# Getting Started with Precision Agriculture

By Amy Winstead and John Fulton

**Precision agriculture (PA) technologies, once thought to be only for large-scale producers focused on intensive management, are readily available and affordable for a wide variety of agricultural operations. Interest in adoption and implementation of PA technology has rapidly increased in the USA, including the demand for high-level GPS [real-time kinematic (RTK)] accuracy, precise applications of inputs, and solutions for information management.**

Precision technologies have not always been economical for small to medium-sized farming operations. However, with PA equipment becoming less expensive, tools such as guidance systems, yield monitors, and variable-rate fertilizer applicators may now contribute to savings for nearly all growers. The costs of inputs and commodity prices considerably increase the risk of making the wrong management decision. Thus, even small farms can profit from using technologies that improve production efficiency.

A survey of Alabama farmers was conducted in 2009 to evaluate current PA adoption and intended adoption of various precision farming technologies **(Figure 1)**. According to the survey results, 58% of respondents are using light bar guidance technology, 34% currently utilize assisted steering technology, and 31% use RTK guidance on their farms. Also, 86% of respondents either currently utilize or intend to implement automatic swath control technology. Yield monitor adoption was separated into three classes: currently using a yield monitor (43%), intending to use a yield monitor in the future (33%), and not intending to use a yield monitor (24%). Survey results indicated significant intended adoption by producers. Fifty-one percent of repondents intend to adopt variable-rate technology in the next 2 years, compared to 24% who are currently using the technology.

**A yield monitor** with GPS is used on a grain combine to geographically map yield data across the field. Yield maps provide a 'report card' for a producer by providing feedback about crop production and management.

**Illustration** of a sprayer equipped with automatic section control technology which turns boom sections or individual nozzles on/off as the sprayer moves through the field. The sprayer uses guidance technology to minimize overlap and skips.

**Abbreviations and notes: GPS = global positioning system; N = nitrogen.**

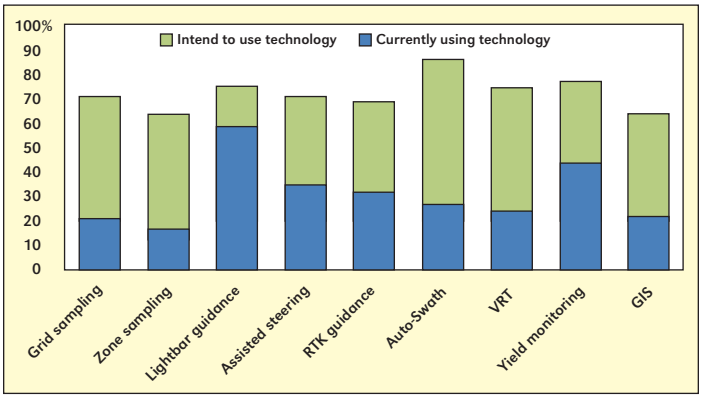


**Figure 1.** Results of 2009-2010 Alabama Precision Ag Adoption Survey.

One technology that farmers are readily adopting in Alabama and across the USA is automatic section control technology (ASC). This technology was initially available for use on sprayers, but is now also being used on planters, spreaders, and other application equipment by PA practitioners.

The premise of this technology is that the operator can turn sections of application equipment off in areas where application has already occurred or in un-targeted areas such as environmentally sensitive grassed waterways. A recent study at Auburn University found that ASC can reduce input usage by 1% to 10% per pass across the field; these savings are a result of reduced overlap at headlands and within point rows. In return, farmers can expect annual savings of between $1.50 to $25.00/A for this technology, depending on crop, management, and field shape and size. On average, the study suggested a 4.3% savings on inputs for a farm operation when using only ASC… with a payback period of less than 2 years for most application equipment (sprayers, planters, and N side-dress units provided the greatest returns). However, even larger savings can be observed if ASC is used in conjunction with a guidance system, which can further reduce overlap and input usage, especially from adjacent passes of application equipment (Troesch et al., 2010). Another study suggested guidance systems can, on average, save an additional 12% on inputs and 15% to 30% overall savings when using both ASC and guidance systems together.

