SAVE TIME AND MONEY • REMOTELY ASSESS SITUATIONS • REDUCE "COURIER" DUTIES • TARGET PESTS

Precision Ag Guide

November 2007

The University of Georgia
National Environmentally Sound
Production Agriculture Laboratory

CONTENTS

PA 3 Practicing What I Preach...
Internet technologies help us keep track of stuff from animals to motors to gates – without having to go to it.

PA 6 Precision Ag – The Next Generation
Technology engineered to work on the farm and be user-friendly is a change that has taken place over time.

PA 8 On-Farm Networks Blazing In Mississippi
Two Mississippi farmers use on-farm networks to improve efficiency and reduce costs.

PA 10 Development Of Biological Sensors
A device using parasitic wasps can currently detect aflatoxin in corn.

PA 12 Site-Specific Management For Root Knot Nematode in Cotton
Create field maps of soil electrical conductivity quickly and easily and use the maps to target nematicide applications.

PA 14 What's Up With WAAS?
Changes in WAAS may affect GPS users. What can you do?

PA 15 Securing Your Farm Network
Keep your on-farm network safe from viruses and hackers with these simple steps.

Practicing What I Preach...

By Craig Kvien, Chair of the Nationally Sound Production Agriculture Laboratory

During a recent move to a small farm in Maryland, I am now presented with the opportunity to practice what I have preached in my professional life as an academic at the University of Georgia. My wife and I are investing in several "new" technologies on our farm. We believe the future of production agriculture is getting brighter. It is exciting and a bit of a gamble, but well worth it.

A few years ago we visited friends in the Midwest and learned more about their ethanol plant investment. Last year we got involved and invested with a nearby group hoping to start an ethanol plant, which today is nearing completion. Given the price of oil and world oil demand, I believe it was a good decision. Time will tell.

Part of our "good feeling" comes from being involved with and invested in the processing end of agriculture. When I look at the price of the raw product and the price of the end product, it sure seems that production agriculture could benefit from some of the upstream revenue.

Keeping Track Of Wandering Animals And Kids

The second thing we are investing in are Internet technologies to help us keep track of stuff - from animals to motors, gates and just being able to see what is happening in the barn without going out to it. We have some wayward animals that are intent on testing how far they can wander. After several two hour search and rescue missions we have decided to put a GPS location device on them. Hopefully our missions will be reduced to less than 30 minutes. Stay tuned.

Like most, we plan our day only to see that plan periodically diverted into chaos and always at the worst possible moment. I am hoping the Internet sensors, cameras and other wireless devices we are spreading over the place will save us time and let us avoid potential disasters before they occur.

Several friends are already ahead of us in this area. One vegetable

Research supported by the State of Georgia, the Georgia Research Alliance, State and Federal Experiment Station appropriations, the Georgia Peanut Commission, the American Peanut Council and the Peanut Foundation, the National Peanut Board through the Southeastern Peanut Research Initiative, the Georgia Cotton Commission, the Cotton Foundation and Cotton Incorporated, Georgia Agricultural Innovation Center, Georgia Department of Economic Development, One Georgia, Flint River Soil & Water Commission, USDA-NRCS , The Nature Conservatory, USDA-ARS, USDA-CSREES, United States Environmental Protection Agency and the Georgia Department of Natural Resources.

growing friend put a simple Internet camera on his gas pumps and saw his gas supply last a fair bit longer. The camera was paid for in less than a month. The same grower has cameras in his packing shed, and those cameras have helped him monitor his help and know when trucks arrive and depart, again saving him time, money and quickly solving disagreements.

Check, Monitor And Solve

Another nearby grower, Joe Boddiford, has a couple of simple Internet cameras on his pivots that allow him to check on their status without driving to them. Joe wants to not only see his pivots moving and spraying, but he also wants to listen to the diesel motors that power them. Fortunately, many Internet cameras also have a built-in microphone.

One of the most exciting, easy to use and technology-rich tools that has recently been introduced is the iPhone. My amazing wife stood in line to get one of these lovely gadgets for my birthday.

If you have not had the opportunity to use one yet, please give them a look. It has become my alarm clock, calendar, calculator and note pad. It has helped me find the roads to distant places when the highway was shut down. When my daughter gave a speech on why the county needs a swimming pool, I grabbed a couple of photos of her on stage. It can play Tony Smith's, a grower cooperator, daughter's newest song, give me the weekly weather forecasts of six, or more, cities that are important to me and keep me informed of how our stock market investments in Deere, Apple and others are doing.

Yet, without doubt, the thing I like most about this phone is its ability to access the Web from anywhere. I can lock into our farm's wireless signal, the one at the local burger place or use the slower cell phone signal and easily read the screen as I pull up Web pages including images and noises from our farm's Internet cameras.

Technologically Challenged? Find A Teenager

I have great hopes for Internet technologies on the farm. I am anxious to get to a point where our sensors and cameras are all linked into a farm-wide system that automatically monitors many critical attributes of the farm operation, such as water and pest conditions, equipment operations and the status of markets, relaying to us the significant opportunities while filtering out the rest. So that when we are on a future search-and-rescue missions for a wayward animal, we can also check in on the children to make sure they are where they need to be and that the gate to the pasture with the broken fence is closed – all from the palm of my hand.

If you feel technology is beyond where you are at this point, find any teen or preteen, tell them what you need done and they will have it up and running for you in short order. I simply give it to one of our children and stand back in amazement.

