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Cause of Witches Broom on Blue Palo Verde

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Witches broom disease of blue palo verde (*Parkinsonia florida*) has become very common in southern Arizona landscapes. Blue palo verde is a native and the state tree of Arizona. It is very popular in urban landscapes due to its striking green-colored trunk and branches, spectacular yellow flowers in spring, fast growth rate, and excellent performance in the arid climate. Brooms are characterized by clusters of dense, short branches with leaves and without thorns and can be found throughout the tree canopy. Some trees have no brooms when transplanted into the landscape and others are composed almost entirely of brooms, making them appear as a dense shrub.

Problems associated with witches broom disease of landscape trees are broom dieback, breaking of large brooms during storms, and structural issues caused by the removal of branches and the possibility for sunburn to occur on branches in the canopy that become exposed to direct sunlight. Witches broom disease of palo verde is most prevalent in blue palo verde, however, very few cases have been observed in the other palo verde species such as Foothills palo verde (*Parkinsonia microphylla*), palo brea (*Parkinsonia praecox*), Mexican palo verde (*Parkinsonia praecox*), the Desert Museum hybrid (*Parkinsonia* x Desert Museum) or other hybrids in the trade.

Witches broom symptoms on palo verde were first described over 50 years ago, however, their cause was unknown. Our research results have identified the presence of a previously unknown plant virus, in the genus Emaravirus, in the shoots, leaves, flowers, seeds, and suckers tested from blue palo verde trees that were affected by broom. The presence of the single-stranded RNA virus was not detected in the same tissues tested from plants showing no symptoms of broom disease. This plant virus associated with broom-affected palo verde trees has not been discovered until now. About 60% of the viral genome sequence is similar to another plant virus named *High Plains wheat mosaic virus*. Other emaravirus species are known that infect European mountain ash (*Sorbus aucuparia*), fig (*Ficus carica*), pigeonpea, (*Cajanus cajan*), raspberry (*Rubus* spp.), and rose (*Rosa multiflora*). The symptoms characteristic of emaravirus infection include blotching, chlorotic ringspots, and mottling of leaves, and smaller than normal, or stunted leaves. Infected rose plants show rose rosette symptom, which appears similar to a witches broom where multiple shoots, densely clustered leaves, and sometimes red-colored leaves emerge from a single node.

Several of the known emaraviruses are transmitted by eriophyid mites. These arthropods are often host specific, meaning they populate only one genus or possibly a single species of plants. The presence of the eriophyid mite *Aculus cercidi* has been associated with broom symptoms for some time, and it was suspected to cause feeding damage that resulted in the development of broom symptoms. However, until now, no causal relationship had been established between the eriophyid mite and the broom symptoms in palo verde tree. Based on insects and arthropods collected from broom infested and healthy, non-symptomatic trees for several years, consistently high populations of *A. cercidi* were observed infesting trees with broom symptoms, while mites were in low abundance or rarely found in apparently healthy, non-symptomatic trees. This strong association between the presence of the emaravirus in broom of blue palo verde trees that were heavily infested with the suspected eriophyid vector and the absence of both virus and vector on non- symptomatic trees provides strong support for a causal relationship between emaravirus and the witches broom disease of blue palo verde.

Eriophyid mites are sometimes confused with spider mites. Eriophyid mites are very small and require usually a 20x magnification hand lens to see on a plant and at least 80x magnification to observe the different life stages more closely under a microscope. Identification of the eriophyid mite species requires an image with an electron microscope and the assistance of a mite expert.

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This blue palo verde appeared healthy without a single broom two years ago. Now the majority of the canopy consists of broom. (Image courtesy of U. Schuch)

Hundreds of eriophyid mites have colonized these leaves of blue palo verde. An eyelash in the picture serves as reference. (Image courtesy of S. Avelar)