Occurrence of Ceratitis capitata and Anastrepha fraterculus (Diptera: Tephritidae) on Cultivated, Exotic Fruit Species in the Highland Valleys of Tucuman in Northwest Argentina

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Source: Florida Entomologist, 93(2) : 277-282

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.093.0219
OCCURRENCE OF CERATITIS CAPITATA AND ANASTREPHA FRATERCULUS (DIPTERA: TEPHRITIDAE) ON CULTIVATED, EXOTIC FRUIT SPECIES IN THE HIGHLAND VALLEYS OF TUCUMAN IN NORTHWEST ARGENTINA

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ABSTRACT

Fruits from 6 exotic, cultivated fruit species were collected in the Tafi and Calchaquí valleys between Jan 2000 and Jan 2002 to determine the occurrence of Ceratitis capitata (Wiedemann) and Anastrepha fraterculus (Wiedemann) and the corresponding fruit infestation levels. The valleys are situated in the western semiarid highlands of Tucumán province (NW Argentina) and the altitude ranges from 1,800 to 2,014 m above sea level. The fruit species surveyed were Cydonia oblonga Miller, Malus domestica Borkh., Prunus armeniaca L., P. domestica L., P. persica (L.) Batsch, and Pyrus communis L. (Rosaceae). Out of a total of 2,129 puparia recovered from infested fruit, 2,112 (98.8%) were C. capitata and only 27 (1.2%) A. fraterculus. Ceratitis capitata was recovered from all fruit species and it was the dominant species. Anastrepha fraterculus was only recovered from C. oblonga, P. persica and P. domestica. All Prunus species and P. communis were the host plants that were infested most by C. capitata. The infestation data of C. oblonga, P. communis and M. domestica demonstrated that these 3 fruit species were acceptable host plants for C. capitata in Tucumán. This study provides the first record of both C. capitata and A. fraterculus infesting fruit species in semiarid highland valleys in Tucumán, and it also expands the altitudinal range of distribution of these two tephritid species to 2,014 m within the Tucumán province.

Key Words: fruit flies, host plants, distribution, Argentina, Tucumán

RESUMEN

Se presentan los resultados de una colecta de frutas de seis especies de plantas exóticas y cultivadas realizada en los Valles de Tafi y Calchaquí entre enero de 2000 y enero de 2002, con el objetivo de determinar la presencia de Ceratitis capitata (Wiedemann) y Anastrepha fraterculus (Wiedemann) y los niveles de infestación en fruta. Ambos valles están situados en el sector montañoso semiarido del oeste de la provincia de Tucumán (noroeste de Argentina), y presentan una rango altitudinal entre 1,800 y 2,014 metros sobre el nivel del mar. Las especies frutales colectadas fueron Cydonia oblonga Miller, Malus domestica Borkh., Prunus armeniaca L., P. domestica L., P. persica (L.) Batsch y Pyrus communis L. (Rosaceae). De un total de 2,129 puparios obtenidos de frutas infestadas, 2,112 (= 98,8%) fueron C. capitata y solo 27 (= 1,2%) fueron A. fraterculus. Ceratitis capitata fue obtenida de las seis especies frutales y fue dominante en todas ellas. A. fraterculus fue solo obtenida de C. oblonga, P. persica y P. domestica. Todas las especies del género Prunus y también P. communis fueron las plantas hospederas más infestadas por C. capitata. Los datos de infestación en C. oblonga, P. communis y M. domestica mostraron que éstas tres especies son hospederas adecuadas para el desarrollo de C. capitata en Tucumán. Este artículo aporta el primer registro de C. capitata y A. fraterculus infestando frutas en los valles montañosos semiaríos del oeste de Tucumán, y también expande el rango altitudinal de distribución de estas dos especies de teñitidos en Tucumán hasta los 2,014 metros sobre el nivel del mar.

Translation by the authors.

In Argentina, the Mediterranean fruit fly, Ceratitis capitata (Wiedemann), and the South American fruit fly, Anastrepha fraterculus (Wiedemann) are serious polyphagous pests that attack several plant families. The medfly is widely distributed throughout Argentina (Guillén & Sánchez 2007). The native A. fraterculus is mainly restricted to NW Argentina (Tucumán, Salta, Jujuy, and Catamarca), NE Argentina (Misiones, Corrientes, and Entre Ríos) and fruit-producing areas of La Rioja, San Juan, and Buenos Aires (Central Argentina) (Guillén & Sánchez 2007).

