**The phytophagous and predatory mites (Acari) on *Prunus* (Rosaceae)
in southeastern Canada.**

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A thesis submitted to the Faculty of Graduate and Postdoctoral Affairs in partial fulfillment of

the

requirements for the degree of

Master of Science

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Ottawa, Canada

January 30, 2017

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Abstract

During summer 2015, 192 samples of foliage were taken from 13 different *Prunus* species found mostly along the Ottawa River (Quebec, Ontario; 148 samples) and in the Vineland region (Ontario; 44 samples). A total of 39 mites species were collected, representing 9 families and 25 genera. Out of 39 species, 20 were strictly phytophagous and 19 were predators. Estimators of the true species diversity indicated that most of the mite fauna associated with the foliage of those *Prunus* species in the areas sampled was captured. One eriophyid mite species appears to represent a new species for science. In terms of host range, phytoseiids appear to be less specific than eriophyoids and both taxa can exhibit host preferences. Eriophyoid mites were not so host specific inside the genus *Prunus*, although they may be restricted to the genus. Tetranychoid mites were generalist. Three species of Eriophyidae were found within galls on *Prunus* leaves: *Eriophyes cerasicrumena*, *E. emarginatae* and *E. prunidemissae*. In addition to providing an overview of the mite fauna of *Prunus* foliage and galls, this project provides two identification keys to the eriophyid mite species associated with galls, one based on the mite morphology, and the other based on the morphology of the galls. .

Key words: *Prunus*; phytophagous mites; predatory mites; survey; biodiversity

Acknowledgments

I want to thank my family, my friends and my boyfriend for their support when times were hard. Life brings surprises that are sometimes difficult to cope with, especially during a master's degree. But there is nothing like having the feeling of contributing to the body of scientific knowledge to keep working. Special thanks to my supervisors (Naomi Cappuccino and Frédéric Beaulieu) for their trust and faith in me during those two years. Un grand merci à mon ami Jacques Cayouette pour son support et son aide. I also want to thank the Gatineau Park, the National Capital Commission (NCC), the Friends of the Fletcher Wildlife Garden and the Botanical Garden of Montreal for their authorization to sample in restricted areas. I want to thank several producers of the Vineland region who gave access to their lands: Juan Miranda, Ed Hughes, Torrie Warner, Tony Scambuler, David Klyn, and Zach Haist. Thanks to Monique & Bruce at Jordan Valley Campground. Thanks to all members of my thesis committee (Julian Starr, Céline Boutin, and my supervisors), to Agriculture Canada and to Carleton University. Thanks to Kellina Higgins, David Martineau and Étienne Léveillé-Bourret for constructive comments on earlier version of the thesis. This research was conducted by M.-È. G.-L. as part of the requirement for a M.Sc. at Carleton University. Financial support was provided through an operating grant from Agriculture and Agri-Food Canada to Frédéric Beaulieu.

Preamble

It all began with the search of a project. My first thought was to compare the mite fauna on introduced host plants vs native host plants in Quebec. However, it was difficult to find sites that had the same introduced and native host plants. This idea was then rejected for a better proposal from my supervisor, Fred Beaulieu. He said: « Why don't you work on the mite fauna of a single genus of plants, like *Prunus*? » I said to myself : « Why not? » Despite its agricultural importance, the genus *Prunus* is not well studied in terms of its mite fauna. So, here is the result of two years of research on the mite fauna

of *Prunus* in Quebec and Ontario. The work is presented as two manuscripts to be later published as scientific articles.

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Introduction

The genus *Prunus* (*Rosaceae*) contains more than 200 species worldwide including well known crops that give us apricots, almonds, peaches, cherries, nectarines and plums (Rohrer, 2015). Furthermore, *Prunus* also contains cultivars grown as ornamental trees and shrubs for the beauty of their flowers, colors, odors and fruits (Rohrer, 2015). Many wild species of *Prunus* also grow naturally in open or forested habitats (Leboeuf, 2007), providing food and shelter for birds, small mammals, insects.

Given their agronomic and horticultural significance, it is crucial to understand the ecology of the pests of *Prunus* spp. as well as their natural enemies that, indirectly, provide protection to the hosts. The tent caterpillars (Lepidoptera: *Malacosoma* spp.) first come to mind when thinking about economically devastating pests of *Prunus* (Hills, 1987). However, other pests have been neglected by agronomists and scientists because their minute size prevents them from being seen with the naked eye. This is the case of phytophagous (plant-eating) mites. When their presence is noticed, it is usually when the injuries become visible on the plants (Keifer et al., 1982).

One taxon of great economic importance among phytophagous mites is the Eriophyoidea (Acari : Prostigmata) (Keifer et al., 1982). They are mostly specialists known to live on a narrow range of hosts, i.e. one plant species or related species within a genus (Skoracka & Kuczyński, 2006). These mites cause a great variety of injuries: leaf and stem galls, blisters and chlorotic flecks on the leaves as well as spotted and deformed fruits (Linquist et al., 1996). Some species are reported to be vectors of diseases such as the Cherry Mottle Leaf Virus (CMLV) and the Peach Mosaic Virus (PMV) (James & Mukerji, 1993; Jeppson et al., 1975). The mites belonging to the superfamily Eriophyoidea (eriphyoids) are recognizable by their worm-shaped body with numerous annuli and by having only

two pairs of legs in their podosomal region (i.e. portion of the body where the legs are inserted) (Lindquist, 1996). There are two families of Eriophyoidea reported on *Prunus*: the Diptilomiopidae and the Eriophyidae (Baker et al., 1996). There are 27 species reported from Canada and the United States. The taxonomy for several of these species remains unresolved (e.g. *Aculus?* *amygdalina* and *Diptacus gigantorhynchus*; Amrine and deLilo unpublished database; Baker et al., 1996), and they may consist of a complex representing multiple species rather than a single entity. On this list, seven species are reported to induce leaf galls.

Table 1. Eriophyoid mites reported from *Prunus* hosts in Canada and in the USA. Data are from Amrine and de Lilo unpublished database, (2012).

Eriophyoid mites	Distribution
Diptilomiopidae	
<i>Diptacus gigantorhynchus</i> (Nalepa, 1892)	Canada, USA
Eriophyidae	
<i>Acalitus phloeocoptes</i> (Nalepa, 1890)*	USA
<i>Aculus fockeui</i> (Nalepa & Trouessart, 1891)	Canada, USA
<i>Aculus wagnoni</i> (Keifer, 1959)	USA
<i>Aculus?</i> <i>amygdalina</i> (Banks, 1912)	USA
<i>Apodiptacus cordiformis</i> Keifer, 1960	USA
<i>Asetacus barbarae</i> Keifer, 1959	USA
<i>Cercodes simondsi</i> Keifer, 1960	USA
<i>Epitrimerus demissae</i> Keifer, 1959	USA
<i>Epitrimerus virginiana</i> Keifer, 1959	USA
<i>Eriophyes breechii</i> Keifer, 1939*	USA
<i>Eriophyes catacardiae</i> Keifer, 1962	USA
<i>Eriophyes cerasicrumena</i> (Walsh, 1867)*	Canada, USA
<i>Eriophyes emarginatae</i> Keifer, 1939*	USA
<i>Eriophyes geratopus</i> Keifer, 1965	USA
<i>Eriophyes hybridicola</i> Keifer, 1957	USA
<i>Eriophyes ilicifoliae</i> Keifer, 1941	USA
<i>Eriophyes inaequalis</i> Wilson & Oldfield, 1966	USA

<i>Eriophyes insidiosus</i> Keifer & Wilson, 1955	USA
<i>Eriophyes maritima</i> Kendall, 1928*	USA
<i>Eriophyes prunandersoni</i> Keifer, 1939*	USA
<i>Eriophyes prunicrumena</i> (Walsh, 1868)	USA
<i>Eriophyes prunidemissae</i> Keifer, 1956	USA
<i>Eriophyes pseudoinsidiosus</i> Wilson, 1965	USA
<i>Eriophyes savagei</i> Keifer, 1939	USA
<i>Eriophyes similisprunianus</i> Masee, 1930*	Canada
<i>Phyllocoptes abaenus</i> Keifer, 1940	Canada, USA

? Could be a junior synonym of *Aculus fockeui* (Nalepa & Trouessart, 1891).

*An asterisk indicates species that induce galls.

Some other mite pests than Eriophyoidea are considered generalists that can be seen on a few families of plants including *Rosaceae*. Two examples are the well-known two-spotted spider mite (*Tetranychus urticae* Koch, 1836) and the brown mite (*Bryobia rubrioculus* [Scheuten, 1857]), both representatives of the spider mite family (Acari : Prostigmata : Tetranychidae) (Jones, 1990). Spider mites are reported to puncture the plant tissues of the stems, leaves and fruits with their cheliceral stylets. This leads to the desiccation, discoloration or abscission of the leaves, or can cause the fruits to be discolored or stunted (McGregor, 1950). Thirty species of spider mites are found on *Prunus* in North America (Table 2). Another family known to contain important pests is the Tenuipalpidae or flat mites (Prostigmata : Tetranychoidea) (Mesa et al., 2009).

Tenuipalpids are represented by around 900 species in 34 different genera distributed worldwide (Mesa et al., 2009). According to the same source, all species are phytophagous and thus feed on the epidermal cells of leafs, stems and fruits. Two important genera are *Brevipalpus* Donnadieu and *Tenuipalpus* Donnadieu (Mesa et al., 2009). Mites in the genus *Brevipalpus* are reported to vector the citrus leprosis in *Citrus* crops (Rodrigues & Childers, 2012). In the Canadian Prairies ecozone, there

are 13 species mentioned (Beaulieu & Knee, 2014).

Table 2. Tetranychidae from North America found on *Prunus* (Migeon & Dorkeld, 2006-2015),

Tetranychidae	
* <i>Bryobia praetiosa</i> Koch, 1836	<i>Oligonychus yotheri</i> (McGregor, 1914)
* <i>Bryobia rubrioculus</i> (Scheuten, 1857)	* <i>Panonychus citri</i> (McGregor, 1916)
<i>Eotetranychus carpini</i> (Oudemans, 1905)	* <i>Panonychus ulmi</i> (Koch, 1836)
<i>Eotetranychus clitus</i> Pritchard & Baker, 1955	<i>Petrobia (Petrobia) latens</i> (Müller, 1776)
<i>Eotetranychus lewisi</i> (McGregor, 1943)	* <i>Tetranychus canadensis</i> (McGregor, 1950)
* <i>Eotetranychus perplexus</i> (McGregor, 1950)	<i>Tetranychus desertorum</i> Banks, 1900
<i>Eotetranychus pruni</i> (Oudemans, 1931)	<i>Tetranychus kanzawai</i> Kishida, 1927
<i>Eotetranychus sexmaculatus</i> (Riley, 1890)	<i>Tetranychus ludeni</i> Zacher, 1913
<i>Eotetranychus smithi</i> Pritchard & Baker, 1955	* <i>Tetranychus mcdanieli</i> McGregor, 1931
* <i>Eotetranychus uncatus</i> Garman, 1952	<i>Tetranychus mexicanus</i> (McGregor, 1950)
<i>Eutetranychus banksi</i> (McGregor, 1914)	<i>Tetranychus neocaledonicus</i> André, 1933
* <i>Oligonychus bicolor</i> (Banks, 1894)	* <i>Tetranychus pacificus</i> McGregor, 1919
<i>Oligonychus coffeae</i> (Nietner, 1861)	<i>Tetranychus schoenei</i> McGregor, 1941
<i>Oligonychus perditus</i> Pritchard & Baker, 1955	<i>Tetranychus turkestani</i> (Ugarov & Nikolskii, 1937)
<i>Oligonychus punicae</i> (Hirst, 1926)	* <i>Tetranychus urticae</i> Koch, 1836

*Asterisk indicate a species found in Canada.

Tarsonemidae is also a family containing pests. It includes around 530 species in 40 genera (Krantz & Walter, 2009). According to these same authors, the family shows a broad variety of feeding preferences with species being algivorous, fungivorous, foliage-feeders, pollen-feeders, predators and even parasites. *Polyphagotarsonemus latus* (Banks, 1904) is a species reported to severely damage some economically important plants (Walter & Proctor, 2013); the same is true for *Hemitarsonemus*, *Phytonemus* and *Steneotarsonemus* (Krantz & Walter, 2009).

Other mites found on *Prunus* are also economically important, but in a different way. Predatory mites play a major role in the biological control of phytophagous pests, as they are being produced and

released to protect different crops (Bostanian et al., 2010). More than one family of predators are naturally found in *Prunus* orchards: Phytoseiidae (Acari : Mesostigmata) are the most commonly encountered, but prostigmatic mites such as Bdellidae, Cunaxidae, Eupallopsellidae, Cheleytidae, Stigmaeidae, Eupodidae, Erythraeidae (Walter, 1999) and Anystidae (Carrillo et al., 2015) are also reported. Thirty six phytoseiid species are reported from a rosaceous host in Canada and USA (Table 3).

Table 3. Phytoseiids from Canada and the United States on Rosaceae (Demite et al., 2015).

Phytoseiidae	
* <i>Amblyseius americanus</i> Garman, 1948	<i>Phytoseius californicus</i> Kennett, 1967
* <i>Amblyseius andersoni</i> (Chant, 1957)	* <i>Phytoseius canadensis</i> Chant, 1965
* <i>Amblyseius duncansonii</i> Specht & Rasmy, 1970	<i>Phytoseius scrobis</i> Denmark, 1966
* <i>Aristadromips masseei</i> (Nesbitt, 1951)	<i>Proprioseiopsis exopodalis</i> (Kennett, 1958)
* <i>Arrenoseius timagami</i> (Chant & Hansell, 1971)	* <i>Proprioseiopsis fragariae</i> (Kennett, 1958)
* <i>Galendromus (Galendromus) longipilus</i> (Nesbitt, 1951)	<i>Proprioseiopsis hippianus</i> Denmark & Evans, 2011
* <i>Galendromus (Galendromus) occidentalis</i> (Nesbitt, 1951)	<i>Proprioseiopsis lepidus</i> (Chant, 1959)
<i>Galendromus (Mugidromus) pinnatus</i> (Schuster & Pritchard, 1963)	<i>Proprioseiopsis mescalero</i> Denmark & Evans, 2011
* <i>Metaseiulus (Metaseiulus) arboreus</i> (Chant, 1957)	* <i>Proprioseiopsis okanagensis</i> (Chant, 1957)
* <i>Metaseiulus (Metaseiulus) columbiensis</i> (Chant, 1959)	* <i>Proprioseius oudemansi</i> (Chant, 1959)
* <i>Metaseiulus (Metaseiulus) herbertae</i> (Nesbitt, 1951)	* <i>Typhlodromina conspicua</i> (Garman, 1948)
* <i>Metaseiulus (Metaseiulus) pomi</i> (Parrott, 1906)	* <i>Typhlodromina eharai</i> Muma & Denmark, 1969
<i>Neoseiulus brevispinus</i> (Kennett, 1958)	<i>Typhlodromips illinoisensis</i> Denmark & Evans, 2011
<i>Neoseiulus crataegi</i> (Jorgensen & Chant, 1960)	<i>Typhlodromips vierhelleri</i> Denmark & Evans, 2011
* <i>Neoseiulus driggeri</i> (Specht, 1968)	* <i>Typhlodromus (Anthoseius) bakeri</i> (Garman, 1948)
* <i>Neoseiulus fallacis</i> (Garman, 1948)	<i>Typhlodromus (Anthoseius) paramontana</i> (Denmark & Evans, 2011)
* <i>Neoseiulus iroquois</i> (Chant & Hansell, 1971)	* <i>Typhlodromus (Typhlodromus) corticis</i> Herbert, 1958
* <i>Neoseiulus micmac</i> (Chant & Hansell, 1971)	---
<i>Neoseiulus shanksi</i> Congdon, 2002	---

* Asterisks indicate that the species has been reported to occur in Canada.

Problems raised

Few surveys have been conducted for mites of *Prunus* spp. in North America, and they rarely concern southeastern Canada (Keifer, 1952; Collyer, 1964; Montes et al., 2012). It is understandable that

cultivated species and varieties of *Prunus* have enjoyed more attention in the acarological literature and are thus evidently more documented than the non-commercial ones. Even then, crop mites have not been studied enough. For example, a document produced by the Pesticide Risk Reduction Program of Agriculture and Agri-Food Canada (2006) reports on only a small subset of the phytophagous mites of the Sweet cherry (*Prunus avium* (L.)L.). Baker et al. (1996) lists and describes the eriophyoid mite species associated with *Prunus* in California. Knowing whether those mites are present in Canada could inform the legislation regarding the importation of vegetative material with the goal of protecting our crops from pests. However, the mite fauna of wild Canadian *Prunus* spp. is poorly known. This work will address this dearth of knowledge by surveying phytophagous and predatory mites on *Prunus* in southeastern Canada.

Determining the mite fauna associated with *Prunus* will provide the basic data needed to address more complex ecological and taxonomic problems. One example is *Aculus fockeui* (Nalepa & Trouessart, 1891; Trombidiformes, Eriophyidae), which is well-known to induce many different symptoms on *Prunus* such as chlorotic flecks, yellow spots and asteroid spots on leaves and the deformation of shoots into 'rosettes' (Keifer et al., 1982; Boczek & Davis, 1984; Olfield, 1984). However, *A. fockeui* is reported to be highly variable in certain morphological characters (Boczek, 1984), which suggests that it could be a species complex. In addition, there are some important taxonomic problems with the Eriophyoidea as many species have more than one morphologically different form (Lindquist & Oldfield, 1996). Males and females are dimorphic (at least in the genitatic region), and some species have two forms of females: a protogyne and a deutogyne. Immature stages, larvae and nymphs, also differ (usually only slightly) from the adult stages. The deutogyne female survives the winter, giving birth to the first generation in the spring (Keifer, 1952). The protogyne female lives mostly during the summer (Keifer, 1952). One example of potential problems associated with this female dimorphism is

seen with *A. fockeui* (protogyne) and *Aculus cornutus* (deutogyne), which were originally described as separate species, but which were eventually determined to be two female forms of the same species (*A. fockeui*; Oldfield, 1984). It can become a puzzle to match the different forms of a single species, especially when basic ecological data and detailed field-based surveys are lacking.

Descriptions of the mite species are often old and incomplete. Descriptions by Baker et al. (1996) are incomplete, because we do not know how many specimens were examined for those descriptions and the variability of individuals within a species is not indicated. Furthermore, descriptions are sometimes hard to compare, because not the same set of characters are used to describe a given mite species versus another species, at least not if described a few decades ago (standards have now improved). Also, some type (and voucher) specimens that were mounted on slides many years ago are often now useless, because the mounting medium is often cracked or is crystalized, making it almost impossible to examine the morphological characters of the specimens. In those cases, mites species have to be collected again, mounted on slides, and redescribed, following the best standards, which would involve examining and measuring a good number of specimens in order to capture fully the intraspecific variation of the species morphology..

Skoracka and Kuczyński (2006) state that there is a need to study the degree of host specificity of eriophyoid mites to fully understand their population dynamics. Some species may not be as specific as thought. Some phytoseiids (predatory mites) have been used for many years as biological control agents, but researchers have pointed out that even though some of them may be generalists in the choice of prey, they may be specific to a single or a few species of host plant (Beard & Walter, 2001). Thus, predatory mites found on wild *Prunus* may be better adapted to their host plants, and thus represent an unexploited source of new biological control organisms for crop species. It is also

important to determine if a mite pest is susceptible to switch hosts if it comes in contact with another close relative of *Prunus*.

There is a need to identify the gall inducers on *Prunus* and associate the species to their galls in order to elaborate the necessary tools to identify them correctly. There are resources to identify gallers, based on the hosts and galls morphology, but they do not apply to Canada (Redfern & Shirley, 2011; Felt, 1940). In a perspective of biocontrol, it is necessary to identify correctly a pest in order to release the adequate biocontrol agent in the crops. It would be risky to identify a galler only by the host and galls, because there could be cryptic species. This might lead to a wrong identification. An identification key based on the morphology of the mites that induce galls in Canada would therefore be complementary to a key based on the hosts and galls.

Chapter 1 presents a survey of the phytophagous and predatory mites of *Prunus* in southeastern Canada, a contribution to the limited literature on the subject. Chapter 2 addresses the issue that mites species that induce galls on different host plants are difficult to identify based on the galls alone. The study of the mites producing leaf galls is economically important, because galls may reduce the photosynthetic abilities of the plants (Carneiro et al., 2014). Since *Prunus* is a genus of economic importance, knowing its pests is crucial. Correct identification of the pest species is critical for their control, especially for biocontrol, where predatory mites may be specific or better adapted to hunt certain pest species (McMurtry et al., 2013).

Chapter 1

A contribution to the phytophagous (Acari: Eriophyoidea, Tetranychoida) and predatory (primarily Acari: Phytoseiidae) mites of *Prunus* spp. (Rosaceae) in southeastern Canada

Introduction

The genus *Prunus* (Rosaceae) comprises over 200 species of flowering trees and shrubs, including many cultivated crops such as apricots, almonds, nectarines, peaches, cherries, and plums (Rohrer, 2015). Given the economic significance of this genus, knowledge of the taxonomy, distribution and ecology of *Prunus*-associated pests and their natural enemies is of great practical importance. Acarine pests of *Prunus* include species of Eriophyoidea (Trombidiformes; Eriophyidae and Diptilomiopidae), Tetranychidae (spider mites, Acari: Trombidiformes), Tenuipalpidae (flat mites, Acari: Trombidiformes) and Tarsonemidae (Acari: Trombidiformes) (Keifer et al., 1982; Jones, 1990; Mesa et al., 2009). Eriophyoid mites are strictly phytophagous and cause a variety of injuries to their host plants, including leaf erineae (i.e. clusters of hairs that grow on the leaf in response to the feeding of the mite), pouch galls, blisters, leaf chlorotic flecks, as well as fruit spots and deformations (Linquist & Oldfield., 1996). They can also transmit viral diseases such as the Cherry Mottle Leaf Virus and the Peach Mosaic Virus (James & Mukerji, 1993; Jeppson et al., 1975). Tetranychoid mites also contain important pests. Two examples are the globally distributed two-spotted spider mite *Tetranychus urticae* Koch, 1836 (Trombidiformes, Tetranychidae) and the brown mite (*Bryobia rubrioculus* (Scheuten, 1857)) (Trombidiformes, Tetranychidae) (Jones, 1990). Spider mites are reported to puncture the plant tissues found on the stems, leaves and fruits with their cheliceral stylets. This feeding action leads to the desiccation, discoloration or abscission of the leaves, or can cause the fruits to be discolored or stunted (McGregor, 1950). Two other mite families are known to contain important

pests: the Tenuipalpidae or flat mites (Prostigmata: Tetranychoida) (Mesa et al., 2009) and the Tarsonemidae (Walter & Proctor, 2013). All species of flat mites are phytophagous, feeding on epidermal cells of different structures (leaves, stems and fruits). Two important tenuipalpid genera are: *Brevipalpus* Donnadieu and *Tenuipalpus* Donnadieu (Mesa et al., 2009). Tarsonemid species show a broad variety of feeding habits with species being algivorous, fungivorous, foliage-feeders, pollen-feeders, predators and even parasites. *Polyphagotarsonemus* is a genus of Tarsonemidae reported to contain some devastating pests on economically important plants (Walter & Proctor, 2013), as are *Hemitarsonemus*, *Phytonemus* and *Steneotarsonemus* (Krantz & Walter, 2009).

Members of other mite taxa, especially Phytoseiidae (phytoseiids) play a role in controlling the populations of the plant pests. Some species of predatory mites are commercially produced and released in the field as biocontrol agents for crop protection (Bostanian et al., 2010). *Neoseiulus fallacis* (Garman) is one of the main predatory mite species released on *Prunus* spp. crops (Bostanian, 2006). Other families of predatory mites (e.g. Anystidae, Cheyletidae, Stigmaeidae and Cunaxidae) include predatory mites that naturally colonize *Prunus* crops, but are rarely released intentionally (Eichelberger et al., 2011; Montes et al., 2012; Bostanian et al., 2012). Most of the information on the association between *Prunus* and predatory mites comes from surveys on commercial *Prunus* in the United States or overseas, rarely in Canada (Eichelberger et al., 2011; Baldo et al., 2016). A better knowledge of the predatory mite fauna would facilitate research and development of new, better adapted biocontrol agents for orchards in Canada and in regions of the USA with similar climates. In parallel, an improved knowledge of mite pests on *Prunus* would enhance regulatory decision-making related to the release of plant material imported for propagative purposes, which includes *Prunus* spp. Knowing the host specificity would help to evaluate the risk of dispersal in the wild and help in the development of adequate control measures (Navia et al., 2010).

The identity and distribution of mites associated with *Prunus* spp. is poorly known, despite their economic significance. In Canada, only five eriophyoids, 23 phytoseiids and 11 spider mites associated with *Prunus* or Rosaceae hosts have been reported in the literature, despite the fact that many more would be expected to occur given their presence in the United States (Amrine & de Lilo unpublished database, 2012; Migeon & Dorkeld, 2006-2015; Demite et al., 2016). As for tenuipalpids, there are thirteen species known to occur in Canada, but they may occur on other genera than *Prunus* (Beaulieu & Knee, 2014). In comparison, in the United States, there are 27 eriophyoid species reported on *Prunus*, 30 phytoseiids and 65 tetranychid species reported on Rosaceae (Amrine & de Lilo unpublished database, 2012; Migeon & Dorkeld, 2006-2015; Demite et al., 2016).

The goal of this study was to survey the phytophagous (Eriophyoidea, Tetranychoidae; Tarsonemidae excluded) and predatory mites of wild and cultivated *Prunus* spp. in southeastern Canada, specifically in the Ottawa River region (Quebec and Ontario) and the region of Vineland (Ontario). It also provides additional baseline data on the diversity, distribution and host range of *Prunus*-associated mites, including potential pests and beneficial mites.

Materials & Methods

Study sites and mite sampling

A total of 115 sites were found in two regions in southeastern Canada (APPENDIX 1, Fig. 1): (1) along the Ottawa River, which lies along the border between the provinces of Quebec and Ontario, between Fort William (QC) and Montreal; and (2) in the Vineland Ontario region. Sites along the

Ottawa River were sampled because of easy access and proximity to work. The Vineland region was sampled because there were crops with species that do not grow in Quebec. Sites along the Ottawa River were selected in May 2015 by driving along highways and roads across the study regions and stopping in locations where blooming *Prunus* patches were seen or were expected to be occurring (i.e. mostly open fields and forest edges), taking care to spread the sampling sites of each species of *Prunus* as evenly as possible across each study region. The maximal distance of a site from the Ottawa River is 7 km. A site was considered suitable for sampling if 3-5 individuals of at least one *Prunus* species were found within a radius of 20 m. Along the Ottawa River, 27 sites were sampled from 16 June 2015 to 2 July 2015 (17-day period) and another 29 sites were sampled from 22 August 2015 to 31 August 2015 (10-day period). Not all the sites found were visited during the sampling. Authorisation for sampling foliage was obtained from Gatineau Park, National Capital Commission (NCC) and land owners in the Vineland region (for sites # see Appendix 1). Habitats at each site were classified into three categories: (1) cultivated sites, where trees were grown in dense rows, or trees that were solitary but that had been planted such as in urban parks; (2) forest edges, where *Prunus* occurred naturally on the border between wooded (deciduous trees) and open (relatively disturbed) areas; (3) open habitats, where the surrounding vegetation was low (open canopy) and where *Prunus* patches were completely exposed to the sun. In crop sites that had received pesticides such as sulfur or pyrethroids, the most frequently sampled host species were *Prunus persica* (Linnaeus) Batsch, *Prunus avium* (L.) L., *Prunus cerasus* L. and *Prunus domestica* L. In park areas, it was possible to find cultivated *Prunus padus* L. and *Prunus munsoniana* W.Wight & Hedrick, as ornamentals. In forest edges, the commonly found species were *Prunus serotina* Ehrh., *Prunus americana* Marshall, *Prunus nigra* Aiton, *Prunus avium*, *Prunus pensylvanica* L. and *Prunus virginiana* L.. *Prunus pumila* var. *suquehanae* (Willdenow) H. Jaeger was found in sandy areas, at the border of coniferous stands. In sandy areas, under full sun exposure and close to water, *Prunus pumila* var. *depressa* (Pursh) Bean were found. Exposed sites such as

wastelands often contained *Prunus americana* and *Prunus nigra*

Each sample consisted of six terminal branch segments or stems 20 cm in length taken from one to six individual plants (mostly 4-5) within a 20 m radius area (1257 square meters). This size of sampling area was chosen in order to maximize the finding of 6 different individuals of a certain host. Each of the branch segments was selected randomly. Each sample was individually placed in a plastic bag and kept refrigerated at 4°C for a maximum of 2 weeks prior to extraction of mites. Cutters were rinsed with ethanol between each sample to reduce the risk of contaminating samples with mites from different samples. On the sites, voucher specimens were collected in order to verify the identity of the hosts. Specimens will be deposited at Agriculture and AgriFood Canada's National Collection of Vascular Plants (DAO) and/or at the Marie-Victorin Herbarium (MT). A total of 192 samples of *Prunus* were collected from 56 sites.

Sorting and identification of mites

Mites were extracted from plant samples by washing in 95% ethanol. Twigs and leaves from each sample were cut in smaller fragments in order to fit them inside a 150 ml jar with ethanol. Each jar was vigorously shaken for about 20 seconds. Plant material was then carefully removed one piece at a time from the jar using tongs and shaken while being removed to reduce chances of removing mites with the material. When the amount of plant material was too voluminous, a few repetitions of the three previous steps (1. filling jar – 2. shaking – 3. removing material) were necessary before the entire material of a given sample was washed. The contents of the ethanol jars were then kept in the freezer until they could be sorted and mounted on slides.

For each foliage sample in which there were galls suspected to be caused by eriophyoid mites (and not from other arthropod groups, such as wasps or flies), all galls were excised from the leaves before washing the material. Mites found in galls were slide-mounted individually for later identification, but were not counted and used in this study. Since the galls were cut from the leaves before the washing, it means that all mites present in the ethanol after the washing were vagrant individuals (i.e. free living on the leaf surface).

To estimate the leaf area represented in each sample, six leaves were randomly taken from each sample prior to washing. The selected leaves were scanned using a scanner (Epson GT 10000+), their area measured using the program ImageJ (Abramoff et al., 2004), and the average area per leaf multiplied by the total number of leaves (counted) in the sample. The leaf area was calculated in order to determine if the amount of washed plant material was similar between the samples.

Finally, mites were sorted under a dissecting microscope, and the number of mites was counted for each different taxa recognized. For each taxa, a portion of the mites were mounted on microscope glass slides in a drop of polyvinyl alcohol, and then placed in a drying oven at 60°C for 3–5 days. Polyvinyl alcohol was chosen over other mediums, because it is easy to use and does not necessitate the use of a sealant around the slip cover.

