Nova Scotia Agricultural College

NSAC. Embrace Your World.

Effect of Soil Variability on Wild Blueberry Fruit Yield

By

Aitazaz Farooque

Introduction

- Wild blueberry is a unique crop
- Native to Northeastern North America
- Situated in naturally acidic soils
- Total area = 86,000 ha[1]
- Yield = 112 million kg and value = $ 470 million[1]

1 Yarborough, D. E. 2009. Available at: www.wildblueberries.maine.edu/

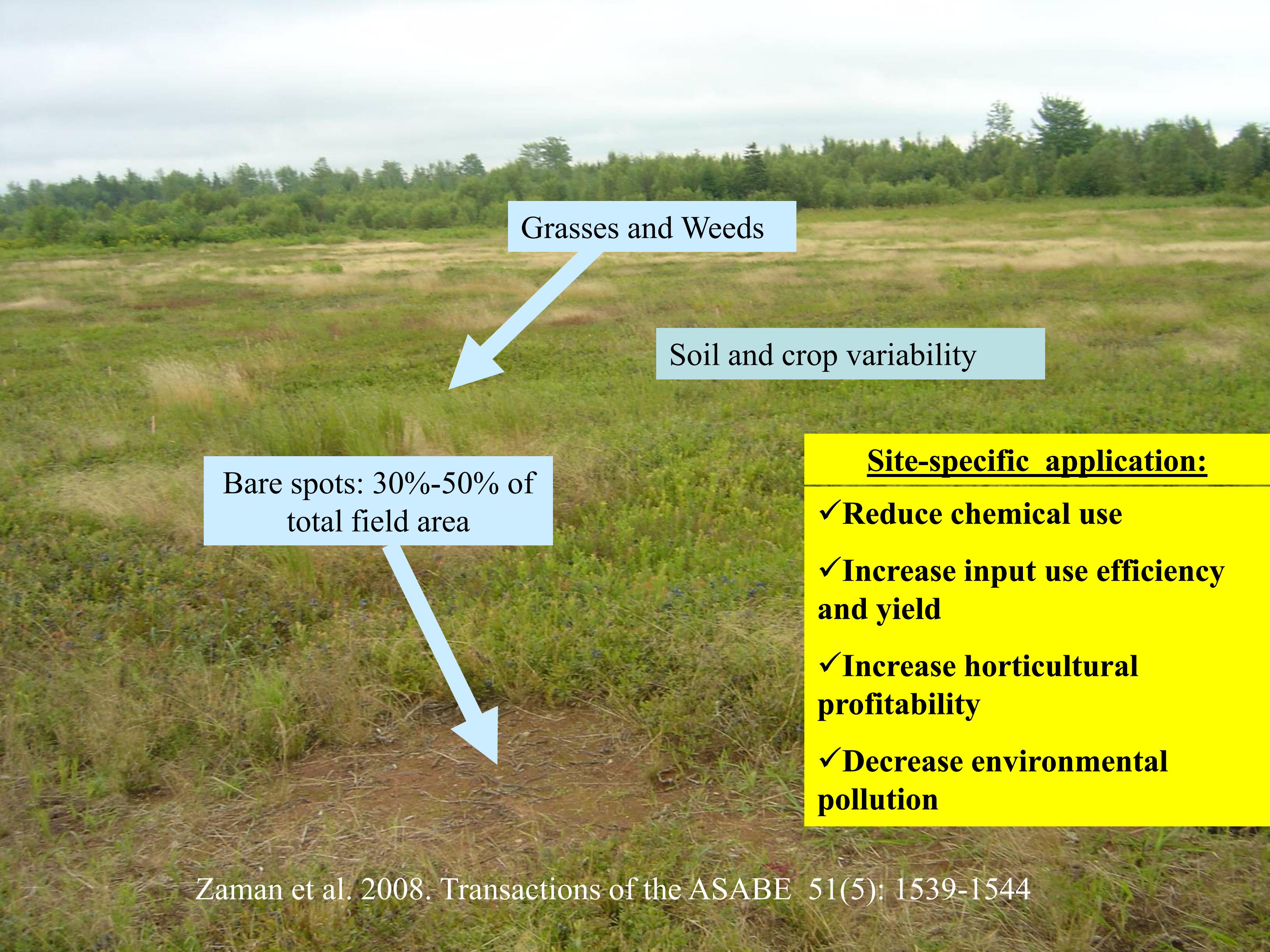
Introduction….

- The increase in yield requires precise agricultural inputs
- Complex interactions occur among topography, climate, cultivation, crop, and agricultural inputs
- Substantial variability can cause yield variability

Introduction….

- Factors causing variation in crop yield include:
  - Soil type and topography
  - Man-related
  - Biological
  - Meteorological

- Management of agricultural inputs results in farm profitability and environmental protection



Site-specific application:

- ✓**Reduce chemical use**
- ✓**Increase input use efficiency and yield**
- ✓**Increase horticultural profitability**
- ✓**Decrease environmental pollution**

Zaman et al. 2008. Transactions of the ASABE 51(5): 1539-1544

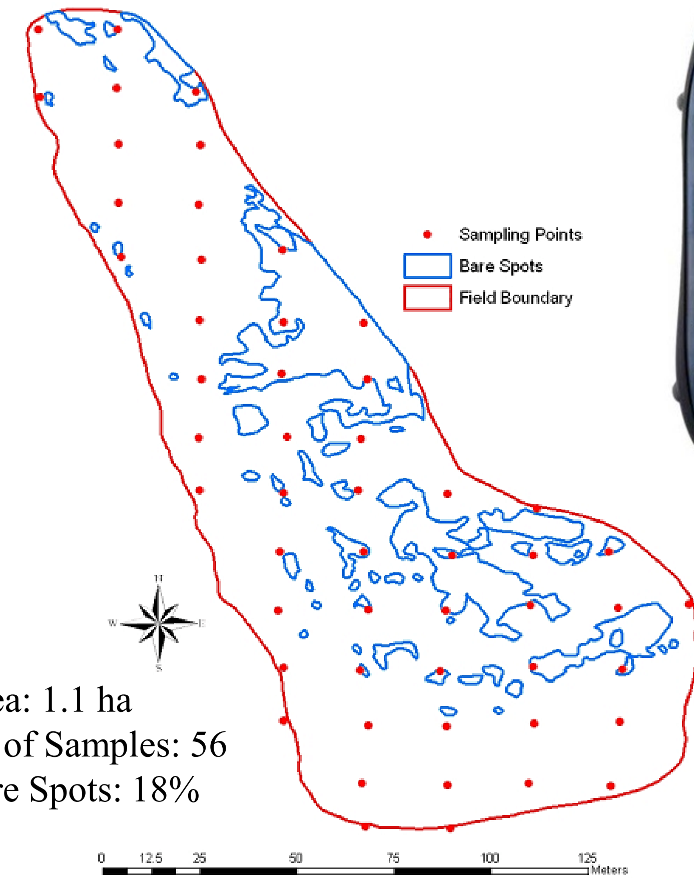
Objectives

- To quantify the spatial patterns of variability in soil properties, leaf nutrient and fruit yield
- To identify the soil properties affecting the wild blueberry yield
- To develop management zones for site-specific fertilization

Nova Scotia Agricultural College

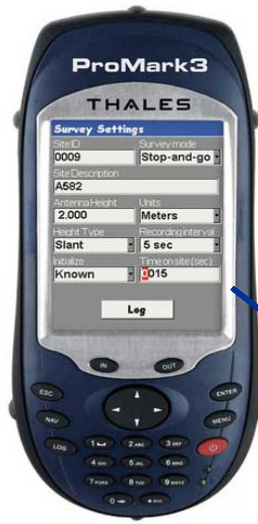
NSAC. Embrace Your World.

Material and Methods

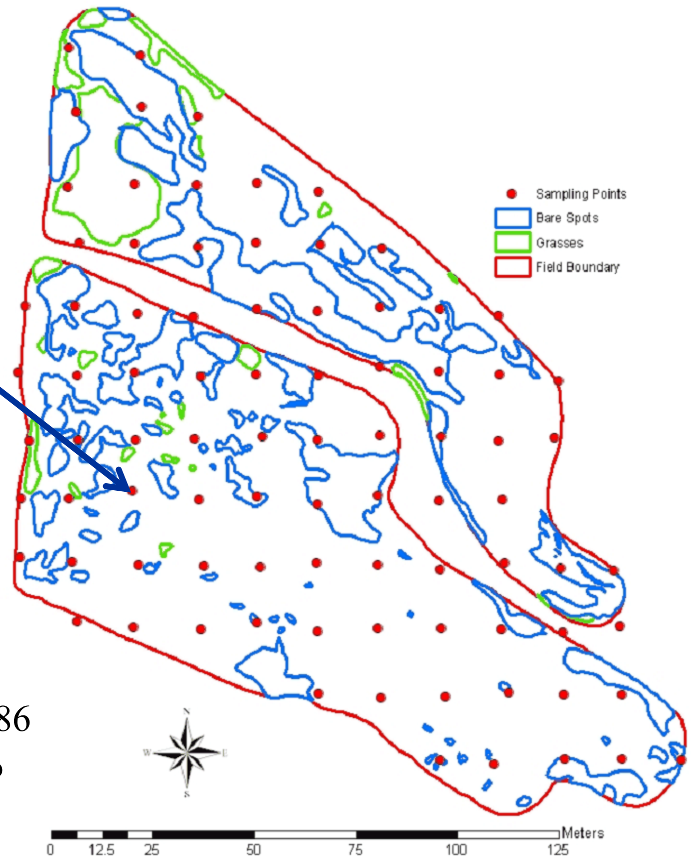


Area: 1.1 ha
No of Samples: 56
Bare Spots: 18%

Carmal Site



Area: 1.6 ha
No of Samples: 86
Bare Spots: 27%



North River Site

Parameters Determined

Soil : NH_4^+-N, NO_3^--N, SOM, texture, moisture content, pH, and EC

Slope: ASMMS

Ground Conductivity: Dual EM

Leaf: % Nitrogen and other nutrients.

Growth Parameters: Height, plant density, no of buds, and branches

Methods….

- **Crop**: Fruit yield

- Soil texture, and pH were measured once. Other soil properties were measured twice in sprout year and once in crop year

Methods….

