Analysis and Practical Use of Information from On-Farm Strip Trials

By D.R. Hicks, R.M. Vanden Heuvel and Z.Q. Fore

New practices and products that growers evaluate on their farms should ideally have previously met the rigors of research testing on small plot, replicated trials where all variables are well controlled and the treatments have shown that they are statistically repeatable. Therefore, the primary purpose of on-farm strip tests is to give the grower an opportunity to try a new practice or product and to find response areas (both negative and positive) within a field. This information will help the grower determine management zones where the practice should be used to maximize the return from the input investment. Following are guidelines on how to conduct on-farm strip tests and how to best use the information from them.

On-farm trials are useful in helping growers become familiar with new products and management practices and in deciding whether they want to adopt the practice on whole fields or their entire farm. Combine yield monitors now make it possible and easy to collect yield information from any part of a new field. Thus, growers may use yield monitors to evaluate new agronomic practices that they have placed in strips or parts of fields. It will be important to collect good information if growers want to use it to make decisions. Profitability depends upon making sound management decisions.

Planning is important to the success of an on-farm trial. What is the objective? Where will it be located? What treatments should be included? What data will be recorded? Who will plant, record information, harvest? These matters should be determined to make the results of the trial most useful.

The objective of on-farm trials may be to evaluate a new product or practice. Growers may adopt a practice or product on part or all of their acreage after they have more experience with it. They may need on-farm experience to gain confidence in the new technology.

Choose a representative area of a field for an on-farm trial. Soil type, slope, tillage, and fertility should be as uniform as possible (unless they are considered to be variables) so that yield differences observed are likely due to treatments rather than soil and field characteristics or natural variability. Record all information in a field book (or a computerized system) and store in a place convenient to continue entries throughout the growing season.

The choice of a treatment is determined by the objective of the trial, such as the evaluation of a new product or practice. The effect obtained from the treatment will be compared to other areas where the treatment was not applied. Yield and moisture at harvest are usually determined. Other effects that might be of interest are traits such as plant height, percent of weeds controlled, plant injury, maturity date, and lodging. A treatment could be a new herbicide, a different rate of the same herbicide, a change in plant population, changes in varieties or hybrids, etc. While all other practices are held constant, any one factor that is changed becomes a "treatment" and can affect yield and other characteristics.

On-farm trials should be kept as simple as possible. For example, two treatments...the new practice or product (treated) and the normal practice (check)...would be ideal. There can be more treatments, but the trial becomes more complicated and more difficult to properly manage as the number of treatments increase. Variety trials are a good example of where there are usually more than two treatments in a strip trial.

One can code with numbers or letters the strips where the treatment and check are laid out in the field to prevent introducing bias to the results. After all field notes are taken and the strips are harvested, the results can be uncoded to study the possible treatment effects. This prevents any bias in the results that might occur due to notions about what results are expected because of the treatment.

The simplest trial is one with only two strips–the treated and the check. There is no replication with this layout and, therefore, there is no estimate of error. As a result, one cannot judge statistically whether or not there is a real treatment difference. There will be a number of combine yields within each of the two strips, but these are not replications because the assignment of treatments along each strip is not re-randomized for each of the areas within the strip where combine yields will be taken. However, combine yields do represent samples within each strip and are valuable information to show variation within the strips.

Three replications of the treated and check strips in each field or farm allow for a statistical analysis, if one wants to do so, and provide a better estimate of the treatment effect by having three estimates rather than one. One replication of the treated and check strips on three or more farms is equally good for statistical analysis, providing all growers do an equally good job of taking care of the trial. The best reason for increasing the number replications of the strips is to provide a better estimate of the treatment effect.

Figure 1 presents the field layout for the simplest situation-two strips (treated and check) in one field. There is no replication with this layout, so conclusions that one can draw from the results are limited. However, results from similar layouts on three or more farms will allow for proper statistical analyses and a broader basis for making decisions regarding the treatment effect.

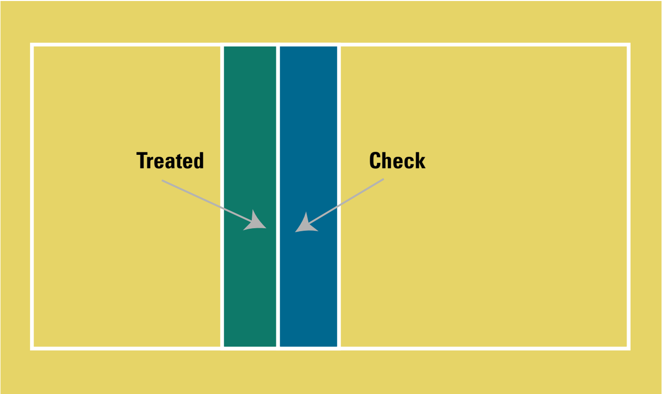

Figure 1. A field layout of an on-farm strip test with two treatments and one replication.

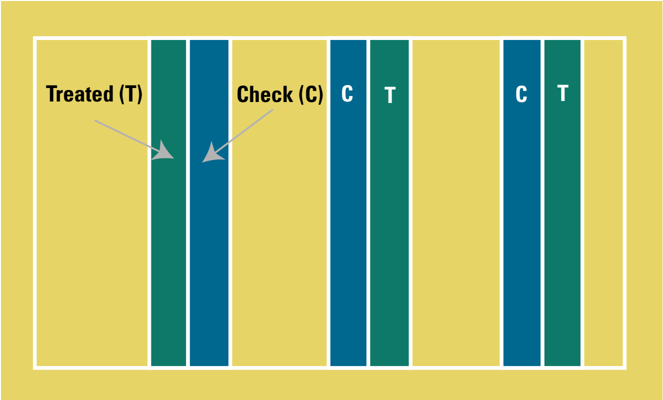

Figure 2. A field layout of an on-farm strip test with two treatments and three replications.

