Research Article

# Some plant mites (Acari: Tetranychidae: Stigmaeidae) from Province of Tungurahua in Ecuador

Algunos ácaros de planta (Acari: Tetranychidae: Stigmaeidae) de la Provincia de Tungurahua en Ecuador

Carlos Vásquez[1*] y Marta Dávila[1]

[1] *Universidad Técnica de Ambato, Facultad de Ciencias Agropecuarias, Cevallos, Provincia de Tungurahua, Ecuador. E-mail: *ca.vasquez@uta.edu.ec; mb.davila@uta.edu.ec*

ZooBank: urn:lsid:zoobank.org:pub:9E6F0CD4-7299-4E5E-8D6F-27A49BC60184

**Abstract.** A survey to identify mites associated to fruit trees, vegetables, ornamental plants, and weed species was conducted between 2016 and 2017 in the Province of Tungurahua, Ecuador. In addition, the database collection of mite species from the Facultad de Ciencias Agropecuarias, Universidad Técnica de Ambato (located in Tungurahua, Ecuador) was revised. A total of 227 specimens belonging to two mite families (Tetranychidae and Stigmaeidae) were collected and identified. These mites are associated with fruit [*Fragaria x ananassa* (strawberry), *Prunus serotina* (capuli cherry), *Rubus gluacus* (blackberry), *Prunus persica* (peach tree), *Passiflora tripartite* (tacso) and *Solanum muricatum* (sweet pepino)], wood trees [*Alnus acuminate* (aliso), *Juglans neotropica* (tocte)], vegetables [*Arracacia xanthorrhiza* (white carrot), *Phaseolus* sp. (ornamental bean) , *Tropaeolum tuberosum* (mashua) and weeds [*Artemisia vulgaris* (mugworts)]. Most of these mite species represent reporting of a new host-plant association. Also, concerning some crops from the Ecuadorian Andes, geographic distribution data are presented in conjunction to the importance of mite species.

**Key words:** Phytophagous mites, predator mites, Andes.

**Resumen.** Entre 2016 y 2017 se realizó un muestreo para identificar ácaros asociados con árboles frutales, hortalizas, plantas ornamentales y especies de malezas en la Provincia de Tungurahua, Ecuador. Adicionalmente, se revisó la base de datos de la colección de ácaros de la Facultad de Ciencias Agropecuarias de la Universidad Técnica de Ambato (ubicada en Tungurahua, Ecuador). Un total de 197 especímenes dentro de dos familias de ácaros (Tetranychidae y Stigmaeidae) fueron recolectados e identificados. Estos ácaros están asociados con frutales [*Fragaria x ananassa* (fresa), *Prunus serotina* (capuli), *Rubus gluacus* (mora), *Prunus persica* (durazno), *Passiflora tripartite* (tacso) y *Solanum muricatum* (pepino dulce)], árboles madereros [*Alnus acuminate* (aliso), *Juglans neotropica* (tocte)], hortalizas [*Arracacia xanthorrhiza* (zanahoria blanca), *Phaseolus* sp. (frijol ornamental), *Tropaeolum tuberosum* (mashua)] y maleza [*Artemisia vulgaris* (artemisa)]. La mayoría de estas especies de ácaros representan un nuevo registro de asociación con plantas hospederas. Además, referido a algunos cultivos de los Andes ecuatorianos, se presentan datos geográficos junto con la importancia económica de estas especies de ácaros.

**Palabras clave:** Ácaros fitófagos, ácaro depredador, Andes.

Received 27 July 2018 / Accepted 11 August 2018 / Published online 5 September 2018
Responsible Editor: José Mondaca E.