- Hydrometer method for texture

- Loss on ignition method for SOM

- pH and EC meter

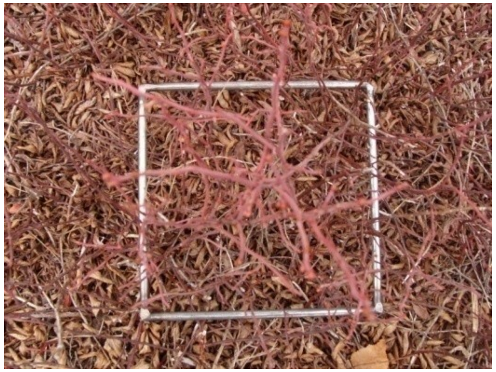
- NH_4^+-N, NO_3^--N were analyzed using Auto Analyzer

- Moisture content was determined using TDR

Methods….

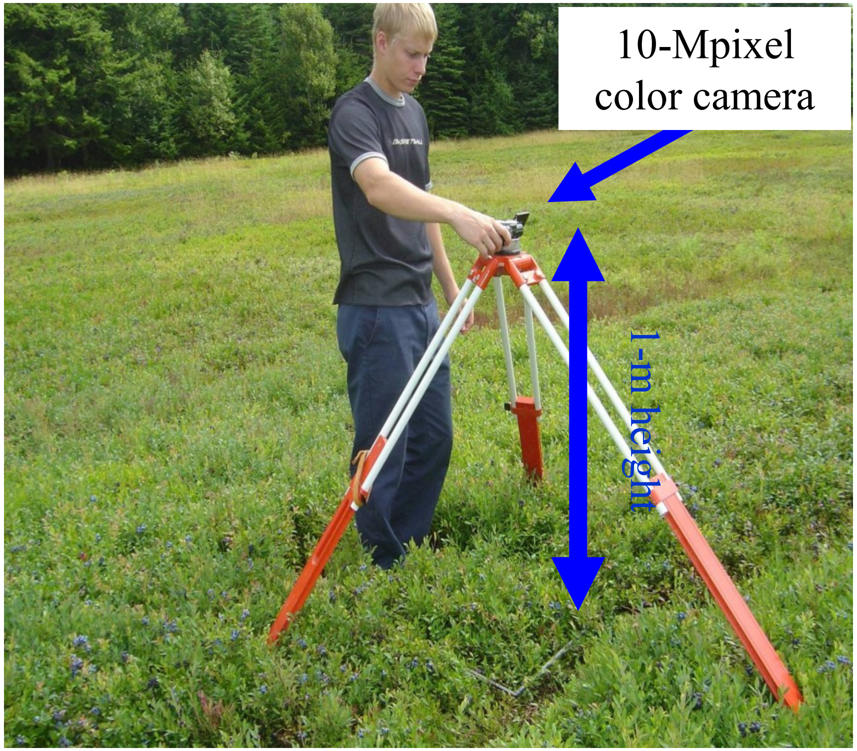
- Leaf samples were collected at tip dieback stage in 2009 and 1st week of June in 2010.
  - ICPES for leaf nutrients

- Plant growth parameters were determined in mid December, 2009



Methods….

- Fruit yield was mapped in 1st week of August, 2010



Zaman et al. 2008. Transactions of the ASABE 51(5): 1539-1544

Statistical Analysis

- Classical statistics
- Geostatistics was performed to quantify variability
- Regression analysis
- Cluster analysis

Analysis….

- Development of maps in Arc GIS 9.3
  - Soil, leaf nutrients, fruit yield and slope
- Kriging interpolation of data sets
- Development of management zones based on clustered data in Arc GIS 9.3

Characterization and Quantification of Variability in Soil Properties, Leaf Nutrients and Fruit Yield

Analysis

- The coefficient of variation (CVs) is normally used to demonstrate the variability
- Soil properties are least variable if the CVs< 15%, moderate with CVs ranging from 15 to 35% and most with CVs > 35% [1]

[1]Wilding, L. 1985. Spatial Variability: Its Documentation, Accommodation and Implication to Soil Surveys. pp. 166-189

Nova Scotia Agricultural College

NSAC. Embrace Your World.

Descriptive Statistics (Carmal Site)

Parameters	Sampling Time	Min	Max	Mean	S.D	C.V (%)
HCP (mS m^{-1})	May, 2009	1.60	10.90	5.81	2.01	34.52
	July, 2009	1.2	11.0	5.82	2.06	35.52
	June, 2010	2.76	12.06	6.93	2.26	38.77
PRP (mS m^{-1})	May, 2009	0.20	8.40	3.98	1.89	47.47
	July, 2009	0.90	9.3	4.97	1.86	37.40
	June, 2010	1.35	9.43	5.14	1.89	36.76
θ_v	May, 2009	16.25	36.42	27.77	4.64	16.72
	July, 2009	17.60	38.15	28.01	5.03	17.97
	Jun , 2010	18.48	38.65	30.01	4.64	19.48
pH	May, 2009	5.05	6.03	5.52	0.19	3.43
EC (µS cm^{-1})	May, 2009	22.65	67.57	41.06	11.04	26.89
	July, 2009	18.26	56.45	38.37	9.01	23.47
	June, 2010	27.88	55.70	28.14	7.18	22.35
SOM (%)	May, 009	5.02	17.67	11.36	2.62	23.12
	June, 2010	5.10	16.67	11.40	2.47	24.71

Conti…

Parameters	Sampling Time	Min	Max	Mean	S.D	C.V (%)
Sand (%)	May, 2009	35.98	58.31	49.52	4.46	9.01
Silt (%)	May, 2009	0.99	14.04	8.24	2.85	34.71
Clay (%)	May, 2009	35.53	52.63	41.88	4.43	10.58
	May, 2009	1.07	24.85	8.57	4.60	53.70
NH_4^+ -N (mg L^{-1})	July, 2009	0.13	23.64	5.53	4.06	74.01
	June, 2010	0.13	18.42	4.39	3.89	55.26
	May, 2009	0.82	8.07	4.05	1.69	41.75
NO_3^--N (mg L^{-1})	July, 2009	1.39	9.50	3.59	2.16	47.09
	June, 2010	1.40	7.89	3.10	1.17	49.42

Descriptive Statistics (N. River Site)

- The HCP, PRP, clay, EC, NH_4^+-N, and NO_3^--N were highly variable with CVs > 35%
- The percent sand, silt, SOM and θ_v were found to be moderately variable with the CVs ranging from 15% to 35%
- Soil pH was less variable with CV of 5.60%
- The CVs of soil properties for the 2nd and 3rd sampling exhibited the large variation except soil EC during the crop year, and θ_v for 2nd soil sampling

Summary Statistics of Leaf Nutrients (Carmal Site)

Parameters	Sampling Time	Min	Max	Mean	S.D	C.V (%)
Nitrogen (%)	July, 2009	1.03	3.68	1.89	0.51	27.24
Nitrogen (%)	June, 2010	1.12	2.46	1.58	0.16	19.12
Phosphorous (%)	July, 2009	0.10	0.53	0.20	0.12	60.29
Phosphorous (%)	June, 2010	0.11	0.18	0.15	0.01	30.41
Potassium (%)	July, 2009	0.14	0.53	0.45	0.08	20.86
Potassium (%)	June, 2010	0.30	0.53	0.41	0.05	17.05
Calcium (%)	July, 2009	0.41	0.66	0.53	0.06	11.13
Calcium (%)	June, 2010	0.33	0.50	0.43	0.04	10.63
Magnesium (%)	July, 2009	0.15	0.25	0.18	0.02	11.58
Magnesium (%)	June, 2010	0.13	0.21	0.17	0.01	10.97
Iron (mg L^{-1})	July, 2009	30.03	127.47	45.96	20.20	43.96
Iron (mg L^{-1})	June, 2010	32.25	76.95	42.68	9.99	31.05

Conti…

Parameters	Sampling Time	Min	Max	Mean	S.D	C.V (%)
Manganese (mg L^{-1})	July, 2009	1175.60	2237.30	1712.50	288.1	16.82
Manganese (mg L^{-1})	June, 2010	624.7	2458.60	1465.60	381.42	26.02
Copper (mg L^{-1})	July, 2009	4.58	11.60	7.62	1.75	23.02
Copper (mg L^{-1})	June, 2010	3.99	7.93	5.75	0.83	24.50
Zinc (mg L^{-1})	July, 2009	14.07	22.02	17.62	1.99	11.30
Zinc (mg L^{-1})	June, 2010	13.42	21.01	16.45	1.67	10.20
Boron (mg L^{-1})	July, 2009	13.32	29.14	19.88	3.55	17.90
Boron (mg L^{-1})	June, 2010	7.79	17.70	12.78	1.94	15.18

- Leaf N, P, and K were observed lower by 18%, 25% and 10%, respectively

- The reduction in the leaf N during crop year was in agreement with the findings of Penney and McRae (2000)

Summary Statistics of Leaf Nutrients (N. River Site)

- Descriptive statistics showed that tissue Fe and N were highly variable with CVs of 55.37% and 35.24%, respectively
- Tissue Mg and Cu were found to be least variable
- All other tissue nutrients were moderately variable with CVs ranging from 15% to 30%
- Similar pattern of variation during the crop year
- The mean values for tissue nutrients were in agreement with the standards set by Trevett (1972)

Nova Scotia Agricultural College

NSAC. Embrace Your World.

