

A New Tool for Precision Agriculture

It's site-specific

By Joanne Littlefield

New tools can help bring in a more cost-effective crop. Whether it's applying fertilizer, ordering irrigation water or assessing crop yield, Arizona's agricultural producers continually adopt—and adapt—new technology to fine-tune their operations.

Pete Waller, an assistant professor in the Department of Agricultural and Biosystems Engineering, in the College of Agriculture and Life Sciences, is part of a team that tests and develops equipment to make farming more precise. He is collaborating with researchers from other departments at the UA and with Ed Barnes and Tom Clarke from the USDA-ARS Water Conservation Laboratory. They have been working on a remote sensing project at the UA's Maricopa Agricultural Center (MAC) in Pinal County for three years.

"In 1999, a remote sensing system was used to develop daily reflectance maps of a cotton field with one square meter resolution," Waller says. "This remote sensing system, called the Agricultural Irrigation Information System (AGIIS), consists of a track mounted on a linear move irrigation system. A cart with a remote sensing package and GPS unit travels back and forth on the track. Based on cart data, images with one square meter resolution are constructed in a geographic information system. Waller believes the AGIIS system is a valuable research tool; researchers in other states have already expressed interest in it.

"Use of this tool may prove to be cost-prohibitive for production agriculture," he says. "It really depends on whether the value of the information exceeds the cost of installation and operation."

There is a patent pending on the AGIIS system's design. The design and construction team included Chris Choi, associate professor, three graduate students from the Department of Agricultural and Biosystems Engineering: Julio Haberland, Mike Kostrzewski, and Paul Colaizzi; and UA shop mechanics Charles Defer and Jack Keating. The design and construction phase of the project was funded by the Department of Energy.

Tom Clarke at the USDA Water Conservation Laboratory in Phoenix used data from the AGIIS system to develop

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The Agricultural Irrigation Information System (AGIIS) moves across the track mounted on top of a linear move irrigation system.

the Canopy Chlorophyll Concentration Index, an algorithm that determines nitrogen stress in cotton, but is not influenced by water stress, according to Waller.

"The CCCI algorithm may be a valuable research and management tool for future remote sensing systems: ground-based, airborne, or satellite," he says.

"Precision agriculture requires a sensor system, decision algorithm and delivery system for application of spatially varying amounts of water, nutrients and pesticides," Waller says. "The goal is to obtain the highest economic profit and least environmental damage by getting the right amount of water and nutrients to the plants at the right time. It's sometimes called 'site-specific' agriculture."

Even fields in the same geographic location can have varying water and nutrient requirements throughout the field, and pest infestations may only occur only in sections of the fields, Waller adds. "The optimal rates of application

of water, fertilizers and pesticides may vary throughout the field for maximum economic return. A yield calculation algorithm based on remotely sensed crop growth, maturity, or quality indices may allow growers to determine the optimal timing and rate of application to each section of the field. The goal is to minimize crop stress in each section of the field with the minimum inputs. In a commercial system, all of these components are necessary."

For the winter 2000-2001 growing season, the research team is developing water and nitrogen stress indices as well as plant quality indices for broccoli. They are also evaluating the system for use at various times of day with different solar angles, and at night.

According to Waller, the AGIIS system, combined with a linear move or pivot irrigation setup, has the potential to fulfill all of the requirements for a precision agriculture system. ❖