## Introduction

Ecuador is located on the northeast side of South America, on the equator, where 29 bioclimatic regions and 25 life zones are distributed into 4 natural regions (Coast, Sierra, Amazon and Galapagos islands) (Cañada-Cruz 1983). The Sierra region sits atop the Andean mountain range, which passes through Ecuador from north to south. In general, the Andean region presents a complex geography with wide-ranging climactic conditions; thus, it presents a great heterogeneous ecosystem which in turn translates to a high biodiversity (Josse *et al*. 2009). Beginning in the south of Colombia, the Oriental and Occidental Mountains range from north to south, forming a narrow band that is approximately 600 km in length (Clapperton 1993) and is joined by multiple inter Andean valleys that are more than 2000 m in altitude. The weather in these mountains varies according to seasonal precipitation or dryness. Even though the tropical Andes represents only 1% of the Earth's continental mass, from a biological standpoint, it contains a great variety of ecosystems, and a high level of endemism of vascular plants and vertebrates (Myers *et al*. 2000). From the total of vascular plants in Ecuador, 52.1 % are endemic to the country, with many of these plants maintaining their natural endemic distribution (Jorgensen *et al*. 2006; Valencia *et al*. 2000). Similarly, the Andean region is considered one of the world's greatest centers of plant domestication (Piperno 2011; Vavilov 1992) particularly in the highest altitudinal zones. In altitudes between 2500-4300 m, many Andean fruit species have been domesticated, including: "tacso" (*Passiflora tripartita;* Passifloraceae), "capuli cherry" (*Prunus serotina*, Rosaceae) and various "peaches" (*Prunus persica*, Rosaceae). Furthermore, the country's flora contains an extensive wealth of useful plant species such as: "wild tobacco or ashpa tobacco" (*Nicotiana rustica*; Solanaceae), "mugworts" (*Artemisia vulgaris*; Compositae) and beans (*Phaseolus* sp.; Fabaceae) (Jorgensen and Leon-Yanez 1999).

According to Fandiño-Lozano and van Wyngaarden (2005), this pattern of diversity is also reflected in arthropods, even when (to date) there is little data available. Because many arthropods are associated with plants, the extensive diversity of plants in the Andes suggests a close relationship to the diversity of the arthropods associated with these plants (Myers *et al*. 2000). A loss of habitats puts this diversity at risk due to the expansion of agricultural borders, and the unlimited use of agrochemical products. Furthering this risk has been the introduction of phytophagous species that can displace the native fauna due to the highly competitive capacity of this invasive species (de la Masselière *et al*. 2017).

In Ecuador, there are few studies available regarding the diversity of mites associated to Andean crops and related weeds. Thus, the following report attempts to offer preliminary information about mites found in fruit species, traditional crops, and common weeds from these Andean agricultural ecosystems.

## Materials and Methods

A survey to identify mites associated to fruit trees, vegetables, ornamental and weed species was conducted in the province of Tungurahua, Ecuador. Monthly, samples consisting on leaves were taken from strawberry and blackberry plants which are commercially produced in Tungurahua but samples also were taken from other plant species (ornamental, vegetables and weeds) growing near those crops. Leaves showing distinctive symptoms of damage from phytophagous mite feeding were collected from April 2016 to April 2017. In each sampling site, leaves showing symptoms by mite's feeding were examined by using hand lens. Samples were placed in plastic bags and taken in ice box to the Entomology Laboratory at the Facultad de Ciencias Agropecuarias, at the Universidad Técnica de Ambato (FCAGP-UTA). Plant material were examined under magnification to select mite morpho-species; then slides for microscopic observations were prepared using Hoyer's

medium. Finally, slides were oven dried, sealed and labeled. Mite species were determined by taxonomical keys for Tetranychidae (Gutierrez 1985) and Stigmaeidae (Summers 1966; Fan *et al*. 2016; Khanjani and Ueckermann 2008). The specimens are now deposited at the Acarology Collection from the Entomology laboratory (FCAGP-UTA). Host plants were identified by Dr. Marta Dávila, and voucher specimens are deposited at the Herbarium at the Universidad Técnica de Ambato.

## Results

A total of 227 specimens belonging to three mite families were collected, including: Tetranychidae and Stigmaeidae (Table 1). These mites are associated with fruit [*Fragaria x ananassa* (strawberry), *Prunus serotina* (capuli cherry), *Rubus gluacus* (blackberry), *Prunus persica* (peach tree), *Passiflora tripartite* (tacso) and *Solanum muricatum* (sweet pepino)], wood trees [*Alnus acuminate* (aliso), *Juglans neotropica* (tocte)], vegetables [*Arracacia xanthorrhiza* (white carrot), *Phaseolus* sp. (ornamental bean), *Tropaeolum tuberosum* (mashua) and weeds [*Artemisia vulgaris* (mugworts)].

**Family Tetranychidae**

***Eotetranychus lewisi* (McGregor, 1943)**

*Tetranychus lewisi* McGregor, 1943.
*Eotetranychus lewisi* (McGregor, 1943) Pritchard and Baker, 1955.