Anastrepha fraterculus attacks approximately 80 species (Norrbom 2004), and C. capitata attacks more than 300 species throughout the world (Copeland et al. 2002). Previous reports have not always followed procedures to determine host un-
equivocally; a host record should state if the infestation occurred under natural conditions (i.e., field), or when fruit is artificially exposed to female flies, and it is necessary to verify if the larvae complete development in the fruit and pupate and if the emerging adults produce viable progeny (Cowley et al. 1992; Aluja et al. 2004).

The aim of this study was to determine the occurrence of *A. fraterculus* and *C. capitata* and report infestation rates on cultivated, exotic fruit in the western semiarid highland valleys of Tucumán.

**MATERIALS AND METHODS**

The collecting sites are located between 26°20' and 26°70'S and between 65°40' and 66°10'W at an altitude between 1,815 and 2,014 m above sea level in the high, western mountainous region of the Tucumán province (NW Argentina), locally known as the Tafi and Calchaquí valleys (Alderete 1998). The latter one spreads from Tucumán to both Catamarca and Salta provinces in the north. The region is characterized by valleys surrounded by vast semi desert plains and high mountains devoid of native fruit fly host plants, but fruit is grown commercially in irrigated oases. The climate varies from desert (cool, dry winters and hot summers; occasional frosts in winter and scanty rains in summer; a mean temperature of 16°C and annual rainfall <200 mm BWkwb, according to the Köppen classification) to semiarid or steppe-dry (cool, dry winters and mild to hot, rainy summers; a mean temperature of 18°C and annual rainfall <300 mm (BSkwb, according to the Köppen classification)] (Torres-Bruchmann 1977; Sesma et al. 1998). Further details on site coordinates, altitudes, geographic units, and climate are provided in Table 1.

The native vegetation of the valleys is represented by a high-elevation deciduous xerophyte forest, mainly characterized by deep-rooted shrubs adapted to a semiarid environment (i.e., *Cercidium praeox* (Ruiz & Pavón) Harms (Leguminosae), *Larrea divaricata* Cav (Zygophyllaceae), *Acacia caven* Molina (Fabaceae) and *Prosopis ferox* (Griseb.) (Mimosaceae)) (Cabrera 1976). Vegetation in this Argentine phyto-geographical region, locally known as “Provincia Fitogeográfica del Monte”, has been partially removed to establish irrigated agricultural or shepherding areas and urban districts with orchards and backyard gardens (Torres-Bruchmann 1977).

Fruit samples were collected monthly from Jan 2000 to Jan 2002. Each sample consisted of 5-6 ripe fruits randomly harvested from a tree canopy and also of 5-6 fruits collected from the ground below the tree canopy. Six cultivated, exotic plant species, all belonging to the Rosaceae family, were sampled in the study area. Table 2 provides a complete list of fruit species collected,
including their common and scientific name, fruit size (measured as mean individual fruit weight) of each species, fruiting season and period when fruits were sampled. All fruit trees sampled were located in small orchards and backyard gardens in rural and urban areas. No insecticides were applied in any of the collecting sites.

Each fruit sample was placed individually into a cloth bag, which was transported to the CIRPON institute (Research Centre for the Population Control of Harmful Organisms) in San Miguel de Tucumán (26°50’ S, 65°13’ W; altitude 426 m). At the laboratory, fruit samples were placed in Styrofoam boxes (20 × 20 × 30 cm) with sand at the bottom for larvae to pupate. Each Styrofoam box contained only 1 fruit sample and all cages were kept inside a room at 26 ± 2°C and 60 ± 10% relative humidity (RH) for 4 weeks. Tephritid puparia from each box were recovered weekly, identified and counted. *Ceratitis capitata* puparia were distinguished from *Anastrepha* Schiner ones based on pupal characteristics (White & Elson-Harris 1992) and puparia were transferred to plastic Petri dishes containing sterilized humid sand. Each Petri dish was then placed inside a sealed wooden box as described by Ovruski et al. (2004). All wooden cages were kept inside a rearing room at 25 ± 1°C and 75 ± 5% RH for 3 months. Once a week all emerged flies were recovered from the cages and adults were identified and counted.

Fruit flies were identified by S. Ovruski using the taxonomic key by Zucchi (2000). Fly specimens were placed in the entomological collection of the Fundación Miguel Lillo (FML; San Miguel de Tucumán, Argentina).

The fruit infestation level reported was based on the number of fruit fly pupae per fruit or per kg of fruit obtained from one sample. Means and Standard Deviation (SD) were calculated as summary statistics for the fruit infestation level.

