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First record of *Erasmoneura vulnerata* Fitch, 1851 (Hemiptera, Cicadellidae, Typhlocybinae) in Switzerland

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Abstract

The first record of *Erasmoneura vulnerata* Fitch, 1851 in Switzerland is reported. Specimens were collected in 2019 using yellow sticky traps during a *Scaphoideus titanus* monitoring campaign in vineyards in Ticino (Southern Switzerland). *E. vulnerata* is a grapevine pest that has recently been introduced to Europe, whose phytophagy causes detrimental damage to grapevine leaves. Its occurrence in this area has likely been favored by the ongoing suspension of insecticide treatments for the control of the *S. titanus* population, the vector agent of the "Flavescence dorée" phytoplasma in grapevines.

Key Words

Erythroneura, grapevine pest, leafhopper, Neozoa

Introduction

Erasmoneura vulnerata Fitch, 1851 (syn. *Erythroneura vulnerata* Fitch, 1851) (Hemiptera, Cicadellidae, Typhlocybinae) is a Nearctic leafhopper that colonizes North-American grape species (*Vitis* spp.) as well as various cultivars of *Vitis vinifera* L. (Dietrich and Dmitriev 2006). It may also use *Parthenocissus quinquefolia* L. Planch. as a secondary host (Dmitriev et al. 2020). In its native range, *E. vulnerata* was first described as a significant grapevine pest by Robinson (1926) and Beamer (1946) and is now considered to be a prominent species among the many leafhoppers associated with grapevines (Martinson and Denney 1995; Paxton and Thorvilson 1996). Vineyards in Colorado and Texas, for example, are attacked by *E. vulnerata* in association with *Erythroneura coloradensis* Gillette, 1892 and *Erythroneura ziczac* Walsh, 1862 (Zimmerman et al. 1996).

E. vulnerata has recently been introduced to Europe, where it was first recorded in Northeastern Italy (Veneto region) in 2004, followed by subsequent findings in Friuli-Venezia Giulia (Duso et al. 2005). Later, additional specimens of the leafhopper were trapped in other North-Italian regions such as Emilia-Romagna and Trentino-Alto Adige on vines of *Vitis labrusca* L. and on French hybrids where no phytosanitary measures were applied, and on *Parthenocissus* spp. (Duso et al. 2008).

E. vulnerata has a very low occurrence rate in the surveyed Italian vineyards treated with insecticides against *Scaphoideus titanus* Ball, 1932, the main vector of *Candidatus* Phytoplasma vitis responsible for the quarantine disease "Flavescence dorée" (Chuche and Thiéry 2014; Duso et al. 2019; OSalV-DEFR-DATEC 2019). This led Duso et al. (2019) to categorize this species as a secondary grapevine pest in North-Italian commercial vineyards, where insecticides are commonly used for the mandatory control of *S. titanus*.

In 2010, *E. vulnerata* specimens were accidentally detected on *Cercis siliquastrum* L. in Slovenia, close to the Italian border (Seljak 2011). Subsequent surveys confirmed the presence of a few specimens of *E. vulnerata* on *Vitis* spp. also, mainly on *Vitis labrusca* which were most

likely not treated with insecticides. Seljak (2011) additionally reported that the Judas tree is a viable and attractive host for adult specimens, but did not elaborate further on the introduction of *E. vulnerata* to Slovenia other than the possible effect of the proximity to the Italian border.

Here, we report the first record of *E. vulnerata* in vineyards in Ticino (Southern Switzerland) which occurred in 2019 and which was already expected by Mühlethaler et al. (2016). The finding took place during a monitoring campaign of the vectoring agent of the grapevine "Flavescence dorée" phytoplasma, *S. titanus*.

