Conducting Experiments on the Farm

By Brenda Frick, Ph.D.

Farmers conduct a wide range of experiments on their farms every year. Most of these are done for the farmers' own information and don't require the "blessings of science". However, a few simple techniques from scientific methodology can give the results of an experiment more credibility, making it easier to share with scientists, academics and even skeptical neighbours.

The question:

The first step of a scientific investigation is to clearly form the research question. Although we often think of science as very objective, this first stage depends on the researcher's (in this case the farmer's) point of view. The type of questions we ask determines the way to best conduct the experiments and the kinds of information we can discover.

A more specific question is often easier to answer. For instance, a broad question such as "would compost tea help my crop" needs to be focused before the research project is set. Usually, it is a matter of narrowing down what you think you might find. Scientists call this the hypothesis. A specific question might be "Would 5 gallons per acre of this specific compost tea applied at the 2 leaf stage of my chickpea crop reduce disease?" The question determines what needs to be measured to decide if the treatment worked, in this case, disease level.

It is always tempting to ask complex questions. Perhaps, in the compost tea example, the researcher may hope to see effects on weed numbers, numbers of insect pests, disease severity, sugar concentration, yield, and seed size. The researcher might want to compare one tea application to 2 or 3 applications, at different times and at different rates. If time and energy are limitless, these might all be useful ideas, but in most cases the experiment quickly becomes overwhelming unless a serious effort is made to keep it simple. Science is an on-going process. No experiment can include everything. A simple one-comparison test can be very useful.

Controls

A control is pivotal in being able to make comparisons. If a field produced a bumper crop when the farmer harrowed, this does not necessarily mean that harrowing was beneficial. Perhaps it was just that sort of season. To scientifically test the effect of harrowing, the farmer would need to have a portion of the field that was harrowed, and a portion of the field that was not. The portion that was not harrowed is the control. The effect of harrowing is seen by comparing the harrowed area to the control area.

A control might also be the “usual” way of management (the old treatment) compared to the new treatment. For instance, in a comparison of seeding depth, the meaningful comparison might be between seeding at 1 in depth compared to seeding at 3 in depth.

A meaningful control has to be as similar to the treatment as possible in every way except for the treatment. For instance, if the treatment is applied to the centre of the field and the control to the headlands, or the treatment on the knolls and the control in the valleys, the difference between treatment and control might be due to position as well as to the treatment. Landscape position and field history are particularly important to consider when deciding where to place a test.

Replication

A single occurrence many not mean much. If something happens in the same way several times, it is more likely to be meaningful. This is the idea behind replication. A minimum of 3 replicates is needed to do a statistical analysis. The more replicates there are, the easier it is to find statistical differences between treatment and control. Of course, the more replicates there are, the more work is involved. Many scientists use 4 replicates in their field trials. That is, the entire set of treatments is repeated 4 times in the field. Some recommend 6 replicates for on farm trials.

Strip trials

A strip trial is a very simple way to make comparisons. For instance, let’s consider the comparison between seeding at 1 bu/ac or 2 bu/ac. If the seeder width is 14 ft, the field could be staked out in 14 ft (one seeding pass) or 28 ft (there and back) strips. Using 4 reps and 2 treatments would require 8 strips across the field. Each pair of strips would be one comparison, or one replicate.

Rep1	Rep1	Rep2	Rep2	Rep3	Rep3	Rep4	Rep4
1 bu/ac	2 bu/ac	2 bu/ac	1 bu/ac	2 bu/ac	1 bu/ac	1 bu/ac	2 bu/ac

The farmer could seed the 1 bu/ac strip of Rep 1, then the 1 bu/ac strip of Rep 2 and so on, then recalibrate the seeder and seed all the 2 bu/ac strips. Of course, a good map of the field, with the trial area well marked on it, and clear and obvious stakes will make this more complicated seeding pattern easier to follow.

Randomization

For each replicate, it is important that treatments are in random order – they don't just follow a pattern of 1,2, 1,2, 1,2, 1,2. This is to help avoid unintentionally favouring one treatment over the other. For instance, if the 1 bu/ac treatment is always downwind, or uphill, or nearer the shelterbelt than the 2 bu/ac, this might unfairly influence the comparison.

Randomization is simply a matter of making sure that each treatment has an equal chance of being in each field position. One way to randomly assign treatments is to put a piece of paper with the names of the treatments in a hat and draw them out as many times as there are reps.

Collecting data

Collecting data can be time consuming, but must be done carefully to be of value. Measures or assessments are generally taken for each treatment in each replicate. Sometimes several measures are taken in each strip. This can be especially useful if there is variability across the field. Samples should be taken in a pattern that is determined without looking at the crop. Taking samples at spots that "look good" can bias the sample.

Good field records can help make sense of confusing data. It is very helpful to keep a record of all operations, and any observations, such as weather, flooding, insects, deer, etc. These observations will be especially useful if results vary from year to year, or if one replicate seems to behave differently from the others. Often data collection comes at a time that is difficult to manage. Careful planning, and willing helpers make this task easier.

Analysis

Sometimes the results of an experiment are very clear cut. If each harrowed treatment has fewer weeds than its paired control, for instance, there is probably no need for statistics. More likely, though, the data will vary from rep to rep, and even from sample to sample within a strip. In this case, statistical analysis can help. Statistics show how big a difference there is, and how likely that difference is to occur by chance alone. If statistics are a challenge, it may be helpful again to seek willing helpers.

Repetition

An experiment may give different results in different years. For instance, doubling the seeding rate may increase yield in a good year, but decrease yield in a drought. Repeating an experiment in a different year helps to show if the result is generally true or true only under specific circumstances.

Conclusions

Sometimes experiments “don’t work”. The treatment may not have the desired effect. The experiment may not have measured the right things. There may not have been time to collect the data. Or perhaps the whole trial was hailed out. These things happen to professional researchers as well, and can be part of the learning process.

Scientific experiments on the farm can be a way of testing new ideas or demonstrating interesting innovations. They can be the focus of farm field days. By doing these experiments themselves, farmers can make sure that the research they want is done in their environment and with their constraints. By making sure that each test follows a scientific methodology, with at least a control and some replication, these experiments can form the basis of a credible network of farm based information.

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