On-Farm Research

On-farm research is an excellent approach to gaining confidence in current management practices or to help identify the need for a change. On-farm research can help improve production efficiency, farm profitability, and environmental stewardship. To be efficient and successful, on-farm trials should be focused, address meaningful questions developed with input from the producer(s), generate meaningful data, and ideally consist of large scale plots to be harvested using farm machinery. The most useful trials are implemented using a statistically valid design and thorough planning before going to the field. In this factsheet we outline 7 steps of on-farm research: (1) define the study question; (2) plot layout and design; (3) field site selection; (4) trial implementation; (5) data collection; (6) data analysis; and (7) learn from data and repeat.

Step 1: Define the study question

A researchable question is simplified as much as possible and can be answered with 2-3 treatments at most. For example, "Can manure replace the need for starter N fertilizer?", or "Can sulfur application increase alfalfa yield?", or "Will yield increase if I apply more manure?" Each of these questions can be answered with a 2-3 treatment comparison. If yield monitors are available, the number of treatments can be increased without adding to the workload.

Step 2: Plot layout and design

Randomize and replicate

Treatments must be repeated in side-by-side strips across the field. Each set of treatments is called a block. Each set of treatments should be repeated ***at least four times***. Each *block* should have a control treatment and treatments should be randomly located within each block. An example is shown in figure 1.

Length, width and total field size

Border rows are needed on each side of the plot to avoid effects from neighboring treatments. Border rows are not included in harvest weights. Plots that are two times the chopper or combine header width (so 8-row plots for a 4-row chopper) allow for the middle rows to be harvested for plot yield, while leaving one full harvest pass of buffer rows. However, application equipment needs to be considered as well. For example, if in a manure application rate trial the spreader pattern is 40 feet wide, plots should be at least 40 feet wide (16 rows at 30-inch spacing).

For combines or forage harvesters with yield monitors, the longer the strip the better (up to ½ mile). For harvest of forage crops like corn silage without yield monitors, the ideal trial is designed so that in an average crop year, the plot yield results in a truck load that is about 75% filled (see Table 1 for an example). Because fields are often irregularly shaped and headlands are not suitable for trials, the actual farm field selected for the trial may need to be 25-50% larger than the actual plot research area.

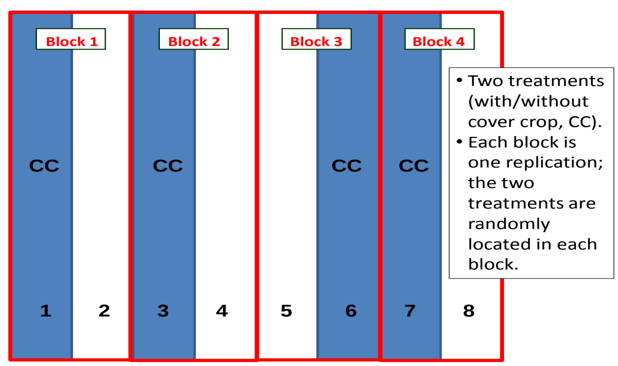

Figure 1: Example of a randomized complete block design for on-farm strip trials comparing the use of a cover crop in a corn rotation.

Table 1: For corn silage trials harvested with trucks, field length is determined by expected yield and truck load size.

Expected yield	Truck load capacity		Chopper width (rows harvested)	Optimal length
	100%	75%		
tons/acre	tons/truck		30-inch rows	Feet
25	10	7.5	2	~2600
25	10	7.5	4	~1300
25	10	7.5	6	~870
25	10	7.5	8	~655

Step 3: Field site selection

It is important to look into field history to answer the question: is it the right field for the test (right pH, similar soil type, similar manure history, no major wet spots, etc.)? In addition, select a field convenient for data collection (close to the farm scales if that is how measurements are done) and that is as uniform as possible. Place the blocks (the sets of treatments) in such a way that variability in slope, soil types, drainage patterns, etc. within a block is minimal. Avoid fields with many soil types, slopes, irregular boundaries, and tile lines running parallel with the rows and never use headlands for trials!

Step 4: Implement trial

To avoid surprises, discuss plot design and implementation with the entire farm crew, flag the plots (and where possible locate with GPS), and record treatment locations on a plot map that is given to everyone involved. It is also important to communicate the importance of consistency in all other field operations taking place beyond the study treatments. Develop a data record sheet for each plot.

Step 5: Collect data

For the best information, data collection must be consistent *and* for each individual plot. The purpose of the trial determines what data to collect. To evaluate the impact of a management change on yield, yield should be determined. If the purpose is to evaluate forage quality, forages should be analyzed.

As "things" happen during a growing season, it is important to record emergence and population density, weed, insect, and/or disease pressure, and soil conditions, rainfall, and temperature, as well as "unusual events" (hail storm, tornado, bear damage, etc.). Situations that could result in discontinuation of a trial include failed weed control, excessive bird damage, planter skips, waterlogged conditions, and uncertainty about plot location or plot treatment.

Step 6: Analyze data

Statistics are used to determine if treatment differences are real (i.e. resulting from the treatments) or due to chance. The probability that a difference between treatments could occur by chance is the *P*-value. If the treatments cause a significant difference ($P<0.05$), the difference is real. University staff can help do the statistical calculations to find real or random differences between treatments. Where possible and relevant, a producer should also consider benefits such as improved soil quality, reduced loss of nutrients to the environment, and cost of production.

Step 7: Learn from data and repeat

It is important to be objective when reviewing results. Much can be learned through discussion with the farm crew and interactive discussions about what the results mean for an individual farmer and for farmers in the region. Because of year to year and field to field variability, it is important to repeat the same research multiple years, until the farmer(s) and farm advisors are comfortable with the results under varying conditions and across fields and/or farms.

New York On-Farm Research Partnership

A single replicated trial has value for the producer but there is much more value in looking at data from many trials across the farm, region or state, especially for nutrient management research. The New York On-Farm Research Partnership was established to facilitate this on-farm research (see link under additional resources below).

Additional Resources

- Nutrient Management Spear Program Agronomy Fact Sheet Series: nmsp.cals.cornell.edu/index.html.
- New York On-Farm Research Partnership: nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/.

Disclaimer

For more information

Cornell University Cooperative Extension

Nutrient Management Spear Program
http://nmsp.cals.cornell.edu

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