Guide to Conducting On-Farm Trials

WHAT IS AN ON-FARM TRIAL?

On-farm trials are replicated, field-scale strip trials that allow farmers to test products or practices in their own fields, using their own equipment. These trials are designed to answer production questions specific to a farm operation, producing yield and economic outcomes under each farm's unique set of management practices and growing season conditions.

WHY ARE ON-FARM TRIALS VALUABLE?

On-farm trials put farmers in control of the practices they test and offer straightforward, powerful scientific evaluation of farm management decisions. Information gained on agronomic and economic performance can be used to guide future management decisions. On-farm data can also be pooled across time and space through organizations like MPSG's On-Farm Network (OFN) to answer production questions at a larger scale and with greater confidence.

STEPS TO SUCCESS

1 FORM A RESEARCH QUESTION

The research question sets the foundation for meaningful results. Develop a specific question that leads to clear treatment selection and that has a defined end goal (e.g., yield and/or quality). The research question will also determine what data should be collected throughout the season to inform yield results. A question that can be answered from two or three treatments will produce the best results.

Example – *Can I reduce double inoculation to single inoculation without reducing nodulation and yield?*

2 SELECT AN APPROPRIATE FIELD AND TREATMENTS

Ensure the treatments answer the research question and that they are realistic for your farm operation. On-farm trial treatments usually include your normal farm practice compared to the new practice you are interested in testing. Treatments must differ enough from one another to potentially see an agronomic difference between them.

The success of your trial and potential application of results to your farm also depend on appropriate field selection. Think about what field scenarios are best suited to answer the research question. Choose a field that is representative of other fields on your farm where you might adopt management practices based on the trial findings.

Example

Treatments – *Single inoculant (on-seed) vs. double inoculant (on-seed plus in-furrow).*

Field selection considerations – *Field history, crop rotation and residual nitrogen. Select a field that has had a minimum of two well-nodulated soybean crops in the last ten years and <50 lbs/ac of residual nitrogen.*

3 PLAN AN EFFECTIVE TRIAL LAYOUT

Two factors are critical for success when planning a trial layout – *replication* and *randomization* (see Figure 1).

Replicate multiple strips of the same treatment in one trial to minimize variability. One replicate (or 'block') is comprised of one set of treatments. Aim to have four to six replicates in your trial. Replicates do not have to be directly adjacent to one another. However, keeping them close together will make the trial easier to manage.

Randomize the order of treatments within each replicate. Randomization helps you avoid patterns of treatments across the trial area, which prevents bias and protects the quality of trial results.

To randomly choose the order of treatments in the trial area, follow a suggested randomized trial layout or create your own randomization plan using a coin toss or online random number generator to determine what treatment will be implemented in each trial strip.

Replication and randomization strengthen your ability to draw statistically-sound conclusions from the results. Both factors account for field variability and enable statistical analysis. In other words, they allow you to confidently conclude that responses occurred due to treatments rather than field variability.

Once the treatment layout is decided, plan where the trial will be established within the field. Avoid areas of the field that introduce variability (e.g., sloughs, drains). If the drain cannot be avoided, arrange the trial so the drain runs equally across all treatments rather than parallel to a treatment strip. If you have complex topography in your field, run the trial across the slopes rather than along them, so each trial strip has the same amount of topographical variability.

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Figure 1. Randomized and replicated trial layout, with two treatments (orange vs. blue) and five replicates of the two treatments.

Choose an area that looks representative of the majority of the trial and scout within each strip along that transect (i.e., at each "x" in the image).

4 ESTABLISH AND MAINTAIN THE TRIAL

Following the trial layout, establish the trial at seeding or spraying time, depending on the trial type. Flag out the boundaries of each strip, or, at minimum, the four corners of the trial. GPS coordinates are also helpful to identify treatment areas. Record which treatments are in each strip of the trial – this should match the planned trial layout. Share the trial location and treatment layout with everyone who will be working in the field. Maintain the trial area as you would the rest of the field, in terms of pest control, seeding rate and other agronomic management considerations. Drive across the trial area, perpendicular to the strips, to equalize the area of each strip affected by wheel tracks.

