

What Scopes are Worth the Money for Pest Identification?

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Correctly identifying what insect pests are plaguing your plants or crops can be difficult. Pest insects and other arthropods are often very small, and the differences between species or even families can be impossible to distinguish with the naked eye. When incorrectly identifying a pest can lead to ineffective treatment, wasted money, or worse, it is crucial to accurately determine what insect you have on your hands.

Fortunately, there are many options available to magnify insects and better see what you are dealing with. Unfortunately, there are so many products and such a huge range in price that it is often hard to tell what tools you should buy. Is the \$400 handheld scope that much better than the \$50 one? If I spend a couple thousand dollars, will I end up with the most versatile tool? And what if I need to take pictures?

I purchased and compared various scopes and magnifiers to figure out which were worth the money for insect pest identification, and which weren't. I primarily focused on tools that could feasibly be used to identify many insects to the species-level and were more powerful than a hand lens you might use in the field. When judging different tools, I used three main criteria:

- How well does the device magnify?
- Is the device versatile and easy-to-use?
- Can it take pictures?

For reference, see Table 1 with all the different tools I compared. Different colors denote different general categories of magnifiers.

Table 1. Different scopes and magnifiers compared. Different row colors and symbols represent the different general categories of magnifiers.

Magnifier/Tool	Name/Brand	Use	Cost
*30x Hand Lens	Kingsmas Jeweler's Loupe	Field Identification	~\$5
*Phone Camera Scope	Apexel Phone Microscope	Field Identification	\$20
^Inexpensive Wireless Digital Scope	Wifi-Digital Microscope	Indoors/Lab Identification	\$50
^Inexpensive Digital Scope	Dinolite AM2111 (R10A)	Indoors/Lab Identification	\$100
^Moderately expensive Digital Scope	Dinolite AM3111T (R10A)	Indoors/Lab Identification	\$200
^Expensive Digital Scope	Dinolite AM4113T (R9)	Indoors/Lab Identification	\$400
^Flexible Digital Scope Stand	MS22B Dinolite Stand	Indoors/Lab Identification	\$40
^Adjustable Digital Scope Stand	RK-06A Dinolite Stand	Indoors/Lab Identification	\$200
#Dissecting Scope	Fowler 53-640-777 Microscope	Indoors/Lab Identification	\$1,000
#Dissecting Scope with Camera	Leica EZ4 W	Indoors/Lab Identification	\$2,318
#Expensive Dissecting Scope	Nikon SMZ1500	Indoors/Lab Identification	\$7,000
#Eyepiece Camera	USB Eyepiece Camera AM702025X	Indoors/Lab Identification	\$649
#LED Ring Light	144 LED Adjustable Ring Light	Indoors/Lab Identification	\$50

To compare the various magnifiers, I looked at two different pests: thrips and agave mites. Both are very small and often require magnification to correctly identify or even see. To get a sense of scale, in Figure 1 are pictures of the thrips and agave mites I examined (both

circled in red) next to a measuring tape. The thrips are difficult to see with the naked eye, and the agave mites cannot be seen at all without magnification.



Figure 1. Thrips (left) and agave mites (right) are very small and often require magnification to see them. Credit: Eric Middleton, UC IPM.

Finally, as a disclaimer, this comparison is not comprehensive nor should it be interpreted as an endorsement of a particular brand. I was only able to purchase and compare so many tools, and each one has a time and place where it may be the best option.

Hand Lenses and Phone Scopes

Most pest control professionals and many growers are well aware of hand lenses and have used them before for pest identification. A basic 30x hand lens is an essential tool for identifying pests in the field. They are very inexpensive, easy to use, versatile, and do a decent job of magnifying.

Another tool that can be used to magnify pests in the field is a phone camera scope. Phone camera scopes clip onto your phone over the camera, and allow you to see a magnified image and take pictures or video. They are inexpensive, intuitive to use, and magnify better than most hand lenses. However, they only focus at a single distance, often very close to the camera, and may not attach to your phone if it has a particularly thick case.

Additionally, newer phones with multiple cameras can be tricky to use with the scope. Your phone may register the scope as an obstruction when you place it over the camera, and automatically switch to a different camera that the scope is not covering. You can often manually fix this in your settings, but it is a pain. So while it is a useful tool, keep in mind phone camera scopes may not be easily compatible with your device.

The phone camera scope I purchased was \$20 and magnifies noticeably better than the hand lens. In Figure 2 are pictures of thrips seen through a hand lens and seen through the phone camera scope. While the phone camera scope magnifies more, the hand lens is ultimately a more versatile tool. Since both are so inexpensive, it probably makes sense to have both on hand when identifying pests in the field.

