Field Management with Aerial Imagery

Technology in Agriculture

Objective: *an informational factsheet on using UAV drone technology to monitor fields and make better management decisions*

NOFIA partnered with Story Environmental Inc. to determine the feasibility of using UAV drone technology in Northern Ontario to monitor fields and make better management decisions.

Aerial Imagery

Using UAV drones to capture field imagery can allow for precision management of the variability affecting crops year to year. This can include effects from drought, nutrient deficiencies, insects, disease, weather damage, etc.

RGB—red, green, blue imagery

- Captures what the human eye would see if you were to fly over the field yourself
- Can be used to see different soil types and create soil sample zones within a field

NIR—near-infrared imagery

- Captures light invisible to the human eye
- Can be used to process the Normalized Difference Vegetative Index (NDVI), which is used to evaluate crop health

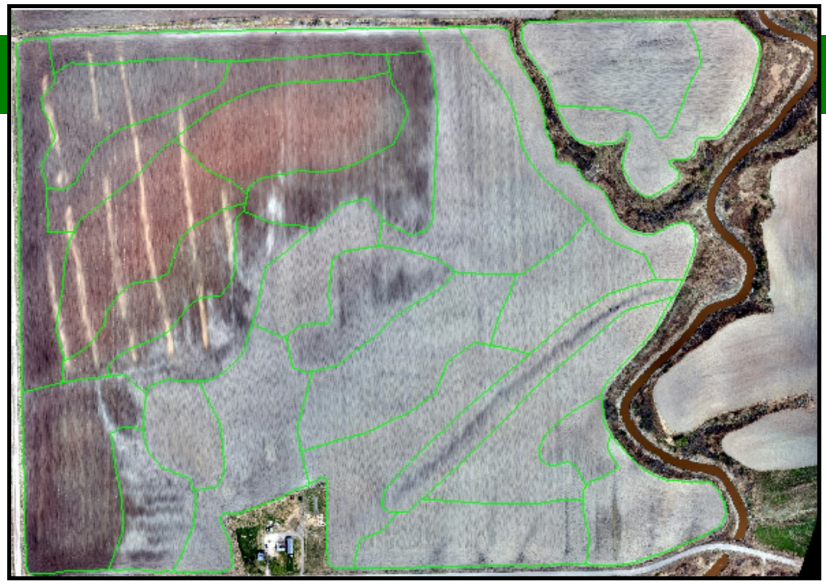

Figure 1. RGB imagery with soil zone boundaries in an 186.46-acre field. Imagery by Story Environmental Inc., zone mapping by Grant Ag agronomist Chris Hunt.

Measuring Crop Health with Aerial Imagery

Visible Atmospherically Resistant Index (VARI):

VARI is used to detect crop stress by measuring the amount of healthy vegetation in an area. By exaggerating colour, it shows how green the plant is in comparison to others to estimate plant health and vigor. NIR imagery isn't necessary to calculate this.

$$VARI = \frac{Green - Red}{Green + Red - Blue}$$

Normalized Difference Vegetation Index (NDVI):

NDVI is used to evaluate crop health by comparing red and NIR lights to differentiate between plant and non-plant material and healthy from sick plants. The NDVI ratio is converted into coloured maps for evaluation.

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

Why Use Aerial Imagery?

The resolution from UAV drone imagery is much higher compared to satellite imagery, but also much more expensive. However, more data collection is possible through drone imagery. Some benefits include faster crop scouting and determining areas performing differently to improve return on investment through zone management.

In-Season Crop Monitoring

Imagery can show nutrient issues and crop damage related to wind damage, drought, flooding, pests, etc., allowing for precision management decisions for application of fertilizers and pesticides.

Post-Season Decision Making

Aerial imagery can be used to identify soil type zones to create a better soil sampling plan, develop variable-rate recommendations for fertilizer applications, assess field drainage and compare yields to field imagery to determine problem areas.

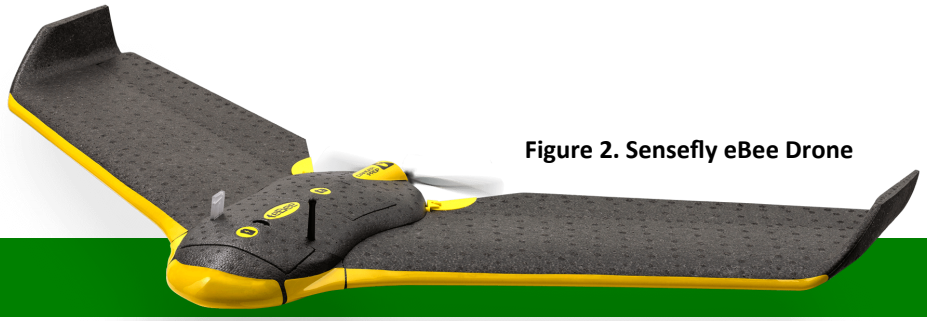

Figure 2. Sensefly eBee Drone

Uses for Aerial Imagery

1. Faster Field Scouting

By using aerial imagery, a producer can identify where a problem exists. They can then walk to the area where the issue was identified to quickly diagnose the issue.

