Straw Management and Crop Rotation Alternatives to Stubble Burning:

Assessing Economic and Environmental Trade-offs

DOE Presentation – Feb 8, 2011

by Gerard Birkhauser

Co-Principle Investigators

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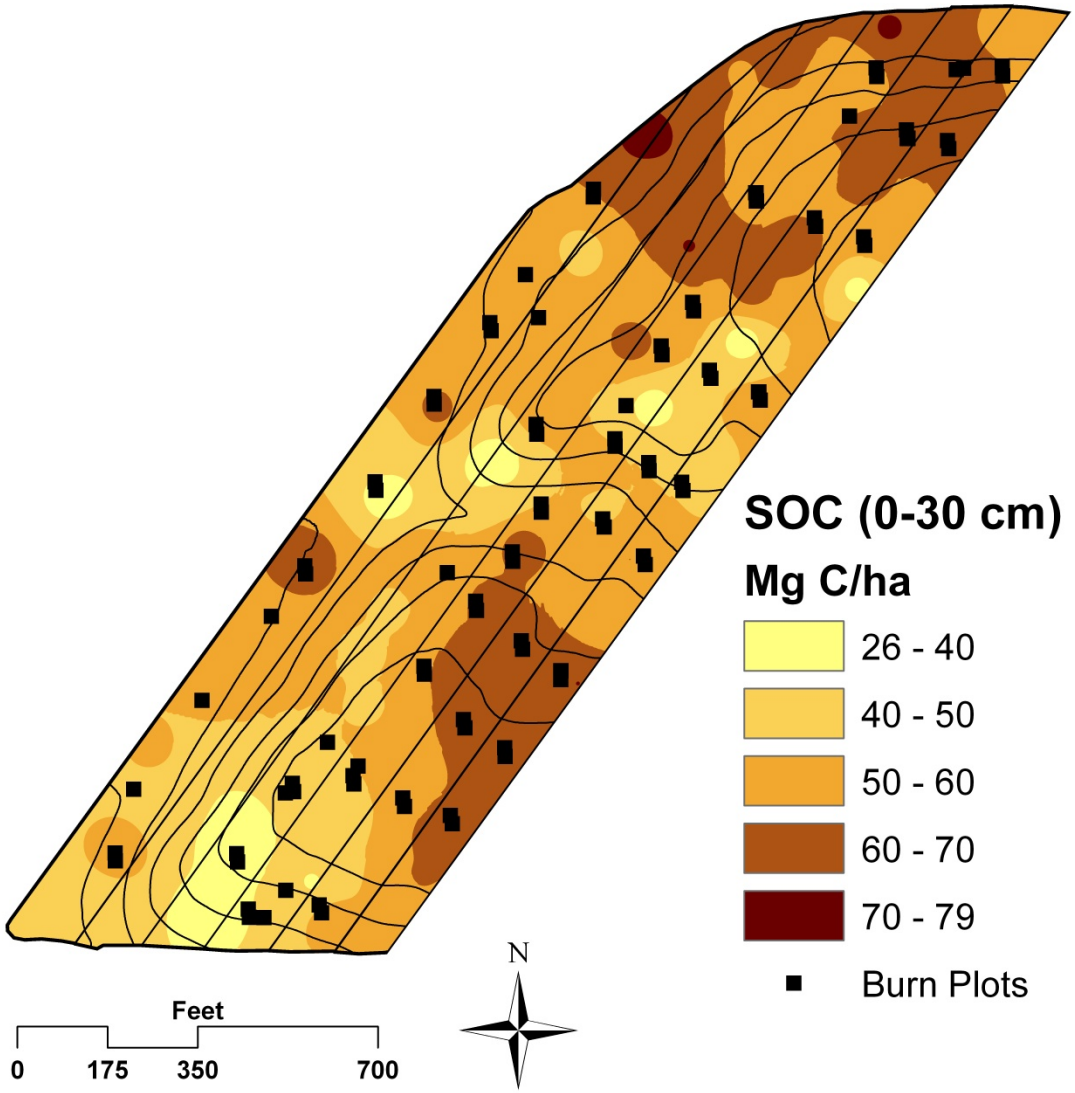
Project Objectives

(1) Analyze wheat stubble burning effects (SOM; C, N, P losses).

(2) Assess crop rotations that benefit from retaining the residues in DS systems.

(3) Investigate effects of wheat straw management and rotation alternatives on root pathogens.

DOE1: Burn Locations Fall 2009 - Spring 2010



Field Studies and Lab Analyses

DOE-1 Field Study (12 x 12 ft plots)

- 15 sites with 6 treatments (Fall ‘09 Burn, Spg. ‘10 Burn, Control, Fertilized/Nonfert.)
- Collected residue after each harvest.

DOE-2 Field Study (12 x 12 ft plots)

- Rotations after Fall Burn: (1) ww-sb-sw; (2) ww-cp-sw; (3) ww-ww-sw.

