Investigation note

Presence of *Bemisia tabaci* Gennadius and *Trialeurodes vaporariorum* Westwood in north-central Mexico

Rodolfo Velásquez-Valle

Experimental Field Zacatecas-INIFAP. Zacatecas-Fresnillo highway km 24.5, Calera de VR, Zacatecas, Mexico. CP. 98500.

Corresponding author: velasquez.rodolfo@inifap.gob.mx.

Abstract

Horticultural and extensive crops in the states of Aguascalientes, Durango and Zacatecas, located in northern central Mexico are susceptible to being infected with viruses transmitted by the sweet potato whitefly *Bemisia tabaci* Genn. (SPWF). SPWF populations can coexist in this region with another species, the greenhouse whitefly (*Trialeurodes vaporariorum* Westwood) (GHWF), the objective of the work was to confirm the presence of SPWF and GHWF in commercial plots of horticultural and extensive crops and areas of Undergrowth in northern central Mexico. During 2017, variable amounts of whitefly were collected in randomly selected plots of chili, beans, tomatoes, melons, watermelons and a patch of weeds. In most of the sampled plots populations of SPWF and GHWF coexist, although the number of GHWF was generally higher than that of SPWF.

Keywords: identification, presence, whitefly.

Reception date: November 2019
Acceptance date: February 2020

Horticultural and extensive crops in the states of Aguascalientes, Durango and Zacatecas, located in northern central Mexico, are susceptible to being infected with viruses belonging to the genus begomovirus such as pepper huasteco yellow vein virus (PHYVV) and pepper golden mosaic virus (PepGMV). Symptoms caused by this type of virus include a bright yellowing of the leaf tissues and severe yield losses. An outstanding feature of these viruses is the requirement of an organism that must be able to transmit them from diseased to healthy plants and which is known as a vector.

These Begomoviruses are transmitted by the whitefly sweet potato *Bemisia tabaci* Genn. (SPWF) (Lugo *et al*., 2011). In Mexico SPWF is distributed in the main horticultural areas, according to Urías-López *et al*. (2015) in the northwestern region of the country and in the state of Jalisco, mixed populations of SPWF and the whitefly of the greenhouses [*Trialeurodes vaporariorum* (Westwood)] (GHWF) coexist.

The presence of Begomovirus infecting chili plants (*Capsicum annuum* L.) in an area of San Luis Potosi near the most important chili producing area of Zacatecas was reported a few years earlier (Reveles-Torres *et al*., 2012). Studies carried out by Mena-Covarrubias (2014) mentioned that SPWF is not present in the Zacatecas highlands, although GHWF populations, which are not able to transmit Begomovirus, are common in that region.

However, the incidence of SPWF has not been confirmed in northern central Mexico, so the objective of the current work was to confirm the presence of SPWF and GHWF in commercial plots of horticultural and extensive crops and weed areas in northern central Mexico.

From June to November 2017, a variable number of whitefly specimens were collected in commercial plots, randomly selected, from chili, common bean, tomato, cucumber and watermelon, as well as in weed areas in the Aguascalientes Valley, area from Poanas, Durango and the high plateau and southeast of Zacatecas. In all the plots the whitefly was trapped in the underside of the leaves of the crops or weeds by means of a suction pump and were identified and counted as SPWF or GHWF in the Phytopathology Laboratory of the Zacatecas Experimental Field (INIFAP).

Using the information for identification provided by Carapia and Castillo-Gutiérrez (2013) and Mena-Covarrubias (2014) considering the morphology of the ocelos; SPWF adults show divided compound eyes and each eye consists of two separate groups of ommatidia with one ommatidia forming a bridge between the two groups of ommatidia mentioned. In contrast, the omissions of GHWF adults are completely separated.

Adults of whitefly were collected in 34 plots; 28, 3 and 3 of them were located in the states of Zacatecas, Aguascalientes and Durango, respectively. Most of the whitefly collections were made in plots of different types of chili for drying (67.6%), other plots with different crops such as common bean (*Phaseolus vulgaris* L.), cucumber (*Cucumis sativus* L.), tomato (*Solanum lycopersicon* Mill.) and watermelon [*Citrullus lanatus* (Thunb) Matsum & Nakai] representing 11.8, 2.9, 11.8 and 2.9% of the total sampled plots.

