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## Jumping plant-lice (Hemiptera, Psylloidea) from sticky traps in carrot fields in Valais, Switzerland

DANIEL BURCKHARDT<sup>1</sup> & JOST FREULER<sup>2</sup>

Sticky traps were used in three carrot fields in the lower Rhône Valley of the Canton Valais in Switzerland for monitoring insect pests. During the survey of 1998 forty-one species of jumping plant-lice (Hemiptera, Psylloidea) were collected. These included the pest species *Trioza apicalis* which produced considerable damage as well as three species (*Trioza anthrisci*, *Bactericera nigricornis* and *B. trigonica*) associated, among other plants, with cultivated carrots. The other 37 species develop on various herbaceous plants other than carrots, growing in or around the plots, or on trees or shrubs. The former are represented mostly in large numbers of individuals, of the latter usually only few specimens were collected suggesting that they develop further away. The number of psyllid species is surprisingly high, over a quarter of the known Swiss psyllid fauna, and interesting from a faunistic point of view. Two species (*Aphalara crispicola* and *Bactericera trigonica*) are new for Switzerland, and two new for Valais (*Aphalara avicularis* and *Homotoma ficus*). A detailed list of the collection is provided with the known general and Swiss distributions. Information on host plants, number of annual generations and overwintering stage is added. A key with illustrations is given for the identification of adults and fifth instar larvae of the four species on carrots.

Keywords: Carrots, Psylloidea, Switzerland, identification, faunistics, new records.

### INTRODUCTION

Carrots are among the most important vegetables in Switzerland. In 1998 they were cultivated on a total surface of 1'200 ha, yielding 53'844 t (J. LÜTHI, pers. comm.). The main areas where carrots are grown are in the cantons Bern/Fribourg, St. Gallen/Thurgau, Aargau/Zürich, Valais, Vaud and, to a lesser extent, Ticino.

The most serious pest of cultivated carrots is the carrot fly (*Chamaepsila rosae* (FABRICIUS), Diptera, Psilidae). For a long time the carrot triozid, *Trioza apicalis* FOERSTER, was considered a secondary pest, sometimes locally building up large populations. Since 1996, however, its economic importance has drastically increased in several areas of western Switzerland. The major damage is caused by females after hibernation. Their saliva produces a phytotoxemia of the persistent systemic type in the host tissue. Externally this becomes visible in the typical curling of the leaves, giving them a parsley-like appearance, in the reduced growth and, sometimes, in the shortening of the carrot with an abundance of secondary roots (FREULER, 1998). In view of supervised control, trapping is the only way to follow the migratory movements of the carrot triozid and, combined with a scouting method, to assess its potential risk to cultures. The triozids are easily collected with the same sticky traps which are used to monitor the carrot fly.

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During a survey in 1998, four trioqid species associated with carrots were collected with sticky traps in three plots in Valais. Currently it is unknown whether *T. apicalis* is the only species responsible for damage, and all four species should be examined in this respect. The present paper provides an illustrated key for the identification of the larvae and adults of the four species associated with carrots. Their frequency is given based on weekly counts, and information on their life cycles is summarized. In addition to the four species of carrot trioquids 37 species of Psylloidea were collected with the sticky traps. The species are listed with their distribution and host plants.

#### MATERIAL AND METHODS

The migratory movements of the carrot trioquids were monitored in three sites. Two of them are in the Chablais Valaisan, i. e. La Rosaire (Angst) near Illarsaz (map reference: Landeskarte 1: 25'000 Monthey 1284, 559 950/129 900) and Saves (Lation) near Collombey (Landeskarte 1: 25'000 Monthey 1284, 560 950/127 000), and one in Central Valais, i. e. Châteauneuf (Ecole cantonale d'agriculture) near Sion (Landeskarte 1 : 25'000 Sion 1306, 590 200/118 500). The first two plots were early, the last plot late sowings respectively.

The sticky traps consisted of a yellowish-orange 3 mm thick, 20 x 20 cm (trapping area 800 cm<sup>2</sup>) acrylic glass (ICI "Perspex", colour code 229, by Wachendorf AG, Technischer Grosshandel, Basel). The acrylic glass was coated on both sides with Tangle-Trap or Soveurode spray. These traps, described by FREULER & FISCHER (1991), are the same as the ones used to monitor the carrot fly, *Chamaepsila rosae*. Five traps per site were run during the whole vegetational period (La Rosaire 12.v–27.x.1998; Saves 8.iv–13.x.1998; Châteauneuf 17.vi–3.xi.1998, detailed faunistic sampling only from 19.viii.). The traps were exchanged once a week, and the psyllids were removed with and stored in Sangayol.

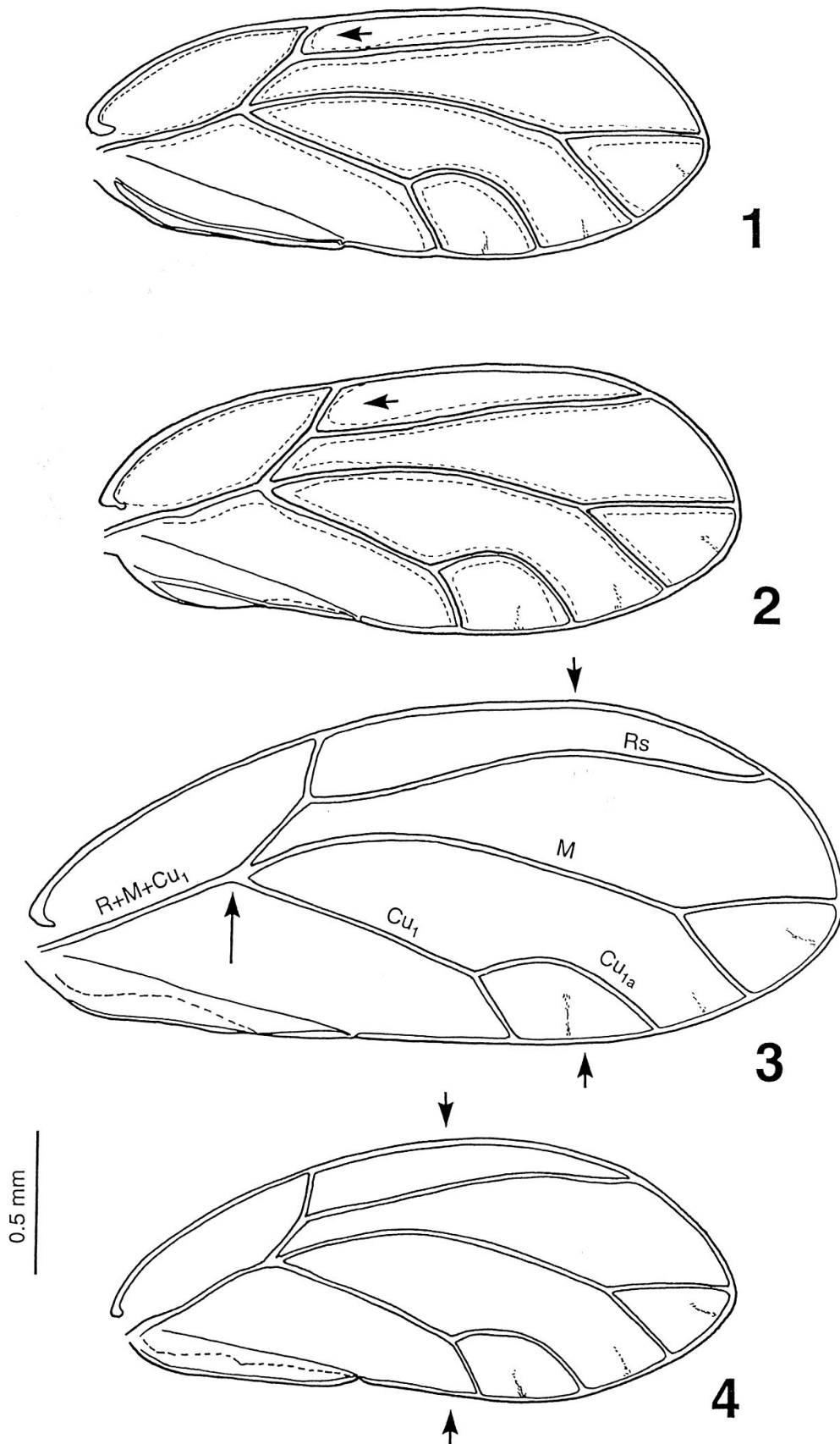
The nomenclature of psyllids follows mostly OSSIANNILSSON (1992), with the exception of *Aphalara* for which that of BURCKHARDT & LAUTERER (1997a) is adopted. The Swiss distribution is taken from SCHAEFER (1949), BURCKHARDT (1983, 1994) and from unpublished material deposited in the Naturhistorisches Museum Basel (NHMB). The morphological terminology accords with that of OSSIANNILSSON (1992).

#### RESULTS

##### *Taxonomy*

The following four species associated with carrots were collected during the survey: *Trioza apicalis* FOERSTER, 1848, *T. anthrisci* BURCKHARDT, 1986 (= *T. pallida* HAUPT, 1935 nec UICHANCO, 1919), *Bactericera nigricornis* (FOERSTER, 1848) and *B. trigonica* HODKINSON, 1981. They are not closely related and are assigned to two different genera. Whereas *Bactericera* constitutes a well-defined monophyletic genus (BURCKHARDT & LAUTERER, 1997b), *Trioza* is highly artificial. *Trioza apicalis* and *T. anthrisci* have been referred to *Dyspersa* KLIMASZEWSKI by some authors (CONCI & TAMANINI, 1991), an action of little phylogenetic or practical significance as pointed out by BURCKHARDT (1986), and which is not followed here.