A camera mounted under the eaves of the barn in a weatherproof dome (top) is used to check on the horses (left) or look out into the pasture (bottom). The camera's movement is controlled from the office computer or anywhere the Internet can be accessed and is secured with password protection. The Linksys switch (right) inside the barn connects to a switch in the office.

Oh, did I warn you that the iPhone also has great text messaging, YouTube and a whole fleet of other applications that can be loaded onto the iPhone by simply accessing the Web (or asking your children to do it while you fill the tank with homegrown E85)?

For more information, contact the author at ckvien@uga.edu.

Precision Ag – The Next Generation

By Keith Rucker

What changes we have seen in the past 15 years of the Precision Ag Revolution! The first time I used GPS in the field to collect data was around 1994: we hooked up a clumsy GPS receiver, with an accuracy level that would make a $75 hand-held receiver from Wal-Mart look like surveying equipment, to an even bigger and "clunkier" laptop running DOS software. A mile of cables were in the cab, all patched together with a hodge-podge of connectors from Radio Shack. Nothing was designed to run in a field environment, and while the rigging worked, we often spent twice as much time troubleshooting as we did in getting the job done.

Incredible progress has taken place. We now have a wide selection of electronics engineered from day one to work on the farm and that have very friendly user interfaces. To match this new generation of field electronics, we have greatly improved software products to handle data created in the field.

Good precision ag software was once too expensive and too difficult for most farmers to adopt. As a result, the majority of farmers depended on paid consultants or the area co-op to process data for them. What the farmer usually received as a result of the collected data was a book of pretty maps that often left him feeling overwhelmed with data and not sure what to do next.

An operator enters data into a PDA running field record-keeping software.

New Software Answers 'What Now?'

As with electronics, precision ag software has evolved into products that are useful to the average farmer. In addition to the traditional GIS (Geographical Information System) interface that displays maps and data, the latest generations of this software have incorporated farm record-keeping capabilities, giving him the tools he needs to finally know what to do next.

Two of the most popular and powerful precision ag software choices with record-keeping capabilities are Farm Trac/Farm Site combo from Farm Works (www.farmworks.com) and the EASi Suite package from MapShots (www.mapshots.com). Both of these products have taken the traditional GIS package and added farm record-keeping capabilities. The result is software that not only gives you those pretty maps but puts the power behind them to keep farm records and assist in decision-making.

Why do we need farm record-keeping software? Almost all growers are required to keep detailed records like never before, from accurate pesticide application records to developing and recording nutrient management plans, and from product traceability for Good Agriculture Practices (GAPs) to being able to generate reports for the Conservation Security Program (CSP). Keeping accurate records is a reality on today's farm.

Decision-Making Power

How does this electronic record keeping work? Relatively easily! Most farmers keep at least some kind of records, commonly in a notebook, where they jot down information such as when fields were planted, what and when products were applied to a field, and any other

information they think they might need later on.

Electronic record keeping does basically the same thing – you are just saving records to an electronic database with a farmer-friendly user-interface. By having the information in a database, farmers are finding that their data has incredible power that will help them make decisions like never before.

Records can be logged in many ways. At the simplest level, somebody can take the traditional notebook logs from the field and hand-enter the data into the computer in the office. While this method works and is probably the most common method of data collection, it does pose problems. Very often, the person writing the data down in the field may not provide all of the information needed for good electronic record keeping, leaving gaps in your database.

Logging records electronically in the field is more beneficial. Both Farm Works and MapShots offer options for software that can be loaded on a hand-held computer or even some of the new "Smart Phones" that can be used to log field operations as they happen. The advantage of keeping records electronically is that it reduces the chances for errors, and the computer will prompt you to get all of the information that you need.

Complete And Accurate Records

Periodically, you simply "sync" the data on the hand-held device with the computer in the office, and the records are entered into the database. Multiple hand-held devices can be used on large operations to collect the data in the field.

The ultimate way of collecting farm records is for the process to be automated by the equipment in the field. In the past few years, more manufacturers of field electronics created "smart" log files of what was happening in the field. In addition to logging the traditional GPS points (indicating where the tractor went in the field), this next generation of electronics is also collecting information such as what products are being applied, at what rate, who is making the application – all on top of where the applications are taking place.

With these kinds of log files, all that needs to be done to get the farm records into the database is simply read the logs into the farm record-keeping software. As long as the manufacturer of the hardware works with the software companies to make a compatible format, the data is read in the computer, and the information is stored with hardly the touch of a button. As wireless networks and network-enabled devices evolve, the syncing of data from the field to the farm office will ultimately become seamless.

Simplified Reporting

Records kept in a farm record-keeping software package have many advantages over traditional hand-written notebook. With good record keeping, analyzing your farm and making plans is as simple as hitting a few buttons on the computer.

For example, if you have a pesticide audit, print a simple report of all of your pesticide applications, what materials were used and at what rates. These reports can be created on a single field, multiple fields, or even the entire farming operation.

Any farmer who has ever applied for the Conservation Security Program knows how much data has to be put together. Some of the latest farm record-keeping software packages actually allow you to print a few specialized reports from your data, and assuming that you have done the job of keeping good records, presto, the bulk of your work is simply printed out to be handed in.

Plan Long Before Planting

These software packages even have planning modes that allow you to "farm" your entire operation on the computer before the first seed is ever planted. Many farmers are discovering that they can save a considerable amount of money if they can pre-order their planned crop protectants and fertilizers at the beginning of the season. With the planning tools in today's record-keeping software, you can enter your expected inputs for different cropping scenarios and get detailed lists of what products you expect to use for the upcoming season.