**Examined material.** *Arracacia xanthorrhiza* Bancr.: El Tambo (0766073-9848775; 2897 masl), X.13.2016, 5♀, 8♂. *Prunus persica* (L.) Batsch: El Tambo (UTM: 0766073-9848775; 2 897 masl), II.10.2017, 11♀, 7♂. *Phaseolus* sp. El Tambo (UTM: 0766073-9848775; 2 897 masl), III.31.2017, 13♀, 9♂. *Tropaeolum tuberosum* Ruiz & Pav.: El Tambo (0766073-9848775; 2 897 masl), II.10.2017, 3♀, ♂.

**Distribution.** Bolivia, Chile, Colombia, Costa Rica, El Salvador, Guadalupe, Guatemala, Hawaii, Honduras, Iran, Lybia, Madeira Island, Mexico, Nicaragua, Panama, Peru, Philipines, South Africa, Taiwan, USA (Migeon *et al*. 2011; Bolland *et al.* 1998). Recently, high population levels of *E. lewisi* were observed on a purple petiolated accession of *A. xanthorrhiza*; while a lower number of this mite were registered on *T. tuberosum,* in Ecuador (Vásquez *et al.* 2017a).

***Oligonychus coffeae* (Nietner, 1861)**

*Acarus coffeae* Nietner, 1861.
*Tetranychus bioculatus* Wood-Mason, 1884.
*Paratetranychus bioculatus* (Wood-Mason, 1884) Baker and Pritchard (1953).
*Oligonychus coffeae* (Nietner, 1861) Pritchard and Baker (1955).

**Examined material.** *Alnus acuminata* Kunth: El Tambo (0766423-9848657; 2 897 masl), VIII.23.2016, 10♀, 9♂. Damage caused by *O. coffea* feeding is mainly confined to the upper surface of the mature foliage which become reddish bronze.

**Distribution.** Australia, Azerbaijan, Bangladesh, Brazil, Burma, CIS, China, Colombia, Congo, Costa Rica, Ecuador, Egypt, Ethiopia, Fiji, French Polynesia, Hainan Island, Hawaii, India, Indonesia, Iran, Japan, Kenya, Madagascar, Malawi, Malaysia, Mauritius, Mozambique, Nepal, New Caledonia, Nigeria, Papua New Guinea, Paraguay, Philippines, Reunion, Samoa, Solomon Island, South Africa, Sri Lanka, Taiwan, Tanzania, Tasmania,

Thailand, Tonga, USA, Uganda, Vanuatu, Vietnam, Wallis and Futuna, Western Samoa, Zaire, Zimbabwe (Migeon *et al*. 2011; Bolland *et al*. 1998). Vásquez *et al*. (2017b) recorded *O. coffeae* for the first time in the Ecuadorian Sierra; however, the most important fact from this finding is the possibility that this mite species could affect coffee plantations from producing areas in eastern region of Ecuador.

***Oligonychus yothersi* (McGregor, 1914)**

*Tetranychus yothersi* McGregor, 1914.
*Paratetranychus yothersi* (McGregor) Banks, 1915.
*Oligonychus yothersi* (McGregor) Pritchard and Baker, 1955.

**Examined material.** *Prunus serotina* subsp. *capuli* (Cav.): El Tambo (453588.9- 8659161; 2 643 masl), VIII.23.2017, 12♀, 5♂.

**Distribution.** Argentina, Brazil, Chile, China, Colombia, Costa Rica, Cuba, Ecuador, Hawaii, Mexico, Nicaragua, Paraguay, Peru, USA. (Migeon *et al*. 2011; Bolland *et al*. 1998). Previously, *O. yothersi* had been reported on coffee and capuli cherry (*P. salicifolia*) in Pomasqui and Guaillabamba (Province of Pichincha, Ecuador), respectively. Recently, in expeditions made in Province of Tungurahua, we found this species feeding on *P. serotina* leaves in Canton of Cevallos and Pelileo. There is no commercial farms devoted to capuli cherry production in Ecuador, however, this fruit tree is widely valuated since it is used for family consumption and local trading (Intriago *et al*. 2013; Palacios 2011). *O. yothersi* feeds on the upper surface mainly on mature leaves. Additionally, similar to *O. coffeae*, this species could threaten coffee plantations in Ecuador.

