Conducting On-Farm Research

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Why Conduct On-Farm Research

- Fact based answers to farmer driven questions.
- Fact based answers to questions to which there are no answers.
- Fact based answers to questions under “normal” or “real-life” farm management.

Types of Investigations

- Demonstration
- Side by Side Comparisons
- Replicated Research
  - Small plot
  - Large plot

Demonstrations

- Is not the same as research.
- Helps us gain experience or expose others to new practices or technology.
- Yield or other data not collected or analyzed.
- Central to field days and outreach.
Side by Side Comparisons

- Is not the same as research.
- Helps us gain experience or expose others to new practices or technology.
- Yield or other data might be collected.
- Data cannot be analyzed and should not draw conclusions from the information.
- Central to field days and outreach.

Replicated Research

- A systematic investigation
- A meaningful question
- The research project is planned and conducted without bias
- Data are carefully measured and recorded.
- Results are statistically interpreted to answer the research question.

Allows for comparison of treatments – including a control.

The treatments are replicated (repeated) to help remove Background Noise to mathematically separate the TRUE treatment effects from those due to Background Noise.

Small Plot Research

- Targets uniform area to minimize error from surroundings (Background Noise) and helps to detect treatment effects.
- Allows for comparison of many treatments – including a control.
- Generally requires specialized equipment for implementation.
- Typically this research occurs at a “research farm” but can also occur on-farms.

Large Plot Research

- Hosted on “real” fields that tend to be highly variable.
- Harder to control Background Noise.
- Limits treatments to be evaluated due to large plot size.
- Field scale/commercial equipment is used to implement research.
- Typically this research includes replicated strips of treatments – otherwise known as a “Strip Trial”.
What is the goal of research?

- Knowledge through
  - Learning
  - Understanding
  - Systematic Testing
  - Observation and Measurement
  - Communicating

Source: Tom Morris, UConn & Sue Ellen Johnson, NE Small Farm Institute

Goals of Agricultural Research

- Greater Production
- Greater production efficiency
- Greater farm profitability
- Better environmental stewardship
- Provide basis for better recommendations

Source: Tom Morris, UConn & Sue Ellen Johnson, NE Small Farm Institute

Designing an Experiment

- First step is to decide what you want to investigate
- Ask a good question
  - “Just what exactly are you trying to find out”
- Remember- Not all questions are worth the effort to investigate

Agronomy Fact Sheet # 68: On-Farm Research
http://nmsp.cals.cornell.edu/guidelines/factsheets.html

Key steps for conducting on-farm research

- Ask yourself what research has been done in this area already
  - You could end up investigating a question with a well-known answer
- Keep your question simple
  - It is easy to ask a very complex question
  - A simple, straightforward approach is best
- Always have a control treatment
  - Ex. 0 lbs/acre of N in a study on N rates
Data Collection & Record Keeping

- Trial Description
- Field History
- Soil Test
- Fertility Program
- Soil Moisture at Planting
- Planting Conditions
- Field Operations and Observations

Weather
- Rainfall
- Growing Degree Days

Insects, Weeds and Diseases

Crop Growth and Development

Design: Site selection is important

- Variability in conditions greatly affect ability to detect significant differences
  - The greater the variability, the less your chance of detecting treatment differences

What is the best plot size?

- Plot size is determined by
  - Field size
  - Uniformity of the field
  - Equipment used
  - Area needed for a particular treatment

Replication: More is better

- Number of times the treatment is in the field
- Allows you to distinguish between random variation in the system and real affects of the treatments
- Analyzing data without replication is nearly impossible without replicated treatments
- More replications increase chances of detecting treatment differences
Randomization: Mixing up the order of the treatments

- Helps draw conclusions that are representative of the area
- If you don’t randomize you can bias your results

Example: Without randomization Treatment “a” could end up situated over tile line in each replication.

Blocking: Small areas of randomized treatments

- Purpose of blocking is to create smaller, more uniform areas where observed differences will be due to the treatments themselves
- Limits the influence of the treatment’s position in the field
- Randomized Complete Block Design is most popular for field research

Spatially Balanced Complete Block Design

What’s Cropping Up? article
Measuring Results

- Plan ahead and identify what should be measured in the research trial
- If the purpose is to increase yield
  - Measure Yield
- If the purpose is to improve forage quality
  - Collect forage samples
- If the purpose is to increase net profit
  - Analyze cost and returns

Yield Measurements

- Measurements must be taken from comparable areas in each treatment plot
- Measure the size of the harvest area
- Measure plot lengths immediately after harvesting each plot
- Distance is multiplied by width of harvest equipment to determine harvested area
- Harvested area is used to calculate yield

Role of Technology

- Precision Planting
  - Allows planting of randomized replicates without the need to change seed each pass
- Prescription based application rates
  - Implement replicated, randomized treatments by pre-programming prescription
    - Seeding rate
    - Fertilizer
  - Allow space (gaps) between treatments for equipment to change from one rate (treatment) to the next
- Yield Monitors
  - Make sure there is confidence in their calibration

Analyzing your data

- Work with:
  - Local Extension office
  - University
  - Consultant
- Free Online Software
  - Internet based statistical analysis software for analyzing on farm test results called AGSTATS02
  - [http://pnwsteep.wsu.edu/onfarmtesting](http://pnwsteep.wsu.edu/onfarmtesting)
What’s in a number?

- Everyone talks about averages
  - Average rainfall
  - Average temperature
  - Average yield
- Averages are meaningless if the data used to calculate it is extreme

Source: Ian McDonald, Applied Research Coordinator, OMAF

Let’s look at an example

- Consider three situations which have the same average bu/ac yields
  - A 90 + 100 + 110 = 300 ÷ 3 = 100
  - B 50 + 100 + 150 = 300 ÷ 3 = 100
  - C 0 + 100 + 200 = 300 ÷ 3 = 100

Which example do you think is more likely to give you more reliable average yield in the future?

Source: Ian McDonald, Applied Research Coordinator, OMAF

Coefficient of Variation (CV)

- Describes the amount of variation in the data
- The lower the CV value, the lower the variation in the data
- CV values of less than 10% are best, numbers of 20-30% are likely acceptable

Source: Ian McDonald, Applied Research Coordinator, OMAF

Least Significant Difference (LSD)

- The amount of difference that has to occur between treatments for them to be assumed to be “statistically” different
- The LSD determines if the differences are a response to a different treatment or due to random chance that result in variations across the trial

Source: Ian McDonald, Applied Research Coordinator, OMAF
Example - LSD

Variety | Not inoc. | Inoculated | Bull | 29.8 | 5.2
| Exact | 30.8 | 4.2
| Lota | 17.8 | 6.0
| Norcen | 28.3 | 8.8
| Pardee | 29.5 | 12.4
| LSD (0.05) | 12.7 | 4.5

M. Smith

Example - Multiple Range Test

Variety | Plant Count
| Best | 63 a
| Okay | 59 ab
| Less Okay | 57 bc
| Worst | 53 c

M. Smith

Summary

- Keep it simple
- Replicate and Randomize
- Stay uniform
- Harvest individual plots
- Repeat the same project for multiple years

Resources

- Agronomy Fact Sheet # 68: On-Farm Research
  http://nmsp.cals.cornell.edu/guidelines/factsheets.html
- Free Online Software
  - AGSTATS02  http://pnwsteep.wsu.edu/onfarmtesting
- Spatially Balanced Complete Block Design
  - Printout
    https://fieldcrops.cals.cornell.edu/sites/fieldcrops.cals.cornell.edu/files/shared/documents/SBCBD_card_053116.pdf
  - What’s Cropping Up? article