The *Trioza apicalis* and the *Bactericera nigricornis* groups were revised by BURCKHARDT (1986) and by HODKINSON (1981) respectively who provided de-



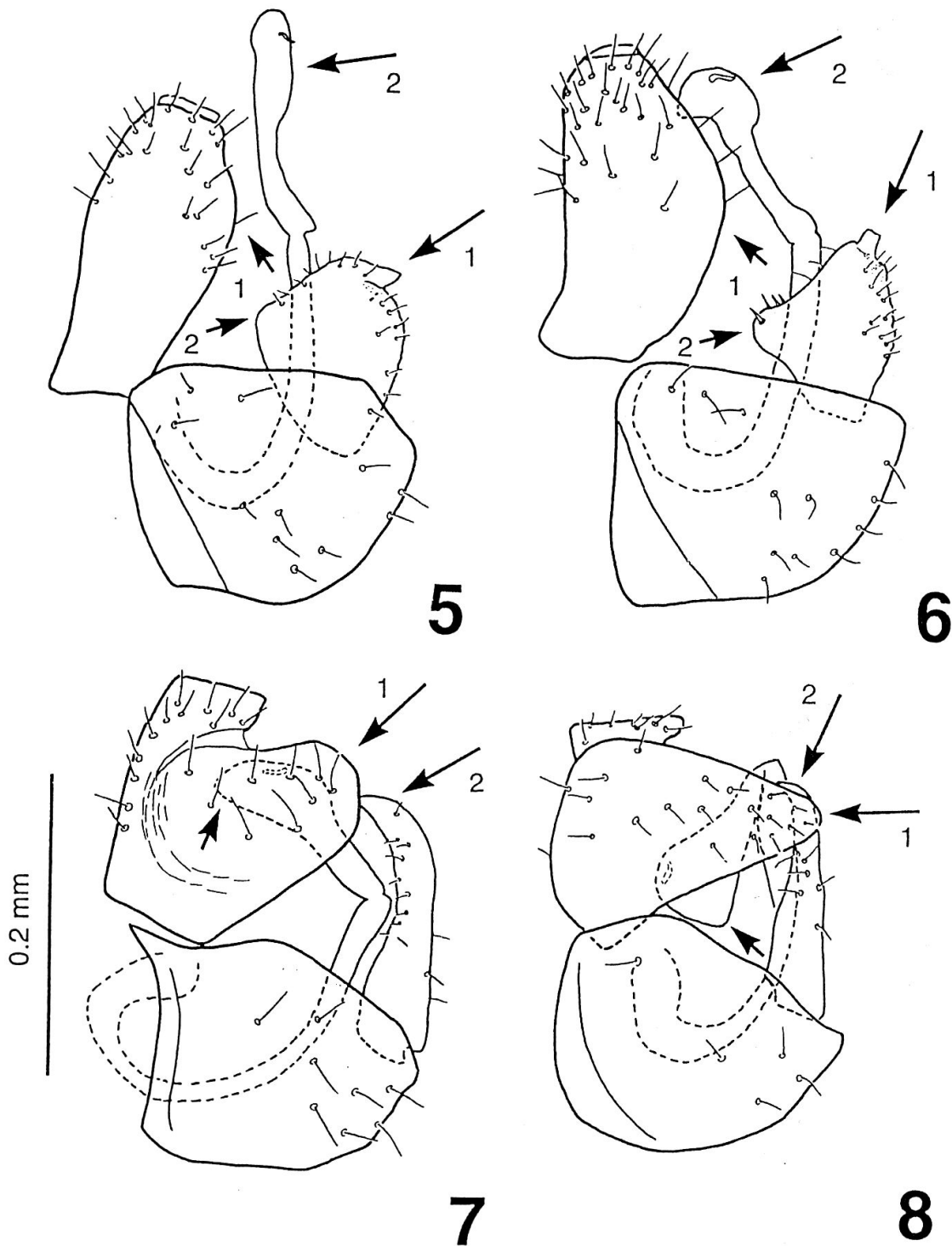
Figs 1–4: Forewing (scale bar = 0.5 mm). – 1. *Trioza apicalis*. – 2. *Trioza anthrisci*. – 3. *Bactericera nigricornis*. – 4. *Bactericera trigonica*.

criptions for the species. Additional descriptions are given by OSSIANNILSSON (1992).

The following keys are intended for the identification of the four species of carrot trioizids and differentiate them from other psylloids which may occur in carrot fields but are not associated directly with *Daucus*.

