Research Concepts: Implementation Version 1.0

SIREN Workshop

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Overview

- Review Methodology

- Research Process
  - Review the nine steps
  - Example using a soil project

- **Remember it is about the PROCESS!**

Methodology Comparison

Quantitative	Qualitative
• Explanation, prediction	• Explanation, description
• Test theories	• Build theories
• Known variables	• Unknown variables
• Large sample	• Small sample
• Standardized instruments	• Observations, interviews
• Deductive	• Inductive

Research Process

- ✓ Originates with a question or problem.
- ✓ Requires clear articulation of a goal.
- ✓ Follows a specific plan or procedure.
- ✓ Often divides main problem into subproblems.
- ✓ Guided by specific problem, question, or hypothesis.
- ✓ Accepts certain critical assumptions.
- ✓ Requires collection and interpretation of data.
- ✓ Cyclical in nature.

step 1
step 2
step 3
step 4
step 5
step 6
step 7
step 8
step 9
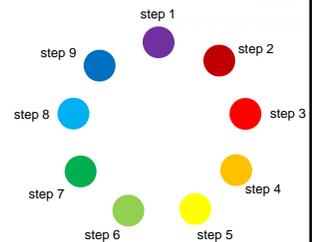
Step 1: A Question Is Raised

- A question occurs to or is posed to the researcher for which that researcher has no answer.
  - This doesn't mean that someone else doesn't already have an answer.
- The question needs to be converted to an appropriate problem statement.

Example:
- **Does *residue* left on the land affect seed germination?**

Step 2: Suggest Hypotheses

- The researcher generates intermediate hypotheses to describe a solution to the problem.
  - This is at best a temporary solution since there is as yet no evidence to support either the acceptance or rejection of these hypotheses.

Example:
- **The hypothesis of this research is that increasing amounts of *residue* left on the land will result in delayed seedling emergence and reduced plant populations.**

Step 3: Literature Review

- The available literature is reviewed to determine if there is already a solution to the problem.
  - Existing solutions do not always explain new observations.
  - The existing solution might require some revision or even be discarded.

- It's possible that the literature review has yielded a solution to the proposed problem.
  - This means that you haven't really done research.

- On the other hand, if the literature review turns up nothing, then additional research activities are justified.

## Step 4: Test Hypotheses

- Plan research
  - Determine variables
    - **Independent variable(s)** – represents the factors or conditions that will be manipulated or changed by the investigator in order to do an experiment.
    - **Dependent variable(s)** – is the observed result of the independent variable being manipulated - the dependent variable *depends* on the outcome of the independent variable.

  - Designing experimental procedure
    - This involves planning how the independent variable will be changed and how to measure the impact that this change has on the dependent variable.

  - Conduct Experiment

Step 4: Test Hypotheses (continued)

- Independent variables
  - Residue management
    - No-till
    - Conservation till
    - Moldboard plow
    - Strip till
  - Soil Type
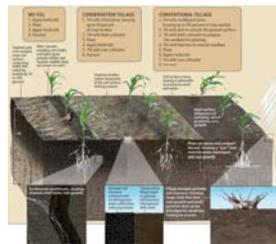
Source: Scientific American

Percent residue cover (source: NRCS)

10%
This level of residue might be expected from a fall chisel with twisted shanks, a deep spring disking, a field cultivation, and planting.

30%
This level of residue might be expected from one fall chisel with straight shanks, a shallow disking in the spring, a field cultivation, and planting.

50%
This level of residue will be difficult to reach without using a no-till system. One tillage system that could produce 50 percent ground cover after planting is to field cultivate twice in the spring and plant.

20%
This level of residue might be expected from a fall chisel with twisted shanks, a spring shallow disking, a field cultivation, and planting.

40%
This level of residue might be expected from a fall shallow disking, one spring field cultivation, and planting.