The Alabama survey documented significant future adoption of auto-guidance systems by Alabama producers; 37% of survey respondents intend to adopt the technology in the next 2 years compared to the 31% currently using it. Producers have cited reduced concentration needed during driving (which leads to less fatigue and an increased ability to focus on other

**The crop** is planted using auto-guidance technology.

tasks) as a major reason for adopting this technology. While the adoption of yield monitors coupled with GPS has been low in Alabama, growers are quickly starting to understand the advantage of yield maps to not only evaluate current and new management practices, but also as a data source for development of site-specific management strategies (i.e. management zones, variable-rate seeding, nutrient prescription maps, etc.). The survey also suggested that growers view grid and zone soil sampling and variable-rate application technology as having significant potential to provide cost savings and yield benefits.

## Considerations for Getting Started

With the increasing interest and predicted adoption of PA technologies, one of the most frequent questions from producers is: "How do I get started using precision agriculture technology?" The following points serve as guidelines for Certified Crop Advisers, consultants, and university extension and industry personnel to use to educate and assist growers in choosing the most appropriate PA technologies for their operations. These guidelines were developed based on grower survey results and personal communications with PA dealers and both long- and short-term users of PA.

**Table 1.** Guidelines for getting started in precision agriculture.

- Establish a clear objective when adopting PA technologies and/or practices.
- Select technologies that can be used for multiple operations.
- Identify tools that can be easily moved among different pieces of farm equipment.
- Choose technologies that will be compatible with current and future farm equipment.
- Ensure PA equipment can be easily and inexpensively upgraded.
- Determine the level of GPS accuracy and year-to-year repeatability required for specific operations.
- Ensure that recorded data will be easily transferrable.
- Determine the future needs for the farming operation and how current PA technologies can play a role.
- Understand the time requirement for adoption of PA systems and determine a timeline for implementation.
- Identify the training, support, and service tools that are available for new products being considered.

First, there should be a clear objective in mind when adopting PA technologies and/or practices. Just as PA allows growers to address site-specific production issues, the reason for getting into precision agriculture will also vary from grower to grower. Is the goal to be more efficient with inputs? Better on-farm record keeping? Are there needed management

**An example** of a precision ag display mounted inside the cab, providing real-time performance parameters to the operator and the ability to collect various data.

changes that require additional knowledge about the farm? Failing to establish a well-defined objective can be costly and counter-productive.

Users of PA technologies consistently stress the importance of selecting products that are compatible with multiple operations. Utilizing components such as monitors, receivers, antennas, and controllers across various applications and equipment can help to spread the cost of PA technology. For example, a PA display monitor can be purchased for guidance. It can be moved to harvest equipment for yield monitoring and then returned to the tractor and used for variable rate fertilizer applications.

An important consideration regarding compatibility is whether the technology is easy to move between farm equipment. If a guidance system being used in a spreader truck to apply fertilizer needs to be moved to a sprayer, will additional specific wiring harnesses or cables be needed for each piece of farm equipment? Also, consider whether the technology will be compatible with future farm equipment. Precision farming tools can be proprietary to farm equipment. If farm equipment upgrades or trades are planned in the future, current PA equipment should be able to be used on the new equipment. If upgrades to PA equipment will be needed, consider the ease and cost. For example, many entry-level guidance systems can be upgraded from utilizing WAAS GPS correction (sub-meter accuracy) to a paid subscription (decimeter-level accuracy) or RTK correction (centimeter-level accuracy). Additional features such as automatic swath control or auto-guidance can be added on.

A major point of consideration that new users of PA technologies need to learn is the level of GPS accuracy and repeatability required for a specific operation. Different levels of GPS correction are more appropriately suited to specific farming practices. For example, strip-tilling and planting peanuts would require centimeter-level accuracy and year-to-year repeatability to be able to plant and harvest directly on the row year after year. However, sub-meter accuracy is sufficient for running a yield monitor on a grain harvester.

While most PA systems currently on the market have the ability to record and download data, not all do. If this is

a desirable feature, certain considerations are needed. The format that data are recorded and exported in varies among PA equipment so it is important to ensure that the data can be downloaded in a format that will be accessible by the user. For example, if an Agricultural Geographic Information System (AgGIS) is not used for data management, then a PA system that can export data as a Portable Document Format (.pdf) or Rich Text Format (.rtf) file would be desirable to allow the user the option of viewing collected data.

It is very important to consider both current and future needs for the farming operation and the role that PA technologies can play. Developing long-term PA implementation plans can help with purchasing decisions. Collected data should always be kept even if it is not currently being utilized in the farm management program. Elevation data collected using an RTK system and yield data are examples of data that can be collected and then used in the future to create management zones or prescription maps for variable rate applications.