### RESULTS

Detailed fruit survey data per collecting site are shown in Table 3. A total of 1,852 fruits (227.3 kg) were collected. The number, weight, and host for fruit collected were as follows:

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Mean individual fruit weight (g) ± SD</th>
<th>Fruiting season</th>
<th>Fruit sampling period</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cydonia oblonga</em> Miller</td>
<td>Quince</td>
<td>311.5 ± 29.2</td>
<td>Jan-Feb</td>
<td>Jan-Feb</td>
</tr>
<tr>
<td><em>Malus domestica</em> Borkh.</td>
<td>Apple</td>
<td>144.9 ± 17.4</td>
<td>Feb-May</td>
<td>Mar-Apr</td>
</tr>
<tr>
<td><em>Prunus armeniaca</em> L.</td>
<td>Apricot</td>
<td>40.0 ± 5.3</td>
<td>Jan-Feb</td>
<td>Jan</td>
</tr>
<tr>
<td><em>Prunus domestica</em> L.</td>
<td>Cultivated Plum</td>
<td>74.5 ± 9.1</td>
<td>Jan-Feb</td>
<td>Jan-Feb</td>
</tr>
<tr>
<td><em>Prunus persica</em> (L.) Batsch</td>
<td>Peach</td>
<td>69.9 ± 8.6</td>
<td>Dec-Jan</td>
<td>Dec-Jan</td>
</tr>
<tr>
<td><em>Pyrus communis</em> L.</td>
<td>Pear</td>
<td>45.1 ± 4.7</td>
<td>Jan-May</td>
<td>Jan-Feb</td>
</tr>
</tbody>
</table>

As shown in Table 3, the infestation levels (number of pupae/kg of fruit) of *C. capitata* varied considerably among host plant species. The 3 *Prunus* species and *P. communis* were the most infested host plants. However, infestation levels in apricot were 3, 4, and 5 times less than those in pear, cultivated plum, and peach, respectively. The lowest infestation values were recorded in *M. domestica* and *C. oblonga*, but infestation in quince were 3-8 times higher than in apple. The infestation levels in *C. oblonga*, *P. persica* and *P. domestica* varied slightly among the collecting sites. Infestation rates in the fruit species collected in Tafi del Valle were relatively stable during the years 2000 and 2001. The levels of infestation by *A. fraterculus* in quince, peach and plum were lower than those by *C. capitata*: 15, 18 and 35 times, respectively. The highest numbers of *C. capitata* pupae per fruit were recovered from *P. persica* and *P. domestica*, with a maximum of 4.4 and 4.1 pupae/fruit, respectively.