Materials and methods

Study area and design

The study area includes the whole vineyard area of Canton Ticino and covers 1093 ha (Fig. 1, Sezione dell'agricoltura Cantone Ticino 2019a). Since the detection of the quarantine disease "Flavescence dorée" in 2004 (Linder and Jermini 2007; Schaerer et al. 2007), two different control strategies have been applied. In the first phase (2004–2018), an eradication approach was implemented

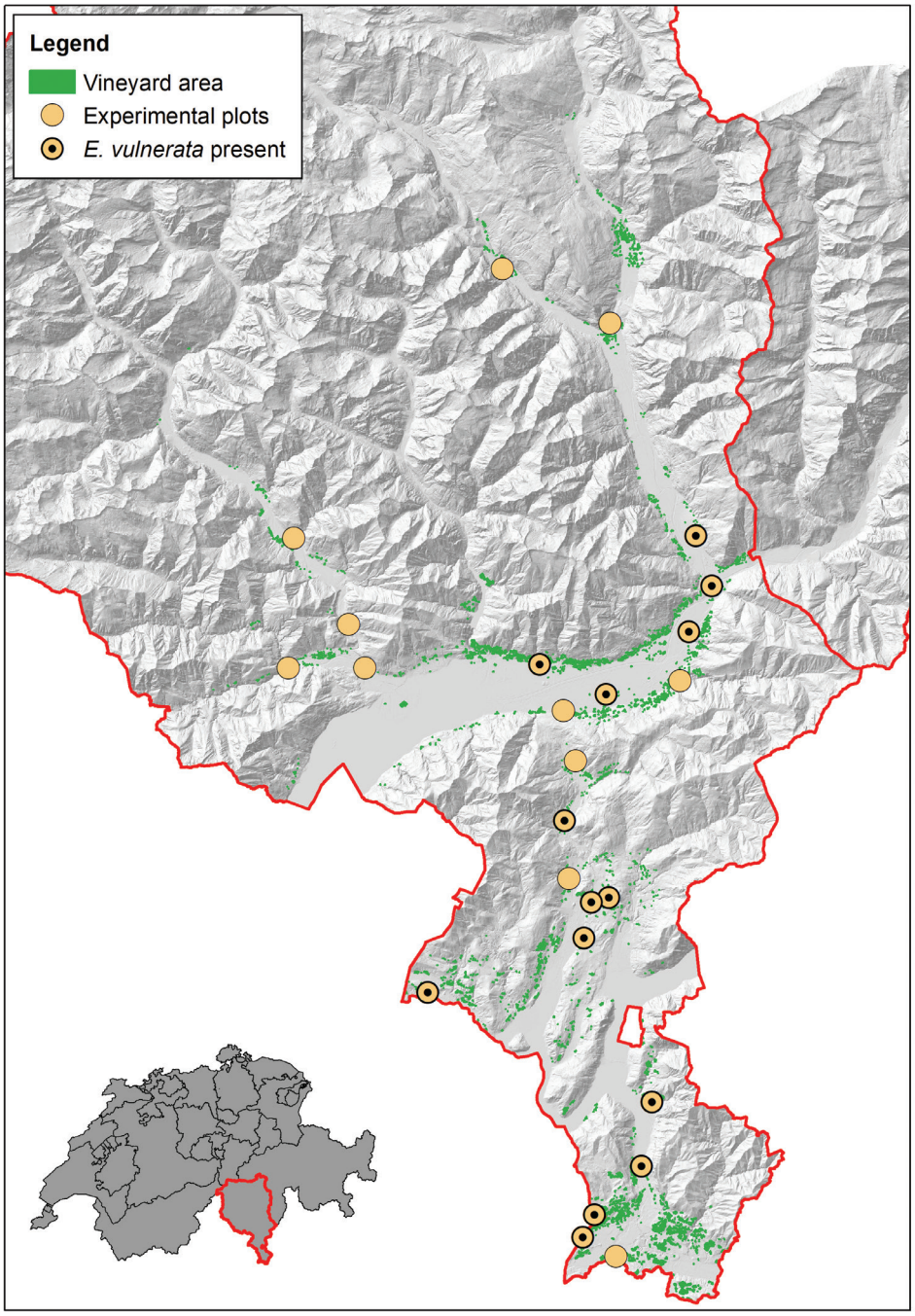

Figure 1. Study area and monitoring design. Green area: vineyard area in Canton Ticino; circles: experimental plots; black dots: *Erasmoneura vulnerata* presence.

in the affected area consisting of the mandatory removal of symptomatic grapevines and the systematic insecticide application to control the phytoplasma vector *S. titanus*. Due to the widespread "Flavescence dorée" diffusion in the area (Jermini et al. 2014), cantonal authorities switched to an adaptive management approach in 2019, consisting of the systematic removal of symptomatic grapevines (as before) and the application of insecticide treatments based on *S. titanus* population growth in the vineyards. Consequently, a temporary suspension of insecticide treatments and the implementation of a monitoring program on the reconstitution of *S. titanus* populations are in place for the period 2019–2020 (Sezione dell'agricoltura Cantone Ticino 2019b).

