Occurrence of Anastrepha fraterculus and Ceratitis capitata (Diptera: Tephritidae) in Organically Grown Rubus (Rosales: Rosaceae), in Two Contrasting Environments of Northwestern Argentina

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Occurrence of *Anastrepha fraterculus* and *Ceratitis capitata* (Diptera: Tephritidae) in organically grown *Rubus* (Rosales: Rosaceae), in two contrasting environments of northwestern Argentina

Claudia Fernanda Funes¹, Lorena Inés Escobar¹,²,*, Natalia Gabriela Meneguzzi¹, Sergio Marcelo Ovruski³, and Daniel Santiago Kirschbaum³

The Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae), and the South American fruit fly, *Anastrepha fraterculus* (Wiedemann) (Diptera: Tephritidae), are widely distributed in Argentina, including the northwestern province of Tucumán (Segura et al. 2006; Guilién & Sánchez 2007; Ovruski et al. 2010). Tucumán is one of the most important berry-exporting regions of the country (Kirschbaum 2011). In Tucumán, the presence of fruit flies, especially *C. capitata*, determines methyl bromide treatments to fresh blueberries exported to the United States (Pérez & Mazzone 2012). In recent years, researchers, fruit growers, and consumers have been increasingly interested in small fruits such as blackberries (*Rubus fruticosus* L.; Rosaceae) and raspberries (*Rubus idaeus* L.; Rosaceae) because of their content of basic nutrients, fiber, vitamins, and phenolic compounds (Angers et al. 2000; Harborne & Williams 2000; Souza et al. 2014). Additionally, they are considered a good alternative crop for small-scale growers because of low production costs and relatively low levels of susceptibility to pests and diseases (Hussain et al. 2016).

In Tucumán, berries are grown in 2 contrasting regions: the humid piedmont and the semiarid intermontane valley of Tafi (Zuccardi & Fadda 1985; del Río et al. 2010). In the humid piedmont, the mesoclimatic zone is wet and warm, with annual rainfall >1,000 mm (concentrated in the summer) and potential evapotranspiration about 900 mm. It is a frost-free region, although frosts can occur occasionally. In the intermontane valley of Tafi, the mesoclimatic zone is temperate semiarid, with about 400 mm annual precipitation (concentrated in the summer), 500 to 600 mm evapotranspiration and a 7 mo frost period (Zuccardi & Fadda 1985). Given that raspberry and blackberry are minor (but expanding) crops in Tucumán, information about their phytosanitary aspects is scarce and fragmented (Reguilón et al. 2015), and counted. The reported fruit infestation level is one of the most important berry-exporting regions of the country (Kirschbaum 2011). In Tucumán, the presence of fruit flies, especially *C. capitata*, determines methyl bromide treatments to fresh blueberries exported to the United States (Pérez & Mazzone 2012). In recent years, researchers, fruit growers, and consumers have been increasingly interested in small fruits such as blackberries (*Rubus fruticosus* L.; Rosaceae) and raspberries (*Rubus idaeus* L.; Rosaceae) because of their content of basic nutrients, fiber, vitamins, and phenolic compounds (Angers et al. 2000; Harborne & Williams 2000; Souza et al. 2014). Additionally, they are considered a good alternative crop for small-scale growers because of low production costs and relatively low levels of susceptibility to pests and diseases (Hussain et al. 2016).

This context, the purpose of this study was to determine the occurrence of 878 and Tupi, whereas *C. capitata* was observed in 878 and Tupi, whereas *C. capitata* ap-
Anastrepha fraterculus were found in raspberries, whereas in blackberries only 29 adults and 4 pupae were recovered. This is the first report of the occurrence of fruit flies in raspberry fruits in northwestern Argentina, and with high infestation levels (Table 1). Infestation levels of A. fraterculus varied considerably between host plant species within the genus Rubus (Table 1). Raspberries were infested more than blackberries. Infestation levels in raspberries were 2.4 and 6.1 times higher than in blackberries, in terms of fruit flies per kg and fruit flies per fruit, respectively.

It is known that for tephritids, in general, first rains stimulate adult emergence from overwintering pupae in the soil, causing fruit flies to become active after periods of relatively high humidity (Bateman 1972). Therefore, rain, soil water content, and air RH may have been involved in the determination of the time of fruit fly emergence in the present study. However, fruit fly abundance should be tracked for several more years for confirmation. In 2014, A. fraterculus was nearly twice as abundant as C. capitata. The absence of C. capitata in Tafi del Valle might be related to climatic and host-related issues (Duyck et al. 2006; Ovruski et al. 2010; Flores et al. 2016).

Future research should include monitoring of fruit flies in neighbor fruit plants, occurrence of natural enemies, and fruit fly preference for blackberry varieties. These monitoring tools will be useful for improving organic berry production.

