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SITE-SPECIFIC TECHNOLOGY CAN HELP BUILD PROFITS--IF WE ARE WILLING TO ADAPT!

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Abstract

Site-specific management employs a variety of technology innovations with traditional agronomy to created opportunities for more intensive management and better-informed decisions. Developing geo-referenced databases for individual fields, using detailed sampling procedures and GPS satellite positioning, is a key component of a modern crop production system. These new technologies can potentially increase yields and profits for those producers who are willing to adapt their operations…and attitudes…to incorporate them into their management system, and are willing and able to make the changes that are indicated from the information collected and interpreted from these technology tools.

Goals of Site-Specific Management

The goals of site-specific management may be summarized in three stages:

1. Identify the variability within fields. Yield monitor maps, digital soil surveys, electrical conductivity measurements, and soil nutrient sampling are examples of geo-referenced data collected for determining the variability within a field.
2. Learn the basis of the variability. Once differences are noted, the next step is to attempt to understand why that variation exists, and what causes may be potentially identified.
3. Learn to manage the variability. We may not be able to eliminate variability, but identifying it and understanding its causes can help us to better understand how to deal with it, and how to change management to optimize production within the limits of resources available.

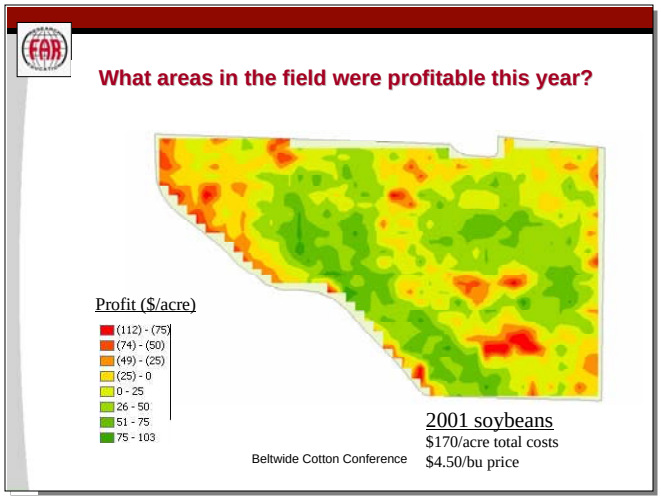
The ultimate goal of site-specific management is to make better-informed management decisions that support increased yields and profits, while maintaining or improving basic resources related to the operation…and protect both on-site and off-site natural resources.

Management Evolution

Crop and soil management have always been the center of crop production systems. During the1970s, pest management grew as a major component. In the 1980s, increased attention was given to better management of resources…soil conservation, water quality, energy, and other resources critical to sustainable production. Information management and the technology for collecting information became the new addition of the 1990s. As we start the 21st century, putting all of these pieces together in *systems management* is the new theme. It encompasses all of the above components of management, but pays special attention to the interactions of all natural and purchased inputs and looks at taking advantage of all of those interactions to improve production and profits and protect resources for the future. Add to that the decisions on marketing, crop mix, and a host of other decisions and you begin to see the complexity facing today's crop producer.

But the availability of detailed, geo-referenced data, collected over a number of growing seasons offers the producer and his advisers a new arsenal of tools to manage this complex system. Computer and communication technology adds the ability to share information…and decisions…with other members of the management team associated with a farming operation. The landowner 10 states away can have as much access to information as the tractor driver in the field. The fertilizer dealer, crop consultant, and various input suppliers all can have access to parts of the information database that pertains to the decisions that they help make for the operation. Action can be taken more quickly and with more confidence that the right decision has been made.

If fields have been carefully managed close to the recommended soil test levels on a field-average basis, switching to site-specific management will always lead to an increase in nutrient needs to bring up the areas of the field that currently test below average. The differential represents the lost yield and profit potential of field-average management…and the potential increase in yield and profit to be gained by shifting to site-specific management. In one Indiana field, average potassium (K) soil test was 170 ppm…high enough that the tri-state soil test recommendation suggested that no potash fertilizer would be needed to optimize yields. But sampling the field by management zones showed that soil K tests ranged from 111 to 279 ppm, with about half of the 140-acre field testing below the level at which full yield potential could be expected. Correcting the deficiency required 10 tons of potash, and resulted in an average yield increase of 35 bu/A of corn. Similar results can be cited for other fields throughout the country where site-specific management is used. Of course, site-specific management can also identify areas of the field that are over-fertilized in field-average management. In these cases, savings on input costs may be realized through site-specific management.



More intensive management and the technology tools associated with it can also be used to map profitability of different parts of a field. This map shows variability in profit for a Minnesota soybean field. A large area to the left side of the field was found to never be profitable and was put into a conservation reserve program. The result was fewer acres to manage and more total profit for the field.