***Tetranychus urticae* Koch, 1836**

*Acarus telarius* Linnaeus, 1758.
*Acarus sambuci* Schrank, 1781.
*Acarus textor* Fourcroy, 1785.
*Tetranychus telarius* (Linnaeus, 1758) Duges (1834).
*Tetranychus russeolus* Koch, 1838.
*Tetranychus viburni* Koch, 1838.
*Tetranychus fervidus* Koch, 1841.
*Tetranychus sambuci* (Schrank, 1781) Koch (1842).
*Tetranychus dugesii* Cano and Alcacio, 1886.
*Acarus cinnabarinus* Boisduval, 1867.
*Acarus cucumeris* Boisduval, 1867.
*Acarus ferrugineus* Boisduval, 1867.
*Acarus haematodes* Boisduval, 1867.
*Acarus rosarum* Boisduval, 1867.
*Acarus vitis* Boisduval, 1867.
*Distigmatus pilosus* Donnadieu, 1875.
*Tetranychus major* Donnadieu, 1875.
*Tetranychus piger* Donnadieu, 1875.
*Tetranychus minor* Donnadieu, 1875.
*Tetranychus longitarsis* Donnadieu, 1875.
*Tetranychus plumistoma* Donnadieu, 1875.
*Tetranychus cucumeris* (Boisduval, 1867) Murray (1877).
*Tetranychus eriostemi* Murray, 1877.
*Tetranychus fici* Murray, 1877.
*Tetranychus rosarum* (Boisduval, 1867) Murray (1877).

*Tetranychus ferrugineus* (Boisduval, 1867) Murray (1877).
*Tetranychus telarius haematodes* (Boisduval, 1867) Murray (1877).
*Tetranychus vitis* (Boisduval, 1867) Murray (1877).
*Tetranychus inaequalis* Targioni Tozzetti, 1878.
*Tetranychus bimaculatus* Harvey, 1892.
*Tetranychus altheae* von Hanstein, 1901.
*Epitetranychus altheae* (von Hanstein, 1901) Zacher (1916).
*Epitetranychus hamatus* Zacher, 1916.
*Epitetranychus aequans* Zacher, 1916.
*Epitetranychus alceae* Oudemans, 1928.
*Tetranychus textor* (Fourcroy, 1785) Oudemans (1929).
*Tetranychus reinwardtiae* Oudemans, 1930.
*Epitetranychus caldarii* Oudemans, 1931.
*Epitetranychus reinwardtiae* (Oudemans, 1930) Ousdemans (1931).
*Epitetranychus sambuci* (Schrank, 1781) Oudemans (1931).
*Tetranychus fragariae* Oudemans, 1931.
*Tetranychus fransseni* Oudemans, 1931.
*Tetranychus aspidistrae* Oudemans, 1931.
*Tetranychus choisyae* Oudemans, 1931.
*Tetranychus stellariae* Oudemans, 1931.
*Tetranychus violae* Oudemans, 1931.
*Tetranychus manihotis* Oudemans, 1931.
*Eotetranychus inexspectatus* André, 1933.
*Schizotetranychus viburni* (Koch, 1838) Oudemans (1937).
*Tetranychus dahliae* Oudemans, 1937.
*Eotetranychus scabrisetus* Ugarov and Nikolskii, 1937.
*Tetranychus caldarii* (Oudemans, 1931) Geijskes (1939).
*Eotetranychus cucurbitacearum* Sayed, 1946.
*Tetranychus multisetis* McGregor, 1950.
*Tetranychus cinnabarinus* (Boisduval, 1867) Bouderaux (1956).
*Tetranychus arabicus* Attiah, 1967.
*Tetranychus aduncus* Flechtmann and Baker, 1967.
*Tetranychus ricinus* Saba, 1973.

