

INFORMATION SHEET:



AGRICULTURAL SURVEY DRONES

THE BENEFITS AND CHALLENGES OF PROVIDING HIGH RESOLUTION REMOTE SENSING IN SUPPORT OF WASHINGTON CRANBERRY FARMERS

STATEMENT OF PURPOSE

The integration of an agricultural survey drone into one or more of the research and extension programs serving Washington State Cranberry growers offers an opportunity to explore options to enhance the efficiency, profitability, and sustainability of the regional cranberry production through the application of remote sensing technology. **Drones equipped with red, green blue (RGB) cameras, multispectral (MS) sensors, and/or thermal cameras can provide high resolution, geospatial data in support of crop monitoring, disease detection, yield estimation, and resource management.** Data collection, analysis, and delivery to growers has the potential to inform management decisions to increase crop yields, reduce resource usage, and promote sustainable farming practices.

Successful integration of an agricultural survey drone is not without monetary, logistical, and even legislative challenges. **Even so, given the high interest that WA cranberry growers have shown in drone-based platforms for field monitoring and chemical distribution, overcoming the challenges associated with drone based agricultural monitoring will likely become essential** to ensure there is adequate research-based support in place as growers continue to explore these new technologies.

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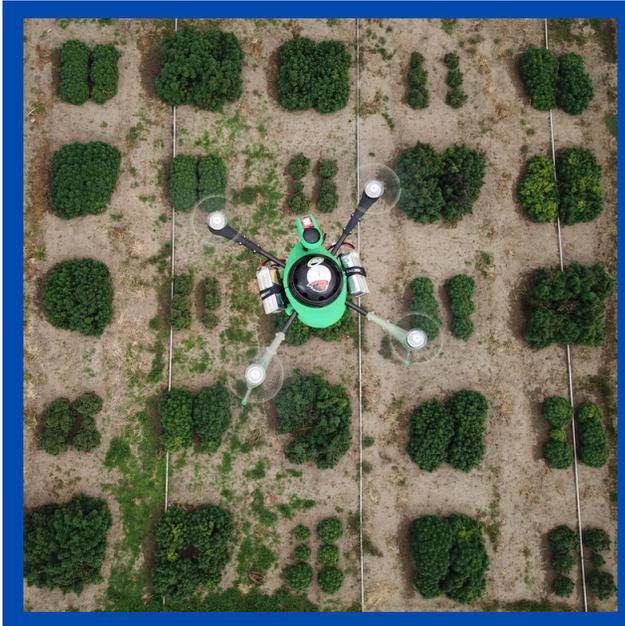


Image: The AgBot V1 agricultural survey drone produced by Oregon-based company [Aerial Technology International \(ATI\)](#) conducting a multispectral imagery collection flight in support of an Oregon State University research trial focused on production of industrial hemp. (Photo credit Alex Gregory)

PENDING LEGISLATION: THE FEDERAL DJI DRONE BAN

DJI is the largest drone manufacturing company in the world, and is currently responsible for over 70% of all global drone sales. [The Countering CCP Drones Act \(H.R. 2864\)](#) is a piece of federal legislation that seeks to prohibit the China-based drone company DJI technologies from operating on U.S. communications infrastructure. **Passage of this bill would make it functionally impossible to operate DJI drones in the United States safely and legally.** The bill has successfully cleared the house of representatives and is moving forward to review by the senate. While alternative US-based drone manufacturers are available, and **DJI has already begun a partnership with US-Based Anzu robotics** to produce comparable drone platforms domestically, the potential loss of DJI as the first choice for agricultural survey drones remains a challenge.

POTENTIAL USE CASES: RGB CAMERAS

USE CASE 1: SITE PHOTOGRAPHY



Image: An aerial photograph of OSU's Hermiston Agricultural Research and Extension Center (HAREC) (Photo credit Alex Gregory)

Photographs are powerful storytelling tools. Showcasing agricultural production from a bird's eye view can be an effective way to display what makes a field, farm, or growing region special. **Providing high-resolution site photography as a service to WA cranberry growers would aid in the development of compelling marketing, promotional, extension, and outreach material.**

USE CASE 3: IMAGE SEGMENTATION USING MACHINE LEARNING

The use of specialized sensors (multispectral, thermal, hyperspectral, LiDAR, etc.) greatly increase the ease and consistency with which agricultural imagery can be analyzed, but it is not strictly necessary. With the improved accessibility of machine learning models, some of which have been developed specifically to interpret images of cranberry plants, **many useful analyses such as plant health estimation, flower and fruit set, and yield prediction can potentially be conducted using imagery captured with a simple RGB camera.**

