

Auchenorrhyncha as pests on grapevine

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Abstract

The Auchenorrhyncha of economic interest in the main grapevine-growing areas of Europe are here considered. For each species, data are given concerning their distribution, biology, ethology, host-plants, and direct or indirect damage of economic importance. A particular attention was addressed to the vectors of phytoplasmas: *Hyalesthes obsoletus* (SIGNORET 1865), the vector of the phytoplasma agent of diseases, known as „Vergilbungs-krankheit“ in Germany and „Bois noir“ in France, and *Scaphoideus titanus* BALL 1932, the vector of the phytoplasma agent of the disease, known as „Flavescence dorée“ in France, Italy, and Spain.

Key words: Grapevine, Cixiidae, Cicadellidae, Direct and indirect damage, Phytoplasma vectors.

1. Introduction

The number of Auchenorrhyncha, commonly known with the name of leafhoppers, planthoppers, treehoppers, froghoppers, etc., that may be collected in the main grapevine-growing areas of Europe, are several tens of species. A lot of species that are caught by means of entomological sweepers and/or of

ecosystem, had the chance to ascertain, through field surveys and experimental tests in the laboratory, that some species, during their feeding activity, may cause both direct (feeding in phloem vessels) and indirect damage (producing honeydew and wax, transmitting phytopathogenic agents and in particular phytoplasmas), that is in several cases also of economic importance in viticulture.

2. Direct damage

Among the facultative Typhlocybae that feed on grapevine phloem, the most noxious pests are the cryophilic species *Empoasca vitis* (GOETHE 1875) in northern Italy and central Europe, and the thermophilic species *Jacobiasca lybica* (BERGEVIN & ZANON 1922) in southern Europe.

Empoasca vitis

It is a holartic species spread also in the Oriental region.

The adult has a body length of 2.9-3.5 mm in the male and 3.0-3.7 mm in the female. The body is basically of a pale green colour. Head and pronotum often have white spots. The forewings are green (fig. 1).

The 1st instar nymph is 0.7-0.9 mm long. The body is slender, of a pearl whitish colour, with green colour shades. The protruding eyes are brick red. The antennae are setiform and as long as the body, directed laterally, and colourless.

The 5th instar nymph is 2.3-3.0 mm long. The body is generally green, in some individuals of a pinky colour. The eyes are big, protruding, of a brick red colour. The antennae are setiform, as long as about a half of the body, directed laterally, and colourless.

Biology and pest status

E. vitis accomplishes from 2 to 4 generations a year according to the latitude. This species overwinters in the adult stage mainly on conifers of the genera *Abies*, *Juniperus*, *Picea*, *Pinus*, and *Taxus*; in the biotopes in which conifers are lacking, it lives on evergreen plants, such as *Buxus*, *Ligustrum*, *Lonicera*, and *Rubus*. The reimmigration onto grapevine occurs in a period between the last ten days of