DOE-3 Field Study (10 x 50 ft plots)

- 2 rotations (ww and ww-l) and 3 tillage


Control
Fall ’09 Burn
Spring ’10 Burn

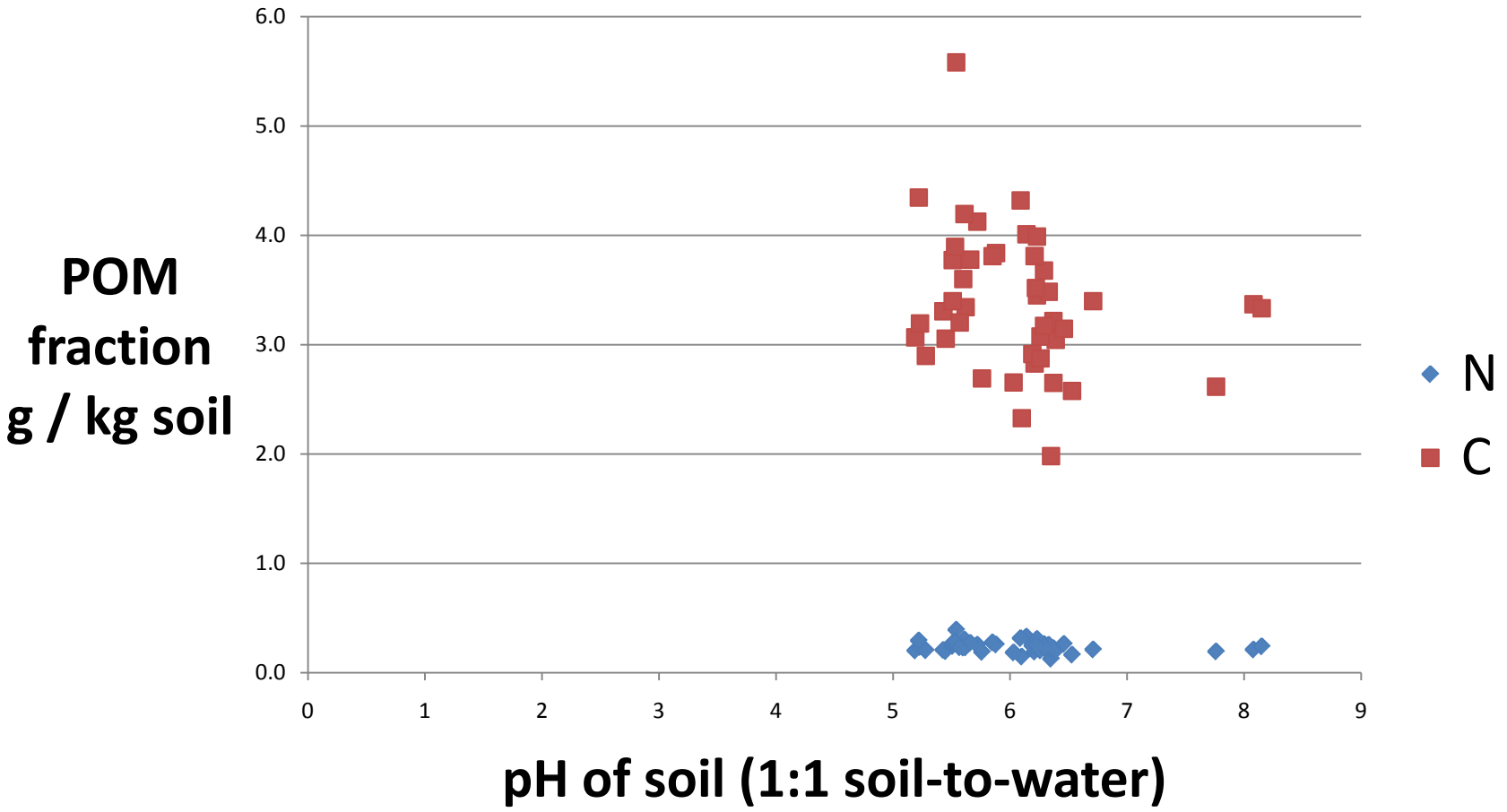
Methodology Used to Accomplish the Objectives

- Measured soil chemical and physical characteristics (soil pH, POM, bulk density, water content, nutrient contents).
- Assessed the residue loads (biomass, yields, C and N contents, net collected weights).
- Accounted for C, N, and P losses (mass balance on soil, plants, and residue).
- Evaluated micronutrient fluxes (PRS probes).

