Satellite Imagery: An Advanced Diagnostic Tool for Crop Scouts using GPS

By Chuck Nichols

At ground level, it is often difficult for crop scouts to see crop health variations in a field much beyond the immediate area where they are standing. This is especially so in tall crops such as corn. Crop scouts can also use up a lot of time monitoring healthy areas that do not require as much attention.

A satellite image is a natural aid for diagnosing crop problems in conjunction with crop scouting. A crop scout can locate, then go directly to the problem area of the field using the satellite image as a guide. Since every pixel in the image has its own latitude/longitude coordinates, crop scouts can more efficiently pinpoint their efforts to the problem areas with global positioning system (GPS) guidance and devote less time to healthy areas.

The satellite system detects in-field variability in fine detail. A near-infrared band measures the reflection from the photosynthetic material of the crop canopy on each one-tenth acre. It records a different signature when the plants are under stress, which is often caused by disease, lack of (or too much) moisture, soil compaction, inadequate nutrients, or a multitude of other reasons. It is up to the crop scout and the grower to determine the reason for the stress in that area.

Images can also be merged with georeferenced data collected throughout the season by the crop scout for further analysis and correlation, such as the locations and types of weed, disease, and insect infestations, nutrient and pesticide applications, seed populations, irrigation water management, weather data, etc.

Infrared satellite images act as a "thermometer" of field health, helping dealerships and crop scouts locate the problem areas in customers' fields. The images won't tell **what** the crop problem is, but they can identify **where** the problem areas are, and the **size** of those areas.

Crop scouts can use the technology to tally the number of acres affected, enabling them to determine the economic impact of their findings. Digital satellite images can be downloaded from a compact disk (CD) with any geographic

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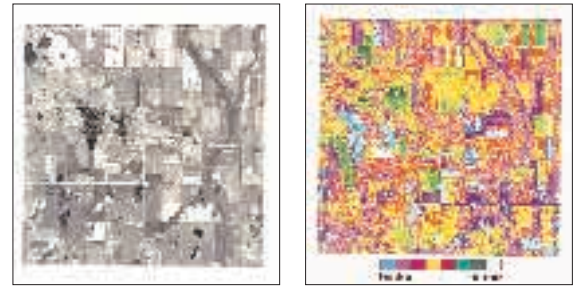

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At left, a black and white image from SPOT satellite shows field boundaries, drainage patterns, buildings and roads in a township in North Dakota. **At right**, near-infrared imagery is used to distinguish patterns of vegetation vigor and stress. Colors represent relative levels of crop or vegetation vigor.

tion, net radiation, incoming and outgoing photosynthetic radiation, air temperature, humidity, soil temperature, soil moisture, and soil evaporation at the site. These instruments provide the additional weather data needed to analyze the response of CO_2 and water vapor fluxes to temperature and water stresses.

While the main purpose of the observations is to understand the effects of crops on the weather, we are able to use the same instruments to monitor the response of the crops to weather.

For example, daily total photosynthesis and respiration were measured for a no-till corn field in Illinois in 1997. The measurements showed that from June 20 to July 31, photosynthesis was closely coupled with net radiation (sunlight). Prior to this period, the canopy was not developed to the point of making leaves compete with one another for light. After this period, soil moisture appeared to be more limiting than net radiation, even though the crop showed no visible signs of moisture stress. These measurements can increase understanding of yield limiting factors and have exciting potential for guiding the development of higher yielding cropping systems.

Farming is the art and science of managing the soil and crops to optimize photosynthesis and conversion of sugars to produce an economic yield. While each individual plant contributes to yield, photosynthesis occurs in a community of plants. The new technology described here allows the simultaneous measurement of weather and C, water and energy fluxes which will aid in the understanding of how different management practices affect crop growth and yield.

Instruments installed in fields with different soil fertility levels or treatments will demonstrate how fertility contributes to photosynthesis and respiration, and ultimately final yield, in different weather environments. BC

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information system (GIS) or desktop mapping program that has a high graphical interface.

The frequency of satellite shots depends on the crop type and how intensely the crop needs to be monitored. For high value, sensitive crops such as potatoes, weekly monitoring may be required. Otherwise, once or twice a season may be adequate. The cost of satellite image maps can range from 10 to 60 cents per acre depending on the number of fields in the image. Township sized images (6 miles x 6 miles) are available from SPOT.

Satellites are capable of photographing the same area every 1 to 6 days. Turnaround time from the date the shot was taken to when it is in the crop scout's hands can be about three days. Without time constraints, it will be 7 to 10 days.

Satellite imagery at a glance:

- Map field boundaries
- Identify crop stress
- Merge with other geo-referenced data to create a spatial database
- Latitude and longitude provide in-field accuracy. BC

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