Enhancing Soil Health in Potato Production Systems

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Enhancing Soil Health in U.S. Potato Production Systems

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- Department: Soil Science
- Degree Objective: PhD
- Statistical Background: ST 511

Background and Objectives

"Potato processors (led by representatives of McCain Foods, Lamb Weston, J. R. Simplot, and Frito-Lay) initiated efforts to investigate soil health in potato production systems in 2013, with a specific emphasis on soilborne diseases."

In 2015, a proposal was submitted but was not funded, in part due to concerns raised by some stakeholders related to perceptions of fumigation. This proposal addresses reviewer and stakeholder concerns with the previous project, while enhancing capacities to address research needs of the industry in the major potato producing regions of the U.S.

Background and Objectives

Objectives: Enhance potato health, productivity, and quality via management-based optimization of soil microbiomes and physicochemical characteristics.

"What effects do different crop rotations have on crop yield and pest populations?"

- The core experimental design will consist of two coordinated experimental field plots representing 3-year (experiment 1) and 2-year (experiment 2) potato rotations to be established at a long-term agricultural research site in every state.
- The client is responsible for implementing these experiments at the Oregon site, and is requesting assistance in experimental design.

Treatments

Core Field Experiment 1:

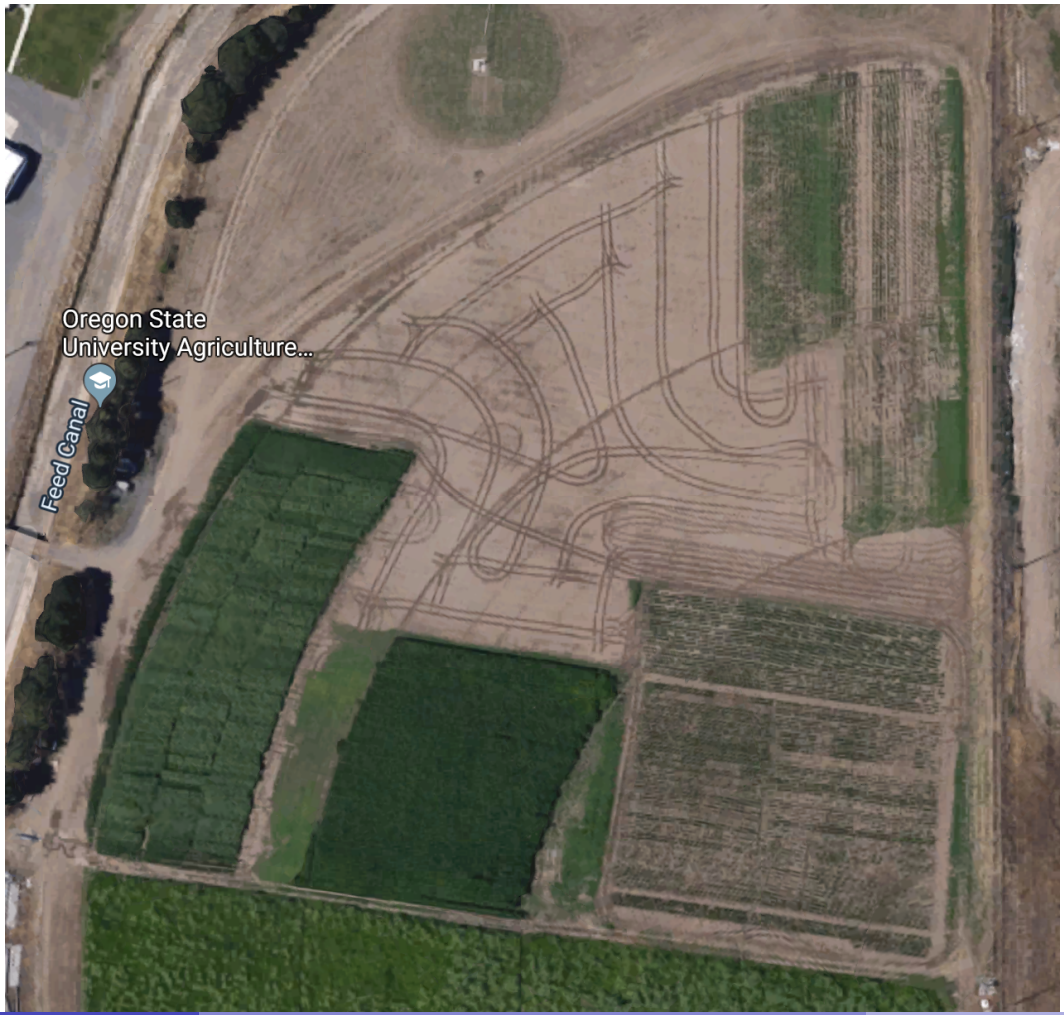
YEAR 1	YEAR 2	YEAR 3	YEAR 4
Potato-control Russet Burbank	Rotation 1	Rotation 2	Potato-control RB
Potato-control Region-specific cv	Rotation 1	Rotation 2	Potato-control RS cv
Potato-TRT 1 Region-specific cv	Rotation 1	Rotation 2	Potato TRT 1
Potato-TRT 2 Region-specific cv	Rotation 1	Rotation 2	Potato TRT 2
Potato-TRT 3 Region-specific cv	Rotation 1	Rotation 2	Potato TRT 3
Potato-TRT 4 Region-specific cv	Rotation 1	Rotation 2	Potato-TRT4