And finally, the software does an excellent job of tracking your operating expenses and determining profit and loss over a single field, a group of fields, by crop, or over your entire operation. Assuming you do your job in keeping good records, the uses of these kinds of software are nearly limitless.

With the technology changes occurring on the farm in the last 15 years, it is time that software is finally coming to maturity. If you are not using record-keeping software on your farm currently, now is the time to give it a serious look.

Keith S. Rucker is an Extension agent with the University of Georgia, Cooperative Extension Service. Keith can be contacted at ksrucker@uga.edu.

Then:

- Large, heavy, clumsy equipment patched together with miles of cable.
- Expensive software that was too difficult to be useful.
- Data maps that were colorful, but left you saying, "What do I do with this?"
- Hand-written notes, often incomplete and sometimes downright illegible.

Now:

- Electronics and software made for the farm and farmers.
- Complete and accurate notes made in the field by the operator or the equipment.
- Reports that can be used to plan and make decisions.
- Records for pesticide applications, CSP, etc., at the touch of a button.

On-Farm Networks Blazing In Mississippi

By Tasha Wells and Sonia Tighe

Once upon a time in Mississippi, Kenneth Hood would jump in his pickup, data card in hand, drive to the field and upload an application map on his sprayer, on standby to apply a growth regulator.

On this particular morning, he is already running late for an out-of-town meeting and is aware of the inefficiency of this operation – driving from the office to the field operator. He reaches the sprayer only to discover a problem with the application map or data card prevents the file from being loaded into the applicator's computer.

Conscious of his impending meeting, Hood realizes he must retrace his steps to the office, get another copy of the data and confirm its integrity. Time and fuel are being expended, but Hood is left with little choice – the cotton needs spraying! Thankfully, this is a story of days gone by for the Hood family at Perthshire Farms in Gunnison, Miss.

Recognizing the potential of technology for improving day-to-day operations, Hood partnered with Mississippi State University research scientists to install and evaluate a wireless on-farm network.

PHOTO BY ROBERT WELLS, DELTA COUNCIL

Kenneth Hood, Perthshire Farms

- Network covers large, non-contiguous acreage, two gins.
- Seamless communications and data transfer.
- Data collected once, but easily accessible when needed.
- Saves time, fuel and inputs; far fewer "courier" duties.

Wireless Network To The Rescue

James McKinion, MSU research engineer, says the purpose of the project was to develop a high-speed farm network that would provide the backbone for other tools and technologies to build on. And that's exactly what the Hoods have done.

"Inefficient data transfer and data movement was impeding the use of imagery for within field crop management and reducing the efficiency of other precision agriculture technologies," says McKinion. "Since the Hoods were integrating imagery into their cropping operation, data movement was an important issue to address."

To eliminate the bottleneck of data delivery, a network was designed and installed that would allow communication and data transfer between consultants and image providers (located off- farm), the office, tractors, harvesters, pickups and field scouts.

The challenge at Perthshire farms, says McKinion, was to design a network that could provide coverage over a large area of non-contiguous fields separated by tree lines.

Wiser Use of Time, Inputs

The network is centered around a tower-mounted radio at the farm manager's office. This radio uses 900MHz frequencies (no license required) to cover a broadcast area of more than 10 miles in radius. Distributed around the farm are repeater stations that rebroadcast the signal using less expensive, but shorter range, 2.4GHz frequencies (no license required) to radios mounted on farm equipment, pickup trucks and sprayers. The use of radios operating on two different frequencies allows for a less expensive and more reliable system. In a manner similar to cell phone operation, farm workers are able to move seamlessly around the farm, continually switching between repeater stations without losing a single byte of data. The network was installed in the summer of 2003 and has been operational since.

The Hoods are committed to precision agriculture and have seen tangible reductions in production costs through variable rate application of seed, nitrogen, insecticide and growth regulator. The on-farm network has helped to integrate and improve the efficiency of existing operations. The gains at Perthshire Farms, with more than 12,000 acres of non-contiguous crop land in cotton, milo and soybeans, are primarily savings of time and fuel, which add up quickly.

Seemless Data Transfer

McKinion says, "The high speed wireless networks have already shown economic benefits. Information is entered once into a PDA that is wirelessly connected to the network. This helps to minimize transcription errors.

"Application maps are transferred directly to the field equipment, saving time and labor of skilled technicians or consultants. Data can also move in the other direction, from the equipment or the field scout directly to the office or consultant who uses the information to generate an application map."

If problems occur, such as the wrong application map is sent to the wrong operator, this is identified and remedied immediately. Innovations that allow growers to use their time and expertise as managers, not couriers, are valuable.

While the system has been capable of providing bidirectional coverage to equipment (with the 2.4 GHz radios) within the coverage areas, progress has been limited by the proprietary nature of the controllers. The variable rate controllers still require PC Cards to be used for data transfer to and from the controller. If the controllers had a standard

network connection (like most computers), data could be uploaded and downloaded directly from the device by remote access from the farm office.

Hood has worked with InTime, Inc., and researchers such as McKinion, to accelerate the development of wireless data transfer in hopes of being able to bring this technology to producers sooner.

Integrating Other Information

Another application of the network at Perthshire Farms was to connect their two gin operations to the farm headquarters. The gins, which are in close proximity to each other and within six miles of the main office, have maintained their own databases containing client and ginning information. Since a customer's cotton could be sent to either gin, it was not uncommon for gin personnel to phone the other gin to respond to a customer's request for information regarding their cotton.

