cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Tobacco Etch Virus

Current Pest Rating: C

Proposed Pest Rating: C

Kingdom: Viruses and viroids, Category: Riboviria

Family: Potyviridae, Genus: Potyvirus

Comment Period: 8/18/2020 through 10/2/2020

Initiating Event:

On August 9, 2019, USDA-APHIS published a list of "Native and Naturalized Plant Pests Permitted by Regulation". Interstate movement of these plant pests is no longer federally regulated within the 48 contiguous United States. There are 49 plant pathogens (bacteria, fungi, viruses, and nematodes) on this list. California may choose to continue to regulate movement of some or all these pathogens into and within the state. In order to assess the needs and potential requirements to issue a state permit, a formal risk analysis for Tobacco etch virus is given herein and a permanent pest rating is proposed.

History & Status:

Background:

The family Potyviridae contains several genera, the largest of which is Potyvirus, which contains by far the highest number of very important plant viruses. They are flexuous filamentous viruses with monopartite particles. They have a single strand positive-sense RNA and surrounded by a capsid made from a single viral encoded protein. The main body of the potyvirus RNA is translated into one polyprotein of about 346,000 daltons that is subsequently cleaved at specific points to produce smaller polyproteins, which are eventually cleaved again. All potyviridae form cylindrical inclusion bodies in infected cells and are transmitted in nature by a variety of vectors, most importantly aphids.

Potyvirus is named after Potato virus Y, which is the type strain for the genus. This genus includes many of the viruses causing the most severe diseases of crop plants. Similar to other potyviruses, TEV infects many host species in the family Solanaceae.

Hosts: Amaranthus caudatus (love-lies-bleeding), *Beta vulgaris* (beet), *Capsicum annuum* (bell pepper), *Capsicum frutescens* (chili pepper), *Celosia argentea* (silver cock's comb), *Chenopodium album* (fat hen), *Chenopodium giganteum* (tree spinach), *Chenopodium foetidum* (stinking goosefoot), *Chenopodium quinoa* (quinoa), *Cirsium vulgare* (spear thistle), *Datura ferox* (fierce thornapple), *Datura metel* (devil's trumpet), *Datura stramonium* (jimsonweed), *Gomphrena globose* (globe amaranth), *Gypsophila elegans* (baby's breath), *Hyoscyamus niger* (henbane), *Lycopersicon esculentum* (tomato), *Melilotus albus* (white sweet clover), *Nicandra physalodes* (shoo-fly plant), *Nicotiana bigelovii* (Indian tobacco), *Nicotiana clevelandii* (Cleveland's tobacco), *Nicotiana glutinosa*, *Nicotiana rustica* (Brazillian tobacco), *Nicotiana sylvestris* (tree tobacco), *Nicotiana tabacum* (tobacco), *Nicotiana × edwardsonii*, *Petunia × hybrida*, *Physalis floridana*, *Physalis peruviana* (cape gooseberry), *Senecio vulgaris* (common groundsel), *Senna obtusifolia* (sicklepod), *Senna tora* (sickle senna), *Solanum melongena* (eggplant), *Solanum nigrum* (black nightshade), *Solanum tuberosum* (potato), *Solanum seaforthianum* (Brazilian nightshade), *Solanum viarum* (tropical soda apple), *Tetragonia tetragonioides* (New Zealand spinach), *Torenia fournieri* (wishbone flower), and *Zinnia elegans* (zinnia) (CABI-CPC, 2020, Brunt et al., 1996).

Symptoms: Virions of TEV can be found in mesophyll and epidermis cells, in the cytoplasm, and in the plasmodesmata of infected plants. Viral inclusions are common inside infected cells. These are crystals in the nucleus and pinwheels in the cytoplasm. Since the virions all look alike, differences in the inclusions can aid in the diagnosis of TEV with their characteristic triangular or pyramid shapes (Purcifull et al., 1970).

