New Technologies to Start the 21st Century

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The 21st century farmer has a much different toolbox to work from. In addition to pliers, vice-grips and a crescent wrench, the new toolbox includes computers, satellites and cell phones. The farm office is likely to be the cab of a combine, tractor or pickup truck---all three depending on the time of year.

In 1994, the Ag Tech 2000 exhibit at the Wisconsin Farm Progress Days brought together for the first time a diverse group of technology providers, with the idea of showing how these components of site-specific management could be organized into a system for practical implementation on the farm.

A sketch developed to describe this concept the night before that show has been used around the world to illustrate site-specific systems **(Fig.1).**

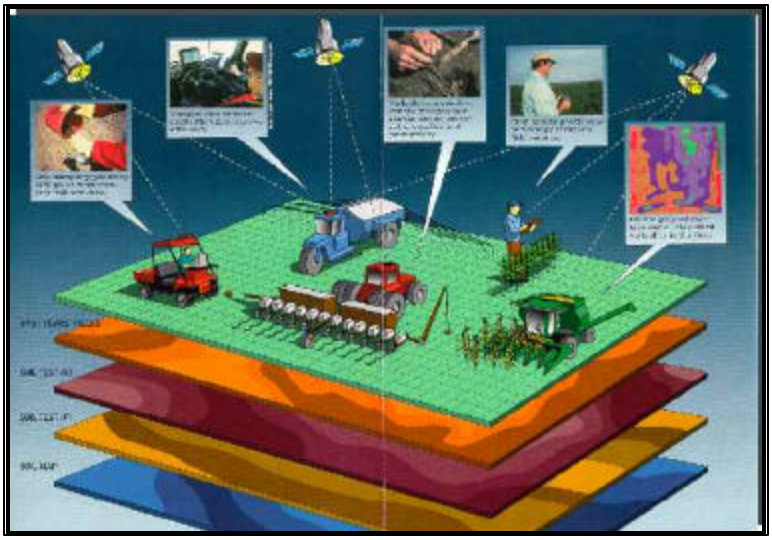

Fig. 1. Diagram of Site-Specific Management Systems

The Farm Progress Show at Bloomington, Illinois later in 1994, again brought these exhibitors together with an expanded Ag Tech 2000 exhibit, and it has been a feature of the Farm Progress Show each year since then. These exhibits led to the development of a demonstration field day at the USDA Research Center at Beltsville, MD, which brought together government agencies and related non-government organizations in the Washington, DC, area. The cooperators on these field demonstrations and exhibits asked the Potash & Phosphate Institute to help organize a conference where the concepts and technologies of site-specific management systems could be discussed. The **Information Agriculture Conference (InfoAg)** series was the result. In 2001, the 5th in the InfoAg series was held in Indianapolis, IN. The 6th,

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InfoAg 2003, is planned for July 30-August 1, 2003, in Indianapolis. Details about the previous InfoAg Conferences and plans for the next one are posted on the website: **www.ppi-far.org/infoag** .

The InfoAg series has been designed to provide a forum for sharing the practical applications of site-specific precision agriculture and Internet communications in crop and soil management. A parallel series, the **International Conference on Precision Agriculture**, have been sponsored semi-annually by the University of Minnesota Precision Agriculture Center has focuses on the research components of precision agriculture systems. The 6th in that series is planned for July 14-17, 2002, in Minneapolis. See **http://precision.agri.umn.edu/** for details.

So where are we as we enter the 21st century? The economic status of agriculture in recent years has slowed the progress in development and adoption of site-specific systems, but this has also helped research catch up. Agricultural universities now have significant site-specific systems research and education programs in place. Many of the technology applications featured in the first exhibits 8 years ago are now is use on the farm. Within a few years, it will be difficult to identify "site-specific" practices, as they will have been integrated into conventional management. Farmers will not use all of the technologies, but most will be using some of the components.

Real benefits already realized include a better understanding of the yield variability within fields, and resulting identification of causes of this variability. Once identified and documented, the next step is to learn to manage that variability with site-specific systems. This doesn't always mean computers and satellites. The real revolution in site-specific systems is in the application of agronomic knowledge on management zones within fields.

Phosphorus variability on a 640-acre Illinois farm was mapped on the basis of 1 million soil tests (**Fig. 2**).

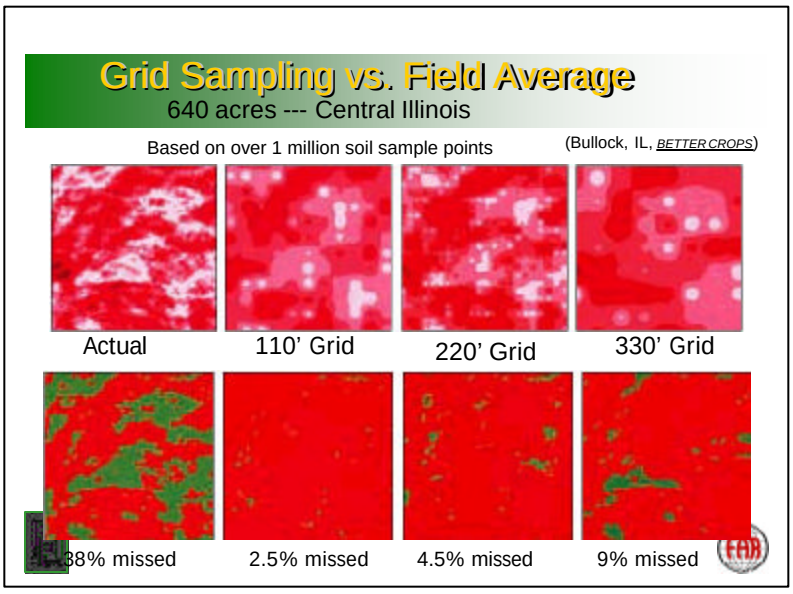

Fig. 2. Comparison of four soil sampling patterns.