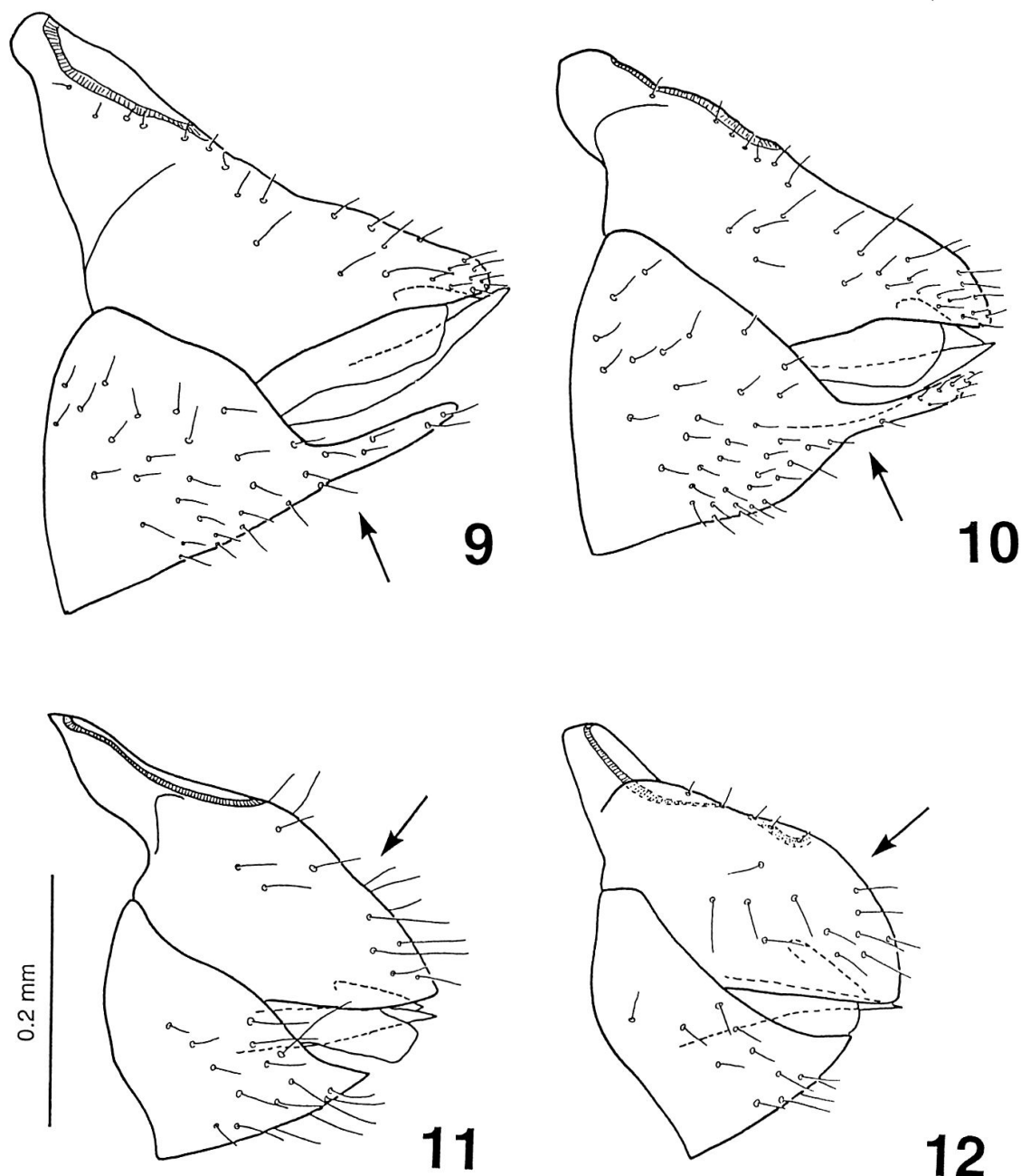
*Key to carrot trioizids: adults*

- 1 Veins M and Cu<sub>1</sub> of forewing with common branch M+Cu<sub>1</sub> (= psylline venetation). Metatibia with 4–8 heavily sclerotised apical spurs .....  
Psyllidae (*Aphalara*, *Baeopelma*, *Cacopsylla*, *Camarotoscena*, *Craspedolepta*, *Livilla*, *Psyllopsis*) and Homotomidae (*Homotoma*)
- Veins M and Cu<sub>1</sub> lacking a common branch, vein R+M+Cu<sub>1</sub> splitting directly into three branches, viz. R, M and Cu<sub>1</sub> (= trioizine venetation) (Fig. 3, large arrow). Metatibia with 3 or 4 heavily sclerotised apical spurs ..... 2
- 2 Metatibia with 1+3 heavily sclerotised apical spurs .....  
..... *Trioza cerastii*, *cirsii*, *galii*, *schranski*, *tatrensis*, *urticae*
- Metatibia with 1+2 heavily sclerotised apical spurs.....3
- 3 Bifurcation of vein M of forewing lying distinctly distal to line between apices of veins Rs and Cu<sub>1a</sub> ..... *Trioza alacris*, *remota*
- Bifurcation of vein M of forewing lying on or proximal to line between apices of veins Rs and Cu<sub>1a</sub> (Fig. 3) ..... 4
- 4 Forewing membrane with surface spinules (Figs 1, 2) ..... 5
- Forewing membrane lacking surface spinules (Figs 3, 4) ..... 7
- 5 Body colour reddish, brown or black ..... *Bactericera femoralis*
- Body colour yellow or green ..... 6
- 6 Male proctiger relatively straight posteriorly (Fig. 5, short arrow 1); paramere, in profile, with small anterior lobe (Fig. 5, small arrow 2) and back-curved apical tooth (Fig. 5, large arrow 1); apical dilatation of distal segment of aedeagus straight (Fig. 5, large arrow 2). Female subgenital plate with relatively broad, evenly tapering apical process (Fig. 9, arrow). Forewing with narrow cell r<sub>1</sub> (Fig. 1, arrow), membrane often yellowish. Antennae yellowish with black, well-contrasted ultimate three segments ..... *Trioza apicalis*
- Male proctiger distinctly produced posteriorly (Fig. 6, small arrow 1), paramere, in profile, with large anterior lobe (Fig. 6, small arrow 2) and up-curved apical tooth (Fig. 6, large arrow 1); apical dilatation of distal segment of aedeagus curved (Fig. 6, large arrow 2). Female subgenital plate with relatively narrow, parallel-sided, basally well-defined apical process (Fig. 10, arrow). Forewing with wide cell r<sub>1</sub> (Fig. 2, arrow), membrane colourless. Antennae yellowish basally, gradually darkening towards apex .....  
..... *Trioza anthrisci*
- 7 Genal processes longer than half vertex length along midline .....  
..... *Bactericera curvatineris*, *Trioza scottii*
- Genal processes shorter than half vertex length along midline ..... 8
- 8 Forewing widest in apical quarter (Fig. 3, small arrows). Male proctiger broadly rounded posteriorly (Fig. 7, large arrow 1). Paramere, in profile, with large, anteriorly pointing apex (Fig. 7, large arrow 2). Apical dilatation of distal portion of aedeagus relatively narrow (Fig. 7, small arrow). Dorsal margin of female proctiger only weakly curved (Fig. 11, arrow) .....  
..... *Bactericera nigricornis*



Figs 5-8: Male genitalia, in profile (scale bar = 0.2 mm). - 5. *Trioza apicalis*. - 6. *Trioza anthrisci*. - 7. *Bactericera nigricornis*. - 8. *Bactericera trigonica*.

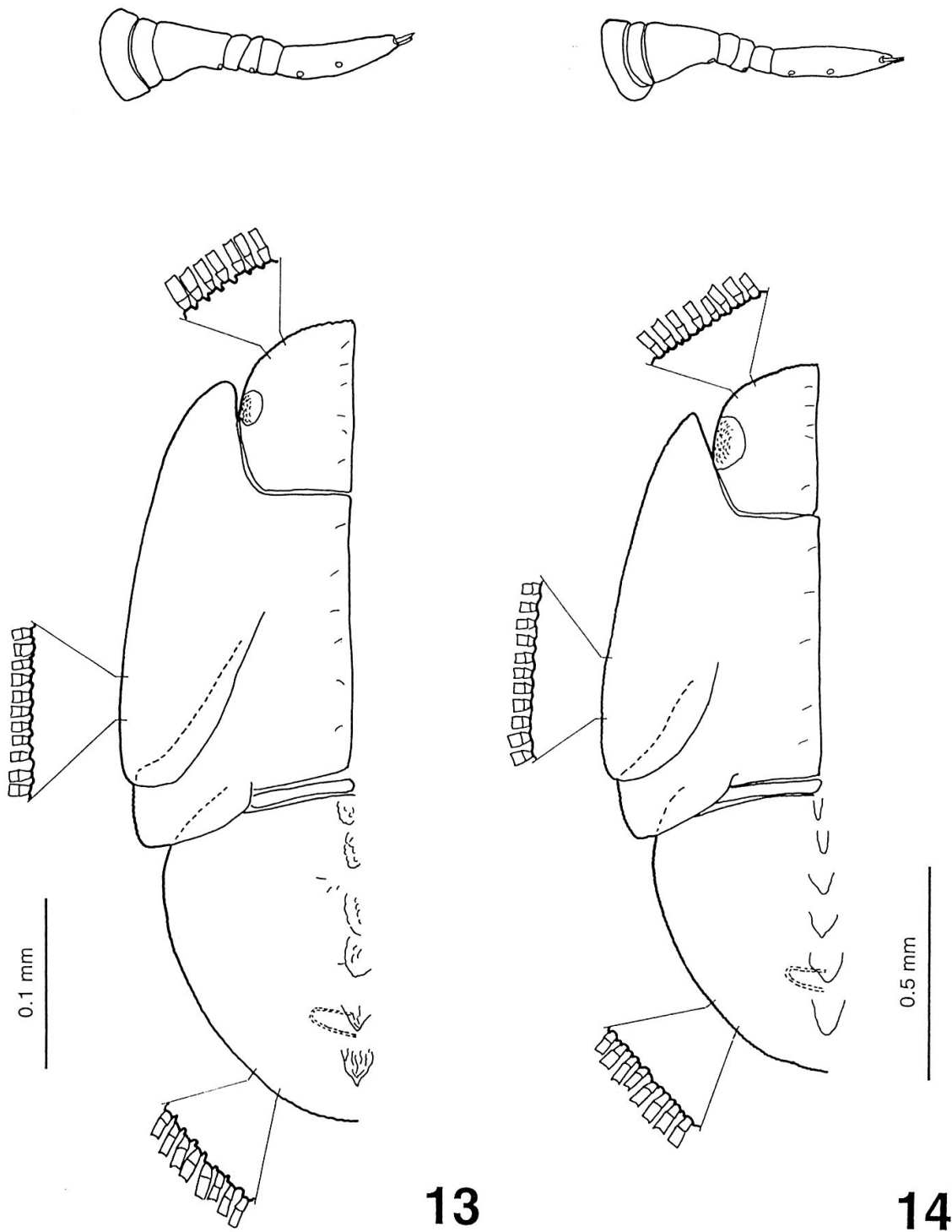
- Forewing widest in the middle (Fig. 4, arrows). Male proctiger triangular posteriorly (Fig. 8, large arrow 1). Paramere, in profile, with small, anteriorly pointing apex (Fig. 8, large arrow 2). Apical dilatation of distal portion of aedeagus relatively wide (Fig. 8, small arrow). Dorsal margin of female proctiger distinctly curved (Fig. 12, arrow) ..... *Bactericera trigonica*



Figs 9–12: Female genitalia, in profile (scale bar = 0.2 mm). – 9. *Trioza apicalis*. – 10. *Trioza anthrisci*. – 11. *Bactericera nigricornis*. – 12 *Bactericera trigonica*.