**Examined material.** *Fragaria x ananassa* Duht.*:* Huachi Grande (UTM: 0761981-9854867; 2 953 masl), IV.04.2016-VI.05.2016, Santa Rosa (UTM: 0758687-9856732; 3 108 masl), IV.11.2016 - VI.12.2016 (0766074-9848778; 2 897 masl), Montalvo (0758687-9856732; 3108 masl); IV.08.2016-VI.19.2016, El Tambo V.16.2016 (UTM: 0766074-9848778; 2 897 masl), 20♀; 12♂. *Rubus glaucus* Bentham: El Tambo XIII.15.2016 (UTM: 0766073-9848775; 2 897 masl), Montalvo: XI.15.2016 (UTM: 0758687-9856732; 3 108 masl), Santa Rosa (0759368-9854836; 3 102 masl) XI.23.2016, 15♀; 10♂. *Arracacia xanthorrhiza*: El Tambo (0766073-9848775; 2 897 masl), X.13.2016, 5♀; 4♂. *Solanum muricatum* Aiton: El Tambo (0766320-9848452; 2 906 masl), IX.15.2016, 6♀; 4♂. *Artemisia sodiroi* Hieron: El Tambo (0766074-9848778; 2 897 masl), III.06.2017, 7♀; 5♂.

**Distribution.** This mite species is worldwide in distribution (Bolland *et al*. 1998); however, information about distribution in Ecuador is still scarce. Vásquez *et al*. (2017c) reported high populations and severe damage from the two-spotted spider mite on *A. xanthorrhiza* and *S. muricatum* leaves in the Ecuadorian province of Tungurahua. Furthermore, this species is presumed to be widely distributed throughout the Ecuadorian Andes.

**Family Stigmaeidae**

***Zetzellia silvicola* Gonzalez-Rodriguez, 1965**
**Examined material.** *Phaseolus* sp.: El Tambo (UTM: 0766073-9848775; 2 897 masl), III.31.2017, 15♀. *Passiflora tripartita*: Cevallos II.15.2017-II.25.2017, 7♀, 2♂. *Artemisia sodioi*: El Tambo (III.06.2017), 5♀. *Juglans neotropica* Diels.: El Tambo, IV.14.2017, 13♀.

**Distribution.** USA (Fan *et al*. 2016).

**Table 1.** Some mite species from plants growing in localities from Province of Tungurahua.

| Mite specie | Plant species | Family | Locality |
|---|---|---|---|
| **Tetranychidae** | | | |
| *E. lewisi* | *Arracacia xanthorrhiza* | Asteraceae | El Tambo |
| | *Prunus persica* | Rosaceae | El Tambo |
| | *Phaseolus* sp. | Fabaceae | El Tambo |
| | *Tropaeolum tuberosum* | Tropaeolaceae | El Tambo |
| *O. coffeae* | *Alnus acuminata* | Betulaceae | El Tambo |
| *O. yothersi* | *Prunus serotina* | Rosaceae | El Tambo |
| *T. urticae* | *Fragaria* x *ananassa* | Rosaceae | Huachi Grande, Santa Rosa, Montalvo, EL Tambo |
| | *Rubus glaucus* | Rosaceae | El Tambo, Montalvo, Santa Rosa |
| | *Arracacia xanthorrhiza* | Asteraceae | El Tambo |
| | *Solanum muricatum* | Solanaceae | El Tambo |
| | *Artemisia sodiroi* | Asteraceae | El Tambo |
| **Stigmaeidae** | | | |
| *Zetzellia silvicola* | *Phaseolus* sp. | | El Tambo |
| | *Passiflora tripartita* | | Cevallos |
| | *Artemisia sodioi* | | El Tambo |
| | *Juglans neotropica* | | El Tambo |

## Acknowledgments

The authors thank Dirección de Investigación y Desarrollo (DIDE, Universidad Técnica de Ambato) for partial funding of the project. Also we are grateful to M.A. Joel Dlouhy (Center of Languages, Universidad Técnica de Ambato) for his valuable revision of English style.

## Literature Cited

**Clapperton, C.M. (1993)** Glacier readvances in the Andes at 12500-10000 YR BP: Implications for mechanism of Late-glacial climatic change. *Journal of Quaternary Science, 8*(3): 197-215.

**De la Masselière, M.C., Ravigné, V., Facon, F., Lefeuvre, P., Massol, F., Quilici, S. and Duyck, P. (2017)** Changes in phytophagous insect host ranges following the invasion of their community: long-term data for fruit flies. *Ecology and Evolution, 7*: 5181-5190.

**Fan, Q., Flechtmann, C.H.W. and De Moraes, G.J. (2016)** Annotated catalogue of Stigmaeidae (Acari: Prostigmata), with a pictorial key to genera. *Zootaxa, 4176*(1): 1-199.

**Fandiño-Lozano, M. and van Wyngaarden, W. (2005)** *Prioridades de Conservación Biológica para Colombia*. Grupo ARCO, Bogotá.