### DISCUSSION

The current fruit fly survey provides the first records of fruit species infested by *C. capitata* and...
<table>
<thead>
<tr>
<th>Sample date (month/year) and study site</th>
<th>Fruit Fly Species</th>
<th>Host plants</th>
<th>Total weight of fruit sampled (kg)</th>
<th>Total N° of pupae</th>
<th>Total N° of adults</th>
<th>Degree of infestation (mean ± SD)</th>
<th>Degree of infestation (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fruit Fly Species</td>
<td>Sample date (month/year) and study site</td>
<td>Total N° of samples</td>
<td>Total N° of fruits</td>
<td>Total N° of pupae</td>
<td>Total N° of adults</td>
<td>pupae/kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Cydonia oblonga</td>
<td>6</td>
<td>67</td>
<td>17.0</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Prunus domestica</td>
<td>6</td>
<td>60</td>
<td>2.3</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Prunus persica</td>
<td>3</td>
<td>36</td>
<td>3.7</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Cydonia oblonga</td>
<td>5</td>
<td>50</td>
<td>12.5</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Prunus persica</td>
<td>4</td>
<td>40</td>
<td>2.5</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Cydonia oblonga</td>
<td>12</td>
<td>130</td>
<td>40.5</td>
<td>164</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Malus domestica</td>
<td>12</td>
<td>138</td>
<td>20.6</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Prunus armeniaca</td>
<td>6</td>
<td>67</td>
<td>2.6</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Prunus domestica</td>
<td>12</td>
<td>124</td>
<td>9.0</td>
<td>236</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Prunus persica</td>
<td>9</td>
<td>99</td>
<td>7.0</td>
<td>243</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2000</td>
<td>Pyrus communis</td>
<td>12</td>
<td>131</td>
<td>5.9</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2001</td>
<td>Cydonia oblonga</td>
<td>12</td>
<td>136</td>
<td>45.7</td>
<td>147</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2001</td>
<td>Malus domestica</td>
<td>12</td>
<td>143</td>
<td>19.3</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2001</td>
<td>Prunus armeniaca</td>
<td>6</td>
<td>68</td>
<td>2.9</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2001</td>
<td>Prunus domestica</td>
<td>12</td>
<td>123</td>
<td>9.3</td>
<td>243</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2001</td>
<td>Prunus persica</td>
<td>18</td>
<td>205</td>
<td>13.8</td>
<td>442</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan-Dec/2001</td>
<td>Pyrus communis</td>
<td>12</td>
<td>129</td>
<td>5.5</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jan/2002</td>
<td>Prunus persica</td>
<td>9</td>
<td>106</td>
<td>7.0</td>
<td>181</td>
</tr>
</tbody>
</table>
A. fraterculus in semiarid environments in the western highland valleys of Tucumán. Our findings expand the altitudinal distribution of these 2 tephritid species to 2,014 m within Tucumán. Before this study, both fruit fly species had only been recorded in Tucumán at lower elevations (below 1,200 m) from xerophyte shrub land, locally known as “phyto-geographical Chaco region”, to subtropical montane rainforest, commonly known as “phyto-geographical region of the Yungas” (Ovruski et al. 2003; Segura et al. 2006). Nevertheless, both C. capitata and A. fraterculus had been found before in 2 other localities of the Calchaquí valley: Cafayate (26°06'S, 65°57'W, 1,624 m) in the Salta province and Santa María (26°42'S, 66°02'W, 1,885 m) in the Catamarca province (Rosillo 1953). These records, though, are based on adult flies captured in traps hung in fruiting trees and not on adults reared from infested fruit. Similarly, C. capitata and A. fraterculus adults were also caught at 2,641 m in fruit-growing irrigated valleys of the northern dry highlands of the Jujuy province (NW Argentina) (Manero et al. 1989).

One host plant species of A. fraterculus (C. oblonga) has been previously reported in local Argentine journals or technical articles by Hayward (1960), Turica & Mallo (1961) and Nasca et al. (1981), although none of the authors provided any infestation data. These findings are presently confirmed by our results and C. oblonga should now formally be considered as a host of A. fraterculus in Argentina.

The infestation data regarding C. oblonga, P. communis and M. domestica reported in this study have demonstrated that these 3 fruit species are acceptable host plants for C. capitata in Tucumán. Similar observations were made by Nasca et al. (1996) and Segura et al. (2006) in dry habitats in the northwestern provinces of La Rioja and Catamarca, respectively, as the authors showed that quinces, pears, and apples were mainly infested by C. capitata. Although our results did not reveal any infestation of P. communis by A. fraterculus, this host species was previously identified by Nasca et al. (1996) as a sporadic host of A. fraterculus in the fruit-producing irrigated valleys of La Rioja.

In agreement with previous reports on several Argentine ecological regions (Nasca et al. 1996; Ovruski et al. 2003; Segura et al. 2006) P. persica, P. domestica and P. armeniaca were heavily infested by C. capitata in our study. Worldwide, these 3 Prunus species are among the most important hosts of the medfly (Copeland et al. 2002), but they are also relatively important host plants of A. fraterculus in Argentina (Ovruski et al. 2003; Norrbom 2004). Large populations of A. fraterculus have been reported in peach, plum and apricot in the subtropical montane rainforest of NW Argentina (Ovruski et al. 2003). In contrast, the 3 Prunus species sampled during the present study were only slightly infested by A. fraterculus. The environmental conditions in semiarid highland areas of Tucumán are probably more suitable for C. capitata than for A. fraterculus. The ability of C. capitata to use fruit in xeric and semi desert areas has been previously reported by several authors in different countries (Copeland et al. 2002; Vera et al. 2002; Israely et al. 2005). Another possible explanation is that C. capitata seems to adapt well to highly perturbed habitats with a predominance of exotic fruit species, such as backyard gardens of urban and rural houses and semi-commercial orchards, whereas A. fraterculus is mostly found in association with native and exotic “feral” fruit species in areas with wild vegetation throughout the Argentine subtropical rainforests (Ovruski et al. 2003, 2008, Schlizerman 2005; Segura et al. 2006). These 2 characteristics, along with the active fruit traffic sustained by road transport (Guillén & Sánchez 2007), may be important factors that possibly allowed C. capitata to spread throughout unsuitable habitats. However, our data do not yet allow a precise analysis of the effect of the type of environment on dispersion of both C. capitata and A. fraterculus in the highland valleys of Tucumán. More exhaustive sampling in this region focused on the search of suitable wild hosts with continuous populations of C. capitata or A. fraterculus is necessary.