*Key to carrot triozids: fifth instar larvae*

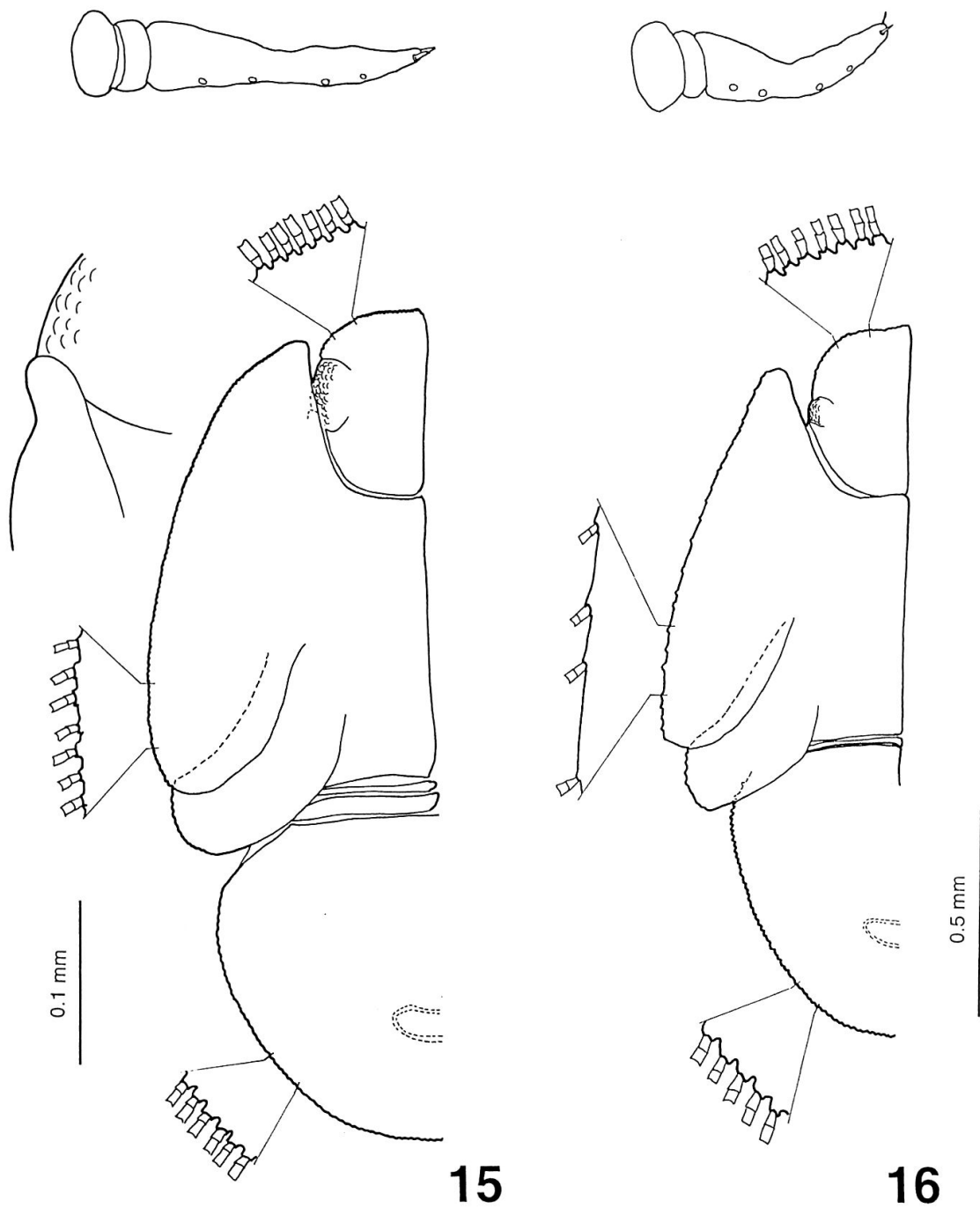
- 1 Head and thoracic dorsum with a median longitudinal ridge, abdomen with a median row of six dorsal humps (Figs 13, 14). Antennae 6 to 7-segmented (Figs 13, 14, detail). Without lobe at base of eye, posterior eye margin therefore convex ..... 2
- Head and thoracic dorsum flattened without median longitudinal ridge, abdomen lacking median row of dorsal humps (Figs 15, 16). Antennae 3-segmented (Figs 15, 16, detail). With small lobe at base of eye, posterior eye margin therefore concave (fig. 15, detail) ..... 3



Figs 13–14: Fifth instar larva of *Trioza* spp., dorsal view (scale bar = 0.5 mm), with details of antenna and marginal setae (scale bar = 0.1 mm). – 13. *T. apicalis*. – 14. *T. anthrisci*.

- 2 Humps on abdominal dorsum approximately equal in size ... *Trioza apicalis*
- Humps on abdominal dorsum relatively small anteriorly, gradually increasing in size caudad ..... *Trioza anthrisci*
- 3 Humeral lobes of forewing pads relatively broad, with densely spaced marginal setae (Fig. 15) ..... *Bactericera nigricornis*





Figs 15–16: Fifth instar larva of *Bactericera* spp., dorsal view (scale bar = 0.5 mm), with details of antenna, base of eye and marginal setae (scale bar = 0.1 mm). – 15. *B. nigricornis*. – 16. *B. trigonica*.

- Humeral lobes of forewing pads relatively narrow with sparsely spaced marginal setae (Fig. 16) ..... *Bactericera trigonica*

*Life cycle*

All four species of carrot trioziids overwinter as adults on conifers. The two *Trioza* spp. are univoltine, the *Bactericera* spp. bivoltine or polyvoltine depending on climatic conditions. The life cycle of *T. apicalis* in Switzerland has been de-

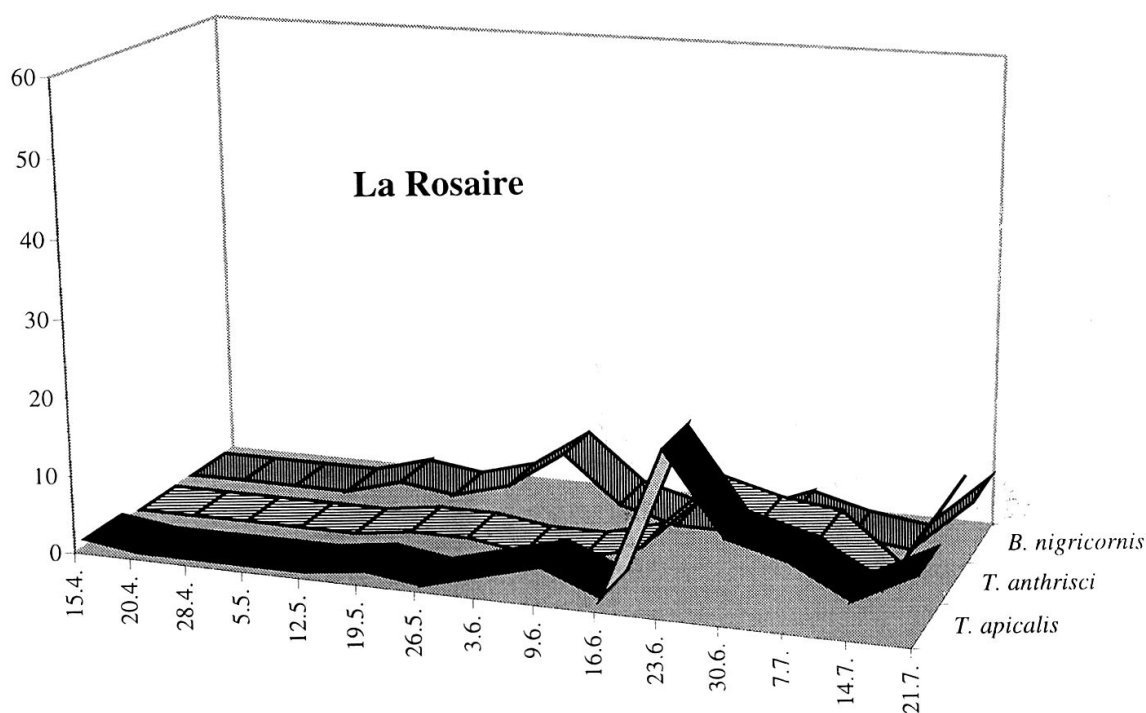


Fig. 17: Weekly counts of the carrot triozyds in La Rosaire.

scribed by FREULER (1998). The arrival of adults on carrots was observed from late Mai to July or even early August. Adults live several weeks on the carrots during which period each female lays several hundred eggs. Young larvae are present on the host from end of June to early August. The larval development takes on average 50 to 65 days. The first adults of the new generation appear usually around mid-August. The young adults leave the host plants, not necessarily moving directly to the hibernating places. This autumnal migration takes place until November. *T. anthrisci* has probably a similar life cycle. The life cycles of the two *Bactericera* spp. in Switzerland have not been described.

Figs 17-19 illustrate the number of specimens per week of *T. apicalis*, *T. anthrisci* and *B. nigricornis*. The curves of the two *Trioza* spp. are similar, and conform with the observations of FREULER (1998). The curve for *B. nigricornis* at Saves shows two peaks suggesting the presence of two generations. Adults of the first generation appear end of June and early July, those of the second in the first half of August. The data for *B. trigonica* are insufficient for further conclusions.

#### FAUNISTICS

During the survey, 41 species were collected, one of which remains unidentified. The following list details the collection data, and provides for each species information on the known general (DIS) as well as Swiss (DIS-CH) distributions. Tab. 1 summarizes the occurrence of each species in the the three plots, indicates the host plant(s), the number of annual generations as well as overwintering stage and place.

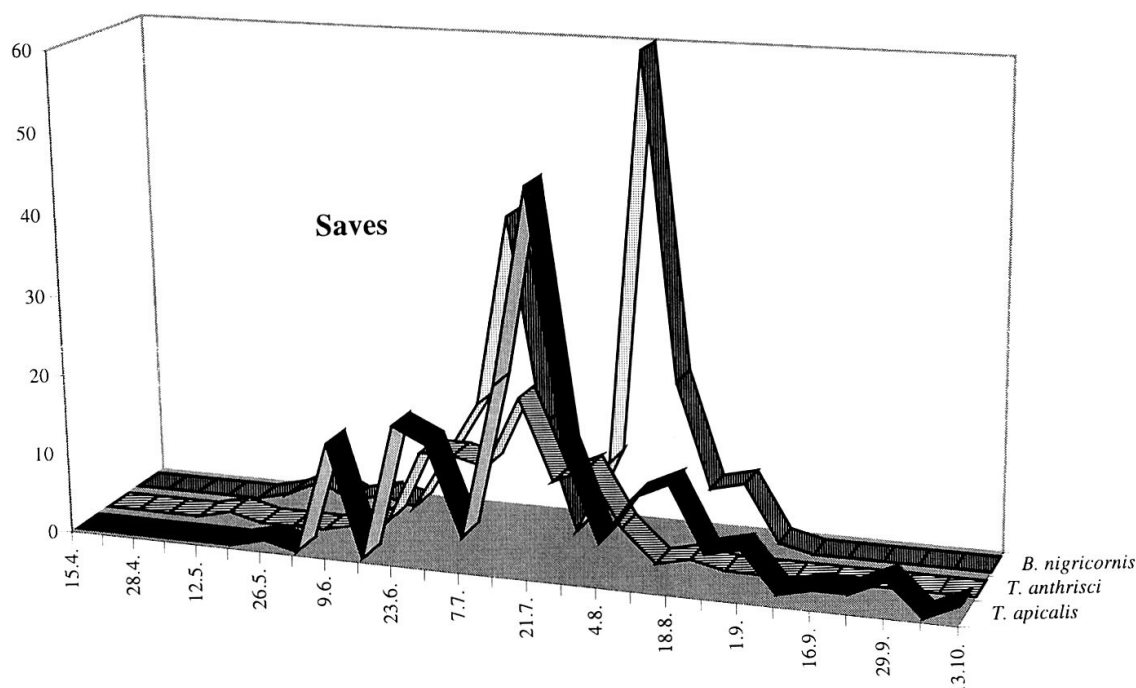


Fig. 18: Weekly counts of the carrot triozids in Saves.