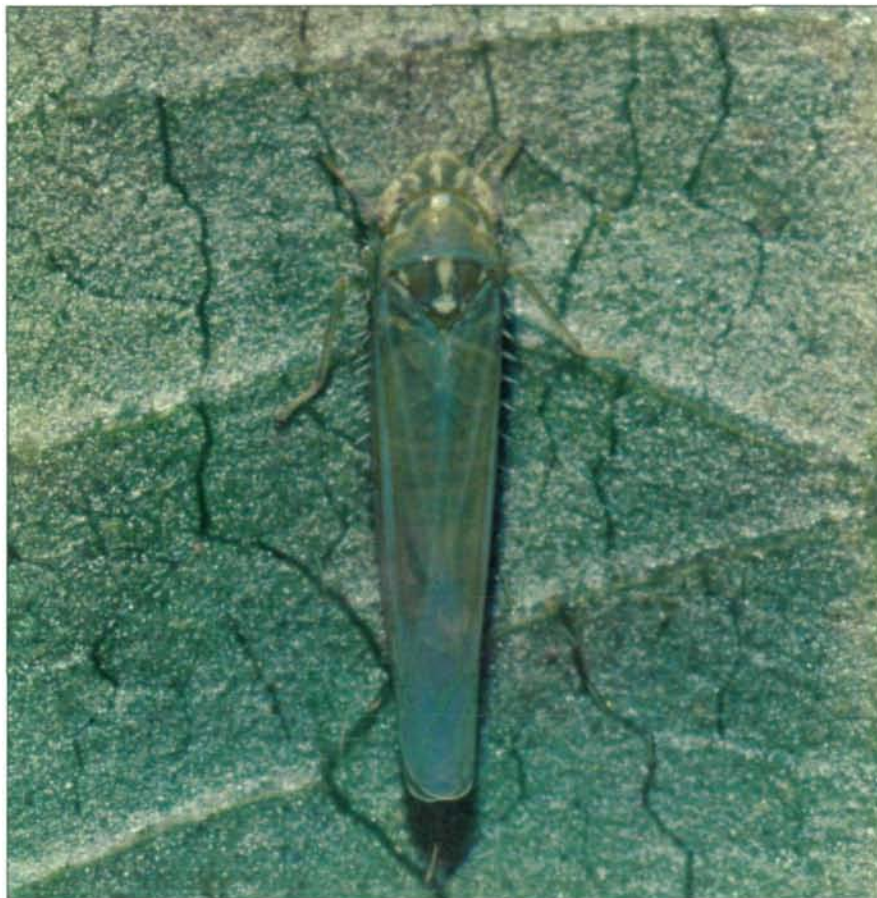


Fig. 1:
Adult of *Empoasca vitis* (GOETHE).

yellow chromotactic sticky traps in the vineyard, usually live on other herbaceous plants, shrubs, and trees in the same agro-ecosystem, and they dwell on grapevine more or less occasionally. Therefore, the Auchenorrhyncha collected on grapevine may be divided into obligatory species, that accomplish their biologic cycle exclusively on grapevine; facultative species, that carry out their life history on other hostplants, but may develop also on grapevine; and occasional species, that dwell on grapevine only during some life stages, generally as adults.

Several authors, who had been dealing with Auchenorrhyncha of the vineyard agro-

April and the first ten days of May. The females lay an average of 15-20 eggs, inserting them in the leaf stalk and veins of the lower page. 30-40 days after oviposition, the first adults of the new generation emerge. The migrations towards winter hostplants begin in September and proceed gradually until the beginning of November, with considerable variations according to the latitude.

The alterations, caused by piercings of young and adult stages on leaf veins for feeding purposes, are very heterogeneous and change with the infested cultivar. The most common symptoms on the leaves are: vein browning, downward rolling, yellowing in white grape cvs and reddening in red grape cvs, withering, centripetal intervein necrosis, and leaf fall in the worst cases (fig. 2).

E. vitis has been reported as a pest in several grapevine-growing areas of northern Italy, France, Switzerland, and Germany.

Jacobiasca lybica

This is a Mediterranean species spread also in the Ethiopian and Oriental regions.

The adult has a body length of 2.5-3.0 mm in the male and 3.0-3.2 mm in the female. The body is basically of a green colour. Head and pronotum have more or less obvious white spots. The forewings are green with yellowish shades (fig. 3).

The 1st instar nymph is 0.7-0.8 mm long. The body is slender, of a creamy colour, with yellow-green colour shades. The protruding eyes are brick red. The antennae are setiform, directed laterally, and colourless.

The 5th instar nymph is 2.1-2.3 mm long. The body is generally green. The eyes are big, protruding, of a creamy or brick red colour. The antennae are setiform, as long as about a half of the body, directed laterally, and colourless.