USE CASE 2: FIELD SCOUTING

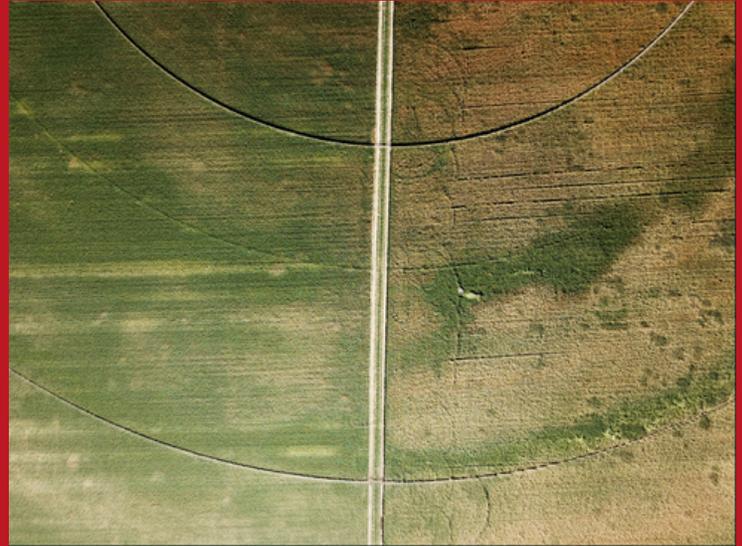


Image: Overhead imagery of a wheat field displaying differing levels of drought stress. Photo credit (Alex Gregory)

Even without specialized sensors or technically intensive analyses, manual review of aerial imagery can provide insights into patterns of crop conditions that may not be clearly visible from the ground. **Conducting aerial scouting on behalf of and in cooperation with cranberry growers can help to inform management decisions in the moment and assist in tracking changes in crop condition over time.**

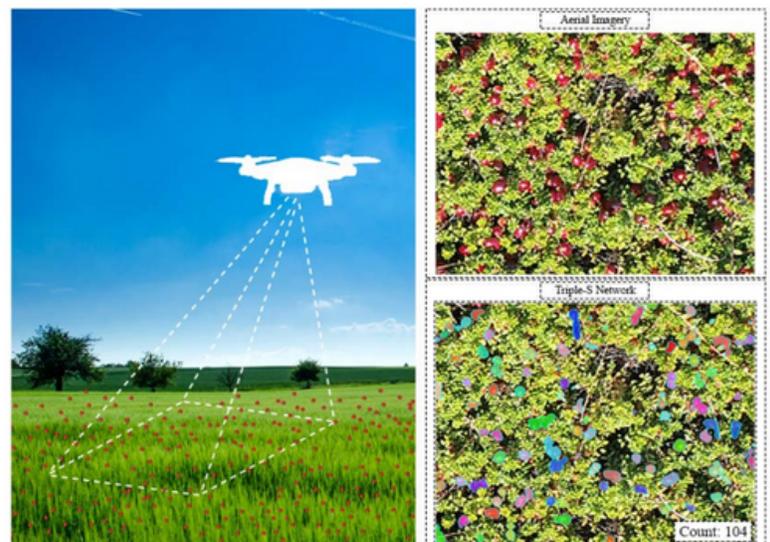


Figure: Image segmentation of drone-based RGB imagery as part of the "[CRanberry Aerial Imagery Database](#)" (CRAID), (figure credit CRAID project)