**Gutierrez, J. (1985)** Systematics. *Spider mites: their biology, natural enemies and control* (eds. Helle, W. & Sabelis, M.W.). p. 75-90. Elsevier Science Publishers B.V. The Netherlands.

**Intriago, D., Torres M., Arahana, V. and Tobar, J. (2013)** Evaluación de la variabilidad genética del capulí (*Prunus serotina* subsp. *capuli*) en tres provincias del Ecuador. *Revista Ecuatoriana de Medicina y Ciencias Biológicas, 34*(1-2): 11-25.

**Jorgensen, P.M. and León-Yánez, S. (1999)** *Catalogue of the vascular plants of Ecuador*. Missouri Botanical Garden, Missouri, USA.

**Jorgensen, P.M., Ulloa, C. and Maldonado, C. (2006)** Botánica económica de los Andes Centrales. *Riqueza de plantas vasculares* (ed. Moraes, R.M., Ollgaard, B., Kvist, L.P., Borchsenius, F. & Balslev H.). p. 37-50. Universidad Mayor de San Andrés, La Paz, Bolivia.

**Josse, C., Cuesta, F., Navarro, G., Barrena, V., Cabrera, E., Chacón-Moreno, E., Ferreira, W., Peralvo, M., Saito, J. and Tovar, A. (2009)** *Ecosistemas de los Andes del Norte y Centro. Bolivia, Colombia, Ecuador, Perú y Venezuela*. Secretaria General de la Comunidad Andina, Programa Regional ECOBONA-Intercooperation, CONDESAN-Proyecto Páramo Andino, Programa BioAndes, EcoCiencia, NatureServe. IAvH, LAT-UNALM, ICAE-ULA, CDC-UNALM, RUMBOL SRL. Lima.

**Khanjani, M. and Ueckermann, E.A. (2008)** A new species of *Zetzellia* Oudemans (Acari: Stigmaeidae) from West Iran. *International Journal of Acarology, 34*: 237-241.

**Migeon, A., Nouguier, E. and Dorkeld, F. (2011)** Spider mites web: a comprehensive database for the Tetranychidae. *Trends in Acarology*, 557-560. Available in: http://www.montpellier.inra.fr/CBGP/spmweb

**Myers, M., Mittermeier, R.A., Mittermeier, C.G., Da Fonseca, G.A.B. and Kent, J. (2000)** Biodiversity hotspots for conservation priorities. *Nature, 403*: 853-858.

**Palacios, W. (2011)** *Árboles del Ecuador-Ministerio del Ambiente del Gobierno Nacional de la República del Ecuador*. Primera edición. Grupo Comunicacional Efigie, Quito. 923 pp.

**Piperno, D.R. (2011)** The origins of plant cultivation and domestication in the New World Tropics: patterns, process, and new developments. *Current Anthropology, 52*: 453-470.

**Summers, F.M. (1966)** Genera of the mite family Stigmaeidae Oudemans (Acarina). *Acarologia, 8*: 230-250.

**Valencia, R., Pitman, N., León-Yánez, S. and Jorgensen, P.M. (2000)** *Libro rojo de las plantas endémicas del Ecuador 2000*. Pontificia Universidad Católica del Ecuador, Quito, Ecuador.

**Vásquez, C., Dávila, M. and Pomboza, P.P. (2017c)** First report of *Tetranychus urticae* Koch (Acari: Tetranychidae) occurring in the Ecuadorian Sierra on two Andean crops. *Entomotropica*, in press.

**Vásquez, C., Dávila, M., Pomboza, P.P. and Telenchana, T. (2017b)** Primer reporte de *Oligonychus coffeae* (Acari: Tetranychidae) sobre *Alnus acuminata* en la región andina. *Revista Mexicana de Biodiversidad, 88*: 256-259.

**Vásquez, C., Dávila, M., Telenchana, N., José, M. and Daniela, N. (2017a)** Primer reporte de *Eotetranychus lewisi* en la región andina del Ecuador en *A. xanthorrhiza* (zanahoria blanca) y *T. tuberosum* (mashua). *Revista Mexicana de Biodiversidad, 8*(4): 992-994.

**Vavilov, N.I. (1992)** *Origin of Cultivated Plants*. Cambridge University Press, Cambridge, UK.