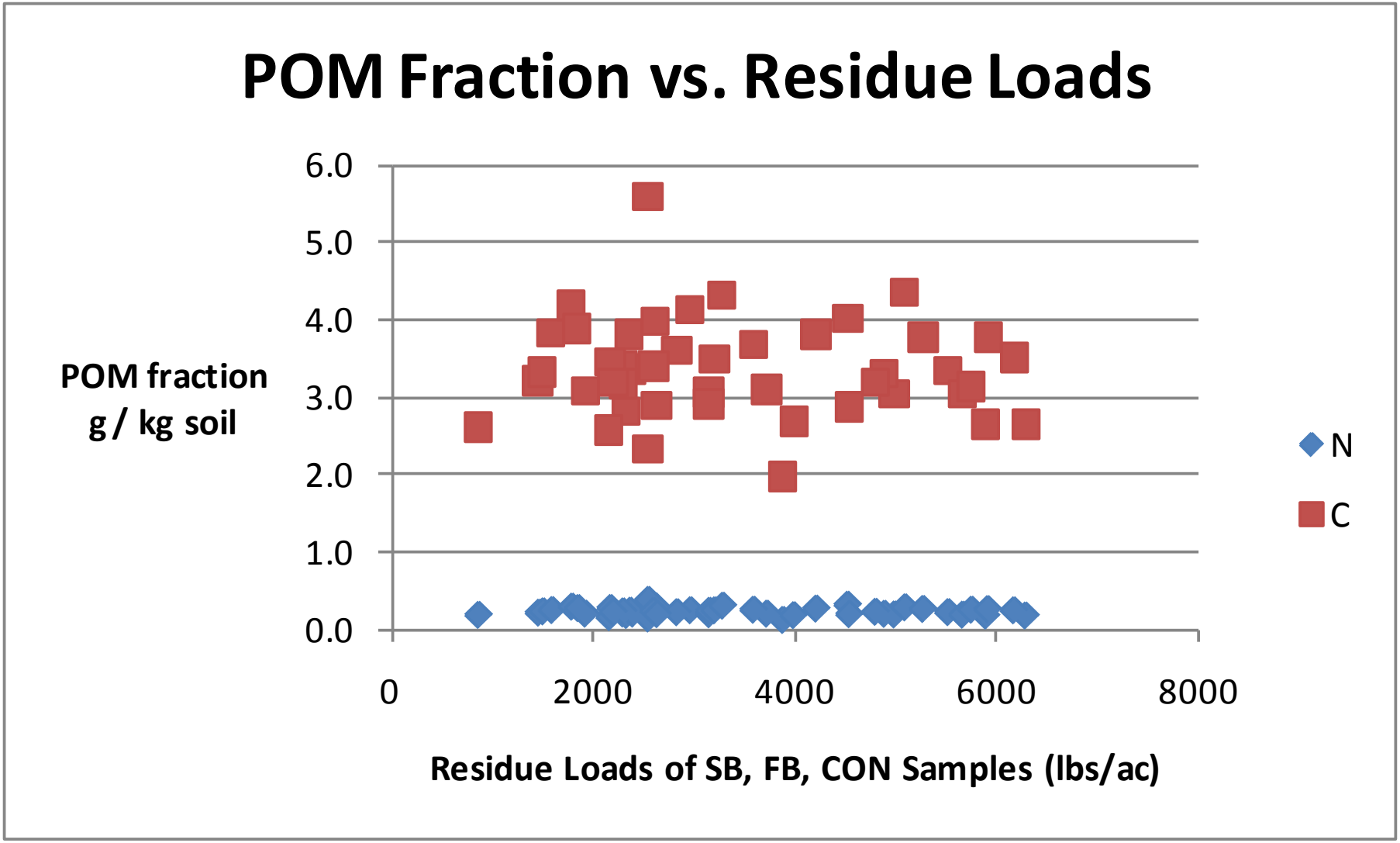
Soil Chemical and Physical Characteristics

- Some results were presented at Nov 9th presentation (soil pH, bulk density, water content, major nutrient contents of soil).
- We are in the process of correlating this information with respect to residue loads.
- The Particulate Organic Matter (POM) data was analyzed.

POM Fraction vs. Soil pH



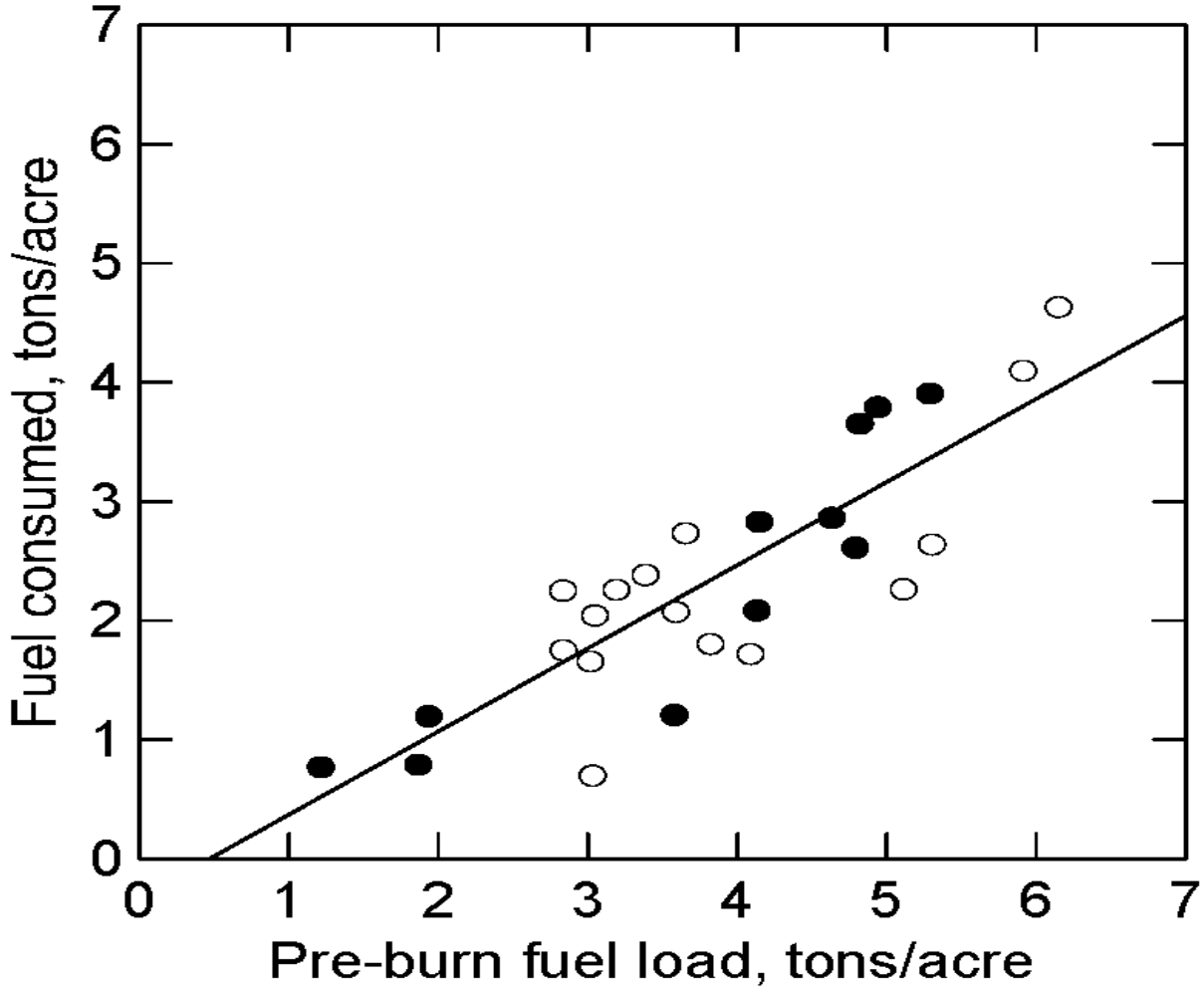
POM vs. Corresponding Residue Loads of 3 Treatments