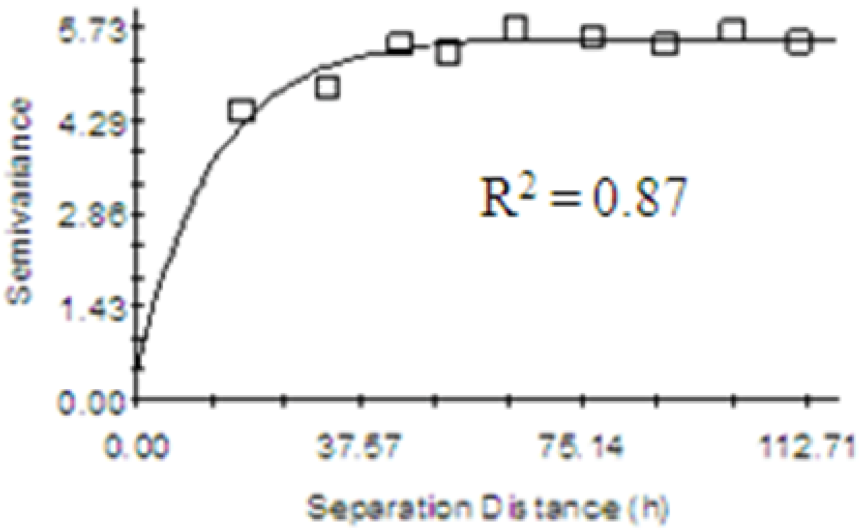
Plant Growth Parameters and Yield

Parameters	Min	Max	Mean	S.D	C.V (%)
Carmal Site					
Plant Density	7.00	25.00	12.89	3.86	29.94
Height	14.00	31.00	19.55	3.67	18.79
Buds	114.00	274.00	179.82	33.24	18.48
Branches	10.00	38.00	20	6.53	32.63
Yield (Kg ha^{-1})	800.00	6344.00	2689.00	1332.00	49.52
Blue Pixel (%)	0.30	9.98	2.67	1.22	43.02
North River Site					
Plant Density	6.00	20.00	11.24	3.17	28.23
Height	10.00	23.00	15.16	3.10	20.44
Buds	95.00	232.00	154.24	33.29	21.58
Branches	12.00	52.00	21.48	6.86	31.97
Yield (Kg ha^{-1})	68.00	5600.00	2583.00	1430.00	55.36
Blue Pixel (%)	0.12	7.00	2.48	1.89	56.17

Nova Scotia Agricultural College

NSAC. Embrace Your World.

Semivariogram



Nugget: 0.48
Sill: 5.57
Range: 13.10 m

NO_3^--N

Geostatistical Analysis of Soil Properties (Carmal Site)

Parameters	Sampling Time	Nugget	Sill	Range (m)	Nugget Sill ratio (%)	R^2
HCP (mS m^{-1})	May, 2009	1.77	3.95	28.30	44.86	0.63
	July, 2009	1.35	4.15	28.10	32.53	0.70
	June, 2010	0.10	3.95	20.50	2.50	0.88
PRP (mS m^{-1})	May, 2009	0.07	3.93	70.80	1.78	0.74
	July, 2009	0.68	3.51	65.60	19.37	0.68
	June, 2010	0.23	3.92	45.93	5.86	0.95
θ_v	May, 2009	1.03	21.42	12.60	4.80	0.31
	July, 2009	8.97	26.96	16.70	33.27	0.77
	Jun , 2010	10.46	21.39	48.90	48.90	0.74
pH	May, 2009	0.02	0.06	76.40	33.33	0.57
EC (µS cm^{-1})	May, 2009	9.80	125.10	24.90	7.8	0.23
	July, 2009	4.00	80.70	26.50	4.95	0.93
	June, 2010	27.80	96.60	28.56	28.77	0.92

Conti…

Parameters	Sampling Time	Nugget	Sill	Range (m)	Nugget Sill ratio (%)	R^2
SOM (%)	May, 009	3.37	6.74	76.10	50	0.65
	June, 2010	3.27	6.32	70.23	51.74	0.72
Sand (%)	May, 2009	18.75	18.75	85.86	100	0.37
Silt (%)	May, 2009	7.62	7.62	81.66	100	0.10
Clay (%)	May, 2009	0.01	19.16	23.70	0.05	0.30
	May, 2009	0.01	17.36	20.30	0.05	0.50
NH_4^+ -N (mg L^{-1})	July, 2009	12.10	43.86	31.90	27.58	0.54
	June, 2010	3.23	16.25	27.80	19.87	0.62
	May, 2009	0.84	2.87	19.00	29.26	0.44
NO_3^--N (mg L^{-1})	July, 2009	0.52	4.89	16.30	10.63	0.40
	June, 2010	0.79	4.28	18.30	18.45	0.54

Geostatistical Analysis of Soil Properties (N. River Site)

- All the soil properties were highly variable within field except θ_v, sand, silt and clay indicating moderate variability with the range of influence 45 to 70 m
- HCP for 2^{nd} sampling and PRP for 3^{rd} sampling were moderately variable
- The spatial pattern of the variability for soil properties during crop year was similar to 1^{st} and 2^{nd} soil sampling
- The θ_v during the crop year was moderate to highly variable within field with the range of influence 14 to 51 m

Geostatistical Analysis of Leaf Nutrients (Carmal Site)

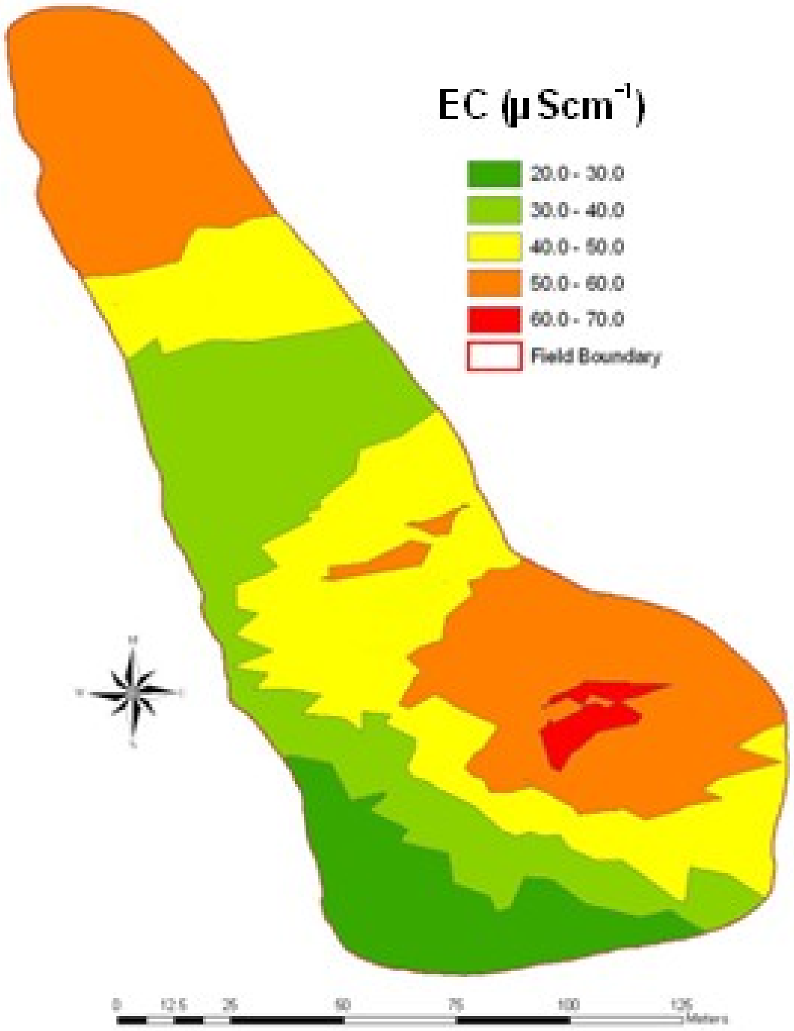
Carmal Site (Sprout Year)						
Parameters	Nugget	Sill	Range (m)	Nugget Sill ratio (%)	R^2	Model
N (%)	0.01	0.02	60.21	50.00	0.47	Linear
P (%)	0.007	0.09	21.10	7.77	0.28	Exponential
K (%)	0.006	0.006	67.10	100.00	0.37	Linear
Ca (%)	0.001	0.004	23.70	25.00	0.49	Spherical
Mg (%)	0.003	0.006	70.40	50.00	0.58	Spherical
Fe (mg L^{-1})	235.00	803.00	63.40	29.26	0.81	Gaussian
Mn (mg L^{-1})	57.00	1587.36	77.10	3.59	0.93	Gaussian
Cu (mg L^{-1})	0.18	3.05	14.90	5.91	0.30	Gaussian
Zn (mg L^{-1})	3.02	7.75	74.20	38.96	0.45	Exponential
B (mg L^{-1})	4.01	12.25	27.80	32.65	0.35	Spherical

- Similar pattern of variation during crop year (Range 14 to 86 m)

Geostatistical Analysis of Leaf Nutrients (N. River Site)

- The semivariogram analysis showed that the leaf P, K, Ca, Fe, B and Zn, were highly variable with the range of variability less than 30 m
- Leaf N, Mg, Mn and Cu showing moderate variability with the range of influence ranging from 45 to 62 m
- Leaf nutrients exhibited the similar pattern of variation during crop year

