

**SMALL-PLOT VERSUS FIELD-SCALE EXPERIMENTS FOR FERTILITY RESEARCH****Terry Griffin****Leo Espinoza****University of Arkansas Division of Agriculture  
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Precision agriculture technologies have reduced the cost of data collection, but most on-farm comparisons continue to be large block, split field or paired field comparisons with little or no replication. For logistical reasons, relatively few are split planter, strip trials or other on-farm designs derived from classical small plot experiments. The general objective of this study was to determine if spatial analysis could help farmers make better use of the limited replication data they are currently collecting with yield monitors.

Large block comparisons are the types of experiments farmers want to conduct. With yield monitor data and spatial statistical methods, more reliable comparisons can be made with limited replication designs. This study evaluates the spatial econometric methods such as Anselin's discrete and Cressie's continuous approach provide unbiased and efficient parameter estimates regardless of variability or number of replicates. These results indicate that replication reduces variance and MSE, but reducing MSE via limited replication experimental designs is not as useful as modeling spatial autocorrelation at the levels found in field-scale precision agriculture datasets. Hence, farmers using split-field large-block comparisons of categorical inputs obtain reliable results with spatial analysis and precision agriculture data.

This study has shown that farmers who prefer not to replicate can obtain useful results by performing spatial statistical analysis on limited replication data rather than adding a replicate and using traditional analysis under the levels of spatial autocorrelation expected at field-scales. In essence, the farmer has the choice of trading management time and effort during on-farm trial implementation with advanced spatial analysis of the resulting data, which can often be conducted at non-intensive times or outsourced.

These results indicate that spatial models dominate the addition of another replicate when considering starting at one and two block designs. When the DGP was unknown, geostatistical models dominated the spatial error process models using empirically determined specification of the spatial weights matrices. There are many factors that plague analysis of field-scale data, and this study examined only spatially autocorrelated errors. The large sample sizes of precision agriculture datasets may be examined to determine the ramification of using differing models and estimators. Other econometric failures and assumption violations may give indication of which spatial models dominate on-farm trial analysis. At the farm level, many factors affecting crop growth and treatment effects are unmeasured and subsequently omitted from the dataset inducing an omitted variable problem. Precision agriculture data are often measured with systematic and random errors in both the dependent and independent variables. Yield monitor data has both erroneously measured observations that lead to errors in variables and improper locational attributes leading to spatial effects. The spatial effects not evaluated in this study may include spatial heteroskedasticity that may be induced by experimental design.

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**References**

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