By integrating the two gins into the wireless farm network, gin operations are now networked to the farm headquarters. Database management software is used to create an automatic back-up database for events at both gins. Now, gin operators are able to access a client's data quickly and efficiently without unnecessary phone calls.

Assess Situations From Afar

James McKinion and his colleagues established another wireless network at Paul Good's farm near Macon, Miss., in Noxubee County in the fall of 2004. The network operates in the 2.4 GHz spectrum and consists of a base station located at the farm manager's office, which provides line-of-sight links to three repeater stations. The repeater stations are located at the northwest, northeast and southwest corners of the contiguous farm area, which is rectangular in shape and has gently rolling land features. The base station is mounted on an equipment barn, the highest structure, and uses an antenna that radiates signal equally in all directions.

Internet access was originally provided via a satellite link but has been replaced by a wide area network recently established by USDA-ARS Genetics and Precision Agriculture Research Unit. Cotton pickers and combines are equipped with 2.4 GHz radios to enable communication with the wireless network. Approximately 80 percent of the Good farm and all of the planted cotton acreage have coverage.

Paul Good, Macon, Miss.

- Network covers 80 percent of farm, all cotton acreage, catfish ponds.
- Cotton pickers and combines communicate with system.
- Remote monitoring and situation assessment.
- Ability to determine urgency of required response without traveling to site of problem.

Solar powered repeater forms part of the Good's wireless network.

In addition to the 2,000 acres of crop land, Good farms several catfish ponds. These are intensively monitored for temperature and oxygen concentration. An alarm is generated when these parameters fall outside an acceptable range, and Good is alerted by a paging system. One of the primary concerns is safeguarding against algal blooms, which can rapidly take over a pond and starve the fish of oxygen, leading to expensive losses.

Using the on-farm network, Good can now monitor the catfish ponds from any location. This allows him to assess alarms generated by the monitoring system and gauge the urgency of the required response.

Shared Systems And Solutions

In 2006 and 2007, a wide area network for delivery of precision ag technology was established in Noxubee County using the 900 MHz unlicensed spectrum. The USDA-ARS precision ag unit contracted with Teletec Communications, Columbus, Miss., to provide service from their 300-foot microwave tower located 10 miles east of Macon. Internet access to the tower was provided by a microwave link from their facilities in Columbus. At the tower, three access point radios provide service to Noxubee County with each radio covering 120 degrees of the service area, providing 2 Mbps uplink and downlink speeds.

Good's farm now receives service from this system. In addition, the farms of Dale Weaver and Phillip Good, the Jimmy Sanders Macon Facility and the Dee River Ranch, all research cooperators, receive Internet access via the system. All cooperators are within nine miles of the tower. The non-line-of-sight zone extends up to four miles from the tower, while the line-of-sight covers 40 miles, in theory.

The Future: High-Speed Broadband

Future applications of wireless technology are bright. Commercial cellular phone companies are expanding their networks to provide medium speed Internet access and, over time, will approach the speeds used for unlicensed technology.

Also, the Federal Communications Commission has announced their intentions to allow unlicensed usage of unused television bands from channels two through 51, except for channel 39 which is reserved for space communications. In many rural areas, only three to six channels are used. Each channel takes up 6 MHz of spectrum, and this spectrum is more suitable for high-speed wireless broadband communications because of its range and signal penetration. If the industry makes the equipment available and at a low cost, there will be a veritable explosion of high-speed broadband in rural America.

James McKinion contributed to this piece.