Residue Loads Studies

Figure 3.2. Absolute Fuel Consumption as a Function of Pre-Burn Residue Loading for Spring (Open Circles) and Fall Season (Closed Circles)

The relationship can be described as follows: Fuel consumption = -0.417 + (0.713 x Pre-Burn Residue Loading), R^2=0.71, $F_{1,24}$=60.85, P<0.001).



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FINAL REPORT:

CEREAL-GRAIN RESIDUE OPEN-FIELD BURNING EMISSIONS STUDY

Prepared for and funded by:

WASHINGTON DEPARTMENT OF ECOLOGY

WASHINGTON ASSOCIATION OF WHEAT GROWERS

U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 10

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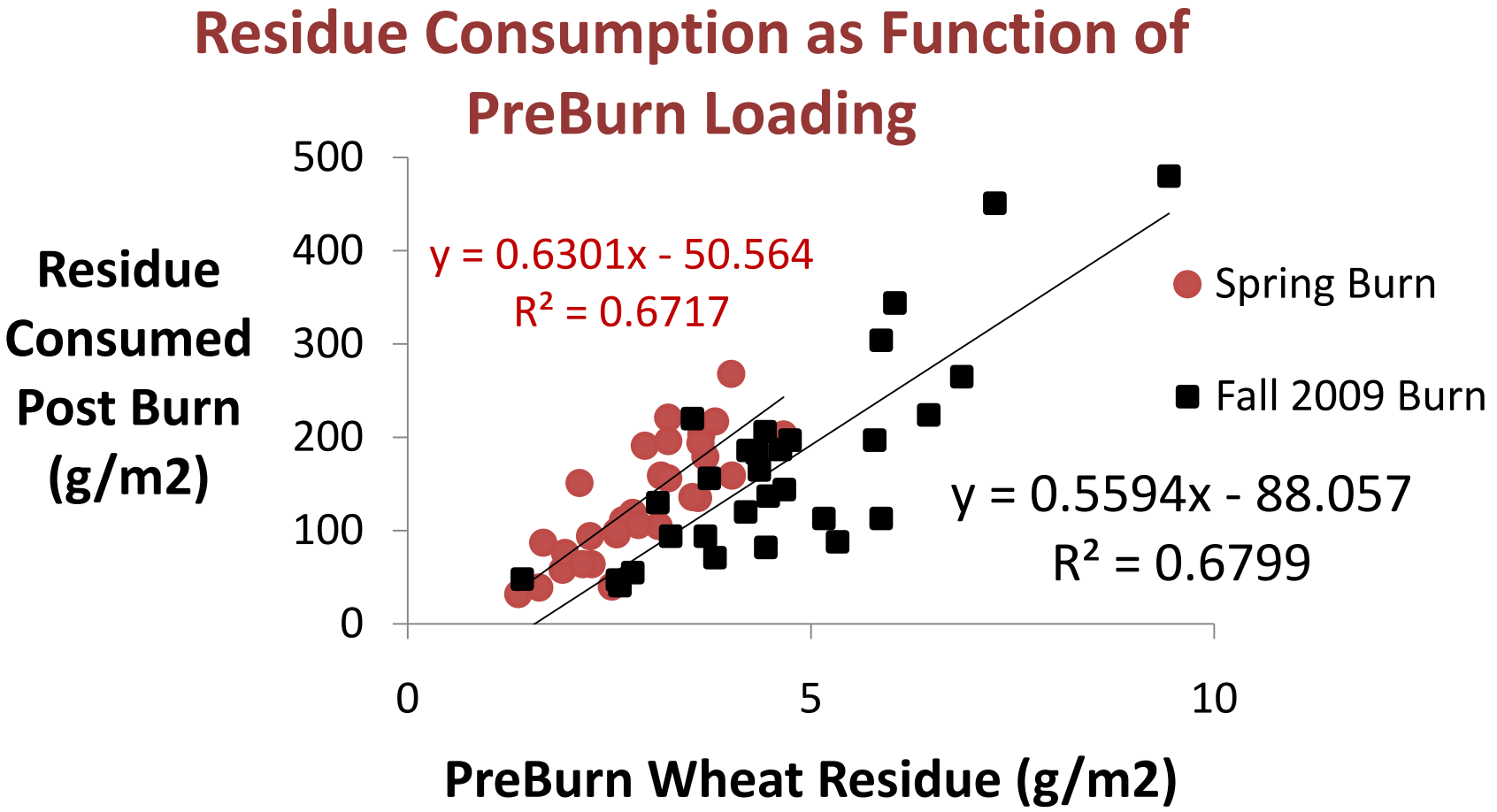
Residue Loads for Fall 2009 and Spring 2010 Burns



Average Yield Data for the 6 Treatments from DOE-1

Sample #	Treatment	Fertilizer Applied	Ave. Plot Yields for 15 locations (bu/ac)
1	Control	No Fertilizer	46
2	Control	Fertilizer	58
3	Fall Burn	No Fertilizer	52
4	Fall Burn	Fertilizer	56
5	Spring Burn	No Fertilizer	44
6	Spring Burn	Fertilizer	52

Yield data is normalized to 12.5% moisture.