For the 2019 monitoring program, 28 vineyards distributed throughout the vineyard area of Canton Ticino were selected (Fig. 1) and provided with 6 to 15 yellow chromotropic sticky traps (Rebell, Giallo; Andermatt Biocontrol AG, Switzerland) based on vineyard size (183 traps in total, see Table 1).

Collection and identification of specimens

Traps were collected and changed every two weeks, from June 24 (week 26) to October 10 (week 41). Collected traps were then systematically checked for the presence of the main "Flavescence dorée" phytoplasma vector *S. titanus* and other alternative and putative vectors such as *Orientus ishidae* Matsumura, 1902 and *Japananus hyalinus* Osborn, 1900 (Lessio et al. 2016; Casati et al. 2017; Jermini et al. 2017). In this context, other particular or unknown species were also checked anecdotally. This was the case for *E. vulnerata*, which was identified following the description of Dmitriev et al. (2020). After the first instance of a presumed *E. vulnerata* specimen, details of leaf lesions and the presence of *E. vulnerata* excrement were additionally checked in the field following the observations of Paxton and Thorvilson (1996) (Fig. 2). Finally, selected males of the presumed *E. vulnerata* specimens were subjected to genitalia extraction to confirm the species according to Dmitriev et al. (2020).

Results

Specimens of *E. vulnerata* were found in 16 out of the 28 monitored plots as reported in Table 1. Currently, *E. vulnerata* is only present in the southern and central parts of Canton Ticino (Fig. 1). Unfortunately, no systematic and comprehensive counting of *E. vulnerata* specimens could be achieved because most of the collected traps had been processed and discarded before the first detection and confirmation of *E. vulnerata*.

Table 1. Experimental plots and occurrence of *Erasmoneura vulnerata*.

Locality	Cultivar	Area [m²]	YST[a]	Latitude[b]	Longitude[b]	Elevation [m a.s.l.]	*E. vulnerata* presence
Arbedo	Gamaret	5336	6	46.21751	9.04110	238	Yes
Arzo	Chardonnay	3084	6	45.86803	8.93728	480	Yes
Avegno	Chardonnay	2256	6	46.19971	8.74874	281	No
Avegno	Merlot	3726	9	46.19970	8.74759	282	No
Bedano	Merlot	1925	6	46.05601	8.92144	394	No
Bellinzona	Merlot	2418	6	46.19212	9.02190	260	Yes
Biasca	Merlot	8340	6	46.36507	8.96342	310	No
Bironico	Gamaret	4967	6	46.12143	8.92886	488	No
Cadenazzo	Merlot	1024	6	46.15828	8.95441	206	Yes
Camorino	Merlot	2138	6	46.16495	9.01409	372	No
Claro	Merlot	9286	6	46.24579	9.02922	255	Yes
Contone	Gamaret	11609	6	46.14920	8.92002	203	No
Genestrerio	Gamaret	1566	6	45.84458	8.95361	376	No
Gerra Piano	Chardonnay & Merlot	10399	6	46.17559	8.90142	198	Yes
Giornico	Merlot	6039	6	46.39669	8.87737	376	No
Intragna	Merlot	1718	6	46.17601	8.69943	330	No
Lamone	Merlot	10510	6	46.04243	8.93926	436	Yes
Losone	Chardonnay	6487	6	46.17545	8.76098	223	No
Maggia	Merlot	2165	6	46.24838	8.70566	336	No
Mendrisio	Cabernet Franc	3514	6	45.89456	8.97548	300	Yes
Mezzovico	Merlot	2981	6	46.08825	8.91926	413	Yes
Monteggio	Merlot	7670	6	45.99369	8.80679	380	Yes
Origlio	Chardonnay & Sauvignon Blanc	13394	15	46.04369	8.94177	430	Yes
Rovio	Merlot	2631	6	45.93004	8.98493	450	Yes
Stabio	Merlot	1066	6	45.85767	8.93077	420	Yes
Stabio	Chardonnay	3224	9	45.85563	8.92752	420	Yes
Stabio	Chardonnay	1724	6	45.85456	8.92869	430	Yes
Vezia	Merlot	4169	6	46.02249	8.93285	325	Yes