Mites were identified using a Leica DM2500 compound microscope with differential interference contrast (DIC), and pictures were taken using a Leica ICC50HD camera. The following references were used for the identification of mite genera and species: Denmark & Evans (2011) for Phytoseiidae; Baker et al. (1996), Keifer (1952) and Amrine et al., (2003) for Eriophyoidea; Tuttle and Baker (1968) for Tetranychidae; and Mesa et al., (2009) for Tenuipalpidae. Phytoseiids were drawn in order to

identify them using their useful characteristics (Fig. 2). Pictures were also taken in order to help in the identification (Fig. 3). Other predatory mites were identified using (Krantz & Walter, 2009). Identifications were verified with original descriptions whenever possible, and with voucher or type specimens available at the Canadian National Collection of Insects, Arachnids and Nematodes (CNC). Families of mites that were primarily not phytophagous or predacious were excluded from the survey, such as Tydeoidea and Tarsonemidae (Gerson et al., 2003). Indeed, these two groups are considered to comprise primarily fungivorous species, although some tydeoids were observed to be at least facultative predators (Gerson et al., 2003). Tarsonemidae was excluded as well, because it does not contain many plant feeding species and predatory mites (Gerson et al., 2003). The authorities of the mite species are provided in Table 1 and will not be repeated in the text.

Analysis

The rarefaction curves and diversity estimators were generated in R software (R Development Core Team, 2008) with the Fossil package (Vavrek, 2012) using 10,000 bootstrap replicates. Rarefaction curves were done for comparing the two regions of study. Mite specimens collected from *Prunus* during two previous collecting events 40 years earlier (11–19 June, 1975; 29 July 1975) conducted in the vicinity of the study regions (Kenora district, Ontario), kept at the (CNC) were also studied in order to strengthen comparison of species host ranges. Statistics are presented as mean value $\pm$ standard deviation, or as ranges. *t*-test results are presented as mean, confidence interval and $\alpha=0.05$.

Results

Diversity

A total of 129 samples (67%) contained mites. Of these samples, 36% had only one species, 25% had

two species, 23% had three, 8% had four, 2% had five and 5% had six species. Eight hundred fifty mites were slide-mounted. A total of 39 mite species were identified, which were collected from a total of 13 species of *Prunus*. The overall rarefaction curve does not reach a plateau, but according to the diversity estimator (ACE), there may be a total of 40 mite species in the regions sampled, which is only one more species than the actual number of species found (ACE min: 1.8; max: 40.4; Fig. 4). *Prunus armeniaca* L. (apricots) (n=4 samples) had no mites and was excluded from further analysis..

There were a total of 20 phytophagous mite species—16 Eriophyoidea (Diptilomiopidae and Eriophyidae) and four Tetranychoidae—and 19 species of predatory mites (14 Phytoseiidae, 1 Anystidae, 1 Cheyletidae, 1 Cunaxidae, 1 Erythraeidae, 1 Stigmaeidae) (Table 1). More mite species were found on *Prunus virginiana* (21 spp.), *P. serotina* (19) and *P. americana* (19) compared to other *Prunus* spp. (2–13 mite spp.), but this is at least in part due to a sampling bias (33, 21 and 17 samples were taken for *P. virginiana*, *P. serotina* and *P. americana*, vs 2-12 samples for other *Prunus* spp.). In the Vineland region, there were 21 mite species, whereas in the Ottawa River region, there were 36 species (Fig. 5). Based on my samples, these regions have 17 species in common. The higher species richness in the Ottawa River region is at least in part due to a sampling bias (44 vs 139 samples, respectively). Four eriophyid species could not be identified to species or even to genus (*Aculus* sp.1, *Aculus* sp.2, *Acalitus/Aceria* sp., *Aculus/Acalitus* sp.). Three of those species were collected only once, whereas *Aculus* sp.1 was found in three samples, on three *Prunus* spp. (*P. pumila* var. *susquehanae*, *P. serotina*, *P. virginiana*). These may represent undescribed species..

Abundance

The species with the highest abundance for a single sample were *Eriophyes emarginatae* (1123 in a *P.*

virginiana sample), *Tetranychus urticae* (422 in a *P. nigra* sample), *Epitrimerus demissae* (277, in a *P. virginiana* sample), *Eriophyes cerasicrumena* (157, in a *P. serotina* sample), and *Eriophyes prunidemissae* (154, in a *P. virginiana* sample) (Table 1).

Accidental visitors

A total of 5 species could be identified as accidental visitors. Two eriophyid species were identified as probable accidental visitors (i.e., not truly associated with *Prunus* spp.) in our samples; *Aceria cirenea*, collected here in one sample *P. persica*, is normally associated with *Juglans cinerea* L. (Juglandaceae; butternut) and *Eriophyes paraspirae*, collected here in one sample of *P. persica*, but is previously only known from *Spiraea splendens* var. *splendens* Baumann ex K. Koch (Amrine & de Lillo unpublished database, 2012). Other mites (e.g., found in low abundance and in only one sample) may be accidental visitors, but it is difficult to determine whether their apparent rarity reflects another process (e.g. low populations, or secondary association for *Prunus* spp.). Among those possible accidental visitors, there are three phytoseiid species: *Proprioseiopsis* cf. *involutus* (otherwise recorded from *Erigeron annuus* (Linnaeus) Persoon) *Phytoseius betulae* (previously found on *Betula nigra* Linnaeus) and *Arrenoseius morgani* (previously recorded from *Taraxacum officinale* F.H. Wiggers) (Demite et al., 2015).

Crop pests

Aculus fockeui (Peach silver mite), *Aculus schlechtendali* (Apple rust mite), *Tetranychus urticae* (Two spotted spider mite; Migeon and Dorkfeld, 2006-2015), *Bryobia rubrioculus* (Brown mite; INRA-CBGP, 2006-2016) and *Panonychus ulmi* (European red mite; David'yan, 2003-2009) are geographically widespread phytophagous pests (Vacante, 2016) that were collected during the survey. In total, more of these pests (all 5 spp.) were found in samples from non-agricultural habitats (e.g.,

forest edges, forest, open habitats) than in orchards (only 3 pest spp.).

Proportion of gall-associated mites

Among all eriophyoid species collected, three species (20%) are known to induce gall (and were generally collected from galls in this study, rarely from leaf surfaces) and 1 species (6%) was an inquiline (i.e., seeking refuge in the galls of other species), 7 species (47%) were free-living or ‘vagrant’ species and 4 species (27%) had an unknown habit. The two gall-inducing species, *Eriophyes cerasicrumena* and *E. emarginatae*, and the gall inquiline, *E. prunidemissae*, were the only mite species found inside galls; however, they were also occasionally extracted from the foliage (and associated twigs) after all galls had been first removed, indicating that they were occasionally on leaf surfaces (or twigs).

Host range

Most of the species of Eriophyoid mites had more than one *Prunus* host (Fig. 6). This means that they were not so host specific within *Prunus*, even though they may be restricted to *Prunus* genus. Three species were host specific: *Epitrimerus demissae*, *E. pyri* and *E. virginiana*. Concerning the Tetranychoid mites, species were not host specific, although it would be premature to make a firm conclusion based on a single collection of *Brevipalpus* sp (Fig. 6). Phytoseid mites were mostly generalists with one species having a host preference (*Euseius finlandicus*) for *Prunus virginiana* (Fig. 6). Again, it is difficult to draw firm conclusions based on single collections of some species (7 spp.). Concerning other predatory mites, some species were well adapted for *Prunus* and were found a few times (*Anystis baccharum*, *Agistemus* near *collyerae* and *Balaustium* sp.).

Discussion

Mite diversity

The rarefaction curve for this study and the true species diversity estimate suggest that most of the acarofauna of the *Prunus* hosts in the two regions studied was captured. There was a higher number of mite species for *Prunus virginiana* (21 mite spp.), *P. serotina* (19 sp.) and *P. americana* (19 sp.) compared to other *Prunus* spp. (2–13 mite spp.), but this, at least in part, reflects a bias caused by a more extensive sampling of these hosts.

Crop pests

Among the five mite species (2 spp. Eriophyoidea, 3 spp. Tetranychidae) that are pests of agricultural crops, all were found in non-agricultural hosts, whereas only three of them were found in cultivated *Prunus* hosts. This can be explained by a sampling bias in terms of number of samples (a total of 36 vs 110 samples, respectively) and number of host species sampled (4 vs 9 *Prunus* spp.). It can further be explained by the cultivated *Prunus* having received treatments of fungicide (sulfur) or pesticides (e.g., pyrethroids) which may have killed mites, many of which are sensitive to pesticides (Gent et al., 2009), resulting in an impoverished fauna. The pests that were found on *Prunus* crops were *A. schlehtendali* (David, 2016), *Bryobia rubrioculus* (Kasap, 2008) and *P. ulmi* (AgroAtlas, 2003-2009). In non-agricultural habitats, two additional species that are considered pests elsewhere occurred: *A. fockeui* (David, 2016) and *T. urticae* (Magalhães et al., 2011).

Biocontrol agents

Three species of phytoseids were collected and were found to be natural biocontrol agents used commercially. *Amblyseius andersoni* is known to occur naturally in vineyards and orchards and feeds

on *Aculus schlechtendali*, *Tetranychus urticae* and on *Panonychus ulmi* (Biobest, ND). The species was found on cultivated *Prunus persica* (peach) and on several non-agricultural species. *Typhlodromus pyri* occurred on many fruit trees and on rosaceous plants and feeds on *Panonychus ulmi*, on *Aculus schlechtendali* and on *Tetranychus urticae* (Washington State University, 2017). In this study, the species was found two times on *Prunus virginiana*, which is a non-cultivated host. *Euseius finlandicus* preys on *Panonychus ulmi*, *Tetranychus urticae* and rust mites and is present worldwide on a wide variety of host plants (Washington State University, 2017). The species was found on three hosts that are being cultivated: *Prunus domestica* (plum), *P. munsoniana* (Munson plum) and *P. padus* (bird cherry).

Host range

Eriophyoid and tetranychoid mites were not so host specific within *Prunus* genus, although they may be restricted to the genus. The two species found in this survey that induce galls are *E. cerasicrumena* and *E. emarginatae*; these two species both have six different hosts out of 13 sampled hosts. *Eriophyes paraspirae* is also known to induce galls on *Spiraea splendens* var. *splendens* Baumann ex K. Koch, but not on *Prunus* (Amrine & de Lillo unpublished database, 2012). *Eriophyes cerasicrumena* and *E. emarginatae* are amongst the most polyphagous species found in this survey, even though they are apparently restricted to the genus *Prunus*. Two vagrant species are also polyphagous within *Prunus* (*Aculus fockeui* and *Aculus schlechtendali*).

Concerning the phytoseid mites, rare are the species being specialists on *Prunus* (1 sp.: *Typhlodromus pyri*). One species seems to have a host preference for *Prunus virginiana* (*Euseius finlandicus*). Three other predatory mites are well adapted for *Prunus* since they were collected a few times on the genus

(*Anystis baccarum*, *Agistemus* near *collyerae* and *Balaustium* sp.). Predatory mites are mostly generalists but they may exhibit host preferences.

Conclusion

Fifty-six sites were visited for sampling and this led to the collection of 192 samples of foliage material. The analysis of the mounted slides led to the identification of 39 mite species on 13 *Prunus* hosts. Twenty mites were phytophagous mites and 19 were predatory mites. Most of the *Prunus*-associated mite diversity was captured in this survey according to the diversity estimator ACE. One species could not be identified and could correspond to an undescribed species (*Aculus* sp.1). This species was collected a few times on *Prunus*, meaning that it is an associate. Some known crop pests were sampled in natural habitats and in crops: *Aculus fockeui*, *Aculus schlechtendali*, *Bryobia rubrioculus*, *Tetranychus urticae* and *Panonychus ulmi*. There were also accidental visitors in eriophyoid mites and predatory mites (mites from other hosts than Rosaceae). Concerning the host-specificity of the mites, eriophyoid mites were not as host-specific inside *Prunus* genus, although they may be exclusive to this genus. Some generalist species exist among eriophyid mites. *Aculus schlechtendali*, *Eriophyes cerasicrumena* and *Eriophyes emarginatae* had six and more hosts. Two eriophyid species were found to induce galls on *Prunus*: *Eriophyes cerasicrumena* and *Eriophyes emarginatae*. Phytoseids were more generalist, but could exhibit host preferences, such as *Euseius finlandicus* on *Prunus virginiana*. Three predatory mites were found, which are natural biocontrol agents used commercially: *Amblyseius andersoni*, *Typhlodromus pyri* and *Euseius finlandicus*. *Euseius finlandicus* seems well adapted to cultivated species of *Prunus* and could be evaluated as a potential biocontrol agent of these crops.

Further research should 1) try to sample and survey other *Prunus* species in North America, 2) focus on determining the host specificity and host range of the mites in the goal of protecting our crops from generalist pests and 3) be done to discover the association of pests and crops.

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Table Chapter 1

Table 1. Number of occurrences of mite species (total abundance of vagrants in parentheses) collected from 13 *Prunus* species along the Ottawa River and the Vineland region. Phytophagous groups (Eriophyoidea, Tetranychoidae) are listed before predatory groups (FAMILIES). The total number of samples (n) is given in brackets after host species names and the asterisk after the host name means that it is cultivated as a crop. The total number of mites does not include the mites that were in galls.

	no. mite species found per host													no. total mites	no. of hosts
	19	4	3	5	4	12	4	10	7	3	2	19	24		
mites	<i>Prunus americana</i> (17)	<i>Prunus avium</i> (6)*	<i>Prunus cerasus</i> (3)*	<i>Prunus domestica</i> (5)*	<i>Prunus munisiana</i> (1)	<i>Prunus nigra</i> (12)	<i>Prunus padus</i> (5)	<i>Prunus pennsylvanica</i> (10)	<i>Prunus persica</i> (3)*	<i>Prunus pumila</i> var. <i>depressa</i> (3)	<i>Prunus pumila</i> var. <i>susquehannae</i> (2)	<i>Prunus serotina</i> (21)	<i>Prunus virginiana</i> (33)		
Eriophyoidea															
Diptilomiopidae															
<i>Diptacus gigantorhynchus</i> (Nalepa)	3 (61)	—	—	—	1 (1)	—	—	—	—	—	—	—	—	62	2
Eriophyidae															
<i>Acalitus/Aceria</i>	—	—	—	—	—	—	—	—	—	—	—	—	1 (2)	2	1
<i>Aceria cinereae</i> (Keifer)	—	—	—	—	—	—	—	—	1 (1)	—	—	—	—	1	1

	no. mite species found per host															
	19	4	3	5	4	12	4	10	7	3	2	19	24	no. total mites	no. of hosts	
mites	<i>Prunus americana</i> (17)	<i>Prunus avium</i> (6)*	<i>Prunus cerasus</i> (3)*	<i>Prunus domestica</i> (5)*	<i>Prunus munsiana</i> (1)	<i>Prunus nigra</i> (12)	<i>Prunus padus</i> (5)	<i>Prunus pensylvanica</i> (10)	<i>Prunus persica</i> (3)*	<i>Prunus pumila</i> var. <i>depressa</i> (3)	<i>Prunus pumila</i> var. <i>susquehanae</i> (2)	<i>Prunus serotina</i> (21)	<i>Prunus virginiana</i> (33)			
<i>Aculus fockeui</i> (Nalepa & Trouessart)	—	—	—	—	—	3 (79)	—	3 (74)	—	—	—	1 (8)	—	161	3	
<i>Aculus schlechtendali</i> (Nalepa)	1 (11)	—	—	2 (501)	—	—	—	1 (48)	2 (35)	2 (18)	—	1 (10)	1 (1)	624	7	
<i>Aculus</i> sp.1	—	—	—	—	—	—	—	—	—	—	1 (1)	1 (3)	1 (5)	9	3	
<i>Aculus</i> sp.2	—	—	1 (2)	—	—	—	—	—	—	—	—	—	—	2	1	
<i>Aculus/Acalitus</i>	1 (1)	—	—	—	—	—	—	—	—	—	—	—	—	1	1	
<i>Epitrimerus demissae</i> Keifer	—	—	—	—	—	—	—	—	—	—	—	—	3 (277)	277	1	
<i>Epitrimerus pyri</i> (Nalepa)	—	—	—	—	—	—	—	—	1 (2)	—	—	—	—	2	1	
<i>Epitrimerus virginiana</i> Keifer	—	—	—	—	—	—	—	—	—	—	—	2 (46)	—	46	1	
* <i>Eriophyes cerasicrumena</i> (Walsh)	6 (99)	—	—	—	1 (2)	2 (11)	—	—	1 (1)	—	—	5 (157)	1 (1)	271	6	
* <i>Eriophyes emarginatae</i> Keifer	2 (4)	—	—	—	—	1 (3)	—	—	—	1 (210)	1 (43)	1 (4)	16 (1123)	1387	6	
* <i>Eriophyes paraspirae</i> (Keifer)	—	—	—	—	—	—	—	—	1 (1)	—	—	—	—	1	1	
<i>Eriophyes prunidemissae</i> Keifer	—	—	—	—	—	—	—	—	—	—	—	—	8 (154)	154	1	
<i>Phyllocoptes abaenus</i> Keifer	1 (2)	—	—	—	—	—	—	—	—	—	—	1 (18)	—	20	2	
Tenuipalpidae																
<i>Brevipalpus</i> sp.	—	—	—	—	—	—	—	—	—	—	—	—	1 (1)	1	1	

	no. mite species found per host															
	19	4	3	5	4	12	4	10	7	3	2	19	24	no. total mites	no. of hosts	
mites	<i>Prunus americana</i> (17)	<i>Prunus avium</i> (6)*	<i>Prunus cerasus</i> (3)*	<i>Prunus domestica</i> (5)*	<i>Prunus munsiana</i> (1)	<i>Prunus nigra</i> (12)	<i>Prunus padus</i> (5)	<i>Prunus pensylvanica</i> (10)	<i>Prunus persica</i> (3)*	<i>Prunus pumila</i> var. <i>depressa</i> (3)	<i>Prunus pumila</i> var. <i>susquehannae</i> (2)	<i>Prunus serotina</i> (21)	<i>Prunus virginiana</i> (33)			
Tetranychoidae																
<i>Bryobia rubrioculus</i> (Scheuten)	—	1 (2)	1 (1)	—	—	—	—	—	—	—	—	—	—	3	2	
<i>Panonychus ulmi</i> Koch	4 (19)	—	—	1 (13)	—	—	—	—	2 (77)	—	—	—	1 (2)	111	4	
<i>Tetranychus urticae</i> Koch	1 (3)	—	—	—	—	5 (241)	—	3 (23)	—	—	—	3 (3)	—	270	4	
Phytoseiidae																
<i>Amblyseius andersoni</i> (Chant)	7 (27)	—	—	—	—	6 (36)	—	2 (8)	1 (2)	—	—	5 (47)	6 (35)	155	6	
<i>Amblyseius krantzi</i> (Chant)	1 (2)	—	—	—	—	—	—	1 (2)	—	—	—	—	1 (10)	14	3	
<i>Arrenoseius morgani</i> (Chant)	—	—	—	—	—	—	—	1 (2)	—	—	—	—	—	2	1	
<i>Euseius finlandicus</i> (Oudemans)	—	—	—	4 (9)	1 (38)	—	3 (12)	—	—	—	—	3 (3)	8 (46)	108	5	
<i>Metaseiulus pomi</i> (Parrott)	4 (36)	1 (3)	—	—	—	2 (7)	2 (4)	—	—	—	—	1 (2)	3 (8)	60	6	
<i>Neoseiulus near cucumeris</i>	2 (13)	—	—	—	—	—	—	—	—	—	—	1 (1)	—	14	2	
<i>Neoseiulus driggeri</i> (Specht)	4 (12)	—	—	—	—	4 (37)	—	1 (3)	—	—	—	1 (2)	4 (10)	64	5	
<i>Paraseiulus soleiger</i> (Ribaga)	1 (3)	—	—	—	1 (8)	1 (2)	3 (33)	—	—	—	—	3 (9)	5 (38)	93	6	
<i>Phytoseius betulae</i> Denmark	—	—	—	—	—	—	—	—	—	—	—	—	1 (5)	5	1	
<i>Phytoseius canadensis</i> Chant	1 (4)	—	—	—	—	—	—	—	—	—	—	2 (6)	5 (15)	25	3	

	no. mite species found per host														no. total mites	no. of hosts
	19	4	3	5	4	12	4	10	7	3	2	19	24			
mites	<i>Prunus americana</i> (17)	<i>Prunus avium</i> (6)*	<i>Prunus cerasus</i> (3)*	<i>Prunus domestica</i> (5)*	<i>Prunus munsiana</i> (1)	<i>Prunus nigra</i> (12)	<i>Prunus padus</i> (5)	<i>Prunus pensylvanica</i> (10)	<i>Prunus persica</i> (3)*	<i>Prunus pumila</i> var. <i>depressa</i> (3)	<i>Prunus pumila</i> var. <i>susquehannae</i> (2)	<i>Prunus serotina</i> (21)	<i>Prunus virginiana</i> (33)			
<i>Proprioseiopsis</i> cf <i>involutus</i> Denmark & Knisley	—	—	—	—	—	—	—	1 (2)	—	—	—	—	—	2	1	
<i>Typhlodromina conspicua</i> (Garman)	2 (15)	—	—	—	—	—	—	—	—	—	—	—	2 (10)	25	2	
<i>Typhlodromus caudiglans</i> Schuster	3 (37)	4 (9)	2 (3)	—	—	4 (43)	—	2 (4)	—	1 (5)		4 (56)	6 (13)	131	8	
<i>Typhlodromus pyri</i> Scheuten	—	—	—	—	—	—	—	—	—	—		—	2 (10)	10	1	
Stigmaeidae																
<i>Agistemus near collyerae</i>	3 (18)	—	—	—	—	1 (5)	—	—	—	—		3 (9)	3 (11)	43	4	
Anystidae																
<i>Anystis baccarum</i> (Linnaeus)	2 (11)	1 (1)	—	1 (1)	—	3 (8)	—	1 (2)	—	—		2 (5)	4 (6)	34	6	
Erythraeidae																
<i>Balaustium</i> sp.	—	—	—	1 (2)	—	1 (4)	1 (2)	—	—	—		—	—	8	3	
Cheyletidae																
<i>Cheletogenes</i> cf. <i>ornatus</i> (Canestrini and Fanzago)	—	—	—	—	—	—	—	—	—	—		—	1 (3)	3	1	

	no. mite species found per host													no. total mites	no. of hosts
	19	4	3	5	4	12	4	10	7	3	2	19	24		
Mites	<i>Prunus americana</i> (17)	<i>Prunus avium</i> (6)*	<i>Prunus cerasus</i> (3)*	<i>Prunus domestica</i> (5)*	<i>Prunus munsiana</i> (1)	<i>Prunus nigra</i> (12)	<i>Prunus padus</i> (5)	<i>Prunus pensylvanica</i> (10)	<i>Prunus persica</i> (3)*	<i>Prunus pumila</i> var. <i>depressa</i> (3)	<i>Prunus pumila</i> var. <i>susquehanae</i> (2)	<i>Prunus serotina</i> (21)	<i>Prunus virginiana</i> (33)		
Cunaxidae															
<i>Cunaxoides biscutum</i> (Nesbitt)	—	—	—	—	—	—	—	—	—	—		1 (1)	1 (2)	3	2

Figures Chapter 1

Figure 1. Distribution of the 115 sites along the Ottawa River and in Vineland region. Map made using Simplemappr (Shorthouse, 2010).

Panonychus ulmi (Koch)

Figure 3. Example of photos taken of a given mite specimen (here a Tetranychidae: *Panonychus ulmi*) used to facilitate species identification. Notation in bottom left photo (tarsus I): a) lateral claw modified into a pair of ‘tenant’ hairs, b) median empodium modified into a claw-shaped structure, c) proximoventral hairs of the empodium

Figure 4. Rarefaction curve of all mite species collected on 13 *Prunus* species in the Ottawa River and Vineland region, Ontario.

Figure 5. Rarefaction curve of all mite species collected on the Ottawa Rivea area (blue curve) and on Vineland area (red curve) on 13 *Prunus* species. The total sample of these two curves is 192 samples.

Figure 6. Distribution of the breadth of host range of phytophagous mites (Eriophyoidea, Tetranychoidae) and predatory (Phytoseiidae and three other families) collected from 13 *Prunus* species in the Ottawa River and Vineland region, Ontario.

APPENDIX 1

Coordinates (WGS84) of sampling sites along the Ottawa River (Quebec, Ontario) and the Vineland Region (Ontario). Sites indicated by asterisks are *Prunus* orchards, and have been subject to insecticides and fungicides prior to collecting (during the summer of collecting, 2015, or the previous year).

Sites	Latitude	Longitude	Sites	Latitude	Longitude	Sites	Latitude	Longitude
1	45.54269	-75.68234	37	45.28082	-75.93369	73	45.43961	-75.75226
2	45.54765	-75.6834	38	45.28053	-75.93509	74	45.48832	-76.39065
3	45.5163	-75.64497	39	45.28068	-75.93516	75	45.57566	-73.84956
4	45.52356	-75.64587	40	45.26154	-76.00213	76	45.604295	-73.642051
5	45.52973	-75.66397	41	45.3668	-76.15614	77	45.45548	75.83878
6	45.52929	-75.67007	42	45.37431	-76.1869	78	45.59866	-76.53250
7	45.51401	-75.61021	43	45.4547	-76.39685	79	45.658058	-73.631470
8	45.53028	-75.62645	44	45.437	-76.37067	80	46.282376	-75.937447
9	45.53101	-75.62694	45	45.45157	-76.54485	81	45.566389	-76.097213
10	45.514157	-75.56284	46	45.58749	-76.58645	82	45.931500	-76.078594
11	45.54425	-75.49548	47	45.5547	-76.39482	83	46.05650	-76.05412
12	45.54459	-75.49373	48	45.55418	-76.39522	84	45.95015	-76.06760
13	45.54608	-75.48678	49	45.658632	-73.631481	85	45.94566	-76.09061
14	45.5502	-75.47260	50	45.486582	-75.594010	86	45.93145	-76.07938
15	45.54713	-75.43194	51	45.801504	-76.707803	96	45.95560	-77.27353
16	45.5484	-75.42287	52	45.801843	-76.706232	97	45.95548	-77.27282
17	45.588403	-75.416708	53	45.439454	-75.751264	98	45.95535	-77.27248
18	45.59316	-75.41856	54	45.441261	-75.763849	99	45.95163	-77.27151
19	45.57841	-75.36644	55	45.55988	-73.56371	100	45.95169	-77.27148
20	45.57882	-75.36085	56	45.55977	-73.56360	101	45.80912	-76.97284
21	45.442150	-75.809397	57	45.56056	-73.56379	102	45.80906	-76.97346
22	45.44402	-75.78822	58	45.56074	-73.56432	103	45.88171	-76.80081
23	45.60746	-73.81429	59	45.56074	-73.56432	104	43.14551	-79.39418
24	45.52855	-73.59679	60	45.56081	-73.56394	105	43.14498	-79.41283
25	45.472877	-75.675834	61	45.56082	-73.56382	106	43.1449	-79.41914
26	45.38715	-75.70219	62	45.56083	-73.56361	107	43.13378	-79.4539
27	45.38814	-75.70145	63	45.55734	-73.56229	108	43.13771	-79.43351
28	45.38425	-75.70259	64	45.558389	-73.560185	109	43.10617	-79.4108
29	45.38568	-75.70450	65	45.63973	-74.33271	110	43.146808	-79.347764
30	45.36677	-75.79678	66	45.63568	-74.35036	111*	43.18271	-79.4381

Sites	Latitude	Longitude	Sites	Latitude	Longitude	Sites	Latitude	Longitude
31	45.36707	-75.79688	67	45.62736	-74.44541	112*	43.1829	-79.5126
32	45.35416	-75.81022	68	45.64100	-74.83445	113*	43.0359	-79.35241
33	45.35289	-75.81319	69	45.65952	-73.62861	114*	43.03461	-79.33175
34	45.35115	-75.81554	70	45.6562	-73.6297	115*	43.17036	-79.42777
35	45.31418	-75.9044	71	45.6572	-73.6307	—	—	—
36	45.31325	-75.90751	72	45,49363	-76,37563	—	—	—

Chapter 2

Gall-associated mites (Eriophyoidea: *Eriophyes* spp.) on *Prunus* spp. (Rosaceae) in southeastern Canada.

Introduction

Galls are the result of an active growth reaction of the plant in response to the feeding of another organism (Shorthouse & Rohfritsch, 1992), leading to deformed or otherwise abnormal structures. They provide shelter and feed the occupant, therefore enabling it to complete its life cycle (Raman et al., 2006). When affecting crops, galls can cause economic damage because they reduce the photosynthetic capacity of the entire leaves on which they occur, in some cases up to 60% (Patankar et al., 2011).

Well-known gall-inducers are found in the insect orders Hymenoptera, Diptera and Thysanoptera (Meyer, 1987), but another important group of gall-inducers are eriophyoid mites (Eriophyoidea), a diverse plant-feeding group for which about a quarter of the species (over 500) are known to induce galls (Chetverikov et al., 2015). In North America, there are at least 162 species of eriophyoid mites reported to induce galls (Felt, 1940). Some examples of the gall they induce on their hosts are pustule galls (the galler remains between the two layers of epidermal cells of the leaf), leaf rolling, pouch galls (Fig.1), erineia (Fig.24) and bud galls (Fig.7; Keifer, 1982). In addition, many free living (i.e. not living inside a gall but rather on leaf surfaces; Dragana et al., 2006) eriophyoid mites provoke a variety of injuries such as blisters and chlorotic flecks on the leaves as well as spotted and deformed fruits (Linguist et al., 1996). Some eriophyoid species are reported to be vectors of diseases such as the Cherry Mottle Leaf Virus (CMLV) and the Peach Mosaic Virus (PMV) (James & Mukerji, 1993;

Jeppson et al., 1975).

Eriophyoid mites are known to induce galls on numerous flowering plant families (Redfern & Shirley, 2011). One of the most important eriophyoid host families is the Rosaceae which includes 55 host species from 19 genera that are being galled by eriophyoid mites (Amrine and de Lillo unpublished database, 2012). Amongst these, the genus *Prunus* includes many hosts for eriophyoids, and some of these hosts have economic importance, comprising many fruit crops such as apricot, almond, peach, nectarine, plum and cherry (Rohrer, 2015), as well as ornamentals. The most commonly observed galls on *Prunus* spp. are finger-shaped pouch galls (Fig. 1), but other types of galls are also reported such as bud gall (Fig.7) and erinea (Fig.24; Amrine & de Lillo, 2012). In North America, seven species of Eriophyoidea, all in the family Eriophyidae, have been reported to cause galls on *Prunus* (Amrine & de Lillo, 2012). Identification guides based on gall morphology exist but do not cover adequately the Canadian fauna (Redfern & Shirley, 2011; Felt, 1940). Felt (1940) only mentions that mites induce pouch galls on Canadian *Prunus*, without stating the species that cause them.