Accounting for C, N, and P Losses

The approach is to perform a mass balance on soil, plant, and residue to track C, N, & P losses from the environmental system.

Plant C and N content on 10 samples was performed to account for plant uptake.

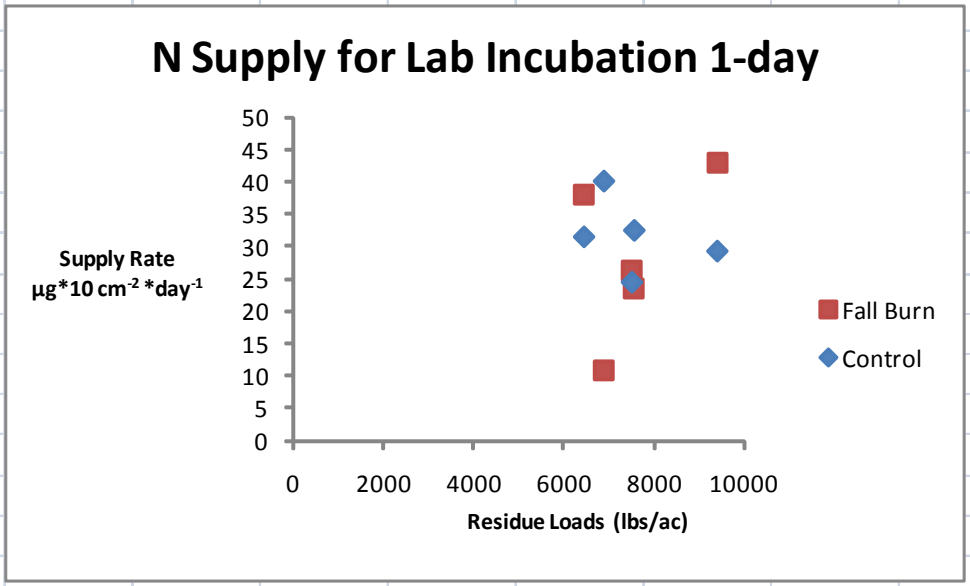
Soil and residue analysis are being performed (some results will be reported).

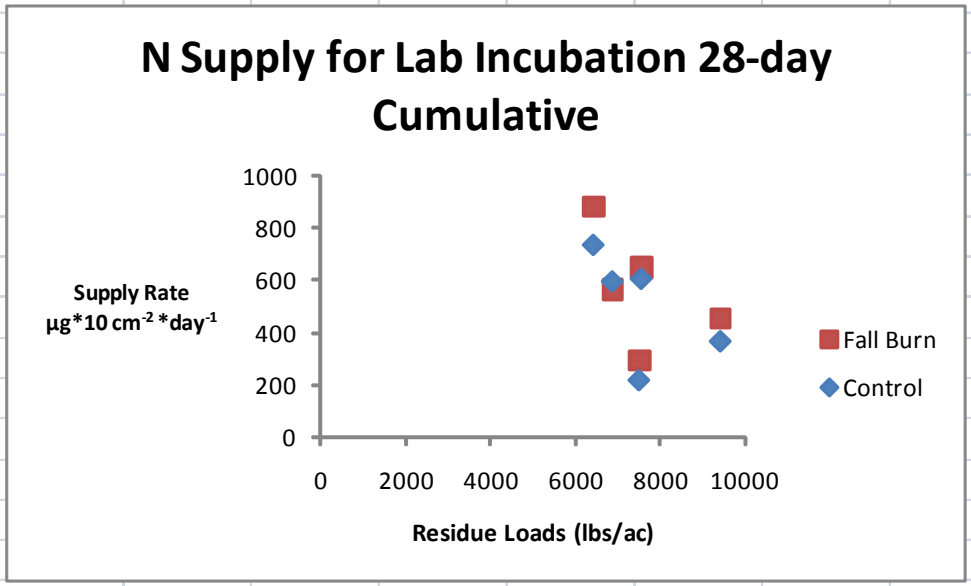
Evaluation of Micronutrient Fluxes

SUMMARY TABLE OF LAB RESULTS FOR 1-DAY & 28-DAY CUMULATIVE SUPPLY RATES FOR VARIOUS TREATMENTS AND RESIDUE LOADS (5 SITES)