[a] Number of yellow sticky traps inside vineyards (YST).
[b] Coordinates in decimal degrees WGS 84 (N, E).

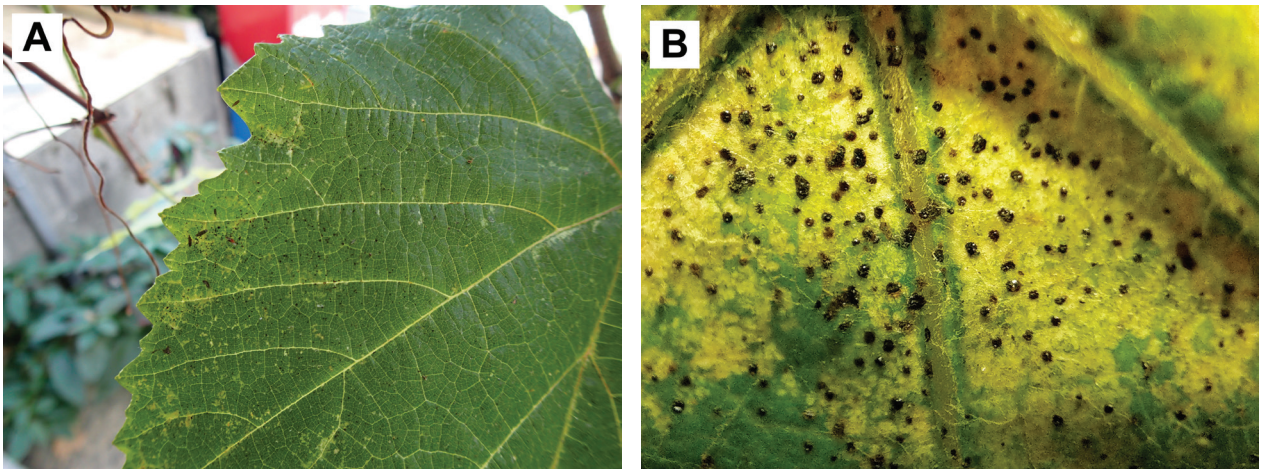

Figure 2. Foliage lesions and *Erasmoneura vulnerata* excrement. **A** Leaf lesions, excrement and specimens of *E. vulnerata*. **B** Details of leaf lesions and excrement left by *E. vulnerata*. Photographs taken in Bellinzona, Switzerland, 46.19212 N, 9.02190 E, 15 July 2019.