### *Aphalara avicularis* OSSIANNILSSON, 1981

La Rosaire: 28.iv. (37 ♂♂, 34 ♀♀); 5.v. (22 ♂♂, 15 ♀♀); 12.v. (131 ♂♂, 104 ♀♀); 19.v. (82 ♂♂, 34 ♀♀); 26.v. (4 ♂♂, 2 ♀♀); 3.vi. (8 ♂♂, 3 ♀♀); 9.vi. (3 ♂♂, 1 ♀); 7.vii. (2 ♂♂, 1 ♀); 21.vii. (3 ♂♂).

Saves: 28.iv. (10 ♂♂, 15 ♀♀); 5.v. (6 ♂♂, 4 ♀♀); 12.v. (42 ♂♂, 29 ♀♀); 19.v. (12 ♂♂, 18 ♀♀); 26.v. (6 ♂♂, 1 ♀); 9.vi. (3 ♂♂, 1 ♀); 23.vi. (3 ♂♂, 1 ♀); 30.vi. (3 ♀♀); 7.vii. (3 ♂♂, 3 ♀♀); 14.vii. (2 ♀♀); 28.vii. (2 ♂♂, 1 ♀).

DIS: Central and North Europe (BURCKHARDT & LAUTERER, 1997a); DIS-CH: GE, ZH (BURCKHARDT, 1994), BE, BL, BS, GR (NHMB data).

Comments. New record for Valais.

### *Aphalara calthae* (L., 1761)

La Rosaire: 12.v. (46 ♂♂, 36 ♀♀); 19.v. (24 ♂♂, 27 ♀♀); 26.v. (1 ♂, 1 ♀); 3.vi. (1 ♂, 1 ♀).

Saves: 5.v. (1 ♂); 12.v. (23 ♂♂, 26 ♀♀); 19.v. (32 ♂♂, 37 ♀♀); 26.v. (11 ♂♂, 6 ♀♀); 3.vi. (4 ♂♂, 1 ♀); 9.vi. (2 ♂♂, 1 ♀).

DIS: Central, North and East Europe, Siberia, Far East Russia, Japan (BURCKHARDT & LAUTERER, 1997a); DIS-CH: JU, SZ, VS, ZH (BURCKHARDT, 1983).

### *Aphalara crispicola* OSSIANNILSSON, 1987

La Rosaire: 12.v. (2 ♂♂, 1 ♀); 19.v. (1 ♂); 3.vi. (11 ♂♂, 9 ♀♀); 9.vi. (28 ♂♂, 19 ♀♀); 16.vi. (3 ♂♂, 5 ♀♀); 23.vi. (3 ♂♂); 30.vi. (1 ♂, 3 ♀♀); 7.vii. (1 ♀).

Saves: 28.iv. (1 ♂, 1 ♀); 12.v. (2 ♂♂); 3.vi. (3 ♂♂, 2 ♀♀); 9.vi. (8 ♂♂, 10 ♀♀); 23.vi. (2 ♂♂, 1 ♀); 30.vi. (1 ♂, 1 ♀); 21.vii. (1 ♂).

DIS: Central and North Europe, Balkan Peninsula (BURCKHARDT & LAUTERER, 1997a); DIS-CH: BL, Liestal, Prometheus, 13.iii.1945, Coniferae (H. SCHAEFER); GR, Malix, 27.vii.1945, *Rumex* sp. (H. SCHAEFER); OW, Pilatus, Fräkmünt, 1500 m, 25.vi.1999 (D. BURCKHARDT) (all NHMB).

Comments. New record for Switzerland.

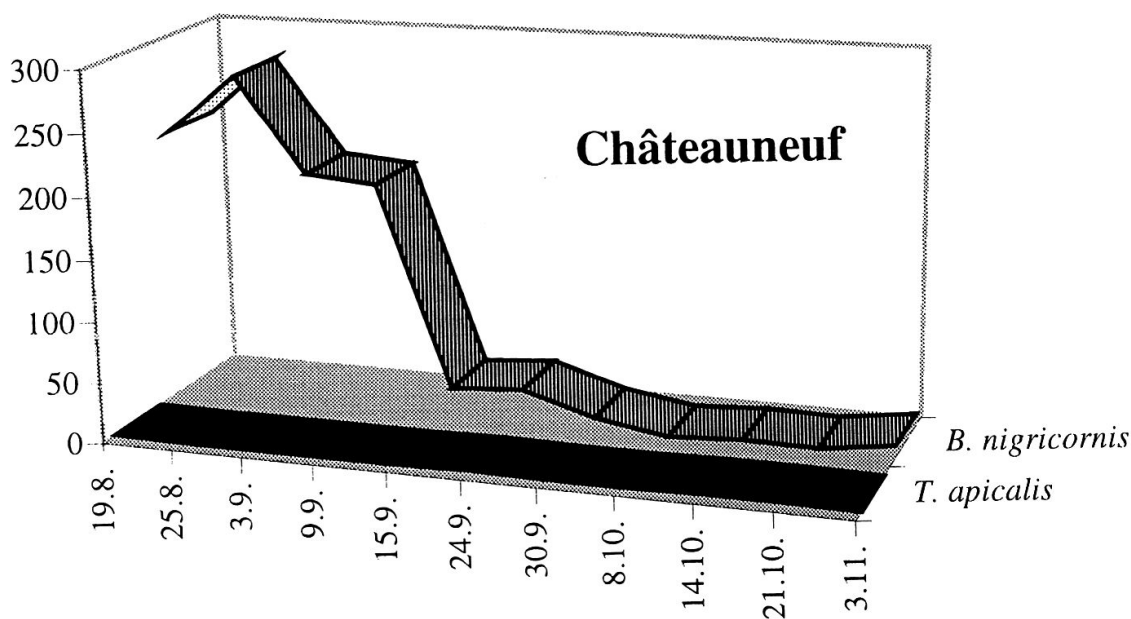


Fig. 19: Weekly counts of the carrot triozids in Châteauneuf.

***Aphalara freji* BURCKHARDT & LAUTERER, 1997**

La Rosaire: 7.vii. (1 ♂, 1 ♀); 14.vii. (1 ♂); 21.vii. (1 ♂).  
 Saves: 20.iv. (1 ♀); 28.iv. (4 ♂♂, 3 ♀♀); 5.v. (14 ♂♂, 8 ♀♀); 12.v. (16 ♂♂, 4 ♀♀); 9.vi. (1 ♂).  
 Châteauneuf: 19.viii. (1 ♀); 3.ix. (1 ♂).

DIS: West Palaearctic, perhaps also Central Asia, China, Japan (BURCKHARDT & LAUTERER, 1997a); DIS-CH: GE (BURCKHARDT & LAUTERER, 1997a), BE, BL, GR, OW, SG, TI, VS (NHMB data).

***Aphalara longicaudata* WAGNER & FRANZ, 1961**

La Rosaire: 3.vi. (1 ♂).  
 Saves: 14.vii. (1 ♀); 21.vii. (2 ♀♀); 11.viii. (1 ♀); 18.viii. (1 ♂).

DIS: Central and North Europe, Central Asia, Mongolia, Siberia (BURCKHARDT & LAUTERER, 1997a); DIS-CH: BL, GR, JU, VS (SCHAEFER, 1949), OW, SZ (NHMB data).

***Aphalara maculipennis* LÖW, 1886**

La Rosaire: 12.v. (2 ♂♂); 19.v. (2 ♂♂, 3 ♀♀); 26.v. (5 ♂♂, 2 ♀♀); 3.vi. (7 ♂♂); 9.vi. (6 ♂♂, 7 ♀♀); 16.vi. (2 ♂♂, 1 ♀); 23.vi. (1 ♀); 30.vi. (1 ♂♂).  
 Saves: 19.v. (3 ♀♀); 26.v. (1 ♂, 1 ♀♀); 3.vi. (1 ♀); 16.vi. (1 ♂); 23.vi. (1 ♂, 1 ♀); 30.vi. (2 ♂♂, 1 ♀); 11.viii. (1 ♂); 18.viii. (1 ♀).

DIS: West Palaearctic, Central Asia, Siberia, Amur, Mongolia, North India, Siberia (BURCKHARDT & LAUTERER, 1997a); DIS-CH: BL, VS (SCHAEFER, 1949), ZH (BURCKHARDT, 1994).

***Aphalara polygona* FOERSTER, 1848**

La Rosaire: 3.vi. (2 ♂♂); 9.vi. (1 ♀).  
 Saves: 19.v. (1 ♂, 1 ♀); 9.vi. (1 ♂).

DIS: Central, North and East Europe (BURCKHARDT & LAUTERER, 1997a); DIS-CH: recorded from Switzerland but without indications of localities (BURCKHARDT, 1983), BL, OW, TI, VS (NHMB data).