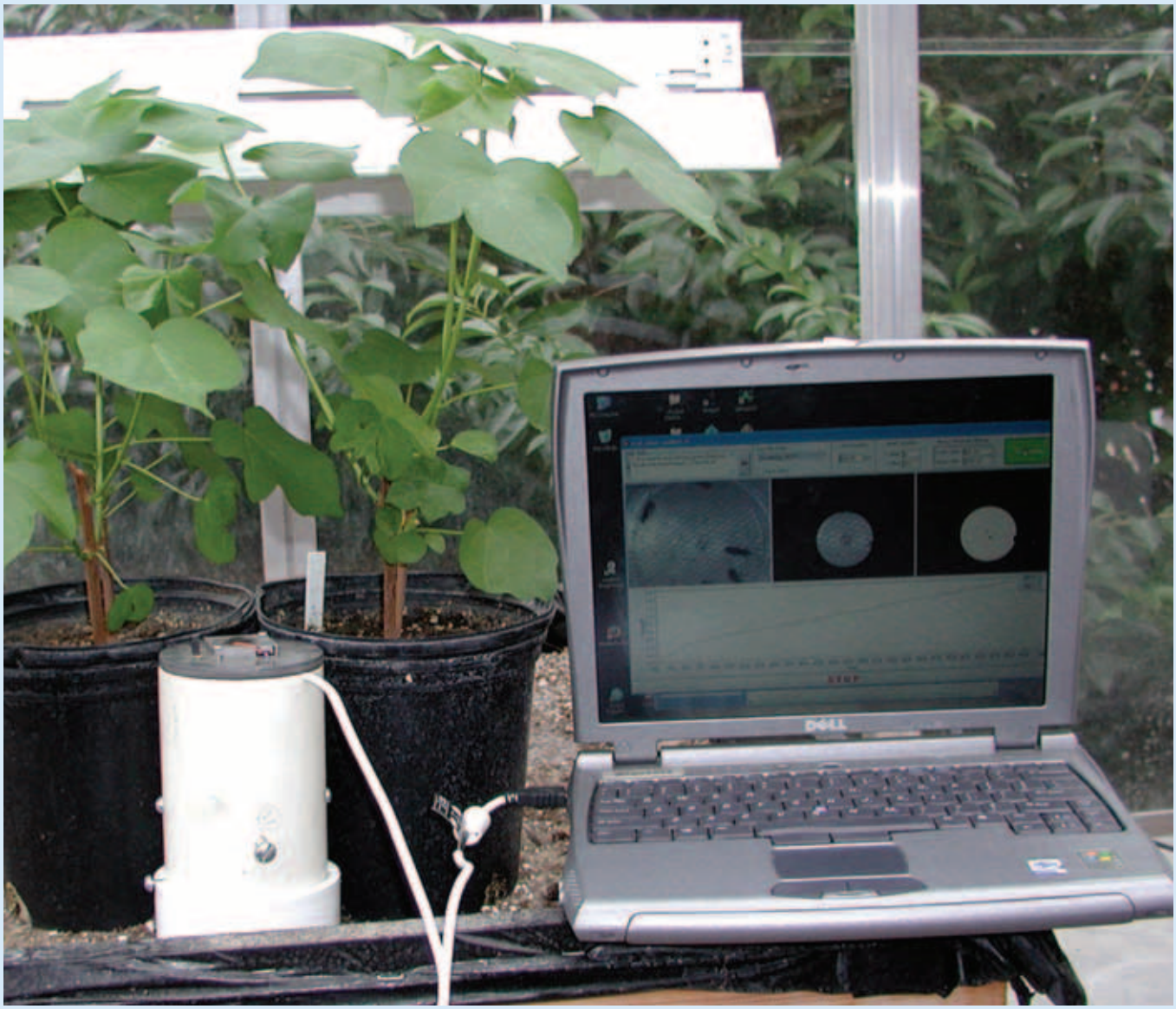
The Development Of Biological Sensors

By Glen Rains

Almost 20 years ago, scientists in Georgia and Florida discovered that some plants emit odors when attacked by insect pests, such as the cotton bollworm and tobacco budworm. It was initially thought that these odors were a defensive mechanism to repel these attacking pests. However, further research revealed these odors were actually SOS signals from the plant to attract beneficial insects.

Pests Attract Their Killers

Certain odors are created and released by plants that are under caterpillar attack. The caterpillar's spit contains chemicals that the plant recognizes, triggering the odor release. These odors attract beneficial insects that feed on or lay eggs in the pests. This discovery has led to considerable research examining the interactions of plants, pests and beneficial insects.



The Wasp Hound is connected to a laptop computer with live video of wasps shown on screen.

The beneficial insect that has received the most attention is the parasitic wasp. These wasps seek out hosts, usually moth eggs or caterpillars, using plant odors. Searching through a field of cotton, peanut, corn or soybeans, these wasps can zero-in on a target using plant odors. Some wasps can even distinguish between different pests using the plant odors.

These specialist wasps only lay eggs in one species of caterpillar, and the plant's response is unique to that caterpillar's feeding. The wasp eggs develop by feeding on their host, killing them within one to two weeks.

Parasitic wasps are also able to learn new odors as they forage through their environment, and they learn to link new odors to food. When the wasp detects an odor that was previously linked to food, it exhibits a clear and easy to recognize food-searching behavior. This ability to learn and respond to odors has lead to a research program to develop a biological chemical detector using the parasitic wasp as a sensor.

Uncle Sam Looks At Wasps

Initially, the Department of Defense (DOD) was interested in ways to utilize insects for detection of explosives and toxins. Current chemical detection techniques suffer from one or more deficiencies, such as lack of portability, low sensitivity, difficulty in finding odors in a mixture of other odors and slow response time.

The DOD funded work in Tifton, Ga., to explore the use of the parasitic wasp, *Microplitis croceipis*. This beneficial insect does not have a common name and has all but disappeared from crops because of its low tolerance of pesticides. But, it has served as a good "white mouse" for researchers to understand how parasitic wasps find hosts, food and mates.

Research has found that *M. croceipis* can be trained in as little as five minutes to recognize almost any type of odor at very low levels, from explosives and food toxins to dead bodies. The initial strategy to capitalize on this wasp was to train, release and follow to the target odor source. It is now evident that tracking individual insects is difficult, especially among plant canopies; and for DOD applications, wasps do not behave as expected inside buildings or other unnatural environments.

Sniffing Out Aflatoxin

Given these issues, it was decided to build a device that uses the ability of the wasp to detect chemicals while controlling the environment around them. A device called the Wasp Hound was developed to collect air samples over five trained wasps held inside a small cartridge within the device. The wasps move around randomly until the odor they were trained to recognize comes into the cartridge. The change in behavior is what indicates the target odor has been detected.

Initially, the device was developed to detect *Aspergillus flavus* (aflatoxin) in peanut and corn by training the wasps to detect chemical odors associated with the fungi that produce aflatoxin. Video images of the wasp response captured by a Web camera are relayed to a laptop computer and analyzed to determine when the wasps have detected aflatoxin. Currently, the Wasp Hound can detect these odors within a background of corn. Future research will examine ways to measure the quantity of aflatoxin detected.

The Wasp Hound currently takes about 20 to 30 seconds to make a determination of the presence of an odor, so its use as a sensor on-board a tractor as it travels over the field would be too slow to pinpoint the location of stressed plants. One option would be to create maps of pest pressure by sampling air around plants as the field is scouted.

