How to Interpret Aerial Photos for Crop Performance Analysis Mapping

INTRODUCTION

Aerial photos are a very effective tool for identifying and quantifying field crop production problems. Growers can use aerial photos to help them calculate the economic differences between the good and bad crop condition zones in their fields for better management decisions.

When standing on the ground, it is often difficult to see overall field condition patterns without a "bird's eye view".

Aerial camera sensors record the amount of NIR (near-infrared), red, and green light energy reflected from the crop canopy. These measurements are used to create two primary types of digital images.

Near-Infrared Crop Condition Images

These images display the relative amount of NIR as shades of red on your computer monitor or printed map. Simply put, the brighter areas of red on the map have denser vegetation.

Crop Performance Images

These images display the zones good, fair, and poor crop conditions as a range of 16 different colors on a map. The green colored zones have the densest and most robust vegetation (whether crops or weeds!), followed by yellows, browns, and blues that are less so.

The Crop Performance Images we use are far more sensitive than the traditional Infrared images because they combine the NIR and Green measurements from the crop canopy to create an index. This index is a measure of both the volume and robustness of the vegetation. The result is that vegetation patterns are more clearly defined.

This index is displayed as 16 colors are evenly divided along the range of brightness value measurements collected. Thus, the number of acres of good, fair, and poor crops can be calculated. The fields having a higher proportion of acres with greens and yellows are better.

Using the Near –Infrared image and Crop Performance images together often reveal more information that either of them separately.

SAMPLING AND SENSING

Effective economic evaluation of the patterns of variability in crop performance uses the strengths of both traditional in-field sampling techniques combined with crop condition zone maps created from images.

Sampling (such as soil nutrient samples) is a measure of specific absolute information at selected point locations in a field. Sampling is used to guide quantified management actions. Because sample density is sparse (5 to 40 samples for an 80 acre field), the geographic boundaries, and acreage corresponding to these point measurements are poorly defined.

Sensing with aerial photos takes thousands of very sensitive relative measurements of crop conditions (over 300,000 one square meter samples for an 80 acre field). So sensing has a very dense number of measurements. Sensing does a wonderful job of defining the geography of crop condition patterns and zones. It answers the questions of acreage, shape, and location of zones of similar crop conditions, but does not include the absolute physical measurements needed to calculate economic benefit.

Sampling and sensing combined builds on the strengths and overcomes the weaknesses of each approach. Simply put, a few samples or observations taken in the field within each zone of similar crop condition as displayed within an aerial photo image provides the absolute measurements, location, geographic extent,

acreage, and shape information needed for sound economic evaluation of crop condition variations.

INTERPRETING IMAGES

Interpreting images is not rocket science, but does require some detective work. The most effective way to interpret images, and calculate the economics involved is to use the three-step correlate-calibrate-calculate process described as follows.

Correlate – compare the patterns of crop health that you see on the photos to what you see in the field, and what you know about the field's production practices and history. Try to determine the predominant causes for the crop condition variations.

Regular patterns such as straight or parallel lines and perfect circles are generally the result of man-made practices.

- Note patterns in tillage or harvest practices, fertilizer or spray applications, planting dates, crop history, or location of crop varieties.
- Match the width of the pattern to the width of equipment, wheel tracks, application width, irrigation nozzle coverage, etc as a clue to determine the type of implement used.
- Watch for repeating patterns as a clue such as tillage practices, planting patterns, compaction, plugged equipment, harvest residue, spray application patterns, etc.
- Consider old fence lines, drainage tile lines, feed lots, and old lanes that may affect the crop.

Irregular patterns tend to be natural variations.

- Soil conditions such as soil type, topography, drainage and ponding, or salt deposits tend to predominate.
- Pest conditions, i.e. weeds, bugs, disease.
- Plant population and stand establishment.
- Physical crop conditions such as uneven crop emergence or growth, wind damage, hail damage, lodging, N deficiencies, etc.
- Relative crop growth, pollination, maturation
- Crop quality such as glume, ear, or pod fill, moisture, or sugar beet/cane N levels near harvest.
- Crop yield

Calibrate – always quantify the relative yield impact of your field observations between each zone of similar crop condition in the field. What is the estimated yield/acre difference between zone A and zone B?

Here is a partial list of things you can measure. Use what is appropriate for your situation.