ACKNOWLEDGMENTS

We express our gratefulness to Eduardo Frías (PROIMI-CONICET) for technical assistance during laboratory work and Hugo Ayarde (Fundación Miguel Lillo, Tucumán, Argentina) for determinations of all plant samples. Special thanks to Nury Ovruski (PROIMI-CONICET) for providing a field vehicle for this project and for invaluable field assistance, to Néstor Zamudio (Instituto Nacional de Tecnología Agropecuaria (INTA)—Tafi del Valle, Tucumán, Argentina) for providing data on fruiting phenology in highland valleys of Tucumán, and to Carlos Alberto Segura (INTA—UE y EA Valles Calchaquíes, Argentina) for providing information on fruit crops in Calchaquí valley. We are grateful to Martín Aluja (Instituto de Ecología, A.C., Xalapa, Veracruz, Mexico) and Antonio Nasca (Universidad Nacional de Tucumán, Argentina) for sharing their enormous experience of fruit fly ecology. This work was primarily supported by Consejo Nacional de Investigaciones Científicas y Técnicas de Argentina (CONICET) (grants No’s 0702/98 and 5129/05) and in part by Agencia Nacional de Promoción Científica y Tecnológica de Argentina through Fondo Nacional de Ciencia y Tecnología (FONCyT) (grant No. 01236/87).

REFERENCES CITED

GUILLÉN, D, AND SÁNCHEZ, R. 2007. Expansion of

OVRUSKI, S. M., SCHLISERMAN, P., OROÑO, L. E.,
NÚÑEZ-CAMPERO, S. R., ALBORNOZ-MEDINA, P.,
Natural occurrence of hymenopterous parasitoids
associated with Anastrepha fraterculus (Diptera: Tephritidae) in Myrtaceae species in Entre Ríos,
Northeastern Argentina. Florida Entomol. 91(2):
220-227.

ROSILLO, M. A. 1953. Resultados preliminares de un
estudio bioecológico de los dipteros “Tripetidae” del
Noroeste Argentino. Revista de Investigaciones
Agrícolas 7: 97-130.

SEGURA, D. F., VERA, M. T., CAGNOTTI, C. L., VACCARO,
N., DECOLL, O. R., OVRUSKI, S. M., AND CLADERA, J.
L. 2006. Relative abundance of Ceratitis capitata
and Anastrepha fraterculus (Diptera: Tephritidae) in
diverse host species and localities of Argentina. Ann.

Clima de la provincia de Tucumán, pp. 41-45. In M.
Gianfrancisco, M. E. Puchulu, J. Durango de Ca-
brera and G. F. Aceñolaza (eds.), Geología de Tu-
cumán. Publicación Especial Colegio de Graduados
en Ciencias Geológicas de Tucumán, Argentina.

SCHLISERMAN, P. 2005. Dinámica poblacional y estructu-
ra de hábitat de Anastrepha fraterculus y Ceratitis

capitata en la ladera Oriental de la Sierra de San
Javier, Tucumán. Doctoral thesis. Facultad de Cien-
cias Naturales e Instituto Miguel Lillo, Universidad
Nacional de Tucumán, Argentina.

TORRES-BRUCHMANN, E. 1977. El clima de Tafí del Valle
y sus posibilidades agropecuarias. Publicación Espe-
cial Facultad de Agronomía y Zootecnia, Universidad

TURICA, A., AND MALLO, R. G. 1961. Observaciones so-
bre la población de las “Tephritidae” y sus en-
doparásitos en algunas regiones cítricas argentin-

VERA, M. T., RODRIGUEZ, R., SEGURA, D. F., CLADERA, J.
L., AND SUTHERST, R. W. 2002. Potential geographi-
cal distribution of the Mediterranean fruit fly, Cer-
atitis capitata (Diptera: Tephritidae), with emphasis
on Argentina and Austrália. Environ. Entomol.

flies of economic significance: their identification and
bionomics. CAB international—ACIAR, Redwood

vasi and R. A. Zucchi [eds.], Moscas-das-frutas de
Importância Econômica no Brasil: Conhecimento
Básico e Aplicado. Holos Editora, Riberão Preto,
Brasil.