Revista Mexicana de Ciencias Agrícolas
REMEXCA

DOI: https://doi.org/10.29312/remexca.v16i4.3703

Investigation note

Arthropods associated with blueberries and their link to bud abortion

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Abstract

In order to describe the arthropod fauna associated with blueberry crops and consider its potential link with bud abortion, a study of the taxa present during a phenological cycle of the crop was carried out in a blueberry orchard, Biloxi variety, in Los Reyes, Michoacán, Mexico, from October to February 2022; the recorded taxa were identified and their potential link with bud abortion was assessed. Seven different taxa of arthropods were found, of which the presence of the following stands out: *Brevipalpus yothersi* Baker (Acari: Tenuipalpidae), which is reported as a virus vector, and *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae), due to the damage it causes from the vegetative phase. The analysis indicated that *S. dorsalis* is a taxon that is present from the first vegetative shoots, whereas *B. yothersi* increases its population level significantly when the crop enters the phenological phase of flowering. Based on the characteristics of both pests, it is considered that the simultaneous presence of *S. dorsalis* and *B. yothersi* could be the cause of the phytosanitary problem observed in blueberries.

Keywords:

Brevipalpus yothersi, Scirtothrips dorsalis, Vaccinium corymbosum.

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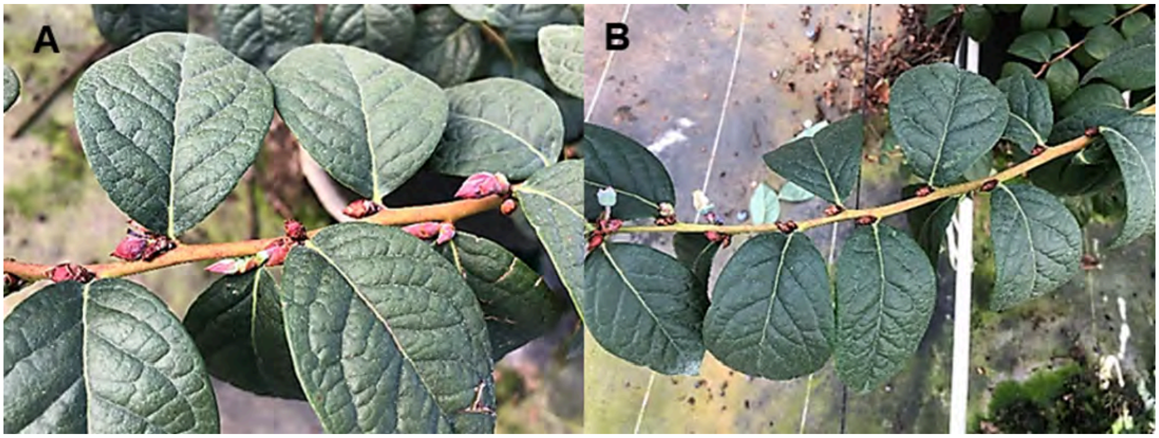
In Mexico, the blueberry *Vaccinium corymbosum* L. (Ericaceae) is the fourth berry of commercial interest in the world, its consumption responds to the interest in the compounds with antioxidant capacity contained in its fruits, which are beneficial for human health (Salgado Vargas *et al*., 2018).

The incidence of pests in blueberries limits and decreases the quantity and quality of the harvest; among them, the microorganisms that cause fruit rot, leaf spots, rust, blighting, and stem cancer stand out, which are caused by *Alternaria* sp., *Colletotrichum* sp.; *Pucciniastrum* sp., *Alternaria* sp., *Colletotrichum* sp., *Curvularia* sp., *Neofusicoccum* sp., *Phomopsis* sp., among others (Mondragón *et al*., 2012).

In addition, there is the presence of very harmful arthropods such as aphids [*Aphis gossypii* (Glover) and *Myzus persicae* (Sulzer)], thrips (*Frankliniella occidentalis* Pergande), scales [*Hemiberlesia rapax* (Comstock) and *Aspidiotus nerii* Bouche], mealy lice [*Pseudococcus viburni* (Signoret)], and mites [*Oligonychus* sp. and *Tetranychus urticae* (Koch)], which are present during all stages of the crop (Larraín *et al*., 2007).