> *Tobacco:* Initial symptoms of TEV on tobacco are very subtle. Veins of inoculated leaves begin to clear which gradually develops into an "etching" pattern. Mosaic symptoms are found on young leaves first, soon after aphid inoculation, and spread systemically. Disease severity depends upon the strain of the virus. Infected plants are often lighter in color. Over time, there is a breakdown of interveinal tissue with necrotic spotting and occasional browning of veins. Leaves are narrowed and plants are stunted. The etching symptom of TEV is restricted to tobacco and although it is a distinctive characteristic, TEV symptoms can often resemble symptoms of other potyviruses that are often found in combination with TEV as a virus complex (Shew and Lucas, 1991).
>
> *Peppers:* The appearance and severity of symptoms varies by pepper variety, strain of virus, age of the plant at infection, and environmental conditions. Symptoms include leaf mottling and distortion and plant stunting. Plants show an overall lighter color along with mosaic patterns (alternating light and dark green areas), especially on the younger leaves. There is also leaf curling and fruit distortion. Hot peppers such as tabasco can develop severe wilting (Greenleaf, 1953). Affected fruits may be smaller and distorted in shape with chlorotic streaks or mosaic patterns. In the field, peppers are usually infected by more than one virus (Koike et al., 2009).

Multiple infections result in more severe and complex symptoms than those caused by TEV alone.

Tomatoes: In general, plants develop an overall lighter coloring and a bushy appearance, and all stages of plant growth may be affected. Mosaics of light and dark green will be visible on some leaves, especially the younger ones. Leaves may show mild mottling, crinkling, distortion, reduction in size, and pronounced downward curling. Plants infected early have shortened internodes and can be severely stunted. Fruit may be distorted and develop mosaic symptoms, and do not reach full size. Internally, brown areas and necrotic areas develop, and the fruit do not ripen normally (Davis et al., 2013).

Transmission: TEV is transmitted plant-to-plant in a non-persistent manner by aphids, especially green peach aphids (*Myzus persicae*). Spread is often very rapid and localized, occurring when aphids are actively moving through the crop, not when they colonize to reproduce on plants. Aphids only retain the ability to transmit the virus for very short periods of time (minutes to hours). There is no evidence that TEV is seedborne or that it follows a seed pathway. Secondary spread occurs as aphids move from plant to plant. The virus may also be transmitted mechanically through sap and during field activities such as staking, pruning, or harvesting from infected plants (Zitter, 1971; Smith et al., 2011).

Damage Potential: Viruses are the most common and damaging disease problems in tobacco, pepper, and tomato. TEV is one of the major aphid vectored viruses in the United States. Occurring alone or in combination, TEV can destroy entire fields. The appearance and severity of TEV is unpredictable, depending on the prevalence and activity of its aphid vectors. Insecticides are generally ineffective since transmission can take place during brief insect feeding periods. TEV exists as a collection of strains, some of which differ in their host range and disease severity. It is common to find plants simultaneously infected by more than one potyviruses or simultaneously infected by cucumber mosaic virus, which complicates disease assessments (Smith et al., 2011; Davis et al., 2009; Koike et al., 2013; Shew and Lucas, 1991).

Worldwide Distribution: Asia: *China, India, Singapore, Turkey. Europe: Cyprus, France, Hungary, Russia, Spain*; North America: *Canada, Cuba, El Salvador, Guatemala, Jamaica, Mexico, Puerto Rico, Trinidad and Tobago, United States* (Alabama, Arizona, California, Connecticut, Delaware, Florida, Georgia, Hawaii, Idaho, Illinois, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Texas, Vermont, Virginia, Wisconsin); South America: *Venezuela*

Official Control: TEV is on USDA's PExD harmful organisms list for these countries: Colombia, Georgia, Israel, Japan, Mexico, Republic of Korea (USDA PCIT, 2020). TEV is an EPPO Quarantine pest for Israel and Mexico, and on the A2 list for Jordan. Peppers are a host of concern for TEV for USDA's export seed certification programs (CDFA Phytosanitary Field Guide, 2020).

California Distribution: Fresno, Imperial, Riverside, Merced, San Benito, San Diego, San Joaquin, Santa Barbara, Santa Clara, Stanislaus, Tulare, Ventura, and Yolo counties on tomato, datura, and pepper. (CDFA PDR Database; French, 1989)

California Interceptions: None

The risk Tobacco etch virus would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** TEV survives inside its agronomic and weed hosts, which grow statewide.

