

## Evaluating Commercial Precision Agriculture Software to Automate On-Farm Research

Shannon, D.K.<sup>1</sup>, Carpenter, B.D.<sup>2</sup>, Ellis, C.E.<sup>3</sup>, Harper, J.R.<sup>4</sup>, Hoorman, R.G.<sup>5</sup>, Lorenz, T.E.<sup>6</sup>, Rapp, W.F.<sup>7</sup>, Schmitz, E.G.<sup>8</sup>

1. Natural Resource Engineering Specialist, University of Missouri Extension, Columbia, MO, 65203
2. Agriculture Business Specialist, University of Missouri Extension, Sedalia, MO, 65301
3. Natural Resource Engineering Specialist, University of Missouri Extension, Troy, MO, 63379
4. Agronomy Specialist, University of Missouri Extension, Versailles, MO, 65084
5. Agronomy Specialist, University of Missouri Extension, Montgomery City, MO, 63361
7. Livestock Specialist, University of Missouri Extension, Fayette, MO, 65248
6. Horticulture/Agronomy Specialist, University of Missouri Extension, Boonville, MO, 65233
8. Livestock Specialist, University of Missouri Extension, Warsaw, MO, 65355

### Abstract

As complicated as precision agriculture is, it offers producers the best opportunity to increase profitability while protecting the environment. The ability to conduct on-farm research is a tool which provides an opportunity for one to succeed in the adoption of precision agriculture technologies. On-farm research is certainly no replacement for the small plot, university trials, but on-farm research can complement small plot research and validate small plot research in a large field environment. Precision agriculture tools, such as a yield monitor, can be utilized for conducting field-scale research and spatially documenting yield differences across fields or treatments. One aspect of on-farm research not as easy to implement is the design and development of field-scale research plots through software automation. The focus of this study is to evaluate two commercial precision agriculture software packages for the purpose of automating the process of designing strip or block on-farm research trials. Part of the study also evaluated the process on analyzing yield monitor data from three example on-farm research trials. It was concluded commercial precision agriculture software can automate the process of conducting on-farm research by extending the functionality of current software capabilities. Future products of this study will be a guide and online course on the design and analysis of on-farm research trials utilizing commercial precision agriculture software.

### Background

The ability to conduct on-farm research is a tool which provides an opportunity for one to succeed in the adoption of precision agriculture technologies and allows producers to make better management decisions. One aspect of on-farm research not as easy to implement is the design and development of field-scale research plots through software automation. In the past one tool available for implementing on-farm research was Enhanced Farm Research Analyst (EFRA) (Rund, 2000). EFRA extended the capabilities of ESRI ArcView GIS to accommodate tasks needed for in field scale experimentation through a variety of tools. EFRA simplified many of the tasks involved in setting up on-farm research plots using a GIS. EFRA also made possible tools for analyzing yield monitor data at the research plot scale. With the evolution of ESRI ArcView GIS and the Windows operating system, EFRA has nearly reached its usefulness leading to the need for this study.

## **Project Objectives**

Evaluate two commercial precision agriculture software packages for the purpose of automating on-farm research processes using the following criteria:

- The ability to create experimental plots either strips or blocks. In the area of plot design, specific items evaluated were the effectiveness in the creation of physical plot dimensions and assignment of treatments and blocks for replication.
- How yield monitor data can be processed to obtain individual plot yield means for the purpose of statistical analysis. This part of the software evaluation included the ability to create plot buffers for accurately selecting yield data points only contained within a plot boundary. These buffers also eliminate any confounding of data due to treatment affect.

## **Materials and Methods**

The two software packages chosen to be evaluated for this project were Ag Leader SMS™ Advanced and Farm Works™ Mapping and Surface. It should be noted at this point in time only Ag Leader SMS™ Advanced software has been evaluated. The software chosen were selected using the following criteria: ability to process soil sample data, develop fertility recommendation maps, create soil sampling grids, and process yield monitor data. The software's ability to create soil sampling grids was utilized for the design of plots as either strips or blocks.