In recent years, in the region of Los Reyes, Michoacán, Mexico, blueberry flower buds that do not sprout have been detected in apparently healthy plants at the beginning of their phenological cycle; bud symptoms range from moderate to severe, with consequent crop losses (Figure 1).

Figure 1. Sprouts on blueberry plants associated with the presence of spider mites. A) healthy plants and B) damaged plants.



Flower bud abortion has been linked to the species *Acalitus vaccinii* (Keifer) (Acari: Eriophyidae), which causes this symptom in blueberries in the United States of America (Cromroy and Kuitert, 2017). It should be noted that this species has not been reported for Mexico (Cervantes Mayagoitia and Huacuja Zamudio, 2020) and is not included in the National List of Regulated Pests (LanGIF, 2009), so its record would imply a new phytosanitary problem for the crop's production process.

In blueberries from Los Reyes, Michoacán, there are no studies that describe the arthropod fauna present and that link it with the symptoms described above, so the taxonomic identification and feeding behavior of the taxa present could reveal the causal agent of the abortion of blueberry buds, which was the objective of this research. The results will offer basic elements that will allow future decision-making in the solution of this phytosanitary problem.

The research was carried out in a blueberry orchard, called GB Isla, located at coordinates 19.6° 05' 41" north latitude, 102.5° 08' 80" west longitude, at 1 290 masl. The orchard received conventional management, which included end-of-season pruning, fertilization, and stimulation in preflowering using the chemical promoter Maxigrow® (1 ml L^{-1} of water), which was applied with a backpack spryer as a contact product.

Sampling began four weeks after pruning, from October to February 2022. The samples were taken every 15 days using the direct collection method: 15 furrows located in the center of the area were

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selected and from them, in a scheme of five coins, 20 plants were chosen, four at each point, 5 organs plant^{-1} were taken, for a total of 100 per sampling; 11 samplings were carried out in total. The organs were taken in similar proportions according to the predominant phenological phase at the time of sampling.

The samples were placed in Ziploc® sealed plastic bags to be taken to the laboratory; once there, all the organs of the branches were separated and then checked by the upper side and underside, plus all the parts of the buds, flowers, and fruits.

All the mites were counted by using the stereo microscope, and with an entomological needle, they were collected and placed in watch glasses with 50% lactic acid. These watch glasses were kept in an oven for four hours at 45 °C to facilitate discoloration and to be mounted on smooth slides in Hoyer's medium. The identification of the mite species was done with an optical microscope with 40x objectives and the identification keys by Lindquist (1986); Chant and McMurtry (2007), and Murillo-Rojas and Aguilar-Piedra (2021).

The thrips were collected in 70° alcohol and their identification was carried out by Dr. Ortiz, J.A. of the Research Department of the company Driscoll SA, Ciudad Guzmán, Jalisco, Mexico. The total count was 945 individuals of the subclass Acari and 636 insects, which are represented in the taxa shown in Table 1.

Table 1. Arthropods recorded in the blueberry orchard under study.

Subclass Acari	
Family Phytoseiidae	*Euseius consors* De Leon
Family Tenuipalpidae	*Brevipalpus yothersi* (Baker)
Family Tetranychidae	*Tetranychus ludeni* Zacher
Family Tarsonemidae	*Tarsonemus* sp.
Family Acaridae	*Tyrophagus putrescentiae* (Schrank)
Class Insecta	
Family Thripidae	*Scirtothrips dorsalis* Hood
Family Chrysopidae	(only eggs)

The presence of *S. dorsalis*, which is considered an important pest that causes significant damage to berries, is recorded from the first sampling (Ortiz *et al*., 2020). In this study, it showed a lot of aggressiveness and strong symptoms that resembled rust on the underside of blueberry leaves (Figure 2), which were observed from the beginning of the vegetative phase and during all phenological stages of the crop.