The morphology of a given gall appears to be directly linked to both the host plant and the gall inducer (Chetverikov et al., 2015). Therefore, knowledge of the host plant and gall morphology are typically enough for species-level identification of the animal inducing the galls. Chetverikov et al. (2015) observed that three species of the genus *Eriophyes* were each found associated with a distinct type of gall on a species of *Tilia*, suggesting that the mites control gall formation. In another case, the same author found what was first thought to be a single species of mite inducing different gall morphologies on different host plants (e.g. *Phytoptus* on *Tilia*, Chetverikov 2015), indicating that the host plant also has an influence on the development of the galls. Chetverikov (2015) later demonstrated with

molecular data that there were effectively more than one *Phytoptus* species causing these different gall morphologies. These observations indicate that host plants, galls, and their inducers should be studied in conjunction to make the best taxonomic decision and facilitate identification. Herein, we compare the galls associated with three species of *Eriophyes* collected from sites in southeastern Canada (Ontario, Quebec) to determine their diagnostic characters, and redescribe the morphology of the three *Eriophyes* spp. collected. Finally a dichotomous key to the seven species of eriophyids associated with *Prunus* galls in North America is provided, based on the mite morphology, but another key is provided based on the gall morphology of these same mites.

Materials & Methods

Sampling

Between June and August 2015 and in June 2016, samples of galled leaves were collected from seven *Prunus* species, at 43 sites along the Ottawa River in Ontario and Quebec (APPENDIX 1). Each sample consisted of six 20cm long branchlets from one to six different individuals found inside a 20m radius area. Each sample was placed in a plastic bag, sealed and kept refrigerated for a maximum of two weeks, before processing.

Galls were counted on each leaf of each sample, and six galls (less when fewer galls were present) per sample were selected for morphometric measurements, in order to capture the full range of their morphological variability. Galls were cut all around the ostiole (plural: ostia; Fig. 2), taking care to not modify the opening of it. Before measuring the galls, they were mounted on cardboard using blue gum (Fun-Tack), ensuring that all were oriented in the same plane, to avoid biasing measurements due to

perspective and the position of the galls. Photographs were taken of the selected galls using a 3 Mpx camera (Leica DFC290) mounted on a stereoscope (Leica MZ16): (1) lateral view of the entire gall; (2) frontal view of the ostiole (i.e. opening of the gall), (3) inside view of the galls, after they were cut open longitudinally with a razor blade.

All galls (including those selected above for measurements and photos) from each sample were then placed in ETOH 95% inside individual 1.5 ml centrifuge tubes. For each sample, some of the galls were cut open with a sharp blade in order to mount the mites on slides. It takes several galls to find mites at the end of August. Mites were mounted on slides with Polyvinyl alcohol (PVA), and then identified to species using Baker et al. (1996) and Keifer (1952).

Gall morphology

Morphometrics of the galls were studied directly on the photos, using the software Image J (Abramoff et al., 2004). A total of 25 morphological characters were selected, because they were thought to characterize well the shape of the galls (Table 1; see Fig. 3 for basic characters related to the shape of the gall). The trichomes inside the ostiole (Fig.2) were chosen in order to represent their variability. Three trichomes were measured when possible and the mean was calculated.

For every quantitative character, the range, mean and standard deviation was computed for each mite species. In addition, differentiation of mite species by their gall morphology was assessed using linear discriminant analysis (LDA). This method was chosen because we were interested in finding characters maximizing the separation between groups of data (Izenman, 2013). Galls that contained

more than one mite species as well as those that contained no mite species were excluded from the LDA analysis (Fig.5), but another figure (LDA) was made adding the galls for which there were more than one associated species (Fig.5.1). The following 5 characters were excluded from analysis because of the presence of missing values for many galls: the density of trichomes on external gall surface, the degree of obstruction of the ostiole by trichomes, the length of trichomes on the gall, the length of trichomes inside ostiole, and the presence of trichomes inside the galls were excluded. The presence of trichomes inside the galls was a perfect classifier. The linear discriminant analysis was made using the MASS package (Ripley et al., 2016) in R (R Development Core Team, 2008). Leave-one-out cross-validation was used to assess the classificatory power of the LDA, and overall significance of the morphological separation between gall mite species was evaluated with MANOVA using R. The goal of the leave-one-out cross-validation was to determine if the model of the LDA was able to correctly classify the galls from the three eriophyid species found in galls. To determine which characters contribute to separation between gall groups, t-tests (for quantitative characters) or Chi-squared tests (for binary characters) were computed for each character between each mite species and significance was determined using the Holm-Bonferroni correction (Holm, 1979) for multiple testing to retain an overall α value of 5%, using also R (R Development Core Team, 2008).

New morphological descriptions of gall mite species found during this survey are given based on at least nine female specimens per species. The terminology of the morphology is based on Lindquist (1996). In addition, the male of *E. emarginatae* was described based on a single specimen (see Appendix 2). The prodorsal shield was measured from the frontal lobe to the posterior margin. The gnathosoma was measured from the base of the motivator to the end of the cheliceral sheath. The length of the idiosoma (main body of the mite) was measured from the tip of the gnathosoma to the end of the opisthosoma. The empodial featherclaw was measured from the distal end to the junction

with the tarsi (Beaulieu et al., 2015). The values in the descriptions are given as mean μm (min μm – max μm).

The taxonomic key of eriophyoid mites associated with galls on *Prunus* was prepared using diagnostic characters observed for each species studied, and using characters mentioned in the literature for species for which I did not collect specimens (Amrine and de Lilo unpublished database; Kendall, 1928; Masee, 1930) or for which had no specimens kept at the Canadian National Collection of Insects, Arachnids and Nematodes (CNC). *Eriophyes maritima* (Kendall, 1928) was excluded from the taxonomic key because the original description does not contain sufficient information to discriminate it from other species.

Results

A total of 44 gall samples (6 galls/sample) were found in the field, representing five species of *Prunus* including two *P. pumila* varieties; from these, 35 samples had mites in the galls (Table 2). The highest number of galls per leaf was found on *Prunus americana* (10.6), whereas *P. pumila* var. *susquehanae* has the least galls per leaf (2.2; Table 2). Three mite species were identified in galls: *Eriophyes cerasicrumena* (Walsh, 1867), *E. emarginatae* Keifer, 1939 and *E. prunidemissae* Keifer, 1956. The MANOVA showed a strongly significant variation between groups (Wilks' lambda = 0.11043, $df_1 = 2$, $df_2 = 150$, $p < 10^{-15}$, Df, n = 153), showing that galls associated with the three mite species are overall distinct in morphology, and that is in agreement with the LDA. The LDA (Fig.5) show slight overlap in gall morphology between *E. cerasicrumena* and *E. emarginatae*, and this overlap is broken down by characters in Table 1. In the LDA plot (Fig. 5.1), *Eriophyes cerasicrumena* forms a group that is

distinct from *E. emarginatae* and *E. prunidemissae*. *Eriophyes emarginatae* and *E. prunidemissae* overlap in gall morphology. Leave-one-out cross-validation shows a clear separation of *Eriophyes cerasicrumena* from *E. emarginatae* galls, and a poor differentiation between *E. emarginatae* and *E. prunidemissae*. Based on the gall morphology, a majority of the galls containing *E. prunidemissae* are classified as *E. emarginatae* (64%), whereas most of the galls of *E. cerasicrumena* (89%) and those of *E. emarginatae* (94%) are correctly classified (Table 3). The *t*-tests revealed that the majority of the gall characters were significantly different between *Eriophyes cerasicrumena* and *E. emarginatae* as well as between *E. cerasicrumena* and *E. prunidemissae*. However, between *E. emarginatae* and *E. prunidemissae*, no characters were significantly different. Figure 5.1 show that the galls in which there were more than one mite species (*E. prunidemissae* + *E. emarginatae*) represent a distinct cluster in red. This cluster represents galls that are slightly longer than the usual galls of *E. emarginatae*.

Key to the eriophyoid mites that induce galls on *Prunus* in North America north of Mexico – based on mite morphology [types of galls induced mentioned in square brackets]

- 1a)** Epigynal coverflap (Fig. 6) microtuberculate; *sc* setae directed posterad; empodial featherclaw with 5 pairs of rays; accessory setae absent; forefemoral and foretibial setae absent [irregular, globular and woody galls around buds] (Fig. 6.1a)..... *Acalitus phloeoptes*
- 1b)** Epigynal coverflap variously ornamented but never with just microtubercles; *sc* setae (Fig. 6) directed anterad; empodial featherclaw (Fig. 6) with variable number of pairs of rays; accessory setae present or absent [inducing various types of galls]..... **2**
- 2a)** Epigynal coverflap smooth, unornamented..... **3**
- 2b)** Epigynal coverflap with ridges..... **4**
- 3a)** Dorsoventral annuli microtuberculate; *sc* setae 16 µm long; accessory setae h1 (Fig. 6) absent [finger-like galls] (no Fig.)..... *Eriophyes similiprunianus*
- 3b)** Dorsoventral annuli without microtuberculation; *sc* setae 19-25 µm long; accessory setae h1 present [finger-like galls] (Fig. 6.1b)..... *Eriophyes emarginatae*
- 4a)** Epigynal coverflap with crescentric ridges distally and small ridges proximally; empodial featherclaw with 5 rays on each side [finger-like galls] (Fig. 6.1c) *Eriophyes cerasicrumena*
- 4b)** Epigynal coverflap with longitudinal ridges; empodial featherclaw with 4 rays on each side
- 5**

5a) Epigynal coverflap with thick and interrupted ridges, dorsoventral microtubercles rounded; 73-81 dorsal annuli and 52-67 ventral annuli ; *sc* setae 14-29 µm long [inquiline in galls of *E. emarginatae*] (Fig. 6.1d)..... *Eriophyes prunidemissae*
5b) Epigynal coverflap with thin ridges, microtubercles somewhat sharp apically 6

6a) Prodorsal shield (prodorsum; Fig. 6) with median line faint anteriorly, admedian lines complete and joined posteriorly (Fig. 6.1e); *sc* setae 23 µm long; coxae I with lines and a few microtubercles; 50-55 dorsoventral annuli [enlarged buds]..... *Eriophyes breechi*
6b) Prodorsal shield with median line interrupted at some points, admedian lines complete and separated posteriorly (Fig. 6.1f); *sc* setae 16 µm long coxae I with microtubercles; 55-70 dorsoventral annuli [erinea and leaf curling]..... *Eriophyes prunandersoni*

Key to the eriophyoid mites that induce galls on *Prunus* in North America north of Mexico based on gall morphology [new hosts in brackets]

1a) Galls on buds or twigs..... 2
1b) Galls on leaves..... 3

2a) Irregular, globular and woody galls around buds (Fig.25) on *P. armeniaca*, on *P. domestica* (Fig. 23), on *P. insititia*, on *P. avium*, on *P. dulcis*, on *P. cerasifera*, on *P. salicina*, on *P. spinosa* and on *P. cerasus*. *Acalitus phloeocoptes*
2b) Enlarged buds (Fig. 7) on *P. andersonii*..... *Eriophyes breechii*

3a) Erinea and leaf curling (Fig.24) *Eriophyes prunandersoni*
3b) Finger-like galls (Fig.1)..... 4

4a) Galls above leaf surface..... 5
4b) Galls below leaf surface..... 6

5a) Galls with trichomes (Fig.4) inside, pointed apically, on *P. serotina* (Figs. 8a & 16). For measurements of gall characters, see Table 1..... *Eriophyes cerasicrumena* (in part)
5b) Galls without trichomes inside (Fig.4) on *P. americana* (Figs. 8d & 17), *P. munsoniana*, on *P. maritima*, on *P. mume*, on *P. subcordata*, on [*P. virginiana* var. *virginiana**] (Figs. 8e & 18), on *P. virginiana* var *demissae*, on [*P. pumila* var *susquehanae*] (Figs. 8f & 19), on *P. emarginata*, on [*P. pumila* var *depressa*] (Figs.8g & 20), on [*P. nigra*] (Figs. 8c & 21) and on [*P. pensylvanica***] (Fig.22). For measurements of gall characters, see Table 1. *Eriophyes emarginatae*

6a) Galls on *P. domestica* (Fig.23), presence of trichomes inside not mentioned in literature (no Fig. of galls)..... *Eriophyes similiprunianus*
6b) Galls on [*P. americana*] (Figs.8b & 17) and on (*P. serotina****) with trichomes inside. For measurements of gall characters, see Table 1..... *Eriophyes cerasicrumena* (in

part)

* *Eriophyes prunidemissae* is an inquiline in the galls of *E. emarginatae*.

** The mites were not found in the galls of *Prunus pensylvanica*, but the galls match the ones from *E. emarginatae*.

*** Baker et al. (1996) mentioned *E. cersicrumena* as inducing galls on both surfaces on *P. serotina*. During this present study, galls on the upper leaf surface only were found on *Prunus serotina*.

Eriophyes maritima Kendall, 1928, recorded from *Prunus maritima* Marshall, was excluded from the key because the original description (Kendall, 1928) does not contain sufficient information to discriminate it from other species. The gall was briefly described as being “dull red, with a shorter stalk, with a rough surface with coarse trichomes and with corrugated inner walls, with trichomes only present in the ostia” (Kendall, 1928). This description is contradictory. The author mentions trichomes outside the gall but then says that the only trichomes are in the “ostia” (singular: ostiole; i. e., opening of the gall; Fig 2). Kendall (1928) mentioned *Eriophyes maritima* to be similar to *Eriophyes padi* which is in Europe.

We observed that at the beginning of the development on *Prunus* spp., the gall is green, then as it matures, it becomes pink. An old gall is dark brown in color and mites are often gone by August. On *Prunus americana* (Fig. 8b) and *P. serotina* (Fig. 8 a), the galls from *Eriophyes cerasicrumena* were finger-shaped, had a very long stalk, and had trichomes inside for feeding (Fig. 4 a-b). These trichomes were exclusively found inside the galls of *E. cerasicrumena*, but never in the galls of *E. emarginatae*. Most of the galls from *Prunus serotina* were acuminate apically (Fig. 8a). The galls from *E. emarginatae* on *Prunus nigra*, *P. americana*, *P. virginiana*, *P. pumila* var. *susquehanae* and *P. pumila* var. *depressa* had a small stalk (Fig. 8 c-d-e-f). The galls were covered with hairs on *P. nigra*, (8c) while they are mostly glabrous for other hosts. On *P. americana*, the galls from *E. emarginatae* were small and bubble-shaped (Fig. 8 d).

Individuals of *E. cerasicrumena* and *E. emarginatae* collected in galls were morphologically studied in order to determine if there were possible species complexes (see Appendix 2). It appears that all individuals studied and compared between hosts enter within the variability of the species. There appears to be no complex of species.

Descriptions of *Eriophyes* species found in *Prunus* galls in southeastern Canada

***Eriophyes cerasicrumena* (Walsh, 1867) (Fig. 9)**

Synonyms:

Acarus serotinae Beutenmueller, 1892; *Eriophyes serotinae* (Beutenmueller, 1892); *Eriophyes padi* (Nalepa, 1892); *Cerasi crumena* Walsh, 1867; *Phytoptus cerasicrumena* (Walsh, 1868); *Eriophyes cerasicrumena* (Walsh, 1868)

Type information:

The species was collected from *Prunus serotina* Ehrh in Illinois, USA.

Diagnosis:

The mite resembles *Eriophyes similiprunianus* Masee, 1930, because they both have (1) an epigynal coverflap that can appear smooth (Not always smooth for *E. cerasicrumena*. Sometimes with crescentric ridges at distal end of epigynal coverflap and with two oblique ridges anteriorly), 2) an opisthosoma with microtuberculate annuli dorsoventrally, and both (3) lack accessory setae *h1*. However, *E. cerasicrumena* can be distinguished from *E. similiprunianus* by having (1) empodial featherclaws with five pairs of rays (four pairs of rays for *E. similiprunianus*), (2) a prodorsal shield ornamented with complete median and admedian ridges and has small ridges and granules all over it (the prodorsal shield of *E. similiprunianus* has submedians added to the two other lines and lacks

dashes and granules).

Description:

female (n=9, some measurements were based on fewer specimens)

Idiosoma somewhat vermiform 184 (112-268) long, 70 (60-80) wide at level of setae *c*2 and gradually tapering posterior to seta *e*. **Gnathosoma** curved downward, 16.6 (12.7-19.6); palpcoxal seta *ep* 2.5 (1.8-3.0), palptarsal seta-like process *v* 3.7 (3.7-3.8); cheliceral stylets 14.7 (13.4-16.2). **Prodorsal shield** somewhat circular; 38 (31-45) long, 53 (50-57) wide, occasionally with a small rounded frontal lobe and with lateral lobes with dashes and microtubercles. Setae *sc* typically about 15 (11-19), inserted at posterior ahead of shield margin, projecting anteriorly, medially or laterally on the side in natural position; *sc* tubercles with their basal axes longitudinal, setae *sc* 20 (16-23) apart. **Shield ornamentation:** median line is complete but faint all along, admedian lines also complete, with granules and dashes all over the prodorsal shield. **Legs** with setation normal as described for Eriophyidae (Lindquist & Amrine 1996). **Leg I;** femur 7.2 (8.7-10.0), *bv* 9.0 (7.6-10.0); genu 6.3 (5.6-6.9), *l''* 24 (21-27); tibia 5.6 (4.5-6.7), *l'* 3.5 (2.7-4.3); tarsus 8.0 (6.8-9.6), *ft'* 14.1 (11.4-17.2), *ft''* 22 (19-24), *u'* 2.8 (2.5-3.2); *ω* 9.7 (9.3-9.7) rodlike; empodium 6.7 (5.8-7.8), with five pairs of rays. **Leg II;** femur 9.5(7.3-11.0), *bv* 12.0 (8.7-22.0); genu 5.0 (4.4-5.8), *l''* 13.0 (8.1-22.0); tibia 6 (5.2-6.5), *l'* absent; tarsus 6.9 (5.8-8.9), *ft'* 3.2 (2.7-3.8), *ft''* 22 (16-23), *u'* 2.1 (1.5-2.6); *ω* 9.3 (8.2-10.0) rodlike; empodium 6.7 (5.8-7.8), with five pairs of rays. **Coxal region** is mostly smooth, sometimes with a few visible microtubercles, Prosternal apodeme (or sternal line) short (i.e coxae I fused on a short distance), strong, and forking anteriorly. Setae *Ib* 3.0 (3.2-2.7) long, 8.8 (6.9-12.0) apart; *Ia* 25 (21-30) long, 9.0 (8.5-9.5) apart; *2a* 30 (21-44) long, 25 (22-29) apart. About (8-15) microtuberculate coxigenital annuli thinner than normal annuli; microtubercles on coxigenital annuli smaller than on

dorsoventral annuli. **External genitalia** with genital coverflap 11.3 (7.2-16.6) long 21 (18-24) wide, more or less semicircular, ornamented with a crescentric ridge posteriorly and two oblique ridges anteriorly (figure); genital 'flange' (on which sits the coverflap at rest) often visible for 3.0 (1.1-5.8) behind coverflap; setae *3a* 10.0 (6.0-14.0) long, 17.0 (15.0-21.0) apart. **Opisthosoma** bearing 55 (45-70) dorsal and 53 (42-66) ventral annuli, microtuberculate throughout. Dorsal microtubercles oval, about 6.8 (6.0-8.0) per 20 µm, ventral microtubercles oval, about 10.6 (8-15) microtubercles per 20 µm. Setal lengths: *c2* 21 (11-38), *d* 44 (23-65), *e* 8.4 (5.1-11.0) *f* 24 (19-29), *h1* absent. Distances between pairs of setae: *c2-c2* 55 (50-64), *d-d* 35 (29-43), *e-e* 23 (19-27), *f-f* 27 (26-29), *h2-h2* 12 (8.4-14.0). Position of setal tubercles (the number of annuli counted from coxal plate II): *c2* 4 (3-5), *d* 13 (10-17), *e* 28 (21-35), *f* 47 (37-60); there are 5-6 annuli past seta *f*.

Hosts: The mite induces finger-shaped galls on *Prunus americana* (Fig. 8b) and *P. serotina* (Fig. 8a). On *P. americana*, the galls are underneath the leaf. It was found as a vagrant (i.e. free-living, outside galls) on *P. munsiana*, *P. virginiana* and on *P. persica* as well as on the previously mentioned hosts.

***Eriophyes emarginatae* Keifer, 1939 (Figs 10-11)**

Synonyms: possible synonyms are *Phytoptus pruni-crumeni* (Walsh, 1868) and *Eriophyes padi* (Nalepa, 1890).

Type information: The specimens were collected from small finger-like galls, on the upper surface of leaves of *Prunus emarginata* (Dougl.). They were collected by D. B. Mackie about five miles west of Tragedy Springs at Maiden's Grave, Amador County, altitude 8000 feet, Sept. 18, 1938. From Keifer (1939).

Diagnosis:

The mite cannot be confused with any other *Eriophyes* from Rosaceae. *Eriophyes emarginatae* has 1) a smooth epyginal coverflap, 2) 3-4 thick coxigenital annuli, 3) dorsoventral annuli without

microtubercles, 4) prodorsal shield completely smooth with complete median, admedian and submedian lines.

Description:

female (n=11, some measurements were based on fewer specimens) (Fig. 17)

Idiosoma somewhat vermiform 234 (192-266) long, 76 (59-88) wide at level of setae *c*2 and gradually tapering posterior to seta *e*. **Gnathosoma** curved downward, 18.5 (16.8-20.2); palpcoxal seta *ep* 3.5 (2.6-5.7), palptarsal seta-like process *v* 5.4 (4.3-6.5); cheliceral stylets 13(11-16). **Prodorsal shield** somewhat circular; 39 (35-42) long, 60 (52-75) wide, with lateral lobes smooth. Setae *sc* typically about 12 (8.3-13.1), inserted at posterior ahead of shield margin, projecting upward or anteriorly with their setal tubercle axis of rotation oblique, setae *sc* 21 (18.9-25.2) apart. **Shield ornamentation:** no ornamentation (smooth). **Legs** with setation normal as described for Eriophyidae (Lindquist & Amrine 1996). **Leg I;** femur 14 (12-17), *bv* 11 (9.4-17); genu 7.7 (6.6-9.3), *l''* 27 (23-30); tibia 11 (7.9-13), *l'* 6.8 (4.8-8.3); tarsus 9.6 (8.4-11), *ft'* 11 (6.6-17), *ft''* 23 (11-29), *u'* 4.1 (2.6-7); ω 8.5 (6.9-9.9) strongly knobbed; empodium 7.5 (5.6-8.5), with four pairs of rays. **Leg II;** femur 14 (12-16), *bv* 10 (9-12); genu 6.7 (6.1-7.2), *l''* 10 (7.6-11); tibia 7.7 (6.5-9.6), *l'* absent; tarsus 9.6 (8.6-11), *ft'* 4.7 (3.3-6.3), *ft''* 25 (17-30), *u'* 3.9 (2.6-6.8); ω 9.2 (8.8-10) strongly knobbed; empodium 7.7 (6.3-8.9), with four pairs of rays. **Coxal region** no ornamentation. Prosternal apodeme (or sternal line) short 7.3 (2.6-9.3) (i.e., coxae I fused on a short distance), sometimes coxae I not touching, line strong, and forking anteriorly. Setae *1b* 7.3 (4.9-8.9) long, 12 (9-13) apart; *1a* 36 (19-47) long, 8.2 (5.2-9.5) apart; *2a* 33 (19-42) long, 27 (21-34) apart. About 3-4 coxigenital annuli. **External genitalia** with genital coverflap 11.9 (9.4-16.5) long 26 (21-28) wide, more or less semicircular, without ornamentation (figure 6b), genital

‘flange’ often visible for 3.2 (1.7-5.3) behind coverflap; setae *3a* 18 (14.7-20.6) long, 18 (16.4-20.6) apart. **Opisthosoma** bearing 59 (55-62) dorsal and 57.3 (55-59) ventral annuli, without microtuberculation. Setal lengths: *c2* 28 (24-35), *d* 25 (19-33), *e* 12 (7-16) *f* 33 (28-37), *h1* 4.4 (3.0-6.2). Distances between pairs of setae: *c2-c2* 60 (50-73), *d-d* 37 (21-48), *e-e* 24 (19-30), *f-f* 31(25-36), *h1-h1* 8,5 (7.3-10.0), *h2-h2* 13 (8.1-15.0), *h1-h2* 3.0 (1.0-3.8). Position of setal tubercles (the number of annuli counted from coxal plate II): *c2* 3,3 (2-4), *d* 15.5 (14-16), *e* 31.5 (29-33) *f* 51.5 (49-53); there are 5-6 annuli past seta *f*.

male (n=1) (Fig. 11)

Idiosoma somewhat vermiform 222 long, 77.5 wide at level of setae *c2* and gradually tapering posterior to seta *e*. **Gnathosoma** curved downward, 12.8; palpcoxal seta *ep* 3.4, palpgenual seta *d* not seen, palptarsal seta-like process *v* not seen; cheliceral stylets 10.0. **Prodorsal shield** somewhat circular; 46 long, 64 wide, with lateral sides granular and a small triangular projection over the gnathosome. Setae *sc* typically about 11, inserted at posterior ahead of shield margin, projecting upward or anteriorly with their setal tubercle axe of rotation oblique, setae *sc* 25 apart. **Shield ornamentation:** with median faint anteriorly on half, with complete admedian and submedian, granular on the sides. **Leg I;** femur 15, *bv* 7.2; genu 7.3, *l''* 34.1; tibia 9.5, *l'* not seen; tarsus 10.0, *ft'* 17.7, *ft''* 28.5, *u'* not seen; ω 8.5 strongly knobbed; empodium 7.4, with four pairs of rays. **Leg II;** femur 12.0, *bv* 8.9; genu 6.0, *l''* 12.7; tibia 8.1, *l'* absent; tarsus 10.0, *ft'* 6.2, *ft''* 18.2, *u'* not seen; ω 9.5 strongly knobbed; empodium 6.7, with four pairs of rays. **Coxal region** of coxae I: a few microtubercles antieriad setae *2a*; coxae II: series of microtubercles found antieriad setae *1a*. Prosternal apodeme (or sternal line) not visible, coxae I not touching. Setae *1b* 8.6 long, 13 apart; *1a* 33 long, 9.1

apart; 2a 34 long, 27 apart; 6 coxigenital annuli. **External genitalia**; setae 3a 21 long, 20 apart. **Opisthosoma** bearing 67 dorsal and 62 ventral annuli, dorsal microtubercles oval, 8 microtubercles per 20 µm; ventral microtubercles oval, 9 per 20 µm. Setal lengths: c2 32, d 25, e 10, f 32, h1 8.1. Distances between pairs of setae: c2–c2 71, d–d 45, e–e 27, f–f 33, h1–h1 7.6, h2–h2 13, h1–h2 2.5. Position of setal tubercles : c2 3, d 16, e 33, f 54; there are 5 annuli past seta f.

Hosts: The mite induces finger-shaped galls on *Prunus americana*, *P. emarginatae*, *P. nigra*, *P. pumila* var. *depressa*, *P. pumila* var. *susquehanae*, and *P. virginiana*.

Remarks: The male description of *Eriophyes emarginatae* is similar to the one written by Oldfield (1968). It differs slightly on a few points. The specimen evaluated had a median line on its prodorsal shield, which, according to Oldfield (1968), should be absent. Also, the coxal plates have microtubercles and lines, whereas they are smooth according to Oldfield (1968). We also noted a higher number of dorsal annuli compared to female individuals.

***Eriophyes prunidemissae* Keifer, 1956 (Fig. 12)**

Synonyms: none.

Type information:

The species was collected from *Prunus demissa* (Nutt.; Western choke-cherry) in Forest Home district, San Bernardino County, California.

Diagnosis:

The mite is morphologically similar to *Eriophyes geratopus* Keifer, 1965 (found on *Prunus*

subcordatus) by having broad and interrupted ridges on its epigynal coverflap (10 ridges in *E. geratopus*, 10-14 in *E. prunidemissae*), as well as *sc* setae of similar length (22 (14-29) in *E. prunidemissae*; 17 in *E. geratopus*), 4-rayed featherclaws and by a similar design on the prodorsal shield. *Eriophyes prunidemissae* differs from *E. geratopus* (based on description by Keifer 1965) by its prodorsal shield (1) with median ridge faint in apical half (clear in *E. geratopus*), (2) v-shaped pattern at base of median ridge (absent in *E. geratopus*), (3) without submedian ridge (submedians present in *E. geratopus*), (4) two short ridges, forming an acute angle, and almost a v-shape, anteromesad to *sc* tubercles (these two ridges stronger, forming a right angle, connected basally with submedian in *E. geratopus*); (5) each coxal field (I-II) with a series of microtubercles that follows anteromedian margins (microtubercles in dense clusters); (6) 73-81 dorsal and 52-67 ventral annuli (*E. geratopus* has 52 dorsal and ventral annuli). *Eriophyes hybridicola* (Keifer 1957) is also similar to *E. prunidemissae* (e.g. 4-rayed featherclaws; prodorsal shield with v-shape at the base of median ridge, opisthosomal annuli 60-65), but the latter can be easily distinguished from *E. hybridicola* by its 1) epigynal coverflap with thick and interrupted ridges (complete and thin in *E. hybridicola*), 2) prodorsal shield without submedian lines (present in *E. hybridicola*) and 3) microtubercles on coxal plates I distributed in line along the anterior margin (elongate microtubercles on coxal plates I, distributed around setae *1a* in *E. hybridicola*).

