THE LODI WINEGRAPE COMMISSION & THE VINEYARD TEAM

bring you todays

AERIAL IMAGERY WORKSHOP

Agenda-ish:

1:00 - 1:45pm	Vendor set-up & presentation loading
1:45 - 2:05pm	**Sign in** & refreshments (Certified Crop Adviser credits!)
2:05 - 2:10pm	**Introduction** - Stephanie Bolton, PhD
2:10 - 2:30pm	**Overview of Aerial Imagery Today** - Craig Macmillan, PhD
2:30 - 3:00pm	**Aerial Imagery Water Projects** - Yufang Jin, PhD
3:00 - 4:15pm	**Vendor/Grower Talks** - TerrAvion, Simplot SmartFarm, Ceres, VineView, Greg Heli & his drone demo
4:15 - 4:30pm	**Open discussions with vendors**

VOCABULARY & ACRONYMS from the AERIAL IMAGERY WORLD

aerial imagery - creating images using a flying and/or elevated object

fixed wing - aircraft with stationary wings

GIS - Geographic Information System; a system which combines multiple types of geographical data to create a user interface which allows one to visualize and analyze patterns and trends

GPS - Global Positioning System; a network of 30 satellites orbiting the Earth to provide geographic locations with a high level of accuracy (from centimeters to meters)

hyperspectral imaging - measures energy with narrower and a greater number of wavelength bands than multispectral imaging; provides a continuous measurement; more sensitive and more expensive than multispectral imaging

multispectral imaging - uses multiple wavelength bands (ex. green, red, near infrared) to detect abnormalities which may otherwise go unnoticed

satellite - an object orbiting the earth

spatial resolution - a measure of the accuracy or detail of an image; usually expressed in meters with smaller distances meaning better resolution (see GPS)

spatial variability - space- or location-based variability

temporal variability - time-based variability

thermal imaging - a measure of the heat given off by a vineyard

UAV's - unmanned aerial vehicles; aka drones

NDVI - Normalized Difference Vegetation Index; usually generated from multispectral imagery to create vine vigor maps

EVI - Enhanced Vigor Index; similar to NDVI but is not dependent on the time of day which the image was captured, on soil variations, or on shadows

FUN FACTS ABOUT AERIAL IMAGERY

- The first commercial drone crop spraying on US soil - a fungicide for powdery mildew - took place in a California vineyard
- Aerial imagery is being used for: mapping of vine vigor, mapping of vine stresses related to water or nutrients, mapping of leafroll and red blotch disease, hail damage assessments, differential harvesting, block mapping in general & more
- Global demand for agricultural drones is expected to grow to $23.3 billion by 2022
- Drones are expected to make the largest impacts in the industries of:
  1. Infrastructure 2. Agriculture 3. Couriers and transportation
- Amazon tested drone delivery, getting the cost for a 6-mile shipment down from $2-8 to 10¢
- Helicopter drones or "choppers" have been used for crop spraying internationally for the past 20 years on over 2.4 million acres of farmland - mainly in rice, wheat, soybeans, and vegetables (spraying chopper pictured above right; photo yamahaprecisionagriculture.com)

SOURCE: North Bay Business Journal "North Coast vineyards see more drone use as agriculture market soars" by Jeff Quackenbush. January 2017.

using AERIAL IMAGERY in general - possible PROS & CONS

possible PROS	possible CONS
• may increase efficiency & profitability	• there may be a learning curve to understand software and maps
• imagery may be able to notice vine health differences which cannot be seen by the naked eye	• may be a waste of money if maps are under-utilized due to a lack of resources (time and people to look at them)
• if done correctly, you can have maps to compare during a growing season and from year to year	• it takes a decent amount of time to be able to interpret and apply the data collected
• may help with the problem of labor shortages	• if the company's mapping technology or system changes from year to year, the comparisons you make are weaker
• may help with pre-planting	• UAVs, software and apps may still be working out some "kinks" as the technology grows
• may allow the grower to be more pro-active than reactive when dealing with vine stresses or non-uniformity	• weather can cause delays in scheduling aerial images

Q & A with GROWERS and CONSULTANTS WHO ACTUALLY USE AERIAL IMAGERY…

We asked four local guys four questions and here is what they said.

1. What do you look for in an aerial imagery company or system?

GROWER #1: Efficiency and reliability are important because if they can't make it to your field for the month or their turn-around time on imaging is weeks out, they are no help. Also the amount of products they offer. Water stress, thermal, NDVI and infrared images are all helpful.