60%
This level of residue might be expected from a no-till system where you plant directly into the existing residue. Another system is to field cultivate once in the spring and plant.

Step 4: Test Hypotheses (continued)

- Dependent variables may include:
  - Percent residue cover
  - Soil Temperature
  - Soil Moisture
  - Soil Bulk Density
  - Time (days) for seedlings to emerge
  - Number of seedlings emerged
  - Plant height
  - Plant weight

These are examples of factors that can be measured.
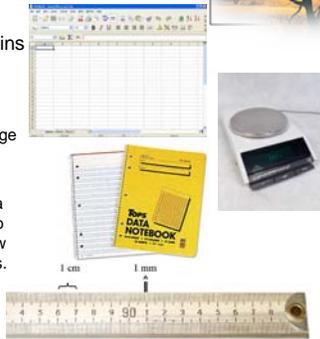
Step 4: Test Hypotheses (continued)

Experimental Design

Step 5: Acquire Data

- The researcher now begins to gather data relating to the research problem.
  - The means of data acquisition will often change based on the type of the research problem.
  - This might entail only data gathering, but it could also require the creation of new measurement instruments.

How to measure residues

- Use any line that is equally divided into 100 parts. Fifty foot cable transect lines are available for this purpose. Another tool is a 50-foot nylon rope with 100 knots, six inches apart. A 50-foot tape measure using the 6-inch and foot marks also works well.
- Stretch the line diagonally across the rows. Count the number of marks (tabs or knots) that have residue under them when sighting from directly above one end of the mark. It is important to use the same point on each mark for accuracy. Don't count residue smaller than 1/8 inch in diameter.
- Walk the entire length of the rope or wire. The total number of marks with residue under them is the percent cover under them is the percent cover for the field. If your rope or tape has only 50 marks, multiply by 2; for 25 marks, multiply by 4.
- Repeat the procedure at least 3 times in different areas of the field and average the findings.

Quantitative soil properties

25% Air

45-47% Mineral

25% Water

3-5%

Organic Matter
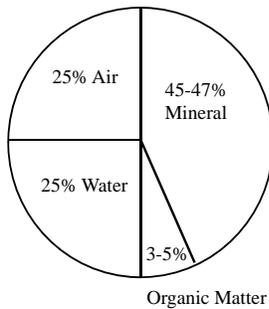
- *Bulk density = dry wt. soil (g) / total volume ring (cm³).*
- *Water content: mass (%) = {[wet wt. soil (g) – dry wt. soil (g)] / dry wt. soil (g)} * 100.*
- *Water content: volume (%) = % water content by mass / bulk density.*
- *Total porosity (%) = [1 – (bulk density / particle density*)] * 100*
- *Water-filled pore space (%) = (% water content by volume / % total porosity) * 100*

* particle density assumed to be 2.65 g/cm³

Step 6: Data Analysis

- The data that were gathered in the previous step are analyzed as a first step in ascertaining their meaning.
- As before, the analysis of the data does not constitute research.
  - This is basic number crunching.
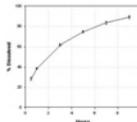
Step 7: Data Interpretation

- The researcher interprets the newly analyzed data and suggests a conclusion.
  - This can be difficult.
  - Keep in mind that data analysis that suggests a correlation between two variables can't automatically be interpreted as suggesting causality between those variables.

Step 8: Hypothesis Support

- The data will either support the hypotheses or they won't.
  - This may lead the researcher to cycle back to an earlier step in the process and begin again with a new hypothesis.
  - This is one of the self-correcting mechanisms associated with the scientific method.

Step 9: Reporting

- **IMPACT!!!**
  - Some research has more impact than others
- In order for research results to have **impact** they need to be shared.
  - Public presentations
  - Written reports (formal and informal)
    - Summary reports, Brochures, Bulletins, Abstracts, etc.
  - Web-based, on-line delivery
  - Peer-reviewed journal articles

THANK YOU!

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