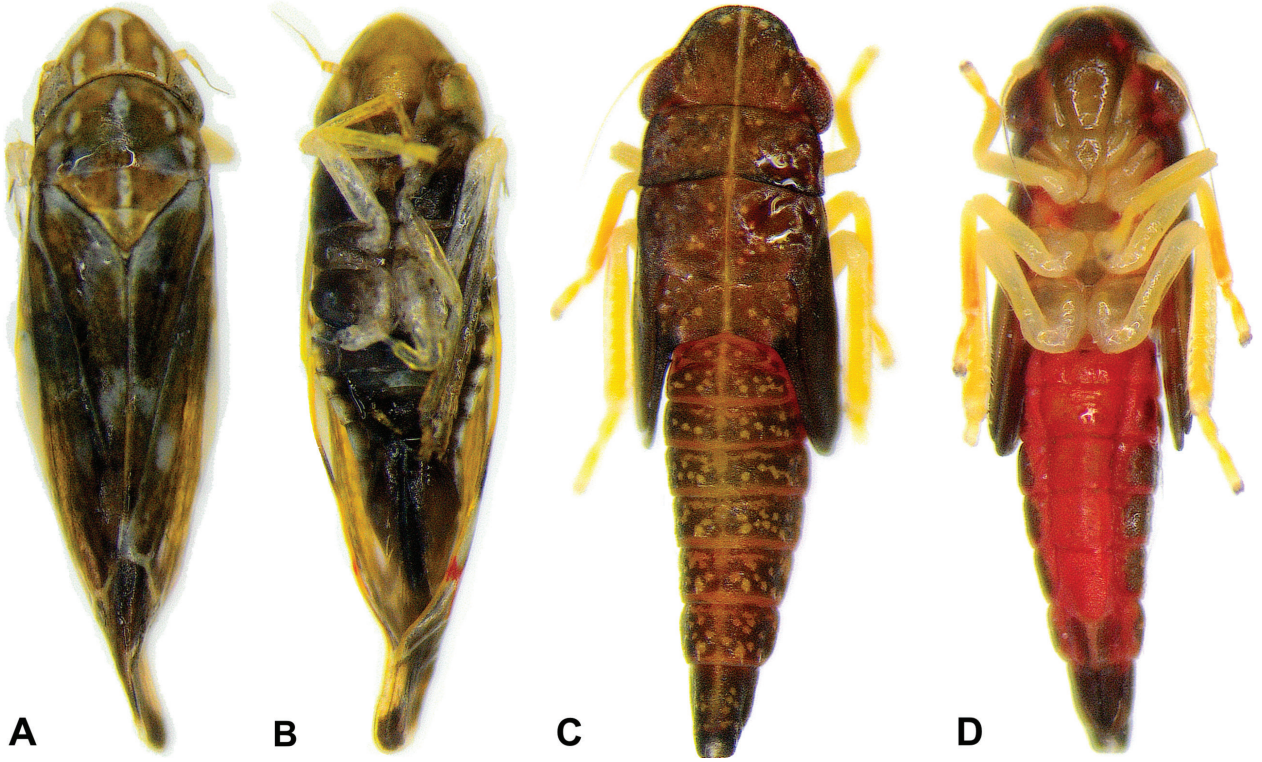

Figure 3. *Erasmoneura vulnerata*. Dorsal (**A**) and ventral (**B**) view of imago. Dorsal (**C**) and ventral (**D**) view of nymph. The real proportions were not retained.

Biology of *E. vulnerata*

Description

Adults of *E. vulnerata* are 2.7–3.2 mm long and are particularly identifiable by the characteristic transversal red veins at the base of the first apical cell on the forewings (Figs 3A, B; 4). Nymphs are reddish-brown with unordered yellowish marbled patches. The whole body is longitudinally divided by a yellowish stripe (Fig. 3C, D). See Dmitriev et al. (2020) for further details on the species' morphology.

Life cycle

E. vulnerata reproduction takes place on *Vitis* spp. where it produces at least two generations per year with the possibility of a third under particularly favorable