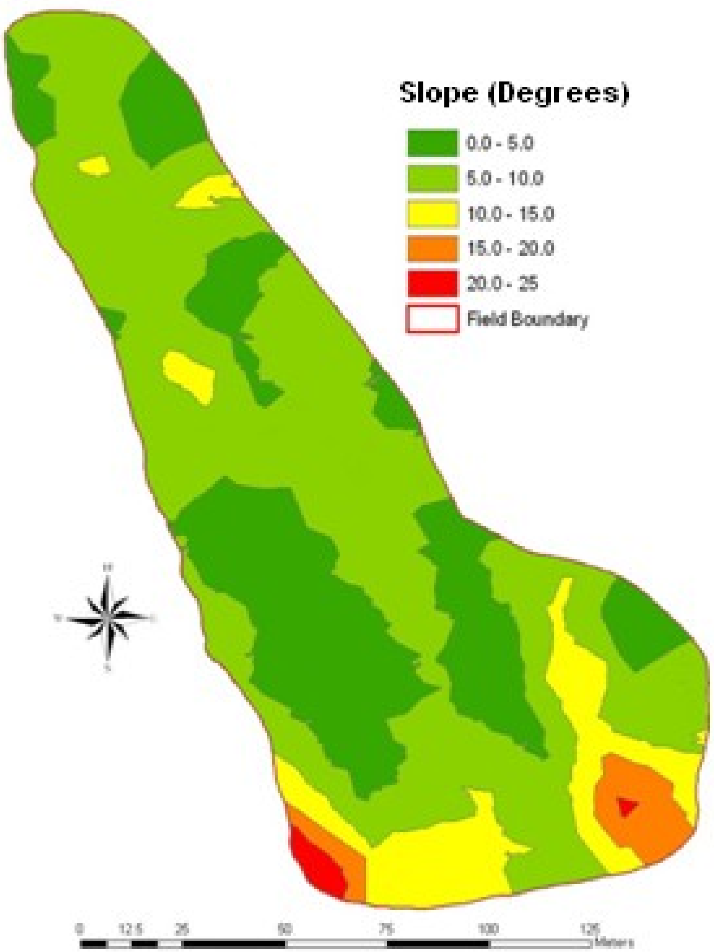
Interpolation and Mapping

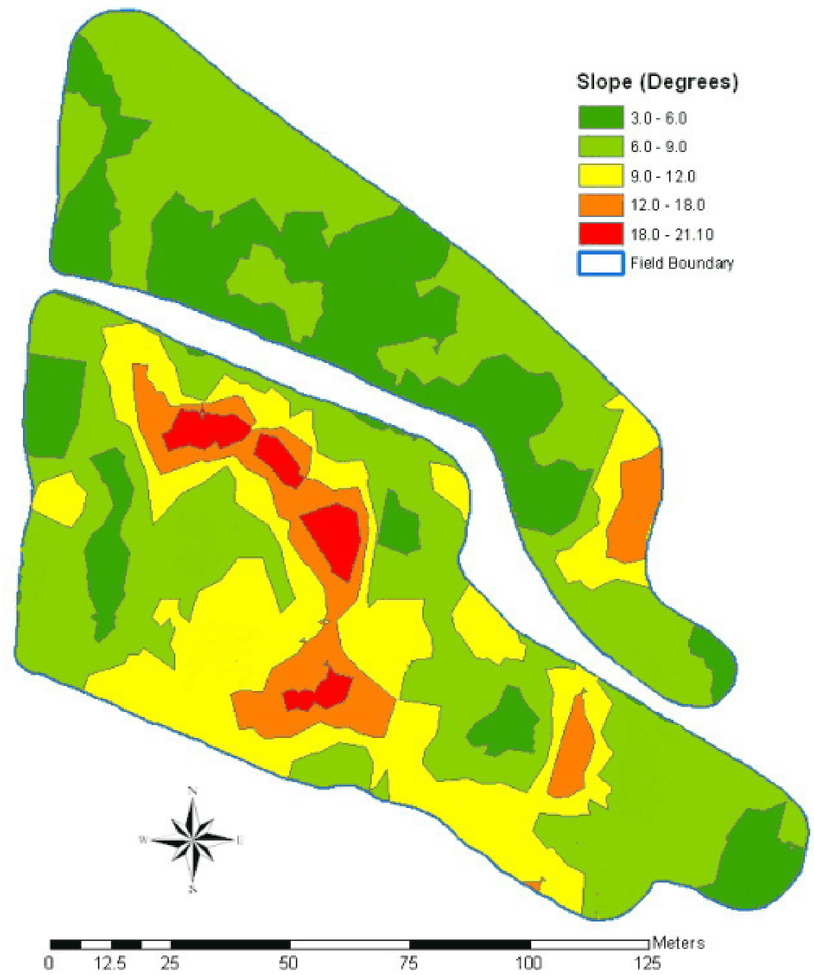


Nova Scotia Agricultural College

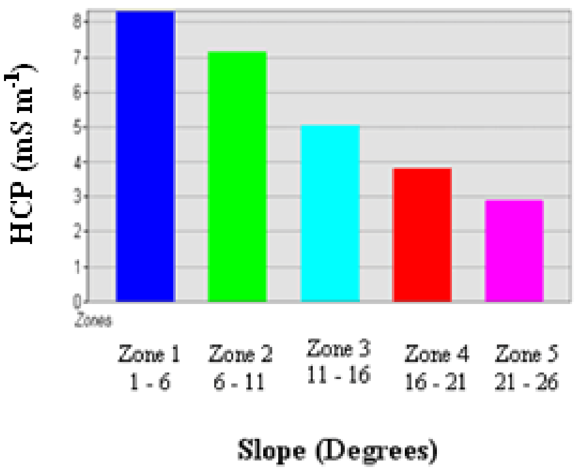
NSAC. Embrace Your World.

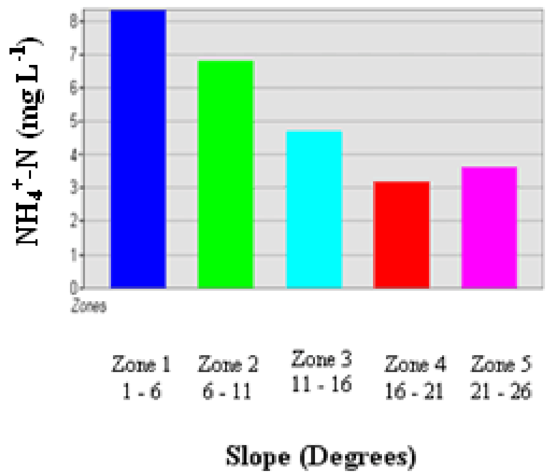
Slope Maps

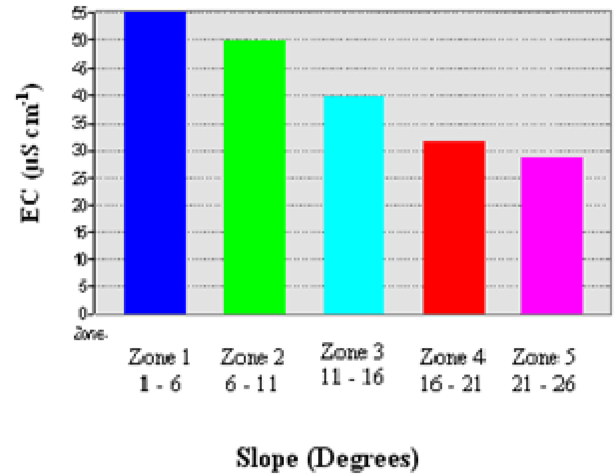


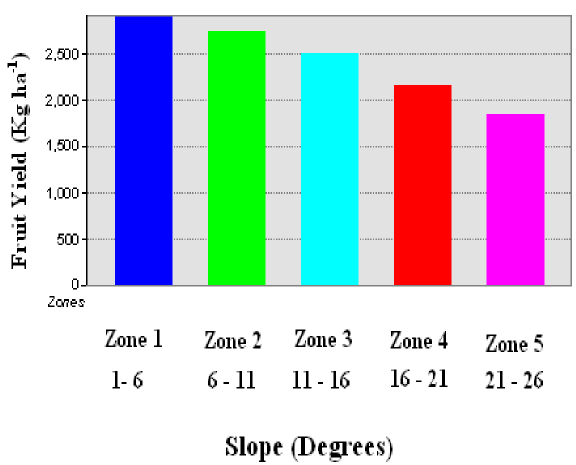


Variation of Soil Properties with Slope









Conclusions (Objective 1)

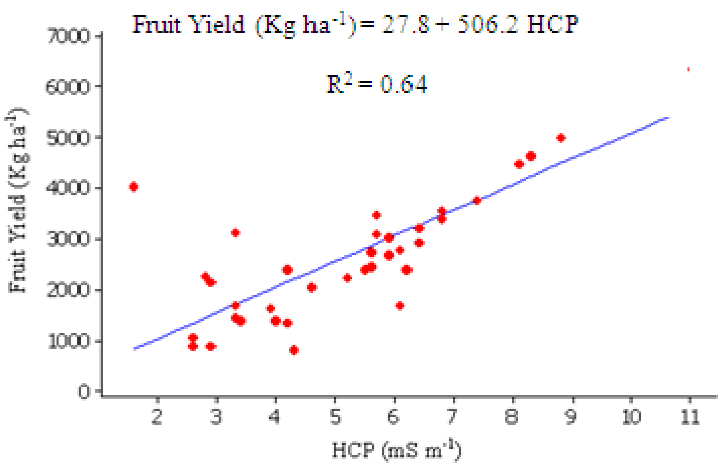
- The CVs suggested moderate to high variation of soil properties, leaf nutrients and fruit yield except soil pH for both fields
- Geostatistical results also indicated moderate to high variability
- The maps developed in Arc GIS 9.3 also indicated the substantial variability of soil properties and leaf nutrients across the field

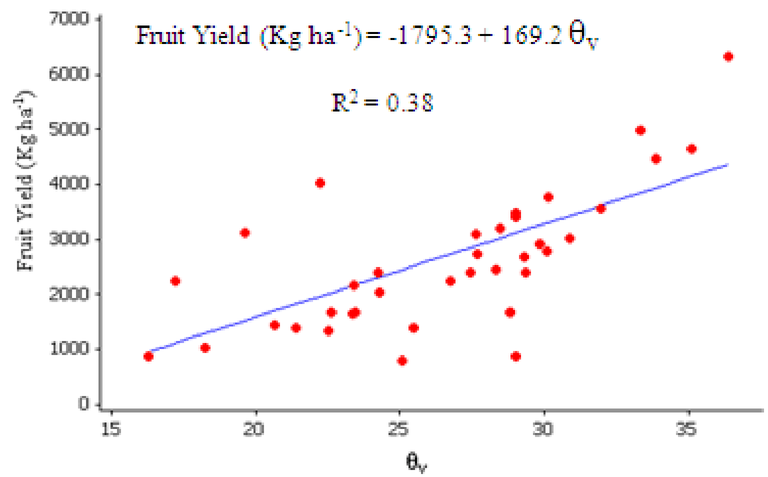
Conclusions (Objective 1)

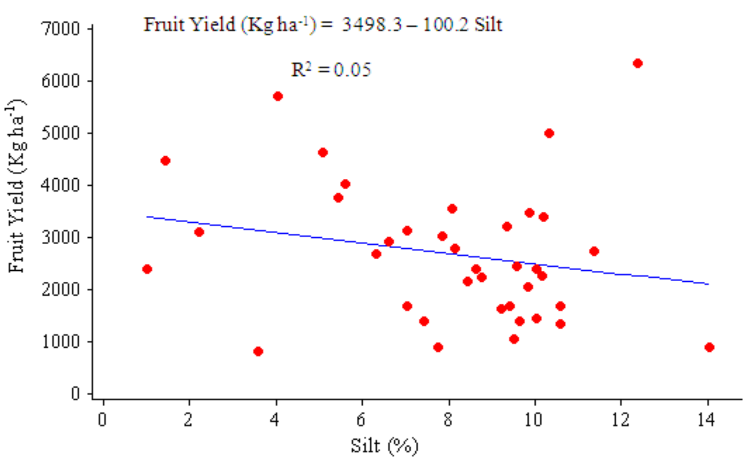
- Planning future soil sampling in the fields having soil and crop variability
- Based on these results 15 to 20 m grid size would be appropriate for future sampling
- These results would help in ameliorating the unproductive areas based on proper soil sampling, soil variability characterization, and identification of the soil properties responsible for yield variability