Table 1. Occurrence of Psylloidea in the three carrot fields R = La Rosaire, S = Saves, C = Château-neuf, N = number of yearly generations, O = overwintering stage (AD = adult, L = larva, E = egg) and place (C = conifers, HP = host plant).

Species name	R	S	C	Host plant(s)	N	O
<i>Aphalara avicularis</i>	x	x		<i>Polygonum aviculare</i>	1?	AD - C
<i>Aphalara calthae</i>	x	x		<i>Caltha palustris</i>	1	AD - C
<i>Aphalara crispicola</i>	x	x		<i>Rumex crispus, domesticus, aquaticus, obtusifolius, conglomeratus</i>	2	AD - C
<i>Aphalara freji</i>	x	x	x	<i>Polygonum amphibium, hydropiper, lapathifolium, mite, persicaria, tomentosum</i>	1	AD - C
<i>Aphalara longicaudata</i>	x	x		<i>Polygonum bistorta</i>	1	AD - C
<i>Aphalara maculipennis</i>	x	x		<i>Polygonum amphibium, lapathifolium, tomentosum</i>	1	AD - C
<i>Aphalara polygoni</i>	x	x		<i>Rumex acetosella, acetosa, scutatus</i>	1?	AD - C
<i>Bactericera curvatineris</i>		x		<i>Salix alba, aurita, caprea, cinerea, purpurea, repens, viminalis</i>	1-2?	AD - C
<i>Bactericera femoralis</i>	x			<i>Alchemilla</i> spp.	2	AD - C
<i>Bactericera nigricornis</i>	x	x	x	polyphagous on herbaceous plants, including <i>Daucus carota</i>	2-3	AD - C
<i>Bactericera trigonica</i>	x	x		<i>Daucus carota</i> , possibly polyphagous	2-3	AD - C
<i>Bactericera</i> sp.		x			?	
<i>Baeopelma foersteri</i>	x	x		<i>Alnus</i> spp.	1	E - HP
<i>Cacopsylla ambigua</i>		x		<i>Salix alba, appendiculata, caprea, cinerea, elaeagnos, viminalis</i>	2	E, L - HP
<i>Cacopsylla breviantennata</i>	x	x		<i>Sorbus aria, boisieri, graeca</i>	1-2	AD - C
<i>Cacopsylla brunneipennis</i>	x	x		<i>Salix</i> spp.	1	AD - C
<i>Cacopsylla mali</i>	x	x		<i>Malus</i> spp.	1	E - HP
<i>Cacopsylla melanoneura</i>	x	x		<i>Crataegus</i> spp. (+ <i>Malus</i> and <i>Pyrus</i> spp.)	1	AD - C
<i>Cacopsylla pulchella</i>		x		<i>Cercis siliquastrum</i>	1	AD - C
<i>Cacopsylla pyri</i>	x	x	x	<i>Pyrus communis, elaeagrifolia</i>	polyvoltine	A - HP
<i>Cacopsylla pyricola</i>		x		<i>Pyrus communis, pyraster</i>	polyvoltine	A - HP
<i>Cacopsylla pyrisuga</i>	x	x		<i>Pyrus</i> spp.	1	AD - C
<i>Cacopsylla saliceti</i>		x		<i>Salix</i> spp.	1-2	AD - C
<i>Cacopsylla visci</i>		x		<i>Viscum album</i>	2-3	A - HP
<i>Camarotoscena speciosa</i>	x	x		<i>Populus</i> spp.	2?	A?
<i>Craspedolepta flavipennis</i>	x	x		various Asteraceae	1	L?
<i>Homotoma ficus</i>			x	<i>Ficus carica</i>	1	E - HP
<i>Livilla variegata</i>		x		<i>Laburnum</i> spp.	1	E or L?
<i>Psyllopsis fraxini</i>	x	x		<i>Fraxinus</i> spp.	1-2	E - HP
<i>Psyllopsis fraxinicola</i>	x	x		<i>Fraxinus</i> spp.	1-2	E - HP
<i>Trioza alacris</i>	x		x	<i>Laurus nobilis</i>	polyvoltine	AD - C
<i>Trioza anthrisci</i>	x	x		various Apiaceae	1	AD - C
<i>Trioza apicalis</i>	x	x	x	various Apiaceae	1	AD - C
<i>Trioza cerastii</i>	x			<i>Cerastium</i> spp.	1	AD - C
<i>Trioza cirsii</i>		x		<i>Cirsium</i> spp.	1?	AD - C
<i>Trioza galii</i>	x	x		<i>Galium</i> spp. and other Rubiaceae	1-2?	L?
<i>Trioza remota</i>	x	x	x	<i>Quercus petraea, robur</i>	1	AD - C
<i>Trioza schrankii</i>	x	x		<i>Astrantia</i> spp.	1	AD - C
<i>Trioza scottii</i>		x	x	<i>Berberis vulgaris</i>	1-2?	AD - C
<i>Trioza tatrensis</i>	x			<i>Hieracium</i> spp.	1?	AD - C
<i>Trioza urticae</i>	x	x	x	<i>Urtica</i> spp.	polyvoltine	AD - C

***Bactericera curvatinervis* (FOERSTER, 1848)**

Saves: 20.iv. (1 ♂).

DIS: Most of Europe, Caucasus, Far East and Japan (BURCKHARDT & LAUTERER, 1997b); DIS-CH: BE, BL, JU, VS (SCHAEFER, 1949), GR, LU, TI, VD (BURCKHARDT, 1983).

***Bactericera femoralis* (FOERSTER, 1848)**

La Rosaire: 28.iv. (1 ♂); 5.v. (1 ♂).

DIS: North, Central and East Europe, Caucasus, Irkutsk and Amur district (BURCKHARDT & LAUTERER, 1997b); DIS-CH: BE, BL, GR, JU, VS (SCHAEFER, 1949), TI (BURCKHARDT, 1983), OW, SG, SZ (NHMB data).

***Bactericera nigricornis* (FOERSTER, 1848)**

La Rosaire: 12.v. (1 ♂, 1 ♀); 19.v. (1 ♂); 26.v. (2 ♂♂, 1 ♀); 3.vi. (7 ♂♂, 2 ♀♀); 9.vi. (2 ♂♂); 30.vi. (2 ♂♂, 1 ♀); 7.vii. (1 ♂); 21.vii. (6 ♂♂, 1 ♀).

Saves: 19.v. (2 ♂♂); 26.v. (1 ♂♂, 2 ♀♀); 3.vi. (1 ♂); 9.vi. (1 ♂, 1 ♀); 16.vi. (1 ♂); 23.vi. (5 ♂♂, 3 ♀♀); 30.vi. (14 ♂♂, 1 ♀); 7.vii. (35 ♂♂, 3 ♀♀); 14.vii. (11 ♂♂, 2 ♀♀); 21.vii. (2 ♂♂); 28.vii. (5 ♂♂, 2 ♀♀); 4.viii. (49 ♂♂, 11 ♀♀); 11.viii. (12 ♂♂, 8 ♀♀); 18.viii. (6 ♂♂, 1 ♀); 25.viii. (6 ♂♂, 2 ♀♀); 1.ix. (1 ♀).

Châteauneuf: 19.viii. (315 ♂♂, 10 ♀♀); 25.viii. (261 ♂♂, 10 ♀♀); 3.ix. (190 ♂♂, 5 ♀♀); 9.ix. (181 ♂♂, 8 ♀♀); 15.ix. (23 ♂♂, 1 ♀); 24.ix. (27 ♂♂, 1 ♀); 30.ix. (10 ♂♂); 14.x. (3 ♂♂); 21.x. (2 ♀♀); 3.xi. (9 ♂♂, 1 ♀).

DIS: West Palaearctic, Central Asia, Siberia, Mongolia (BURCKHARDT & LAUTERER, 1997b); DIS-CH: AG, BE, BL, GR, JU, VS (SCHAEFER, 1949).

***Bactericera trigonica* HODKINSON, 1981**

La Rosaire: 21.vii. (3 ♂♂, 1 ♀).

Saves: 7.vii. (1 ♂); 4.viii. (2 ♂♂); 18.viii. (1 ♂); 8.ix. (3 ♂♂).

DIS: Portugal, Italy, Cyprus, former Czechoslovakia, Turkey, Iran (BURCKHARDT & LAUTERER, 1997b), Malta (MIFSUD, 1997), Algeria, Israel (MHNG data); DIS-CH: VS, Branson, Follatères, 530–560 m, 25.vii.1985 (C. LIENHARD) (MHNG).

Comments. New record for Switzerland. The record of *Bactericera kratochvili* VONDRAČEK from Switzerland by BURCKHARDT & LAUTERER (1997b) is a mistake. It is based on the specimen from Follatères which belongs to *B. trigonica*.

***Bactericera* sp.**

Saves: 23.vi. (1 ♀).

Comments. More material is required to identify this species.

***Baeopelma foersteri* (FLOR, 1861)**

La Rosaire: 7.vii. (1 ♂, 2 ♀).

Saves: 30.vi. (1 ♂); 7.vii. (1 ♂).

DIS: Palaearctic region (OSSIANNILSSON, 1992); DIS-CH: AG, BE, BL, BS, GE, GR, TG, TI, VD, VS (SCHAEFER, 1949), SZ (BURCKHARDT, 1983), LU (NHMB data).

***Cacopsylla ambigua* (FOERSTER, 1848)**

Saves: 7.vii. (1 ♀).