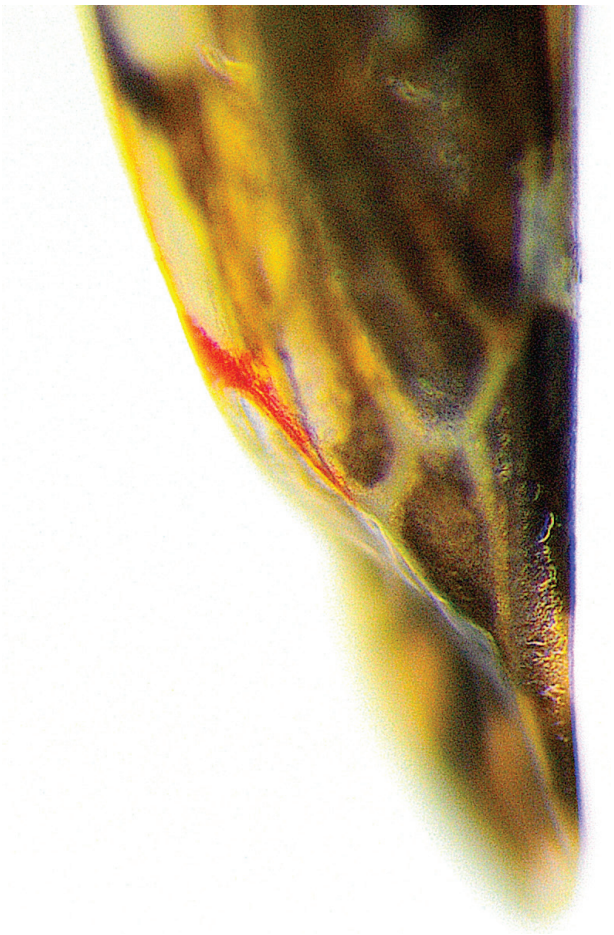

Figure 4. Detailed view of transversal red vein on forewing wing of *Erasmoneura vulnerata*.

conditions (Girolami et al. 2006). Adults begin colonizing grapevines at bud burst, moving from neighboring woody overwintering sites, the proximity of which to vineyards appears to be crucial for the establishment of *E. vulnerata* populations (Duso et al. 2019). Egg laying occurs in the tissue of larger leaf veins and the leaf midrib in particular. Egg laying peaks in June and August for the first and second generations, respectively (Duso et al. 2019). After hatching, both nymphal instars and adults mainly inhabit upper leaf surfaces, whereas exuviae are mainly observed on leaf undersides (Duso et al. 2005).

Host plants and damage

Vitis spp. is *E. vulnerata*'s most suitable host plant (Dmitriev et al. 2020). In Europe, *Vitis labrusca* and *Vitis vinifera* are both colonized (Duso et al. 2019). However, Dmitriev et al. (2020) list many other host plant species in their database, including *Parthenocissus quinquefolia*, *Ilex decidua* Walter, and *Aesculus* spp. To date in Europe, the only species other than *Vitis vinifera*, *Vitis labrusca*, and *Parthenocissus* spp. that *E. vulnerata* has been found on is *Cercis siliquastrum* in Slovenia (Seljak 2011).

E. vulnerata is a mesophyll-feeding leafhopper. Leaf damage is recognizable as speckled whitish lesions, similar to those caused by the autochthonous *Zygina rhamni* Ferrari, 1882 (Seljak 2011). The presence of leaf lesions together with excrement left by *E. vulnerata* help differentiate damage caused by the two leafhopper species (Fig. 2; Paxton and Thorvilson 1996).

Discussion

The application of insecticides is the most important means of controlling leafhopper populations in vineyards (Duso et al. 2019). The ongoing temporary suspension of insecticide applications against *S. titanus* in Ticino has most likely permitted a general increase in leafhopper populations on grapevines, making the first occurrence of *E. vulnerata* in Switzerland in the frame of the current *S. titanus* monitoring program possible. This facilitation effect was already indirectly described by Duso et al. (2008), whose reports of *E. vulnerata* in Northeastern Italy refer to untreated *Vitis labrusca* and French hybrids.

The current spatial distribution of *E. vulnerata* in the study area suggests that this species had already been present for several years, and that the colonization most likely began from the southernmost part of Canton Ticino (Fig. 1), as already observed for *Phyllocnistis vitegenella* Clemens, 1859 (Cara and Jermini 2011; Cara et al. 2013). There is, however, no evidence to establish whether the arrival of *E. vulnerata* in Ticino is an example of accidental introduction or active migration from neighboring Italian vineyards, as proposed by Seljak (2011) for Slovenia.

E. vulnerata joins the three main vineyard leafhoppers that carry out part or their life cycle in the vineyards of Canton Ticino, namely *Scaphoideus titanus*, *Zygina rhamni*, and *Empoasca vitis* Goethe, 1875 (Viggiani 2002; Chuche and Thiéry 2014; Trivellone et al. 2016). While it is quite certain that the adaptive management approach currently being applied in Canton Ticino has permitted the reconstitution of leafhopper populations in vineyards, none of the aforementioned species currently poses a threat to grapevines in Southern Switzerland. In any case, the monitoring campaign in 2020 will allow for a better definition of the biology of *E. vulnerata* in the study area, determining, for example, the start of its colonization of grapevines and the number of generations since its introduction to Ticino.

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