



NATIONAL AWARD *The GreenSeeker™ team received the prestigious Secretary's Honor Award for 2002 from the US Department of Agriculture for expanding economic and trade opportunities for US agricultural producers.*

▲ Aerial view of GreenSeeker™ with 30' booms extended.

Sci-Fi on the Farm

A team of OSU researchers in collaboration with a commercial firm has developed a revolutionary product that seems more like something from science fiction than traditional agriculture. GreenSeeker™ is an integrated optical sensor and fertilizer sprayer that senses the nutrient needs of each 2-foot by 2-foot area of a field and automatically applies exactly the right amount of nitrogen as it moves across the field, all in one seamless operation. The sensors and nozzles are mounted on booms and can be configured to accommodate various sizes and types of sprayer vehicles. A handheld version is now available.

The advantages of such a product are both numerous and substantial: It increases yields and reduces fertilizer costs because the optimal amount—and only the optimal amount—is applied, resulting in an average additional profit of \$18 per acre. Because there is little wasted fertilizer, runoff is significantly reduced, and the result is cleaner surface and groundwater. It can operate in a wide range of light conditions—from bright sunlight to complete darkness. It operates in real time, with no waiting for results of a soil sample or data from a satellite or airplane.

The optical sensor measures the green material (stems and leaves, called “forage biomass”) of the plants in the 2' x 2' segment of the field, compares that to an index, computes the amount of nitrogen required for optimal growth, chooses from one of eight application rates, and sends a signal to the applicator. The nozzle immediately sprays the designated amount of nitrogen.

Nitrogen needs can vary widely throughout a field, so using the historical practice of applying an average amount of fertilizer per acre is wasteful and does not produce maximum yields. At present, nitrogen use efficiency (NUE) in cereal (wheat, corn, maize, rice, etc.) production is about

33 percent. The remainder of the applied nitrogen is lost to air and runoff.

Each one percent increase in NUE is worth \$400 million globally. GreenSeeker™ can increase NUE a minimum of 20 percent, although there is evidence to suggest a more substantial increase. The implications of this are staggering when one considers the ramifications of inadequate food worldwide. Each day, 33,000 people die from starvation or the effects of malnutrition. Bill Raun, a member of the

Team Building

Progressing from a concept to a commercial product (GreenSeeker™) was not easy. Melding into a team a group of professors who by nature are very independent and who have different perspectives took time. Add to these inherent differences the various personalities: John Solie, the contemplative engineer/attorney familiar with intellectual property issues; Marvin Stone, the practical, internationally-recognized electronic communications engineer; Bill Raun, the intense, passion-

ate soil fertility expert with a world view stemming from his six years experience in Mexico and Guatemala; Gordon Johnson, the deliberate, layperson-oriented extension specialist; and Greg Bell, the turf specialist with a business perspective (a former owner of a golf-club manufacturing and repair firm), who joined the team about mid-point.

The team members candidly admit there were periodic intense arguments arising from different assumptions and from a commitment “not to take anything at face value,

GreenSeeker™ development team, says, “Having to squeeze by 33,000 skeletons every day when you come to work can keep you motivated.”

In 2001 OSU and NTech Industries Incorporated, of Ukiah, California, signed a license agreement as well as an agreement for continuing research. Norman Borlaug, the only Nobel Peace Prize recipient in agriculture and “Father of the Green Revolution,” delivered the keynote address at the licensing ceremony.

Sensors detect the fertilizer needs of small areas of a field and automatically apply the required amount, resulting in increased profits and decreased environmental contamination.

Research leading to GreenSeeker™ began at OSU nine years before it was licensed to NTech. John M. Mayfield, Jr., NTech’s CEO, owned an agricultural services firm in California and was aware that OSU researchers were working on technology similar to his firm’s herbicide sensor/sprayer marketed as Weed Seeker™. He realized that a cooperative venture would be in the best interests of both.

Beginning in 1999, OSU researchers and Patchen personnel collaborated on integration of technologies. John Solie, the biosystems and agricultural engineering professor responsible for overall coordination of the project says, “They brought certain patents they developed for lighting technologies and the knowledge and experience to manufacture and market sensors. We brought the science to make the determination of how much fertilizer and other materials to apply as well as improvements in sensor and

electronic communications technology.” NTech is manufacturing the sensor/sprayer at its facility in Stillwater and expects to establish a larger plant elsewhere in the state as volume grows.

The algorithm (step-by-step instructions to the computer) for wheat is complete. Development is underway for algorithms for corn, barley, and turf, to be followed by cotton, peanuts, and soybeans.

The GreenSeeker™ project has brought many benefits to OSU. D.C. Coston, associate director of the Oklahoma Agricultural Experiment Station, says it has engendered funding for continued research and development for the other crops and will bring royalties to the University.

The project incorporates all aspects of the land-grant university mission: teaching, research, and extension. In addition to research and technology transfer, it resulted in the development of a course in precision agriculture, taught by members of the GreenSeeker™ team. It also broadened the understanding of 33 students who studied at the International Maize and Wheat Improvement Center in Mexico and who spoke with awe of the opportunity to associate with Borlaug.

It has provided a learning experience for over 100 students, 40 of them graduate students. It has led directly to employment for some, as NTech hired some of the students who worked on the project. Coston says the students’ team experience is a definite advantage when they apply for jobs.

Shari Dunn

but to question,” to which Raun attributes the successes of the project. He says that in academia, it’s easy to avoid conflict by working in a solitary situation. “But I’m willing to deal with a lack of harmony because I am interested in delivering a better product. Forced communication leads to improvements.”

Despite technical differences, the team members always had immense respect for each other personally and professionally. Johnson says, “The team members respect each others’ discipline; the ag engineer doesn’t try to make a soil scientist into an engineer, and vice versa.

There is a synergy in the group.” Stone says a clear sense of mission guided the interaction and there were no issues of department or territory. Raun says the team members merged into a unit that became much like a family and that this extended to the graduate and undergraduate students and the support staff involved with the project.

D. C. Coston, associate director of the Oklahoma Agricultural Experiment Station, has been a champion of the cross-disciplinary approach to research throughout his tenure at OSU. When the GreenSeeker™ team won the USDA award, the team



▲ GreenSeeker™ team members, from left, Greg Bell, Gordon Johnson, John Solie, Marvin Stone, and Bill Raun.

members thought John Solie, the unofficial team leader, should be the one to travel to Washington, DC, to accept the award. Coston had other ideas. He was determined that all members of the team should be present to accept

the award. He found funding so all could attend, then presented the plaque to the team at a special ceremony hosted by the Division of Agricultural Sciences and Natural Resources.