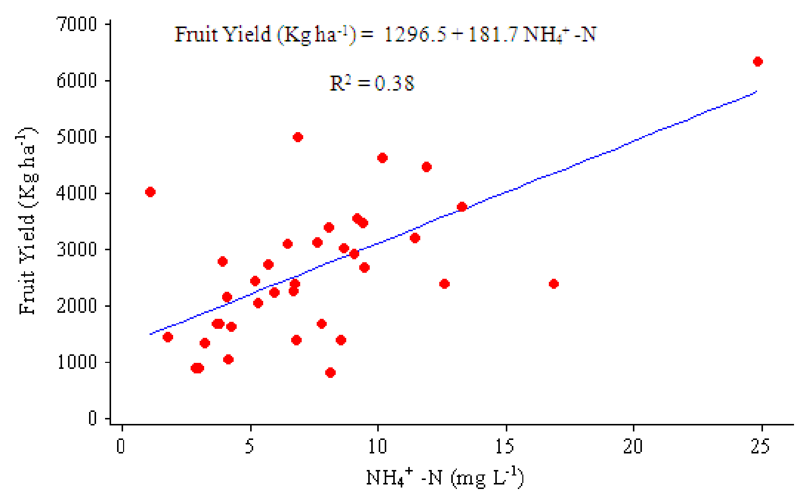
Identification of Soil Properties Affecting Wild Blueberry Fruit Yield

Fruit Yield VS. Soil Properties (Carmal Site)









Conti…

2nd Sampling (2009)			
Soil property	**Regression Model**	**R^2**	**P-Value**
HCP ($mS\ m^{-1}$)	Yield ($Kg\ ha^{-1}$)= 178.6 + 477.3 HCP	0.58	0.000
PRP ($mS\ m^{-1}$)	Yield ($Kg\ ha^{-1}$)= 457.3 + 497.7 PRP	0.48	0.000
θ_v	Yield ($Kg\ ha^{-1}$)= -2056 + 177.5 θ_v	0.46	0.000
EC ($\mu S\ cm^{-1}$)	Yield ($Kg\ ha^{-1}$)= 151.2 + 71.3 EC	0.25	0.002
NH_4^+ -N ($mg\ L^{-1}$)	Yield ($Kg\ ha^{-1}$)= 1248 + 1951 NH_4^+-N	0.50	0.000
NO_3^--N ($mg\ L^{-1}$)	Yield ($Kg\ ha^{-1}$)= 1179 + 2693 NO_3^--N	0.46	0.000
3rd Sampling (2010)			
Soil property	**Regression Model**	**R^2**	**P-Value**
HCP ($mS\ m^{-1}$)	Yield ($Kg\ ha^{-1}$) = -559.4 + 506.2 HCP	0.64	0.000
PRP ($mS\ m^{-1}$)	Yield ($Kg\ ha^{-1}$) = 1166 + 326.9 PRP	0.23	0.003
θ_v	Yield ($Kg\ ha^{-1}$) = -2172 + 169.2 θ_v	0.38	0.000
EC ($\mu S\ cm^{-1}$)	Yield ($Kg\ ha^{-1}$) = 154.2 + 69.7 EC	0.24	0.002
SOM (%)	Yield ($Kg\ ha^{-1}$) = -653.9 + 306.1 SOM	0.40	0.000
NH_4^+ -N ($mg\ L^{-1}$)	Yield ($Kg\ ha^{-1}$) = 1438 + 277.3 NH_4^+-N	0.52	0.000
NO_3^--N ($mg\ L^{-1}$)	Yield ($Kg\ ha^{-1}$) = 1142 + 370.5 NO_3^--N	0.38	0.000

Fruit Yield VS Soil Properties (N. River Site)

2nd Sampling (2009)			
Soil property	**Regression Model**	**R^2**	**P-Value**
HCP (mS m^{-1})	Yield (Kg ha^{-1}) = 545.1 + 319.7 HCP	0.56	0.000
PRP (mS m^{-1})	Yield (Kg ha^{-1}) = 1187 + 320.1 PRP	0.30	0.000
θ_v	Yield (Kg ha^{-1}) = -1267 + 152 θ_v	0.28	0.000
EC (µS cm^{-1})	Yield (Kg ha^{-1}) = -342.3 + 63.6 EC	0.55	0.002
NH_4^+ -N (mg L^{-1})	Yield (Kg ha^{-1}) = 1494 + 232.8 NH_4^+-N	0.29	0.000
NO_3^--N (mg L^{-1})	Yield (Kg ha^{-1}) = 1395 + 343.9 NO_3^--N	0.31	0.000
3rd Sampling (2010)			
Soil property	**Regression Model**	**R^2**	**P-Value**
HCP (mS m^{-1})	Yield (Kg ha^{-1}) = -844.4 + 357.7 HCP	0.64	0.000
PRP (mS m^{-1})	Yield (Kg ha^{-1}) = -1479 + 464.2 PRP	0.50	0.003
θ_v	Yield (Kg ha^{-1}) = -1958 + 151.5 θ_v	0.29	0.000
EC (µS cm^{-1})	Yield (Kg ha^{-1}) = -361.9 + 68.3 EC	0.51	0.000
SOM (%)	Yield (Kg ha^{-1}) = -352.7 + 341.7 SOM	0.30	0.000
NH_4^+ -N (mg L^{-1})	Yield (Kg ha^{-1}) = 2010 + 12.6 NH_4^+-N	0.12	0.015
NO_3^--N (mg L^{-1})	Yield (Kg ha^{-1}) = 1395 + 343.9 NO_3^--N	0.27	0.000

- Fruit yield having non-significant correlations with sand, silt and pH for N. R. Site

Multiple and Stepwise Regression

Carmal Site

Fruit yield (Kg ha^{-1}) = 18028 + 916 $HCP_{(S)}$ - 3.8 $PRP_{(S)}$ - 93.3 $\theta_{v\,(S)}$ + 111 $pH_{(S)}$ - 20.4 $EC_{(S)}$ - 326 $SOM_{(S)}$ - 153 $Sand_{(S)}$ - 235 $Silt_{(S)}$ - 182 $Clay_{(S)}$ + 33.1 $NH_4^+\text{-}N_{(S)}$ - 32 $NO_3^-\text{-}N_{(S)}$ + 273 $SOM_{(c)}$ + 59.8 $NH_4^+\text{-}N_{(c)}$ - 70 $NO_3^-\text{-}N_{(c)}$

($R^2 = 0.78$, $p < 0.001$)

Fruit yield (Kg ha^{-1}) = 1134 + 723 $HCP_{(c)}$ - 38 $\theta_{v\,(c)}$ – 101 $SOM_{(s)}$ + 14 $NH_4^+\text{-}N_{(c)}$ - 70 $NO_3^-\text{-}N_{(c)}$

($R^2 = 0.66$, $p < 0.001$)

Fruit Yield VS. Leaf Nutrients

Carmal Site										
	Coefficient of correlation (r)									
Sampling Time	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn	B
July, 2009	0.53***	0.66***	0.46***	0.30*	0.16 NS	0.09 NS	0.21 NS	-0.11 NS	0.33*	-0.07 NS
June, 2010	0.58***	0.49***	0.39**	0.32*	0.11 NS	0.05 NS	0.24 NS	-0.15 NS	0.35**	-0.11 NS
North River Site										
Sampling Time	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn	B
July, 2009	0.55***	0.40**	0.33*	0.12NS	-0.19 NS	-0.05 NS	0.18 NS	0.32*	0.30*	0.16 NS
June, 2010	0.48***	0.33*	0.29*	0.19 NS	-0.24 NS	-0.01 NS	0.20 NS	0.30*	0.33*	0.13 NS

Significance of correlations indicated by *, ** and ***, are equivalent to p = 0.05, p = 0.01 and p = 0.001.
NS, non significant at p = 0.05

Conclusions (Objective 2)

