# Digital Imagery to Measure Grape Canopy Responses

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There is a saying that a picture is worth a thousand words. When it comes to trying to get the whole picture for grape management, this may well hold.

Efforts in using digital imagery for grape canaopy management were pioneered at WSU by Drs. Suzanne Lang and Bob Wample. In 1997 they experimented with a number of different techniques to take pictures of Concord grape vines to try to assess the distribution of the physiological disorder “blackleaf”. Since then things have evolved.

Digital imagery can be used for many things in a vineyard. There are different types of images, thus a need to matching image type to management need. In addition, for digital imagery to be effective there are some aspects of image acquisition that need to be considered.

A digital image is an electronically stored picture (image). There are several different types of files (formats) that can be used for digital images and each has various features in terms of size and level of detail (see Table 1). In addition, programs used to interpret information from digital images may require a specific format.

Digital images are usually acquired digitally but they do not have to be. Digital acquisition uses either digital still or video cameras. These can be full color (nultiple wavelengths) or they target specific wavelengths of light. The most well-know wavelength specific images are Infra-Red (IR) images. Film photographs (positives/negatives) and video recordings can be scanned to create digital images. However, there are some drawbacks to this approach in that the . In the case of full-color photographs, whether film or digital, interpretation of the results requires either camera calibration or use of a color card so that the image’s color can be “calibrated” to light wavelengths.

Another aspect of image acquisition is image location. Depending on the intended use of the image, there may be a need to know the location the image was acquired from so. This, known as georeferencing, involves some process whereby the latitude and longitude (or other geographic referencing system) can be identifed. It is easiest if this is determined at the time of image acquisition although georeferencing may be established later.

Research initiated at WSU-Prosser to determine if digital imagery could be used for early detection of the physiological disorder “blackleaf” has been ongoing for several years. Over the past four years, from bloom through pre-harvest, we have taken digital images of at least once per month in three different commercial vineyards. The images are taken in with a grey/black card (Fig. 1) of known reflectance so that images can be calibrated to eachother from field to field, sampling time to sampling time, and year to year. Figure 2 shows images taken both prior to and after the onset of blackleaf. To get a “picture” of the whole canopy we also had aerial photos taken within a few days of taking the ground based images. These were taken in full color, IR and with a filter to only allow a green wavelength of light through (Fig. 3).

Prior to developing our sampling (digital photograph) locations we used a Trimble GPS system to mark the vines for georeferencing. With this, we have been able to “map” the amount of blackleaf in the fields. Figure 4 shows an example of a the amount of greenness in a vineyard by vine and across the entire canopy.

At key development stages during the growing season, both leaf and canopy level spectral reflectance measurements (350- 2500 nm) were collected using a portable field spectroradiometer. This gives us the ability to compare the information in the images with direct field measurements.

Ultimately our goal is to use the information developed from this project to provide a system that will allow early detection of blackleaf in grape vineyards so that management practices can be modified to reduce crop stress. Management practice may involve the use of UV inhibitors, either across blocks or spot treatments, or modification of water management.

Another tool that is beginning to be examined is the use of wavelength specific aerial photograph to assess differences in canopy vigor. During the late summer and early autumn of 2001, Resource 21, in conjunction with the WSU Center for Precision Agricultural Systems, took aerial images of a number of vineyards at known wavelengths. The information in these phots can be used in conjuction with wavelength specific models to determine things like canopy vigor in a vineyard. This information can be used to direct management practices – such as pruning, thinning, leaf or fruit removal. Collecting additional measurements in spots of variability could lead to the ability to predict other things such as yield or water or nutrient management needs.

Table 1: Image file formats and some of their features.

| Format Name | | | Features |
|---|---|---|---|
| Short Form | Long Form | File Extension | |
| BMP | Bitmap | *.bmp | Multi colored; Developed for photographs; no compression |
| GIF | Graphical Interchange Format | *.gif | Only supports 256 color; built in compression; proprietary encryption |
| JPEG | Joint Photographic Experts Group Graphic | *.jpg | Multi-colored; Developed for photgraphs; choice of compression rate where quality decreases with higher compression |
| PDF | Portable Document Format | *.pdf | Supports images but more frequently know for it's text feature |
| TIFF | Text Image File Format | *.tif | Developed for library services to replace fiche; large in size and limited compression ability |

Figure 1:  Black and grey card used to calibrate digital images.

Figure 2: Concord grape leaves without (a) and with (b) blackleaf.

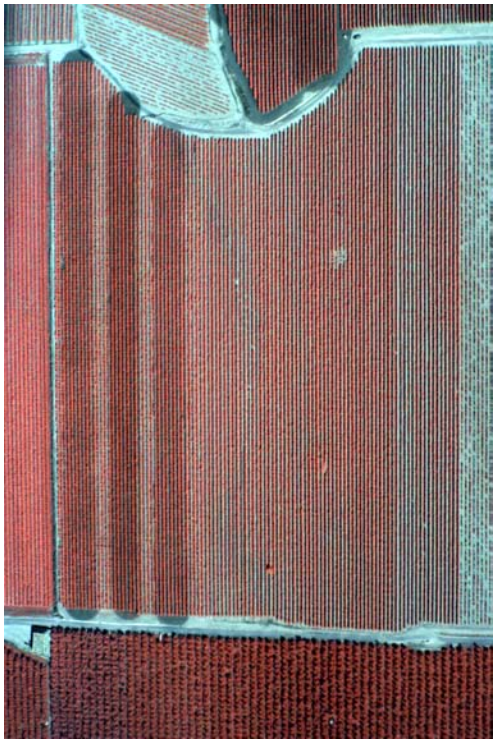
a)

b)

Figure 3:  Aerial images taken in full color (a), as IR (infra-red) image (b), or with a green color filter (c).

a)

b)



c)

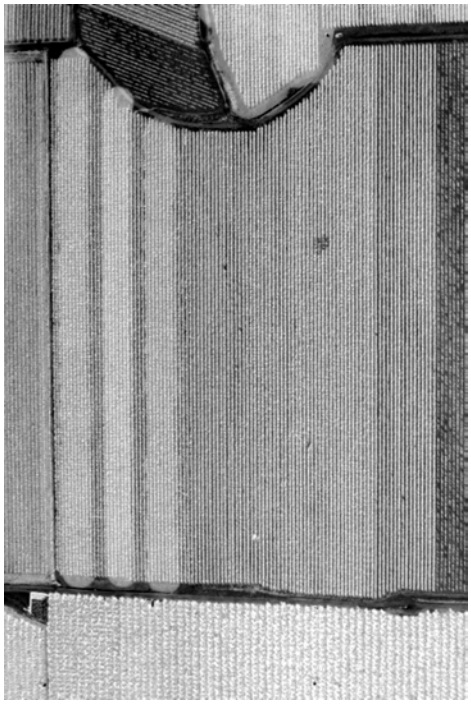


Figure 4:  Aerial image of concord vineyard with GIS map of amount of green leaf tissue overlayed.