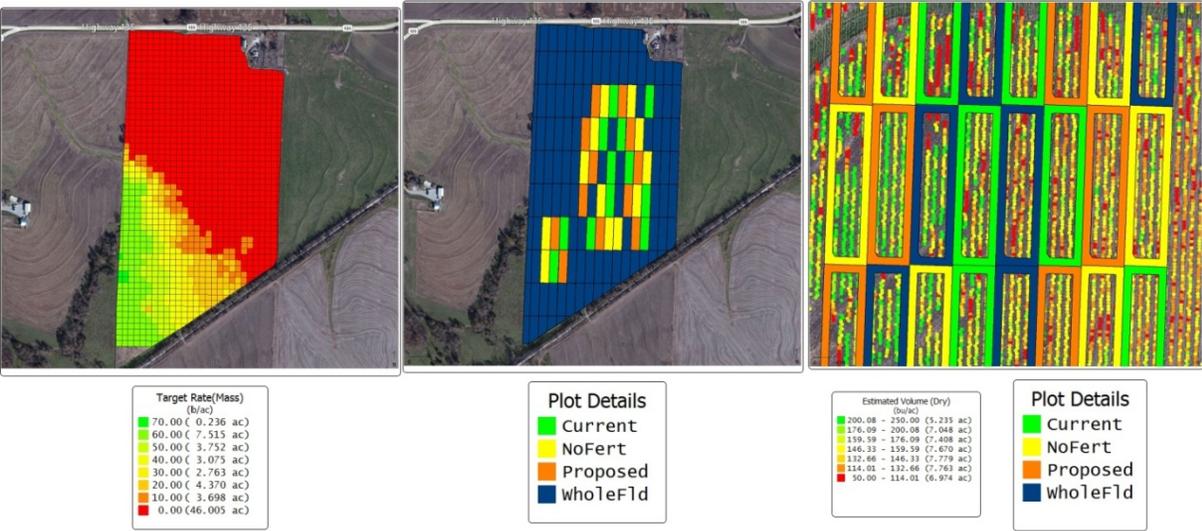
## **Example of Implementation**

The following is an example of an on-farm research study evaluating variable rate phosphorous and potassium fertility recommendation strategies. The fields selected for this study were grid soil sampled utilizing a one acre grid. Four different fertility recommendation maps were created utilizing Ag Leader SMS™ Advanced software as treatments for the study (Figure 1). Each treatment was overlaid on 80' x 300' plots and replicated 12 times in each field (Figure 2). Plots were embedded in a variable rate application map and applied with standard variable rate fertilizer application equipment. Plots were harvested with a yield mapping equipped combine. Yield data was processed utilizing Ag Leader SMS™ Advanced software to analyze treatment differences. In obtaining treatment differences, 15' analysis buffers were applied to each plot allowing the selection of yield data points only within the plot boundary (Figure 3). It was found by using the 15' buffers 7 of the replications from each field could not be included in the data analysis due to few yield data points within the plot boundary. Table 1 shows the summary of yield results for one field in the study.

	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Treatment Mean
<b>Treatment</b>	---- bu/acre ----					
<b>No Fertilizer</b>	163.4	172.3	155.2	188.2	146.2	164.8
<b>Whole Field</b>	149.2	150.7	142.6	190.8	148.9	156.1
<b>Current Recommendations</b>	150.8	180.2	153.0	182.3	151.3	163.0
<b>Proposed Recommendations</b>	156.4	171.7	153.5	194.8	165.4	169.1
<b>Block Mean</b>	154.9	170.4	150.6	189.2	152.8	163.1
<b>No significant treatment differences (P=0.05)</b>						LSD 9.9

**Table 1. Yield Results for Example Field**

There were no significant yield differences between treatments at the 5% probability level. In this field, the phosphorus recommendation was 36 lbs/acre less and the potassium recommendation was 56 lbs/acre less.



**Figure 1. Phosphorus Proposed Fertility Recommendation Map**

**Figure 2. Plot Layout Map**

**Figure 3. Analysis Buffer Overlaid on a Yield Map**

**Conclusions and Future Work**

It was concluded commercial precision agriculture software can assist in automating the process of conducting on-farm research. This will allow producers to further utilize precision agriculture technologies for improving management decisions. During the next year, Farm Works™ Mapping and

Surface software will be evaluated. Future products of this study will be a guide and online course on the design and analysis of on-farm research trials utilizing commercial precision agriculture software.

## **References**

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