Biology and pest status

J. lybica carries out from 3 to 5 generations a year according to the latitude. This species overwinters in the adult stage on herbaceous plants and shrubs of several families, such as Anacardiaceae, Labiatae, Leguminosae, and Malvaceae. After winter the adults return to

grapevine in the months of April and May. The females lay an average of 50 eggs in the leaf stalk and in the main veins. This species colonizes the lower page of the leaves, leaf stalks and young growing shoots. In the months of October and November the adults destined to overwinter move into the winter hostplants infesting the neighbouring areas of the vineyards.

Fig. 2:
Common symptoms on the leaves caused by *Empoasca vitis* (GOETHE).



Fig. 3:
Adult of *Jacobiasca lybica* (BERGEVIN & ZANON).

The alterations caused by the feeding activity are very similar to those of *E. vitis*. The attack proceeds on grapevine in a proximo-distal way and carries on until autumn, or at least until there are feasible leaves on the plant. In the case of heavy infestations the leaf marginal necrosis may involve at the same time the whole foliage, that goes through the fall of the leaf blades, but not of the stalks (fig. 4).

Fig. 4:
Alterations caused by *Jacobiasca lybica* (BERGEVIN & ZANON).



Fig. 5:
Adults of *Metcalfa pruinosa* (SAY).

J. lybica has been considered a pest of vineyards in the Mediterranean basin, i.e. in Portugal, Spain, and in the two Italian islands, Sardinia and Sicily.

3. Indirect damage

3.1 Indirect damage by honeydew and wax

On grapevine, the indirect kind of damage, i.e. the abundant production of honeydew and wax, is caused by the Nearctic Flatid Metcalfa pruinosa (SAY 1830).

Metcalfa pruinosa

This is a species of Northamerican origin and was reported in the Palaearctic region for the first time in Italy at the end of the '70s. Presently, *M. pruinosa* lives, besides on all the Italian peninsula and in the two larger islands, in southern France and in Corsica, in Switzerland, Slovenia, and Croatia.

The male and female are 7.0-8.0 mm long. The body is grey or hazelnut-grey. The head and pronotum are of the same colour. Also the powdery wax, spread more or less uniformly on the integument, gives its contribution to the general colour of the insect. The eyes are yellow-orange. The forewings are trapezoidal, of a grey-brown colour (fig. 5).

The 1st instar nymph is 1.0 mm long. The body is flattened, of a whitish colour, with light green shades. The abdomen is truncate, with the wax producing areas holding tufts of candid wax. The antennae are short, composed of three segments, colourless.

The 5th instar nymph is 3.3-3.5 mm long. The body and antennae have a similar colour like in the 1st instar nymph.

Biology and pest status

M. pruinosa accomplishes one generation a year. This species overwinters in the egg stage laid on the trunk and branches, starting from the soil level until the higher parts of the foliage of several plants, both wild and/or cultivated, provided that the bark is properly rugged. Every female may lay up to 90 eggs in a period of 10-15 days. The egg hatching is graduated and takes place in a period between the beginning of May and the end of June. Nymphs and adults colonize gregariously several plants, belonging to over 50 botanical families, both ornamental and of agricultural interest, among which fruit trees and grapevine. The adults live until the end of October or the beginning of November.

On grapevine the worst problems are caused by colonies of nymphs and adults producing a high quantity of honeydew that dirties the foliage. Honeydew, when not collected as a food source by the great number of glyciphagous insects, and in particular by honeybees, falls on leaves and grapes, becomes the developmental substrate of epiphytic fungi, known as sooty moulds because of the obvious blackening of their colonies (fig. 6). Even if less interesting, there is also an aesthetical damage caused by wax residues on different parts of grapevines, in particular on grape bunches in table grape cvs.

Presently, the research carried out has not yet proved experimentally the real role played by *M. pruinosa* in the transmission of phytopathogenic agents, in particular of phytoplasmas; even if some individuals of this species resulted to be positive to these unicellular procarotes at molecular diagnoses (Polymerase chain reaction, PCR).

