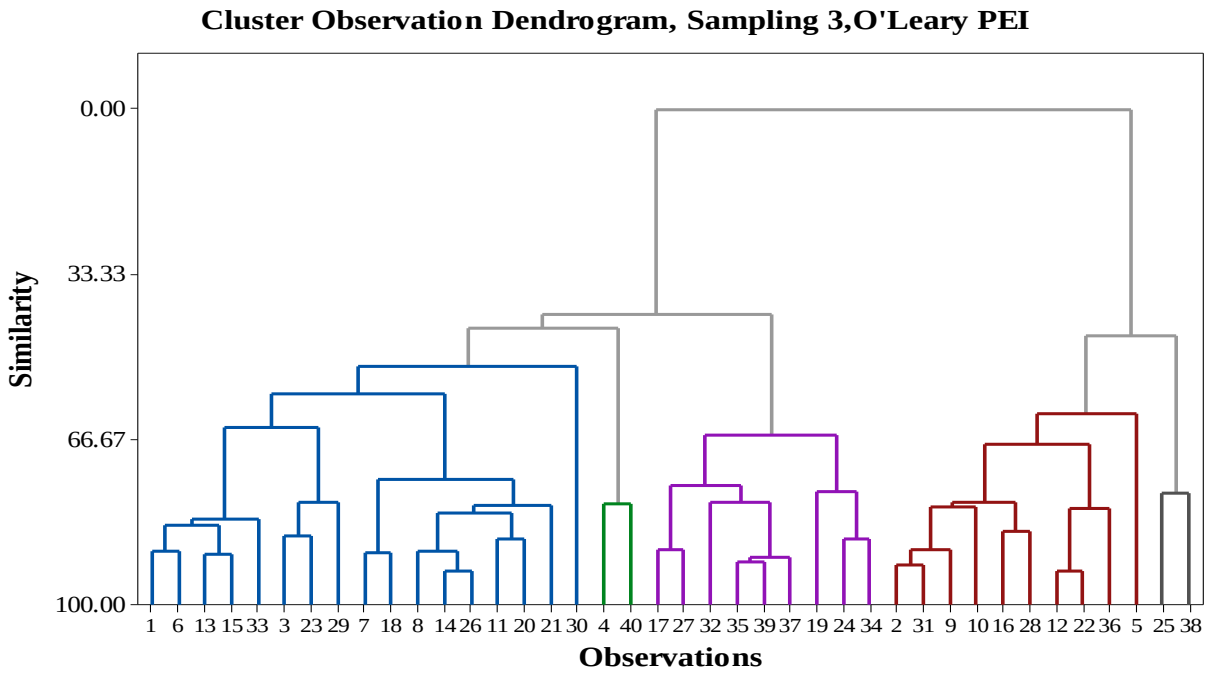








Cluster Analysis, O'Leary



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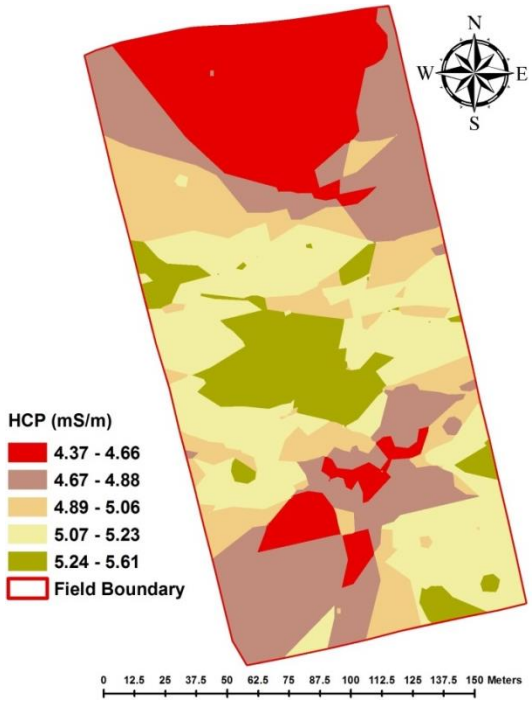
