



How to Take a Photo for Crop Diagnostics

Elizabeth Buck, Cornell Cooperative Extension, Cornell Vegetable Program

Capturing diagnostically useful images is not as simple as snapping a picture of cute children or animals.

With the current push to work remotely, using pictures to quickly address production questions has a lot of appeal and utility. I love the idea of using grower-captured photos to hasten the trouble-shooting process, especially since it isn't always possible to make prompt farm visits. But in practice it can be quite tough to work out a problem using photos because of poor image quality.

High quality diagnostic photos absolutely can allow us (and other ag professionals) to make pretty confident IDs and assessments of what is going wrong. I frequently send diagnostic images to our plant pathologists for a preliminary read on the situation, it works great. Examples of high quality diagnostic images are regularly published in our pest/disease/weed management articles.

WHAT MAKES A HIGH QUALITY IMAGE?

A high quality image has 3 key components:

1. The image matches exactly what you are seeing. Same colors, same level of detail.
2. The image is well focused on the intended subject (is "sharp").
3. The image captures the correct part of the field, plant, bug, etc to make an ID.

In practice, meeting these three criteria takes some time. I typically spend 3-5 minutes capturing a series of high quality images to use in VegEdge or to send off to our plant pathologists or entomologists.

THINGS YOU SHOULD KNOW

Cameras sense a lot more light than our eyes can.

Our eyes saturate with light and stop perceiving increased light well below the level of light that a camera (and plants) can perceive. This is why images taken in a sunny field tend to be over exposed and look washed out relative to what your eye perceives. The camera is showing you how much more light there is than you can physically realize. In a way, the camera is better than our eyes at showing us the relative amount of light a plant "sees".

So much of diagnostics relies on picking out slight color differences in plant tissue.

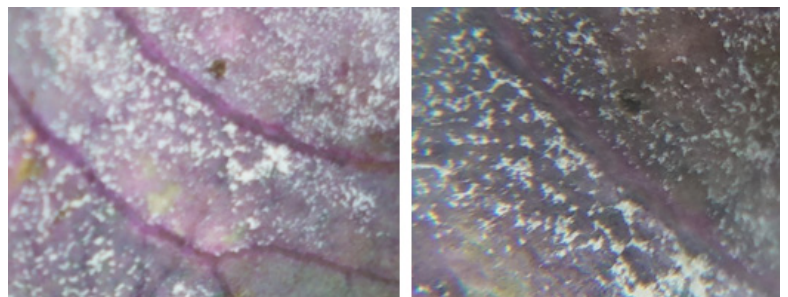
Sunglasses alter how colors look. Something that stands out well with sunglasses on may not be as distinct with them off. I cannot pick out the slight yellow checkerboard of early stage cucurbit downy mildew when I scout with my sunglasses on because my shades filter out light in a way that changes the appearance of yellow objects. Cameras don't filter light and color the same way as your sunglasses do. It is difficult to get the photo to capture exactly what someone wearing sunglasses perceives – far easier to take shades off.

Making an ID usually takes at several photos.

This number changes based on the problem. Insects can be done in as little as 1 or 2 high quality pictures. Weeds and feeding damage on crops usually require 2-3 good images. Plant diseases and mystery problems are almost always 3-5 photos. Remember that disease symptoms can vary from the upper and lower sides of leaves and images of both can be helpful.

DIFFERENT PROBLEMS NEED DIFFERENT IMAGES

- For insects you see, take a focused close-up of the pest. A couple images showing feeding damage, any frass, and where on the plant you're finding the damage can ID pests you don't see.
- To ID caterpillars, a top shot showing its head and a side shot of its pattern are really useful.
- For broadleaf weeds, take photos of the overall growth habit, a detail shot of some middle aged leaves, and one showing flowers or any other distinctive features like spines or rosettes.
- For grasses, a picture of the growth habit and a close-up, a focused image showing where the leaf meets the stem while you gently tug on the leaf blade will work well.
- For diseases causing foliar symptoms, include the overall plant, the portion of the plant showing symptoms but not yet fully destroyed, and a focused close up of the symptom. For example with septoria of tomatoes, I'd take pictures of a couple of staked plants showing that the problem is worst lower on the plant and that there is mud splashed up on the lower leaves. The next photo would be of a mid-aged leaf that is starting to yellow and is showing lesions. The last photo would be a close up of a mature lesion showing the surrounding tissue and a pale lesion with black specks in the center.
- For diseases causing root symptoms, abiotic issues, or mysteries take a picture of the field where the problem is occurring, a whole plant above-ground photo, pictures any above ground symptoms on the foliage, a shot of what the roots look like, and an image of the crown sliced open vertically. For example, if I'm diagnosing sad transplants, I take a photo of the greenhouse area with bad flats, a picture of the condition of the flat showing the soil and tops of the healthy and affected plants, a close-up of a sad plant focused at the lower stem, and a shot of a sick seedling's roots.



