3-14-2019

Conducting On-Farm Trials

Mark Licht
Iowa State University, lichtma@iastate.edu

Mike Witt
Iowa State University, witt@iastate.edu

Conducting On-Farm Trials

Abstract
On-farm trials are an easy way for farmers to learn how practices, products and equipment will work in their cropping systems. The concept of on-farm trials has been around for decades, with farmers placing rows or strips of different practices within their fields for comparison. On-farm trials are easier to conduct now with assistance from formalized on-farm trial programs and the use of GPS and precision technologies.

Disciplines
Agricultural Science | Agriculture

IOWA STATE UNIVERSITY
Extension and Outreach

Integrated Crop Management

Conducting On-Farm Trials

March 14, 2019

On-farm trials are an easy way for farmers to learn how practices, products and equipment will work in their cropping systems. The concept of on-farm trials has been around for decades, with farmers placing rows or strips of different practices within their fields for comparison. On-farm trials are easier to conduct now with assistance from formalized on-farm trial programs and the use of GPS and precision technologies.

The premise behind an on-farm trial is to evaluate production practices under realistic growing conditions. Ultimately, properly designed on-farm trials are used to predict responses to products, practices and technologies when used in the same or neighboring fields. Additionally, on-farm trials are used to validate small plot research with larger field-scale evaluations. On-farm trials are the citizen science for farmers. That is, farmers conducting on-farm trials; sharing results from many sites within a region and across years; and better understanding how management decisions interact with weather and soil variability for improved profitability.

Designing an on-farm trial

Formulate a question that can be tested simply and effectively. The on-farm trial must be designed to fairly test the question without an outcome bias. Keep it simple by asking yes/no questions or looking at only one variable. For example, does ultra-early soybean planting increase yields compared to a normal planting date? A fair on-farm trial would use the same soybean cultivar at both the ultra-early and normal planting dates to compare yield.

Include a control treatment to test other treatments against. Controls are not used to adjust yield results but rather to provide a baseline. Most commonly, the standard practice used on the farm serves as the control. From the example above, the control is the normal

planting date (likely early to mid-May for much of Iowa) with the ultra-early planting as the test treatment in question.

Randomize and replicate to account for field variability and as well as build statistical power to detect differences between treatments. Replication is extremely important to understand how much variability exists within the on-farm trial results. The lower the variability the greater the certainty of the results. Start with a minimum of four replications to account for in-field variability. Splitting a field in half for comparison is not a sound way conduct on-farm trials because the data will not be accurate enough to use in other environments. Replication also helps to avoid bias by not allowing placement of one treatment in a more favorable environment within a field and skewing the results.

Consistent management practices across the field is a must. The saying "you can't compare apples to oranges" comes to mind. The only management factor to change in the on-farm trial area is the factor being tested. Any other factors that change will confound the results making it hard to determine what caused the results.

Know the field history to avoid conducting a trail in an area where variability is high or something else may affect your results. Conducting a starter fertilizer test in an area that has an extensive manure history may be problematic due to high soil test levels. Place on-farm trials in areas that are uniform or equally account for the variability within each strip. Avoid areas of know high or low productivity if it would insert bias to a treatment.

Convince a neighbor to conduct the on-farm trial and share the data. There is great benefit in conducting on-farm trials on different farms. The more locations a trial can be conducted the greater confidence found in the results. Extrapolating on-farm trial data from a single or few locations can be risky. More locations allow for a wider range of environmental conditions to be taken into account to show the treatment results stand up to more than just one farm.

Conducting the on-farm trial

Match equipment widths to ensure field operations can be conducted with ease. Treatments or strips dimensions must be equal to each other within the field so that yield results match and each treatment is fairly evaluated. Corn trials are typically easy to accommodate because the planter width is a multiple of the harvest width. Soybean trials can be tricky and often result in a mismatch between planter/sprayer and harvest width. Planning your strips to make sure they are wide enough to easily harvest is a good rule of thumb. Harvest should always be conducted in the direction the treatment was applied, not at a diagonal to avoid post-harvest processing challenges.