   Evaluate if the pest would have suitable hosts and climate to establish in California.

   Score: **3**
   - Low (1) Not likely to establish in California; or likely to establish in very limited areas.
   - Medium (2) may be able to establish in a larger but limited part of California.
   - High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** The host range of this virus is large including plants in multiple families

   Evaluate the host range of the pest.

   Score: 3
   - Low (1) has a very limited host range.
   - Medium (2) has a moderate host range.
   - High (3) has a wide host range.

3) **Pest Reproductive Potential:** TEV reproduces to high titer inside its hosts. It is vectored non-persistently by many species of aphids.

   Evaluate the natural and artificial dispersal potential of the pest.

   Score: 3
   - Low (1) does not have high reproductive or dispersal potential.
   - Medium (2) has either high reproductive or dispersal potential.
   - High (3) has both high reproduction and dispersal potential.

4) **Economic Impact:** Damage to pepper and tomato fruit leaves them unmarketable. Yield is depressed when plants are stunted.

   Evaluate the economic impact of the pest to California using the criteria below.

   Economic Impact: A, B, E.
   A. The pest could lower crop yield.
   B. The pest could lower crop value (includes increasing crop production costs).

C. The pest could trigger the loss of markets (includes quarantines).
D. The pest could negatively change normal cultural practices.
E. The pest can vector, or is vectored, by another pestiferous organism.
F. The organism is injurious or poisonous to agriculturally important animals.
G. The organism can interfere with the delivery or supply of water for agricultural uses.

Economic Impact Score: **3**
- Low (1) causes 0 or 1 of these impacts.
- Medium (2) causes 2 of these impacts.
- High (3) causes 3 or more of these impacts.

5) **Environmental Impact:** There are many weedy hosts of this disease, some of which are native to California i.e. *Nicotiana clevelandii*. Damage has been reported on some of these (Brundt et al., 1996). Perennial weedy hosts act as a virus reservoir and a site of aphid reproduction to nearby crops.

Environmental Impact: A
A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.
B. The pest could directly affect threatened or endangered species.
C. The pest could impact threatened or endangered species by disrupting critical habitats.
D. The pest could trigger additional official or private treatment programs.
E. The pest significantly impacts cultural practices, home/urban gardening or ornamental plantings.

Environmental Impact Score: 2
- Low (1) causes none of the above to occur.
- Medium (2) causes one of the above to occur.
- High (3) causes two or more of the above to occur.

Consequences of Introduction to California for Tobacco etch virus*:* High

Add up the total score and include it here. **14**
-Low = 5-8 points
-Medium = 9-12 points
-**High = 13-15 points**

6) **Post Entry Distribution and Survey Information**: Evaluate the known distribution in California. Only official records identified by a taxonomic expert and supported by voucher specimens deposited in natural history collections should be considered. Pest incursions that have been eradicated, are under eradication, or have been delimited with no further detections should not be included.

Evaluation is 'high'. There are official records of TEV in 13 California counties.

Score: -3
-Not established (0) Pest never detected in California or known only from incursions.
-Low (-1) Pest has a localized distribution in California or is established in one suitable climate/host area (region).
-Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.
-High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

7) **The final score is** the consequences of introduction score minus the post entry distribution and survey information score: (Score)

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* **= 11**

Uncertainty:

None

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for Tobacco etch virus is C.

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Responsible Party:

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***Comment Period: 8/18/2020 through 10/2/2020**

***NOTE:**

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at permits[@]cdfa.ca.gov.

Comment Format:

- Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

  Example Comment:

  Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to "Climate/Host Interaction" here.]

- Posted comments will not be able to be viewed immediately.
- Comments may not be posted if they:

  Contain inappropriate language which is not germane to the pest rating proposal;

  Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;

  Violates agency regulations prohibiting sexual harassment or other forms of discrimination;

  Violates agency regulations prohibiting workplace violence, including threats.

- Comments may be edited prior to posting to ensure they are entirely germane.
- Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.

Proposed Pest Rating: C