

California Pest Rating Profile for *Alstroemeria necrotic streak virus*

Pest Rating: A

Comment Period **CLOSED**: 4/3/2019 – 5/18/2019

Initiating Event:

On October 9, 2018, samples of diseased *Hoya carnosa* (porcelain flower/wax plant) plants exhibiting leaf symptoms of necrotic ring spots were collected from a nursery in San Diego County during an annual CDFA nursery inspection by J. Wilson, San Diego County Agricultural Inspector. These *H. carnosa* plants had originated from Guatemala (Tian, 2019). The samples were sent to the CDFA Plant Pathology Lab for diagnosis of the pathogen associated with the disease. On November 11, 2018, Tongyan Tian, CDFA Plant Pathologist, identified *Alstroemeria necrotic streak virus* (ANSV) by reverse-transcription polymerase chain reaction (RT-PCR) and sequencing, as the pathogen associated with the disease, and sent a leaf sample to the USDA for confirmation of the identification. On January 18, 2019, the USDA notified CDFA of their confirmed identification of ANSV (Condos, 2019). This identification marked the first record of ANSV in the United States. On December 17, 2018, ANSV was detected again in a resample of the affected plants from the same nursery in San Diego County. Also, on December 17, 2018, T. Tian detected ANSV in samples of symptomatic *H. kerrii* (sweetheart plant/valentine hoyo) plants that were collected by J. Wilson, San Diego County, on December 4, 2018, from the same nursery in San Diego County. These *H. kerrii* plants had originated from Thailand (Tian, 2019). Subsequently, all symptomatic *H. carnosa* and *H. kerrii* plants were rendered unmarketable and voluntarily destroyed by the nursery, thereby resulting in the eradication of the associated pathogen (Lovig, 2019). Nevertheless, the risk associated with the possible introduction of ANSV and a proposed rating for this pathogen are documented here.

History & Status:

Background: *Alstroemeria necrotic streak virus* was first described in 2010 from Colombia where it was isolated from *Alstroemeria* plants showing necrotic streak symptoms on leaves and stems (Hassani-Mehraban et al., 2010). In 2017, ANSV was found in field-grown tomato and bell pepper plants in Colombia (Olaya et al., 2017). The recent detection of ANSV in a nursery in San Diego County in California is the first record of this virus outside of Colombia.

Alstroemeria necrotic streak virus belongs to the genus *Tospovirus* in the family Bunyaviridae. Hassani-Mehraban et al. (2010) reported that prior to the development of species-specific molecular tests (RT-PCR and gene sequencing) in 2010, ANSV may have been misidentified as an isolate of *Tomato spotted wilt tospovirus* through serological analytical tests which do not discriminate ANSV from TSWV and other Tospoviruses, and therefore, was not likely to be reported outside of Colombia.

Tospoviruses are transmitted by thrips. In virus transmission tests conducted by Hassani-Mehraban et al. (2010), western flower thrips, *Frankliniella occidentalis*, larvae were found to transmit ANSV when placed on ANSV-infected *Datura stramonium* plants for virus acquisition and then transferred to healthy *D. stramonium*

plants for a limited feeding period and subsequent monitoring for two weeks. Western flower thrips are native to California and widely distributed within the state (CABI, 2019).

Hosts: Presently, ANSV has a range of naturally-infected hosts that is limited to *Alstroemeria* spp. (Peruvian lily), *Solanum lycopersicum* (tomato), and *Capsicum annuum* (bell pepper) (Hassani-Mehraban et al., 2010; Olaya et al., 2017). Several experimental hosts were tested under artificial conditions by Hassani-Mehraban et al., (2010), of which only tomato and bell pepper were recently found to be infected naturally. In addition to the above-mentioned naturally-infected hosts, ANSV was recently detected in *Hoya carnosa* (porcelain flower/wax plant) and *H. kerrii* (sweetheart plant/valentine hoyo) in California (see: 'Initiating Event').

Symptoms: ANSV-infected *Alstroemeria* plants exhibit necrotic streak symptoms on leaves and stems (Hassani-Mehraban et al., 2010). In tomato and bell pepper the virus causes foliar symptoms consisting of necrotic lesion, necrotic rings, veinal necrosis and stem necrosis. Similar symptoms were observed in fruit of bell pepper (Olaya et al., 2017). In California, ANSV-infested *Hoya carnosa* and *H. kerrii* plants exhibited necrotic ring spotting in leaves, with or without necrosis of the vine ends (Lovig, 2019).

Transmission: ANSV is transmitted naturally by the western flower thrips, *Frankliniella occidentalis*. Generally, Tospoviruses are transmitted by at least seven species of thrips. However, the possibility of transmission of ANSV by other species of thrips is not known (Hassani-Mehraban et al., 2010). Tospoviruses are acquired from infected plants by thrips larvae, but not by adult thrips. However, once a larva acquires the virus after feeding on an infected leaf for at least 30 minutes, it retains the virus so that the developed adult thrip is viruliferous and can transmit the virus to healthy plants for the rest of its life (Agrios, 2005). ANSV can also be transmitted through mechanical inoculation and the wide-spread movement of infested plants to non-infested regions.