5 COLLECT RELEVANT DATA

Depending on the trial type, in-season data collection may be necessary to help interpret yield results at the end of the season. Examples include plant counts, nodule counts and disease scouting. Collecting in-season data across representative transects within the trial is an efficient method for large-scale trials (see Figure 1).

Example – *To assess the effect of double vs. single inoculation on nodulation, dig up 10 plants at each 'X' across a representative transect in the trial to record the number of nodules and note if they are active (pink inside).*

A weigh wagon or grain cart with a scale should be used to collect accurate harvest data. Record the weight of each strip, or at least one combine pass worth of crop from each strip. Harvest all trial strips on the same day, in as short of a window as possible and using a single machine, to keep harvest conditions uniform across the trial area. If a handheld moisture meter is available, determine harvest moisture content using a sample of grain from each strip. Then, calculate yield at the standard moisture content for the crop (13% for soybeans, 16% for peas and faba beans and 17% for dry beans). Use the standardized yields for statistical analysis.

6 ANALYZE THE DATA

Statistical analysis and interpretation of the data are critical to determine the outcome of the trial. Yield naturally varies across a field. Statistics are the only way to determine if numerical differences in yield between treatments are the result of field variability or a result of the treatments. For most on-farm trials, a simple paired t-test is a sufficient statistical analysis. Fillable excel calculators to conduct statistics can be found at manitobapulse.ca. Alternatively, contact MPSG or Manitoba Agriculture and Resource Development to assist with analysis of your data.

Statistical analysis and interpretation allow you to draw conclusions about the agronomic effects of the treatments. The next step is to examine the economics. Simple economic analysis can follow a formula like this:

Example – *[Yield difference (bu/ac or lbs/ac)* Expected market price ($/bu or $/lb)] – Treatment cost ($/ac) = Economic outcome ($/ac)*

If this calculation results in a positive $/ac value, the treatment and resulting yield change were profitable. If the outcome is a negative $/ac value, then the change in yield was not enough to justify the cost of the treatment and the outcome was not economically favourable. Economic analysis can only be applied when there is a significant yield difference between treatments. If there is no statistical significance, any numerical differences in yield are the result of random variation and the increased cost of the treatment is simply a loss in profit per acre.

Example – *Interpreting the results of a double vs. single inoculant trial with a statistically significant yield difference (scenario 1) and without a significant yield difference (scenario 2).*

	SCENARIO 1	SCENARIO 2
Double Inoculant	31.6 bu/ac	21.0 bu/ac
Single Inoculant	30.1 bu/ac	20.0 bu/ac
Yield Difference	1.5 bu/ac	1.0 bu/ac
Statistical Significance?	**Yes**	**No**
	To determine if double inoculation was profitable, calculate the expected revenue increase minus the cost increase from double inoculation compared to single inoculation. *[1.5 bu/ac * $12/ bu] – $10/ ac = $8/ac → profitable*	While there was a numerical yield difference, double inoculation did not significantly increase yield compared to single inoculation. The cost increase from double inoculation resulted in a loss in profit.

7 LEARN FROM THE DATA AND SHARE WITH OTHERS

After using statistics to determine the trial's outcome and proceeding with economic analysis in cases where significant differences occurred, take time to evaluate the impact of the trial results for your farm operation. Do the results suggest that you could benefit from changing your practices? Consider the growing season conditions and any mid-season observations and measurements you collected. Do you think it would be valuable to run the same trial in a different year and a different field?

Pooling trial results with other farmers and learning from the experience of others is also beneficial when evaluating your farm's agronomic management practices. Participating in the OFN is a great way to facilitate this networking and grow a large database of site years to determine the response to various agronomic decisions across time and space.

on-farm network
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