Description:

female (*n*=14, some measurements based on fewer specimens)

Idiosoma somewhat vermiform 224 (141-283) long, 64.5 (55.4-71.8) wide at level of setae *c*₂ and gradually tapering posterior to seta *e*. **Gnathosoma** curved downward, 24.7 (20.5-26.9); cheliceral stylets 23 (20-26). **Prodorsal shield** somewhat circular; 33 (29-37) long, 57 (51-61) wide, with small

and acute frontal lobe, 4.7 (3.8-6.0) long x 7.0 (6.3-7.5) wide and with lateral lobes with curved lines of microtubercles. Setae *sc* typically about 22 (14-19), inserted at posterior near shield margin, projecting anteriorly in natural position and can sometimes be directed posteriorly on slide-mounted specimens; *sc* tubercles with their basal axes oblique, setae *sc* 23 (14-29) apart. **Shield ornamentation:** admedian lines are complete, median line is faint in apical half, v-shape anteriorly to *sc* tubercles, v-shape basally to the median line **Legs** with setation normal as described for Eriophyidae (Lindquist & Amrine 1996). **Leg I;** femur 8.3 (6.4-9.9), *bv* 5.8 (2.1-8.5); genu 4.8 (4.4-5.4), *l''* 23 (21-26); tibia 4.5 (3.9-5.5), *l'* 4.6 (2.4-6.7); tarsus 6.2 (5.7-7.0), *ft'* 9 (6.4-11), *ft''* 13 (11-16), *u'* 2.7 (2.6-2.7); ω 7.5 (7-7.7) rodlike; empodium 5.3 (4.9-5.5), with four pairs of rays. **Leg II;** femur 7 (5.8-9.2), *bv* 5.9 (3.4-8.3); genu 4.2 (3.8-4.7), *l''* 9.2 (5.4-18); tibia 4.1 (3.5-4.9), *l'* absent; tarsus 5.5 (4.8-6.3), *ft'* 3.4 (2.3-4.3), *ft''* 17 (16-18), *u'* 2.4 (1.6-2.8); ω 8.8 (8.3-9.1) rodlike; empodium 5.2 (4.7-5.7), with four pairs of rays. **Coxal region** ornamented with a few microtubercles, in coxal field I: line of microtubercles closely spaced anteriorly to setae *1a*, under the line, pack of 3 microtubercles spaced, in coxal field 2; line of microtubercles closely spaced anteriorly to setae *2a*, under pack of 3 microtubercles spaced. Prosternal apodeme (or sternal line) short (i.e coxae I fused on a short distance), strong, and forking anteriorly. Setae *1b* 5.5 (3-7.1) long, 12 (11-13) apart; *1a* 19 (16-24) long, 9.2 (8.2-11) apart; *2a* 32 (23-45) long, 24 (22-26) apart. About 5–7 microtuberculate coxigenital annuli, of which the 1-2 anteriormost annuli are incomplete; microtubercles on coxigenital annuli the same size and shape as the ones on ventral annuli posterior to the epigynal coverflap. **External genitalia** with genital coverflap 10.9 (8.1–14.5) long x 20 (19-23) wide, more or less semicircular, ornamented with 3–11 thick longitudinal ridges, some are interrupted (figure); setae *3a* 9.6 (5–14) long, 16 (14-20) apart. **Opisthosoma** bearing 77.6 (73-81) dorsal and 59.8 (52–67) ventral annuli, microtuberculate throughout. Dorsal microtubercles oval, about 10 (9-11) per 20 μ m, ventral microtubercles oval, about 12.3 (11-13) microtubercles per 20 μ m. Setal lengths: *c2* 29 (21-35), *d* 31

(24-40), *e* 11 (4.5-23), *f* 23 (20-26), *h1* 4 (2.7-4.7). Distances between pairs of setae: *c2*–*c2* 59 (51-66), *d*–*d* 41 (36-42), *e*–*e* 21 (19-23), *f*–*f* 26 (22-27), *h1*–*h1* 8.3 (7.5-9.3), *h2*–*h2* 13 (12-14), *h1*–*h2* 3.1 (2.5-3.5). Position of setal tubercles (the number of annuli counted from coxal plate II): *c2* 2.7 (2-5), *d* 14.5 (12-20), *e* 29.8 (26-37), *f* 54.4 (47-61); there are 4–6 annuli past seta *f*.

Host: The mite inhabits the galls of *Eriophyes emarginatae* Keifer, 1939 on *Prunus virginiana* and is also sometimes found as vagrant (outside galls) on the leaves of *P. virginiana*.

Remarks: No males were found in the present study; however males exist, according to Keifer (1956).

Discussion

Three species were found in the galls: *Eriophyes cerasicrumena*, *E. emarginatae* and *E. prunidemissae*. Based on the observations of Oldfield (1968), *E. prunidemissae* is a facultative inquiline in the galls of *E. emarginatae*. It is more commonly found living in the buds of *Prunus virginiana* and secondarily invading the galls caused by *E. emarginatae*. There are no significant differences in the morphology of the galls between *Eriophyes emarginatae* and *E. prunidemissae*.

The galls induced by *E. emarginatae* show a surprising variability in morphology. Galls on *Prunus nigra* are densely covered with hairs, whereas the galls on other hosts are mostly glabrous. *Prunus nigra* has hairy leaves (pers. obs.), so it is possible that when the galls develop, they retain the hairs on the tissue surface that become part of the galls. The morphology of *E. emarginatae* has been evaluated to determine if there were species complexes that could explain this variability. All studied mites were

similar in characters for compared hosts.

Observations indicate that there are some uncertainties in species boundaries of the mites studied and in terms of their respective host associations. *Eriophyes similiprunianus* and *E. cerasicrumena* are similar morphologically (see diagnosis of *E. cerasicrumena*). *Eriophyes similiprunianus* is reported to induce galls on the underside of the leaves on *Prunus domestica* (Masse, 1930). *Eriophyes cerasicrumena* induces galls on the underside of the leaf of *Prunus americana* and on the upper or lower surface of the leaves of *P. serotina*. *Prunus americana* and *P. domestica* are close relatives according to a molecular-based phylogenetic analysis (Bortiri et al., 2001). Could *E. cerasicrumena* and *E. similiprunianus* represent a single though variable species that induces galls on the underside of leaves of these two related *Prunus* spp, and *E. cerasicrumena* inducing galls on the upper or lower surface of *P. serotina* leaves, representing a distinct though morphologically cryptic species? Two individuals with empodial featherclaws bearing four pairs of rays like *Eriophyes similiprunianus* were found each on *P. americana* and *P. serotina*. The one on *P. americana* has shorter opisthosomal setae *c2* (11 µm vs 14-38 µm) and *d* (23 µm vs 27-67 µm). The individual on *P. serotina* has an unusually large number of ventral annuli (21 vs 6-13) between setae *c2* and *d*. Otherwise, both of these individuals agree with characters of other individuals found on *P. serotina* and *P. americana*. They could simply be morphological extremes for *E. cerasicrumena*. Unfortunately, the original description of *E. similiprunianus* does not contain sufficient information, and further morphological, as well as molecular studies will be needed to answer these questions.

The LDA (Fig.5) revealed two distinct groups. The galls from *Eriophyes cerasicrumena* are well distinguished, while *E. emarginatae* and *E. prunidemissae* overlap for the morphological characters of the galls, reinforcing the fact that *E. prunidemissae* is an inquiline. The gall samples in which both *E.*

emarginatae and *E. prunidemissae* were found were clustered separately from other samples (Fig. 5.1; red dots); these galls were slightly longer than other galls containing only *E. emarginatae*. It may be possible that sometimes, the presence and feeding of the inquiline species (*E. prunidemissae*) results in added growth of the gall, resulting in longer galls.

The most reliable character to distinguish the galls of *Eriophyes cerasicrumena* vs. of *E. emarginatae* is the presence/absence of clavate trichomes inside the galls. All the galls of *Eriophyes cerasicrumena* had trichomes inside, while all the galls of *E. emarginatae* had a more regular surface, lacking trichomes. The key of the host and galls is mainly based on the type of gall, the position on the leaves (upper vs lower surface) and the presence of trichomes.

Conclusion

In this study, particular attention was given to the wild *Prunus* species for the collection of galls. Three mite species were found in the galls: *Eriophyes cerasicrumena*, *E. emarginatae* and *E. prunidemissae*. The last species does not induce galls and is an inquiline in the galls of *E. emarginatae*. These three gall-associated species have been recorded from cultivated *Prunus*; however, fruit crops are usually treated with pesticides, preventing the formation of galls.

The taxonomic key that I developed for the identification of eriophyids associated with *Prunus* galls based on gall characteristics should be easier for non-experts to use than those based on the morphology of the mites, which require a microscope for observing the tiny details. The danger of using only the key based on gall appearance and the hosts that the galls occur on is that there may be

cryptic species that form similar galls, which would result in erroneous identifications.

Twenty species of *Prunus* are found in Canada. The association between the mites and their galls found on these host species is not completely known, because not all these species were surveyed. Future research on the gall-associated mites of *Prunus* should include host species not included in the present survey, as well as samples taken over a wider geographic area. As well, future studies using molecular techniques should focus on determining if there are cryptic species that cannot be identified on the basis of mite and gall morphology.

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Tables Chapter 2

Table 1. Morphological characters of galls of *Eriophyes cerasicrumena*, *E. emarginatae*, and *E. prunidemissae*. Values indicated are ranges (mean $\pm$ st. dev.). See Fig. 3 for more clarification on characters #5–10, Fig. 13 for #14–15 and Fig. 15 for #25. The number of galls with condition on total of galls studied are indicated in parenthesis. Asterisk (*) indicate characters excluded from linear discriminant analysis.

#	Character	<i>E. cerasicrumena</i> (n=47)	<i>E. emarginatae</i> (n=81)	<i>E. prunidemissae</i> (n=25)
1	Gall position	lower surface on <i>P. americana</i> , upper surface for other hosts	upper surface (lower surface in 1 case)	upper surface
2	trichomes on stalk	more often absent (31 galls/47) than present	absent (<i>P. virginiana</i> , <i>P. pumila</i>) or present (<i>P. nigra</i> , <i>P. americana</i>)	mostly absent (20 galls/25)
3	trichomes on main shaft	mostly absent (36 galls/47)	absent (<i>P. virginiana</i> , <i>P. pumila</i>) or present (<i>P. nigra</i> , <i>P. americana</i>)	mostly absent (16 galls/25)
4*	density of trichomes on (external) gall surface	sparse	sparse (77 galls/81) except on <i>P. nigra</i> (dense)	sparse
5	stalk L	0.62–3.34 (1.72 ± 0.78)	0.03–1.40 (0.44 ± 0.30)	0.04–1.51 (0.44 ± 0.33)
6	L of main shaft L	1.95–11.90 (5.24 ± 2.07)	0.50–4.72 (1.74 ± 0.81)	0.44–4.53 (2.32 ± 0.44)
7	stalk: broadest W	0.42–1.63 (0.87 ± 0.28)	0.24–1.57 (0.56 ± 0.25)	0.27–0.98 (0.57 ± 0.23)
8	stalk: narrowest W	0.25–0.95 (0.52 ± 0.17)	0.21–0.96 (0.39 ± 0.16)	0.26–0.77 (0.44 ± 0.17)
9	main shaft: broadest W	0.86–2.88 (1.34 ± 0.43)	0.26–2.73 (0.70 ± 0.46)	0.29–1.45 (0.68 ± 0.29)
10	main shaft: L from base to broadest level	0.60–5.41 (2.43 ± 1.27)	0.03–2.84 (0.92 ± 0.03)	0.24–3.51 (1.15 ± 0.24)
11	angle between stalk and main shaft	33–180 (138 ± 35)	44–180 (138.71 ± 26.44)	35–180 (140.66 ± 39.40)
12	ostia W	0.29–1.33 (0.65 ± 0.28)	0.14–2.38 (0.43 ± 0.37)	0.18–1.17 (0.41 ± 0.21)
13	ostia H	0.14–0.98 (0.36 ± 0.17)	0.03–1.64 (0.27 ± 0.24)	0.05–0.56 (0.27 ± 0.13)
14	lips (thickening) around the ostia	present or absent	present or absent	present or absent
15*	ostia: degree of obstruction by trichomes	obstructed by trichomes except on <i>P. serotina</i> (open)	Open, obstructed or partly obstructed by trichomes	open, obstructed or partly obstructed–close by trichomes
16	total L of gall (stalk + main shaft)	3.57–14.53 (7.00 ± 2.44)	0.53–5.26 (2.18 ± 1.13)	0.50–5.26 (2.76 ± 1.50)
17	ratio: L of stalk / main shaft	0.13–0.85 (0.35 ± 0.19)	0.04–0.80 (0.25 ± 0.12)	0.06–0.49 (0.20 ± 0.11)
18	ratio stalk L / total gall L	0.11–0.46 (0.25 ± 0.09)	0.04–0.45 (0.19 ± 0.07)	0.06–0.33 (0.16 ± 0.07)

#	Character	<i>E. cerasicrumena</i> (n=47)	<i>E. emarginatae</i> (n=81)	<i>E. prunidemissae</i> (n=25)
19	ratio: narrowest stalk width / L from base to broadest W	0.33–1.19 (0.67 ± 0.20)	0.34–2.58 (0.90 ± 0.37)	0.54–1.45 (0.88 ± 0.22)
20	ratio: narrowest W of stalk / total gall L	0.059–0.26 (0.14 ± 0.6)	0.10–0.91 (0.29 ± 0.14)	0.11–0.93 (0.27 ± 0.17)
21*	L of trichomes on gall	0.12–0.27 (0.19 ± 0.05)	0.03–0.27 (0.09 ± 0.06)	0.05–0.12 (0.07 ± 0.03)
22*	L of trichomes inside ostia (Fig. 14)	0.07–0.24 (0.15 ± 0.04)	0.04–0.82 (0.14 ± 0.12)	0.06–0.34 (0.16 ± 0.08)
23	ratio: ostia W / H (Fig. 15)	0.90–5.23 (2.04 ± 1.09)	0.77–10.28 (1.80 ± 1.21)	0.99–3.96 (1.75 ± 0.86)
24*	trichomes: inside galls	present	absent	absent
25	gall walls: thickness	0.05–0.41 (0.19 ± 0.10)	0.04–0.17 (0.08 ± 0.04)	0.05–0.65 (0.25 ± 0.26)
Hosts on which mites were found in galls		<i>Prunus americana</i> , <i>P. serotina</i>	<i>P. virginiana</i> , <i>P. pumila</i> var. <i>susquehanae</i> , <i>P. nigra</i> , <i>P. americana</i> , <i>P. pumila</i> var. <i>depressa</i>	<i>P. virginiana</i>
Hosts on which mites were found on the leaf surfaces (not in galls)		<i>P. persica</i> , <i>P. nigra</i> , <i>P. munsiana</i> and <i>P. virginiana</i>	<i>P. serotina</i>	–

L: length, W: width, H: height.

Table 2. Number of samples of hosts (*Prunus* spp.) that were found with galls of *Eriophyes* spp. and mean galls per leaf ± (st. dev).

<i>Prunus</i> spp.	<i>E. cerasicrumena</i>		<i>E. emarginatae</i>		<i>E. prunidemissae</i>	
	no. samples	no. galls/leaf	no. samples	no. galls/leaf	no. samples	no. galls/leaf
<i>P. americana</i>	6	8.3 ± 9.2	1	10.6	–	–
<i>P. nigra</i>	–	–	1	3.5	–	–
<i>P. pumila</i> var. <i>depressa</i>	–	–	1	2.8	–	–
<i>P. serotina</i>	3	3.2 ± 3.9	–	–	–	–
<i>P. pumila</i> var. <i>susquehanae</i>	–	–	1	2.2	–	–
<i>P. virginiana</i>	–	–	17	4.8 ± 3.2	5*	6.9 ± 5.2

* *E. prunidemissae* is considered an inquiline in the galls of *E. emarginatae* (based on Oldfield, 1968)

Table 3. Results of leave-one-out cross-validation of LDA analysis comparing predicted identification of each individual gall included in LDA, with the actual species identification based on the mite morphology.

True species identity	Predicted identity		
	<i>E. cerasicrumena</i>	<i>E. emarginatae</i>	<i>E. prunidemissae</i>
<i>E. cerasicrumena</i> (n=47)	89% (42)	8.5% (4)	2.1% (1)
<i>E. emarginatae</i> (n=81)	2.5% (2)	94% (76)	3.7% (3)
<i>E. prunidemissae</i> (n=25)	0% (0)	64% (16)	36% (9)

Table 4. Results of t-tests or Chi-squared tests showing uncorrected p-values only for significant differences according to the Holm-Bonferroni adjustment. NS indicates a non-significant difference.

#	Character	<i>E. cerasicrumena</i> <i>E. emarginatae</i>	vs <i>E. cerasicrumena</i> <i>E. prunidemissae</i>	vs <i>E. emarginatae</i> <i>E. prunidemissae</i>
1	gall position (upper vs lower leaf surface)	$p < 10^{-14}$	$p < 10^{-16}$	NS
2	trichomes on stalk	NS	NS	NS
3	trichomes on main shaft	NS	NS	NS
5	stalk L	$p < 10^{-14}$	$p < 10^{-13}$	NS
6	L of main shaft	$p < 10^{-14}$	$p < 10^{-9}$	NS
7	stalk: broadest W	$p < 10^{-7}$	$p < 0.00001$	NS
8	stalk: narrowest W	$P < 0.0001$	NS	NS
9	main shaft: broadest W	$p < 10^{-11}$	$p < 10^{-10}$	NS
10	main shaft: L from base to broadest level	$p < 10^{-9}$	$P < 0.00001$	NS
11	angle between stalk and main shaft	NS	NS	NS
12	ostia W	$P < 0.001$	$p < 0.001$	NS
13	ostia H	NS	NS	NS
14	lips (thickening) around the ostia	NS	NS	NS
16	total L of gall (stalk + main shaft)	$p < 10^{-17}$	$p < 10^{-12}$	NS
17	ratio: L of stalk / main shaft	NS	$P < 0.0001$	NS
18	ratio stalk L / total gall L	$p < 0.01$	$P < 0.0001$	NS

#	Character	<i>E. cerasicrumena</i> <i>E. emarginatae</i>	vs <i>E. cerasicrumena</i> <i>E. prunidemissae</i>	vs <i>E. emarginatae</i> <i>E. prunidemissae</i>
19	ratio: narrowest stalk width / L from base to broadest W	P < 0.0001	P < 0.001	NS
20	ratio: narrowest W of stalk / total gall L	p < 10 ⁻¹³	P < 0.001	NS
23	ratio: ostia W / H (Fig. 15)	NS	NS	NS
25	gall walls: thickness	p < 10 ⁻⁹	NS	NS

Figures Chapter 2

Figure 1. Pouch or finger-like galls on *Prunus serotina*.

Figure 2. View of an ostiole (entrance hole of the gall) with trichomes inside

Figure 3. Six measured characters on the gall. The explanation of the characters are in table 1 with their respective number.

Figure 4. Presence (top picture) or absence (bottom picture) of feeding trichomes inside the galls. In b) there are mites

Figure 5. LDA based on all characters for which there were no missing values (see Table 1). *Eriophyes cerasicrumena* (blue), *E. emarginatae* (green) and *E. prunidemissae* (red). Note that *E. prunidemissae* occurs in the galls of (induced by) *Eriophyes emarginatae*, although does not induce them, based on Oldfield (1968). The characters (#) with the highest loadings on the LDA axes are; axis 1 (% of variance explained): #17 (18%)- #18 (14%) - #1 (14%) - #16 (12%) - #6 (8%) and on axis 2: #18 (27%)- #17 (23.5%) - #6 (7%) - #7 (6.6%) - #12 (3.9%) (see Table 1).

Figure 5.1 LDA based on all characters for which there were no missing values (see Table 1). *Eriophyes cerasicrumena* (blue), *E. emarginatae* (green) and *E. prunidemissae* (red). Note that *E. prunidemissae* occurs in the galls of (induced by) *Eriophyes emarginatae*, although does not induce them, based on Oldfield (1968). The characters (#) with the highest loadings on the LDA axes are; axis 1 (% of variance explained): #16 (19%)- #17 (17%) - #18 (15.5%) - #6 (15%) - #1 (12%) and on axis 2: #18 (13%)- #16 (13%) - #17 (13%) - #6 (13%) - #25 (9.5%) (see Table 1).

Figure 6. Explanatory figure of the anatomy of an eriophyid mite.

Figure 6.1. (a) epigynal coverflap with microtubercles; (b) smooth (unornamented) epigynal coverflap; without ornamentation, (c) epigynal coverflap with crescentic ridge; (d) epigynal coverflap with (longitudinal) thick and interrupted ridges; (e) *Eriophyes breechi* prodorsal shields of (e) *Eriophyes breechi*, and (f) *Eriophyes prunandersoni*. Drawing 4a,e,f from Baker et al. (1996).

Figure 6.2. Prodorsal shield ornamentation with median, admedian and submedian ridges.

Figure 7. On *Prunus virginiana*: a) big bud gall, b) normal bud

Figure 8. a) Galls of *Eriophyes cerasicrumena* on *P. serotina*; (b) Galls of *E. cerasicrumena* on *P. americana*, and (c) Galls of *Eriophyes emarginatae* on *Prunus nigra* (Figure cont'd next page)

Figure 8 (cont'd). (d) Galls of *Eriophyes emarginatae* on *Prunus americana*, (e) *P. virginiana*, and (f) *P. pumila* var. *susquehanae* (Figure cont'd next page)

Figure 8 (cont'd). (g) Galls of *Eriophyes emarginatae* on *Prunus pumila* var. *depressa*.

***Eriophyes cerasicrumena* (Walsh, 1867) (female)**

Figure 9. *Eriophyes cerasicrumena*. (a) dorsal view, (b) tarsus I with empodial featherclaw, (c) prodorsal shield, (d) coxigenital region.

Eriophyes emarginatae (female)

Figure 10. *Eriophyes emarginatae*; (a) lateral view, (b) empodial featherclaw and solenidion of tarsus I, c) *h1* and *h2* setae, d) dorsal annuli that splits in two, (e) prodorsal shield, (f) coxigenital region.

Eriophyes emarginatae (male)

Figure 11. *Eriophyes emarginatae* male: a) dorsal view; (b) male genitalia; (c) Prodorsal shield with frontal lobe; microtubercles of (d) ventral and (e) dorsal opisthosomal annuli; (f) empodial featherclaw and solenidion of tarsus I (top) and tarsus II (bottom).

Eriophyes prunidemissae (female)

Figure 12. *Eriophyes prunidemissae*: a) dorsal view; b) empodial featherclaw and tarsus I, c) posterior region of opisthosoma; (d) microtubercles of (d) dorsal, and (e) ventral opisthosomal annuli; f) epigynal coverflap with thick (longitudinal), interrupted ridges, g) prodorsal shield with small but sharp frontal lobe.

Figure 13. Degree of obstruction of the ostia a) open, b) semi-open, c) closed; d) presence of lips (thickening) around the ostia, e) absence of lips

Figure 14. Example of ostia with (top) and without (bottom) trichomes inside

Figure 15. Width (the largest length) on Height of the ostia.

Figure 16. *Prunus serotina* distinctive characteristics (from left to right): inflorescence and leaves; young bark; fringe of orange hairs at the base of the leaf; general view of the plant; old bark.

Prunus americana Marshall

Figure 17. *Prunus americana* distinctive characteristics (from left to right): flowers and inflorescence; twigs with plums; leaf with sharp teeth.

Prunus virginiana Linnaeus

Figure 18. *Prunus virginiana* distinctive characteristics (from left to right): general view of the plant; flowers and inflorescence; leaf; sharp teeth at the margin of the leaf.

Prunus pumila L. var. *susquehanae*

Figure 19. *Prunus pumila* var. *susquehanae* distinctive characteristics (from left to right): flowers and general view of the plant; twigs with leaves; habitat; cherries.

Prunus pumila L. var. *depressa* (Pursh)

Figure 20. *Prunus pumila* var. *depressa* distinctive characteristics: general view of the plant with flowers.

Prunus nigra Aiton

Figure 21. *Prunus nigra* distinctive characteristics (from left to right): general view of the plant with flowers; trunk with bark; thicket with purple tinge; flowers and inflorescence; leaf with rounded teeth.

Prunus pensylvanica L.

Figure 22. *Prunus pensylvanica* distinctive characteristics (from left to right) : general view of the plant in bloom; view of the gall; close-up of the inflorescence with leaves

Prunus domestica Linnaeus

Figure 23. *Prunus domestica* distinctive characteristics (from left to right) : Plums; leaf; trunk with thornes; bark; general view of the plant.

Figure 24. Erinea from *Eriophyes distinguendus* (Kieffer; Palearctic mite) on *Prunus padus* L.
Pictures from Alan's blog link : <http://www.alansblog.org.uk/?p=3330> (authorization received for the use of those pictures)

Figure 25. Galls from *Acalitus phloeoptes* on *Prunus domestica*. Pictures from (Lacasa et al., 1990)

APPENDIX 1

Coordinates of the gall samples taken in 2015-2016 along the Ottawa River and in Vineland region.

Sample	host	Eriophyid species	location (WGS84)	date sampled
QC15FAME005	<i>P. americana</i>	<i>E. cerasicrumena</i>	45.56662 -76.09823	2015-VIII-24
QC1521FAME007	<i>P. americana</i>	<i>E. cerasicrumena</i>	45.442150 -75.809397	2015-VIII-27
QC1521FAME007	<i>P. americana</i>	<i>E. emarginatae</i>	45.442150 -75.809397	2015-VIII-27
QC1525FAME010	<i>P. americana</i>	<i>E. cerasicrumena</i>	45.472877 -75.675834	2015-VIII-27
QC1528FAME011	<i>P. americana</i>	<i>E. cerasicrumena</i>	45.38425 -75.70259	2015-VIII-31
QC1548AME002	<i>P. americana</i>	<i>E. cerasicrumena</i>	45.55418 -76.39522	2015-VI-26
QC1577AME006	<i>P. americana</i>	<i>E. cerasicrumena</i>	45.45548 -75.83878	2015-VII-01
QC1515AME001	<i>P. americana</i>	<i>E. cerasicrumena</i>	45.54713 -75.43194	2015-VI-24
QC1570NIG006G1	<i>P. nigra</i>	<i>E. emarginatae</i>	45.64100 -74.83445	2015-VI-29
QC15PUM010	<i>P. pumila</i> var. <i>depressa</i>	<i>E. emarginatae</i>	45.46808 -76.31683	2015-VII-04
QC1552SUS002	<i>P. pumila</i> var. <i>susquahanae</i>	<i>E. emarginatae</i>	45.801843 -76.706232	2015-VI-26
g2016	<i>P. serotina</i>	<i>E. cerasicrumena</i>	45.66609 -76.24381	2016-VI-25
NN15FNKB16A	<i>P. serotina</i>	<i>E. cerasicrumena</i>	43.03461 -79.33175	2015-VI-18
NN15FNKB14A	<i>P. serotina</i>	<i>E. cerasicrumena</i>	43.03461 -79.33175	2015-VI-18
QC1524FVIR001	<i>P. virginiana</i>	<i>E. emarginatae</i>	45.52855 -73.59679	2015-VIII-22
QC1523FVIR003	<i>P. virginiana</i>	<i>E. emarginatae</i>	45.60746 -73.81429	2015-VIII-22
QC1575FVIR004	<i>P. virginiana</i>	<i>E. emarginatae</i>	45.57566 -73.84956	2015-VIII-22
QC1518FVIR007	<i>P. virginiana</i>	<i>E. emarginatae</i>	45.59316 -75.41856	2015-VIII-23
QC1516FVIR008	<i>P. virginiana</i>	<i>E. emarginatae</i>	45.5484 -75.42287	2015-VIII-23
QC1582FVIR011	<i>P. virginiana</i>	<i>E. emarginatae</i>	45.931500 -76.078594	2015-VIII-24
QC15(83)FVIR012	<i>P. virginiana</i>	<i>E. emarginatae</i>	46.05650 -76.05412	2015-VIII-24
QC15(86)FVIR014	<i>P. virginiana</i>	<i>E. emarginatae</i>	45.93145 -76.07938	2015-VIII-24
QC1553FVIR021	<i>P. virginiana</i>	<i>E. emarginatae</i>	45.439454 -75.751264	2015-VIII-27
QC1572VIR004	<i>P. virginiana</i>	<i>E. emarginatae</i>	45.49363 -76.37563	2015-VI-21
QC1534FVIR019	<i>P. virginiana</i>	<i>E. prunidemissae</i>	45.35115 -75.81554	2015-VIII-27
QC153FVIR023	<i>P. virginiana</i>	<i>E. emarginatae</i> + <i>E. prunidemissae</i>	45.5163 -75.64497	2015-VIII-27
QC1570VIR009G1	<i>P. virginiana</i>	<i>E. emarginatae</i>	45.64100 -74.83445	2015-VI-29
ON15BEA1VIR1G1	<i>P. virginiana</i>	<i>E. emarginatae</i> + <i>E. prunidemissae</i>	43.18271 -79.4381	2015-VI-16
QC1572VIR005G1	<i>P. virginiana</i>	<i>E. emarginatae</i> + <i>E. prunidemissae</i>	45.48832 -76.39065	2015-VI-26
QC1563VIR010	<i>P. virginiana</i>	<i>E. emarginatae</i> + <i>E. prunidemissae</i>	45.55988 -73.56371	2015-VI-29

APPENDIX 2

Collection data of specimens studied for the redescription of *Eriophyes emarginatae*, *E. prunidemissae*, and *E. cerasicrumena*. Note that all samples collected by M.-E. Garon-Labrecque are from the Ottawa-Gatineau region.