DIS: Palaearctic region, Greenland (LAUTERER & BURCKHARDT, 1997); DIS-CH: BE, BL, BS, VS (SCHAEFER, 1949), AG, GR, SZ, ZH (BURCKHARDT, 1983), JU, OW (NHMB data).

***Cacopsylla brevi antennata*** (FLOR, 1861)

La Rosaire: 20.iv. (1 ♂); 28.iv. (1 ♀).

Saves: 12.v. (1 ♀).

DIS: Central, South and East Europe including Caucasus (KLIMASZEWSKI, 1973); DIS-CH: BE, BL, BS, JU, VS (SCHAEFER, 1949), GR, OW, SH, SZ, TI (BURCKHARDT, 1983).

***Cacopsylla brunneipennis*** (EDWARDS, 1896)

La Rosaire: 5.v. (1 ♀); 12.v. (1 ♂, 6 ♀ ♀); 19.v. (1 ♀).

Saves: 12.v. (1 ♀); 19.v. (3 ♀ ♀); 9.vi. (1 ♀); 7.vii. (1 ♀).

DIS: Widely distributed in Europe (LAUTERER & BURCKHARDT, 1997); DIS-CH: BE, VS (SCHAEFER, 1949), AG, OW, SZ, TI (BURCKHARDT, 1983), BS, JU (NHMB data).

***Cacopsylla mali*** (SCHMIDBERGER, 1836)

La Rosaire: 21.vii. (1 ♂).

Saves: 9.vi. (1 ♀); 4.viii. (1 ♀).

DIS: Palaearctic, introduced into North America (OSSIANNILSSON, 1993); DIS-CH: AG, BE, BL, BS, GR, JU, SO, TG, VS (SCHAEFER, 1949), TI (BURCKHARDT, 1983).

***Cacopsylla melanoneura*** (FOERSTER, 1848)

La Rosaire: 15.iv. (1 ♀); 28.iv. (1 ♀); 9.vi. (1 ♀).

Saves: 28.iv. (1 ♂); 23.vi. (1 ♂).

DIS: Europe, Siberia, Russian Far East, Dzungaria, Mongolia, China, Japan (OSSIANNILSSON, 1992); DIS-CH: BE, BL, BS, GE, JU, SO, VD, VS (SCHAEFER, 1949), AG, GR, TI (BURCKHARDT, 1983), LU, OW, SZ, ZH (NHMB data).

***Cacopsylla pulchella*** (LÖW, 1877)

Saves: 26.v. (2 ♂ ♂).

DIS: Mostly Mediterranean (BURCKHARDT, 1999); DIS-CH: TI (BURCKHARDT, 1983), BS, GE, VS (BURCKHARDT, 1999).

***Cacopsylla pyri*** (L., 1758)

La Rosaire: 19.v. (1 ♂, 1 ♀); 23.vi. (1 ♂, 1 ♀); 30.vi. (7 ♂ ♂, 4 ♀ ♀); 7.vii. (2 ♂ ♂, 1 ♀); 14.vii. (1 ♂).

Saves: 30.vi. (1 ♂); 14.vii. (1 ♀); 28.vii. (1 ♀); 18.viii. (3 ♀ ♀).

Châteauneuf: 19.viii. (3 ♂ ♂, 3 ♀ ♀); 25.viii. (4 ♂ ♂, 2 ♀ ♀); 3.ix. (1 ♂); 9.ix. (2 ♂ ♂, 1 ♀); 8.x. (1 ♀); 14.x. (1 ♂, 1 ♀); 21.x. (1 ♂, 1 ♀); 3.xi. (2 ♂ ♂, 4 ♀ ♀).

DIS: Europe, Caucasus, Georgia, Central Asia, Russian Far East, China (OSSIANNILSSON, 1992); DIS-CH: BL, BS, GR, VS (SCHAEFER, 1949), VD (NHMB data).

***Cacopsylla pyricola*** (FOERSTER, 1848)

Saves: 7.vii. (1 ♂); 28.vii. (1 ♀).

DIS: Western and eastern Palaearctic, introduced into North America (OSSIANNILSSON, 1992); DIS-CH: AG, BE, BL, BS, GR, SO, TG, VS (SCHAEFER, 1949), TI (BURCKHARDT, 1983).

***Cacopsylla pyrisuga*** (FOERSTER, 1848)

La Rosaire: 28.iv. (1 ♂); 19.v. (1 ♀).

Saves: 12.v. (1 ♂, 1 ♀).

DIS: Palaearctic (OSSIANNILSSON, 1992); DIS-CH: AG, BE, BL, GE, GR, JU, SO, TG, VD, VS (SCHAEFER, 1949), TI (BURCKHARDT, 1983).

***Cacopsylla saliceti*** (FOERSTER, 1848)

Saves: 28.iv. (1 ♂).

DIS: Europe except for the North, Caucasus, Russian Far East (LAUTERER & BURCKHARDT, 1997); DIS-CH: AG, VS (SCHAEFER, 1949), BE (BURCKHARDT, 1983), OW, SZ (NHMB data).

***Cacopsylla visci*** (CURTIS, 1835)

Saves: 20.iv. (3 ♂♂, 1 ♀); 28.iv. (1 ♂); 9.vi. (1 ♂, 1 ♀); 14.vii. (2 ♀♀).

DIS: Europe except for North and West, Morocco, Caucasus, Irak (CONCI *et al.*, 1993); DIS-CH: BS, SO, VS (SCHAEFER, 1949).

***Camarotoscena speciosa*** (FLOR, 1861)

La Rosaire: 26.v. (1 ♂).

Saves: 12.v. (1 ♀); 7.vii. (1 ♀); 28.vii. (1 ♂).

DIS: West Palaearctic except for the North, Caucasus, Turkestan, Mongolia (OSSIANNILSSON, 1992); DIS-CH: GE, VS (SCHAEFER, 1949).

***Craspedolepta flavipennis*** (FOERSTER, 1848)

La Rosaire: 30.vi. (2 ♀♀).

Saves: 9.vi. (2 ♂♂); 7.vii. (2 ♀♀); 4.viii. (1 ♂, 1 ♀).

DIS: Over large parts of the West Palaearctic, East Asia (CONCI *et al.*, 1993); DIS-CH: AG, BE, GR, VS (SCHAEFER, 1949).

***Homotoma ficus*** (L., 1758)

Châteauneuf: 9.ix. (1 ♂); 24.ix. (1 ♂); 30.ix. (1 ♂).

DIS: Mediterranean eastwards to Iran, northwards reaching Central Europe, introduced into Great Britain and North America (CONCI *et al.*, 1996); DIS-CH: TI (SCHAEFER, 1949), VD (BURCKHARDT, 1983), BS (NHMB data).

Comments. The species is new for Valais and Basel-Stadt.

***Livilla variegata*** (LÖW, 1882)

Saves: 9.vi. (1 ♂).

DIS: Southern Europe and Great Britain (CONCI *et al.*, 1993); DIS-CH: VS (SCHAEFER, 1949), GE, LU, TI, SH, ZH (BURCKHARDT, 1983), VD (BURCKHARDT, 1994).

***Psyllopsis fraxini*** (L., 1758)

La Rosaire: 9.vi. (1 ♀).

Saves: 3.vi. (1 ♂); 9.vi. (3 ♀♀); 14.vii. (1 ♀).

DIS: Western Palaearctic, introduced into North America (OSSIANNILSSON, 1992); DIS-CH: AG, BL, BS, VD, VS, ZH (SCHAEFER, 1949), GR, TI (BURCKHARDT, 1983), JU, LU, OW, SZ (NHMB data).



***Psyllopsis fraxinicola*** (FOERSTER, 1848)

La Rosaire: 23.vi. (1 ♂).

Saves: 9.vi. (4 ♂♂, 1 ♀).

DIS: Western Palaearctic, Central Asia introduced into North and South America (OSSIANNILSSON, 1992); DIS-CH: AG, BE, BL, BS, GE, GR, VD, VS (SCHAEFER, 1949), TI (BURCKHARDT, 1983), LU, OW, SH, UR, ZG, ZH (NHMB data).

***Trioza alacris*** FLOR, 1861

La Rosaire: 19.v. (1 ♀); 23.vi. (1 ♀).

Châteauneuf: 24.ix. (1 ♀).

DIS: Mediterranean, Crimea, Caucasus, introduced into Central and North Europe, North and South America (OSSIANNILSSON, 1992); DIS-CH: BE, BS, ZH (SCHAEFER, 1949), TI (BURCKHARDT, 1983), GE, VS (BURCKHARDT, 1994).

***Trioza anthrisci*** BURCKHARDT, 1986

La Rosaire: 12.v. (1 ♂); 26.v. (1 ♀); 9.vi. (1 ♂); 16.vi. (2 ♂♂); 23.vi. (5 ♂♂, 4 ♀♀); 30.vi. (6 ♂♂, 1 ♀); 7.vii. (4 ♂♂, 2 ♀♀); 21.vii. (11 ♂♂, 1 ♀).

Saves: 12.v. (1 ♂); 9.vi. (1 ♂); 16.vi. (2 ♂♂); 23.vi. (10 ♂♂, 1 ♀); 30.vi. (6 ♂♂, 5 ♀♀); 7.vii. (6 ♂♂, 4 ♀♀); 14.vii. (13 ♂♂, 6 ♀♀); 21.vii. (8 ♂♂, 1 ♀); 28.vii. (9 ♂♂, 2 ♀♀); 4.viii. (1 ♂♂, 3 ♀♀); 18.viii. (1 ♂).