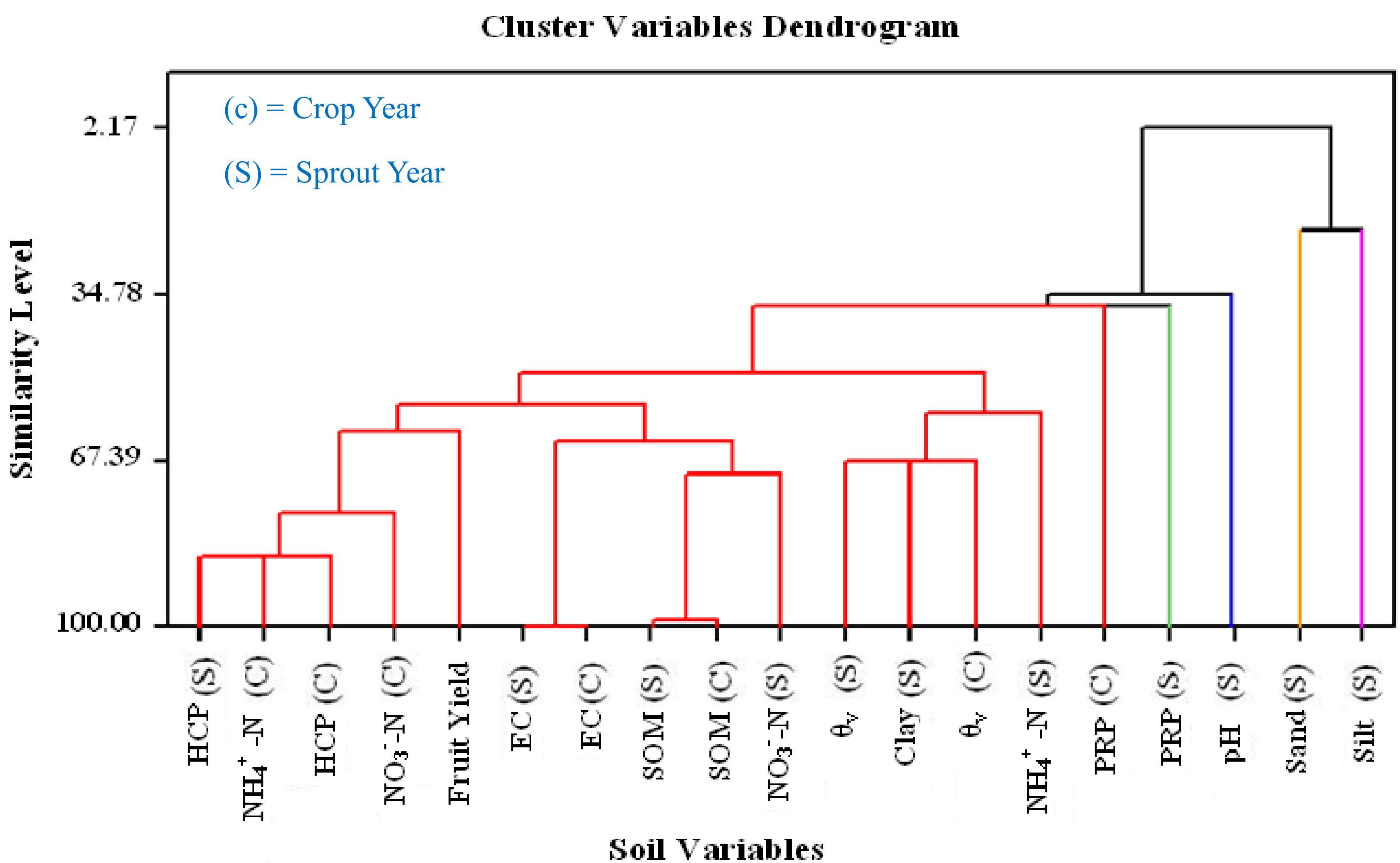
- The fruit yield was significantly correlated with soil SOM, θ_v, clay, EC, NH_4^+-N, NO_3^--N, HCP and PRP
- Stepwise regression suggested that θ_v, HCP, NH_4^+-N, NO_3^--N, SOM and EC were found to be major yield-limiting factor for both fields
- Major yield-limiting factors can be used to delineate management zones

Nova Scotia Agricultural College

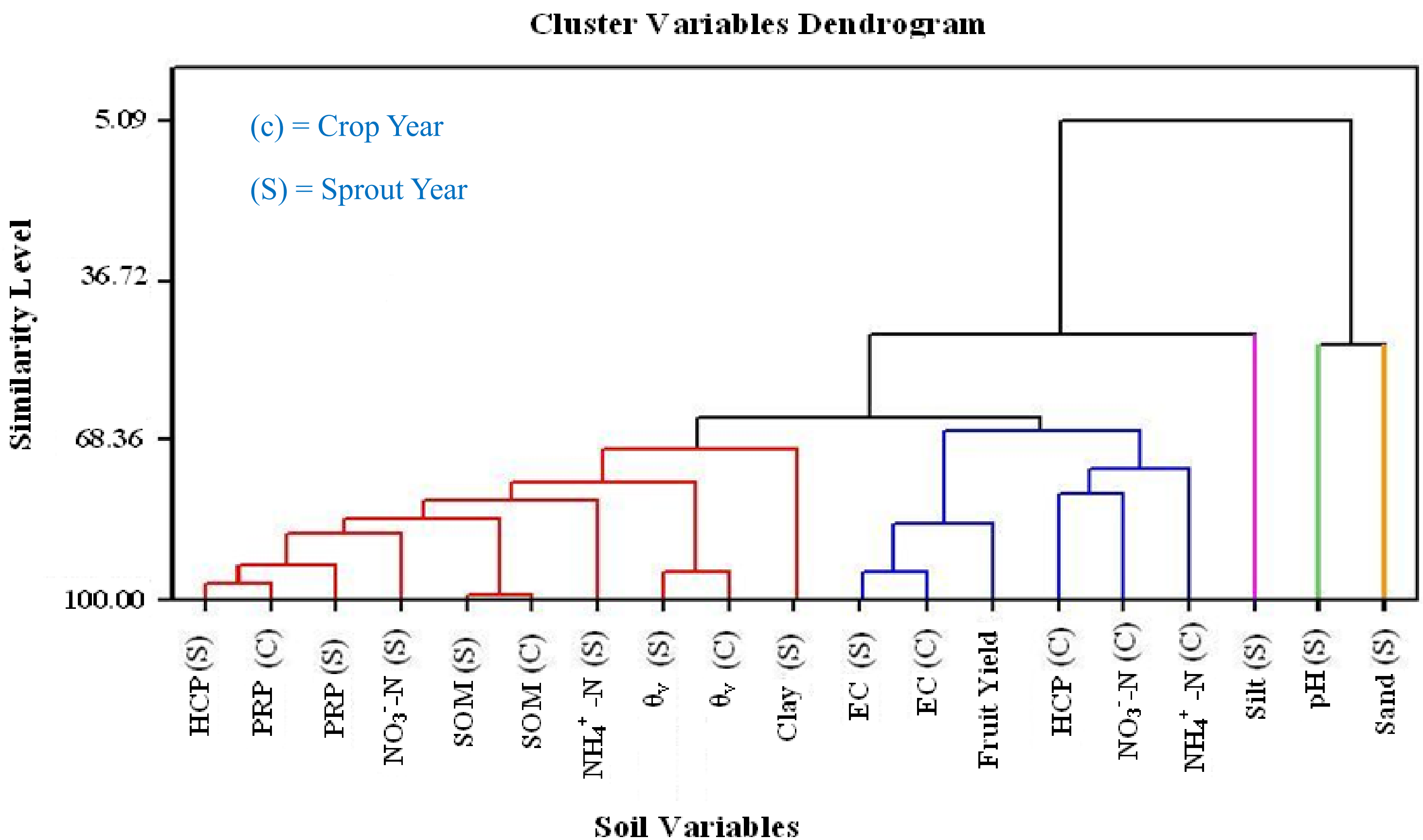
NSAC. Embrace Your World.

Delineation of Management Zones for Site-Specific Fertilization

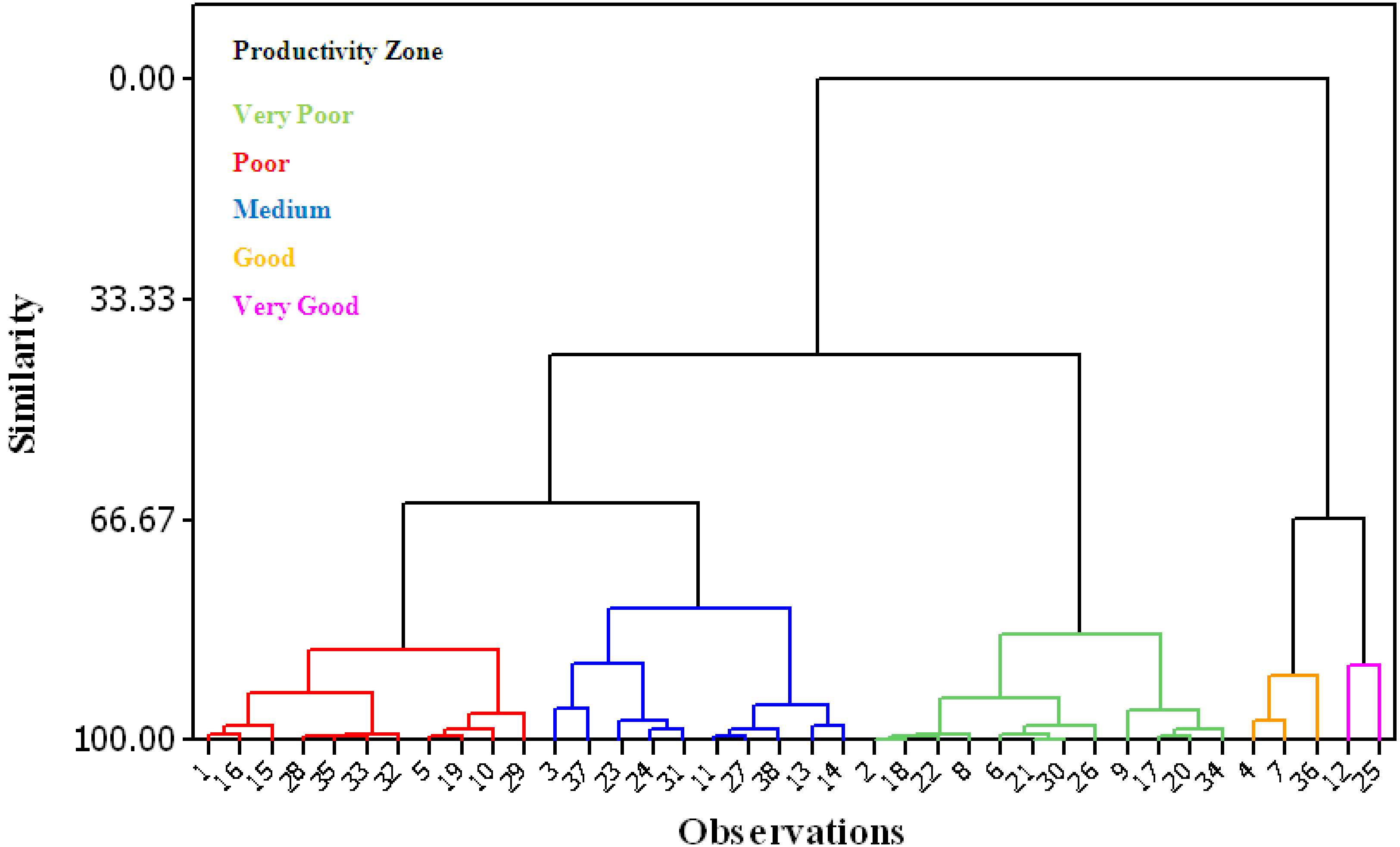
Cluster Analysis of Soil Variables and Fruit Yield (Carmal Site)