Technology Tools

Yield Monitors.
Yield monitors have been the key to implementation of more intensive management for many growers. The availability in recent years of reliable cotton yield monitors has stimulated more interest in site-specific systems in the Cotton Belt. That then paves the way for using the technology for other crops. Yield monitors must be kept calibrated to function properly, and the yield data collected must be carefully managed to be useful. Various procedures to "clean" the data file are important steps to take before using the data for making decisions. It is also important to collect several years of data before making major changes in the management plan. Future technology may make it possible to develop maps of important crop quality components in addition to yield.

EC Measurement.
Another popular technology tool is the Veris system for measuring electrical conductivity (EC). One of its big advantages is that it produces a relatively dense data set, not quite as dense as yield data, but more points than can be reasonably obtained with traditional soil sampling. EC is affected by a number of factors, including salt content, soil moisture, organic matter, pH, and soil texture. So it is most useful in mapping general variability, and may not be diagnostic for a specific soil characteristic.

Remote Sensing.
Remote sensing is another tool that helps map variability, but may not be specifically diagnostic. But it is useful in showing the location and extent of variability. Combined with "ground truth" measurements, remote sensing can be an important tool for monitoring extent of a problem and for tracking changes over time in crop condition and stresses.

Controllers.
A wide range of controller systems is available for varying application rates of production inputs…fertilizer, seed, pesticides, plant growth regulators, and defoliants. Each must be managed with an algorithm that relates the proper rate to measured variability within the field as determined by different measurements, maps, and real-time sensors. These controllers and the algorithms to guide them are the basis of site-specific management.

Identity-Preserved Production

Increased interest in identity-preserved production and markets for specific quality or genetic types of crops opens some additional opportunities for technology. Accountability for management inputs is becoming a more common requirement by consumers and processors. Often detailed information is required by contract if a producer is to participate in certain market opportunities. Growers who maintain detailed records and can provide the proper information will have access to these markets. Those who do not take the proper steps will be left out. For many it is becoming a part of doing business in the 21st century.

On-Farm Research

On-farm research is another part of site-specific production systems. Every field can now be a research site. Ability to variable-rate apply different inputs helps facilitate laying out experimental plots. Remote sensing helps monitor changes throughout the season. Yield monitors collect the response data. GIS software tools help map and analyze the results. Such research does not replace small-plot studies, but that can enhance the value of small-plot work by testing it on a larger scale, and on-farm research helps expedite getting improve practices implemented on more farms. An understanding of basic statistics for design and analysis is helpful, and there are some important limitations that must be considered. But knowledge can be advanced must more rapidly if more on-farm studies are put in place. They are a great learning tool and help bring a local focus to science and to management recommendations. Software tools are available to assist in conducting on-farm research and analyzing and interpreting the results. Some simple tools can be found on the website: www.farmresearch.com.

Farmers are generally independent by nature, but sharing information from their site-specific records and their on-farm research is an important way to speed progress in improving management systems. They can learn from one another's experience and avoid repeating mistakes. Many are more willing to share with "neighbors" whose farms are at least 50 miles apart. Farmers also gain by sharing their information with other members of the "support team" for the farm. Crop consultants, local Extension and NRCS staff, and input suppliers are all part of the team. It also helps to travel to other parts of the country and learn about the new approaches being used by producers of other crops. Many of those practices may be adaptable to their own situation.

InfoAg Conferences

The Foundation for Agronomic Research (FAR) and the Potash & Phosphate Institute (PPI) have since 1995 hosted a series of national/international InfoAg Conferences, which bring together producers, technology and service providers, researchers, and government, industry, and university specialists, to share their ideas and experiences. Over 4,000 people have participated in these conferences. The first regional InfoAg Conference will be held February 7-9, 2005, in Tunica, Mississippi, focusing on the needs of the Midsouth cotton, rice, and soybean producers. The next national/international InfoAg Conference will be July 19-21, 2005, in Springfield, Illinois. Information on these and past InfoAg Conferences is available on the website: www.infoag.org. Perhaps the greatest result of these conferences is the interpersonal "networking" that occurs during the conference and afterward. Such communication with other precision farming people has been a great force in advancing the implementation of the technology.

Does Site-Specific Management Pay?

Does site-specific, precision farming pay? That is the question of the day. The answer is *site-specific*. It depends on the natural variability in the fields you manage…the soils and other resources available. It depends on the detail and quality of your record system. It depends on your management ability and the support of the "management

team" for your operation. Most of all, it depends on your commitment to make the system work and your willingness and ability to make the necessary changes to make it work. U.S. farmers will continue to succeed if they can adopt more intensive management and utilize the best technologies available. Producers in other parts of the world can succeed by expanding their operations and taking advantage of cheap land and labor. That is not an option for U.S. farmers. Land and labor are too expensive. But they can compete best by making better-informed decisions to improve yields and profits.

Site-specific technology can help build profits…*if we are willing to adapt.*