M. pruinosa is reported as a worrying pest for grapevine in northern and central Italy. In the last years the infestations of this species decreased considerably because of the action of the Dryinid hymenopteran *Neodryinus typhlocybae* (ASHMEAD), a parasitoid of the young instars, that was introduced into Italy from USA during a biologic control programme.

3.2 Indirect damage by transmitting phytoplasmas

Other Auchenorrhyncha known to cause serious indirect damage to grapevine are phytoplasma vectors.

Under the name phytoplasmas we include unicellular, pleomorphic organisms, without a rigid wall, but surrounded by a membrane. These organisms are associated to a great number of diseases of wild and cultivated plants called with the general name of yellows. In the plants, the phytoplasmas develop exclusively in phloem cells and tend to colonize all organs, including roots. In the field, these pathogens are transmitted, in a persistent-propagative way, by insects belonging to the Rhynchotha Homoptera (families Cixiidae, Cercopidae, Cicadellidae, and Psyllidae).

The transmission process is characterized by three moments or „phases“, that are separa-

ted but closely interdependent: acquisition, latency, and inoculation.

Acquisition. It is the starting phase during which the leafhoppers feed on infected plants, not necessarily grapevine, assuming the phytoplasma. Generally the acquisition happens in the young instars (nymphs of 3rd-5th instar) and takes from some hours to some days of time.



Fig. 6: Grapevine leaf with honeydew produced by *Metcalfa pruinosa* (SAY).

Latency. It is a variable period (14-28 days) necessary for the leafhoppers that acquired the phytoplasmas to become, from infected, infective. During this phase, in the insect the phytoplasmas, from the midgut by the haemolymphatic way, reach the cells of several organs, among which the salivary glands, where they multiply.

Inoculation. It is the ending phase of transmission, in which, by introducing saliva during the feeding process, the leafhopper adults are able to infect healthy plants on which they feed. The inoculation times are of some hours and the transmission probability increases considerably when the inoculation period is prolonged.

The Auchenorrhyncha species that have been ascertained experimentally to be grapevine phytoplasma vectors are the Cixiid *Hyalosthes obsoletus* (SIGNORET 1865) and the Cicadellid *Scaphoideus titanus* BALL 1932.

Hyalesthes obsoletus

It is a Turanic-Euromediterranean species.

The adults have a body length of 3.8-4.0 mm in the male and 5.0-5.1 mm in the female. The body is of a grey-black colour. The head has the vertex shiny black. The eggs are red. The antennae are filiform, the first article short, the second one big and globular. The pronotum is large and short, the mesonotum is

Biology and pest status

H. obsoletus carries out one generation a year. This cixiid overwinters as a nymph, generally in the 3rd instar, on roots of wild herbaceous plants, such as nettles (*Urtica dioica*) and bindweed (*Convolvulus arvensis*), at a depth of about 10-15 cm. The nymphs live exclusively in the soil on the roots of their hostplants. The first adults emerge at the beginning of July and remain active until the end of August or the beginning of September. In summer one can see the adults of *H. obsoletus* on grapevine where they feed on leaves and twig apices. This species may be found more easily in the grapevine areas where their hostplants are more diffused, especially nettles and convolvulus, that are indispensable for the oviposition and the development of the nymphs.

H. obsoletus is the vector of the phytoplasma, agent of grapevine diseases known as „Vergilbungskrankheit“ in Germany and „Bois noir“ in France. The role of this species in the transmission of the phytoplasma is still to be



Fig. 7:
Male and female of *Hyalesthes obsoletus* (SIGNORET).

large, shiny black with three carinae. The forewings are big, large, hyaline, with infumate veins. The female has an ovipositor protruding beyond the abdomen and covered by a waxy mass (fig. 7).

The 1st instar nymph is 0.50-0.55 mm long. The body is stocky, uniformly white. The eyes are white, the antennae are short. The end of the abdomen is crowned by rays of white wax a little shorter than the body.

The 5th instar nymph is 3.20-3.40 mm long. The body is stocky, uniformly creamy-white. The eyes are red. The antennae are filiform and colourless. The end of the abdomen is crowned by rays of white wax that are as long as the half of the body.