Core Field Experiment 2:

Year 1	YEAR 2	YEAR 3	YEAR 4
Rotation 1	Potato-control RB	Rotation 2	Potato-control RB
Rotation 1	Potato-control Region-specific cv	Rotation 2	Potato-control RS cv
Rotation 1	Potato-TRT 1 Region-specific cv	Rotation 2	Potato-TRT 1
Rotation 1	Potato-TRT 2 Region-specific cv	Rotation 2	Potato-TRT 2
Rotation 1	Potato-TRT 3 Region-specific cv	Rotation 2	Potato-TRT 3
Rotation 1	Potato-TRT 4 Region-specific cv	Rotation 2	Potato-TRT 4

Experimental Design

Field receives irrigation from a center-pivot system, and has an apparent experiemental history that could effect soil uniformity.



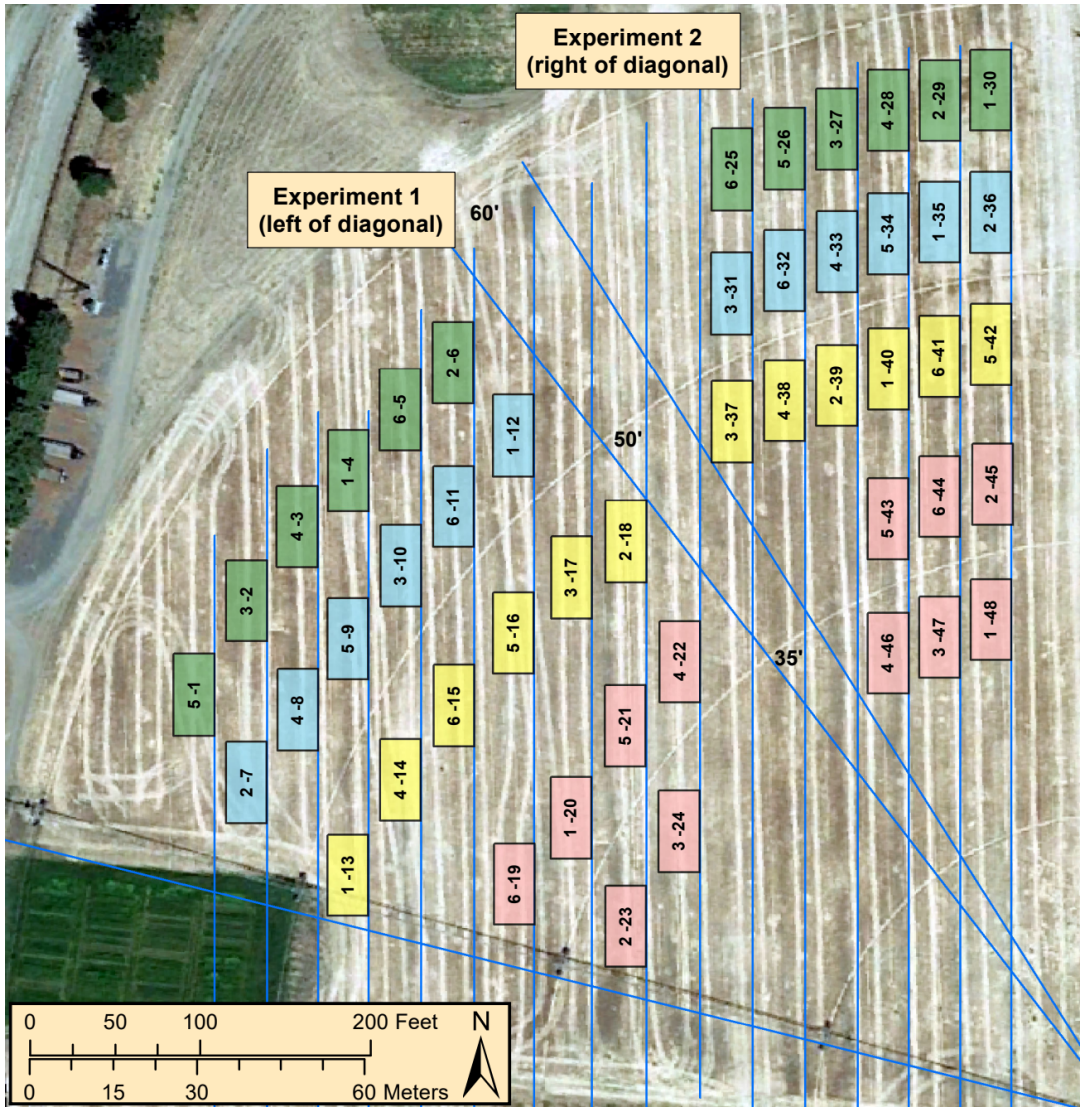
Randomized Complete Block Design (RCBD)

- The RCBD assumes that a population of experimental units can be divided into a number of relatively homogeneous subpopulations or blocks.
- Treatments are then randomly assigned to experimental units such that each treatment occurs equally often (usually once) in each block
- Blocks usually represent levels of naturally-occurring differences or sources of variation that are unrelated to the treatments
- In the analysis, the variation among blocks can be partitioned out of the experimental error (MSE), thereby reducing this error and increasing the power of the test

Other considerations

- Blocked by distance from center pivot irrigation
- Randomly assigned treatments
- All plots measure 24 feet x 48 feet
- At least 20 feet between plots in the north-south direction;
- 5.7 feet (2 rows' width) between plots in east-west direction,
- 5 feet from wheel tracks, and 50 feet from east edge of field.
- Client does not believe that relevant pests could travel between plots with this spacing.

Final Experimental Design



Analysis

ANOVA table for the RCBD (one replication per block-treatment combination):

Source	df	SS	MS	F
Total	rt - 1	TSS		
Treatments	t - 1	SST	SST/(t-1)	MST/MSE
Blocks	r - 1	SSB	SSB/(r-1)	
Error	(r-1)(t-1)	TSS-SST-SSB	SSE/(r-1)(t-1)	

- We can use an extra sum of squares F-statistic to obtain a p-value to test for treatment effect.
- If a treatment effect is detected (i.e. small p-value) we can use Tukey's HSD, a multiple comparison procedure, to look for pairwise differences among the six treatments.

Questions?

Thank you!

Carly Hammond