Need a close up shot of some mold? Take photo through a hand lens.

Left: Zoomed in image vaguely shows downy mildew sporulation on a brassica seedling. Right: By taking the image through a hand lens, greater detail including the separation of individual mold colonies and the structural shape of the sporulation can be seen. Note image is clear near the central leaf vein and blurry on the edges due to the effect of the hand lens.

STEPS FOR TAKING A HIGH QUALITY IMAGE

1. Clean off the lens of your camera before taking an image.
2. Clean up the area around the subject. Push unwanted leaves out of the way, pull up weeds. This will help the camera isolate the subject from the background and improve the sharpness.
3. Take off your sunglasses so you can match the image exactly to what you see.
4. On bright days, hold your ball cap bill over the phone to shade the lens & reduce oversaturation.
5. Stabilize the camera. Prop your elbow on your knee, ribs, the ground, stakes, etc.
6. Center the focal point on the subject.
7. Zooming in too far blurs an image. Better to adjust your distance from the subject first, then zoom so you maintain sharpness and level of detail.
8. Adjust the lighting (white balance) of your image before taking the photo! This is the last thing you do before taking an image. Many phones have a little sun icon that you can slide higher or lower. Make the colors match what your eye sees.

PRO TIPS

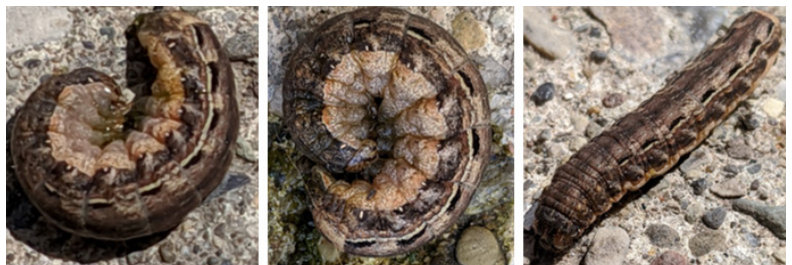
- **Windy day?** Take leaves off plants, especially for shots of feeding damage and diseases. Place on any non-reflective surface like the ground, a truck seat, or even your pant leg.
- **Really tiny bug or something you saw with a hand lens?** Hold the scouting lens up to the camera lens. Move closer or further from the subject to take macro shots, don't zoom. The hand lens will distort the edges of the image, so make sure the subject is in the center.
- **Bugs moving around too much?** Catch them and toss them in the freezer over lunch. They'll be dead or very slow at the end of lunch and they'll still have all their original coloring.
- **Having trouble focusing sharply on the subject instead of the background?** Try using portrait mode on your phone. Or, put your hand directly behind the subject to obscure the background and refocus your image. Once it refocuses, remove your hand and quickly take the picture. This requires one-handed picture taking so be sure to stabilize the camera.



Adjust the lighting setting. Left: Overexposed image captured by just snapping a photo. Right: Same seedling, with white balance adjusted on phone so screen display matches what the eye sees; clearly shows the outline and wide range of discoloration (tan, bronze, yellow), which allows for a downy mildew diagnosis. The same diagnosis cannot be made from the image on the left.



Correct focus point. Pepper seedlings with discoloration on the cotyledons. Left: Camera focused on leaves behind the scarring, leaving the lesion blurry and small. Too much extra foliage in the image. Right: Brought camera closer to subject, re-set the focus on the lesion, and stabilized the camera. These three actions yielded a sharper image that shows two different injury patterns – coppery sunken tissue in the center with no yellow margins and reddish-brown lesions with yellow margins moving in from the edge of the leaf.



Caterpillar ID. Left: Blurry, curled up caterpillar, zoomed in on worm's side marking pattern. Center: Sharper view of same caterpillar taken by shifting camera angle, placing subject and camera lens in the shade of a ball cap to remove the shadow, and bringing the lens closer to avoid distortion caused by zooming. Right: Caterpillar glamour shot showing both top and side patterns, useful for ID.



Use the portrait mode. Left: Necrotic leaf is blurry while the background soil is in focus. Right: By using portrait mode, the downy mildew infected leaf becomes sharp and isolated from the background soil. The added sharpness reveals the darkening lines and veins in the chlorotic upper left part of the leaf, despite the right image being taken from a greater lens distance than the image on the left.