Use of demonstration plots as extension tools

Emerson D. Nafziger

ABSTRACT

The use of county demonstration plots has been a common practice since the beginning of organized extension efforts. While the primary purpose for establishing these plots was to demonstrate scientifically proven practices, the increased commercialization of the plots in recent years has resulted in increased emphasis on varietal (cultivar) performance evaluation. However, the inability to perform statistical analyses on data from unreplicated plots makes these trials, if used alone, unreliable as tests of performance. Two approaches are suggested to remedy this proliferation of data from unreplicated plots. One is to collect no data, but to plant the plots only as “first-look” demonstrations and as agronomic teaching tools. The second approach is to substantially standardize varietal tests among a group of counties, and report the results as averages across locations. This method would allow for statistical analysis. An example is presented using data from county demonstration trials on varieties of wheat (Triticum aestivum L.).

Additional index words: Variety testing, Data handling, Statistical analysis.

The use of county demonstration plots to aid in crops extension dates from the earliest days of organized extension in the USA. A report from 1923 (1) indicates that there were 27 soybean (Glycine max L. Merr.), more than 50 corn (Zea mays L.), 9 small grain, and several legume crop demonstration trials in Illinois that year. These trials were organized by counties, and served to introduce a number of crops (e.g., soybean), to compare varieties (cultivars), or to show the advantage of a specific cultural practice such as “culling” seed corn. Organized field days were an important part of these programs, since producers were not generally well served by mass media. Yields were taken from most of these plots, with data being summarized by state specialists or reported by counties.

In most cases these early demonstration plots were useful as a tool to introduce farmers to the radically new concepts of scientific agriculture. Demonstrating an entirely new crop or new variety that greatly outyielded existing varieties had great impact on farmers who, due to limited research, communication, and transportation systems, previously had little opportunity to witness solid improvements in agricultural productivity. As an example, the demonstration of “chinch bug resistant” corn varieties in the early 1920s not only showed farmers that they could reduce damage from this pest, but also demonstrated that a scientist located elsewhere could approach and help solve a specific production problem.

Early demonstration plots were thus crucial in helping to lead farmers into the scientific age. They allowed farmers to see improvements personally, and to use...
those improvements on their own farm. At the same time, these demonstration plots presented an excellent opportunity for teaching scientific principles.

PRESENT USE OF DEMONSTRATION PLOTS

County demonstration plots continue to be widely used as extension tools. With few exceptions, counties annually organize at least one demonstration for one or more major crops.

In recent years, several changes occurred in the way demonstration plots are assembled and conducted. In most cases, commercial hybrids and varieties now constitute the majority of entries in a given demonstration. Extension personnel generally accept entries from most of the seed companies operating in the county. Public varieties of crops such as wheat (*Triticum aestivum* L. Thell.) and soybean, which constituted the entire trial until relatively recently, now often make up less than half of the entries. Corn hybrid trials are generally entirely commercial, while demonstrations of a few crops such as oat (*Avena sativa* L.) may include only public varieties.

Along with the acceptance of commercial entries has come more cooperation between extension advisers and commercial seed dealers. Many companies assist in attracting people to field days by providing a meal or refreshments. Commercial representatives are also sometimes involved in the planting and harvesting of demonstration plots.

Partly as a result of these changes, the present emphasis often appears to be on the use of demonstration plots to compare the performances of a number of varieties or hybrids, many of which sold by commercial firms. This emphasis on performance evaluation has reduced the effectiveness of these plots as a teaching tool. First, many demonstrations are so large that they require all available effort, with no time or space left to perform trials (e.g., plant population) that are useful largely as teaching tools. Secondly, many commercial firms are not willing to support teaching demonstrations that are not likely to provide direct commercial benefits.

Though varietal performance evaluation is a primary goal in many of the demonstration plots, they can and do continue to function as a way to introduce new varieties to producers. Besides getting a “first look” at new cultivars, producers are often receptive to the presentation of selection criteria at field days held at the plots. Thus, the plots can serve as a focal point for teaching agronomic principles to producers. Problems with this approach include: 1) hesitation to identify private varieties as having traits that are not very favorable, and 2) the fact that most producers take careful note of the plots at only one time during the season, and thus often do not see problems which develop before or after that time.

DEMONSTRATION PLOTS AS VARIETAL TESTS

As discussed above, most county demonstration plots are presently used as varietal performance comparison tests, with yield, moisture, standability, and other performance data generally collected on each variety. These data are usually assembled and printed for distribution to farmers in the county, thus providing measured yields on unreplicated plots for varieties or hybrids that producers were able to observe during the growing season.