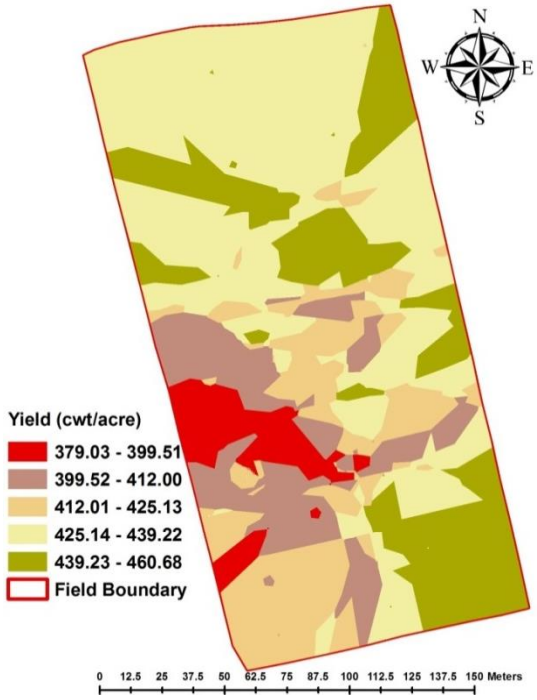
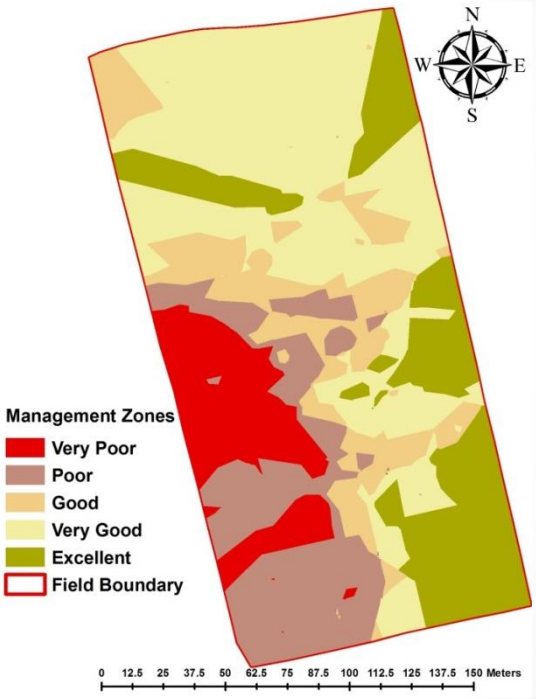
Excellent Gray 683.10
Very Good Red 563.30
Good Purple 452.10
Poor Green 378.00
Very Poor Blue 323.90

