Site-Specific Crop Management

This project has advanced site-specific crop management by fostering collaborative research between institutions, strengthening interaction with industry, and extending up-to-date information and technology to policymakers, farmers, crop advisors, educators, and environmentalists.

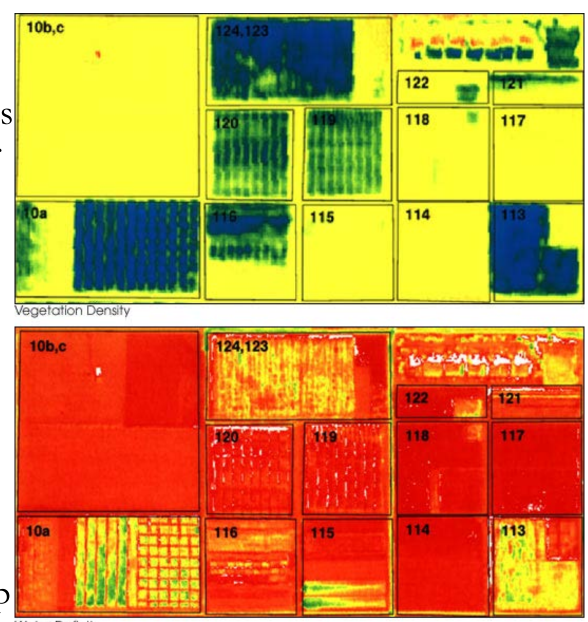
Who cares and why?

Precision farming improves farmers' profits and harvest yields while reducing negative environmental impacts. Using sensors and GPS to fine-tune fertilizer applications instead of applying it all at once helps farmers prevent the build up of excess nutrients, which can pollute groundwater and adjacent streams. Photo courtesy of USDA-NRCS.

Site-specific crop management, commonly known as precision agriculture, holds significant potential for agriculture. Precision agriculture uses innovative technologies and principles to identify and manage spatial and temporal variability in crop production. By focusing on variability in a specific site, such as a single field, precision agriculture promotes efficient use of fertilizers, pesticides, and other inputs. Efficient agricultural production systems increase farmers' profitability and decrease the environmental impact of their operations. Therefore, continued advancement of precision agriculture fosters strong, healthy farming communities. Developing new techniques and technologies requires interdisciplinary efforts. Engineers design and construct the technology for measuring and delivering of site-specific activities. Natural scientists conduct field research to evaluate the efficacy of these developments and economists determine the financial impact. Industry representatives also play a critical role by developing and marketing developments. NCERA-180 provides a committee that seamlessly integrates these different groups into a single, cohesive unit.

What has the project done so far?

NCERA-180 has brought together public and private sector research scientists and engineers to develop and test technologies and techniques for improving site-specific crop management for several major U.S. and international commodity crops, including corn, soybeans, sugar beets, cotton, citrus, tomatoes, rice, oil palm, and cabbage. NCERA-180 scientists have developed software, Management Zone Analyst (MZA), that uses quantitative, georeferenced field information to mathematically divide a field into natural clusters, or zones, and also helps determine the optimum number of management zones for each field. Project researchers have also tested several new sensors, including an on-the-go soil pH sensor, on-the-go soil nutrient sensors, crop remote sensing sensors, a soil compaction sensor, crop chemical flow control sensors, and GPS sensors. The group



These colorized aerial images were acquired by the Daedalus sensor aboard a NASA aircraft. The top image shows crop density, where dark blues and greens indicate lush vegetation and reds indicate areas of bare soil. The bottom image shows water deficit (based on reflectance and temperature measurements), where greens and blues indicate wet soil and reds indicate dry soil. Image courtesy of NASA Earth Observatory.

has developed numerous well-attended national, regional, and international conferences on an array of precision agriculture topics. Members have also presented exhibits and demonstrations at Farm Progress Shows and for congressional staff and agency personnel. The group's outreach strategies have been successful, with surveys of crop retailers showing that site-specific crop management tools and principles have been widely adopted.

Impact Statements

Tested several new sensors that have since been commercialized, stimulating the economy and providing farmers with better tools for more efficient management of inputs (e.g., fertilizers) and fine-tuned disease detection, mapping, and control.

Conducted evaluations of field equipment innovations that will save farmers as much as 15% in input costs in irregularly-shaped fields.

Brought together industry personnel and scientists to standardize the hardware (e.g., cables, plugs), software, and data types used in precision agriculture equipment, making these tools and techniques easier to use on their own or in concert.

Fostered opportunities for sharing resources and knowledge, helping field practitioners use precision farming technology, GIS, data management, and Internet applications.

Increased the acreage of crops under site-specific management to over 3 million acres in NCERA-180 states in the 2007-08 season. Enhanced crop management has led to improved efficiency, productivity, and environmental impacts of several major commodity crops. For instance, many corn growers in the Upper Midwest use precision technologies to save on fertilizer, fuel, and/or time. In Nebraska, farmers who use these technologies to determine nitrogen applications have reduced amount used by 45%. In the Southern U.S., 30% of cotton growers use these technologies to guide plant growth regulator applications, reducing amount applied by 58%.

Developed software that helps farmers and consultants quickly process map information (such as elevation and soil electrical conductivity) and make more informed decisions about management zones and nutrient applications.

The Yara N-Sensor ALS mounted on this tractor's canopy records light reflection of crops, calculates fertilization recommendations, and then varies the amount of fertilizer spread. Photo by bdk, Wikimedia Commons/CC-BY-SA-3.0.

What research is needed?

Scientists need to continue to evaluate how soil variation relate to plant nutrient needs. To do this, scientists need improved tools for analyzing and interpreting precision farming data and relating it to data about soil, weather, and other factors influencing crop systems. In addition, various remote sensing platforms need to be calibrated in order to determine plant nutrient status.

Want to know more?

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Edited and designed by Sara Delheimer