Only one site with a weed population such as *Malva parviflora* L. and *Amaranthus* spp., as well as a few spontaneous squash plants (*Cucurbita pepo* L.) was included in the work. Despite the culture or geographic location, SPWF or GHWF specimens were identified in 31 of the sampling sites in both cases. SPWF adults were not found in two plots of Mirasol-type chili in Zacatecas and in one of Pasilla-type chili in Aguascalientes.

On the other hand, adults of GHWF were absent in plots of tomato (var. Galilee), cucumber and watermelon, coincidentally, these three plots were in the southeast region of Zacatecas, characterized by its warm climate. Whitefly were collected in an area of weeds located in the municipality of Morelos, Zacatecas by the end of June 2017, individuals were identified as SPWF (33.3%) and GHWF (66.6%) (Table 1).

Table 1. Presence of *B. tabaci* (SPWF) and *T. vaporariorum* (GHWF) in plots of different crops and weed areas in Aguascalientes, Durango and Zacatecas, Mexico.

Crop/weed	State	Proportion of whitefly (%)	
		T. vaporariorum	*B. tabaci*
Amaranthus spp./*M. parviflora*/*C. pepo*	Zacatecas	66.6[1]	33.3
Cucumber	Zacatecas	0	100
Watermelon	Zacatecas	0	100
Common bean	Zacatecas	75	25
Common bean	Zacatecas	25	75
Common bean	Zacatecas	42.8	57.2
Common bean	Durango	20	80
Tomato	Aguascalientes	75	25
Tomato	Aguascalientes	0	100
Tomato	Zacatecas	66.6	33.3
Tomato	Zacatecas	62.5	37.5
Chili (Pasilla type)	Zacatecas	80	20
Chili (Pasilla type)	Zacatecas	60	40
Chili (Pasilla type)	Zacatecas	66.6	33.3
Chili (Pasilla type)	Zacatecas	85.7	14.2
Chili (Pasilla type)	Zacatecas	81.8	18.2
Chili (Pasilla type)	Aguascalientes	88.9	11.1
Chili (Pasilla type)	Aguascalientes	100	0
Chili (Mirasol type)	Zacatecas	75	25
Chili (Mirasol type)	Zacatecas	100	0
Chili (Mirasol type)	Zacatecas	83.3	16.7
Chili (Mirasol type)	Zacatecas	70	30
Chili (Mirasol type)	Zacatecas	75	25
Chili (Mirasol type)	Zacatecas	63.6	36.4
Chili (Mirasol type)	Zacatecas	83.3	16.7

Crop/weed	State	Proportion of whitefly (%)	
		T. vaporariorum	*B. tabaci*
Chili (Mirasol type)	Zacatecas	40	60
Chili (Mirasol type)	Zacatecas	41.2	58.8
Chili (Mirasol type)	Zacatecas	60	40
Chili (Mirasol type)	Zacatecas	66.6	33.3
Chili (Mirasol type)	Zacatecas	100	0
Chili (Mirasol type)	Zacatecas	66.6	33.3
Chili (Mirasol type)	Durango	61.5	38.4
Chili (Ancho type)	Aguascalientes	71.4	28.6
Chili (Ancho type)	Durango	66.6	33.3
Chili (Ancho type)	Zacatecas	15.4	84.6
Chili (Ancho type)	Zacatecas	60	40

[1]= percentage of the total population captured in each plot or sampling site.

Two species of the genus *Amaranthus*, (*A. blitus* L. and *A. quitensis* Kunth) were reported in Argentina as hosts of SPWF and GHWF (Gonsebatt *et al*., 2012), as were *Amaranthus* plants found in the weed zone in Morelos, Zacatecas, are hosts of SPWF and GHWF. All whitefly collected in cucumber and watermelon plots located in the municipality of Huanusco, Zacatecas. They were identified as SPWF (Table 1) independently of the sampling date.

On the cucumber plot, whitefly were collected in August 2017 while whitefly on the watermelon plot were caught in November 2017, suggesting that SPWF populations may be uninterrupted for a long period; throughout the year and consequently, it highlights the importance of interrupting the planting or transplantation of susceptible crops in specific regions during given periods.

Four plots of common beans were sampled for whitefly; three of them located in Zacatecas and the other in Durango; all under irrigation conditions. Individuals of SPWF and GHWF were found in the four plots; in three of them the number of SPWF was higher than that of GHWF (Table 1). Although bean plants have been, nationally and globally, reported as hosts of SPWF (Cuellar and Morales, 2006; Ortiz *et al*., 2010), until 2010, SPWF infestation of bean plots in Zacatecas had not been mentioned (Mena and Velasquez, 2010).