Species	Sex	host	Province	location (WGS84)	collector	Coll. number	# slide	Date sampled
<i>E. emarginatae</i>	M	<i>P. americana</i>	QC	45.55418, -76.39522	M.-E. Garon-Labrecque	qc1548ame002	6	2015-VI-26
<i>E. emarginatae</i>	F	<i>P. americana</i>	QC	45.55418, -76.39522	M.-E. Garon-Labrecque	qc1548ame002	3	2015-VI-26
<i>E. emarginatae</i>	F	<i>P. virginiana</i>	QC	45,49363, -76,37563	M.-E. Garon-Labrecque	qc1572vir005	12	2015-VI-26
<i>E. emarginatae</i>	F	<i>P. nigra</i>	QC	45.6562, -73.6297	M.-E. Garon-Labrecque	qc1570nig006	4	2015-VI-29
<i>E. emarginatae</i>	F	<i>P. virginiana</i>	QC	45.93150, -76.07859	M.-E. Garon-Labrecque	qc1582fvir011	1	2015-VII-24
<i>E. emarginatae</i>	F	<i>P. virginiana</i>	QC	45.93150, -76.07859	M.-E. Garon-Labrecque	qc1582fvir011	2	2015-VII-24
<i>E. emarginatae</i>	F	<i>P. virginiana</i>	QC	43.18271, -79.4381	M.-E. Garon-Labrecque	bea1vir1	6	2015-VI-16
<i>E. emarginatae</i>	F	<i>P. virginiana</i>	QC	45,49363, -76,37563	M.-E. Garon-Labrecque	qc1572vir004	1	2015-VI-21
<i>E. emarginatae</i>	F	<i>P. virginiana</i>	QC	45.60746, -73.81429	M.-E. Garon-Labrecque	qc1523fvir003	1	2015-VII-22
<i>E. emarginatae</i>	F	<i>P. virginiana</i>	QC	45.59316, -75.41856	M.-E. Garon-Labrecque	qc1518fvir007	2	2015-VII-23
<i>E. emarginatae</i>	F	<i>P. virginiana</i>	QC	45.54713, -75.43194	M.-E. Garon-Labrecque	qc15fvir012	4	2015-VIII-24
<i>E. emarginatae</i>	F	<i>P. virginiana</i>	QC	45,49363, -76,37563	M.-E. Garon-Labrecque	qc1572vir004	6	2015-VI-21
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	45.5163, -75.64497	M.-E. Garon-Labrecque	3fvir023	3	2015-VIII-27
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	45.35115, -75.81554	M.-E. Garon-Labrecque	qc1534fvir019	2	2015-VIII-27
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	45.5163, -75.64497	M.-E. Garon-Labrecque	3fvir023	8	2015-VIII-27
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	45.35115, -75.81554	M.-E. Garon-Labrecque	qc1534fvir019	1	2015-VIII-27
<i>E. prunidemissae</i>	F	eastern choke cherry	ON	Kenora Dist. Ontario	I.M.Smith	m7501915	---	1975
<i>E. prunidemissae</i>	F	choke cherry galls	ON	St. Lawrence islands, Ontario	I.M.Smith	1-2857-23	---	1975
<i>E. prunidemissae</i>	F	choke cherry galls	ON	St. Lawrence islands, Ontario	I.M.Smith	1-2857-22	---	1975

<i>E. prunidemissae</i>	F	Eastern choke cherry	ON	Kenora district, Ontario	I.M.Smith	m750191s	---	1975
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	45.59316, -75.41856	M.-E. Garon-Labrecque	Qc1518fvir007	4	2015-VIII-23
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	45.5484, -75.42287	M.-E. Garon-Labrecque	qc1516fvir008	5	2015-VIII-23
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	45.6562, -73.6297	M.-E. Garon-Labrecque	qc1570vir009	5	2015-VI-29
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	43.18271, -79.4381	M.-E. Garon-Labrecque	bea1vir1	13	2015-VI-16
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	43.18271, -79.4381	M.-E. Garon-Labrecque	bea1vir1	3	2015-VI-16
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	45,49363, -76,37563	M.-E. Garon-Labrecque	qc1572vir005	8	2015-VI-21
<i>E. prunidemissae</i>	F	<i>P. virginiana</i>	QC	45,49363, -76,37563	M.-E. Garon-Labrecque	qc1572vir005	14	2015-VI-21
<i>E. cerasicrumena</i>	F	<i>P. serotina</i>	QC	43.03461, -79.33175	M.-E. Garon-Labrecque	FNKB14A	2	2015-VI-18
<i>E. cerasicrumena</i>	F	<i>P. americana</i>	QC	45.437, -76.37067	M.-E. Garon-Labrecque	44ame008	2	2015-VII-02
<i>E. cerasicrumena</i>	F	<i>P. americana</i>	QC	45.38425, -75.70259	M.-E. Garon-Labrecque	28fame011	3	2015-VIII-31
<i>E. cerasicrumena</i>	F	<i>P. nigra</i>	QC	45.442150, -75.809397	M.-E. Garon-Labrecque	21fnig008	3	2015-VIII-27
<i>E. cerasicrumena</i>	F	<i>P. americana</i>	QC	45.54713, -75.43194	M.-E. Garon-Labrecque	qc1515ame001	3	2015-VI-24
<i>E. cerasicrumena</i>	F	<i>P. americana</i>	QC	45.45548, 75.83878	M.-E. Garon-Labrecque	qc1577ame006	3	2015-VII-01
<i>E. cerasicrumena</i>	F	<i>P. nigra</i>	QC	45.442150, -75.809397	M.-E. Garon-Labrecque	qc1521fnig008	3	2015-VIII-27
<i>E. cerasicrumena</i>	F	<i>P. serotina</i>	QC	45.57882, -75.36085	M.-E. Garon-Labrecque	qc20fser002	3	2015-VIII-23
<i>E. cerasicrumena</i>	F	<i>P. serotina</i>	QC	45.36707, -75.79688	M.-E. Garon-Labrecque	qc31fser008	3	2015-VIII-27

Conclusion

First of all, the survey of the *Prunus* in southeastern Canada led to the finding of 39 mite species on 13 different hosts, which include 20 phytophagous mites and 19 predatory mites. In this study, 47% were vagrant species (7 spp.), 27% had an unknown habit (4 spp.), 20% were gall inducers (3 spp.) and 6% were inquiline (1sp.). According to the diversity estimator ACE, this survey effectively captured the species richness of the sampled areas. At least one eriophyid species is new for science. *Aculus* sp.1 did not fit to any mite description from the Rosaceae family and was collected a few times on *Prunus*. It is thus an associate of *Prunus* and could be a new species for science. Three species were found in the galls: *Eriophyes emarginatae*, *E.cerasicrumena* and *E. prunidemissae*, but the last species is an inquiline in the galls of *E. emarginatae*.

Mites having an economical significance can be injurious to their host, or on the contrary be beneficial. Well known pests were collected such as *Aculus fockeui*, *Aculus schlechtendali*, *Tetranychus urticae*, *Bryobia rubrioculus* and *Panonychus ulmi*. On the other hand, predatory mites that are known to be biocontrol agents used commercially were sampled: *Amblyseius andersoni*, *Typhlodromus pyri* and *Euseius finlandicus*. The frequency with which these phytoseids were sampled indicates that they could be used for *Prunus* crops, since they are apparently well adapted to these hosts.

Most of the species of Eriophyoid mites had more than one *Prunus* host. This means that they were not so host specific within *Prunus*, even though they may be restricted to *Prunus* genus. Three species were host specific: *Epitrimerus demissae*, *E. pyri* and *E. virginiana*. Concerning the Tetranychoid mites, species were not host specific, although it would be premature to make a firm

conclusion based on a single collection of *Brevipalpus* sp. Predatory mites were mostly generalists with one species having a host preference (*Euseius finlandicus*) for *Prunus virginiana*. Again, it is difficult to draw firm conclusions based on single collections of some species (7 spp.).

Since the old descriptions of the mites are often incomplete, the description of the three mites that were found in the galls of *Prunus* are given. Furthermore, two identification keys are provided: 1) based on the morphology of the mite species known to induce galls on *Prunus* in Canada and USA, and 2) based on the host and on the morphology of the galls of the seven mite species that induce galls in Canada and USA. The latter key is designed for non-experts and includes pictures of most of the *Prunus* for verification of the host identity. The key to mite species is technical, but it is complementary to the key of the galls. The danger of using only the key of the hosts and galls is that there could be cryptic species that induce similar galls and would be erroneously identified.

Further studies should focus on expanding surveys of the mite fauna to other *Prunus* species and other regions of Canada in order to have a full overview of the diversity of mites on *Prunus* in Canada. There are 20 species of *Prunus* in Canada and only 13 species were surveyed. As well, the host specificity and host range of the mite species should be assessed in order to yield additional background information on the ecology of mites on *Prunus* and to test or at least formulate new hypotheses on the determinants of host range in plant-associated mites. The associations between mites and crops requires additional attention, to better protect our crops from injurious pests. Host shifts can occur as mite species move from a host to another morphologically close relative.

We should explore further the associations of eriophyid mites with *Prunus* hosts, especially those

inducing galls. The morphology of galls, as a function of *Prunus* hosts, and mite inhabitants must be studied. Molecular analysis should be done in order to determine if *Eriophyes cerasicrumena* is the same mite as *E. similiprunianus* and to test whether other eriophyid species on *Prunus* may be hiding cryptic species associated with distinct hosts (e.g. *E. emarginatae*, which occur on many *Prunus* spp.)

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APPENDIX 1

General data of the sites and sampleshosts

ID_sample_jar	date_sampled	no. ind. sampled	Coordinates		Status (W) wild (C) cultivated	Habitat (F) forest (O) open (FE) forest edge	ID_sample_jar	Species ID	No. leaves sample (total)	Fruits? P/A	Galls? P/A	Estimated total galls per sample (no. leaves * mean of galls per leaf)	True galls count for sample	True no. leaves with galls
			LAT	LONG										
PT-183	2015-VI-19	3	43.14498	-79.41283	W	FE	PT-183	<i>Prunus gajum</i>	119	A	A	NA	NA	NA
PT-187	2015-VI-19	2	43.13378	-79.4539	W	FE	PT-187	<i>Prunus virginiana</i>	153	P	A	NA	NA	NA
PT-187(2)	2015-VI-19	1	43.13378	-79.4539	W	FE	PT-187(2)	<i>Prunus serotina</i>	112	A	A	NA	NA	NA
PT-185	2015-VI-19	6	43.13378	-79.4539	W	FE	PT-185	<i>Prunus gajum</i>	124	P	A	NA	NA	NA
PT-186	2015-VI-19	4	43.13771	-79.43351	W	FE	PT-186	<i>Prunus virginiana</i>	128	P	A	NA	NA	NA
PT-188	2015-VI-19	2	43.10617	-79.4108	W	FE	PT-188	<i>Prunus gajum</i>	107	P	A	NA	NA	NA
PT-187(3)	2015-VI-19	2	43.13378	-79.4539	W	FE	PT-187(3)	<i>Prunus gajum</i>	168	P	A	NA	NA	NA
PT-184	2015-VI-19	6	43.1449	-79.41914	W	O	PT-184	<i>Prunus americana</i>	204	P	A	NA	NA	NA
PT-188(2)	2015-VI-19	1	43.10617	-79.4108	W	FE	PT-188(2)	<i>Prunus virginiana</i>	106	A	A	NA	NA	NA
QC1564PUM002	2015-VI-29	1	45.558389	-73.560185	C	O	QC1564PUM002	<i>Prunus pumila</i> var. <i>depressa</i>	165	A	A	NA	NA	NA
QC1514NIG001	2015-VI-24	6	45.5502	-75.47260	W	O	QC1514NIG001	<i>Prunus nigra</i>	99	A	A	NA	NA	NA
PT-182	2015-VI-19	7	43.14551	-79.39418	W	FE	PT-182	<i>Prunus gajum</i>	82	A	A	NA	NA	NA
ON15NGA1	2015-VI-18	6	43.16568	-79.10149	W	O	ON15NGA1	<i>Prunus virginiana</i>	94	P	A	NA	NA	NA
ON15LNC1DOM1	2015-VI-16	6	43.17036	-79.42777	C	O	ON15LNC1DOM1	<i>Prunus domestica</i> (Europe)	114	A	A	NA	NA	NA
On15LNC1PER2	2015-VI-16	6	43.17036	-79.42777	C	O	On15LNC1PER2	<i>Prunus persica</i>	139	A	A	NA	NA	NA
ON1542NIG008	2015-VII-02	6	45.37431	-76.1869	W	O	ON1542NIG008	<i>Prunus nigra</i>	72	P	A	NA	NA	NA
ON1535SER009	2015-VII-02	1	45.47287	-75.67583	W	O	ON1535SER009	<i>Prunus serotina</i>	76	A	A	NA	NA	NA
ON15LNC1IARM1	2015-VI-16	6	43.17036	-79.42777	C	O	ON15LNC1IARM1	<i>Prunus americana</i>	184	A	A	NA	NA	NA
ON15BEMC19ARM	2015-VI-19	6	43.1829	-79.5126	C	O	ON15BEMC19ARM	<i>Prunus americana</i>	111	A	A	NA	NA	NA
ON1541AME007	2015-VII-02	6	45.3668	-76.15614	W	O	ON1541AME007	<i>Prunus americana</i>	49	P	A	NA	NA	NA
ON1542VIR014	2015-VII-02	4	45.37431	-76.1869	W	O	ON1542VIR014	<i>Prunus virginiana</i>	288	P	A	NA	NA	NA
ON1535PEN007	2015-VII-02	4	45.47287	-75.67583	W	O	ON1535PEN007	<i>Prunus pennsylvanica</i>	106	A	A	NA	NA	NA
ON158EA1SER1	2015-VI-16	2	43.18271	-79.4381	W	FE	ON158EA1SER1	<i>Prunus serotina</i>	139	P	A	NA	NA	NA
QC1552PEN003	2015-VI-26	6	45.801843	-76.706232	W	FE	QC1552PEN003	<i>Prunus serotina</i>	180	A	A	NA	NA	NA
ON1535VIR013	2015-VII-02	6	45.47287	-75.67583	W	FE	ON1535VIR013	<i>Prunus pennsylvanica</i>	102	A	A	NA	NA	NA
QC158PEN002	2015-VI-24	1	45.53028	-75.62645	W	O	QC158PEN002	<i>Prunus pennsylvanica</i>	247	P	A	NA	NA	NA
QC1565PEN004	2015-VI-27	1	45.63973	-74.33271	W	O	QC1565PEN004	<i>Prunus pennsylvanica</i>	147	P	A	NA	NA	NA
QC158VIR003	2015-VI-24	3	45.53028	-75.62645	W	O	QC158VIR003	<i>Prunus virginiana</i>	129	P	A	NA	NA	NA
QC1558ARM001	2015-VI-29	1	45.56074	-73.56432	C	O	QC1558ARM001	<i>Prunus americana</i>	113	A	A	NA	NA	NA
ONLNC1DOM2	2015-VI-16	6	43.17036	-79.42777	C	O	ONLNC1DOM2	<i>Prunus domestica</i> (Europe)	248	A	A	NA	NA	NA
QC1572PUM001	2015-VI-26	6	45.48832	-76.39065	W	O	QC1572PUM001	<i>Prunus pumila</i> var. <i>depressa</i>	183	A	A	NA	NA	NA

ID_sample_jar	date_sampled	no. ind. sampled	Coordinates		Status (W) wild (C) cultivated	Habitat (F) forest (O) open (FE) forest edge	ID_sample_jar	Species ID	No. leaves sample (total)	Fruits? P/A	Galls? P/A	Estimated total galls per sample (no. leaves * mean of galls per leaf)	True galls count for sample	True no. leaves with galls
			LAT	LONG										
QC1552SUS002	2015-VI-26	6	45.801843	-76.706232	W	FE	QC1552SUS002	<i>Prunus susquehanna</i>	201	A	P	435.50	439	NA
QC1566SER008	2015-VI-30	2	45.63568	-74.35036	W	F	QC1566SER008	<i>Prunus serotina</i>	83	A	A	NA	NA	NA
NN15BEMC2A	2015-VI-17	6	43.1829	-79.5126	C	O	NN15BEMC2A	<i>Prunus domestica</i> (Europe)	104	A	A	NA	NA	NA
NN15FNKB10A	2015-VI-18	6	43.03461	-79.33175	C	O	NN15FNKB10A	<i>Prunus domestica</i> (Japanese)	75	A	A	NA	NA	NA
NN15FNKB8A	2015-VI-18	6	43.03461	-79.33175	C	O	NN15FNKB8A	<i>Prunus persica</i>	137	A	A	NA	NA	NA
NN15BEMC26A	2015-VI-17	6	43.1829	-79.5126	C	O	NN15BEMC26A	<i>Prunus persica</i>	100	A	A	NA	NA	NA
QC1572VIR005	2015-VI-26	6	45.48832	-76.39065	W	FE	QC1572VIR005	<i>Prunus virginiana</i>	64	A	P	10.67	55	NA
NN15PEL1A	2015-VI-18	6	43.05597	-79.32389	C	O	NN15PEL1A	<i>Prunus cerasus</i>	71	P	A	NA	NA	NA
QC1519VIR002	2015-VI-24	3	45.57841	-75.36644	W	FE	QC1519VIR002	<i>Prunus virginiana</i>	62	P	A	NA	NA	NA
QC1572SER004	2015-VI-26	1	45.48832	-76.39065	W	FE	QC1572SER004	<i>Prunus serotina</i>	49	A	A	NA	NA	NA
QC1578AME003	2015-VI-26	6	45.59866	-76.53250	W	O	QC1578AME003	<i>Prunus americana</i>	66	A	A	NA	NA	NA
NN15BEMC9A	2015-VI-17	1	43.146856	-79.374565	W	F	NN15BEMC9A	<i>Prunus serotina</i>	144	P	A	NA	NA	NA
QC1563VIR010	2015-VI-29	4	45.59988	-73.56371	W	FE	QC1563VIR010	<i>Prunus virginiana</i>	84	P	P	28.00	48	NA
NN15PEL2A	2015-VI-18	6	43.05597	-79.32389	C	O	NN15PEL2A	<i>Prunus cerasus</i>	75	A	A	NA	NA	NA
NN15BEMC13A	2015-VI-17	6	43.1829	-79.5126	C	O	NN15BEMC13A	<i>Prunus domestica</i> (Europe)	96	A	A	NA	NA	NA
NN15FNKB9A	2015-VI-18	6	43.03461	-79.33175	C	O	NN15FNKB9A	<i>Prunus cerasus</i>	83	A	A	NA	NA	NA
NN15PEL04A	2015-VI-18	7	43.05597	-79.32389	C	O	NN15PEL04A	<i>Prunus domestica</i>	?	?	?	NA	NA	NA
QC1524FPA001	2015-VIII-22	2	45.52855	-73.59679	W	O	QC1524FPA001	<i>Prunus padus</i>	51	A	A	NA	NA	NA
QC1524FVIR001	2015-VIII-22	5	45.52855	-73.59679	W	O	QC1524FVIR001	<i>Prunus virginiana</i>	129	P	P	NA	194	31
QC1576FPA002	2015-VIII-22	1	45.604295	-73.642051	C	O	QC1576FPA002	<i>Prunus padus</i>	94	P	A	NA	NA	NA
QC1576FVIR002	2015-VIII-22	1	45.604295	-73.642051	W	O	QC1576FVIR002	<i>Prunus virginiana</i>	172	A	A	NA	NA	NA
QC1523FAME001	2015-VIII-22	6	45.60746	-73.81429	W	F	QC1523FAME001	<i>Prunus americana</i>	83	P	A	NA	NA	NA
QC1523FNI001	2015-VIII-22	4	45.60746	-73.81429	W	FE	QC1523FNI001	<i>Prunus nigra</i>	57	A	A	NA	NA	NA
QC1523FVIR003	2015-VIII-22	6	45.60746	-73.81429	W	F	QC1523FVIR003	<i>Prunus virginiana</i>	96	A	P	NA	412	58
QC1575FPM001	2015-VIII-22	6	45.57566	-73.84956	W	O	QC1575FPM001	<i>Prunus pumila</i> var. <i>depressa</i>	121	A	A	NA	NA	NA
QC1575FVIR004	2015-VIII-22	5	45.57566	-73.84956	W	F	QC1575FVIR004	<i>Prunus virginiana</i>	99	A	P	NA	106	15
QC1567FSER001	2015-VIII-23	1	45.62736	-74.44541	W	O	QC1567FSER001	<i>Prunus serotina</i>	150	A	A	NA	NA	NA

ID_sample_jar	date_sampled	no. ind. sampled	Coordinates		Status (W) wild (C) cultivated	Habitat (F) forest (O) open (FE) forest edge	ID_sample_jar	Species ID	No. leaves sample (total)	Fruits? P/A	Galls? P/A	Estimated total galls per sample (no. leaves * mean of galls per leaf)	True galls count for sample	True no. leaves with galls
			LAT	LONG										
QC1550FAME009	2015-VIII-27	2	45.486582	-75.594010	W	F	QC1550FAME009	<i>Prunus americana</i>	72	A	A	NA	NA	NA
QC1550FVIR022	2015-VIII-27	3	45.486582	-75.594010	W	F	QC1550FVIR022	<i>Prunus virginiana</i>	125	A	A	NA	NA	NA
QC1525FAME010	2015-VIII-27	6	45.472877	-75.675834	W	O	QC1525FAME010	<i>Prunus americana</i>	110	P	P	NA	54	16
QC153FVIR023	2015-VIII-27	3	45.5163	-75.64497	W	FE	QC153FVIR023	<i>Prunus virginiana</i>	126	A	P	NA	49	16
QC153FPEN011	2015-VIII-27	6	45.5163	-75.64497	W	O	QC153FPEN011	<i>Prunus pennsylvanica</i>	117	A	A	NA	NA	NA
QC153FNI009	2015-VIII-27	2	45.5163	-75.64497	W	FE	QC153FNI009	<i>Prunus nigra</i>	79	A	A	NA	NA	NA
QC28FPAD004	2015-VIII-31	1	45.38425	-75.70259	C	O	QC28FPAD004	<i>Prunus padus</i>	95	A	A	NA	NA	NA
QC1528FVIR024	2015-VIII-31	4	45.38425	-75.70259	W	FE	QC1528FVIR024	<i>Prunus virginiana</i>	123	A	A	NA	NA	NA
QC1528FPM001	2015-VIII-31	4	45.38425	-75.70259	C	O	QC1528FPM001	<i>Prunus munisiana</i>	65	A	A	NA	NA	NA
NN15PRC21A	2015-VII-17	7	66.28750171	-66.22309997	W	?	NN15PRC21A	<i>Prunus pumila</i>	396	A	A	NA	NA	NA
QC1528FAME011	2015-VIII-31	6	45.38425	-75.70259	WC	FE	QC1528FAME011	<i>Prunus americana</i>	94	A	P	NA	25	5
QC1528FSER012	2015-VIII-31	2	45.38425	-75.70259	C	O	QC1528FSER012	<i>Prunus serotina</i>	162	A	P	NA	22	2

ID_sample_jar	date_sampled	no. ind. sampled	Coordinates		Status (W) wild (C) cultivated	Habitat (F) forest (O) open (FE) forest edge	ID_sample_jar	Species ID	No. leaves sample (total)	Fruits? P/A	Galls? P/A	Estimated total galls per sample (no. leaves * mean of galls per leaf)	True galls count for sample	True no. leaves with galls
			LAT	LONG										
QC1572SER003	2015-VI-21	1	45.49363	-76.37563	W	O	QC1572SER003	<i>Prunus serotina</i>	127	P	A	NA	NA	NA
QC1565VIR008	2015-VI-27	6	45.63973	-74.33271	W	O	QC1565VIR008	<i>Prunus virginiana</i>	176	P	A	NA	NA	NA
ON15BEA1VIR1	2015-VI-16	6	43.18271	-79.4381	W	FE	ON15BEA1VIR1	<i>Prunus virginiana</i>	123	A	P	1742.50	NA	NA
NN15BEMC15A	2015-VI-17	6	43.1829	-79.5126	C	O	NN15BEMC15A	<i>Prunus pennsylvanica</i>	72	A	A	NA	NA	NA
QC1552VIR007	2015-VI-26	6	45.801843	-76.706232	W	FE	QC1552VIR007	<i>Prunus virginiana</i>	119	A	A	NA	NA	NA
QC1566VIR011	2015-VI-30	4	45.63568	-74.35036	W	FE	QC1566VIR011	<i>Prunus virginiana</i>	53	A	Maybe	NA	NA	NA
QC1568VIR012	2015-VI-30	6	45.64100	-74.83445	W	O	QC1568VIR012	<i>Prunus virginiana</i>	50	P	A	NA	NA	NA
QC1566PEN006	2015-VI-30	1	45.63568	-74.35036	W	FE	QC1566PEN006	<i>Prunus pennsylvanica</i>	140	P	A	NA	NA	NA
NN15FNKB13A	2015-VI-18	6	43.03461	-79.33175	C	O	NN15FNKB13A	<i>Prunus serotina</i>	78	A	A	NA	NA	NA
NN15NGA2VIR	2015-VI-18	6	43.16568	-79.10149	W	FE	NN15NGA2VIR	<i>Prunus virginiana</i>	98	P	A	NA	NA	NA
NN15BEMC06A	2015-VI-17	4	43.15206	-79.47352	W	FE	NN15BEMC06A	<i>Prunus virginiana</i>	95	P	A	NA	NA	NA
QC1515AME001	2015-VI-24	6	45.54713	-75.43194	W	FE	QC1515AME001	<i>Prunus serotina</i>	96	P	P	400.00	130	NA
NN15FNKB17A	2015-VI-18	6	43.03461	-79.33175	C	O	NN15FNKB17A	<i>Prunus domestica (Japanese)</i>	201	A	A	NA	NA	NA
NN15BEMC7A	2015-VI-17	3	43.146808	-79.347764	W	FE	NN15BEMC7A	<i>Prunus virginiana</i>	114	P	A	NA	NA	NA
QC1515VIR001	2015-VI-24	3	45.54713	-75.43194	W	FE	QC1515VIR001	<i>Prunus virginiana</i>	54	A	A	NA	NA	NA
NN15FNKB5A	2015-VI-18	6	43.03461	-79.33175	C	O	NN15FNKB5A	<i>Prunus domestica (Europe)</i>	73	A	A	NA	NA	NA
NN15FNKB15A	2015-VI-18	6	43.03461	-79.33175	C	O	NN15FNKB15A	<i>Prunus serotina</i>	66	A	A	NA	NA	NA
NN15FNKB11A	2015-VI-18	6	43.03461	-79.33175	C	O	NN15FNKB11A	<i>Prunus virginiana</i>	62	A	A	NA	NA	NA
NN15FNKB7A	2015-VI-18	6	43.03461	-79.33175	C	O	NN15FNKB7A	<i>Prunus persica</i>	105	A	A	NA	NA	NA
QC1577AME006	2015-VII-01	4	45.45548	-75.83878	W	O	QC1577AME006	<i>Prunus americana</i>	133	A	P	88.67	50	NA
NN15PT177SER	2015-VI-17	4	43.146808	-79.347764	W	F	NN15PT177SER	<i>Prunus serotina</i>	93	A	A	NA	NA	NA
QC1548VIR006	2015-VI-26	2	45.55418	-76.39522	W	O	QC1548VIR006	<i>Prunus virginiana</i>	77	A	A	NA	NA	NA
QC1572NIG004	2015-VI-26	3	45.48832	-76.39065	W	FE	QC1572NIG004	<i>Prunus nigra</i>	85	A	A	NA	NA	NA
QC1569AME004	2015-VI-29	6	45.65952	-73.62861	W	FE	QC1569AME004	<i>Prunus americana</i>	79	A	A	NA	NA	NA
QC158NIG003	2015-VI-24	6	45.53028	-75.62645	W	O	QC158NIG003	<i>Prunus nigra</i>	84	A	A	NA	NA	NA
NN15FNKB14A	2015-VI-18	?	43.03461	-79.33175	W	FE	NN15FNKB14A	<i>Prunus serotina</i>	125	P	P	83.33	165	NA
QC1547NIG005	2015-VI-26	6	45.58749	-76.58645	W	O	QC1547NIG005	<i>Prunus nigra</i>	105	A	A	NA	NA	NA
QC1519SER001	2015-VI-24	1	45.57841	-75.36644	W	O	QC1519SER001	<i>Prunus serotina</i>	113	A	A	NA	NA	NA
NN15FNK19A	2015-VI-16	6	43.0359	-79.35241	C	O	NN15FNK19A	<i>Prunus persica</i>	80	A	A	NA	NA	NA
QC1519PEN001	2015-VI-24	?	45.57841	-75.36644	W	O	QC1519PEN001	<i>Prunus pennsylvanica</i>	77	A	A	NA	NA	NA

ID_sample_jar	date_sampled	no. ind. sampled	Coordinates		Status (W) wild (C) cultivated	Habitat (F) forest (O) open (FE) forest edge	ID_sample_jar	Species ID	No. leaves sample (total)	Fruits? P/A	Galls? P/A	Estimated total galls per sample (no. leaves * mean of galls per leaf)	True galls count for sample	True no. leaves with galls
			LAT	LONG										
QC155APA001	2015-VI-29	1	45.56081	-73.56394	C	O	QC155APA001	<i>Prunus sapu</i>	77	P	A	NA	NA	NA
ON15BEA2DOM1	2015-VI-16	4	43.1821	-79.41832	C	O	ON15BEA2DOM1	<i>Prunus domestica</i>	212	P	A	NA	NA	NA
QC1563PAD001	2015-VI-29	1	45.55988	-73.56371	C	O	QC1563PAD001	<i>Prunus padus</i>	69	P	A	NA	NA	NA
ON15BEMC11AVI	2015-VI-17	6	43.1829	-79.5126	C	O	ON15BEMC11AVI	<i>Prunus virginiana</i>	60	A	A	NA	NA	NA
QC1561CERASUS001	2015-VI-29	3	45.56082	-73.56382	C	O	QC1561CERASUS001	<i>Prunus serotina</i>	70	P	A	NA	NA	NA
QC158SER002	2015-VI-24	1	45.53028	-75.62645	W	O	QC158SER002	<i>Prunus serotina</i>	55	A	A	NA	NA	NA
QC1563NIG007	2015-VI-29	3	45.55988	-73.56371	C	FE	QC1563NIG007	<i>Prunus nigra</i>	52	P	A	NA	NA	NA
QC1565SER005	2015-VI-27	1	45.63973	-74.33271	W	O	QC1565SER005	<i>Prunus serotina</i>	79	A	A	NA	NA	NA
QC1561SER007	2015-VI-29	1	45.56082	-73.56382	C	O	QC1561SER007	<i>Prunus serotina</i>	79	A	P	NA	NA	NA
QC1571SER006	2015-VI-29	2	45.6572	-73.6307	W	F	QC1571SER006	<i>Prunus serotina</i>	72	A	A	NA	NA	NA
ON15BEMC3PER	2015-VI-17	6	43.1829	-79.5126	C	O	ON15BEMC3PER	<i>Prunus persica (nectarine)</i>	108	A	A	NA	NA	NA
QC1519NIG002	2015-VI-24	3	45.57841	-75.36644	W	FE	QC1519NIG002	<i>Prunus nigra</i>	63	P	A	NA	NA	NA
QC1544AME008	2015-VII-02	6	45.437	-76.37067	W	O	QC1544AME008	<i>Prunus americana</i>	67	P	A	NA	NA	NA
ON15LNC1PER1	2015-VI-16	6	43.17036	-79.42777	C	O	ON15LNC1PER1	<i>Prunus persica</i>	147	A	A	NA	NA	NA
ON15FNK13AVI	2015-VI-16	6	43.0359	-79.35241	C	O	ON15FNK13AVI	<i>Prunus virginiana</i>	130	P	A	NA	NA	NA
QC1568AME005	2015-VI-30	6	45.64100	-74.83445	W	O	QC1568AME005	<i>Prunus americana</i>	74	A	A	NA	NA	NA
ON15FNK1SER	2015-VI-16	?	43.0359	-79.35241	W	FE	ON15FNK1SER	<i>Prunus serotina</i>	121	P	A	NA	NA	NA
ON15FNK22AVI	2015-VI-16	6	43.0359	-79.35241	C	O	ON15FNK22AVI	<i>Prunus virginiana</i>	159	P	A	NA	NA	NA
ON15BEMC16PER	2015-VI-17	6	43.1829	-79.5126	C	O	ON15BEMC16PER	<i>Prunus persica</i>	121	A	A	NA	NA	NA
ON15BEMC12AVI	2015-VI-17	6	43.1829	-79.5126	C	O	ON15BEMC12AVI	<i>Prunus virginiana</i>	135	A	A	NA	NA	NA
QC15PUM010	2015-VII-04	6	45.46808	-76.31683	W	O	QC15PUM010	<i>Prunus pennsylvanica</i> var. <i>depressa</i>	146	A	P	267.67	NA	NA
QC1548AME002	2015-VI-26	6	45.55418	-76.39522	W	O	QC1548AME002	<i>Prunus americana</i>	78	A	P	130.00	NA	NA
QC1572VIR004	2015-VI-21	6	45.49363	-76.37563	W	O	QC1572VIR004	<i>Prunus virginiana</i>	117	P	A	604.50	NA	NA
QC1552SUS001	2015-VI-26	6	45.801843	-76.706232	W	O	QC1552SUS001	<i>Prunus pennsylvanica</i>	99	A	A	NA	NA	NA
QC1579PEN005	2015-VI-29	1	45.658058	-73.631470	W	FE	QC1579PEN005	<i>Prunus domestica</i>	120	P	A	NA	NA	NA
ON15LNC1JAP1	2015-VI-16	6	43.17036	-79.42777	C	O	ON15LNC1JAP1	<i>Prunus domestica (Japanese)</i>	299	A	A	NA	NA	NA
NN15BEMC17A	2015-VI-17	6	43.1829	-79.5126	C	O	NN15BEMC17A	<i>Prunus domestica (Japanese)?</i>	108	A	A	NA	NA	NA
QC1570NIG006	2015-VI-29	6	45.64100	-74.83445	W	FE	QC1570NIG006	<i>Prunus nigra</i>	62	A	P	217.00	NA	NA
NN15FNKB12A	2015-VI-18	6	43.03461	-79.33175	C	O	NN15FNKB12A	<i>Prunus virginiana</i>	84	A	A	NA	NA	NA
NN15FNKB16A	2015-VI-18	2	43.03461	-79.33175	W	FE	NN15FNKB16A	<i>Prunus serotina</i>	96	A	P	480.00	NA	NA
QC1570VIR009	2015-VI-29	6	45.64100	-74.83445	W	F	QC1570VIR009	<i>Prunus virginiana</i>	104	A	P	52.00	NA	NA