POTENTIAL USE CASES: SPECIALIZED SENSORS

USE CASE 4: THERMAL IMAGING

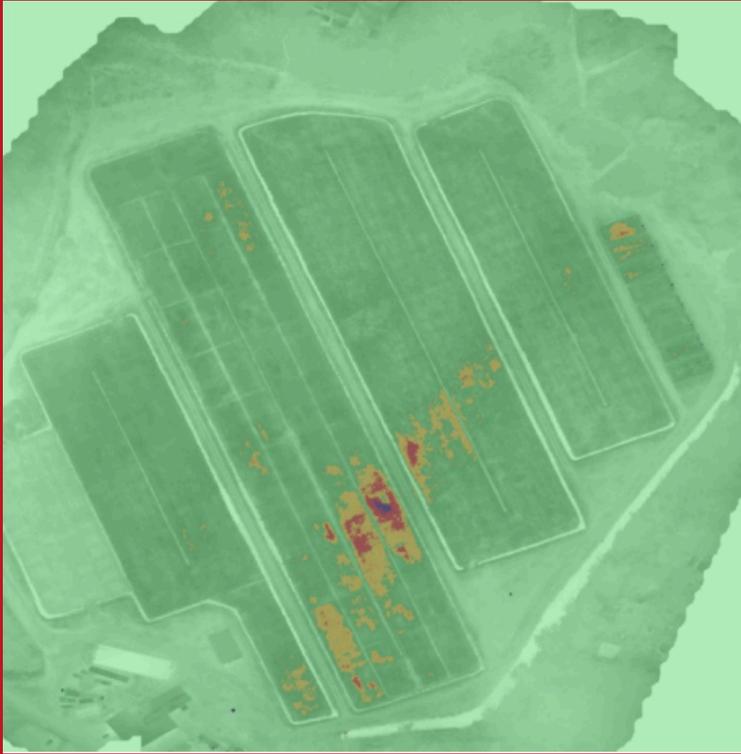


Figure: Thermal imagery being used to assess cold spots in cranberry. Orange and red areas indicate areas of below-average temperatures for the given farm. Collected as a means of identifying optimal in-field thermal sensor placement. (Figure credit Mupambi and Wicks 2024.)

Thermal sensors measure infrared radiation to detect temperature changes across space and time. **These sensors are most directly applicable to agriculture for use in monitoring of extreme environmental conditions, namely drought stress, extreme heat, extreme cold, and frost damage.** Thermal imagery could quickly become relevant to cranberry production if used to: identify areas where frost damage is most likely, assist in the optimal placement of environmental monitoring systems, and to assess the degree of damage caused by extreme temperature events and the effectiveness of protection measures used during those events.

USE CASE 5: MULTISPECTRAL IMAGING

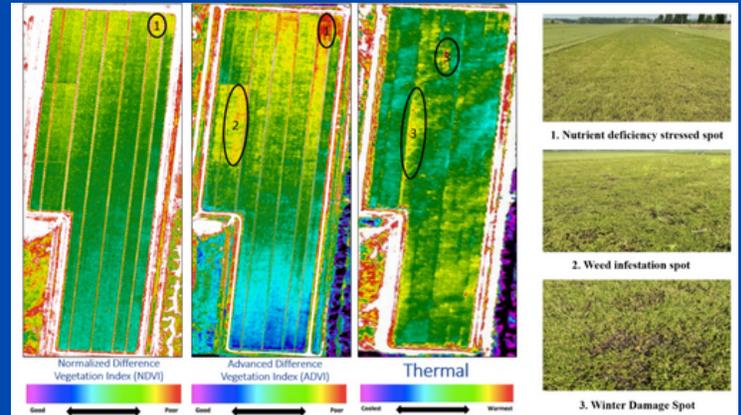


Image: Multispectral and thermal imagery of a cranberry bed highlighting detection of different crop health metrics. Figure credit UW-Madison Small fruit program.

Multispectral (MS) imagery collects High-resolution analysis of MS imagery to accurately assess various aspects of crop health including: nutrient deficiency, weed pressure, and abiotic damage, has been demonstrated in a wide variety of crops, including cranberry. Crop monitoring using a drone-based MS sensor would allow WA cranberry growers to leverage well established crop health metrics while allowing for future research into vegetative indices designed specifically for cranberry production.

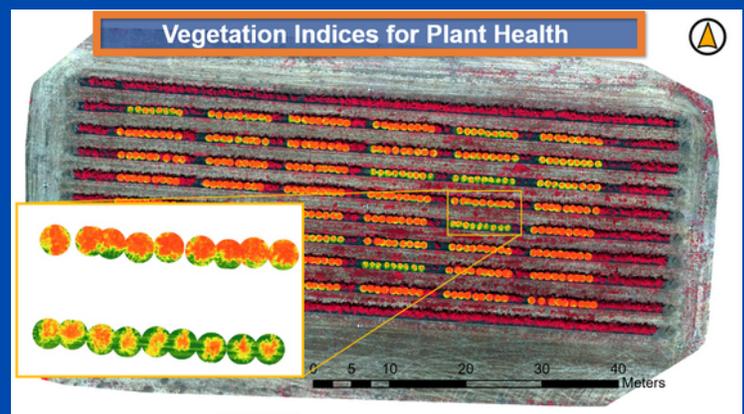


Figure: Multispectral and thermal imagery of a cranberry bed highlighting detection of different crop health metrics. Figure credit UW-Madison Small fruit program.