2. Development of Crop Potential Maps

A fly over the field during the reproductive stage will allow the producer to predict yields across the field and then scout the field for yield estimations based on zones created from the fly-over.

3. Creation of Field Management Zones

A fly-over when the ground is bare (least amount of residue) can allow for zone creation based on soil type, allowing for variable-rate management decisions related to seeding, chemical and fertilizer application. This will lead to improved return on investments because products are being used to their maximum efficiency by the crop.

4. Getting Ahead of Pests & Diseases

This will allow the producer to identify issues within the field and spray the problem areas before the entire field is affected, preventing major losses from that crop.

5. Creation of Elevation Maps

The best time to do this is during the spring or fall when there is no crop growing. This gives the producer a better idea of the layout of the field and drainage associated with this, once again allowing for better crop management.

Figure 3. Flight with UAV drones with Story Environmental to test out RGB and NIR cameras with the drone to see how they can measure plant health and growth throughout the summer on a nitrogen stabilizer trial on spring wheat.

Summer 2018 Story Environmental Flights with NOFIA

Figure 4. Initial flight RGB imagery. Different soil types within the field are clearly visible.

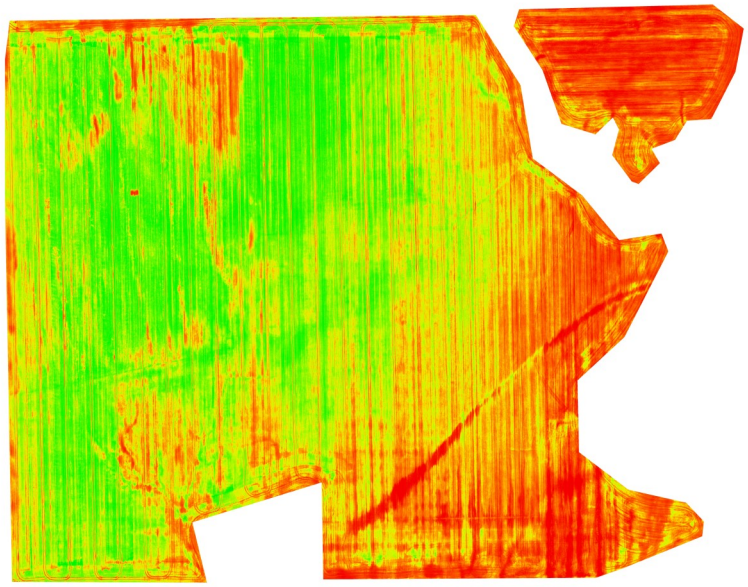

Figure 5. RGB crop performance imagery from mid-June. Green denotes good crop growth, red denotes poor crop growth.

Cost Breakdown

Here is a breakdown of the costs to use UAV drone imagery over the growing season. Flight planning and equipment set-up accounts for 35% of the total cost, 50% to the actual field work and flight and 15% to data processing and analysis. Average cost per acre is $2.50-5.00. This estimate is based on 100 acres.

Flight	Description	Cost
Pre-Plant	Mapping of bare soil and field evaluation	$500.00
Emergence	Stand count & evaluation of planting success	$500.00
Mid-Season Growth Evaluation #1	Detection of crop stress and recommendations made for variable-rate applications of fertilizer, pesticides, irrigation, etc. Yield projection	$500.00
Mid-Season Growth Evaluation #2	Detection of crop stress and recommendations made for variable-rate applications of fertilizer, pesticides, irrigation, etc. Yield projection	$500.00
Post-Harvest	Evaluation of field health and drainage	$500.00
Total		**$2,500.00**

Conclusion

UAV drone technology has come a long way over the years, and improvements are being made continuously. From being used for land assessment, to being used to apply crop inputs and make informed management decisions, drones have opened up possibilities and changed the way that agriculture is done.

If looking at costs, using drones in Northern Ontario doesn't necessarily make sense. The more acres of land flown over in one flight, the less overall cost per acre for drone land assessment. Typically, this kind of technology is used for large fields that grow high-value crops, such as tomatoes, where making decisions such as soil sampling the field in zones and making fertilizer input decisions can make a huge difference in potential revenue from that crop. However, the money spent on drone flights, more soil samples and making adjustments to inputs may not make sense on a lower-value crop such as oats. However, as drone technology becomes more common, drone technology may have a place in Northern Ontario agriculture yet.

References

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