Hide & Seek Virus Testing

(by Linda Taylor, written for the Dec 2017 issue of the PNDC Dahlia Times)

Recently, in a conversation with a dahlia friend, she characterized the virus testing as "hide & seek", which in my opinion, is spot on. The amount of virus varies in different parts of the plant, and changes over time and in response to growing conditions, not to mention that there are differences between cultivars. The trick is to catch the right parts of the plant at the right time to get a sample containing a high enough concentration of the virus for the tests to be able to detect the virus. The tests are sensitive, but not perfect.

The population of virus in a plant and its parts are directly connected to the metabolism of the tissues the virus is in. Viruses cannot replicate by themselves. They use the machinery of the cell they are in to replicate. It is often said that the virus "hijacks" the cell's natural processes to multiply. It would be more correct to say that the virus "borrows" them. A virus that completely uses up the resources of its cell, or its host, is a short-lived virus. For the virus to succeed in the long run, the host plant must be allowed enough resources and metabolism to survive. The tissues in different parts of the host plant are growing and metabolizing at different speeds - emerging shoots, expanding leaves, fully grown leaves at maximum photosynthetic capacity, aging deteriorating leaves, plus all the stem & stalk tissues connecting them. So, the population of virus in each of these tissues is likely to vary accordingly, with the higher metabolism enabling more growth of the virus. At the end of the growing season, when the dahlia plant is moving all its resources from the above-ground parts into the tubers, the virus population in the leaves & stems drops. When the tubers are dormant, they are not growing, metabolizing or circulating much, so the virus is pretty much dormant too.

The movement of virus through the host plant is also connected to the natural movement of nutrients and other molecules through the plant. Most viruses have some mechanism for movement from one cell to another. But this is slow, and for the infection to spread to the whole plant, viruses generally make use of the phloem system (food-transporting channels, somewhat like arteries in animals). Again, the more vigorously the host plant is growing, the faster the virus can spread within the plant. The same conditions that favor the growth of the plant favor the spread of the virus.

So, on the one hand, the more vigorously the host plant is growing, the more virus replication and movement it is able to support. But the plant has defenses against the viral infection, and the more strongly it is growing, the more effectively it can fight back against the virus. A plant or cultivar with a strong immune response can sometimes diminish the population of a virus to a level where it is no longer detectable by the usual tests. However, the plant still carries the virus, and it can still be spread to other plants. In some cases, the plant defense is strong enough to keep the virus from taking hold in the first place. But of course, it is hard to tell which is the case, and the situation with a particular plant may not be characteristic of the cultivar as a whole.

A cultivar (or species) which generally can carry the virus without showing symptoms is said to be “tolerant” of that virus. One which is routinely able to avoid infection is said to be “resistant”, or in extreme cases, “immune”.

In natural circumstances, the viruses and the host plant have evolved together over millennia, so that both can survive and fill their ecological niche. The problems generally arise when the host species and viruses are removed from their natural situations, and especially when the hosts are grown intensively, and bred for (in the case of dahlias) qualities like flower color and form, without regard to virus tolerance.

So, our “hide & seek” game is to find the virus, when & where it is present in the host plant, in sufficient quantity to be detectable by the tests currently available. The tests that have been developed are very specific to the molecular properties of each individual virus. Only the exact virus being tested for will trigger a positive response, so there are almost no false positive results. But there are many circumstances that can lead to false negative results. One of the goals of our research is to figure out how and when to collect and process samples, so that we can more accurately identify which plants are infected.