Parasitic Wasps:

- Can be trained to recognize almost any type of odor in as little as five minutes.
- A change in behavior indicates the target odor has been detected.
- Can currently detect aflatoxin in corn.
- Are trained one at a time, but a new method of training several hundred at once is in testing.
- Detect odors too slowly to be used as an on-board tractor device.
- Could potentially be used to create maps of field pest pressure.

Smelling Other Problems

Several potential applications are being explored, such as detecting nematodes and aflatoxin without needing to inspect plant roots. We are currently investigating whether the plant leaves produce unique odors to nematode or aflatoxin attack. Other applications, such as detecting certain plant pathogens, stink bugs, spoiled produce and other forms of plant stress are also candidates for future use.

There are still issues that need to be resolved for the Wasp Hound to be a useful instrument for field use. Currently, wasps lose their sensitivity to an odor after they are exposed to it for two to three minutes. This can be solved by adapting the Wasp Hound so that the wasps receive a food reward, such as sugar water, when they provide a positive response to an odor.

Another issue is training multiple insects at once. We currently train one insect at a time which can be tedious. Preliminary tests of a new method show success at training several hundred at once. Finally, we are working to improve the reliability of detection through better interpretation of wasp movements.

For more information, contact the author at grains@uga.edu

Site-Specific Management For Root Knot Nematode in Cotton

By Brenda Ortiz, George Vellidis, Calvin Perry and Dana Sullivan

Across the U.S. Cotton Belt, the southern root knot nematode (RKN), microscopic pathogens, cause considerable yield loss. A University of Georgia survey carried out between 2002 and 2003 by Extension specialists Bob Kemerait and Cliff Brewer found RKN in all 67 cotton-producing counties in Georgia. Sixty-eight percent of the fields they surveyed were infested. Root knot nematodes damage the roots of cotton plants by forming knots. These knots interfere with the plant's ability to take up water and nutrients, resulting in stunted growth and ultimately reduced yield.

Target The Problem

Nematologists have known for some time that RKN prefer sandy soils and consequently aggregate in sandy patches of fields. In the Southeast, this has been shown by researchers in South Carolina, Georgia and Louisiana. Despite this knowledge, most growers collect soil samples for nematode analysis from a field in a random pattern or on an evenly spaced grid. Because of the patchy nature of RKN, these sampling techniques may miss areas that have high populations of RKN and may lead to inefficient application of expensive nematicides. If growers had the ability to identify areas within fields that are at high risk for RKN, sampling strategies could be more efficient and nematicides could be targeted to these high-risk areas. Site-specific management (SSM) offers this potential.

As part of a large project funded in part by Cotton Incorporated and the Georgia Cotton Commission, the Precision Farming Team at the University of Georgia has evaluated a number of techniques for delineating areas within fields at high risk for RKN. Because sampling for RKN is so expensive, the project has focused on identifying other field properties that can be more easily and less expensively measured than RKN, but also serve to identify high-risk areas.

Ways Of Finding The Pest

The fact that RKN prefer sandy areas has encouraged us and other research teams to find ways to rapidly measure soil texture – either directly or indirectly. One of the most promising techniques is to measure soil electrical conductivity. Soil electrical conductivity, or soil EC, is mostly a function of soil texture and soil moisture. Sandy soils produce low soil EC, while heavier soils result in higher values of soil EC.

Different instruments have been developed to measure soil electrical conductivity, but one of the most popular is the VERIS 3100. This instrument has six coulter-electrodes (disks) mounted on a toolbar. As it is pulled through the field by a tractor, one pair of disks transmits an electrical current into the soil while another pair of disks measures the drop in voltage. The separation between the disks determines the depth to which soil EC can be measured. In the most commonly used configuration, soil EC is measured simultaneously from zero to one feet (shallow) and zero to three feet (deep).

The VERIS 3100 instrument was used to create soil electrical conductivity maps. The instrument can be pulled behind a tractor or truck at speeds of up to 15 mph.

In addition to soil EC, we are evaluating other promising methods for indirectly measuring soil texture. These include:

1. Using real time kinematic (RTK) GPS to rapidly create detailed topographic maps of fields. Elevation and slope of the terrain frequently dictate where coarse textured soil particles are deposited by erosion.

2. Soil color is generally associated with differences in soil texture. Bare soil aerial photographs or images taken from satellites can be used to identify these features.

Over the past two years, we have measured these and many other parameters in 11 different cotton fields near Tifton, Ga. We