Damage Potential: Quantitative losses due to ANSV have not been reported. Several other Tospoviruses such as *Tomato spotted wilt virus* and *Impatiens necrotic spot virus*, are known to cause severe damage to their host crops (Hassani-Mehraban et al., 2010). *Alstroemeria necrotic streak virus* can negatively affect growth of *Alstroemeria*, bell pepper, tomato, and *Hoya* plants if the virus was allowed to establish in California. Furthermore, if not effectively controlled, the western flower thrips may spread the pathogen from infested sites to non-infested ones and thereby cause possible losses in crop value and increased costs in pest management and overall crop production. Ornamental and transplant crop nurseries may be at particular risk of accidentally introducing ANSV-infested transplants into field production. California's tomato, bell pepper and ornamental plant industry are major contributors to the state's agricultural economy and can be significantly affected by this pathogen.

Worldwide Distribution: *South America:* Colombia (Hassani-Mehraban et al., 2010; Olaya et al., 2017)

Official Control: Presently, in California, ANSV is a quarantine actionable pathogen with a temporary Q rating. No other official control either within the US or internationally, has been reported.

California Distribution: *Alstroemeria necrotic streak virus* is not established in California (see: 'Initiating Event').

California Interceptions: None reported.

The risk *Alstroemeria necrotic streak virus* would pose to California is evaluated below.

Consequences of Introduction:

- 1) Climate/Host Interaction:** ANSV systemically infests its natural hosts. If introduced into California, is likely to establish in climates suitable for the growth of its host plants. Since these host plants are widespread within the state, it is likely for the virus to also be widespread.

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:** Presently, ANSV has a range of naturally-infected hosts that includes *Alstroemeria* sp. (Peruvian lily), *Solanum lycopersicum* (tomato), *Capsicum annuum* (bell pepper), *Hoya carnosa* (porcelain flower/wax plant) and *H. kerrii* (sweetheart plant/valentine hoyo).

Evaluate the host range of the pest.

Score: 1

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

- 3) Pest Dispersal Potential:** ANSV has high reproductive potential within plants and is spread naturally mainly by the western flower thrips, *Frankliniella occidentalis*, which is present in California. It is also spread through the movement of infested planting stock to non-infested sites and can be transmitted mechanically by inoculation.

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:** While quantitative losses due to ANSV have not been reported, it is likely that this pathogen will behave similar to other Tospoviruses that are known to cause severe damage to their host crops (Hassani-Mehraban et al., 2010). If allowed to establish in California, ANSV may negatively affect growth of *Alstroemeria*, bell pepper, tomato, and *Hoya* plants. Furthermore, if not effectively controlled, the Western flower thrips may spread the pathogen from infested sites to non-infested ones thereby, causing possible losses in crop value and increasing costs in pest management and overall crop production. Ornamental and transplant crop nurseries may be at particular risk of

accidentally introducing ANSV-infested transplants into field production. California's tomato, bell pepper and ornamental plant industry are major contributors to the state's agricultural economy and could be significantly impacted by this pathogen.

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

Economic Impact: A, B, C, 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:** Home, urban, private and commercial ornamental and vegetable gardens may be significantly impacted by ANSV which could trigger development of additional official or private treatment programs.

Environmental Impact: D, E

- 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: 3

- 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 *Alstroemeria necrotic streak virus*:

Add up the total score and include it here.

- 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 'Not Established'. The 2019 detections of ANSV-infested Hoya plants in a nursery in San Diego County resulted in the destruction of the infested plants.

Score: 0

-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 = 13*

Uncertainty:

The full host range of ANSV, quantitative losses in crop production caused by ANSV, and the ability of other species of thrips to vector ANSV, are not yet known. Information gained in these areas is essential for a full understanding of the epidemiology of the pathogen.

Conclusion and Rating Justification:

Based on the evidence provided above **the proposed rating for *Alstroemeria necrotic streak virus* is A.**

References:

- Agrios, G. N. 2005. Plant Pathology (Fifth Edition). Elsevier Academic Press, USA. 922 p.
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- Hassani-Mehraban, A., Botermans, M., Verhoeven, J. Th., J., Meekes, E., Saaijer, J., Peters, D., Goldbach, R., and Kormelink, R. 2010. A distinct tospovirus causing necrotic streak on *Alstroemeria* sp. in Colombia. Archives of Virology, 155:423-428.
- Lovig, E. 2019. Email from A. Shepherd, San Diego County to E. Lovig, CDFFA, sent Tuesday, January 22, 2019, 9:51:51 am, Forwarded by E. Lovig to J. Chitambar, CDFFA. Date: Wednesday, March 13, 2019, 10:48:23 am.

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Tian, T. 2019. Email to J. Chitambar, CDFA; cc: J. Wilson and P. Nolan, San Diego County, and U. Kodira, CDFA. Subject: *Orthospovirus Alstroemeria Necrotic Streak Virus* (ANSV). Date: Monday, January 28, 2019, 2:35:07 pm.

Responsible Party:

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