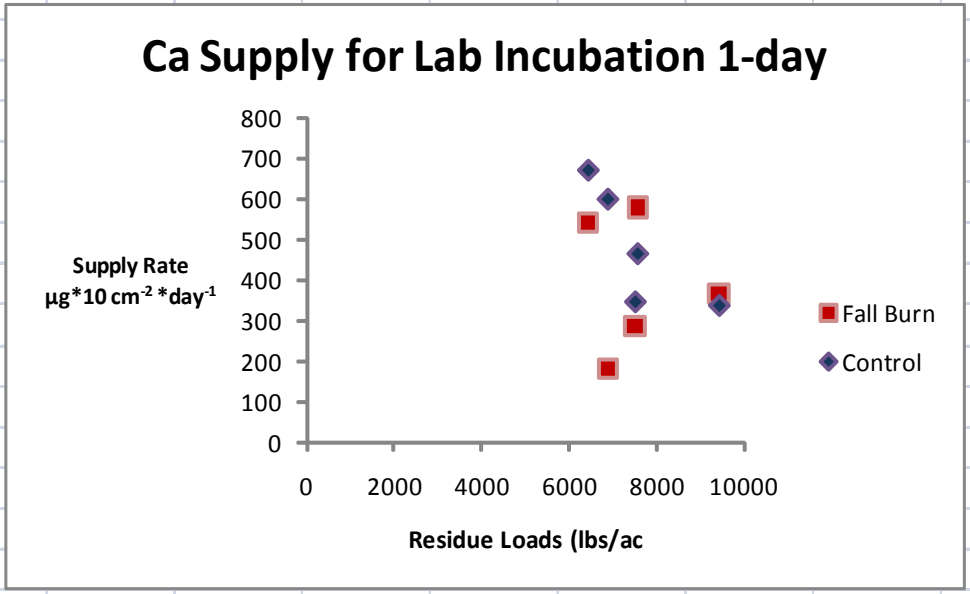
Site #	Residue Loads		Treatment	Time Interval	Residue	PRS Probe Nutrient Supply Rate (µg/10cm^2/burial length) [Method Detection Limits (mdl)]						
(Strip-Plot)	(g/m2)	(1b/ac)	(FB or CON)	(# days)	Load (1b/ac)	Total N [2]	Ca [2]	Mg [4]	K [4]	Mn [0.2]	S [2]	Al [0.4]
Site #1 (3-1)	436	3888	CON	1	6439	32	670	114	18	2	12	16
Site #8 (4-5)	548	4887	CON	1	6884	40	599	98	136	2	22	16
Site #10 (4-7)	510	4548	CON	1	7562	33	464	83	22	1	16	13
Site #11 (4-8)	538	4798	CON	1	9417	29	337	52	92	1	23	13
Site #15 (4-12)	692	6171	CON	1	7509	25	346	72	51	1	17	13
Site #1 (3-1)	436	3888	CON	28	6439	738	4370	560	57	43	92	87
Site #8 (4-5)	548	4887	CON	28	6884	597	3857	569	661	28	67	99
Site #10 (4-7)	510	4548	CON	28	7562	607	3912	503	101	15	100	72
Site #11 (4-8)	538	4798	CON	28	9417	366	1535	189	319	13	69	72
Site #15 (4-12)	692	6171	CON	28	7509	216	1973	363	257	6	79	64
Site #1 (3-1)	722	6439	FB	1	6439	38	540	76	13	2	11	13
Site #8 (4-5)	772	6884	FB	1	6884	11	182	46	61	1	19	13
Site #10 (4-7)	848	7562	FB	1	7562	23	579	101	50	1	23	18
Site #11 (4-8)	1056	9417	FB	1	9417	43	368	51	92	1	15	13
Site #15 (4-12)	842	7509	FB	1	7509	26	286	59	48	1	19	17
Site #1 (3-1)	722	6439	FB	28	6439	881	4464	543	41	52	76	100
Site #8 (4-5)	772	6884	FB	28	6884	564	3015	425	462	17	90	73
Site #10 (4-7)	848	7562	FB	28	7562	648	3562	476	184	19	90	85
Site #11 (4-8)	1056	9417	FB	28	9417	453	1716	215	357	11	102	66
Site #15 (4-12)	842	7509	FB	28	7509	295	2125	366	242	8	75	76