DIS: Central, North and East Europe, Siberia (OSSIANNILSSON, 1992); DIS-CH: BE, BL, GR, JU, VS (SCHAEFER, 1949), OW, SZ (NHMB data).

Comments. The records by SCHAEFER concern both *T. anthrisci* and *T. apicalis*. The distributions cited here (and for *T. apicalis*) and referred to SCHAEFER are taken from SCHAEFER's original material deposited in the NHMB.

***Trioza apicalis*** FOERSTER, 1848

La Rosaire: 15.iv. (1 ♀); 12.v. (1 ♂); 3.vi. (1 ♂, 1 ♀); 9.vi. (3 ♂♂, 1 ♀); 16.vi. (1 ♀); 23.vi. (14 ♂♂, 6 ♀♀); 30.vi. (9 ♂♂, 3 ♀♀); 7.vii. (6 ♂♂, 2 ♀♀); 14.vii. (2 ♂♂, 2 ♀♀); 21.vii. (6 ♂♂, 2 ♀♀).

Saves: 26.v. (1 ♀); 9.vi. (10 ♂♂, 4 ♀♀); 23.vi. (10 ♂♂, 7 ♀♀); 30.vi. (11 ♂♂, 4 ♀♀); 7.vii. (4 ♂♂); 14.vii. (22 ♂♂, 1 ♀); 21.vii. (43 ♂♂, 4 ♀♀); 28.vii. (13 ♂♂, 3 ♀♀); 4.viii. (5 ♂♂); 11.viii. (8 ♂♂, 3 ♀♀); 18.viii. (7 ♂♂, 6 ♀♀); 25.viii. (2 ♂♂, 3 ♀♀); 1.ix. (1 ♂♂, 5 ♀♀); 8.ix. (1 ♂); 16.ix. (1 ♂, 1 ♀); 23.ix. (1 ♂, 1 ♀); 29.ix. (3 ♂♂, 1 ♀); 13.x. (1 ♂, 1 ♀).

Châteauneuf: 19.viii. (1 ♀); 25.viii. (1 ♀); 24.ix. (1 ♂); 14.x. (1 ♀); 21.x. (1 ♂).

DIS: Palaearctic (OSSIANNILSSON, 1992); DIS-CH: BE, BL, GR, VS (SCHAEFER, 1949), TI (BURCKHARDT, 1983).

Comments. See comments to *T. anthrisci*.

***Trioza cerastii*** (L., 1758)

La Rosaire: 3.vi. (1 ♂).

DIS: Europe (OSSIANNILSSON, 1992); DIS-CH: BE, BL, JU, GR, SO, VS (SCHAEFER, 1949), OW (NHMB data).

***Trioza cirsii*** (LÖW, 1881)

Saves: 14.vii. (1 ♀); 21.vii. (3 ♂♂, 3 ♀♀); 28.vii. (1 ♂, 1 ♀).

DIS: Europe (OSSIANNILSSON, 1992); DIS-CH: BE, BL, JU, SO, VS (SCHAEFER, 1949), AG, NE, SZ, VD (BURCKHARDT, 1983), GR, OW (NHMB data).

***Trioza galii* FOERSTER, 1848**

La Rosaire: 26.v. (1 ♀); 9.vi. (2 ♂♂, 1 ♀); 23.vi. (1 ♂); 30.vi. (11 ♂♂); 7.vii. (5 ♂♂); 14.vii. (5 ♂♂); 21.vii. (6 ♂♂, 1 ♀).

Saves: 3.vi. (6 ♂♂); 9.vi. (19 ♂♂, 1 ♀); 16.vi. (3 ♂♂, 2 ♀♀); 23.vi. (8 ♂♂, 1 ♀); 30.vi. (3 ♂♂, 1 ♀); 7.vii. (1 ♂, 2 ♀♀); 14.vii. (1 ♂); 21.vii. (2 ♂♂); 28.vii. (4 ♂♂); 4.viii. (1 ♂, 1 ♀); 11.viii. (2 ♂♂); 16.ix. (6 ♂♂); 23.ix. (1 ♀); 29.ix. (2 ♂♂, 1 ♀); 7.x. (1 ♂).

DIS: Palearctic (OSSIANNILSSON, 1992); DIS-CH: AG, BE, BL, BS, GR, VS (SCHAEFER, 1949), GE, VD (BURCKHARDT, 1994), LU (NHMB data).

***Trioza remota* FOERSTER, 1848**

La Rosaire: 12.v. (1 ♂, 5 ♀♀); 19.v. (5 ♀♀); 9.vi. (1 ♀).

Saves: 12.v. (2 ♀♀); 9.vi. (1 ♂).

Châteauneuf: 3.xi. (1 ♀).

DIS: West Palearctic, Japan (OSSIANNILSSON, 1992); DIS-CH: AG, BE, BS, BL, JU, TI, VS (SCHAEFER, 1949).

***Trioza schrankii* FLOR, 1861**

La Rosaire: 9.vi. (1 ♂).

Saves: 5.v. (1 ♂).

DIS: Central Europe, Romania (CONCI *et al.*, 1996); DIS-CH: BE, GR, VS (SCHAEFER, 1949), SZ, VD (BURCKHARDT, 1983), OW (NHMB data).

***Trioza scottii* LÖW, 1880**

Châteauneuf: 21.x. (1 ♂, 2 ♀♀); 3.xi. (1 ♂, 1 ♀).

Saves: 3.vi. (1 ♀).

DIS: Central Europe, Algeria, Turkey, Caucasus, Iran, North India (CONCI *et al.*, 1996); DIS-CH: VS (SCHAEFER, 1949), AG, GR (BURCKHARDT, 1983), BS (NHMB data).

***Trioza tatrensis* KLIMASZEWSKI, 1965**

La Rosaire: 20.iv. (1 ♀).

DIS: Northern Europe, Alps, Romania (OSSIANNILSSON, 1992); DIS-CH: BL, GR, JU, VS (SCHAEFER, 1939), SZ, TI, VD (BURCKHARDT, 1983), OW (NHB data).

***Trioza urticae* (L., 1758)**

La Rosaire: 15.iv. (1 ♂, 1 ♀); 20.iv. (1 ♀); 28.iv. (7 ♂♂, 7 ♀♀); 5.v. (4 ♂♂, 4 ♀♀); 12.v. (26 ♂♂, 23 ♀♀); 19.v. (6 ♂♂, 6 ♀♀); 9.vi. (1 ♂, 1 ♀); 16.vi. (1 ♀); 30.vi. (1 ♂, 2 ♀♀); 7.vii. (1 ♂); 14.vii. (1 ♂); 21.vii. (1 ♂).

Saves: 20.iv. (6 ♂♂, 4 ♀♀); 28.iv. (57 ♂♂, 64 ♀♀); 5.v. (24 ♂♂, 30 ♀♀); 12.v. (29 ♂♂, 36 ♀♀); 19.v. (24 ♂♂, 18 ♀♀); 26.v. (9 ♂♂, 5 ♀♀); 3.vi. (41 ♂♂, 24 ♀♀); 9.vi. (31 ♂♂, 27 ♀♀); 16.vi. (4 ♂♂, 3 ♀♀); 23.vi. (3 ♂♂, 1 ♀); 30.vi. (19 ♂♂, 24 ♀♀); 7.vii. (6 ♂♂, 10 ♀♀); 14.vii. (3 ♂♂, 6 ♀♀); 28.vii. (1 ♂); 4.viii. (2 ♂♂); 18.viii. (1 ♀); 25.viii. (1 ♂).

Châteauneuf: 9.ix. (1 ♂); 3.xi. (2 ♂♂).

DIS: Palearctic without Japan, India (OSSIANNILSSON, 1992); DIS-CH: AG, BE, BL, BS, GR, JU, SO, UR, VS (SCHAEFER, 1949), LU, OW, SZ, TI, VD (BURCKHARDT, 1983), ZH (NHMB data).

## DISCUSSION

Apart from *T. apicalis*, another three trioqid species associated with carrots have been collected during a survey of three plots in 1998. None of the four species is strictly monophagous on *Daucus carota*. *T. apicalis* and *T. anthrisci* are re-

stricted to hosts of the Apiaceae (BURCKHARDT, 1986). *B. nigricornis* is polyphagous (HODKINSON, 1981) as is probably *B. trigonica*. At the moment it is unknown whether *T. anthrisci* and *B. nigricornis* are producing any damage to the carrots. These two species could be of economic relevance as vector of the phytoplasma "Aster yellow".

The total number of 41 species of Psylloidea trapped during the survey is surprisingly high. Two species, *Aphalara crispicola* and *Bactericera trigonica*, are recorded here for the first time. The former is known also from other localities in Switzerland whereas the latter is restricted to the Valais, at the moment. About half of the species (21) are represented by small numbers of individuals. They are species developing on trees and shrubs growing probably near the carrot fields. The other half (19 species) consists of species developing on herbaceous plants usually considered weeds. These species are represented often by large numbers of individuals suggesting that their hosts grow in and around the carrot fields (table 1). The high psyllid diversity of the studied carrot fields, in particular La Rosaire and Saves, has to be emphasised.

The differentiation of the potentially harmful carrot trioqid species may be difficult for the practitioner. As during the critical period *T. apicalis* is the most abundant species, occasional misidentifications are of secondary importance for supervised control.

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