Weeds as Hosts (and Non-Hosts) of Vegetable Pathogens

Steven T. Koike, University of California Cooperative Extension, Monterey County
1432 Abbott Street, Salinas CA 93901 Email: stkoike@ucdavis.edu

Introduction

It is well known that weeds (defined here as non-crop plants) can be an important part in the epidemiology of vegetable diseases. Weeds can play the following roles: reservoirs or initial inoculum sources of the pathogens; means of pathogen survival between crops; reservoir or source of the pathogen vectors; possible mechanism for effecting genetic change and variation in the pathogen. Weeds perhaps are most noted as playing a part in virus diseases of vegetables but can also be important in several fungal and bacterial problems as well. In recent years there have been some important vegetable crop disease outbreaks that include a weed component in the disease epidemiology.

Case studies: recent vegetable disease/weed host interactions in coastal California

Impatiens necrotic spot virus (INSV) in lettuce. Historically and worldwide, INSV never was found to infect lettuce. However, beginning in 2006 and continuing through 2010, significant and damaging cases of INSV were experienced on numerous romaine, greenleaf, redleaf, butter, and iceberg plantings in Monterey and San Benito counties. Researchers wondered why INSV, which had been present in coastal counties for many years on horticultural crops and landscape plants, would now infect lettuce and cause such significant losses. Hypotheses about a novel INSV strain were discounted when molecular evidence indicated that the coastal INSV outbreaks are caused by a typical strain of INSV that does not differ significantly from ornamental INSV strains. A two-year survey indicated that the vast majority of thrips present in diseased lettuce fields are western flower thrips (*Frankliniella occidentalis*), showing that the vector is the usual and expected species. The source of virus inoculum also remained a mystery as field surveys conducted in 2007 and 2008 failed to find a widespread weed or alternate host candidate that could act as a reservoir of INSV. However, the summer 2009 and winter 2010 surveys revealed that cheeseweed (*Malva parviflora*) and shepherd's purse (*Capsella bursa-pastoris*) weeds were widely infected; such weeds were collected on and around ranches having a history of INSV outbreaks. At two lettuce-producing sites having chronic INSV problems, INSV-positive cheeseweed was readily found in vineyards adjacent to and upwind from the lettuce plots. It is notable that infected weeds appear symptomless and therefore do not give visual indications of being reservoirs of INSV.

Apium virus Y (ApVY) in celery. Starting in 2007 and continuing through 2010, striking disease symptoms were detected on celery grown in various locations in Santa Clara and Monterey counties. Affected plants could show extensive yellowing and deformity of the leaves, as well as distinct, large brown to tan lesions on the petioles. Such petiole lesions prevented the celery from being marketable and resulted in direct crop loss. The new disease was caused by *Apium virus Y* (ApVY), a virus not reported previously on celery in California. The virus appears to be host specific to plants in the Apiaceae. Because the virus was proven to not be carried in celery seed, attention was focused on finding alternative Apiaceae hosts as sources of viral

inoculum. An extensive survey showed that poison hemlock weed in Monterey and Santa Clara counties was commonly infected (64%) with ApVY. Anise weed (only four collected) was negative. Positive poison hemlock was also found in Santa Cruz and Ventura counties; ApVY-infected parsley was later confirmed in Ventura County. The widespread infection of poison hemlock was an important finding and demonstrates that this weed can be a significant reservoir host for ApVY. Management of ApVY in celery likely depends on control of poison hemlock and the aphids that vector the virus.

When a weed host is not a "host"

Understanding the diagnostic process and disease epidemiology in crop/weed dynamics relies on knowing which diseases affect crops and weeds. Two valuable sources of this knowledge are host range and pathogen lists. On a host range list, for any particular pathogen there is listed all the plants that are known to be susceptible to that pathogen. On a pathogen list, for any particular plant there is listed all the pathogens that are known to cause disease on that plant. These lists are found in books, journals, other printed publications, and on-line sources. While host range and pathogen lists are essential tools, such lists also have their limitations. For example, white rust (*Albugo candida*) of crucifers and downy mildew (*Peronospora farinosa*) of chenopodium plants are two diseases listed as affecting a number of crop and weed species. However, the crops and weeds are actually infected by different races, so the race colonizing a weed will not infect crops. Therefore, one needs to evaluate and use such lists carefully.

Diagnostic implications

1. The infected weed host of a pathogen (especially pertaining to viruses) may be symptomless. Therefore, surveys and studies should account for this possibility.
2. Mis-diagnosis of virus pathogens can readily occur. Therefore, reliance on symptoms is not recommended. More robust diagnostic methods (ELISA, PCR) are required.
3. Host range lists should be used carefully. If crop and weed species are listed as hosts of the same pathogen, one must define "same." The existence of races and strains means that any one particular pathogen may not cross infect both the crop and the weed.

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