On the other hand, the presence of GHWF was constant in the four plots sampled in the current work; GHWF is an important bean plague in Colombia and Ecuador and is capable of transmitting species of the genus *Crinivirus* (Manzano and van Lenteren, 2009; Cavalieri *et al*., 2014), there is a lack of information on the ability of GHWF to transmit viruses in it Mexico region.

Four tomato plots were sampled to detect the presence of whitefly, two of them were located in Aguascalientes and the other two in Zacatecas, SPWF indivi0duals were identified in the four tomato plots; however, the number of SPWF individuals was greater than that of GHWF in only one plot located in the southeast region of Zacatecas, this plot was sampled in November 2017 and conserved a population of SPWF that could infest freshly transplanted horticultural crops in that region (Table 1).

Whitefly of three types of chili for drying (Mirasol, Pasilla and Ancho) were obtained in 23 plots. GHWF specimens were identified in all of them; on the other hand, SPWF was also found in most chili plots except for three of them. Except for two plots, the number of GHWF was greater than that of SPWF in all sampled chili plots (Table 1).

The constant presence of SPWF in chili plots may partially explain the incidence of Begomovirus-infected chili plants (PHYVV and PepGMV) in an area of San Luis Potosi (Reveles-Torres *et al*., 2012), close to the main producing region from chili from Zacatecas.

The chili producing areas in southeastern Zacatecas and central Durango have shown an increase in the incidence of plants with symptoms associated with Begomovirus infection in recent crop cycles. However, in the highlands region of Aguascalientes and Zacatecas only chili plants are presented in isolation with the typical symptoms of Begomovirus infection; this could be explained by a reduced availability of viral inoculum or climatic conditions (low temperature) that limit the expression of symptoms or delay the development of the vector.

Currently, *B. tabaci* is considered as a complex of species with at least 24 morphologically indistinguishable biotypes (Torres-Trujillo *et al*., 2017), therefore, the presence of SPWF in different cultivated and wild hosts in the north central region leads to consider the need to identify by molecular means, the biotype or biotypes that infest them.

To date, there is a lack of confirmation of the identity of Begomoviruses infecting chili plants in this region; however, SPWF can transmit other viruses such as *Cucurbit leaf crumple virus* (CLCrV), which has been detected in the eastern part of the state of Durango (Torres-Trujillo *et al*., 2017), it is important to determine its presence/absence in cucurbitaceae de Zacatecas, mainly.

In addition, SPWF has been mentioned as a vector of some members of the *Crinivirus* genus (Tzanetakis *et al*., 2013), which highlights the importance of knowing the full status of this genus as a virus vector in northern central Mexico. GHWF is considered a secondary pest in this region because of its limitation to transmit viruses; however, it is capable of transmitting a limited number of viruses within the genera *Crinivirus* (*tomato infectious chlorosis virus* and *tomato chlorosis virus*) and *Torradovirus* (*tomato torrado virus*) (Amari *et al*., 2008; Méndez-Lozano *et al*., 2012).

Some of these viruses have already been reported in other areas of Mexico, therefore, it is necessary to conduct a search that allows to know the basic epidemiological aspects related to SPWF, GHWF, Begomoviruses and potentially, *Crinivirus* and *Torradovirus* in the most important vegetables for the states from Aguascalientes, Durango and Zacatecas, Mexico.

Conclusions

Populations of whitefly sweet potato (*Bemisia tabaci* Genn.) and greenhouses [*Trialeurodes vaporariorum* (Westwood)] were detected in bean, cucumber, watermelon, tomato and chili plots, as well as in a patch of weed in the north center from Mexico.

In most of the sampled plots populations of *B. tabaci* and *T. vaporariorum* exploding coexist, the same hosts, although those of *T. vaporariorum* were generally larger in proportion than those of *B. tabaci*.

Cited literature

Amari, K.; González-Ibeas, D.; Gómez, P.; Sempere, R. N.; Sánchez-Pina, M. A.; Aranda, M. A.; Diaz-Pendon, J. A.; Navas-Castillo, J. A.; Moriones, Blanca, J. E.; Hernández-Gallardo, M. D. and Anastasio, G. 2008. Tomato torrado virus is transmitted by *Bemisia tabaci* and infects pepper and eggplant in addition to tomato. Plant Dis. 92(7):1139.