Figure 2 gives a field layout for two strips (treated and check) with three replications in the same field (there could be more replications, but we believe three are sufficient and push the limit of time and space that a grower should spend with an on-farm trial). When assigning the treatment and check to the strips, one should randomly assign the treatment and check to each of the strips. The layouts in **Figures 1** and **2** can be repeated on two or more fields or farms and the results combined to increase the number of replications of the treated and check strips. This will improve the estimate of the treatment effect.

Keep detailed records of the field where on-farm strip trials are located. Use Global Positioning System (GPS) equipment to locate the strips in the field and label them on a GPS generated field map. One could mark the strips with flags in the field such that they are easily found during the growing season to observe crop conditions. Record all events during the growing season that may help to explain the yields that are recorded later. This includes planting date, rainfall, unique weather conditions, fertility applied, pesticide use (kind, amount, and date applied), harvest date, and other pertinent data.

Results of replicated on-farm trials can be statistically analyzed. The purpose of a statistical analysis is to determine whether the treatment effect is repeatable (which may be known from previous research in small plot, replicated trials). Results from non-replicated on-farm trials can also be statistically analyzed if there are two or more farms (or locations) where farms are used as replicates in the statistical analysis.

Statistical analyses of on-farm data will likely show the treatment effect to be statistically significant at a very high level of confidence, even when very small differences occur between the treated and check strips. This will be especially true when large numbers of combine yield data are used as replicates in a statistical analysis.

A statistical analysis of data from on-farm trials may not be very important to a grower if the treatment has been thoroughly evaluated in small plot, replicated trials (normally including more than one location and year). If so, a grower can expect the treatment effect to be real and testing on that farm is not necessary except to become familiar with and gain confidence in the treatment technology.

In addition to the statistical analysis, one should determine if the treatment is profitable. A statistically significant effect does not mean that a practice or product will be economically significant or feasible. On the other hand, a treatment that does not give a statistically significant effect does not mean that the effect is not economically significant. Economic significance occurs when the value of the

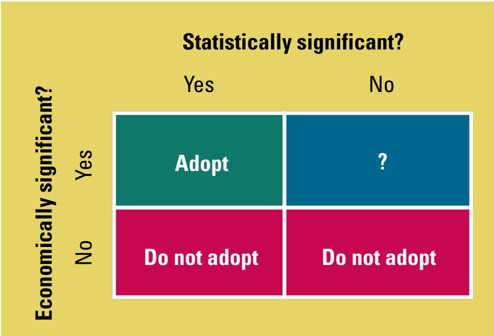

Figure 3. Matrix to evaluate the adoptability of an agronomic practice based on statistical and economic significance.

average treatment effect is greater than the cost of the treatment. To evaluate economic significance, one needs to know the average treatment response, expected crop price, and the cost of the treatment. These parameters are necessary to evaluate the average return on investment for the treatment.

Figure 3 graphically presents the decision options regarding adoption of a practice considering statistical and economic significances. Technologies should be adopted to improve profitability when the practice is both statistically and economically significant and not adopted when the practice is not economically significant, even though it may be statistically significant. The combination of economically significant and not statistically significant in the upper right quadrant in **Figure 3** represents a more difficult decision.

Both the cost of the treatment and the probability of a treatment response are important components of the decision to adopt new technologies. The relationship is shown conceptually in **Figure 4**. Ideally, the probability of a real response to a new technology should be very high or close to 1.0, especially when the cost of the technology (treatment) is high. But when the cost of the treatment is low, one might accept a lower required probability of a real treatment response when considering whether or not to adopt the new technology.

On-farm trials help growers become familiar with new products and management practices and should be helpful when determining whether they want to adopt the practice on whole fields or their entire farm. Combine yield monitors make it possible and easy to collect yield information from any part of a field. Growers may use yield monitors to evaluate new agronomic practices that they have placed in strips or parts of fields. Combine yield monitors also help growers to fine tune management practices that improve their profitability and efficiency in crop production.

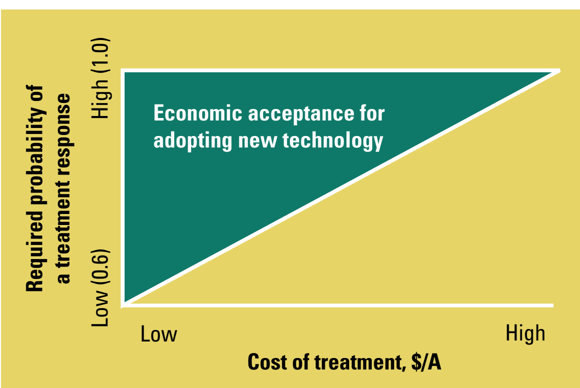

Figure 4. The conceptual relationship between the cost of a treatment and the required probability of a response.

Dr. Hicks is Extension Specialist, Corn Production, University of Minnesota, St. Paul. Dr. Vanden Heuvel and Mr. Fore are with Cenex/Land O'Lakes.