Uninhabited Aerial Vehicles (UAVs) at the 2004 Top Farmer Crop Workshop

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Introduction

A demonstration of a recently developed "Uninhabited Aerial Vehicle" (UAV) at the Purdue Agronomy Center for Research and Education (ACRE) was a last minute addition to the 2004 Top Farmer Crop Workshop program on July 19th. The UAV is being developed by Purdue and Calmar Soil Testing Labs, Remington, IN, to provide crop imagery.

"The UAV will help us provide crop imagery when other technologies can't" said Curt Ross, Calmar Labs. "In the eastern Corn Belt clouds often interfere with satellite images and we can't always get pilots and airplanes to fly when we want them."

The 2004 Top Farmer Crop Workshop attracted 100 participants from nine states to the Purdue University campus July 18 to 21. GPS auto guidance, yield monitor data analysis and use of remote sensing for creating management zones were other precision agriculture topics at the workshop.

The UAV is essentially a low cost version of the unmanned drones used for military applications. The Purdue-Calmar UAV weighs about 18 pounds and has a wing span of 10 feet. The key researchers at Purdue are John Sullivan, Professor in the School of Aeronautics and Astronautics and new director of the Purdue Center for Advanced Manufacturing, and Mike Leasure**,** Professor in the Department of Aviation Technology.

Ross said that Calmar expected the UAV to be in commercial use by the end of the 2004 crop season. Agricultural use is expected to include imagery for use in soil mapping, weed and pest scouting, and yield monitoring. Non-crop uses of the imagery may include forest management and helping drug enforcement agencies identify marijuana patches.

Several agricultural technologies firms have considered using drone-type aircraft for crop imagery, but have been discouraged by the cost of the military technology. Military drones often cost millions of dollars per aircraft. The Purdue-Calmar team has kept the cost down to the $20,000 to $30,000 range by using commercial off-the-shelf components and reducing the aircraft to its bare essentials.

For example, the Purdue-Calmar UAV has no wheels. At the July 19th demonstration the UAV was launched by a graduate student running with the aircraft and hurling it into the air. It landed unscathed in a plot of tall prairie grasses near the ACRE shop buildings.

GPS Auto Guidance

In addition to the UAV, there were two GPS auto guidance demonstrations at ACRE on July 19th. Both John Deere and AGCO demonstrated their Real Time Kinematic (RTK) auto guidance technology. Purdue Agricultural and Biological Engineering undergraduate students Brian Bauman and Jennifer Stamper demonstrated a Fendt tractor equipped with RTK auto guidance.

Agricultural Economics graduate student Terry Griffin used the B21 linear programming model to show that some growers could substantially increase farm returns by installing GPS autoguidance on just one tractor. Top Farmer participants model their own farms using the B21 model and frequently use it to test the economics of new equipment and other cropping technology.

Griffin's results indicate that competition for rental land may be increased because GPS auto guidance allows growers to farm more land with the same equipment. With auto guidance a farm that starts at 3000 acres may grow to 3800 acres without additional equipment and without sacrificing timeliness. Griffin indicates that auto guidance may add about $7/acre to the rent that can be bid on the last tract added to a farm operation.

Some participants questioned whether speed would be increased with GPS auto guidance, particularly for planting.

"I think most of us are already going as fast as we can planting," said Jake Fredrick, a Crawfordsville area farmer. "If we go any faster we will have uneven stands."

In his presentation Fredrick explained to the workshop how he used RTK auto guidance in strip till, placing fertilizer in the strip in the fall and coming back to plant in the same strip in the spring. He noted that RTK allowed him to use mismatched equipment including 12-row strip till machines and 16-row planters.

Fredrick emphasized the need for both good support from the manufacturer and someone in the farming operation who understands the technology.

Yield Monitor Data Analysis

The majority of Top Farmer participants have yield monitors on their combines and a common complaint is that they do not know what to do with the data. Following the model of the B21 linear programming analysis, this year the Top Farmer Team offered analysis of "planned comparisons" using techniques that have been developed over the last several years by researchers in the Purdue Agricultural Economics Department.

Some participants had trouble with the concept of a "planned comparison." A planned comparison is any time there is a clearly identify "treatment" in a crop field. Examples of "treatments" include hybrid or variety changes, different tillage, weed control alternatives, or fertilizer rates. In classic on-farm research, treatments must be randomized and replicated for reliable results. However, with spatial statistical techniques useful information can be generated from a range of designs with little or no replication. This includes split field and paired field designs.

"They call it a 'planned comparison', but in our case it wasn't planned," said Daryl Star, a farmer from Connersville, IN. "It just happened that way."

Whether the "treatment" was planned or not, the key is that one part of the field was managed differently from another part, and that the farmer can clearly identify where that "treatment" stopped and started.

"Farmers are always making comparison in their fields, mostly unreplicated comparisons between fields or large plots within fields. We would just like to make better use of the data that they are already collecting," said Dayton Lambert, Agricultural Economics graduate student and member of the Top Farmer Team.

Researchers in the Purdue Agricultural Economics agree that replication and randomization are good ways to increase the reliability of results, but that they are not

always logistically or economically possible. For example, cleaning planter boxes for replicated variety trials is hard for Top Farmer participants to justify when the B21 analysis indicates planter time may be worth $500/hour or more.

The phrase "planned comparison" is intended to distinguish data with "treatments" from data on fields with no intentional differences in crop management. Many farmers want to use this data from fields with uniform management to identify management zones or to diagnose problems.

Analysis for the uniform management data requires techniques broadly known as "data mining". These techniques are commonly used in some industries, for instance, in nuclear engineering to diagnose problems in nuclear power plants, and by credit card companies to estimate the probability of default among new customers. Purdue researchers are adapting data mining techniques to crop data, but this is still in the research stage.

Top Farmer Crop Workshop

Next year's Top Farmer Crop Workshop is scheduled for July 17 to 20 on the Purdue Campus. An after-harvest workshop focused on yield monitor data analysis is also being considered. Suggestions for the after-harvest workshop or the 2005 workshop can be sent to Jess Lowenberg-DeBoer (phone: 765 494-4230, email: lowenbej@purdue.edu) or Terry Griffin (phone 765 494-4257, email: twgriffi@purdue.edu).

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