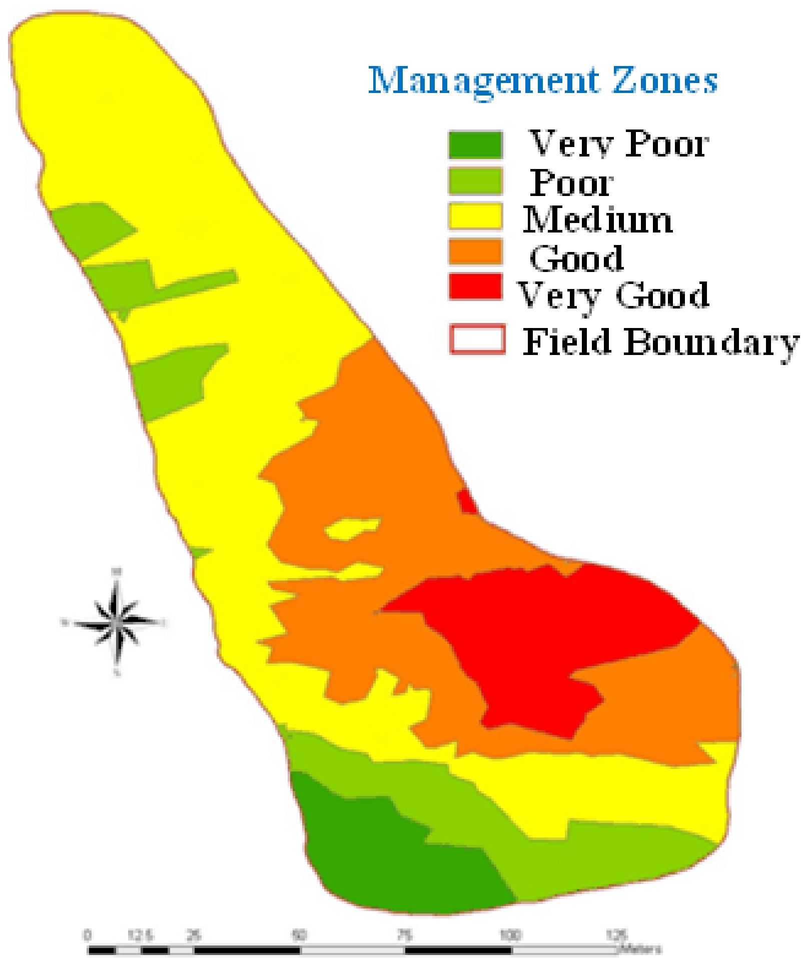
Cluster Analysis of Soil Variables and Fruit Yield (N. River Site)



Observation Dendrogram (Carmal Site)



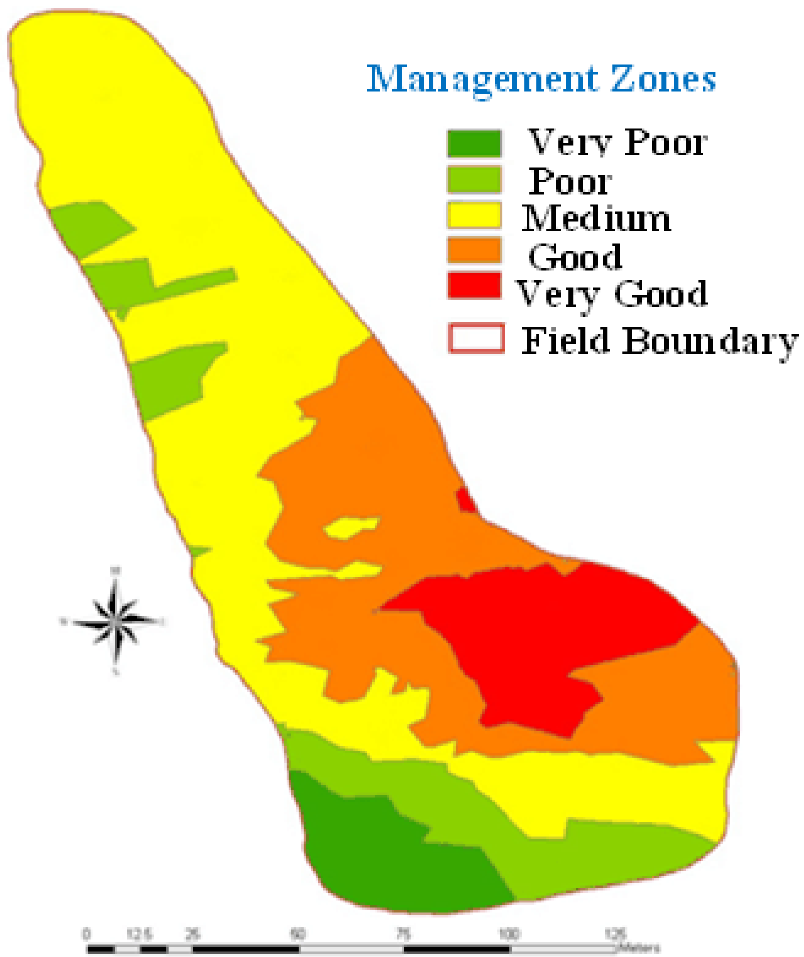
Management Zones

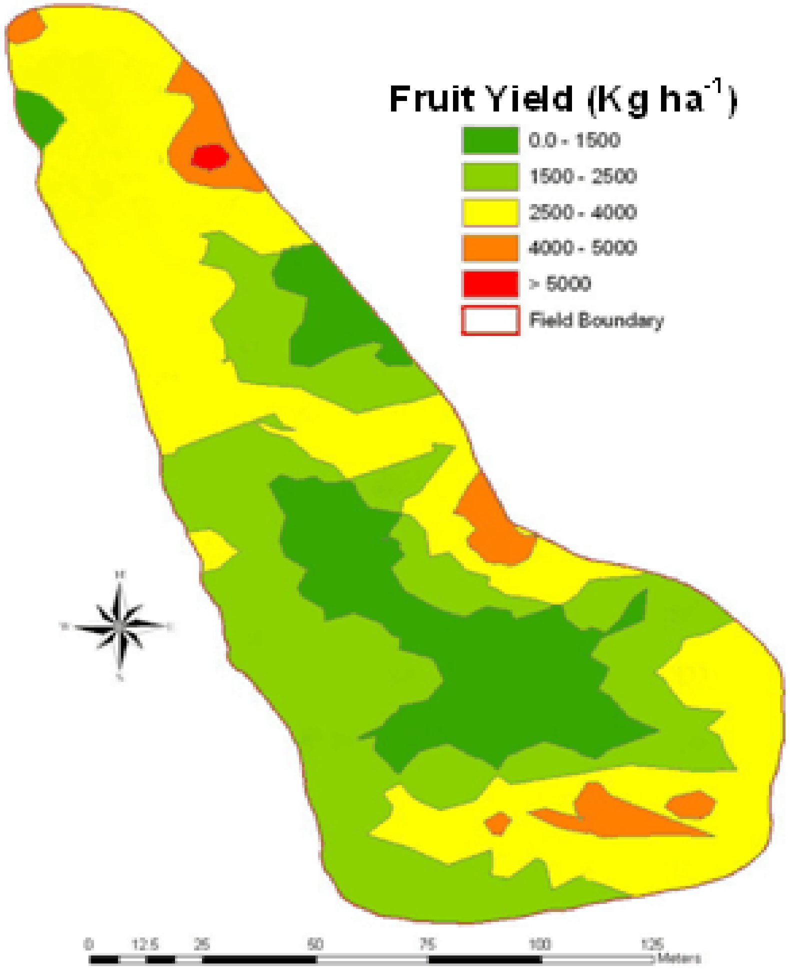


Comparison of Means (Carmal Site)

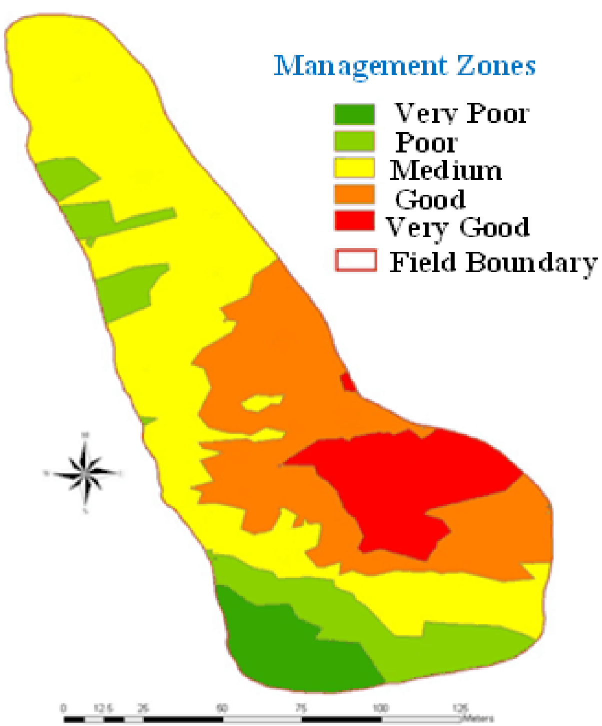
Soil Properties	Fruit Yield (Kg ha^{-1}) Management Zone				
	Zone 1 Yield <1500 **(Very Poor)**	Zone 2 Yield 1500-2500 **(Poor)**	Zone 3 Yield 2500- 4000 **(Medium)**	Zone 4 Yield 4000-5000 **(Good)**	Zone 5 Yield > 5000 **(Very Good)**
Fruit Yield (Kg ha^{-1})	1322.22**d**	2413.20**c**	3360**e**	4707.00**b**	6032.00**a**
HCP (mSm^{-1})	3.66**b**	4.96**b**	5.60**c**	8.4**b**	10.05**a**
PRP (mSm^{-1})	2.68**b**	3.49**b**	3.47**b**	4.54**ab**	7.05**a**
θ_v	23.07**bc**	26.19**b**	27.88**c**	34.10**a**	30.34**ab**
pH	5.3 **a**	5.56**a**	5.56**a**	5.54**a**	5.58**a**
EC (µScm^{-1})	32.83**b**	36.64**b**	37.89**b**	51.47**a**	61.18**a**
SOM (%)	8.83**b**	11.09**b**	11.07**c**	13.81**ab**	16.59**a**
Sand (%)	51.87**ab**	49.70**ab**	49.35**a**	50.11**ab**	45.94**b**
Silt (%)	9.07**a**	8.39**a**	7.22**a**	5.61**a**	8.22**a**
Clay (%)	38.21**a**	41.70**a**	42.02**b**	45.28**a**	46.34**a**
NH_4^+ -N (mgL^{-1})	4.84**bc**	7.51**b**	8.42**c**	9.66**b**	16.62**a**
NO_3^--N (mgL^{-1})	2.59**cd**	3.46**bc**	3.75**d**	5.65**ab**	6.36**a**