The dissemination of such single-plot data is problematic, and can lead to serious errors if producers depend largely on these data to decide which cultivars to grow. From a statistical standpoint, such data cannot be used with any confidence because the inherent variability in the field has not been measured. Even where a design is used in which a check variety is repeated at intervals across the field, the results are not normally statistically analyzed, and the repeated checks often simply demonstrate that variability in the field is high.

While not always clearly visible, variability in a field is almost always present (3). The reason for using statistical methods is not primarily to reduce this variability, though careful design of experiments will use plot arrangements and sizes that help reduce it. Rather, statistics are needed to measure variability to allow a certain level of confidence in drawing conclusions from the work. Unreplicated plots do not allow the measurement of variability in the field, since varietal differences are confounded with the field variability. In other words, we do not know whether an observed difference is due to the variety or to the variability of the field.

The widely held idea that results are more valid if the size of individual plots is increased is not correct. It is certainly advantageous to use plots large enough to allow the use of conventional planting and harvesting equipment. However, increasing the size of plots does not automatically reduce plot-to-plot variability, and may increase it by requiring the use of a larger area. As an example, six-row plots on the outside edges of a 4 ha (10-acre) demonstration field are not likely to differ less than 12-row plots on the outside edges of a 8 ha (20-acre) field. In any event, larger plots can not substitute for the measurement of variability using statistical methods.

It is clear that the inability to separate true varietal differences from differences caused by field variability makes data from single plots of little value as a decision-making tool. Yet such data are widely distributed to farmers who want to see results from “their own county,” and to sponsoring seed company personnel, who may use these results in advertising campaigns.

HOW SHOULD DEMONSTRATIONS BE USED?

The primary use of county demonstration trials should be that of extension education. These plots often can be used to demonstrate qualitative selection criteria for varieties. For example, producers attending a field day can be shown how to recognize a certain disease, or what the advantages and disadvantages are of a certain agronomic trait (e.g., upright leaves in corn). Field days at such plots often attract a receptive audience, and the
The opportunity for effective teaching at these events is generally quite good.

The major question about the use of demonstration plots concerns the handling of yield data from these plots. One approach is to collect no yield data at all. While this practice does not detract from the educational uses of these plots, it effectively prevents the misuse of single-plot results, and the errors that can result from application of these results. This approach should be accompanied by an effort to encourage the use of results of the replicated hybrid and variety trials conducted by universities. While some farmers and seed dealers would not favor this approach, a thorough explanation by extension advisers would probably help overcome their opposition. Most producers are already aware of the problems of variability, and so would probably not object strongly. However, some seed company support may be lost if this approach were adopted.

A second approach would be to combine results from a number of locations and present these data as averages. This approach permits a statistical analysis of the results by treating each location as one block (2). As an example, wheat variety demonstration results were averaged across 15 Southern Illinois counties in 1982. The results are presented in Table 1.

The success of this approach depends on each variety being grown at most of the locations, though a few missing plots are not a serious problem. Attaining this uniformity across wheat trials was not difficult, since seed of the public varieties was supplied to each county. Any demonstration trials involving private varieties or hybrids would be more difficult to standardize to a degree sufficient to permit useful statistical analyses. This standardization could be improved by county extension advisers approaching seed companies collectively by indicating that the same private varieties or hybrids would be grown at each demonstration site within an extension region or other appropriate group of counties. The number of counties involved in such a region would probably range from 4 or 5 up to 10 to 12. The extension personnel from counties in a region would need to cooperate in assembling and analyzing data following harvest. Data could then be presented as averages across the trials in the area, and would be released by all cooperating counties.

This type of statistical analysis would be based on the assumption that no cultivar-by-location interaction exists in the trials within a region. Given the range of soil types and environments in which the trials would be conducted, this assumption would not necessarily be correct. While the result of such an interaction would be an increase in the standard error (and fewer statistically significant differences among cultivars), the average for a cultivar would still be a fair estimation of the expected performance of that cultivar under conditions of the region.

Using this approach would not prevent individual counties from including cultivars from very small companies who may only wish to enter demonstration trials in one or two counties. However, meaningful comparisons between these and more widely grown cultivars would require more complex statistical techniques (3). It may be preferable to exclude these from statistical analyses, and simply present these data as single observations, or as averages across years.

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**REFERENCES**