COST BREAKDOWN: SOFTWARE, HARDWARE, AND SENSORS

SOFTWARE

Without access to the appropriate processing and analysis software, the usefulness of imagery collected using drones is limited to what a person can interpret from a set of pictures by visual inspection. Use of software to process large amounts of imagery and analyze it using computational models greatly increases the speed and scale at which imagery of cranberry fields can be analyzed. The appropriate software also allows for analysis of imagery that is not readily interpretable by the human eye, such as multispectral imagery.

GEOGRAPHIC INFORMATION SYSTEM (GIS) APPLICATIONS



ArcGIS Pro:
Global Information
System (GIS) platform

ESTIMATED COST:

\$250/YEAR

A professional GIS application like ArcGIS Pro provides all the digital tools necessary to process and analyze all types of aerial imagery and geospatial data regardless of sensor or data type. While free, open-source GIS platforms exist, the high quality of ArcGIS Pro and extensive customer support offered by ESRI, the world's most prominent GIS technology company, generally make the yearly subscription cost well worth the investment.

PLATFORM 1: DJI M3M



ESTIMATED COST:

\$4800

PROS

- **High-resolution RGB and MS sensors**
- **RTK GPS** allows for centimeter-level precision during flights
- **Low Cost** relative to other MS-equipped drones
- **High Quality** compared to US-based drone suppliers
- **Easy Integration** with popular route planning, image processing, and data analysis software

CONS

- **No Customization** due to proprietary nature of DJI platforms
- **No Thermal Sensor**
- **Non-standard MS sensor** has only 4 measurement bands rather than the standard 5
- **Pending Legislation** may make use of DJI drones illegal

PLATFORM 2: ANZU RAPTOR T



ESTIMATED COST:

\$9500

PROS

- **High-resolution RGB and Thermal sensors**
- **RTK GPS** allows for centimeter-level precision during flights
- **High Quality** due to close partnership with DJI
- **Easy Integration** with popular route planning, image processing, and data analysis software
- **US-based company** that will not be included in the congressional DJI drone ban if legislation passes

CONS

- **No Customization** due to proprietary nature of Anzu platforms
- **No MS Sensor**
- **Higher Cost** due to manufacturing and sales facilities being located in the United States

NOTE: A detailed description of the practical and technical considerations of different types of drone bases sensors is beyond the scope of this document. For more information, please refer to the many online resources available, including:

Alex Gregory Spring Seminar Presentation:
[Changing Landscapes: UAS Applications in Agricultural Research](#)

University of Nebraska Extension Publication
[Getting Started with Drones in Agriculture:](#)

COST BREAKDOWN: SOFTWARE, HARDWARE, AND SENSORS

PLATFORM 3: ATI AGBOT V2



ESTIMATED COST:
DRONE: \$5200
SENSOR(S): \$5K - 10K

PROS

- **Highly Customizable** due to modular design
- **Integrates all sensors** including RGB, Thermal, and MS
- **Oregon-based company** makes support and repairs easier
- **Open-source internal and external software** allows for greater control of flight parameters and reduces software costs

CONS

- **High Cost**
- **No sensors** - all sensors must be purchased and installed separately
- **Fewer Safety features** than a DJI or Anzu drone
- **Open-source software** increases the chances of malfunction and requires a higher degree of technical expertise on the part of the operator

PLATFORM 4: DJI MATRICE 350 RTK

PROS



ESTIMATED COST:
DRONE: \$12K
SENSOR(S): \$5K - 10K

CONS

- **Highly customizable** due to modular design
 - **Integrates all sensors** including RGB, Thermal, and MS
 - **RTK GPS** allows for centimeter-level precision during flights
 - **High Quality** compared to US-based drone suppliers
 - **Easy Integration** with popular route planning, image processing, and data analysis software
 - **Powerful platform** allows for extra-long flight times
- **Expensive** due to enterprise model pricing and lack of included sensors
 - **Large size** makes handling and transport more difficult than smaller platforms.
 - **Pending Legislation** may make use of DJI drones illegal

CONCLUSION

Successful integration of an agricultural survey drone into one or more of the research and extension programs supporting Washington State cranberry growers has huge potential, but is not without its challenges. While there are many examples of viable use cases for drone-based imaging in support of agricultural production, including examples tailored specifically towards cranberry, there are several logistical, monetary, and regulatory factors that must be considered before deciding if the purchase of an agricultural survey drone is the correct choice.

While this document is in no way meant to be an authoritative or exhaustive summary of all the potential use cases, likely challenges, and available hardware and software options available when designing an aerial agricultural imaging program, the information provided thus far should help support an informed conversation about whether or not an agricultural survey drone would be a worthwhile investment for community stakeholders engaged in professional cranberry production.