- Yield – preharvest yield sampling by zone.
- Weeds – height, density, growth stage
- Insects – populations counts for egg masses, % crop damage, insects/sweep.
- Plants – population, plant height, growth stage, % canopy, maturity, color, seed/plant
- Disease – measured level of infestation
- Hail – percent damage
- Fertility – late spring N test, leaf tissue testing, spad meter readings, NPK levels
- Soil Compaction – meter readings
- Soil moisture – degree of saturation
- Lodging – percent lodged plants

Calculate – Determine the cost/benefit for making a management change for each zone.

Zone A: Estimated yield/acre improvement x price/bushel x acres, minus cost to fix.

Then ask:

- Is the size of the zone big enough to mess with?
- Can it be fixed?
- Is the problem perennial or random? Fixing perennial problems provides long term annual payoffs.
- What is the cost versus benefit?

HOT TIPS ON INTERPRETATION

Squint – Pretty low tech, but it helps. Squinting as you look at the photos may help you define larger zones of similar crop conditions. You can use a marker pen to define the perimeter of these zones to aid in your perspective.

Crop varieties - Different crop varieties or hybrids may reflect light differently. Just because one variety reflects more NIR than another only means that it has a different leaf structure and is not necessarily performing any better or worse than the other. Concentrate instead on looking for crop health variations on the aerial photo within the same variety.

Weeds – Different plants reflect light differently, so crops and weeds often appear differently on aerial photos. Thus you can map weed pockets with ground verification. Be careful not to interpret an area of dense healthy vegetation as a zone of good crops. It may be a good crop of weeds! Do a field check to confirm.

Soil types - Most irregular vegetation patterns are linked to variations in soil types and topography. From a management perspective, similar soil types should have uniform crop conditions throughout that soil type in a field. If not, it may indicate a crop problem that is fixable by different management practices. You can overlay soil type boundaries, and elevation contour lines on the aerial photo as an aid in interpretation.

Irrigation pivot wheel tracks – Since no crops grow in the wheel tracks, you will often see this pattern in the photos.

Uneven irrigation watering – Plugged, worn, stuck, or misplaced nozzles will result in circular crop response patterns seen in the aerial photo that are centered on the pivot. Radial pie-slice crop response patterns as seen in the aerial photo are often due to varying pivot advance rates, or water pressure affecting the rate of water application.

Determining the culprit of streaks – Where you see parallel vegetation patterns, use a ruler to measure the distance between 20 streaks on the photo, then divide that distance by 20 to come up with the distance for one streak. This technique greatly improves the accuracy of determining the width of the implement that created the streaks, and could be a clue to the reasons for the streaks of good and bad crop areas.

APPLICATIONS

Here is a list of some crop condition zone mapping applications of economic value. For best results, apply the correlate-calibrate-calculate process!

Targeted Crop Scouting – Use the crop performance zone map as a guide for where to make field observations to calibrate each zone, map zone boundaries, and quantify field observations based on yield impact for each zone. Know the size, location, and economic impact of the problem to make better decisions.

Irrigation water distribution performance – Use to identify and quantify crop response to uneven water application problems.

Crop damage assessment by zone – use point field samples in each crop condition zone to map the geography and quantify the level of damage and yield impact in each zone. Use for hail, MPCI, insect, disease or chemical damage.

Drainage tile layout and design – map zones of poorly drained zones based on crop response as seen on the image. Calibrate yield loss for each zone with field estimates. Measure and quantify cost versus expected returns for installing tile, surface drains, ditches, etc.

Yield Mapping – In the field, pull point yield estimates within each zone shown in the aerial photo to calibrate the zone. Use zone boundaries to define acreage for each yield level. Better yet, harvest row segments (GPS points on each end) within each zone to calibrate the zone. Determine Acres X Yield for each zone.

Nitrogen Zone Management – calibrate nitrogen levels for each zone using the image as a guide on where to pull GPS sample points in the field. Sample N levels by soil, or by leaf using a SPAD meter, as the situation warrants. Apply the appropriate level of N for each zone after calculating the cost/benefit.

VRT – use the aerial photo maps as a guide for variable rate application of nutrients/chemicals by zone as the situation warrants.

To see examples of aerial photos of crops, and comments on their interpretation go to:

www.eagleviewmaps.com/WebDemo/MainMenu.html