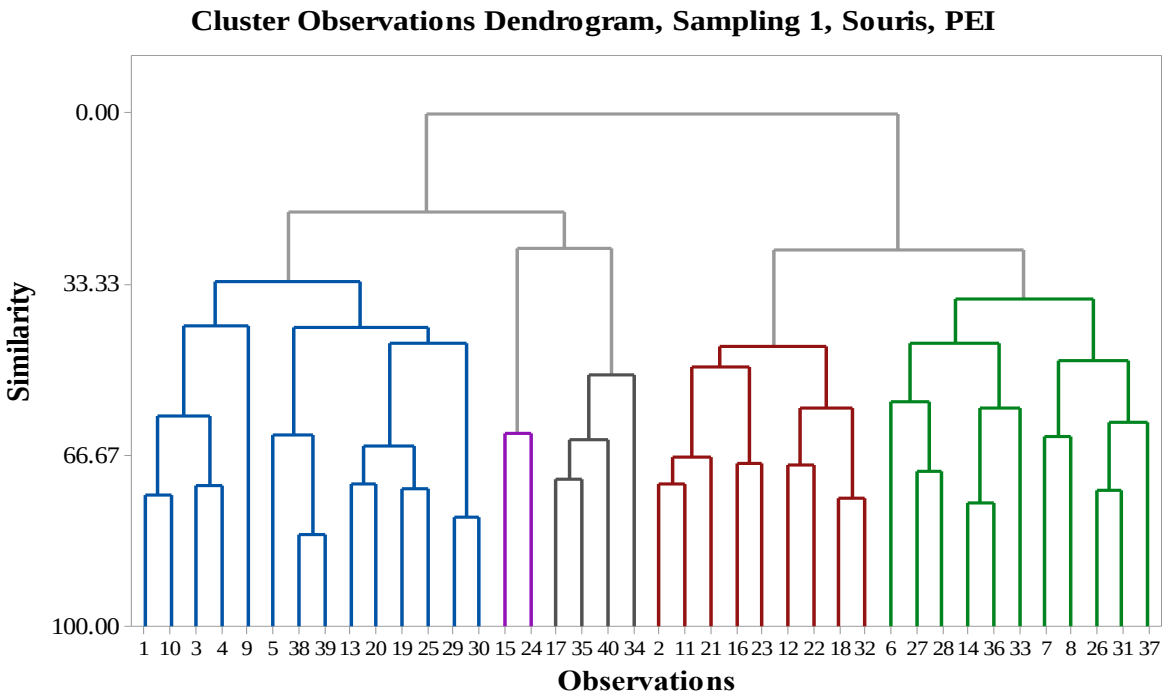
Management Zones, O'Leary PEI





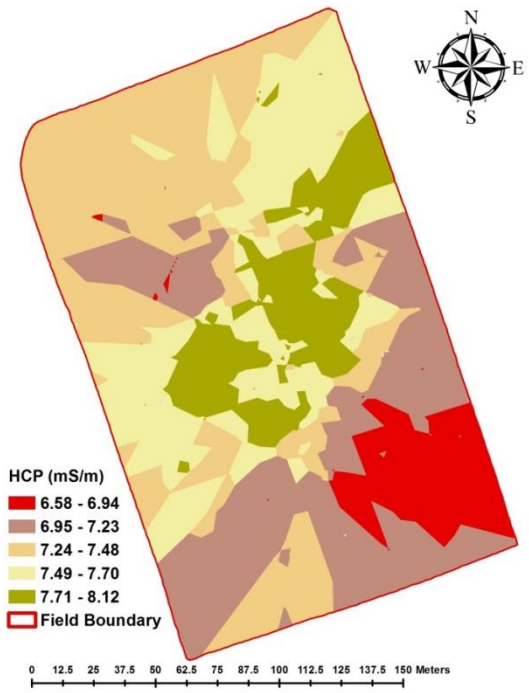


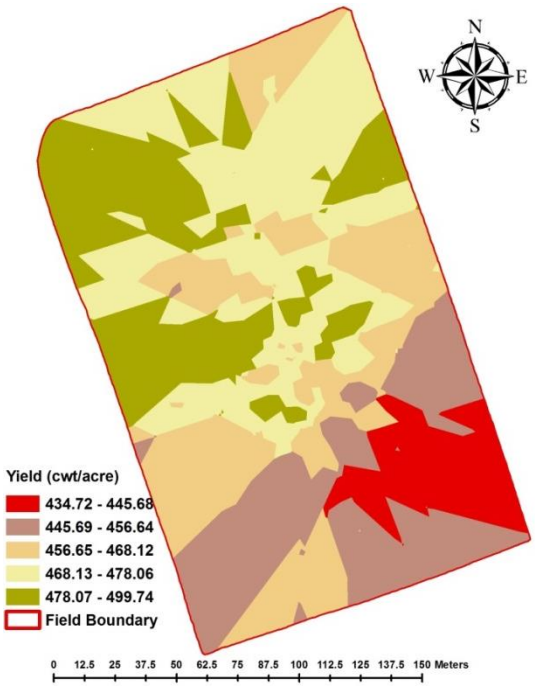
Cluster Analysis, Souris

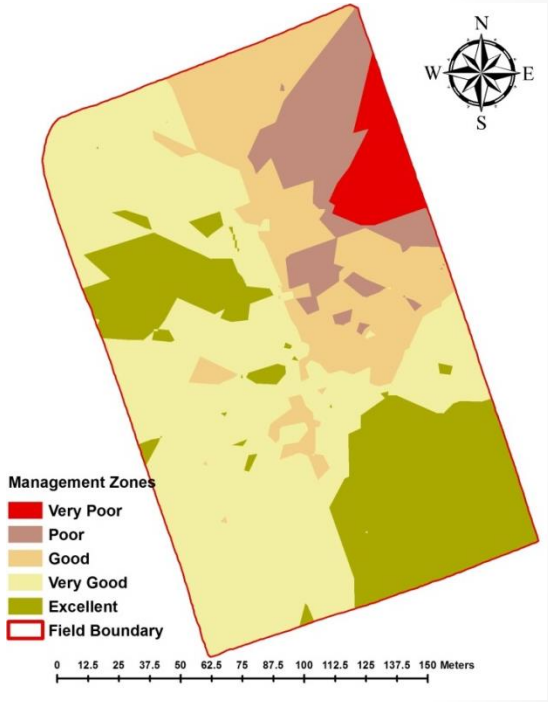


Yield Mean (cwt/acre)
Excellent: Blue 539.50
Very Good: Purple 535.43
Good: Gray 507.00
Poor: Green 426.00
Very Poor: 365.25 Red