Fig. 8:
Grapevine affected by the phytoplasma disease transmitted by *Hyalesthes obsoletus* (SIGNORET).

proved, the latter is of the same genetic group of the agent of the disease spread in Italy and known with the name of „Legno nero“. The grapevines affected in spring show an anomalous leaf colouring, that become yellow in white grapes and deep red in red grapes. The colour changes sometimes are not extended to the whole leaf blade, but are limited to the secondary veins. Subsequently the leaves roll down assuming a triangular shape, they thicken, necrotize, and may get detached from the stalk, that remains on the shoot (fig. 8). The shoots show a shortening of internodes and do not lignify, assuming a flexuous shape directed downwards. This infection may also become particularly serious with the withering and drying of the whole fruit shoot. After some years the plants of some cvs may even die.

Scaphoideus titanus

This species is originary of North America. In the Nearctic distribution area, this leafhopper is spread in a wide belt comprised between the 50th and the 30th parallels. Precisely, it lives in five regions of southern Canada and in thirtyeight states of the USA, from Montana to California. In Europe this species was found for the first time in southern France in 1960 and was recorded with the name *S. littoralis* BALL. This name remained valid until the revision of the genus *Scaphoideus* in which eight species, among which *S. littoralis*, were put in synonymy with *S. titanus*. Since then all the European populations of this leafhopper, that in the meantime was found also in Italy in 1964 and in Switzerland in 1968, took the new name of *S. titanus*. Presently, in Europe, at 40 years since its first record, *S. titanus* has been found in seven states along the 45th parallel. Starting from the introduction point in southern France, this species spread almost exclusively towards eastern Europe, reaching in the mid '80s Croatia and Slovenia. Its expansion westwards was much slower and only in the mid '90s it was reported in vineyards of northern Spain and in 2000 in those of the North of Portugal.

The adult has a body length of 4.8-5.2 mm in the male and 5.5-6.0 mm in the female. The head has the vertex very prominent, with some black transversal lines anteriorly, bet-

ween the eyes, and an irregularly bordered brown-reddish spot dorsally. Pronotum and mesonotum have two and one transversal stripes respectively, of a brown-reddish colour. The forewings are ochre-brownish, with whitish areas and black spots, the veins are brown (fig. 9).

The 1st instar nymph is 1.5-1.8 mm long. The head has a prominent vertex. The anten-



Fig. 9:
Adult of *Scaphoideus titanus* BALL.

nae are relatively long, filiform. The body is whitish. The last abdominal segment has one black rhomboidal spot on each side.

The 5th instar nymph is 4.3-5.2 mm long. The head has a prominent vertex, sometimes with some ochreous dots with an irregular border. The antennae are long and filiform. The body has a yellowish colour, the wing pads are ochreous, the thorax and part of the abdomen have dorsal ochre-blackish spots with irregular, more or less large borders. The last abdominal segment is like in the 1st instar nymph.

Biology and pest status

S. titanus is monophagous on grapevine. It accomplishes one generation a year and overwinters in the egg stage laid in the bark of two-year old shoots. The egg hatching begins in the second half of May and continues until over the first ten days of July. The nymphs live mainly on the lower page of basal leaves of shoots near to the canes in which the eggs were inserted. The adults, that



emerge around the middle of July, remain active on grapevine until end September-beginning of October.

In Europe, among the several diseases of phytoplasmic origin detected in grapevine, known with the generic name of yellows, the only one with an epidemic character and of considerable economic importance is „Golden Flavescence“ transmitted by *S. tianus*. This disease, probably present in all the distribution area of its specific vector, has been presently diagnosed only in the vineyards of northern Spain, of southern France and northern Italy. The symptoms induced by the phytoplasma transmitted by *S. tianus* on grapevine are undistinguishable from those induced by *H. obsoletus* and described above (fig. 10). Therefore the certain identification of the diseases with a phytoplasmic etiology in grapevine may be made only through molecular diagnosis of the DNA of the phytoplasmas present in the phloem vessels of symptomatic plants.

