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VIRUS AND VIROID DISEASES OF AVOCADO

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Viruses are generally thought to be parasites or pathogens of all living things. The common crops we are familiar with all have at least one, and usually several known viruses. Citrus, for example, is infected with a long list including citrus tristeza virus, psorosis virus and infectious variegation virus. This is not the case for avocado. While this is somewhat surprising, it probably simply reflects the lack of effort by plant virologists to seek out and characterize avocado viruses. Having said that, it is still probably true that viruses are not causing widespread diseases of avocado. If viruses were causing widespread disease they probably would have already been detected.

We have looked for viruses using the detection of double stranded (ds) RNA molecules in extracts from avocado tissue. DsRNAs can be the footprints of RNA viruses, but can also have non-viral sources. They are common in avocado, and can be categorized into at least 4 separate groupings of molecules, each group being present alone or mixed with others, depending on the avocado variety. None of the dsRNA types have yet been clearly associated with any disease of avocado, or any characterized viral RNA. Recently we were asked to look into viruses in the dwarfing avocado variety Colin. When we extracted dsRNA from this variety we detected a new group. A single high molecular weight and unusually abundant dsRNA was associated with this host. Work is in progress to determine if this or the earlier detected avocado dsRNAs are of viral origin and what if any effect they are having on tree growth or fruit production.

When viruses that infect avocado are finally discovered, there could be a long-term benefit from this discovery, since viruses offer one means to deliver foreign genes selected for crop improvement. The way this is done is through genetic engineering of the virus. The viral genes which that cause disease are disarmed. Additionally the genes that are not essential for the virus are removed and replaced with genes that are candidates for crop improvement.

Avocado sunblotch viroid (ASBVd) is not a virus, but is a graft transmissible viral-like pathogen. It causes deformity and often white blotching of fruits and leaves. Stems can have necrotic streaks. We have developed a rapid, sensitive detection method based on RT-PCR (reverse transcription polymerase chain reaction), using a simple sample preparation method. Using this method we have re-confirmed ASBVd freedom in the main UCR variety block and have determine the ASBVd status of important trees for growers, nurserymen and researchers.

We have determined that leaves of a moderate age are optimal for PCR testing. Leaves from a new flush of growth which have not yet hardened off or old leaves which are nearing senescence do not give consistent results. All parts of the leaf are satisfactory. We use a slice of tissue from the middle of the leaves which includes a section of the midrib. It is critical to correctly sample the trees in order to obtain a representative sample. We recommend collecting approximately 20 leaves from around the entire canopy of the tree (5

leaves from each of the 4 compass points, from separate branches works well), which are separated into 2 samples for analysis. When testing individual branches of an infected tree, not all branches test positive. Upon retesting, it was concluded that these results were correct, that the entire tree was not yet infected with ASBVd. This points out that proper collection of tissue is critical is assessing the infection status of the tree.

Avocado fruit itself is also a satisfactory source of tissue and gives a strong PCR result. We have identified several samples in which the fruit was symptomatic for ASBVd and tested positive for it by PCR. However, the tree itself repeatedly tested negative for ASBVd. This could be related to the classic example of fruit becoming infected with ASBVd by pollen transmission. It has been previously reported that this is common and that infection of the tree itself does not occur and only those fruit which obtain the viroid from infected pollen are affected. This is important to note because it can be tempting to remove a tree with symptomatic fruit, but without testing of leaves from the tree itself and confirming that it is infected, that tree may be needlessly destroyed.

For almost a year, monthly collections from symptomless carriers of ASBVd have been made and analyzed by PCR. To date, no decline in the sensitivity of detection has occurred regardless of the time of year. With some pathogens severe heat or cold can affect the titre and therefore detection of the agent. This does not seem to be a problem with ASBVd.

Future research is aimed at determining to what extent samples from trees to be tested can be pooled so that by running a single test it will be possible to confirm that all included samples were free from ASBVd.

The benefits to the industry that we can see from this research is that it should lead to an increase in the overall freedom from pathogens in our avocado trees. Identification of the presence of ASBVd in new and established varieties as well as certified nursery trees can only strengthen the industry as a whole. New technology is available that will aid in the identification of other viral pathogens and their possible relationship to diseases such as black streak, the problem of using Thomas as a rootstock, and the dwarfing nature of the 'Colin V-33' variety. Topworking of new varieties on old varieties and or rootstocks is practiced with little thought to viral status. Much valuable work on crop improvement that has been incorporated into the development of new varieties, either rootstocks or scions, could be lost if no attention is given to the possibility of acquiring graft transmissible agents from the material used to increase the new materials.

Figure 1. Fruit symptoms caused by the Avocado sunblotch viroid (ASBVd).