Pepper Viruses: Survey Update
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INTRODUCTION

Several viruses attack pepper worldwide. In California, many of these viruses have created difficulties for growers. However, we witnessed cycles of high virus presence, viral infection, and yield losses alternating with cycles of low-level impact. Year 2004 was one of those years where the central coast production area witnessed a high level of virus presence.

The following report is based on a field survey we undertook in the fall of 2004 to assess the presence and identify the main viruses infecting fields in Santa Carla and San Benito counties. We focused our effort on the Gilroy and surrounding areas. Gilroy has historically exhibited a variable but sustained presence of viruses over the past 15 years.

SURVEY—

The survey included 14 pepper production fields. Half were growing bells and the other half chili peppers. We took 29 samples as follows: 16 were bell pepper samples, 12 were chili type samples, and one was sowthistle weed.

The sampling was biased toward selecting plants that exhibiting some symptoms. All samples were catalogued and submitted to a local serology lab for virus identification.

SURVEY RESULTS

Infection by viruses level varied from field to field and even within given fields. Infection rate, based on rough visual rating, was between 5 to over 75% (?) per field. Several fields had large weeds populations.

A couple of fields looked like they have been severally attacked and very little harvest was realized. Others had patches of severe infection, while a few may have been infested early in the season (late June early July). Every sample collected was infected (sampled only affected plants). CMV was found in 38% of samples.

Table 1. Virus Incidence in the surveyed areas, fall 2004

	TMV	TSWV	CMV	PeMoV	PVY	TEV	Total
#	**1**	**21**	**16**	**1**	**2**	**1**	**42**
%	**2.4%**	**50%**	**38%**	**2.4%**	**4.8%**	**2.4%**	**--**

TSWV accounted for 72% of the infections. CMV was found in 48% of the samples while multiple-infections (2 or more viruses) were detected in 38% of the samples.
Misc. low-level detection (2-5% for: Pepper mottle virus, Potato virus Y)

CUCUMOVIRUS – CMV: Cucumber mosaic virus (38% presence)

Symptoms

- Symptoms on plants affected with CMV vary
- Plants show an overall lighter color: mosaic patterns (alternating light and dark green areas) especially on the younger leaves.
- Often, the main leaf vein is distorted and somewhat zigzag in appearance.
- Generally, plants show stunting, leaf curling, and mosaic, and oak leaf patterns.
- Fruit may be malformed and have conspicuous concentric rings or spots.

Transmission

CMV is spread from plant to plant by aphid vectors. Many aphid species are competent vectors. Transmission occurs while aphid is probing the leaf tissues.

- Aphid retains virus for only a short time, minutes to hour, a non-persistent manner
- In general, field spread is related to overall aphid activity, not to the presence of colonizing aphids.

Host range

Several crops, ornamentals, and weed species are host to the virus: tomato, pepper, cucumber, melons, squash, spinach, celery, beets, petunia, chickweed, mustard, sowthistle, and nightshade

Management

No good sources of cucumber mosaic cucumovirus resistance in peppers are currently available. Efforts are underway to develop resistant cultivars that also have commercial fruit quality.

TOSPOVIRUS—TSWV: Tomato spotted wilt virus (50% presence)

For years, TSWV was encountered in the fields in the vicinity of Gilroy, but not of great importance to the pepper industry. In 2004, late season sampling indicated that 50% of the samples were infected with solely or partially by TSWV.

Symptoms

Infected plants with tomato spotted wilt virus are overall yellowing (chlorosis), stunted with dead (necrotic) spots on leaves or terminal shoots.

Fruits show chlorotic spots, red and/or green areas surrounded by yellow halos, concentric rings that may become necrotic.

Transmission

Tomato spotted wilt tospovirus is transmitted by various species of thrips, Western flower thrips *(Franklinella occidentalis),* and Onion thrips *(Thrips tabaci),* and chili thrips *(Scirtothrips dorsalis).* Tomato spotted wilt tospovirus also infects the thrips vector.

It is one of the few plant viruses whose host range includes broadleaf and monocot plants (such as onions).

Host range
Tomato spotted wilt tospovirus has an extremely wide host range among plants, including many crops, ornamental, and weed plant including several greenhouse plants.

Management
No completely effective control strategies are currently available in California. No resistant cultivars are available, but sources of resistance have been identified and may be introduced soon. TSWV remains a big problem in greenhouse crops

OTHER MINOR VIRUSES IN THE SURVEY
TOBAMOVIRUS—FROM TOBACCO—TMV: Tobacco mosaic virus (2% presence)

Transmission
An important source of primary inoculum is contaminated seed. The virus is carried on the seed coat, and thus can be removed from contaminated seeds by washing seed with dilute solutions of tri-sodium phosphate.
Mechanical spread by handling and by mechanical damage to plants (not insects)
The tobamoviruses are very stable viruses. They can survive in plant debris for many years.

Management
The best control is to use seed that has been treated to eliminate the seedborne inoculum.
Minimizing plant handling and damage.
Good sources of plant resistance genes (L1-L4 genes) to various pepper tobamoviruses exist
No chemical strategies are effective.

POTYVIRUS— PVY: Potato virus Y (5% presence)
TEV: Tobacco etch virus (2% presence)
PepMoV: Pepper mottle virus (2% presence

Symptoms
Overall light color with mosaic (contrasting light and green colors) patterns on younger leaves.

Transmission
Active aphids (as opposed to colonizing) are the main vector.

Host Range
Wide host range including several solanaceae plants (tomato, potato, eggplant)

Management
Management is difficult because of the unpredictable nature of virus outbreak. Silver reflective mulch use may delay aphid establishment in early plant growth (less than 50% cover of mulch)

CONCLUSION:

Virus control is not easy and may not be achievable in the soon. A management strategy combining different tactics may be useful in alleviating the impact but may not eliminate the threat in the immediate future.
Virus occurrence is very dynamic and varies among season, within same season, and among fields and often within a given field. Mixed infections by more than one virus are not rare and complicate the diagnosis and control strategies.

So, there is an increasing need for a more comprehensive approach combining vigilance, field scouting, frequent sanitation, use of alternate control strategies and pesticides to avoid vector resistance buildup, isolation, breeding, with regional and statewide cooperation that involve trade associations, industry and university research, regulatory and educational intuitions.

Table 2. Viruses Affecting Pepper Plants in California

Virus name	Acronym	Group	Transmission by
Alfalfa mosaic virus	AMV	Alfamovirus	Aphid
Cucumber mosaic virus	CMV	Cucumovirus	Aphid
Pepper mild mottle virus	PMMoV	Tobamovirus	See, mechanical
Pepper mottle potyvirus	PeMV	Potyvirus	Aphid
Tobacco mosaic virus	TMV	Tobamovirus	Seed, mechanical
Tomato mosaic virus	ToMV	Tobamovirus	Seed, mechanical
Pepper mottle virus	PepMoV	Potyvirus	Aphid
Potato virus Y	PVY	Potyvirus	Aphid
Tobacco Etch virus	TEV	Potyvirus	Aphid
Tomato spotted wilt virus	TSWV	Tospovirus	Thrips
Beet curly top virus	BCTV	Geminivirus	Leafhopper
Beet western yellows	BWYV	Luteovirus	Aphid (persistent)
Potato leafroll virus	PLRV	Luteovirus	Aphid (persistent)