Carapia, R. V. E. y Castillo-Gutiérrez, A. 2013. Estudio comparativo sobre la morfología de *Trialeurodes vaporariorum* (Westwood) y *Bemisia tabaci* (Gennadius) (Hemiptera:Aleyrodidae). Acta Zoologica mexicana. 29(1):178-193.

Cavalieri, V.; Manglli, A.; Tiberini, A.; Tomassoli, L. and Rapisarda, C. 2014. Rapid identification of *Trialeurodes vaporariorum, Bemisia tabaci* (MEAM1 and MED) and tomato infecting criniviruses in whiteflies and in tomato leaves by real-time reverse transcription-PCR assay. Bulletin of Insectology. 67(2):219-225.

Cuellar, M. E. y Morales, F. J. 2006. La mosca blanca *Bemisia tabaci* (Gennadius) como plaga y vectora de virus en frijol común (*Phaseolus vulgaris* L.). Rev. Colomb. Entomol. 32(1):1-9.

Gonsebatt, G. G.; Viscarret, M. M. and Lietti, M. M. 2012. Whitefly species (Hemiptera:Aleyrodidae) on wild and cultivated plants in the horticultural region of Rosario, Santa Fe, Argentina. Rev. Soc. Entomol. Argent. 71(1-2):125-136.

Lugo, M. O. Y.; Guzmán, U. R.; García, E. R. S. y León, J. F. 2011. Geminivirus transmitidos por mosca blanca (*Bemisia tabaci*) en tomate, en el valle agrícola de Culiacán, Sinaloa. Rev. Mex. Fitopatol. 29(2):109-118.

Manzano, M. R. y van Lenteren, J. C. 2009. Life history parameters of *Trialeurodes vaporariorum* (Westwood) (Hemiptera:Aleyrodidae) at different environmental conditions on two bean cultivars. Neotropical Entomol. 38(4):452-458.

Mena, C. J. y Velásquez, V. R. 2010. Manejo integrado de plagas y enfermedades de frijol en Zacatecas. Folleto técnico núm. 24. Campo Experimental Zacatecas-INIFAP. Aguascalientes, Aguascalientes, México. 83 p.

Mena-Covarrubias, J. 2014. Insectos vectores de virus y fitoplasmas en el cultivo de chile en México. *In*: virus y fitoplasmas de chile: una perspectiva regional. Libro técnico núm. 14. Campo Experimental Zacatecas-INIFAP. Calera de V. R., Zacatecas, México. 279 p.

Ortiz, C. M.; Medina, T. R.; Valdivia, R. B.; Ortiz, C. A.; Alvarado, C. S. y Rodríguez, B. J. R. 2010. Mosquitas blancas plaga primaria de hortalizas en Nayarit. Rev. Fuente. 2(5):31-39.

Reveles-Torres, L. R.; Velásquez-Valle, R.; Mauricio-Castillo, J. A. y Salas-Muñoz, S. 2012. Detección de infecciones mixtas causadas por begomovirus y curtovirus en plantas de chile para secado en San Luis Potosí, México. Rev. Mex. Fitopatol. 30(2):155-160.

Torres-Trujillo, P. B.; Alvarado-Gómez, O. G.; Estrada-Hernández, M. G.; Ojeda-Zacarías, M. C.; Ávila-Rodríguez, V.; Nava-Camberos, U. y González-Garza, R. 2017. Identificación de biotipos del complejo *Bemisia tabaci* L. y sus Begomovirus asociados en Coahuila y Durango, México. Southwestern Entomologist. 42(1):523-529.

Tzanetakis, I. E.; Martin, R. R. and Wintermantel, W. M. 2013. Epidemiology of criniviruses: an emerging problema in world agriculture. Frontiers in Microbiology. 4:article 119. Doi: 10.3389/fmicb.2013.00119.

Urías-López A. M.; Byerly-Murphy, K. F.; Osuna-García, J. A. y García-Berber, A. 2015. Incidencia de mosquita blanca (Hemiptera:Aleyrodidae), áfidos (Hemiptera:Aphididae) y virosis en melón de Jalisco, México. Folia Entomológica Mexicana. 44(3):331-337.