ID_sample_jar	date_sampled	no. ind. sampled	Coordinates		Status (W) wild (C) cultivated	Habitat (F) forest (O) open (FE) forest edge	ID_sample_jar	Species ID	No. leaves sample (total)	Fruits? P/A	Galls? P/A	Estimated total galls per sample (no. leaves * mean of galls per leaf)	True galls count for sample	True no. leaves with galls
			LAT	LONG										
QC1567FVIR005	2015-VIII-23	1	45.62736	-74.44541	W	FH	QC1567FVIR005	<i>Prunus virginiana</i>	66	A	P	NA	1	—
QC1567FNIG002	2015-VIII-23	3	45.62736	-74.44541	W	FH	QC1567FNIG002	<i>Prunus nigra</i>	80	A	A	NA	NA	NA
QC1520FNIG003	2015-VIII-23	6	45.57882	-75.36085	W	O	QC1520FNIG003	<i>Prunus nigra</i>	67	P	A	NA	NA	NA
QC1520FSER002	2015-VIII-23	2	45.57882	-75.36085	W	O	QC1520FSER002	<i>Prunus serotina</i>	81	A	A	NA	NA	NA
QC1520FVIR006	2015-VIII-23	2	45.57882	-75.36085	W	O	QC1520FVIR006	<i>Prunus virginiana</i>	75	A	P	NA	56	29
QC1517PAD003	2015-VIII-23	2	45.588403	-75.416708	C	O	QC1517PAD003	<i>Prunus padus</i>	52	A	A	NA	NA	NA
QC1518FNIG004	2015-VIII-23	1	45.59316	-75.41856	W	FH	QC1518FNIG004	<i>Prunus nigra</i>	65	A	A	NA	NA	NA
QC1518FSER003	2015-VIII-23	3	45.59316	-75.41856	W	FH	QC1518FSER003	<i>Prunus serotina</i>	52	A	A	NA	NA	NA
QC1518FVIR007	2015-VIII-23	6	45.59316	-75.41856	W	FH	QC1518FVIR007	<i>Prunus virginiana</i>	81	A	P	NA	113	13
QC1518FAME002	2015-VIII-23	3	45.59316	-75.41856	W	FH	QC1518FAME002	<i>Prunus americana</i>	74	A	A	NA	NA	NA
QC1516FAME003	2015-VIII-23	6	45.5484	-75.42287	W	FH	QC1516FAME003	<i>Prunus americana</i>	65	A	A	NA	NA	NA
QC1516FVIR008	2015-VIII-23	2	45.5484	-75.42287	W	FH	QC1516FVIR008	<i>Prunus virginiana</i>	72	A	P	NA	14	6
QC155FSER005	2015-VIII-23	1	45.52973	-75.66397	W	FH	QC155FSER005	<i>Prunus serotina</i>	73	A	A	NA	NA	NA
QC155FNIG005	2015-VIII-23	4	45.52973	-75.66397	W	FH	QC155FNIG005	<i>Prunus nigra</i>	59	A	P	NA	62	22
QC155FVIR009	2015-VIII-23	3	45.52973	-75.66397	W	FH	QC155FVIR009	<i>Prunus virginiana</i>	59	A	A	NA	NA	NA
QC1512FEN001	2015-VIII-23	6	45.54459	-75.49373	W	O	QC1512FEN001	<i>Prunus pennsylvanica</i>	116	A	A	NA	NA	NA
QC155FSER006	2015-VIII-23	1	45.52929	-75.67007	W	O	QC155FSER006	<i>Prunus serotina</i>	124	A	P	NA	4	4
QC156FVIR006	2015-VIII-23	6	45.52929	-75.67007	W	FH	QC156FVIR006	<i>Prunus nigra</i>	75	A	A	NA	NA	NA
QC156FPEN002	2015-VIII-23	1	45.52929	-75.67007	W	O	QC156FPEN002	<i>Prunus pennsylvanica</i>	89	A	A	NA	NA	NA
QC152FVIR010	2015-VIII-23	6	45.54765	-75.6834	W	FH	QC152FVIR010	<i>Prunus virginiana</i>	75	P	A	NA	NA	NA
QC1582FVIR011	2015-VIII-24	2	45.931500	-76.078594	W	O	QC1582FVIR011	<i>Prunus virginiana</i>	110	P	P	NA	264	51
QC1582FPM002	2015-VIII-24	5	45.931500	-76.078594	W	O	QC1582FPM002	<i>Prunus punctata</i> var. <i>depressa</i>	140	A	A	NA	NA	NA
QC1582FPEN003	2015-VIII-24	6	45.931500	-76.078594	W	FH	QC1582FPEN003	<i>Prunus pennsylvanica</i>	95	A	A	NA	NA	NA
QC1583FAME004	2015-VIII-24	3	46.05650	-76.05412	W	O	QC1583FAME004	<i>Prunus americana</i>	79	A	A	NA	NA	NA
QC1583FVIR012	2015-VIII-24	3	46.05650	-76.05412	W	O	QC1583FVIR012	<i>Prunus virginiana</i>	171	P	P	NA	87	39
QC1584FVIR013	2015-VIII-24	5	45.95015	-76.06760	W	O	QC1584FVIR013	<i>Prunus virginiana</i>	122	A	P	NA	16	6
QC1584FPEN004	2015-VIII-24	6	45.95015	-76.06760	W	O	QC1584FPEN004	<i>Prunus pennsylvanica</i>	98	A	A	NA	NA	NA
QC1585FSUS001	2015-VIII-24	6	45.94566	-76.09061	W	O	QC1585FSUS001	<i>Prunus susquehanna</i>	107	A	A	NA	NA	NA
QC1586FPEN005	2015-VIII-24	4	45.93145	-76.07938	W	F	QC1586FPEN005	<i>Prunus pennsylvanica</i>	87	A	P	NA	72	11
QC1586FSE007	2015-VIII-24	4	45.93145	-76.07938	W	FH	QC1586FSE007	<i>Prunus serotina</i>	65	A	A	NA	NA	NA

ID_sample_jar	date_sampled	no. ind. sampled	Coordinates		Status (W) wild (C) cultivated	Habitat (F) forest (O) open (FE) forest edge	ID_sample_jar	Species ID	No. insect sample (total)	Fruits? P/A	Galls? P/A	Estimated total galls per sample (no. leaves * mean of galls per leaf)	True galls count for sample	True no. leaves w/ galls
			LAT	LONG										
QC15(86)FSUS002	2015-VIII-24	6	45.93145	-76.07938	W	FH	QC15(86)FSUS002	<i>Prunus susquehannae</i>	115	A	A	NA	NA	NA
QC15(86)FVIR014	2015-VIII-24	4	45.93145	-76.07938	W	F	QC15(86)FVIR014	<i>Prunus virginiana</i>	106	A	P	NA	36	13
QC15FAME005	2015-VIII-24	7	45.56662	-76.09823	W	FH	QC15FAME005	<i>Prunus americana</i>	108	A	P	NA	53	21
QC15FPEN006	2015-VIII-24	6	45.56662	-76.09823	W	O	QC15FPEN006	<i>Prunus pennsylvanica</i>	174	A	A	NA	NA	NA
QC15FVIR015	2015-VIII-24	6	45.56662	-76.09823	W	FH	QC15FVIR015	<i>Prunus virginiana</i>	77	A	A	NA	NA	NA
QC15FPEN007	2015-VIII-25	4	45.95169	-77.27148	W	O	QC15FPEN007	<i>Prunus pennsylvanica</i>	194	A	A	NA	NA	NA
QC1596F	2015-VIII-25	1	45.95560	-77.27353	W	O	QC1596F	<i>Prunus pumila</i> var. <i>susquehannae</i>	96	A	A	NA	NA	NA
QC1597F	2015-VIII-25	2	45.95548	-77.27282	W	O	QC1597F	<i>Prunus pumila</i> var. <i>susquehannae</i>	103	A	A	NA	NA	NA
QC1598F	2015-VIII-25	2	45.95535	-77.27248	W	O	QC1598F	<i>Prunus pumila</i> var. <i>susquehannae</i>	107	A	A	NA	NA	NA
QC1599F	2015-VIII-25	2	45.95163	-77.27151	W	O	QC1599F	<i>Prunus pumila</i> var. <i>susquehannae</i>	70	A	A	NA	NA	NA
QC15100F	2015-VIII-25	2	45.95169	-77.27148	W	O	QC15100F	<i>Prunus pumila</i> var. <i>susquehannae</i>	86	A	A	NA	NA	NA
QC15102FPEN008	2015-VIII-25	6	45.80906	-76.97346	W	FH	QC15102FPEN008	<i>Prunus pennsylvanica</i>	113	A	A	NA	NA	NA
QC15102FVIR016	2015-VIII-25	4	45.80906	-76.97346	W	FH	QC15102FVIR016	<i>Prunus virginiana</i>	79	A	A	NA	NA	NA
QC15102FSUS003	2015-VIII-25	12	45.80906	-76.97346	W	FH	QC15102FSUS003	<i>Prunus susquehannae</i>	106	A	A	NA	NA	NA
QC15103FPUM003	2015-VIII-25	1	45.88171	-76.80081	W	FH	QC15103FPUM003	<i>Prunus pumila</i> var. <i>depressa</i>	108	A	A	NA	NA	NA
QC1546FAME006	2015-VIII-25	6	45.58749	-76.58645	W	O	QC1546FAME006	<i>Prunus americana</i>	82	A	A	NA	NA	NA
QC1545FVIR017	2015-VIII-26	6	45.45157	-76.54485	W	O	QC1545FVIR017	<i>Prunus virginiana</i>	146	A	A	NA	NA	NA
QC1543FNIG007	2015-VIII-26	4	45.4547	-76.39685	W	FH	QC1543FNIG007	<i>Prunus nigra</i>	67	A	P	NA	1	1
QC1545FPEN009	2015-VIII-26	6	45.45157	-76.54485	W	O	QC1545FPEN009	<i>Prunus pennsylvanica</i>	83	A	A	NA	NA	NA
QC1531FSER008	2015-VIII-27	1	45.36707	-75.79688	W	FH	QC1531FSER008	<i>Prunus serotina</i>	85	A	A	NA	NA	NA
QC1531FVIR018	2015-VIII-27	4	45.36707	-75.79688	W	FH	QC1531FVIR018	<i>Prunus virginiana</i>	55	A	P	NA	9	4
QC1534FVIR019	2015-VIII-27	6	45.35115	-75.81554	W	FH	QC1534FVIR019	<i>Prunus virginiana</i>	80	A	P	NA	92	26
QC1534FSER009	2015-VIII-27	2	45.35115	-75.81554	W	FH	QC1534FSER009	<i>Prunus serotina</i>	74	A	A	NA	NA	NA
QC1521FNIG008	2015-VIII-27	4	45.442150	-75.809397	W	FH	QC1521FNIG008	<i>Prunus nigra</i>	68	A	P	NA	1	1
QC1521FPEN010	2015-VIII-27	1	45.442150	-75.809397	W	FH	QC1521FPEN010	<i>Prunus pennsylvanica</i>	86	A	A	NA	NA	NA
QC1521FAME007	2015-VIII-27	6	45.442150	-75.809397	W	O	QC1521FAME007	<i>Prunus americana</i>	45	P	P	NA	580	45
QC1521FVIR020	2015-VIII-27	3	45.442150	-75.809397	W	FH	QC1521FVIR020	<i>Prunus virginiana</i>	90	A	P	NA	196	34
QC1573FAME008	2015-VIII-27	3	45.43961	-75.75226	W	F	QC1573FAME008	<i>Prunus americana</i>	61±8	A	P	NA	9	1±8
QC1553FSER010	2015-VIII-27	1	45.439454	-75.751264	W	F	QC1553FSER010	<i>Prunus serotina</i>	62±4	A	P	NA	5	1±4
QC1553FVIR021	2015-VIII-27	2	45.439454	-75.751264	W	F	QC1553FVIR021	<i>Prunus virginiana</i>	92	A	P	NA	93	15
QC1550FSER011	2015-VIII-27	2	45.486582	-75.594010	W	F	QC1550FSER011	<i>Prunus serotina</i>	109	A	A	NA	NA	NA
QC1550FAME009	2015-VIII-27	2	45.486582	-75.594010	W	F	QC1550FAME009	<i>Prunus americana</i>	73	A	A	NA	NA	NA

ID_sample_jar	Estim. no. leaves with galls	Estimated LA (cm²)	Erio Vagrant	Phyto/Pred	Tetra	Tenui	Tyde	Tarso	Astig	Orib	Other
PT-183	NA	2282.02	0	0	0	0	1	0	0	0	0
PT-187	NA	2506.14	0	0	0	0	3	0	0	0	0
PT-187(2)	NA	2400.53	0	0	0	0	1	0	0	0	0
PT-185	NA	1435.92	0	1	0	0	1	0	0	0	0
PT-186	NA	2894.08	0	0	0	0	0	0	0	0	0
PT-188	NA	4540.72	0	5	0	0	3	0	0	0	0
PT-187(3)	NA	6365.52	0	2	0	0	1	0	0	0	0
PT-184	NA	1788.40	0	0	0	0	1	0	0	0	0
PT-188(2)	NA	2175.76	0	0	0	0	3	0	0	0	0
QC1564PUM002	NA	1288.29	0	0	0	0	1	0	0	0	0
QC1514NIG001	NA	2389.83	0	0	0	0	0	0	0	0	0
PT-182	NA	3919.30	2	2	0	0	2	0	0	0	0
ON15NGA1	NA	1178.13	0	0	0	0	5	0	0	0	0
ON15LNC1DOM1	NA	2598.82	1	0	0	0	2	0	0	0	0
ON15LNC1PER2	NA	2766.80	0	0	0	0	1	0	0	0	0
ON1542NIG008	NA	3184.22	0	0	0	0	11	0	0	0	0
ON1535SER009	NA	1524.31	0	0	0	0	7	0	0	0	0
ON15LNC1ARM1	NA	4462.24	0	0	0	0	1	0	0	0	0
ON15BEMC19ARM	NA	3951.23	0	0	0	0	0	0	0	0	0
ON1541AME007	NA	1585.88	0	1	0	0	6	0	0	0	0
ON1542VIR014	NA	942.43	0	1	0	0	0	0	0	0	0
ON1535PEN007	NA	1428.62	1	0	0	0	1	0	0	0	0
ON15BEA1SER1	NA	2512.84	0	0	0	0	0	0	0	0	0
QC1552PEN003	NA	1200.45	0	0	0	0	0	0	0	0	0
ON1535VIR013	NA	2092.02	0	0	0	0	0	0	0	0	0
QC158PEN002	NA	2493.63	0	0	0	0	0	0	0	0	0
QC1565PEN004	NA	2688.04	0	0	0	0	0	0	0	0	0
QC158VIR003	NA	1466.13	0	0	0	0	2	0	0	0	0
QC1558ARM001	NA	3418.83	0	0	0	0	1	0	0	0	0
ONLNC1DOM2	NA	3739.14	0	0	0	0	0	0	0	0	0
QC1572PUM001	NA	NA	0	1	0	0	0	0	0	0	0

ID_sample_jar	Estim. no. leaves with galls	Estimated LA (cm ²)	Erio Vagrant	Phyto/Pred	Tetra	Tenui	Tyde	Tarso	Astig	Orib	Other
QC15SAPA001	NA	2085,03	0	1	0	0	5	0	0	0	0
ON15BEA2DOM1	NA	3205,02	0	3	0	0	1	0	1	1	0
QC1563PAD001	NA	2832,15	0	4	0	0	6	0	0	0	0
ON15BEMC11AVI	NA	3488,03	0	0	0	0	1	0	0	0	0
QC1561CERASUS001	NA	2199,11	0	2	1	0	31	0	0	0	0
QC158SER002	NA	1220,84	0	0	0	0	2	0	0	0	0
QC1563NIG007	NA	2718,72	0	0	0	0	0	0	0	0	0
QC1565SER005	NA	2507,30	0	1	0	0	1	0	0	0	0
QC1561SER007	NA	1930,73	0	0	0	0	0	0	0	0	0
QC1571SER006	NA	2253,65	0	1	0	0	10	0	0	0	0
ON15BEMC3PER	NA	2924,82	0	0	0	0	0	0	0	0	0
QC1519NIG002	NA	3025,52	0	1	0	0	1	0	0	0	0
QC1544AME008	11,17	1701,23	0	1	0	0	6	0	0	0	0
ON15LNC1PER1	NA	2225,51	0	2	0	0	0	0	0	0	3
ON15FNK13AVI	NA	7204,15	0	2	0	0	2	0	0	0	0
QC1568AME005	NA	1592,92	0	0	0	0	4	0	0	0	0
ON15FNK1SER	NA	2246,18	0	3	0	0	7	0	0	0	0
ON15FNK22AVI	NA	6206,19	0	4	0	0	0	0	0	0	0
ON15BEMC16PER	NA	4338,52	0	0	0	0	0	0	0	0	0
ON15BEMC12AVI	NA	6025,23	0	0	2	0	0	0	0	0	0
QC15PUM010	97,33	702,09	210	5	0	0	4	0	0	0	0
QC1548AME002	NA	1206,80	3	0	0	0	1	0	0	0	0
QC1572VIR004	NA	8723,46	30	0	0	0	0	0	0	0	0
QC1552SUS001	NA	917,02	0	0	0	0	0	0	0	0	0
QC1579PEN005	NA	2266,34	0	0	1	0	11	0	0	0	0
ON15LNC1JAP1	NA	3645,51	0	1	0	0	0	0	0	0	0
NN15BEMC17A	NA	1630,98	0	5	0	0	0	0	0	0	0
QC1570NIG006	NA	2124,93	3	6	0	0	3	0	0	0	0
NN15FNKB12A	NA	3515,18	0	0	0	0	8	0	0	0	0
NN15FNKB16A	48,00	2631,18	101	1	0	0	9	1	0	0	0
QC1570VIR009	NA	1588,67	0	1	0	0	13	0	0	0	0

ID_sample_jar	Estim. no. leaves with galls	Estimated LA (cm²)	Erio Vagrant	Phyto/Pred	Tetra	Tenui	Tyde	Tarso	Astig	Orib	Other
QC1572SER003	NA	2417,47	0	0	0	0	0	0	0	0	0
QC1565VIR008	NA	2227,63	0	0	0	0	0	0	0	0	0
ON15BEA1VIR1	123,00	2029,52	1032	20	2	0	50	7	1	1	0
NN15BEMC15A	NA	2351,89	0	0	0	0	0	0	0	0	0
QC1552VIR007	NA	2367,94	0	2	0	0	1	0	0	0	0
QC1566VIR011	NA	NA	0	2	0	0	2	0	0	0	0
QC1568VIR012	NA	1090,18	0	0	0	0	9	0	0	0	0
QC1566PEN006	NA	2585,12	0	4	0	0	0	0	0	0	0
NN15FNKB13A	NA	1756,48	0	1	0	0	0	0	0	0	0
NN15NGA2VIR	NA	1219,38	0	0	0	0	5	0	0	0	0
NN15BEMC06A	NA	3303,37	0	0	0	0	1	0	0	0	0
QC1515AME001	16,00	2605,60	2	12	3	0	52	5	2	0	0
NN15FNKB17A	NA	2518,80	0	0	0	0	19	0	0	0	0
NN15BEMC7A	NA	1934,88	0	5	0	0	33	0	0	0	0
QC1515VIR001	NA	1611,22	1	1	0	0	171	3	0	0	0
NN15FNKB5A	NA	2427,49	0	0	0	0	3	0	0	0	0
NN15FNKB15A	NA	1523,61	0	0	0	0	0	0	0	0	0
NN15FNKB11A	NA	3701,00	0	1	0	0	12	0	0	0	0
NN15FNKB7A	NA	3332,35	7	0	1	0	0	1	0	0	0
QC1577AME006	NA	1772,82	0	1	0	0	2	0	0	0	0
NN15PT177SER	NA	2056,34	0	2	0	0	6	0	0	0	0
QC1548VIR006	NA	1816,82	0	2	0	0	7	0	0	0	0
QC1572NIG004	NA	2331,93	0	9	0	0	3	0	0	0	0
QC1569AME004	NA	1788,51	0	3	0	0	5	0	0	0	0
QC158NIG003	NA	2261,36	0	0	0	0	3	0	0	0	0
NN15FNKB14A	62,50	2834,17	24	2	0	0	2	1	0	0	0
QC1547NIG005	NA	3009,69	0	0	0	0	1	0	0	0	0
QC1519SER001	NA	1544,11	0	4	0	0	6	0	0	0	0
NN15FNK19A	NA	2898,59	0	0	0	0	0	0	0	0	0
QC1519PEN001	NA	1886,19	0	0	0	0	4	0	0	0	0

ID_sample_jar	Estim. no. leaves with galls	Estimated LA (cm²)	Erio Vagrant	Phyto/Pred	Tetra	Tenui	Tyde	Tarso	Astig	Orib	Other
QC1552SUS002	NA	1799,72	43	0	0	0	0	0	0	0	0
QC1566SER008	NA	1326,62	3	8	0	0	7	0	0	0	0
NN15BEMC2A	NA	1705,84	0	3	0	0	1	0	0	0	0
NN15FNKB10A	NA	1990,13	1	0	13	0	42	0	0	0	0
NN15FNKB6A	NA	4838,22	31	0	76	0	0	~10	0	0	0
NN15BEMC26A	NA	2880,88	0	0	0	0	0	0	0	0	0
QC1572VIR005	NA	2042,04	22	10	1	0	25	~10	1	0	0
NN15PEL1A	NA	1323,44	0	0	0	0	0	0	0	0	0
QC1519VIR002	NA	1839,66	0	6	1	0	20	0	0	0	0
QC1572SER004	NA	2957,77	0	4	1	0	8	1	0	0	0
QC1578AME003	NA	1256,26	111	18	2	0	0	0	0	0	30
NN15BEMC9A	NA	3228,19	1	2	0	0	52	1	0	0	0
QC1563VIR010	NA	1531,11	2	3	0	0	38	0	0	0	0
NN15PEL2A	NA	1528,75	2	0	0	0	0	0	0	0	0
NN15BEMC13A	NA	3250,90	0	0	0	0	1	0	0	0	0
NN15FNKB9A	NA	2415,19	0	0	0	0	1	0	0	0	0
NN15PEL04A	NA	NA	500	3	0	0	14	0	0	0	0
QC1524FPA001	NA	2811,94	3	34	0	0	76	1	1	0	0
QC1524FVIR001	NA	4256,59	3	17	0	0	38	3	2	0	0
QC1576FPA002	NA	1435,74	0	3	0	0	5	0	0	0	0
QC1576FVIR002	NA	2672,22	2	8	0	0	90	7	0	1	0
QC1523FAME001	NA	2186,77	0	13	0	0	5	0	0	0	0
QC1523FNIG001	NA	3144,48	8	10	0	0	93	0	0	0	0
QC1523FVIR003	NA	2983,14	14	1	0	0	0	1	0	0	0
QC1575FPUM001	NA	1518,39	0	1	0	0	4	0	0	0	0
QC1575FVIR004	NA	2863,64	14	5	0	0	37	4	0	0	0
QC1567FSER001	NA	3093,15	0	34	0	0	15	7	0	1	0

ID_sample_jar	Estim. no. leaves with galls	Estimated LA (cm ²)	Erio Vagrant	Phyto/Pred	Tetra	Tenui	Tyde	Tarso	Astig	Orib	Other
QC1567FVIR005	NA	1759,37	0	3	0	0	11	6	0	0	0
QC1567FNIG002	NA	2563,43	1	16	7	0	11	6	0	0	0
QC1520FNIG003	NA	1970,56	12	16	12	0	38	0	6	0	0
QC1520FSER002	NA	1736,15	11	1	0	0	67	10	0	0	0
QC1520FVIR006	NA	1710,21	0	0	0	0	0	0	0	0	0
QC15(17)PAD003	NA	2437,44	0	4	0	0	6	0	0	0	0
QC1518FNIG004	NA	1841,09	0	1	0	0	53	5	0	0	0
QC1518FSER003	NA	2101,97	3	1	0	0	87	9	16	0	0
QC1518FVIR007	NA	1939,03	12	1	0	0	9	3	0	0	0
QC1518FAME002	NA	1720,69	0	5	0	0	16	0	1	0	0
QC1516FAME003	NA	1363,73	5	6	0	0	148	1	0	0	0
QC1516FVIR008	NA	1502,21	8	6	0	0	99	2	1	0	0
QC155FSER005	NA	2397,10	0	2	0	0	51	6	0	0	0
QC155FNIG005	NA	1940,37	0	2	0	0	9	0	0	0	0
QC155FVIR009	NA	1670,92	0	1	0	0	16	4	0	0	0
QC1512FPEN001	NA	1155,50	0	0	11	0	13	2	0	0	0
QC156FSER006	NA	2075,82	12	17	0	0	5	37	0	0	0
QC156FNIG006	NA	2105,53	34	33	0	0	23	25	0	0	0
QC156FPEN002	NA	1240,13	0	1	0	0	0	0	0	0	0
QC152FVIR010	NA	2069,84	0	12	2	0	206	7	0	1	0
QC1582FVIR011	NA	1093,79	5	0	0	0	2	0	0	0	0
QC1582FPUM002	NA	912,31	17	0	0	0	2	0	0	1	0
QC1582FPEN003	NA	1584,51	40	3	0	0	2	27	0	0	0
QC15(83)FAME004	NA	1312,22	0	1	0	0	2	0	0	0	0
QC15(83)FVIR012	NA	2072,55	56	2	0	0	9	3	0	0	0
QC15(84)FVIR013	NA	1624,92	0	0	0	0	0	0	0	0	0
QC15(84)FPEN004	NA	1124,22	48	4	0	0	0	0	0	0	0
QC15(85)FSUS001	NA	1222,37	0	0	0	0	0	0	0	0	0
QC15(86)FPEN005	NA	2384,66	0	4	0	0	0	0	0	0	0
QC15(86)FSER007	NA	2198,05	51	2	0	0	4	4	0	0	0

ID_sample_jar	Estim. no. leaves with galls	Estimated LA (cm²)	Erio Vagrant	Phyto/Pred	Tetra	Tenui	Tyde	Tarso	Astiq	Orib	Other
QC15(86)FSUS002	NA	912,12	0	1	0	0	0	0	0	0	0
QC15(86)FVIR014	NA	1258,52	5	10	0	0	4	1	0	0	0
QC15FAME005	NA	1447,87	100	25	0	0	18	1	0	0	0
QC15FPEN006	NA	1632,00	0	0	0	0	0	0	0	0	0
QC15FVIR015	NA	1767,96	1	3	0	0	33	3	0	0	0
QC15FPEN007	NA	1590,35	18	0	0	0	15	3	0	0	0
QC1596F	NA	1198,82	0	0	0	0	0	0	0	0	0
QC1597F	NA	1181,77	0	1	0	0	2	0	0	0	0
QC1598F	NA	711,41	0	1	0	0	2	0	0	0	0
QC1599F	NA	794,03	0	0	0	0	0	0	0	0	0
QC15100F	NA	537,70	0	0	0	0	0	0	0	0	0
QC15102FPEN008	NA	1148,57	16	3	0	0	0	29	0	0	0
QC15102FVIR016	NA	907,46	0	1	0	0	1	6	0	0	0
QC15102FSUS003	NA	1471,46	1	0	0	0	1	11	0	0	0
QC15103FPUM003	NA	848,34	0	0	0	0	0	0	0	0	0
QC1546FAME006	NA	1987,20	0	29	0	0	1	0	0	0	0
QC1545FVIR017	NA	1057,75	270	1	0	0	20	1	0	0	0
QC1543FNIG007	NA	1893,00	0	7	224	0	1298	3	5	0	0
QC1545FPEN009	NA	1559,68	0	4	11	0	7	3	0	0	0
QC1531FSER008	NA	1188,27	36	27	1	0	57	1	0	0	0
QC1531FVIR018	NA	1924,88	0	15	0	1	2	0	0	0	0
QC1534FVIR019	NA	2313,27	3	8	0	0	7	0	0	0	1
QC1534FSER009	NA	1601,42	0	2	0	0	28	1	0	0	0
QC1521FNIG008	NA	1905,18	0	14	1	0	4	4	0	0	0
QC1521FPEN010	NA	1704,43	0	0	0	0	0	0	0	0	0
QC1521FAME007	NA	816,50	82	34	1	0	36	1	9	0	0
QC1521FVIR020	NA	2293,55	23	2	0	0	40	6	0	0	0
QC1573FAME008	NA	2399,02	0	14	0	0	52	1	0	0	0
QC1553FSER010	NA	1344,68	0	5	0	0	9	0	1	0	0
QC1553FVIR021	NA	2554,12	0	13	1	0	12	5	0	0	0
QC1550FSER011	NA	1686,07	18	6	1	0	15	3	0	1	0

ID_sample_jar	Estim. no. leaves with galls	Estimated LA (cm ²)	<u>Erio</u> <u>Vagrant</u>	<u>Phyto/Pred</u>	<u>Tetra</u>	<u>Tenui</u>	<u>Tyde</u>	<u>Tarso</u>	<u>Astiq</u>	<u>Orib</u>	<u>Other</u>
QC1550FAME009	NA	1986,32	6	4	13	0	71	26	37	0	0
QC1550FVIR022	NA	1897,46	0	6	0	0	13	0	0	0	0
QC1525FAME010	NA	2678,08	5	2	0	0	30	2	0	0	0
QC153FVIR023	NA	1363,74	40	1	0	0	15	1	0	0	0
QC153FPEN011	NA	1302,66	0	0	0	0	71	3	0	0	0
QC153FNIG009	NA	1975,53	48	15	2	0	43	38	1	0	0
QC28FPAD004	NA	2665,18	0	6	0	0	6	0	0	0	0
QC1528FVIR024	NA	2693,88	1	26	0	0	382	0	0	0	0
QC1528FMUN001	NA	2920,63	3	45	0	0	10	0	12	0	0
NN15PRC21A	NA	1845,36	1	0	0	0	5	0	0	2	0
QC1528FAME011	NA	2066,03	28	7	3	0	4	8	0	1	0
QC1528FSER012	NA	2526,795	0	8	0	0	36	0	0	13	0