GROWER #2: Quality image, with a user-friendly interface, with strong support and non-aggressive sales people.

GROWER/CONSULTANT #3:
Resolution of the camera, what types of cameras (ie IR, Thermal, RGB, Hyperspectal).
What platform that the images are released to. Online, ftp download, etc.
Any additional software to process the images.
Typical imaging services today that are using satellite or fixed wing aircraft give good data, but a limiting factor could be you are at the mercy of their flight schedule and possibly other circumstances like the smoke that could hinder the flight.

CONSULTANT #4: The minimum I expect from an aerial imagery product is affordability, timeliness, accessibility, accuracy, and consistency. For my purposes, descriptive statistics and graphics are additionally beneficial, as are tools for measuring distance and area. Ultimately, aerial images ought to serve as a communication hub for my clients, myself, and their other service and materials providers about events in vineyards and where they are happening.

2. What are you currently using aerial imagery for with any success?

GROWER #1: I use it for water stress images to help identify irrigation inefficiencies and areas and blocks that might be getting too much water. We pressure bomb our vineyards as much as we can around the same time as aerial images are being taken. Sometimes we might be a day ahead or behind but so far, the pressure bomb samples seem to be similar to the images. We have also used the NDVI images to help us identify areas in a field with higher amounts of esca or virus. I've used aerial images to figure out how far mite damage had spread into a vineyard as well.

GROWER #2: Strong/weak-area identification to improve uniformity and for preplant decision making, irrigation system issues, water stress.

GROWER/CONSULTANT #3: This is a very difficult question, because I have not yet been able to quantify the worth of using imagery. However, I believe there is value in having a recorded snapshot of the field - particularly when you start to see problems arise. For example when a spot in the field starts to die, you have evidence of where exactly it is and the size of it. You can then use that as a baseline to show the rate of growth in additional years or use it to navigate to when the field is dormant or taken out and further testing is required.

CONSULTANT #4: I currently use aerial imagery for weekly (when available) vineyard monitoring of canopy condition (NDVI) and temperature (thermal) as an aid to vineyard management decisions involving applied resources, including water, labor, and machinery. Periodically, I will use aerial images to discern unusually high levels of vineyard variability and sometimes, to follow the effects of remedial measures to correct it.

Q & A with GROWERS and CONSULTANTS WHO ACTUALLY USE AERIAL IMAGERY…continued

3. What advice would you give a grower who wants to try an aerial imagery service?

GROWER #1: Do not waste your time with drones unless you have very small acreages. Anything over 5 acres I would recommend a fixed wing aircraft. Look into what kind of software/App the company provides because in the end it needs to be user friendly and adaptable so that the images make sense to you.

GROWER #2: The cost of one flight is not that expensive. Have 3 companies fly your block in the same week to compare the images, cost and service. Multiple flights are interesting but can quickly get overwhelming. If you are going with multiple flights limit it to 6/year to start.

GROWER/CONSULTANT #3: Try it! With the relatively low cost I would suggest trying it to get some familiarity with the technology. No one set of cameras, or flight platform, or software are the hands down best. Depending on what you want to get out of the image you will probably be seeking different service providers or capturing images yourself. But before you know exactly what you need you have to start with something.

CONSULTANT #4: I advise growers who are interested in aerial imagery to use it regularly and consistently. That is the only way to become comfortable and competent with it and acquire a return on the aerial image investment.

4. Any other comments?

GROWER #1: Some aerial imagery companies can be very expensive. It is a helpful tool but not the silver bullet. If it's not in your budget don't sweat not having it.

GROWER #2: The technology and companies change quickly. It is easy to get frustrated and overwhelmed. If you have a company that you like, stick with it and ignore the noise.

GROWER/CONSULTANT #3: You can look at aerial imagery like golf clubs. Depending on what you are trying to achieve you may need a different club. If I am looking for an immediate image to show flooding across a field, perhaps a personally piloted quad copter with a good RBG camera would do the trick. But if I want hyperspectral image, a fixed wing aircraft will have to be flown in order to carry the larger camera system. Depending on what you are trying to gain with the image, it will help determine how to get the image.

CONSULTANT #4:

I will state what I look for in technology in general with a few questions.

1. Does the technology increase fruit yields or quality?
2. Does the technology save time, resources, or operating costs?
3. Does the technology make a vineyard managers life easier?

The answers to one or more of these questions must be yes for me to be interested.

AERIAL IMAGERY COMPANIES

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EDUCATIONAL RESOURCES

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* These individuals were somehow involved in today's Aerial Imagery Workshop - thank you!!

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