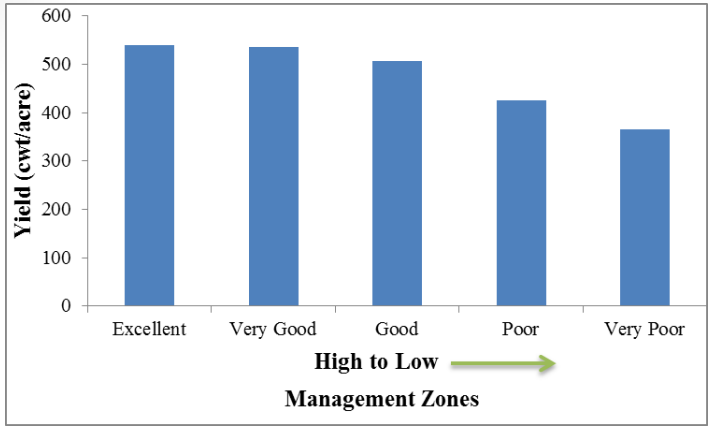
Management Zones, Souris

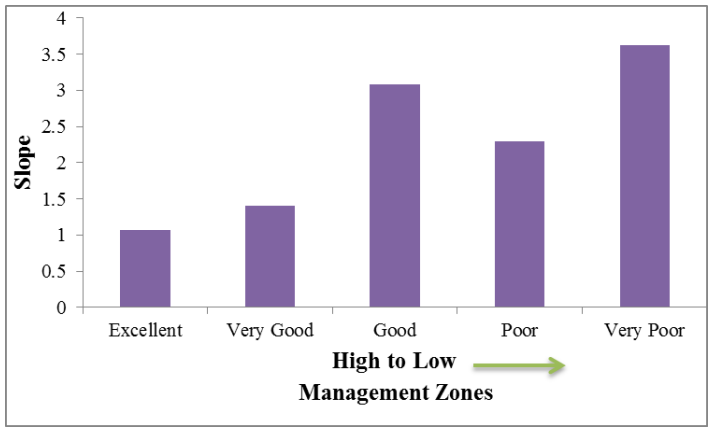


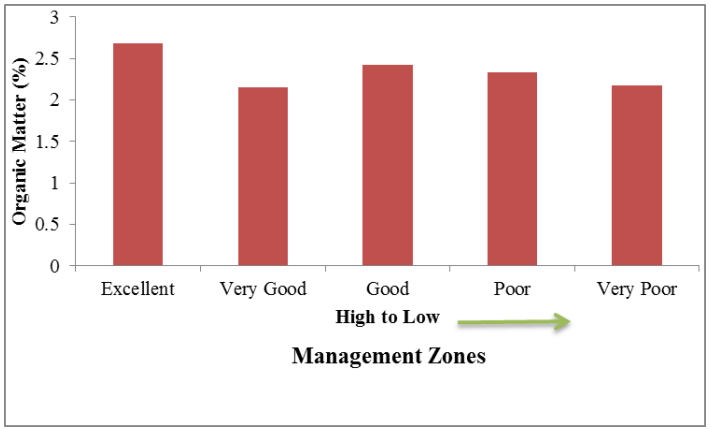


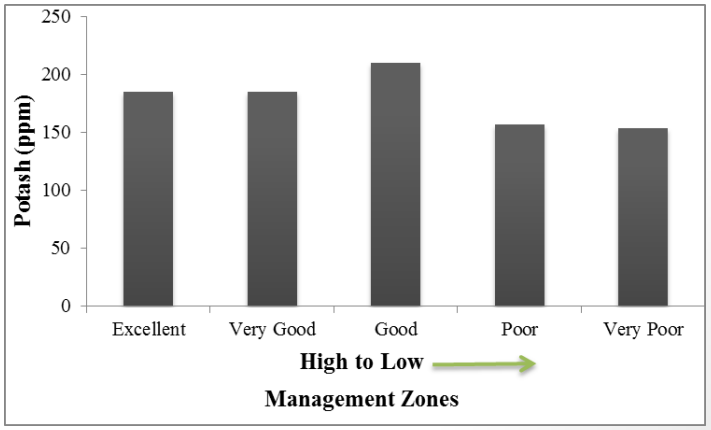


Zonal Analysis – Souris, PEI









Conclusions

- The CVs showed moderate to high variability
- Range of influence and geo-referenced mapping in GIS showed substantial spatial variability.
- The HCP was found to explain > 50% of variability in tuber yield within selected fields
- The DualEM showed significant potential to be used for delineation of MZs

Future Steps

- Repeat experiments for 2-3 years to cover temporal variability and stability of data
- Apply nutrient based on developed MZs using map based VR spreader to evaluate the productivity benefits.
- Include fall sampling prior to potato production to examine the impact of rotation on developing MZs.
- Evaluate environmental benefits of the variable rate nutrient management based on prescription maps
- Develop user friendly protocols for farmers/industry use
- Train HQP and industry personnel

Collaborators/ Funding Agencies

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Precision Agriculture Research Group – UPEI
Potato Board PEI

THANK YOU FOR YOUR ATTENTION

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