Whether based on a uniform grid or on zones defined by knowledge of sources of variability, zone management allows agronomic principles to be implemented on a more targeted basis.

Sub-sampling this database on ½-acre, 1-acre, and 2 ½-acre grids showed the relative amount of P fertilizer requirement that was detected with each sampling plan. Even the course grid missed only 9% of the fertilizer requirement, compared with 38% missed with a field-average nutrient management plan. Thus managing on the basis of a 2 ½-acre grid identified 29% of the field needing P. That represents missed market opportunity for the dealer, and missed yield and profit opportunity for the farmer when field-average management is used.

If more is known about a field, there may be advantages of defining management zones based on other information. **Figure 3**. shows the potassium (K) fertilizer need identified by using zone management instead of field-average. No potassium was recommended on this central Indiana field based on field-average soil tests, but when zone management was used, a need for over 10 tons of potash was identified on this field.

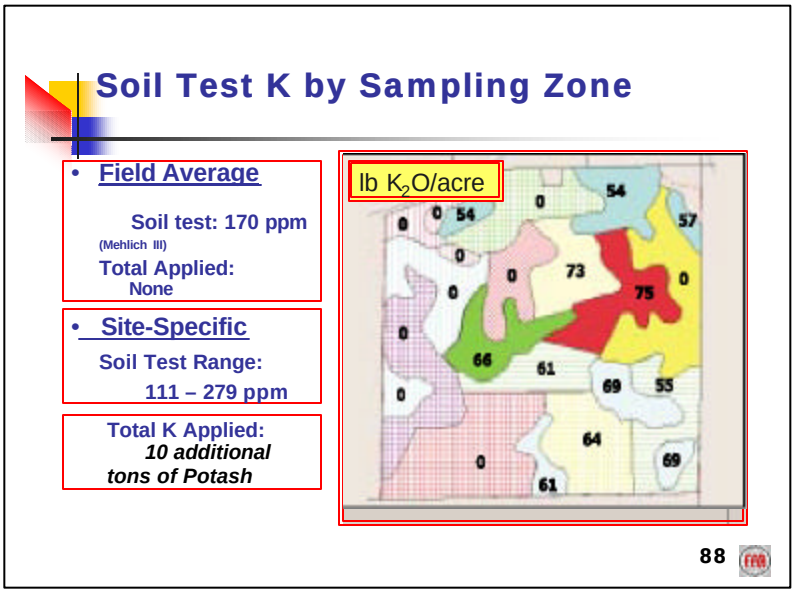

Fig. 3. Zone sampling improved K recommendations.

The tools of site-specific management, including zone or grid sampling, yield monitor data, geographic information system (GIS) software, variable-rate nutrient applicators, and global positioning satellite (GPS) systems for precise location identification, all become part of the 21st century farmer's toolbox. They allow farmers and their advisers to obtain and use information in their decision-making that was impossible to have just a few years ago. Those who take advantage of these tools have an edge on their competitors, both locally and worldwide, in working toward more efficient and profitable management systems. Of course the farmer has to take the initiative to use the tools and must be willing and able to act upon the information to implement changes that will take advantage of the information and tools. The decisions are still

only as good as the agronomic information available, but the technology tools may help with the implementation process.

Communication is a natural need that comes along with more information. Much of the value of more information is in the ability to share it with others who need to be involved in decisions. As wireless broadband communication systems are becoming available in rural areas, the ability to share information, including maps, databases, photos, and even video clips opens new possibilities for keeping landowners, suppliers, service providers and other cooperator informed and involved in key decisions. Here again, farmers who use these tools, and who are willing and able to act upon the information, can have a significant competitive advantage.

Communication on the farm is also important. Most computer-based record systems now have portable interfaces that synchronize with Palm or PocketPC computers, so that the farmer, fields scouts and service providers can electronically collect notes and measurements, collect data from sensor systems, and even link to the Internet directly from the field. Quick linkage to information services, diagnostic centers, and other services can provide more information resources to the decision process. By avoiding re-entry of data, time consuming steps are eliminated and errors are greatly reduced.

New sensors systems for monitoring and guiding equipment and even making automatic adjustments are relatively new additions to the toolbox. Sensors to measure weather parameters, monitor machinery performance, separate grain on the basis of protein content, count plant population and adjust planting depth based on soil moisture are among the tools available or on the horizon. GPS-based guidance systems that maintain accurate traffic patterns and line up planting with fall fertilizer strips are gaining in popularity. The step to driverless field equipment may be some time away, but some promising units are already being used in research plots and on a few farms.

With sensors and guidance systems handling the details, the farmer is free to handle other tasks such as communication and data management while doing field work. Here again, wireless broadband communication for rural areas may soon make such ideas a reality for many farmers.

The 21st century farmer who can make use of the new technologies to gain an advantage over other farmers will help insure his operation will be competitive for the long run, by being more efficient, productive and profitable in the short run. For more information on these technologies and how they are being evaluated and used, please refer to the following websites:

Potash & Phosphate Institute: **www.ppi-ppic.org**
Foundation for Agronomic Research: **www.ppi-far.org**
Site-Specific Systems Research: **www.farmresearch.com**
InfoAg Conferences: **www.ppi-far.org/infoag**