Use technology to your benefit. Guidance systems, monitors and prescriptions take the hassle out of conducting on-farm trials. This is a great way to track how and when the field operations were conducted. Additionally, guidance systems allow the operator to 'skip' around the field applying one treatment followed by the other without much hassle. Using combine yield monitors and grain carts with load cells has become a reliable way collect harvest information on the treatments. Yield monitors allow for spatial analysis of the data. However, it is important to remember that grain is co-mingled across the harvest width where the outside row is harvested many feet and seconds before the center rows when they reach the combine.

Plant border rows between treatments or wider strips to buffer treatment effects from neighboring strips. This is particularly important for foliar applications and if there is potential for lateral movement of nutrients such as nitrogen. Treatments that have a dramatic effect on crop growth where neighboring strips are much taller or shorter should also have border rows. While border rows increase the area of each treatment strip, it is an easy way to avoid confounding influence of a neighboring strip. An example would be planting an 8-row treatment strip and harvesting the middle 6 rows to avoid border effects.

Take notes and observe throughout the growing season to fully understand what impact is occurring due to treatment effects. While yields and profits are important at the end of the year, knowing if and when a treatment might have an adverse effect may indicate the ability to overcome them if results are promising. Collecting aerial imagery may provide a better understanding of the results of the trial as well as indicate if a portion of the trial was compromised.

Analyzing the results

When comparing treatments from a field the measured yields may very well be different, even when the strips are adjacent to each other. Treatment differences may be caused by several factors other than the treatment, including soil variation, soil fertility, moisture availability, insect, weed or, disease pressure, differences in planting or harvesting techniques, or field history. When at least three replications of a trial are conducted, statistics can be used to determine if variations are attributed to the treatment or to factors not controllable by the on-farm trial.

Statistics provide a rigorous process for comparing treatments with *p*-values being the key matrix used to determine if differences can be attributed to treatments and some other factor. The lower the *p*-value, the more likely it is that the treatments are affecting the independent variable (often yield). Common benchmarks for *p*-values determined from

on-farm trials are 0.10 and 0.05. If an experiment has a *p*-value of 0.10, it is said to be 90 percent confident that differences observed are in response to the treatments. Likewise, if an experiment has a *p*-value of 0.05, it can be said with 95 percent confidence that the differences observed were in response to the treatments. Larger *p*-values result in a lower the probability that the treatments effected the differences observed.

A least significant difference (LSD) is sometimes calculated to describe the smallest difference allowable between two treatments to be statistically different. Thus, for averaged yield data, differences between treatment values must be greater than or equal to the LSD to be statistically significant. For example, an on-farm trial testing a fungicide (200 bu/ac) against a control (190 bu/ac) results in a 10 bu/ac average yield difference with a LSD of 5.5. In this situation, the fungicide yield was statistically greater than the control because the difference was greater than the LSD.

Statistics can be complicated and often are underutilized in on-farm trials. Raw number comparisons can show differences but these often mask the real answer to the question. Statistical analysis is often the reason why on-farm trials and their data can be either highly valuable or not. There are many freely available programs to run statistics or partnering with organizations such as Iowa State University to gain an understanding the true results of on-farm trial data.

Even if treatments are found not to be statistically different, it is important to remember the data are still valuable because they tell us the treatments did not produce a difference in yield (or other factors measured). Simply knowing this can help us learn more about the conditions and performance of a given field, as well as aid future management decisions. Zero difference is just as valuable as a measurable difference in yield results.

Sharing the data

The more you share the data you are collecting, the more excited others will be to conduct a similar on-farm trial or a different on-farm trial. It is contagious. More locations and more trial types result in more local information to make management decisions from. Citizen science for farmers has been and will always be a key component in increasing farmer knowledge. On-farm trials are the best way to get results of products and practices in your local area or on your farm to answer the questions that matter to your operation.

Category: Crop Production

Crops:

Corn Minor crops Soybean Biomass and Forage Cover Crop

Tags: on-farm trials statistics conducting trials

Authors:

Mark Licht *Assistant Professor*

Dr. Mark Licht is an assistant professor and extension cropping systems specialist with Iowa State University Extension and Outreach. His extension, research and teaching program is focused on how to holistically manage Iowa cropping systems to achieve productivity, profitability and en...

Michael Witt *Field Agronomist in WC Iowa*

Michael Witt is a field agronomist in west central Iowa for Iowa State University Extension and Outreach. Educational programs and learning opportunities are available for farmers, agribusinesses, certified crop advisors, agronomists, and farm managers. Areas of expertise include agronomic evalua...