

Role of Weeds in Pathogen Management

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Of the groups of plant pathogens, viruses are probably the most dependent on alternate host plants for their survival. Viruses are intracellular obligate parasites and as such are absolutely dependent on their plant hosts (Table 1). All plant viruses have host-ranges including crop and weed host plants and as such weeds can be important factors in virus incidence and epidemiology. However, just because a weed or alternate host plant is susceptible to a given virus this does not mean that it is an epidemiologically important host plant. In addition to being dependent on their plant hosts, viruses must have a means to move from plant-to-plant. For most viruses this is accomplished by a vector (Table 1). Most vectors are arthropods with insects being far and away the most frequent, and of the insects that transmit viruses to plants, aphids are the most common plant virus vectors. However, not all aphids can transmit all plant viruses; vector transmission is specific. It is determined in part by genetic information contained within the virus genome, and in some cases a given virus may have only one or a few species of vector, while others may have many. But this means that in addition to the virus having a plant host and a vector, for the virus to survive and spread the vector must encounter the host plant. It must acquire the virus from the virus-infected plant and then transmit the virus to the healthy plant. Thus, if a plant (weed) is a good host for the virus but not encountered by the vector for that virus, the plant will very likely be unimportant epidemiologically. Finally, for the host plant to be epidemiologically important as an alternate host, the virus, host plant and vector must be present at the right time and place. Therefore, each virus disease must be considered separately. Weeds, as important alternate host plants for a given virus could vary in their importance depending on many factors. Some examples are discussed briefly below.

Carrot motley dwarf (CMD; 4), lettuce mosaic caused by *Lettuce mosaic virus* (LMV; 3), and curly top caused by *Beet curly top virus* (BCTV; 1, 2) have varying dependence on weeds in regards to resulting disease. CMD, which occurs in carrots in the Salinas and San Joaquin valleys of California can be a devastating disease of carrots, especially early spring carrots. If carrot plants are infected early in their growth they will be stunted, yellowed and have very poor root growth. The viruses causing CMD are transmitted from plant-to-plant by only one species of aphid, the carrot aphid, *Cavariella aegopodii*. The viruses causing CMD and the carrot aphid both have narrow host ranges and in the Salinas and San Joaquin Valleys their host ranges only overlap in carrots (4). Thus, carrots are the sole important host plant in disease epidemiology. If carrots are over-wintered in the ground in the Salinas Valley, then these can serve as an important source of primary inoculum for subsequent CMD development. Weeds are of no

significance. CMD can then be easily controlled by not over-wintering carrots or not planting early spring carrots near overwintered fields.

LMV also can cause a devastating lettuce disease and is the most important virus pathogen of lettuce worldwide. LMV has a moderate host range including a number of plants (weed, crop and ornamentals) in the family Asteraceae. LMV also can be spread efficiently from plant-to-plant by a number of aphids so adequate opportunities exist for spread. However, just because host plants exist does not mean that they are important sources of virus for subsequent disease development. Data have clearly demonstrated that weeds and other alternate host plants are not significant sources of inoculum (3). The most important source of primary inoculum is seedborne LMV. As long as lettuce seed is tested and only seed that has fewer than 1 LMV-infected seed in 30/000 is planted, significant LMV epidemics will not develop. In this example we know that weed hosts are present. It is a good idea (and in fact is done) to eliminate weed hosts nearby lettuce fields, but controlling weed host plants alone will not give adequate disease control.

Curly top, caused by BCTV, is a widespread and important disease. BCTV and its vector, the beet leafhopper (*Circulifer tenellus*), both have tremendously wide host ranges and are endemic throughout the western U. S (1). In this example, weeds and other alternate host plants have essential roles in disease epidemiology and in attempts to control BCTV. The beet leafhopper is a migratory insect and overwinters in the foothills of the westside of the San Joaquin valley of California. As viruliferous leafhoppers can carry BCTV essentially for life leafhoppers can remain viruliferous through the winter. In addition, perennial shrubs such as buckbrush are perennial hosts for BCTV and thus abundant BCTV-infected hosts are always present (2). In early spring the leafhopper migrates from its overwintering plants onto the germinating dicots on the westside foothills. This includes host plants such as mustards and filaree, good hosts for both the leafhopper and BCTV. In the spring the leafhopper populations begin to build up and many of the leafhoppers become viruliferous. As the annual dicots on the hills begin to dry up the leafhoppers migrate down into the valley floor where there are now abundant crop host plants including tomatoes, beans, peppers and sugarbeets. Curly top can develop. In this situation weeds are important in overwintering and spring population build up of the viruliferous vector. Control strategies are aimed at these two non-crop locations. However there are so many weed hosts that attempting to eliminate them would be unsuccessful. Therefore the strategy is to attempt to control the leafhopper on the non-crop, alternate plant hosts before it migrates into crop plants.

The above examples represent just three of the many different plant viruses, but these show different importance of weeds in resulting disease incidence and epidemiology. Because plant viruses are so dependent on their plant hosts for survival it is easy to make assumptions that weeds (or other alternate host plants) have important roles in the resulting disease development and epidemiology. This is not always true. Each virus situation can be different and it is important to do careful research to determine the real role of weeds in disease epidemiology.

Table 1. Characteristics of Viruses

1. Viruses are obligate parasites, they must have a living host (a plant, crop or weed host).
2. Viruses are non-cellular molecular parasites, they use the host cell molecular machinery to replicate.
3. Viruses must have a means to move from host-to-host, for plant viruses this is among a sedentary host population.
4. For movement, they depend on vectors.

Table 2. Host ranges and importance of weeds in resulting disease incidence for selected plant viruses.

| | <u>Virus</u> | <u>Vector**</u> | <u>Importance</u> |
|-----------------------------|--------------|-----------------|-------------------|
| Carrot Motley Dwarf* | Narrow | Narrow | Little/None |
| <i>Lettuce mosaic Virus</i> | Moderate | Wide | Little |
| <i>Beet curly top virus</i> | Wide | Wide | High |

*Carrot Motley Dwarf is caused by a co-infection of *Carrot red leaf virus* and *Carrot mottle virus*.

**The vectors are: the carrot aphid, *Cavariella aegopodii* for the Carrot motley dwarf viruses; many aphids efficiently transmit *Lettuce mosaic virus* in a nonpersistent manner; the beet leafhopper, *Circulifer tenellus* is the vector of *Beet curly top virus*.

References:

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