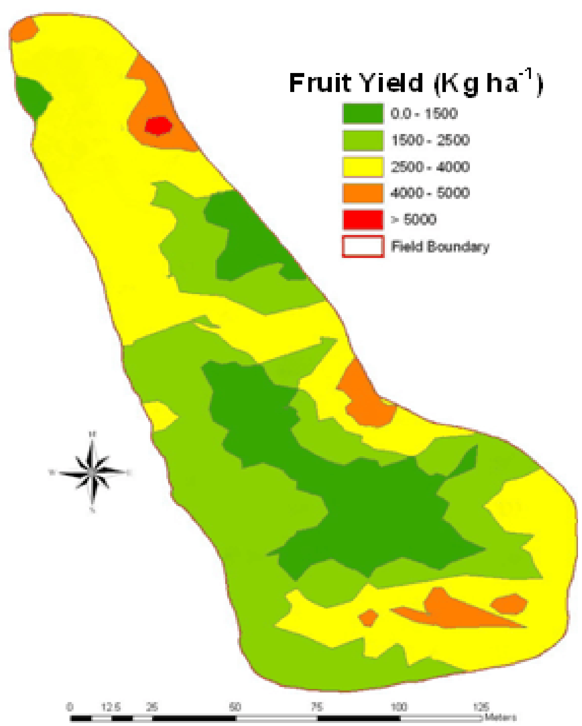
Comparison of Maps

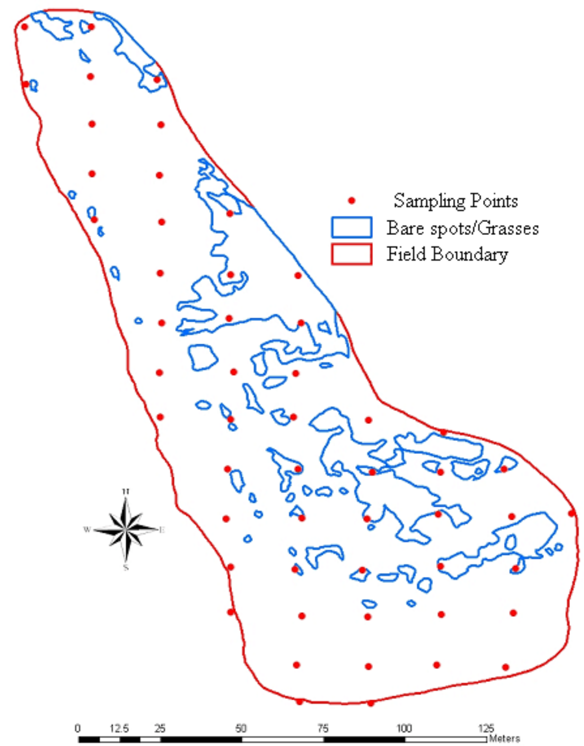




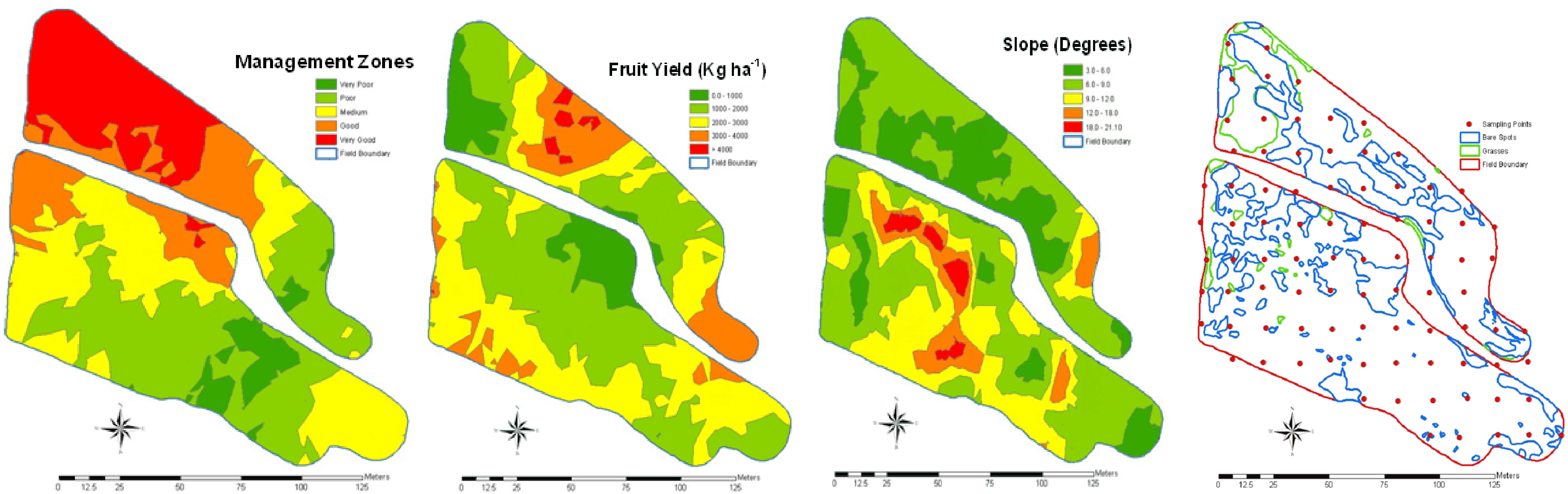
Comparison of Maps







Management Zones (N. River Site)



Conclusions (Objective 3)

- The results of ANOVA suggested that fruit yield, HCP, inorganic nitrogen, SOM and EC were significantly different among the developed management zones
- Fruit yield, slope and HCP maps in combination can be used to delineate MZs
- Dual EM could be used to develop management zones for site-specific fertilization

Conclusions (Objective 3)

- Variation in soil properties and fruit yield with slope also suggested that slope/elevation maps can be used to develop MZs
- This information can be used to develop prescription maps to allocate fertilizer rate based on the productivity potential

Course Work

Start Date: January, 2009

Course No.	Course Title	University	Grade
AGRI. 5700	Communication Skills	NSAC	A-
AGRI. 5705	Introduction to C++ Programming Application of RTK GPS in PA Geoinformatics in Agriculture	NSAC	A+
ERTH. 5600	Exploring GIS	Dalhousie	A +
ENGM. 6617	Applied Regression Analysis	Dalhousie	A
AGRI. 5710	-GPS & GIS application in Agriculture -Wild Blueberry culture, Classification and Production -Spreadsheet Programming	NSAC	A

Publications

Farooque, A., Q. Zaman, F. Abbas, Madani, D. Percival, and T. Esau. 2010. Ecological impacts of the N-Viro biosolids land-application for wild blueberry (*Vaccinium angustifolium.*Ait) production in Nova Scotia. J. Envir. Sci. &Health, Part B. **In Press**

Farooque, A., F. Abbas, Q. Zaman, A. Madani, D. Percival, M. Arshad. 2010. Soil Nutrient Availability, Plant Nutrients Uptake, and Wild Blueberry (*Vaccinium angustifolium.* Ait) Yield in Response to N-Viro Biosolids and Irrigation Applications. Pedosphere Journal**. In Review**

Zaman, Q., T. Esau, A. Schumann, D. Percival, S. Read, Y. Chang and **A. Farooque**. 2010. Development of prototype variable rate spryer for real time spot application of agrochemicals in wild blueberry fields. Computer and Electronics in Agriculture. **In Review**

Farooque, A., Q. Zaman, A. Schumann, A. Madani, D. Percival. 2011. Characterization and Quantification of Spatial Variability of Soil Properties and Fruit Yield in Wild Blueberry Field. 8th European Conference on Precision Agriculture, Prague. July 11-14, 2011.

Farooque, A., Q. Zaman, A. Schumann, A. Madani, D. Percival. 2011. Delineation of Management Zones for Site-specific Fertilization in Wild Blueberry Fields . Annual International Meeting ASABE, Louisville, Kentucky, USA. June 20-23, 2010.

Zaman, Q, T. Esau, A. Schumann, D. Percival, Y. Chang, S. Read, and **A. Farooque.** 2010**.** Variable rate sprayer for spot-application of pesticides in wild blueberry. Annual Meeting WBPANS, Truro, Nova Scotia, Canada. November 17, 2010.

Farooque, A., Q. Zaman, A. Schumann, A. Madani, D. Percival. 2009. Mapping soil Moisture Variability Using Electromagnetic Induction Methods. . In Proc. of 9th International Drainage Symposium, held jointly with CIGR and CSBE/SCGAB. Quebec City, Canada. **Paper Number:** IDS-CSBE100204.

Farooque, A., Q. Zaman, A. Schumann, A. Madani, D. Percival. 2009. Prediction of soil Organic Matter and Clay Content Using Electromagnetic Induction Methods. . In Proc. of 10th International, Conference on Precision Agriculture, Denver, Colorado, USA. Available online at: http://www.icpaonline.org/finalpdf/abstract_303.pdf.

Farooque, A., Q. Zaman, A. Schumann, A. Madani, D. Percival. 2009. Effect of soil variability on wild blueberry fruit yield. Poster and oral presentation at Graduate Research Day, NSAC, Truro Nova Scotia Canada. March 27, 2009

Nova Scotia Agricultural College

NSAC. Embrace Your World.

Acknowledgements

- I would like to thank Oxford Frozen Foods, WBPANS, Agri. Futures and Nova Scotia Department of Agriculture for providing funds
- I am also thankful to Dr. Zaman, Dr. Percival, Dr. Schumann and Dr. Madani
- Thanks to Morgan, Kelsy, Travis, Young, Gashaw, Fahad and Shoaib.
- Druice, Darrel, Margi for lab facilities. Thanks to Marie Law
- Department of Engineering

Thanks