APPENDIX 2

id	sp	Erio	gall_pos	sole_stipe	sole_tete	dens_tr	lg_base	lg_end	wd_base	wd_narr	wd_larg_top	largest_wd	aspect	ostia_wd	ostia_lg	lips	ostia_op_clo	i
QC1524FVIR001G1	Pyrginiana	E.emarginatae	0	0	0	NA	0.195	0.915	0.422	0.292	0.590	0.381	180.000	0.312	0.261	0	0	0
QC1524FVIR001G2	Pyrginiana	E.emarginatae	0	0	0	NA	0.330	1.777	0.697	0.352	0.870	1.269	180.000	0.807	0.712	0	0	0
QC1524FVIR001G3	Pyrginiana	E.emarginatae	0	0	0	NA	0.443	1.378	0.545	0.426	0.601	0.426	138.399	0.326	0.254	0	0	0
QC1524FVIR001G4	Pyrginiana	E.emarginatae	0	0	0	NA	0.633	1.968	0.732	0.354	0.591	1.450	153.424	2.381	1.643	0	0	0
QC1524FVIR001G5	Pyrginiana	E.emarginatae	0	0	0	NA	0.317	1.570	0.565	0.304	0.553	1.684	129.186	0.324	0.293	0	1	0
QC1524FVIR001G6	Pyrginiana	E.emarginatae	0	1	0	0	0.647	2.039	1.116	0.268	0.432	1.717	141.596	0.348	0.279	0	0	0
QC1523FVIR003G1	Pyrginiana	E.emarginatae	0	0	0	NA	0.579	2.477	0.763	0.281	0.711	1.097	92.610	1.748	0.719	0	0	0
QC1523FVIR003G2	Pyrginiana	E.emarginatae	0	0	0	NA	0.106	1.206	0.568	0.380	0.658	0.646	149.594	0.365	0.256	0	0	0
QC1523FVIR003G3	Pyrginiana	E.emarginatae	0	0	0	NA	0.373	2.052	0.596	0.310	0.498	0.418	93.825	0.427	0.406	0	1	0
QC1523FVIR003G4	Pyrginiana	E.emarginatae	0	0	0	NA	0.109	0.873	0.440	0.427	0.582	0.136	163.051	0.326	0.203	0	0	0
QC1523FVIR003G5	Pyrginiana	E.emarginatae	0	0	0	NA	0.274	1.353	0.572	0.289	0.590	0.308	90.500	0.305	0.155	0	0	0
QC1523FVIR003G6	Pyrginiana	E.emarginatae	0	0	0	NA	0.213	0.659	0.239	0.239	0.630	0.242	140.079	0.435	0.214	0	0	0
QC1575FVIR004G1	Pyrginiana	E.emarginatae	0	0	0	NA	0.493	1.742	0.442	0.292	0.638	0.908	128.820	2.122	0.926	0	0	0
QC1575FVIR004G2	Pyrginiana	E.emarginatae	0	0	0	NA	0.315	1.542	0.382	0.279	0.450	1.268	136.654	0.277	0.218	0	0	0
QC1575FVIR004G3	Pyrginiana	E.emarginatae	0	0	0	NA	0.350	1.888	0.496	0.260	0.500	1.442	132.151	0.282	0.170	0	0	0
QC1575FVIR004G4	Pyrginiana	E.emarginatae	0	0	0	NA	0.377	2.257	0.706	0.384	0.511	0.252	129.947	0.443	0.177	0	1	0
QC1575FVIR004G5	Pyrginiana	E.emarginatae	0	0	0	NA	0.267	1.866	0.723	0.295	0.417	1.559	155.582	0.250	0.168	0	0	0
QC1575FVIR004G6	Pyrginiana	E.emarginatae	0	0	0	NA	0.070	0.552	0.467	0.337	0.517	0.170	180.000	0.350	0.162	1	0	0
QC1518FVIR007G1	Pyrginiana	E.emarginatae	0	0	0	NA	0.541	1.242	0.493	0.247	0.385	0.615	136.584	0.252	0.196	0	0	0
QC1518FVIR007G2	Pyrginiana	E.emarginatae	0	0	0	NA	0.416	1.541	0.366	0.283	0.486	1.717	129.016	0.272	0.171	0	0	0
QC1518FVIR007G3	Pyrginiana	E.emarginatae	0	0	0	NA	0.464	2.309	0.597	0.283	0.486	1.853	129.016	0.268	0.188	0	1	0
QC1518FVIR007G4	Pyrginiana	E.emarginatae	0	1	0	0	0.349	1.424	0.436	0.252	0.515	0.695	153.567	0.254	0.169	0	0	2
QC1518FVIR007G5	Pyrginiana	E.emarginatae	0	0	0	NA	0.442	0.820	0.703	0.443	0.359	0.231	180.000	0.476	0.216	0	0	0
QC1518FVIR007G6	Pyrginiana	E.emarginatae	0	0	0	NA	0.153	1.051	0.384	0.290	0.430	0.525	111.936	0.997	0.835	0	0	2
QC1516FVIR008G1	Pyrginiana	E.emarginatae	0	0	0	NA	0.389	1.675	0.549	0.322	0.540	0.352	100.546	0.554	0.505	0	0	0
QC1516FVIR008G2	Pyrginiana	E.emarginatae	0	1	0	0	0.340	1.543	0.545	0.314	0.489	0.462	134.944	0.252	0.131	0	0	2
QC1516FVIR008G3	Pyrginiana	E.emarginatae	0	0	0	NA	0.261	1.720	0.612	0.321	0.495	0.788	146.134	0.337	0.192	1	0	1
QC1516FVIR008G4	Pyrginiana	E.emarginatae	0	0	0	NA	0.193	0.595	0.714	0.297	0.347	0.273	168.586	0.241	0.190	0	0	1
QC1516FVIR008G5	Pyrginiana	E.emarginatae	0	1	0	0	0.119	0.845	0.493	0.354	0.631	0.398	97.131	0.295	0.116	1	0	1
QC1516FVIR008G6	Pyrginiana	E.emarginatae	0	1	0	0	0.530	1.371	0.413	0.413	0.483	0.602	160.862	0.335	0.190	0	0	1
QC1582FVIR111G1	Pyrginiana	E.emarginatae	0	1	1	0	0.319	1.721	0.246	0.246	0.407	1.344	131.582	0.331	0.145	0	0	1
QC1582FVIR111G3	Pyrginiana	E.emarginatae	0	1	0	0	0.252	0.774	0.292	0.260	0.257	0.062	115.260	0.277	0.115	0	0	0
QC1582FVIR111G4	Pyrginiana	E.emarginatae	0	1	0	0	0.416	2.020	0.237	0.237	0.552	1.216	92.212	0.356	0.213	0	0	2
QC1582FVIR111G5	Pyrginiana	E.emarginatae	0	0	0	NA	0.034	0.498	0.251	0.353	0.353	0.309	180.000	0.220	0.207	0	0	1
QC1582FVIR111G6	Pyrginiana	E.emarginatae	0	0	0	NA	0.260	0.783	0.413	0.330	0.454	0.279	149.088	0.252	0.210	0	0	1
QC15(83)FVIR112G1	Pyrginiana	E.emarginatae	0	0	1	0	0.476	1.711	0.434	0.434	0.549	0.403	152.594	0.200	0.113	1	0	2
QC15(83)FVIR112G2	Pyrginiana	E.emarginatae	0	1	0	0	0.382	1.547	0.558	0.288	0.539	0.770	142.256	0.194	0.131	1	0	1
QC15(83)FVIR112G3	Pyrginiana	E.emarginatae	0	0	1	0	0.277	1.365	0.289	0.289	0.517	0.520	120.828	0.167	0.218	0	0	2
QC15(83)FVIR112G4	Pyrginiana	E.emarginatae	0	1	0	0	0.273	1.319	0.366	0.366	0.491	0.931	144.004	0.535	0.524	1	0	1
QC15(83)FVIR112G5	Pyrginiana	E.emarginatae	1	1	1	0	0.271	1.062	0.351	0.351	0.518	0.286	139.262	0.244	0.225	0	0	1
QC15(83)FVIR112G6	Pyrginiana	E.emarginatae	0	1	1	0	0.251	1.833	0.270	0.260	0.491	0.536	165.746	0.188	0.113	0	0	2

id	sp	Erio	gall_pos	sole_stipe	sole_tete	dens_tr	lg_base	lg_end	wd_base	wd_narr	wd_larg_top	largest_wd	aspect	ostia_wd	ostia_lg	lips	ostia_op_clo	tc
QC15(86)FVIR14G1	Pyrginiana	E.emarginatae	0	0	0	NA	0.264	1.244	0.505	0.343	0.452	0.468	130.602	0.136	0.099	0	0	0
QC15(86)FVIR14G2	Pyrginiana	E.emarginatae	0	1	0	0	0.387	1.992	0.391	0.224	0.501	0.846	145.803	0.253	0.154	0	0	0
QC15(86)FVIR14G3	Pyrginiana	E.emarginatae	0	1	0	0	0.578	1.710	0.391	0.321	0.451	1.318	132.225	0.351	0.057	1	0	1
QC15(86)FVIR14G4	Pyrginiana	E.emarginatae	0	1	1	0	0.378	1.333	0.469	0.292	0.503	0.652	129.341	0.312	0.107	0	0	0
QC15(86)FVIR14G5	Pyrginiana	E.emarginatae	0	1	1	0	0.241	1.273	0.346	0.279	0.466	0.673	164.634	0.264	0.113	0	0	2
QC15(86)FVIR14G6	Pyrginiana	E.emarginatae	0	0	0	NA	0.249	0.939	0.431	0.298	0.485	0.223	122.707	0.280	0.179	0	0	0
QC15FAME005G1	Pameriana	E.cerasicumena	1	0	0	NA	1.429	4.595	0.454	0.308	1.189	2.257	141.231	0.391	0.282	0	0	2
QC15FAME005G2	Pameriana	E.cerasicumena	1	1	1	0	1.510	5.083	0.511	0.319	0.863	1.107	157.654	0.469	0.187	0	0	1
QC15FAME005G3	Pameriana	E.cerasicumena	1	1	1	0	1.574	5.703	0.960	0.254	0.956	3.863	147.547	0.328	0.291	0	0	1
QC15FAME005G4	Pameriana	E.cerasicumena	1	0	0	NA	0.728	4.170	0.537	0.366	1.372	3.425	112.562	0.285	0.315	0	0	1
QC15FAME005G5	Pameriana	E.cerasicumena	1	1	0	0	1.232	6.719	0.535	0.334	0.951	4.615	111.188	0.374	0.204	0	0	1
QC15FAME005G6	Pameriana	E.cerasicumena	1	1	0	0	1.172	4.954	0.537	0.351	0.958	0.659	167.412	0.482	0.406	0	0	2
QC1521FAME007G1	Pameriana	E.emarginatae	0	0	1	0	0.141	1.742	0.272	0.259	0.421	0.848	145.117	0.253	0.151	1	0	1
QC1521FAME007G2	Pameriana	E.emarginatae	0	0	1	0	0.128	1.909	0.292	0.284	0.529	0.923	152.875	0.282	0.270	0	0	1
QC1521FAME007G3	Pameriana	E.emarginatae	0	0	1	0	0.191	1.426	0.344	0.298	0.505	0.900	128.151	0.242	0.180	0	0	1
QC1521FAME007G4	Pameriana	E.emarginatae	0	1	0	0	0.209	1.572	0.420	0.316	0.442	0.873	167.222	0.260	0.224	0	0	1
QC1521FAME007G5	Pameriana	E.emarginatae	0	0	1	0	0.172	1.505	0.528	0.431	0.459	0.622	143.527	0.341	0.277	0	0	1
QC1521FAME007G6	Pameriana	E.emarginatae	0	0	1	0	0.498	1.917	0.431	0.339	0.634	0.821	165.996	0.528	0.401	0	0	1
QC1521FAME007G7	Pameriana	E.cerasicumena	1	1	0	0	2.474	7.770	0.846	0.378	1.006	4.273	111.648	0.985	0.193	0	0	1
QC1521FAME007G8	Pameriana	E.cerasicumena	1	0	0	NA	1.806	6.993	0.976	0.429	1.306	1.037	46.452	0.620	0.160	0	0	1
QC1521FAME007G9	Pameriana	E.cerasicumena	1	1	1	0	3.114	7.885	1.142	0.301	1.031	5.411	122.605	1.013	0.410	0	0	2
QC1521FAME007G10	Pameriana	E.cerasicumena	1	1	0	0	1.844	7.775	0.600	0.362	0.897	2.225	146.601	0.632	0.136	0	0	0
QC1521FAME007G11	Pameriana	E.cerasicumena	1	1	1	0	2.317	5.451	0.565	0.313	1.091	3.527	139.104	0.570	0.221	0	0	1
QC1521FAME007G12	Pameriana	E.cerasicumena	1	1	1	0	1.070	7.869	0.976	0.548	1.232	2.783	40.174	1.291	0.247	0	0	2
QC1521FVIR020G1	Pyrginiana	E.emarginatae	0	0	0	NA	0.604	1.888	0.758	0.366	0.678	0.696	150.352	0.470	0.184	0	0	0
QC1521FVIR020G2	Pyrginiana	E.emarginatae	0	0	1	0	0.432	1.311	0.361	0.272	0.457	1.196	136.738	0.258	0.100	1	0	2
QC1521FVIR020G3	Pyrginiana	E.emarginatae	0	1	0	0	0.369	0.877	0.331	0.299	0.562	0.582	156.630	0.176	0.138	1	0	2
QC1521FVIR020G4	Pyrginiana	E.emarginatae	0	1	0	0	0.453	1.958	0.576	0.374	0.569	1.294	151.319	0.320	0.182	0	0	0
QC1521FVIR020G5	Pyrginiana	E.emarginatae	0	1	0	0	0.102	1.261	0.650	0.376	0.655	0.587	123.017	0.287	0.187	0	0	2
QC1521FVIR020G6	Pyrginiana	E.emarginatae	0	0	1	0	0.191	0.805	0.462	0.393	0.376	0.459	144.697	0.528	0.327	0	0	1
QC1553FVIR021G1	Pyrginiana	E.emarginatae	0	0	0	NA	0.491	1.074	0.528	0.323	0.546	0.635	131.230	0.271	0.214	0	0	0
QC1553FVIR021G2	Pyrginiana	E.emarginatae	0	0	NA	0	0.077	0.370	0.493	0.296	0.515	0.131	304.000	0.095	0.095	0	0	1
QC1553FVIR021G3	Pyrginiana	E.emarginatae	0	0	0	NA	0.384	0.945	0.360	0.205	0.454	0.607	140.801	0.199	0.090	0	0	0
QC1553FVIR021G4	Pyrginiana	E.emarginatae	0	0	0	NA	0.072	1.802	0.305	0.275	0.325	0.780	146.464	0.171	0.137	0	0	1
QC1553FVIR021G5	Pyrginiana	E.emarginatae	0	0	0	NA	0.232	0.942	0.380	0.281	0.335	0.244	142.242	0.363	0.092	0	0	2
QC1553FVIR021G6	Pyrginiana	E.emarginatae	0	0	0	NA	0.127	0.755	0.326	0.326	0.581	0.034	136.506	0.298	0.029	1	0	0
QC1525FAME010G1	Pameriana	E.cerasicumena	1	1	1	0	0.755	3.755	0.511	0.455	1.003	1.890	154.250	0.818	0.358	0	0	1
QC1525FAME010G2	Pameriana	E.cerasicumena	1	0	0	NA	0.989	0.813	0.330	0.280	2.589	1.100	241.873	0.416	0.183	0	0	1
QC1525FAME010G3	Pameriana	E.cerasicumena	1	0	0	NA	1.416	5.220	0.687	0.351	0.183	3.778	25.311	0.656	0.255	0	0	0
QC1525FAME010G4	Pameriana	E.cerasicumena	1	1	1	0	0.839	4.064	0.785	0.516	0.976	2.996	32.496	0.470	0.452	0	0	0
QC1525FAME010G5	Pameriana	E.cerasicumena	1	1	1	0	0.757	3.432	0.767	0.587	1.208	2.993	151.816	1.134	0.370	0	0	1

id	sp	Erio	gall_pos	sole_stipe	sole_tete	dens_tr	lg_base	lg_end	wd_base	wd_narr	wd_larg_top	largest_wd	aspect	ostia_wd	ostia_lg	lips_ostia_op_clo	t
G2016G1	Pserotina	E.cerascurumena	0	0	0	NA	2,480	3,657	1,157	0,529	1,315	2,103	116,854	0,487	0,311	0	0
G2016G2	Pserotina	E.cerascurumena	0	0	0	NA	2,955	3,720	1,625	0,786	2,139	2,641	125,824	0,646	0,543	0	0
G2016G3	Pserotina	E.cerascurumena	0	0	0	NA	3,198	4,497	1,167	0,512	1,406	2,315	107,652	1,332	0,835	0	0
G2016G4	Pserotina	E.cerascurumena	0	0	0	NA	3,183	4,536	1,010	0,776	1,985	2,060	138,598	0,869	0,325	1	0
G2016G5	Pserotina	E.cerascurumena	0	0	0	NA	1,632	4,009	0,749	0,552	1,367	1,198	173,258	0,868	0,338	0	0

id	total_lg	mean_trgall	mean_trostia	ratio_ostia	Interior	thick
QC1524FVIR001G1	1,11	NA	0,087	1	0	0,056
QC1524FVIR001G2	2,107	NA	0,147	1	0	0,056
QC1524FVIR001G3	1,821	NA	0,141	1	0	0,056
QC1524FVIR001G4	2,601	NA	0,356	1	0	0,056
QC1524FVIR001G5	1,887	NA	0,063	1	0	0,056
QC1524FVIR001G6	2,686	NA	NA	1	0	0,056
QC1523FVIR003G1	3,056	NA	0,431	2	0	0,066
QC1523FVIR003G2	1,312	NA	0,042	1	0	0,066
QC1523FVIR003G3	2,425	NA	0,056	1	0	0,066
QC1523FVIR003G4	0,982	NA	NA	2	0	0,066
QC1523FVIR003G5	1,627	NA	0,044	2	0	0,066
QC1523FVIR003G6	0,872	NA	0,060	2	0	0,066
QC1575FVIR004G1	2,235	NA	0,346	2	0	0,067
QC1575FVIR004G2	1,857	NA	0,057	1	0	0,067
QC1575FVIR004G3	2,238	NA	0,065	2	0	0,067
QC1575FVIR004G4	2,634	NA	0,102	3	0	0,067
QC1575FVIR004G5	2,133	NA	NA	1	0	0,067
QC1575FVIR004G6	0,622	NA	0,068	2	0	0,067
QC1518FVIR007G1	1,783	NA	0,060	1	0	0,043
QC1518FVIR007G2	2,846	0,031	0,061	2	0	0,043
QC1518FVIR007G3	2,773	NA	0,052	1	0	0,043
QC1518FVIR007G4	1,773	0,048	NA	2	0	0,043
QC1518FVIR007G5	1,262	NA	0,057	2	0	0,043
QC1518FVIR007G6	1,204	NA	0,819	1	0	0,043
QC1516FVIR008G1	2,064	NA	NA	1	0	0,094
QC1516FVIR008G2	1,883	0,098	0,107	2	0	0,094
QC1516FVIR008G3	1,981	NA	0,128	2	0	0,094
QC1516FVIR008G4	0,788	NA	0,106	1	0	0,094
QC1516FVIR008G5	0,964	0,041	0,133	3	0	0,094
QC1516FVIR008G6	1,901	0,185	0,233	2	0	0,094
QC1582FVIR011G1	2,04	0,060	0,154	2	0	0,088
QC1582FVIR011G3	1,026	0,030	0,068	2	0	0,088
QC1582FVIR011G4	2,436	0,102	0,115	2	0	0,088
QC1582FVIR011G5	0,532	NA	0,178	1	0	0,088
QC1582FVIR011G6	1,043	NA	0,124	1	0	0,088
QC15(83)FVIR012G1	2,187	0,166	0,119	2	0	0,057
QC15(83)FVIR012G2	1,929	0,099	0,171	1	0	0,057
QC15(83)FVIR012G3	1,642	0,113	0,153	1	0	0,057
QC15(83)FVIR012G4	1,592	0,162	0,118	1	0	0,057
QC15(83)FVIR012G5	1,333	0,130	0,087	1	0	0,057
QC15(83)FVIR012G6	2,084	0,131	NA	2	0	0,057

id	total_lg	mean_trgall	mean_trostia	ratio_ostia	Interior	thick
QC15(86)FVIR014G1	1,508	NA	NA	1	0	0,045
QC15(86)FVIR014G2	2,379	NA	NA	2	0	0,045
QC15(86)FVIR014G3	2,288	0,033	NA	6	0	0,045
QC15(86)FVIR014G4	1,711	0,065	NA	3	0	0,045
QC15(86)FVIR014G5	1,514	0,049	NA	2	0	0,045
QC15(86)FVIR014G6	1,188	NA	0,090	2	0	0,045
QC15FAME005G1	6,024	NA	0,072	1	1	0,181
QC15FAME005G2	6,593	0,202	0,145	3	1	0,181
QC15FAME005G3	7,277	NA	NA	1	1	0,181
QC15FAME005G4	4,898	NA	0,140	1	1	0,181
QC15FAME005G5	7,951	NA	NA	2	1	0,181
QC15FAME005G6	6,126	NA	NA	1	1	0,181
QC1521FAME007G1	1,883	NA	NA	2	0	0,128
QC1521FAME007G2	2,037	0,132	NA	1	0	0,128
QC1521FAME007G3	1,617	0,109	NA	1	0	0,128
QC1521FAME007G4	1,781	0,126	NA	1	0	0,128
QC1521FAME007G5	1,677	0,094	NA	1	0	0,128
QC1521FAME007G6	2,415	0,274	0,235	1	0	0,128
QC1521FAME007G7	10,244	0,168	NA	5	1	0,155
QC1521FAME007G8	8,799	NA	NA	4	1	0,155
QC1521FAME007G9	10,999	0,275	0,192	2	1	0,155
QC1521FAME007G10	9,619	NA	0,119	5	1	0,155
QC1521FAME007G11	7,768	0,201	0,186	3	1	0,155
QC1521FAME007G12	8,939	NA	NA	5	1	0,155
QC1521FVIR020G1	2,492	NA	0,066	3	0	0,053
QC1521FVIR020G2	1,743	NA	0,094	3	0	0,053
QC1521FVIR020G3	1,246	0,050	0,127	1	0	0,053
QC1521FVIR020G4	2,411	0,033	0,070	2	0	0,053
QC1521FVIR020G5	2,273	0,037	0,087	2	0	0,053
QC1521FVIR020G6	0,996	0,051	0,074	2	0	0,053
QC1553FVIR021G1	1,565	NA	0,073	1	0	0,044
QC1553FVIR021G2	2,398	NA	0,099	2	0	0,044
QC1553FVIR021G3	1,329	NA	0,056	2	0	0,044
QC1553FVIR021G4	1,874	NA	0,055	1	0	0,044
QC1553FVIR021G5	1,174	NA	0,095	4	0	0,044
QC1553FVIR021G6	0,882	NA	0,068	10	0	0,044
QC1525FAME010G1	4,51	0,220	NA	2	1	0,188
QC1525FAME010G2	3,609	NA	0,244	2	1	0,188
QC1525FAME010G3	6,636	0,218	0,115	3	1	0,188
QC1525FAME010G4	4,903	0,118	0,118	1	1	0,188
QC1525FAME010G5	4,189	0,232	0,136	3	1	0,188

<u>id</u>	<u>total_lg</u>	<u>mean_trgall</u>	<u>mean_trostia</u>	<u>ratio_ostia</u>	<u>Interior</u>	<u>thick</u>
QC1525FAME010G6	5,474	0,117	0,154	1	1	0,188
QC1528FAME011G1	4,691	NA	0,148	1	1	0,096
QC1528FAME011G2	4,571	NA	0,215	3	1	0,096
QC1528FAME011G3	4,608	NA	NA	1	1	0,096
QC1528FAME011G4	5,001	0,134	NA	2	1	0,096
QC1528FAME011G5	5,5	NA	NA	1	1	0,096
QC1528FAME011G6	3,574	0,195	0,115	1	1	0,096
QC15PUM010G1	3,104	NA	NA	3	0	0,168
QC15PUM010G2	3,902	NA	NA	2	0	0,168
QC15PUM010G3	2,759	NA	0,077	1	0	0,168
QC15PUM010G4	4,035	NA	NA	1	0	0,168
QC15PUM010G5	4,191	NA	0,140	2	0	0,168
QC15PUM010G6	3,297	NA	NA	2	0	0,168
QC1548AME002G1	2,086	NA	0,237	1	0	0,152
QC1572VIR004G1	3,504	NA	0,327	2	0	0,053
QC1572VIR004G2	3,471	NA	NA	1	0	0,053
QC1570NIG006G1	4,073	NA	0,131	1	0	0,095
QC1570NIG006G2	3,933	NA	0,165	1	0	0,095
QC1570NIG006G3	3,597	NA	0,154	1	0	0,095
QC1570NIG006G4	5,255	NA	0,266	1	0	0,095
NN15FNKB16AG1	4,841	NA	NA	1	1	0,053
NN15FNKB16AG2	6,198	NA	NA	1	1	0,053
NN15FNKB16AG3	4,326	NA	NA	1	1	0,053
NN15FNKB16AG4	4,383	NA	NA	1	1	0,053
NN15FNKB16AG5	3,613	NA	NA	1	1	0,053
QC1577AME006G1	11,037	NA	0,140	2	1	0,163
QC1577AME006G2	10,598	NA	0,179	2	1	0,163
QC1577AME006G3	14,533	NA	0,132	2	1	0,163
QC1577AME006G4	10,022	NA	NA	3	1	0,163
QC1577AME006G5	7,687	NA	NA	1	1	0,163
QC1577AME006G6	10,749	NA	NA	1	1	0,163
NN15FNKB14AG1	8,909	NA	NA	1	1	0,294
NN15FNKB14AG2	4,233	NA	NA	4	1	0,294
NN15FNKB14AG3	7,972	NA	NA	2	1	0,294
NN15FNKB14AG4	8,292	NA	NA	2	1	0,294
NN15FNKB14AG5	7,938	NA	NA	1	1	0,294
NN15FNKB14AG6	7,375	NA	NA	2	1	0,294
QC1552SUS002G1	4,786	NA	0,093	1	0	0,142
QC1552SUS002G2	4,6	NA	0,122	2	0	0,142
QC1552SUS002G3	4,272	NA	0,128	2	0	0,142
QC1515AME001G1	7,886	NA	NA	3	1	0,294

<u>id</u>	<u>total_lg</u>	<u>mean_trgall</u>	<u>mean_trostia</u>	<u>ratio_ostia</u>	<u>Interior</u>	<u>thick</u>
G2016G1	7,886	NA	NA	3	1	0,406
G2016G2	6,137	NA	NA	2	1	0,406
G2016G3	6,675	NA	NA	1	1	0,406
G2016G4	7,695	NA	NA	2	1	0,406
G2016G5	7,719	NA	NA	3	1	0,406

APPENDIX 3

Measurements of the *Eriophyes* spp.

