Precision soil sampling allows growers to manage field variability by optimizing lime and nutrient inputs on a site-specific basis. Precision soil sampling is accomplished by geo-referencing soil samples from the area which the sample was taken using a Global Positioning System (GPS) (Figure 1). Geographic Information Systems (GIS) are used in conjunction with GPS to record, process, and analyze the data. Precision soil sampling using GPS and GIS is accomplished using either zone management or grid sampling methods. This timely information sheet will discuss the various methods and applications of precision soil sampling along with their advantages and disadvantages.

Grid Sampling

Grid soil sampling employs the use of a GPS to divide fields into square grid sections from which samples are collected. These sections can be of any size although grids of 1 to 2.5 acres in size are the most typical and practical to manage. Smaller grid sizes provide more detailed information and therefore better characterize field variability, while larger grid sizes are more economically feasible and realistic to achieve in a large acreage situation. Once collected, samples are analyzed and results depict nutrient needs within the grid. A GIS is then used to join soil test results to the corresponding sample location in the field, producing lime and nutrient application maps. Variable-rate applicators allow producers to target lime and fertilizer applications based on the grid pattern.
Grid sampling is accomplished through one of two methods: grid-point sampling and grid-cell sampling (Figure 2). Grid-point samples are collected from the center of each grid and composited to obtain a sample for the grid. In grid-cell sampling, samples are taken randomly across the grid and composited for a representative sample of the grid. While grid-point sampling requires less labor and time, it sometimes does not yield a true representation of the grid area because samples are only collected from the center of the grid. Grid-cell sampling requires a more intensive sampling routine and increased labor, but samples provide a composite of the entire grid. Research has shown grid-cell sampling to be the most effective of the grid sampling methods for identifying field nutrient variability.

![Grid-Cell Sampling and Grid-point Sampling](image)

**Figure 2.** Maps showing grid-cell and grid-point sampling patterns.

Grid sampling is a simple and productive way to better identify nutrient differences and pinpoint areas of variability in a field. A major disadvantage to grid sampling is that the grid pattern is often arbitrarily set over the field. Depending on the grid size used, this may result in joining together areas of the field that could be managed differently. For example, if a grid encompasses areas of the field with obvious differences in soil texture and/or yield productivity, this may result in skewed soil test results by diluting instead of identifying nutrient differences.

**Management Zones**

Management zones are created within a field to group similar soil and yield properties and minimize variability. Once zones are established, they are managed according to their unique properties and inputs are optimized to meet production potential. Crop management zones can be established using a variety of resources including: 1) remote sensing and aerial photographs, 2) soil surveys and landscape characterization, 3) farmer knowledge, 4) yield maps and soil electrical conductivity maps and 5) conventional soil testing (Figure 3). A GIS is used to illustrate and transfer zones to a hand-held computer that is used with a GPS to delineate zones in the field. Composited samples are collected and analyzed for each zone in a "directed"
A significant advantage to zone sampling is that while it is more time consuming to develop initially, zones require less intensive sampling and are less expensive to sample than with grid sampling. Zone management, because it is based on yield and/or soil properties, is also a more logical approach for determining sampling locations than grid sampling. According to research conducted by Auburn University and the Alabama Cooperative Extension System, management zones were an effective approach for characterizing nutrient variability in fields with significant soil-derived variability. Precision soil sampling utilizing a zone approach is often more advantageous for characterizing and managing field-scale variability than grid soil sampling.

**Conclusion**

Precision soil sampling utilizing GIS and GPS is a beneficial and effective tool for Alabama farmers to manage natural field variability. Precision soil sampling increases farmer revenues by optimizing inputs and maximizing profitability. Targeting fertilizer inputs to specific areas is also environmentally friendly by reducing excessive nutrient applications and decreasing the risk of off-site leaching of nutrients. Soil sampling using grid or zone management is often a simple first-step for growers who want to become involved in precision farming. These technologies allow farmers to collect valuable information about their fields, enabling them to formulate a more cost-effective management plan. Precision soil sampling provides growers the capability of taking decision making to a higher, more efficient level of farming.