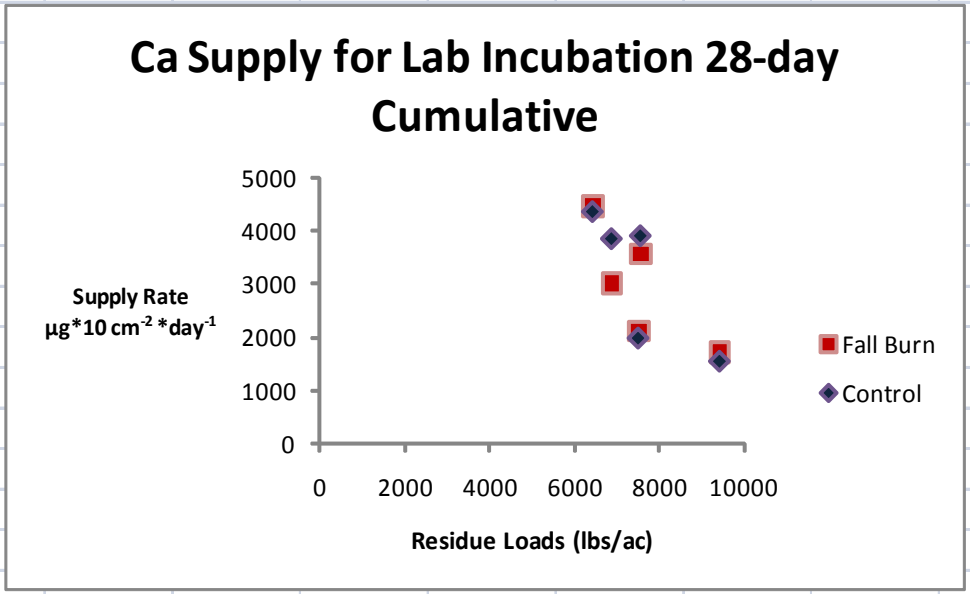
PRS Probe Results





More PRS Probe Results





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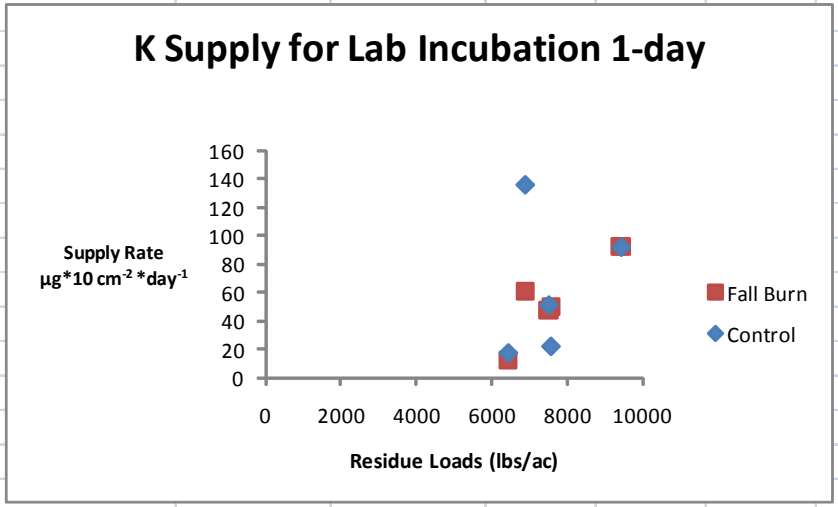
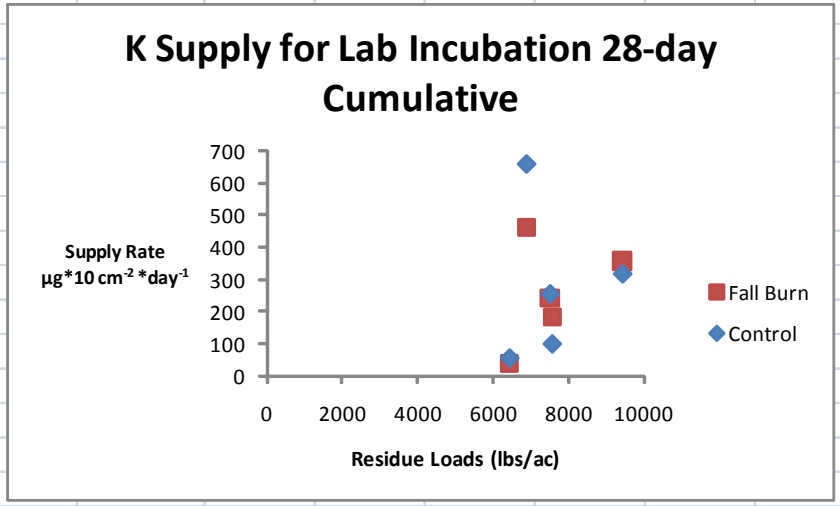
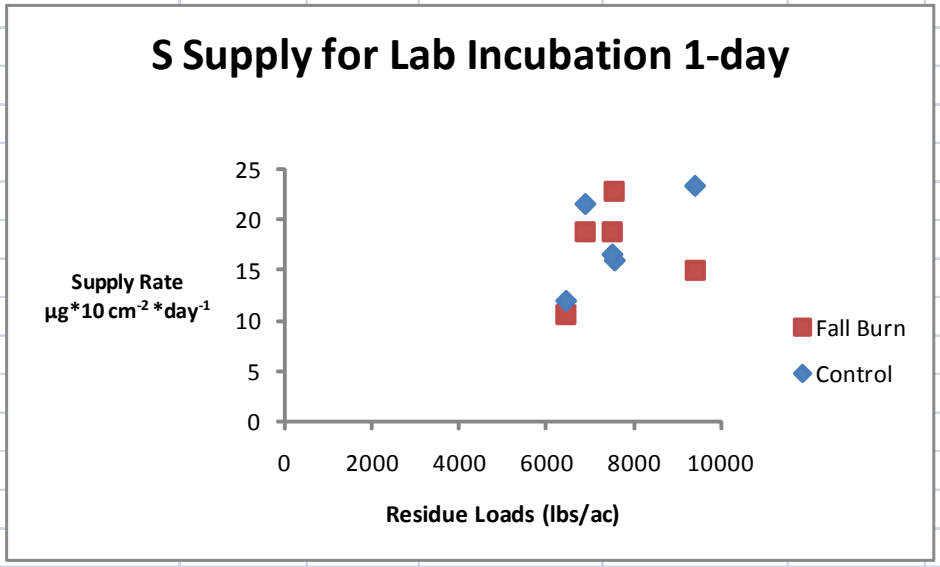
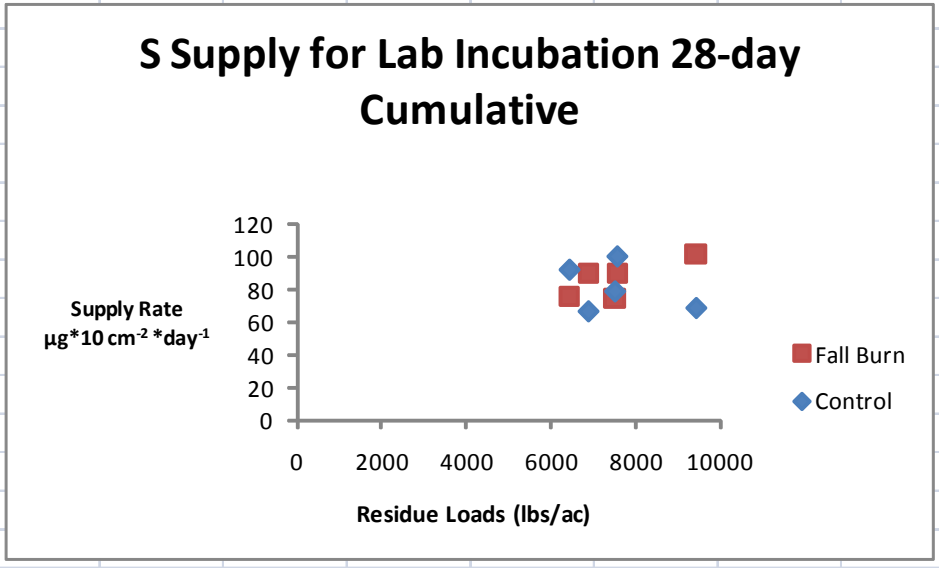
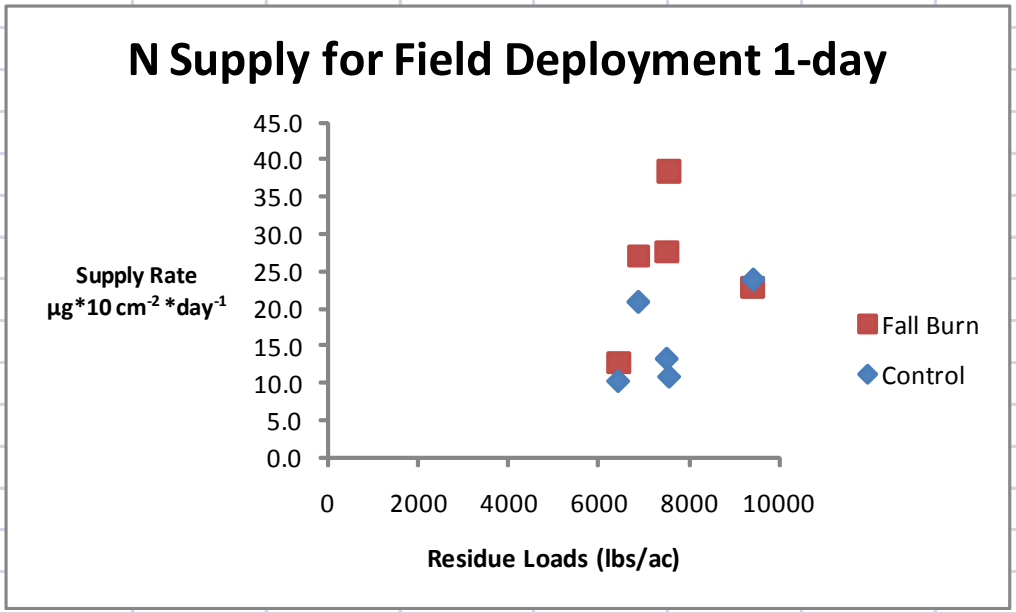