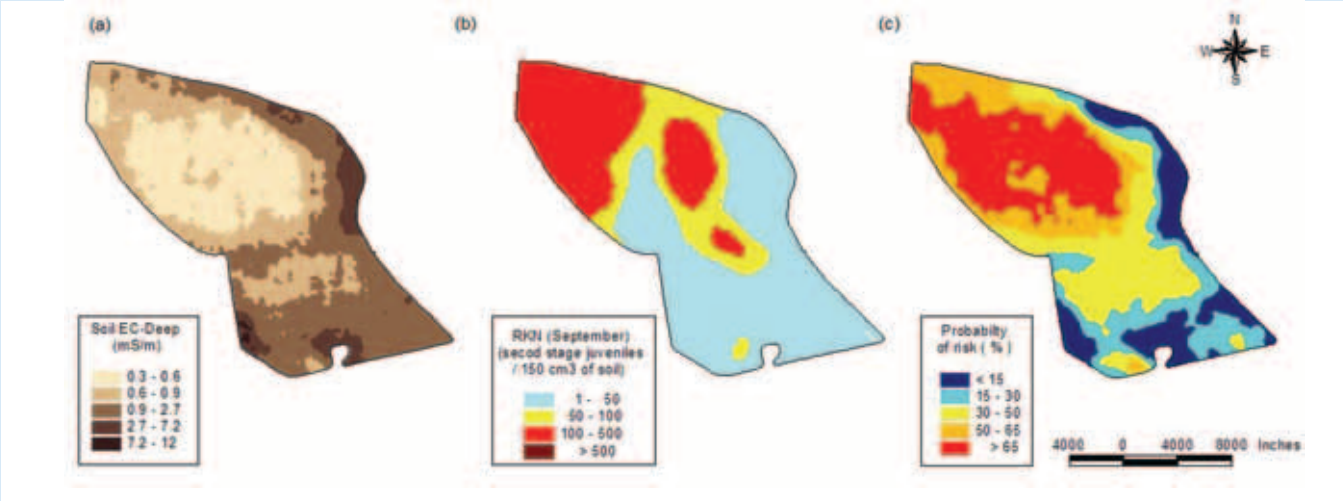


Figure 2: This shows the maps of one of the 11 study fields: (a) soil EC from 0 to 3 feet; (b) RKN populations in a cotton crop in September 2006; (c) risk level, in percent, of exceeding the threshold of 100 second-stage juveniles per 150 cubic centimeters of soil, the recommended threshold for a nematicide application.

have found that in Georgia's Coastal Plain it is more difficult than expected to identify nematode-prone areas because soils are almost always sandy. Nevertheless, even within sandy soils, there are important texture differences and the nematodes seem to prefer the coarser sands.

Less Electrical Conductivity, More Nematodes

Our results indicate that we can statistically combine elevation, slope, bare soil images and soil EC to delineate areas at risk for having a high population of RKN with a high level of confidence. But we have also found that we can obtain surprisingly good results by using soil EC alone – particularly soil EC measured over the first 3 feet of the soil profile, which we refer to as soil ECdeep.

Figure 2 is a good example of the relationship between soil EC and RKN population density. The areas in the field with the lowest values of ECdeep (Figure 2a) closely correspond to the areas with high populations of RKN (Figure 2b). This relationship can be used to create a third map showing areas within different risk levels (Figure 2c). The risk map shows the risk level, in terms of percent, of exceeding the threshold of 100 second-stage juveniles per 150 cubic centimeters of soil – the threshold typically used in Georgia for nematicide application.

Field maps of soil EC can be created quickly and inexpensively and can be used repeatedly unless major earth moving is done or a large amount of organic matter is added to the field. The information provided by the risk map empowers the grower to make sound management decisions. Soil samples for RKN can be concentrated in high-risk areas and those results used to guide nematicide application.

Using site-specific management techniques improves the efficiency of the farm operation and also benefits the environment.

Product names are provided for information only and do not imply endorsement by the University of Georgia or the United States Department of Agriculture Agricultural Research Service. For more information contact the authors at bvortiz@uga.edu or yiorgos@uga.edu

What's Up With WAAS?

By Tasha Wells

If you have been experiencing difficulties picking up WAAS (Wide Area Augmentation Service) signal with your GPS unit, don't panic. WAAS has recently undergone some changes. These changes will affect many agricultural and non-agricultural GPS receivers that utilize the free differential correction signal. The good news is that in most instances the problem can be remedied with a firmware upgrade.

WAAS Widely Used In Ag

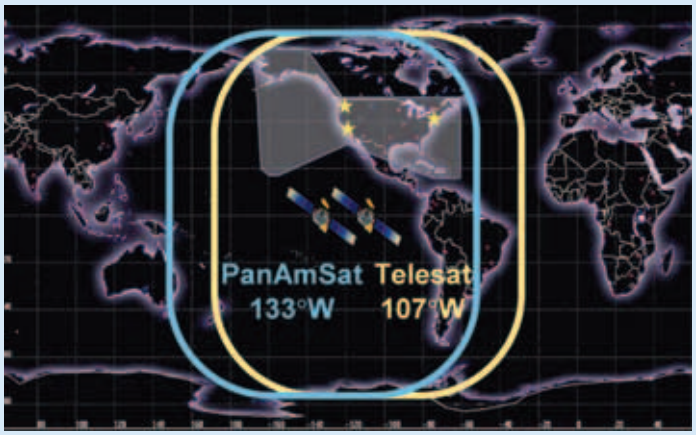
For many years, GPS applications in precision farming were reliant on subscription-based differential correction to achieve sub-meter accuracies. The availability of the Wide Area Augmentation System (WAAS) by the Federal Aviation Administration (FAA), soon after the new millennium, offered farmers a reliable, cheap signal with superior coverage to Coast Guard beacon, now known as Nationwide Differential GPS.

WAAS correction combined with the falling price of GPS receivers enabled agricultural manufacturers to market a selection of more affordable precision farming tools such as lightbars, which used a WAAS-only receiver. Today, WAAS has become integral to many agricultural applications including yield monitoring, guidance, field sampling and variable rate applications.

WAAS employs a system of about 29 reference stations spread across the United States. Each station monitors data from the GPS satellites and feeds into a master station (one on each coast). The master stations are responsible for generating the correction message. This signal is uplinked to geostationary satellites located over the equator. The correction is then broadcast from the satellite on one of the same frequencies as GPS. This means no additional equipment is required to receive the signal. You simply need a WAAS-enabled GPS receiver. Most new receivers come with WAAS capabilities.

An Upgrade May Be Needed

In July of this year, two of the WAAS satellites were decommissioned. The Atlantic Ocean Region – West (AOR-W) represented by PRN 122 and the Pacific Ocean Region (POR) satellite, represented by PRN 134 were removed from service as the lease on the satellites ended.