Genus	Species	sample # (or NIS)	their sample #	Day	Month	L idiosoma (prodorsum-tip)	W idiosoma	Prod. L (unc lobe)	Prod. W	frontal lobe L	frontal lobe W	sc (s.d.)	sc-sc D (setal base-base)	gnathos. L (from molivator base)	palpcoxal (ep)	cheliceral stylet	palptarsal apical v seta	L flap post. marg TO postgen plate post margin	W (from 200x)	No. ridges on gen. flap
Eriophyes	cerasicrumena	FNKB14A Garon-Labrecque_sld2				236.5		42				11	20							smooth
Eriophyes	cerasicrumena	qc1515ame001 Garon-Labrecque_sld3				242.7		41				12	23							smooth
Eriophyes	cerasicrumena	qc20fser002 Garon-Labrecque_sld4				112.3	47	31				19	19							2 oblique lines
Eriophyes	cerasicrumena	qc31fser008 Garon-Labrecque_sld3				127.4		38				19	20							1 crescentric, 2 oblique
Eriophyes	cerasicrumena	28fame011 Garon-Labrecque_sld3				178.3		37				16	22							2 curved lines at bottom
Eriophyes	cerasicrumena	21fnig008 Garon-Labrecque_sld3				152	71	37	50			13	16	19.56	na	16.23	na	1.113	23	smooth, lines at base
Eriophyes	cerasicrumena	qc1577ame006 Garon-Labrecque_sld3						40				15	19	17.42	3	15.765	3.67	5.822	23	smooth
Eriophyes	cerasicrumena	qc1521fnig008 Garon-Labrecque_sld3				154.9	60	34	57			13	17	12.7	2.5	na	na	2.925	23	smooth
Eriophyes	cerasicrumena	onFNKB14As4												17.06	1.8	13.474		2.33	27	
Eriophyes	cerasicrumena	44ame008 Garon-Labrecque_sld2				267.5	80	45	53	7.6		19	23	16.37	2.8	13.514	3.8	2.835	26	with a curved line at bott
Eriophyes	emarginatae	qc1548ame002 Garon-Labrecque_sld3				232.2						11	21	20.17	2.9	11.676	6.35	3.721	23	0
Eriophyes	emarginatae	qc1572vir005 Garon-Labrecque_sld12				250.4		42				8.3	?	19.49		11.36	6.06	5.269	25	0
Eriophyes	emarginatae	qc1570nig006 Garon-Labrecque_sld4				240.3	78.82	40	59			12	22	16.85	3.8	13.265	4.32	1.903	27	0
Eriophyes	emarginatae	qc1582fvir011 Garon-Labrecque_sld1				237.3	74.61	37	64			13	19	18.56	4.3	13.699	na	4.872	22	0
Eriophyes	emarginatae	qc1582fvir011 Garon-Labrecque_sld2				218.9	75.39	35	66			11	20	18.72	2.6	14.071	na	2.433	26	0
Eriophyes	emarginatae	bea1vir1 Garon-Labrecque_sld6				234.3	79	37	54			13	21	17.81	2.6	16.075	na	4.424	26	0
Eriophyes	emarginatae	qc1572vir004 Garon-Labrecque_sld1				266	88.52	41	75			12	25	18.31	3.1	10.925	na	1.661	27	0
Eriophyes	emarginatae	qc1523fvir003 Garon-Labrecque_sld1				192.3	77.9	41	54			11	22	19.4	2.8	14.748	5	2.545	22	0
Eriophyes	emarginatae	qc1548ame002_s4				231.5	59.36		52					17	5.7	14.616		1.68	25	0
Eriophyes	emarginatae	qc1518fvir007 Garon-Labrecque_sld2				222.5		39				12	21							0

Genus	Species	sample # (or NIS)	their sample #	Day	Month	L idiosoma (prodorsum-tip)	W idiosoma	Prod. L (unc lobe)	Prod. W	frontal lobe L	frontal lobe W	sc (s.d.)	sc-sc D (setal base-base)	gnathos. L (from molivator base)	palpcoxal (ep)	cheliceral stylet	palptarsal apical v seta	L flap post. marg TO postgen plate post margin	W (from 200x)	No. ridges on gen. flap
Eriophyes	emarginatae	qc15fvir012 Garon-Labrecque_sld4				238.3		42				13	21							0
Eriophyes	emarginatae	qc1572vir004 Garon-Labrecque_sld6				246.4		38				13	21							0
Eriophyes	emarginatae	qc70nig006s3males				222	77.54	46	64			11	25	12.78	3.4	9.986	na	na		NA
Eriophyes	emarginatae	qc1548ame002 Garon-Labrecque_sld6				267.9		44				13	26							3
Eriophyes	prunidemissae	qc1518fvir007 Garon-Labrecque_sld4				242.6		32				19	18							5
Eriophyes	prunidemissae	qc1516fvir008 Garon-Labrecque_sld5				246.4		37				19	19							9
Eriophyes	prunidemissae	qc1570vir009 Garon-Labrecque_sld5				216.1		36		6	7.5	29	18							7
Eriophyes	prunidemissae	bea1vir1 Garon-Labrecque_sld13				199.4		33				27	17							7
Eriophyes	prunidemissae	bea1vir1 Garon-Labrecque_sld3				246.5		34				19	16							5?
Eriophyes	prunidemissae	qc1572vir005 Garon-Labrecque_sld8				256.5		35				27	19							11
Eriophyes	prunidemissae	qc1572vir005 Garon-Labrecque_sld14				282.7		33				27	16							7
Eriophyes	savagei	m750191s IM.Smith Eastern choke chem				195.5		32				24	16							7
Eriophyes	savagei	I.M.Smith m7		29	7	184.3		29				14	16							9
Eriophyes	savagei	I.M.Smith 1-2		17-19	6	281.9		33		4.8	6.3	27	19							10
Eriophyes	savagei	I.M.Smith 1-2		17-19	6	273.2		35				27	17							
Eriophyes	prunidemissae	???					70.57		61					25.31		20.659	4.566	22		9
Eriophyes	prunidemissae	3fvir023 Garon-Labrecque_sld3				170.4	64.59	31	58	4.2		24	17	25.9		26.025	3.657	20		8
Eriophyes	prunidemissae	qc1534fvir019 Garon-Labrecque_sld2				141.3	55.44	30	51			21	17	25		19.698	3.092	19		9
Eriophyes	prunidemissae	3fvir023s8					71.82		61					26.93		24.907	4.317	22		8
Eriophyes	prunidemissae	qc1534vir019 Garon-Labrecque_sld1				252	59.77	30	54			21	18	20.52		22.96	4.9	20		9
Eriophyes	prunidemissae	qc1533fvir023 Garon-Labrecque_sld3				167.3	64.76	31	59	3.8	7.3	23	17	24.48		23.147	1.638	19		8

Genus	Species	sample # (or NIS)	their sample #	Day	Month	coverflap s. stricto L	coverflap s. stricto W	coxal ornamentation	prosternal apodeme	3a (gen. s.)	3a-3a	No. coxigen. annuli (median, ANT. to flap) (before a3 for La & N)	c2 (lat. s.)	d (ventral s. s.)	e (ventral s. s.)
Eriophyes	cerasicrumena	FNKB14A_Garon-Labrecque_sld2						curved lines and mt		6,6	16	13, thinner	18	27	11
Eriophyes	cerasicrumena	qc1515ame001_Garon-Labrecque_sld3				10,4	22	smooth		12	18	?	38	64	7
Eriophyes	cerasicrumena	qc20fser002_Garon-Labrecque_sld4				7,2	21	smooth		12	16	>10 thinner	15	47	10
Eriophyes	cerasicrumena	qc31fser008_Garon-Labrecque_sld3				10,4	22	smooth		13	18	13 thinner	14	37	10
Eriophyes	cerasicrumena	28fame011_Garon-Labrecque_sld3				10,7	18	lines		14	16	8, thinner	11	23	7,4
Eriophyes	cerasicrumena	21fnig008_Garon-Labrecque_sld3				15	21	smooth	na	6	15	?	19	35	5,1
Eriophyes	cerasicrumena	qc1577ame006_Garon-Labrecque_sld3				10,7	22	smooth	na	11	17	?	25	65	10
Eriophyes	cerasicrumena	qc1521fnig008_Garon-Labrecque_sld3				9,2	22	smooth	na	9,4	16	?thinner than	26	53	5,6
Eriophyes	cerasicrumena	onFNKB14As4													
Eriophyes	cerasicrumena	44ame008_Garon-Labrecque_sld2				16,6	24	smooth	coxae1 fused on 6,230	10	21	?	19	41	8,3
Eriophyes	emarginatae	qc1548ame002_Garon-Labrecque_sld3				12,1	21	smooth	coxae I almost touching	18	16	3	28	28	15
Eriophyes	emarginatae	qc1572vir005_Garon-Labrecque_sld12				14,5	28	smooth	Coxae 1 touching on 4,438 um	20	17	3	27	23	12
Eriophyes	emarginatae	qc1570nig006_Garon-Labrecque_sld4				16,5	27	smooth	coxae I does not touch together	17	20	3	30	20	7
Eriophyes	emarginatae	qc1582fvir011_Garon-Labrecque_sld1				10,5	24	smooth	coxae1 touching on 7,255um	21	18	3	25	19	16
Eriophyes	emarginatae	qc1582fvir011_Garon-Labrecque_sld2				9,4	26	smooth	coxae I touching on 8,182 um	20	19	3	30	21	12
Eriophyes	emarginatae	bea1vir1_Garon-Labrecque_sld6				11,1	27	smooth	coxae1 fused on 9,275 um	19	18	3	35	30	14
Eriophyes	emarginatae	qc1572vir004_Garon-Labrecque_sld1				11,1	28	smooth	coxae1 fused on 5,109 um	18	21	?	27	25	7,3
Eriophyes	emarginatae	qc1523fvir003_Garon-Labrecque_sld1				10,8	25	smooth	coxae1 fused on 2,582um	15	19	3	24	21	13
Eriophyes	emarginatae	qc1548ame002_s4							coxae1 touching on 8,246 um						
Eriophyes	emarginatae	qc1518fvir007_Garon-Labrecque_sld2				11,5	26	smooth		18	18	3	25	31	15

Genus	Species	sample # (or NIS)	their sample #	Day	Month	coverflap s. stricto L	coverflap s. stricto W	coxal ornamentation	prosternal apodeme	3a (gen. s.)	3a-3a	No. coxigen. annuli (median, ANT. to flap) (before a3 for La & N)	c2 (lat. s.)	d (ventral s. s.)	e (ventral s. s.)
Eriophyes	emarginatae	qc15fvir012_Garon-Labrecque_sld4				12,5	27	smooth		16	20	3	29	27	13
Eriophyes	emarginatae	qc1572vir004_Garon-Labrecque_sld6				11,2	25	smooth		18	17	4	32	33	12
Eriophyes	emarginatae	qc70nig006s3males				na	ana		coxae1 doesn't touch each other	21	20	6	32	25	10
Eriophyes	emarginatae	qc1548ame002_Garon-Labrecque_sld6				NA	NA	lines and mt		18	23	3	37	32	17
Eriophyes	prunidemissae	Qc1518fvir007_Garon-Labrecque_sld4						smooth		11	17	?	28	24	10
Eriophyes	prunidemissae	qc1516fvir008_Garon-Labrecque_sld5				8,1	22	smooth		9,1	15	>3	21	29	8,9
Eriophyes	prunidemissae	qc1570vir009_Garon-Labrecque_sld5				10,9	19	few mt		11	16	6	24	31	12
Eriophyes	prunidemissae	bea1vir1_Garon-Labrecque_sld13				12,5	19	few mt		5,7	15	6	33	36	23
Eriophyes	prunidemissae	bea1vir1_Garon-Labrecque_sld3				11,2	22	few mt		7,5	18	5	32	33	13
Eriophyes	prunidemissae	qc1572vir005_Garon-Labrecque_sld8				14,5	23	few mt		11	18	6	25	33	11
Eriophyes	prunidemissae	qc1572vir005_Garon-Labrecque_sld14				11,2	20	few mt		14	16	7	30	28	11
Eriophyes	savagei	m750191s IM.Smith Eastern choke cherry				10,7	22	few mt		10	14	7	34	31	9
Eriophyes	savagei	I.M.Smith m7	29		7	11,4	20	few mt		11	15	6	26	24	10
Eriophyes	savagei	I.M.Smith 1-2	17-19		6			few mt		9,3	17	23	25	12	
Eriophyes	savagei	I.M.Smith 1-2	17-19		6			few mt		13	20	7	35	35	13
Eriophyes	prunidemissae	???							forked anteriorly and posteriorly, connected on 4,7 um						
Eriophyes	prunidemissae	3fvir023_Garon-Labrecque_sld3				10,4	20	few mt	forking anteriorly, line short and faint	6,2	15	5	34	40	4,5
Eriophyes	prunidemissae	qc1534fvir019_Garon-Labrecque_sld2				9,6	19	few mt	forking anteriorly, but short and open between coxae	11	14	5	22	25	7,6
Eriophyes	prunidemissae	3fvir023s8							?						
Eriophyes	prunidemissae	qc1534vir019_Garon-Labrecque_sld1				9,6	21	few mt	forked anteriorly	11	14	5	27	37	7,6

Genus	Species	sample # (or NIS)	their sample #	Day	Month	f (ventral S, B)	h1 (dorsal S, S.a.)	c2-c2	d-d	e-e	f-f	h1-h1	h2-h2	h1-h2	c2 (in groups with 1-11)	c2-d	d-e	e-f	f-h	No. MEDIAN ventral annuli (from gen.flap; or from cox2 in La & N)	No. MEDIAN dors al annu li (excl apica l lobe)	dorsal	ventral	no. microtub (Ventral) per 20 microns	no. microtub (Dorsal) per 20 microns	Tarsus I (v)	Tibia I (d)	
Eriophyes	cerasicrumena	FNKB14A Garon-Labrecque_sld2														4	10	21	25	6	66	70						
Eriophyes	cerasicrumena	qc1515ame001 Garon-Labrecque_sld3														4	10	16	20	5	55	60						
Eriophyes	cerasicrumena	qc20fser002 Garon-Labrecque_sld4														5	21	15	16	6	63	51						
Eriophyes	cerasicrumena	qc31fser008 Garon-Labrecque_sld3														5	8	14	14	6	47	50						
Eriophyes	cerasicrumena	28fame011 Garon-Labrecque_sld3														3	11	13	18	5	50	56					7.2	6.5
Eriophyes	cerasicrumena	21fnig008 Garon-Labrecque_sld3				19	na	54	36	24	26	na	13	na		4	6	13	16	5	44	45	oval	oval	9	6	6.8	5.4
Eriophyes	cerasicrumena	qc1577ame006 Garon-Labrecque_sld3				29	na	55	30	20	na	na	13	na								oval	oval	11	7	7.5	4.5	
Eriophyes	cerasicrumena	qc1521fnig008 Garon-Labrecque_sld3				26	na	50	29	19	27	na	14	na		3	7	11	16	5	42	45	oval	oval	10		7.9	5.9
Eriophyes	cerasicrumena	onFNKB14As4				23	na	52	36	24	28	na	9.8	na								oval	oval	15	8	9.6	6.7	
Eriophyes	cerasicrumena	44ame008 Garon-Labrecque_sld2				23	na	64	43	27	26	na	8.6	na		4	13	15	22	5	59	65	oval	oval	8	6		
Eriophyes	emarginatae	qc1548ame002 Garon-Labrecque_sld3				33	5	na	35	24	25	7.3	11	2.8		4	12	17	20	6	59	58	na	na	na	na	11	11
Eriophyes	emarginatae	qc1572vir005 Garon-Labrecque_sld12				37	4.1	50	40	23	30	10	15	1.1		3	12	17	20	?	>52	?	na	na	na	na	8.4	11
Eriophyes	emarginatae	qc1570nig006 Garon-Labrecque_sld4														4	12	16	19	5	56	58	na	na	na	na	11	13
Eriophyes	emarginatae	qc1582fvir011 Garon-Labrecque_sld1				28	3	59	40	24	33	8.3	14	3.5		4	12	16	21	6	59	59	na	na	na	na	9.5	11
Eriophyes	emarginatae	qc1582fvir011 Garon-Labrecque_sld2				36	4.8	62	37	22	34	na	15	3.1		4	12	15	21	5	57	61	na	na	na	na	8.6	10
Eriophyes	emarginatae	bealvir1 Garon-Labrecque_sld6				37	4.4	58	42	23	28	9.1	12	3.1		3	12	16	20	5	57	59	na	na	na	na	9.9	9.5
Eriophyes	emarginatae	qc1572vir004 Garon-Labrecque_sld1				35	3.9	73	48	30	36	8.3	13	3.4								na	na	na	na	9.3	11	
Eriophyes	emarginatae	qc1523fvir003 Garon-Labrecque_sld1				28	4.2	60	21	19	36	7.6	8.1	3.8		3	13	15	21	5	57	58	na	na	na	na	8.8	7.9
Eriophyes	emarginatae	qc1548ame002_s4				33	6.2	57	36	24	30	9	13	3.2								na	na	na	na	11	12	
Eriophyes	emarginatae	qc1518fvir007 Garon-Labrecque_sld2														3	13	16	21	5	58	61						

Genus	Species	sample # (or NIS)	their sample #	Day	Month	f (ventral S, B)	h1 (dorsal S, S.a.)	c2-c2	d-d	e-e	f-f	h1-h1	h2-h2	h1-h2	c2 (in groups with 1-11)	c2-d	d-e	e-f	f-h	No. MEDIAN ventral annuli (from gen.flap or from cox2 in La & N)	No. MEDIAN dors al annu li (excl apica l lobe)	dorsal	ventral	no. microtub (Ventral) per 20 microns	no. microtub (Dorsal) per 20 microns	Tarsus I (v)	Tibia I (d)	
Eriophyes	emarginatae	qc15fvir012 Garon-Labrecque_sld4													3	11	15	20	6	55	55							
Eriophyes	emarginatae	qc1572vir004 Garon-Labrecque_sld6													2	13	17	21	5	58	62							
Eriophyes	emarginatae	qc70nig006s3males				32	8.1	71	45	27	33	7.6	13	2.5		3	13	17	21	5	60	67	oval a	oval a	9	8	10	9.5
Eriophyes	emarginatae	qc1548ame002 Garon-Labrecque_sld6													3	9	17	25	6	60	60							
Eriophyes	prunidemiassae	Qc1518fvir007 Garon-Labrecque_sld4													2	12	15	22	5	56	?							
Eriophyes	prunidemiassae	qc1516fvir008 Garon-Labrecque_sld5																										
Eriophyes	prunidemiassae	qc1570vir009 garon-Labrecque_sld5													4	12	17	26	6	65	81							
Eriophyes	prunidemiassae	bealvir1_Garon-Labrecque_sld13													2	11	17	26	6	62	79							
Eriophyes	prunidemiassae	bealvir1_Garon-Labrecque_sld3													4	16	17	24	6	67	80							
Eriophyes	prunidemiassae	qc1572vir005 Garon-Labrecque_sld8													?	14	18	28	6	>66	?							
Eriophyes	prunidemiassae	qc1572vir005 Garon-Labrecque_sld14													5	11	17	27	6	66	?							
Eriophyes	savagei	m750191s IM.Smith Eastern choke cherm													2	12	15	24	5	58	76							
Eriophyes	savagei	I.M.Smith m7		29	7										2	12	15	23	4	56	73							
Eriophyes	savagei	I.M.Smith 1-2		17-19	6										2	11	14	25	5	57	?							
Eriophyes	savagei	I.M.Smith 1-2		17-19	6										3	11	17	30	6	67	?							
Eriophyes	prunidemiassae	???				22	4.1	63	42	20	27	8.2	12	2.5								oval	oval	13	9	6	5.5	
Eriophyes	prunidemiassae	3fvir023_Garon-Labrecque_sld3				26	3.7	56	42	21	27	8.1	14	3.5		3	14	14	24	6	61	76	oval	oval	12	10	6.2	4.6
Eriophyes	prunidemiassae	qc1534fvir019_Garon-Labrecque_sld2				20	3.9	51	36	19	22	7.5	13	3.3		2	11	14	24	5	56	74	oval	oval	13	10	6	4.6
Eriophyes	prunidemiassae	3fvir023s8				22	2.7	66	42	23	27	9.3	12	3								oval	oval	11		6	3.9	
Eriophyes	prunidemiassae	qc1534vir019_Garon-Labrecque_sld1				23	4.6	59	42	22	26	8.7	13	2.9		2	11	13	21	5	52	80	oval	oval	13	10	5.7	3.9
Eriophyes	prunidemiassae	qc153fvir023_Garon-Labrecque_sld3				26	4.7	58	42	21	26	8	14	3.3		2	10	14	23	6	55	79	oval	oval	12	11	7	4.2

Genus	Species	sample # (or NIS)	their sample #	Day	Month	Gen I (d)	Fem I (v)	Tarsus II	Tibia II	Gen II	Fem II (v)	u' I (from pigmented base, not socket arc)	u' II	Empod. I (from pigmented base to apicalmost seg)	Empod. II	leg I (before: was both for legs I-II)	leg II	ft' ta I	ft' ta II	ft'' ta I	ft'' ta II	u' ta I	u' ta II	phi tib I	r' tib I	r' tib II
Eriophyes	cerasicrumena	FNKB14A Garon-Labrecque_sld2														5/7,5/7	5/5, 5/7									
Eriophyes	cerasicrumena	qc1515ame001 Garon-Labrecque_sld3														5/5,5/7	5/5,5/7									
Eriophyes	cerasicrumena	qc20fser002 Garon-Labrecque_sld4														4/7,4/7	4/4,4/7									
Eriophyes	cerasicrumena	qc31fser008 Garon-Labrecque_sld3														5/7, 4/7	5/7,4/7									
Eriophyes	cerasicrumena	28fame011 Garon-Labrecque_sld3				5.7	8.1	7	4.5	4.4	10	9.27	8.36	6.8	1	5/7,4/7	4/7,4/7									
Eriophyes	cerasicrumena	21fnig008 Garon-Labrecque_sld3				6.3	8.1	6.2	6.2	5	10	9.32	9.06	6.1	5.75	5/5,5/7	5/5,5/7									
Eriophyes	cerasicrumena	qc1577ame006 Garon-Labrecque_sld3				5.6	7.2	5.8	6	4.4	9.4	9.43	9.6	6.6	6.51	5/5,5/7	5/5,5/7	13	3.56	21	23	3.17	na		na	na
Eriophyes	cerasicrumena	qc1521fnig008 Garon-Labrecque_sld3				6.9	9.6	6.6	5.2	5	7.3	9.41	8.21	7.9	7.76	5/5,5/7	5/5,5/7	13	3.76	23	23	2.52	1.54		3.36	na
Eriophyes	cerasicrumena	onFNKB14As4				6.5	10	8.9	6.5	5.8	11	11	10	7.4	6.69			15	2.75	19	19	2.83	na		2.74	abs
Eriophyes	cerasicrumena	44ame008 Garon-Labrecque_sld2														5/7, 5/7	5/5, 5/7	17	2.72	22	21	2.73	2.64		4.26	abs
Eriophyes	emarginatae	qc1548ame002 Garon-Labrecque_sld3				7.7	15	9.8	9.3	6.8	12	9	8.77	7.8	8	4/7,4/7	4/4,4/7	17	5	29	30	abs	4.4		7.79	abs
Eriophyes	emarginatae	qc1572vir005 Garon-Labrecque_sld12				7.6	14	9.2	6.7	6.9	14	9	8.94	7.8	8.94	4/4,4/7	4/4,4/7	16	6.64	26	27	2.64	3.25		7.11	abs
Eriophyes	emarginatae	qc1570nig006 Garon-Labrecque_sld4				9.3	17	11	9.6	6.6	15	9.85	9.68	8.3	8.27	4/4,4/7	4/7,4/7	8.7	5.51	29	29	7	6.78		4.85	abs
Eriophyes	emarginatae	qc1582fvir011 Garon-Labrecque_sld1				6.6	12	9.2	6.5	7.2	12	8	9	5.6	6.3	4/7, 7/7	4/7, 7/7	11	abs	19	24	abs	2.59		abs	abs
Eriophyes	emarginatae	qc1582fvir011 Garon-Labrecque_sld2				7.2	12	9.6	7.4	6.8	12	8.07	8.85	7.2	7.43	4/4,4/7	4/4,4/7	8.21	abs	29	25	4	2.88		6.14	abs
Eriophyes	emarginatae	bealvir1 Garon-Labrecque_sld6				8.5	13	9.2	6.7	6.9	14	6.87	9	7.9	8.36	4/7,4/7	4/4,4/7	9.8	5.2	18	17	abs	abs		6.85	abs
Eriophyes	emarginatae	qc1572vir004 Garon-Labrecque_sld1				6.8	14	8.6	7.5	6.1	16	8.72	9.33	8.5	6.93	4/4,4/7	4/7,7/7	6.6	3.89	11	26	3.63	abs		7	abs
Eriophyes	emarginatae	qc1523fvir003 Garon-Labrecque_sld1				8.6	13	9.5	7.9	6.6	13	7.41	8.89	7.6	7.1	4/7,4/7	4/4, 4/7	12	3.26	23	21	3.41	3.23		6.07	abs
Eriophyes	emarginatae	qc1548ame002_s4				7	16	10	7.8	6.8	16	9.77	10	6.9	7.66			9.83	3.59	21	22	not seen	not seen		8.29	abs
Eriophyes	emarginatae	qc1518fvir007 Garon-Labrecque_sld2														4/4,4/7	4/4,4/7									

Genus	Species	sample # (or NIS)	their sample #	Day	Month	I ⁿ gen I	I ⁿ gen II	bv fem I	bv fem II	1b	1a	2a	1b-1b D	1a-1a D	2a-2a D	1b-1a long. D	1b-2a long. D	1a-2a long. D
Eriophyes	cerasicrumena	FNKB14A_Garon-Labrecque_sld2																
Eriophyes	cerasicrumena	qc1515ame001_Garon-Labrecque_sld3								2	16	29	9,1	9,4	27	7,9	15	10,031
Eriophyes	cerasicrumena	qc20fser002_Garon-Labrecque_sld4											9,7	9,3	24	5,4	11	
Eriophyes	cerasicrumena	qc31fser008_Garon-Labrecque_sld3											9,1	8,6	22	5,9	12	
Eriophyes	cerasicrumena	28fame011_Garon-Labrecque_sld3											8,1	9,2	24	7	13	
Eriophyes	cerasicrumena	21fnig008_Garon-Labrecque_sld3				23	14	8,55	8,71				7,6	8,7	24	7,9	14	
Eriophyes	cerasicrumena	qc1577ame006_Garon-Labrecque_sld3				23	8,11	10	9,3	3,2	30	30	6,9	9,2	na	8,7	15	9,971
Eriophyes	cerasicrumena	qc1521fnig008_Garon-Labrecque_sld3				24	22	7,64	22	3,2	22	26	7,7	8,5	24	7,9	14	8,591
Eriophyes	cerasicrumena	onFNKB14As4				27	9,1	9,69	8,9	2,7	27	44						9,507
Eriophyes	cerasicrumena	44ame008_Garon-Labrecque_sld2				20,8	9,61	8,92	9,64	na	21	21	12	9,5	29	8,1	15	10,754
Eriophyes	emarginatae	qc1548ame002_Garon-Labrecque_sld3				27	10	13	12	7,9	27	41	12	7,9	24	8,5	15	9,511
Eriophyes	emarginatae	qc1572vir005_Garon-Labrecque_sld12				28	11	10	11	6	47	42	13	8,5	29	7,3	17	10,956
Eriophyes	emarginatae	qc1570nig006_Garon-Labrecque_sld4				23	11	9,41	9,62	8,4	45	26	13	9,2	32	7,6	17	13,862
Eriophyes	emarginatae	qc1582fvir011_Garon-Labrecque_sld1				29	10	na	12	7,6	35	21	12	7,8	27	7,5	14	12,06
Eriophyes	emarginatae	qc1582fvir011_Garon-Labrecque_sld2				27	na	9,89	11	8,5	36	19	12	8,5	28	8	15	11,692
Eriophyes	emarginatae	bea1vir1_Garon-Labrecque_sld6				28	9,82	11	9	8,9	na	37	9,6	7	22	5,5	9,9	12,707
Eriophyes	emarginatae	qc1572vir004_Garon-Labrecque_sld1				27	7,61	9,92	10	7,2	34	36		9,5	34			14,505
Eriophyes	emarginatae	qc1523fvir003_Garon-Labrecque_sld1				27	11	9,44	9,81	4,9	19	42	11	8,3		6,6	13	7,897
Eriophyes	emarginatae	qc1548ame002_s4				30,3	9,95	17	9,81	6,7	40	32						9,263
Eriophyes	emarginatae	qc1518fvir007_Garon-Labrecque_sld2											8,9		29			

Genus	Species	sample # (or NIS)	their sample #	Day	Month	Gen I (d)	Fem I (v)	Tarsus II	Tibia II	Gen II	Fem II (v)	ω I (from pigmented base, not socket arc)	ω II	Empod. I (from apical dist to apical post-ray)	Empod. II	leg I (before: was both for legs I-II)	leg II	ft' ta I	ft' ta II	ft'' ta I	ft'' ta II	u' ta I	u' ta II	phi tib I	I' tib I	I' tib II
Eriophyes	emarginatae	qc15fvir012_Garon-Labrecque_sld4														4/7,?	4/7, 3/7									
Eriophyes	emarginatae	qc1572vir004_Garon-Labrecque_sld6														4/7,4/7	4/4,4/7									
Eriophyes	emarginatae	qc70nig006s3males				7,3	15	10	8,1	6	12	8,52	9,5	7,4	6,73	4	4	18	6,25	29	18	not seen	not seen		abs	abs
Eriophyes	emarginatae	qc1548ame002_Garon-Labrecque_sld6														4/7,4/7	4/7,4/7									
Eriophyes	prunidemissae	qc1518fvir007_Garon-Labrecque_sld4																								
Eriophyes	prunidemissae	qc1516fvir008_Garon-Labrecque_sld5														4/4,4/7	4/4,4/7									
Eriophyes	prunidemissae	qc1570vir009_Garon-Labrecque_sld5														4/7,4/7	4/7,4/7									
Eriophyes	prunidemissae	bea1vir1_Garon-Labrecque_sld13														4/7,4/4	4/7									
Eriophyes	prunidemissae	bea1vir1_Garon-Labrecque_sld3														4/7,4/7	4/4, 4/7									
Eriophyes	prunidemissae	qc1572vir005_Garon-Labrecque_sld8														3/4,4/4	4/4,4/7									
Eriophyes	prunidemissae	qc1572vir005_Garon-Labrecque_sld14														4/4,4/4	4/4,4/7									
Eriophyes	savagei	m750191s IM.Smith.Eastern choke cherry														4/4,4/7	4/4,4/7									
Eriophyes	savagei	I.M.Smith m7	29	7												4/4,4/4	4/4,4/4									
Eriophyes	savagei	I.M.Smith 1-2	17-19	6												4/4,4/4	4/4,4/4									
Eriophyes	savagei	I.M.Smith 1-2	17-19	6												4/4,4/4	4/4,4/4									
Eriophyes	prunidemissae	???				4,9	6,7	5,5	4,1	4,7	5,8				4,9	4,74		7,53	2,32	11	17	2,73	2,57		4,47	abs
Eriophyes	prunidemissae	3fvir023_Garon-Labrecque_sld3				5	8,6	5,4	4,3	3,8	6	6,96	9,11	5,5	5,28	4/4,4/4	4/4,4/7	10	3,64	16	18	?	?		2,88	abs
Eriophyes	prunidemissae	qc1534fvir019_Garon-Labrecque_sld2				4,5	9,4	4,8	3,5	4,2	5,9	7,73	8,48	5,4	5,7	4	4	9,74	2,81	14	17	2,65	na		6,62	abs
Eriophyes	prunidemissae	3fvir023s8				5,4	6,4	5,1	4,9	4	7,3	7,46	8,34	5,3	4,78			9	4	12	16	2,71	2,76		2,36	abs
Eriophyes	prunidemissae	qc1534vir019_Garon-Labrecque_sld1				4,4	8,6	5,7	3,6	3,9	7,6	7,52	8,77	5,3	5,19	4	4/4,4/7	6,37	na	13	18	na	1,56		na	na
Eriophyes	prunidemissae	qc153fvir023_Garon-Labrecque_sld3				4,9	9,9	6,3	4,2	4,5	9,2	7,69	9,13	5,5	5,21	4/4,4/4	4/4,4/7	11	4,3	16	17	2,74	2,68		6,7	na

Genus	Species	sample # (or NIS)	their sample #	Day	Month	I st gen I	I st gen II	bv fem I	bv fem II	1b	1a	2a	1b-1b D	1a-1a D	2a-2a D	1b-1a long. D	1b-2a long. D	1a-2a long. D
Eriophyes	emarginatae	qc15fvir012_Garon-Labrecque_sld4											9	5,2	21	5,2	12	
Eriophyes	emarginatae	qc1572vir004_Garon-Labrecque_sld6											12	9,5	28	8,3	15	
Eriophyes	emarginatae	qc70nig006s3males				34	13	7,2	8,86	8,6	33	34	13	9,1	27	7,7	15	10,611
Eriophyes	emarginatae	qc1548ame002_Garon-Labrecque_sld6											14	10	31	7,7	17	
Eriophyes	prunidemissae	Qc1518fvir007_Garon-Labrecque_sld4											13	11	27	6,2	13	
Eriophyes	prunidemissae	qc1516fvir008_Garon-Labrecque_sld5																
Eriophyes	prunidemissae	qc1570vir009_garon-Labrecque_sld5											11	9,3	24	5,7	12	
Eriophyes	prunidemissae	bealvir1_Garon-Labrecque_sld13											11	11	29	4,4	12	
Eriophyes	prunidemissae	bealvir1_Garon-Labrecque_sld3											13	8,2	24	8,7	16	
Eriophyes	prunidemissae	qc1572vir005_Garon-Labrecque_sld8											9,8	7,8	21	5	11	
Eriophyes	prunidemissae	qc1572vir005_Garon-Labrecque_sld14											9,6	8,2	21	5	9,3	
Eriophyes	savagei	m750191s IM.Smith.Eastern choke cherry											16	10	25	6,3	12	
Eriophyes	savagei	I.M.Smith	m7	29	7								12	9,7	25	6	11	
Eriophyes	savagei	I.M.Smith	1-2	17-19	6								13	11	27	6,2	12	
Eriophyes	savagei	I.M.Smith	1-2	17-19	6								13	10	26	6,2	12	
Eriophyes	prunidemissae	???				21		6,38	6,5	3	16	23						8,51
Eriophyes	prunidemissae	3fvir023_Garon-Labrecque_sld3				24	18	4,48	8,33	6,3	17	37	13	9,2	24	6,1	12	8,343
Eriophyes	prunidemissae	qc1534fvir019_Garon-Labrecque_sld2				24	7	na	5,83	7,1	17	45	11	8,2	22	6,4	11	6,639
Eriophyes	prunidemissae	3fvir023s8				22	5,45	7,81	5,47	4,7	17	27						8,898
Eriophyes	prunidemissae	qc1534vir019_Garon-Labrecque_sld1				23	7,47	8,52	na	6,9	22	24	12	11	26	5,6	11	8,971
Eriophyes	prunidemissae	qc153fvir023_Garon-Labrecque_sld3				26	8,42	2,06	3,41	5,3	24	38	13	8,9	24	7	12	8,331