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Figure 2. Symptoms of *S. dorsalis* damage observed in blueberry leaves.

Hatched eggs of Chrysopidae were also found, which were identified by the characteristic peduncle, and no larvae or adults of this taxon were observed, so it was not possible to make their taxonomic identification. Members of the family Chrysopidae are predatory and are considered biological control agents in many agroecosystems worldwide (Bastidas *et al*., 2010). Among the mites, *Euseius consors* De Leon (Acari: Phytoseiidae) was found, which is classified as a biological control agent; this is the first report of this species for blueberries in Mexico, and it has been previously recorded in avocados (Ramos *et al*., 2021).

Other recorded mite taxa belong to the families Tarsonemidae (*Tarsonemus* sp.) and Acaridae [(*Tyrophagus putrescentiae* (Schrank)], both in sporadic and low populations. These mites are detritivores (Krantz and Walter, 2009). The presence of *A. vaccinii* is not recorded in any sampling.

From the superfamily Tetranychoidea, two species were recorded: *Tetranychus ludeni* Zacher (Acari Tetranychidae) and *Brevipalpus yothersi* Baker (Acari: Tenuipalpidae). *T. ludeni* has been reported in different host plants; in Mexico, it has been reported on blackberry (Ayala *et al*., 2019), and this is the first record in blueberry crops.

B. yothersi has been reported in many host plants (Aguilar Piedra and Solano Guevara, 2020), and in this study, it was particularly abundant at the time of flowering and early fruiting, forming colonies on the underside of the leaves, just at the phenological moment when it could cause the abortion of the buds.

In Childers *et al*. (2003) study, they stated that the species *B. yothersi* is important not only because of the direct damage it produces, given by lesions on the leaves and fruits due to the toxic action of its saliva, but also because it causes dry, necrotic areas and leaf and fruit drop. It is reported as a vector of plant viruses and is recorded in species of Caricaceae, Rubiaceae, and Rutaceae in the Americas and Hawaii (Beard *et al*., 2015).

By analyzing the symptoms of the damage of these species, the times in which they were recorded in the crop, and the fact that they are the only arthropods observed with high populations and that have the potential to cause this symptomatology, given their previous records as pests Domínguez-Gabriel *et al*. (2021), it is possible to relate that the observed bud abortion is the result of the synergistic interaction of *S. dorsalis* and *B. yothersi*, in which both species are jointly influencing the physiology of the blueberry. This would be a new phytosanitary problem that the crop will have to face.

The report on blueberry crops is a vitally important element for blueberry plant health and it is suggested that the implications of their interactions should be corroborated in future research.

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However, it is recommended that they be observed and managed by producers with the phytosanitary measures established for both.

For example, Vera *et al*. (2018) have recorded the action of species complexes that act synergistically in agroecosystems, with negative consequences for crop productivity; these are antecedents that should not be underestimated.

Conclusions

Although additional studies are needed, it is likely that *S. dorsalis* (which is present from the vegetative phase) and *B. yothersi* (which appears at the time of flowering) are synergistically responsible for the abortion of buds, which would indicate the surveillance of these arthropods in the crop and the timely decision-making for both pests.

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Journal Information
Journal ID (publisher-id): remexca
Title: Revista mexicana de ciencias agrícolas
Abbreviated Title: Rev. Mex. Cienc. Agríc
ISSN (print): 2007-0934
Publisher: Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias

Article/Issue Information
Date received: 01 March 2025
Date accepted: 01 June 2025
Publication date: 14 July 2025
Publication date: May-Jun 2025
Volume: 16
Issue: 4
Electronic Location Identifier: e3703
DOI: 10.29312/remexca.v16i4.3703

Categories

Subject: Investigation note

Keywords:

Keywords:

Brevipalpus yothersi

Scirtothrips dorsalis

Vaccinium corymbosum

Counts

Figures: 2

Tables: 1

Equations: 0

References: 18

Pages: 0