This graphic shows the new WAAS satellite coverage. Source: The FAA at ***www.nstb.tc.faa.gov***

In preparation for this, two new satellites, Galaxy XV (PRN 135) and Anik F1R (PRN 138) were launched in 2005. As of mid-July, these were both operational and available for use by WAAS-capable receivers. According to the FAA, PRN 138 is expected to provide improved WAAS performance to the Northeast coast, as well as extending the signal into Northeast Canada.

In order to use the new WAAS satellites (PRN 135 & PRN 138), many agricultural users are required to upgrade their receivers. The satellites will provide differential correction signals to all parts of the country. However receivers that are running older versions of firmware may not be capable of tracking the new satellites. In most cases, this problem can be overcome by updating the receiver's firmware.

To find out how to handle these changes, refer to your GPS manufacturer's Web site or contact your local dealer. Most GPS manufacturers have guidelines posted on their Web site as well as any new firmware that may need to be installed. In some instances hardware will need to be sent back to the factory for updating. Some GPS units, such as many handheld devices, are programmed to scan for available signals and should not experience an interruption in differential correction signal.

Some Systems Unaffected

Manufacturers may recommend determining which satellite works best in your area and then locking onto that satellite. This will avoid brief signal loss that may occur if the GPS switches between WAAS satellites when set to autoselect mode.

Agricultural users who rely on subscription-based differential correction such as OmniSTAR or John Deere's Starfire will be unaffected by WAAS satellite updates. High accuracy survey grade systems (RTK), employed by many autosteer guidance systems, will also be unaffected as they receive their position corrections from a base station.

For up-to-date information regarding WAAS, refer to the FAA Web site at www.nstb.tc.faa.gov. This gives information on satellite status, as well as daily plots and real time data.

For more information contact the author at nwells@uga.edu

Securing Your Farm Network

By Vickie Garrick

Farm networks offer growers a way to perform tasks remotely. Turning on and off irrigation pumps and monitoring employees with a camera are examples of jobs that can be achieved with the click of the mouse from the comfort of the office. If the farm network is connected to the Internet, a grower doesn't even need to be physically on the farm to monitor and control any devices on the network. As more network-enabled gadgets evolve for agriculture, the benefits of having a globally accessible farm network will continue to grow.

Although global access offers clear benefits, it is important to take the necessary precautions to ensure that the security of the network, computers and data are not compromised by hackers, viruses or other destructive programs or files.

The farm network and its components are all valuable assets. Upfront planning and continued maintenance of these resources can stretch the life of your investment. The simple steps outlined in this article don't cost a great deal of money or time, but can save you many headaches.

For more information contact the author at garrick@uga.edu

To help keep your network safe:

1. Purchase a router with an integrated firewall and gateway for your network. This device attaches to the modem your ISP (Internet Service Provider) supplies and keeps you secure by inspecting all data that flows into and out of your network. If unauthorized activity is detected, it will be blocked before any damage can be done. This tool helps keep your network secure as well as providing an internet connection for other computers. A router will cost from $40 to $120 depending on the model. Low-end models should be sufficient for most users. Reliable brands include: Linksys, DLink, Netgear and Belkin.

2. Take the time to configure your router. The default options may allow someone to log into the router (through the Internet) and make changes. A setup wizard is normally provided to guide you through the configuration.

3. Passwords need to be unique and are best if they include numbers, characters and special characters such as: !@#$%*& (no profanity intended).

4. Tips on the setup of a wireless router include:

a. Be sure to name your SSID (Service Set IDentifier) something that relates to your farm network. This is the ID or name of a wireless local network and it is important that it is changed from the default ID as this information is accessible to hackers.

b. Setup encryption. Encryption scrambles communications over the Internet and is one of the most effective ways to secure your network from hackers. WEP (Wired Equivalent Privacy) and MAC (Media Access Control) filtering is better than not using anything. However, I suggest either WPA (Wi-Fi Protected Access) or WPA2 (Wi-Fi Protected Access 2), which offers more protection. Once the router is configured, you will need to configure any laptops or desktops to connect to your secure wireless network.

c. Remember the more exclusive your passwords on any device the harder it is for someone to breach your network.

d. Note: if you do not secure your wireless network, any unwelcome visitor with a wireless device can connect to your network, use your bandwidth and infect your computers.

5. Update your computers' OS (Operating System) regularly. Keeping the OS up-to-date helps block destructive programs or files that attack your computer or network. These include Trojans, Malware, Spyware, Worms and Viruses. Updates for Microsoft Windows OS can be downloaded from Microsoft's Web site. To check for updates connect to the Internet and open Internet Explorer, click on "Tools" then "Windows updates". Follow the instructions on the screen. All vendors of operating systems post updates on their Web sites.

6. Invest in Anti-Virus software and keep your subscriptions current. Configure the software to automatically update, scan your hard drive on a weekly or daily basis, scan incoming email and clean any infected file.

7. Use caution opening files sent by Email. Email attachments are used to spread Trojans, Worms and Viruses so be sure you know who is sending you the attachment. If you do not recognize the sender, delete the email before opening it.

8. Backup your data on a regular schedule. External hard drives can be purchased for a few hundred dollars. For example: Seagate 300GB for $119 or WD Elements 500GB for $134. The best way to protect your data is to maintain current backups. Look for a way to automate the backup process. Microsoft Windows XP and Vista both have built in backup software you can utilize. Go to "Help" in your OS and type "backup" for options and instructions.