4. Conclusion

The above list of Auchenorrhyncha considered grapevine pests in different countries has not the pretention to be completely exhaustive. The number of species and their dangerousness may change in different vineyard agro-ecosystems according to environmental modifications, hostplants, cultivation techniques, and the different control strategies employed. The latter often have a negative impact on natural enemies, that contribute to maintain the Auchenorrhyncha populations in a balance under dangerousness thresholds. This complex biocoenotic pattern may be further modified after the incidental introduction of exotic Auchenorrhyncha. Particularly dangerous for European viticulture would be the introduction of nearctic cicadellids vectors of the xylem-borne bacterium *Xylella fastidiosa* WELLS et al., that in USA causes the serious disease of economic importance called „Pierce's disease“.

5. Zusammenfassung

Fünf Zikadenarten, die in den Weinbaugebieten Europas als wichtige Schädlinge auftreten, werden hier diskutiert. Für jede Art

(*Hyalesthes obsoletus* (SIGNORET), *Metcalfa pruinosa* SAY, *Empoasca vitis* GOETHE, *Jacobiasca lybica* BERGEVIN und *Scaphoideus tianus* BALL) werden Verbreitung, Biologie, Ethologie, Nährpflanzenspektrum, Schadenstyp und wirtschaftliche Bedeutung genannt. Besondere Aufmerksamkeit wird *Hyalesthes obsoletus* als Überträger der Vergilbungskrankheit und *Scaphoideus tianus* als Überträger von „Flavescence dorée“ gewidmet.

6. Essential bibliography

- ARZONE A. & A. ALMA (2000): Insetti vettori di fitoplasmi in Europa. Conoscenze, acquisizioni, aspettative. — *Petria* **10**: 121-127.
- ARZONE A., VIDANO C. & A. ALMA (1987): Auchenorrhyncha introduced into Europe from the Nearctic region: taxonomic and phytopathological problems. — *Proc. 2nd Int. Workshop of Leafhoppers and Planthoppers Econ. Importance*, Provo, Utah, U.S.A., 28-VII/1-VIII-1986: 3-17.
- BOSCO D., ALMA A. & A. ARZONE (1997): Studies on population dynamics and spatial distribution of leafhoppers in vineyards (Homoptera Cicadellidae). — *Annls of Applied Biology* **130**: 1-11.
- BOSCO D., ALMA A., BONELLI S. & A. ARZONE (1996): Phenology and within-vineyard distribution of *Empoasca vitis* GOETHE adults (Cicadellidae Typhlocybinae). — *Redia* **79** (1): 1-9.
- BOUDON-PADIEU E. (2000): Recent advances on grapevine yellows: detection, etiology, epidemiology and control strategies. — *Proc. 13th Conf. ICVG*, Adelaide (Australia), March 12-17, 2000: 87-88.
- CERUTTI F., BAUMGÄRTNER J. & V. DELUCCHI (1991): The dynamics of grape leafhopper *Empoasca vitis* GOETHE populations in Southern Switzerland and the implications for habit management. — *Biocontrol Sci. Technol.* **1**: 177-194.
- MAIXNER M. (1994): Transmission of German grapevine yellows (Vergilbungskrankheit) by the planthopper *Hyalesthes obsoletus* (Auchenorrhyncha: Cixiidae). — *Vitis* **33**: 103-104.
- VIDANO C. (1962): La *Empoasca libyca* BERGEVIN nuovo nemico della vite in Italia. — *L'Italia Agricola* **4**: 329-346.
- VIDANO C., ARNÒ C. & A. ALMA (1988): On the *Empoasca vitis* intervention threshold on vine (Rhynchota Auchenorrhyncha). — *Proc. 6th Auchen. Meeting*, Turin, Italy 7/11-IX-1987: 525-537.

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