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### Summary

In Tucumán (northwestern Argentina) during 2013 and 2014, Anastrepha fraterculus (Wiedemann) (Diptera: Tephritidae) and Ceratitis capitata (Wiedemann) (Diptera: Tephritidae) were found infesting organically grown blackberries in the humid piedmont region (Monte Grande, Famaillá). In 2016, only A. fraterculus was found infesting organically grown blackberries and raspberries in

![Fig. 1. Precipitation (P), evapotranspiration (ET), and hydric balance (HB = P – ET) near Monte Grande (27.0000°S, 65.4000°W; 350 m altitude; Tucumán, Argentina) in 2013 (A) and 2014 (B).](image-url)

### Table 1

<table>
<thead>
<tr>
<th>Location and year</th>
<th>Rubus species and cultivar</th>
<th>Total fruit weight (kg)</th>
<th>Total fruit number</th>
<th>A. fraterculus</th>
<th>C. capitata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monte Grande</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>Blackberry 878</td>
<td>2.81</td>
<td>454</td>
<td>0</td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td>Blackberry Tupi</td>
<td>2.08</td>
<td>389</td>
<td>0</td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td>Blackberry Navaho</td>
<td>2.69</td>
<td>737</td>
<td>0</td>
<td>0.066</td>
</tr>
<tr>
<td>2014</td>
<td>Blackberry 878</td>
<td>1.41</td>
<td>267</td>
<td>0</td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td>Blackberry Tupi</td>
<td>1.51</td>
<td>312</td>
<td>0</td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td>Blackberry Navaho</td>
<td>1.38</td>
<td>414</td>
<td>0</td>
<td>0.066</td>
</tr>
<tr>
<td>Tafi del Valle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>Blackberry 878</td>
<td>0.73</td>
<td>102</td>
<td>0</td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td>Raspberry Heritage</td>
<td>0.60</td>
<td>214</td>
<td>0</td>
<td>0.066</td>
</tr>
</tbody>
</table>

*Nff: number of fruit flies.
the temperate semi-arid region (Tafi del Valles), where studies conducted in prior years showed coexistence of both fruit fly species with prevalence of *C. capitata* over *A. fraterculus*, but in other fruit species. In this study, we found that *A. fraterculus* had a remarkable preference for raspberries over blackberries. These are the first records of fruit fly occurrence in *Rubus* (Rosales: Rosaceae) in Northwestern Argentina and expand the range of host species for fruit flies in the region. Fruit fly infestation levels in blackberries in the humid region were very low, whereas fruit fly infestation in the semi-arid region was relatively high. Based on our observations, we hypothesize that spring rains, soil moisture, and relative humidity determine the time of appearance of fruit flies in blackberries in the humid region. Fruit fly abundance should be tracked for several more years to test this hypothesis. In addition, fruit flies were not recovered from fruit samples of the blackberry cultivar Navaho, which is interesting from both an agronomic and scientific perspective.

Key Words: fruit fly; blackberry; raspberry; host preference; Tucumán

**Sumario**

En Tucumán (noroeste de Argentina) durante 2013 y 2014 se encontraron *Anastrepha fraterculus* (Wiedemann) (Diptera: Tephritidae) y *Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae) infestando zarzamoras orgánicas en la región del pedemonte húmedo (Monte Grande, Famaillá). En 2016, sólo se encontró *A. fraterculus* infestando zarzamoras y frambuesas orgánicas en la región templada semiárida (Tafi del Valle), donde estudios realizados en años anteriores mostraron la coexistencia de ambas especies de mosca de la fruta con prevalencia de *C. capitata* sobre *A. fraterculus*, pero en otras especies frutales. Cabe señalar que en este estudio, encontramos que *A. fraterculus* tenía una notable preferencia por las framboesas sobre las moras. Estos son los primeros registros de ocurrencia de moscas de la fruta en *Rubus* (Rosales: Rosaceae) en el noroeste de Argentina y amplían el rango de especies hospedantes para las moscas de la fruta en la región. Los niveles de infestación en moras en la región húmeda fueron muy bajos, mientras que en la región semiárida fueron relativamente altos. Sobre la base de nuestras observaciones, hipotetizamos que las lluvias de primavera, la humedad del suelo y la humedad relativa determinan el momento de aparición de las moscas de la fruta en moras en la región húmeda. La abundancia de la mosca de la fruta se debería seguir durante varios años más para probar esta hipótesis. Además, las moscas de la fruta no se recuperaron de las muestras de fruta de la variedad de zarzamora Navaho, lo cual es interesante desde una perspectiva agronómica y científica.

Palabras Clave: mosca de la fruta; mora; frambuesa; preferencia de hospedero; Tucumán

**References Cited**


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