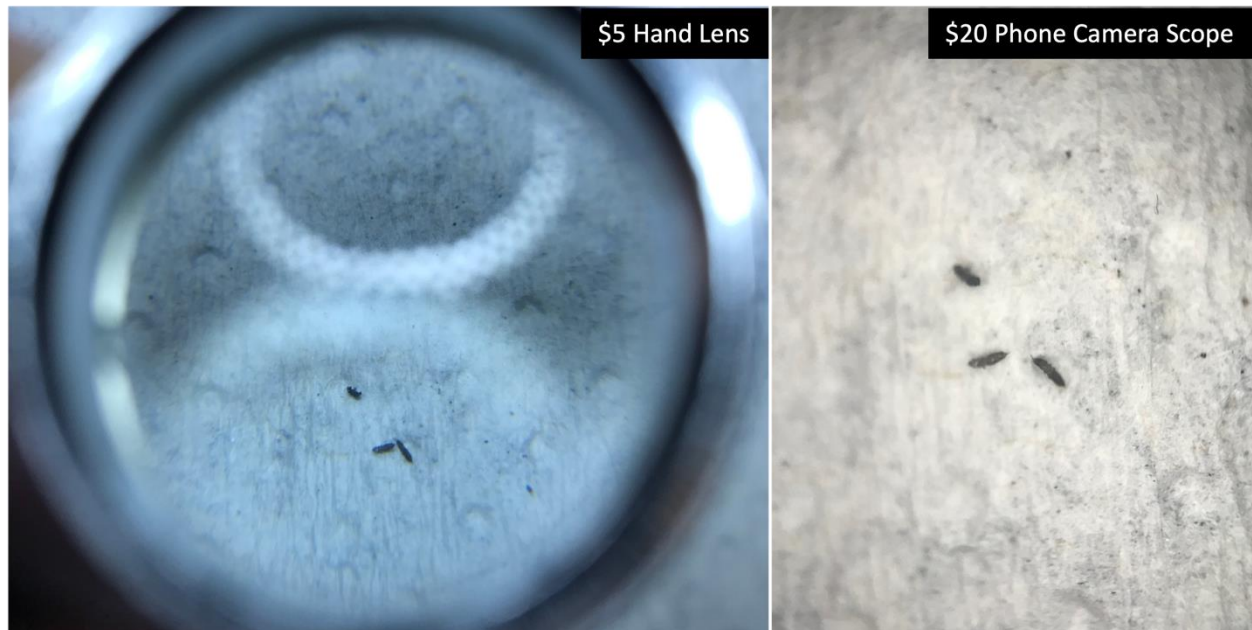


Figure 2. Thrips seen through a hand lens (left) and phone camera scope (right). Credit: Eric Middleton, UC IPM.

To see more detail or identify smaller pests however, we need to look at more powerful and more expensive options.

Handheld Digital Scopes

While they are not great tools for field identification, handheld digital scopes are a good option for identifying pests once you bring them indoors. These scopes are small, compact, and relatively easy to use. They have a built-in light source and a single dial that controls both zoom and focus. You can also easily take pictures with them. However, you need a computer or phone to connect to them to see what you are magnifying, and they only have two magnification ranges where they are in focus. This means that you can only be very zoomed in, or very zoomed out when looking at an insect. Finally, while you can use them without a stand, a stand is very helpful to take pictures or get a steady image, especially when the scope is zoomed in.

I purchased four handheld digital scopes, one wireless and three corded, ranging in price from about \$50 to \$400. I also bought two stands for the scopes: one flexible stand (\$40) and another that can be adjusted to hold the scope at various heights (\$200).

In Figure 3 are pictures of the same three thrips taken when all scopes were zoomed out as much as possible. The thrips are much more clearly visible than they were through the hand lens or through the phone camera scope, and the magnification is noticeably better. Comparing between the digital scopes, the two more expensive options (\$200 and \$400) were a bit clearer, although there isn't much of a difference.



Figure 3. Comparing variously priced digital scopes by looking at tiny thrips. Credit: Eric Middleton, UC IPM.

When the scopes are zoomed in all the way, the difference becomes more apparent, as seen In Figure 4. For both of the less expensive options (\$50 and \$100), the thrips look like silhouettes, and you can't distinguish any features or colors, which is very important to differentiate pest species. As price goes up, there is a noticeable difference in quality. The

more expensive digital scopes allow you to see features and different colors on the thrips, and the \$400 scope is a bit better than the \$200 scope.



Figure 4. Zooming in on a thrips using variously priced digital scopes. Credit: Eric Middleton, UC IPM.

When it comes to scope stands, I found them to be necessary. Holding the scope steady enough by hand was almost impossible, especially when zoomed in. While the \$40 flexible stand was useful, the \$200 adjustable stand was much more effective, and allowed me to easily take pictures and view insects under high magnification.

Overall, the more expensive options for both the stands and the digital scopes yielded noticeably better results, but the \$200 scope was relatively comparable in quality to the \$400 scope.

Dissecting Scopes

Dissecting scopes are commonly used by entomologists or other scientists to identify all but the smallest of arthropods. They are more expensive, are not mobile, but are also very versatile and powerful. You can focus at many different heights and magnifications, and they are much easier to use effectively after you get over the initial learning curve. Unfortunately, most have no built-in capability to take photos, and most do not have a built-in light source.

I compared three different dissecting scopes that I had access to, ranging in price from about \$1,000 to \$7,000. I also purchased an eyepiece camera to take pictures through the scope and a light source to use with the scopes.

Since dissecting scopes have many different ranges, they can focus on, I'll only show the most magnified views and compare those to the \$400 digital scope. In Figure 5 are pictures of agave mites, which are about 1/3mm long and essentially impossible to see with the naked eye. Fully magnified, the \$1,000 dissecting scope is noticeably slightly more magnified than the \$400 digital scope, and the \$7,000 dissecting scope is clearly more powerful and produces a sharper image. However, the \$2,318 dissecting scope with a built-in camera is noticeably worse than any of the others. It cannot magnify nearly as much, and the agave mites are difficult to see even under good circumstances.