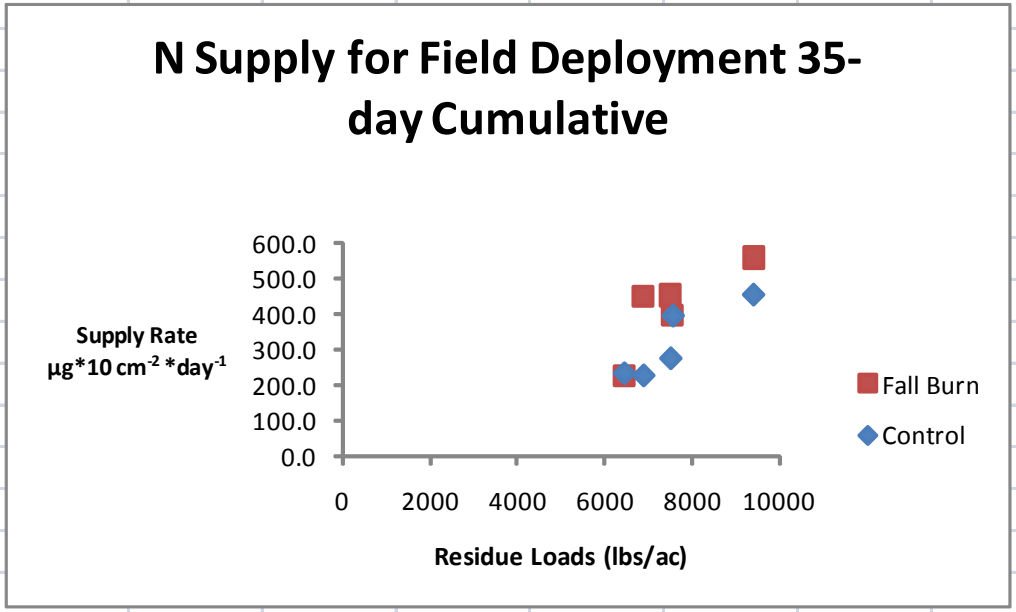






Field PRS Probe Data





Major Items to Complete

- Analyze residue C and N contents for both Fall ‘09 and Spring ’10 Burns (150 samples).
- Conduct soil C and N analysis (45 samples).
- Perform soil total N content collected in October 2010 (450 samples).
- Carry out a statistical analysis on the data.
- Summarize straw management and rotation alternatives on root pathogens.
- Assemble results and compile a final report.

It has been a real pleasure making progress along side our talented research team.