Finally, potential users of PA technologies need to be aware of the time requirement for adoption of PA systems and determine a timeline for implementation. There is a learning curve associated with PA technology and installations can often take longer than anticipated. In addition, even the most "operator-friendly" tool will require an adjustment period. An adoption and implementation timeline might need to extend over a few growing seasons, not just to work out the kinks and get comfortable with the new tools, but to fully establish the system needed to obtain the desired results. Successful adoption of PA technologies will in many cases be more of an evolving process rather than a quick-fix that will show immediate results. The associated learning curves for PA adoption make it important to identify the training, support, and service tools that are available for new products during the selection process. Most experienced PA users agree that service for PA equipment is one of the most important things to consider when making a new purchase.

Overall, there is no right or wrong approach to adopting and implementing PA technology. Potential users of PA should be encouraged to conduct on-farm studies to evaluate which PA practices will provide the best return for their operation. While PA technologies and practices can appear overwhelming at first, it is important to remind newcomers to take the process slow and in steps. Guidance systems and ASC provide quick, tangible benefits to farmers while other technologies and site-specific management approaches can provide benefits, but should be evaluated over several years. It can take time for practitioners to fully start to experience savings or increased profit from precision agriculture, especially precision-based nutrient management practices. BC

*For more on precision agriculture technologies, visit the Alabama Precision Ag website: www.AlabamaPrecisonAgOnline.com.*

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## Reference

Troesch, A., D.K. Mullenix, J.P. Fulton, A.T. Winstead, and S.H. Norwood. 2010 Economic analysis of auto-swath control for Alabama crop production. *In* Proceedings of the 10th International Conference on Precision Agriculture, Denver, CO, July, 23-25

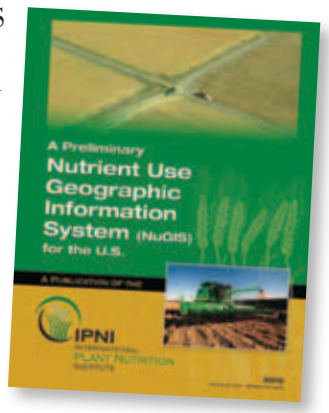
# IPNI Introduces NuGIS – A New Tool for Evaluation of Nutrient Use and Balance in the U.S.

IPNI has unveiled a new publication titled *A Preliminary Nutrient Use Geographic Information System (NuGIS)* for the U.S., along with an interactive on-line interface.

"For the past couple of years, IPNI scientific staff and other cooperators have been working on a rigorous GIS-based model for assessing nutrient balance and balance trends in the U.S., termed 'NuGIS'. This project is part of our responsibility for understanding the nutrient status of cropping systems and as a complement to our periodic inventorying of soil fertility levels in the U.S.," said IPNI President Dr. Terry Roberts.

By integrating multiple data layers to create county-level estimates of nutrient removal by crops, fertilizer applied, and manure nutrients, NuGIS offers a rather clear picture of nutrient balance for most of the contiguous 48 states, as well as temporal trends over the last 20 years. Geospatial techniques are used to migrate the county data to watersheds which allows NuGIS output to be compared to the output of other natural resource models.

"IPNI sees on-going assessment of nutrient balance and nutrient use efficiency in crop production as one of its responsibilities. That assessment is one of the two primary objectives of NuGIS. The other objective is to identify weaknesses in the process of doing that assessment," explains Dr. Paul Fixen, IPNI Senior Vice President and Director of Research. He has been the leader of the NuGIS effort.




"An extensive in-depth methods section is provided in the bulletin to offer complete transparency into how the balance estimates are made and displayed. Results are shown in a combination of color maps, tables, and graphs, summarized in a 60-page publication and available on CD. The CD also contains a PowerPoint file of figures and an Excel workbook containing all balance component data at a state level. Interpretation of the results is rather limited.

*A Preliminary Nutrient Use Geographic Information System (NuGIS) for the U.S.*, the 60-page, 8 ½ x 11 in. booklet, is available for purchase at USD 25.00 per copy, plus shipping/handling. An order form with more information plus a PDF of the complete publication are available for download at the IPNI website: >www.ipni.net/nugis<. Visitors to the website may also access the interactive on-line tool. Comments, suggestions, or questions may be sent by e-mail to: >nugis@ipni.net<.