

Host-plant relationships and life history of some *Alebra* species in Italy (Auchenorrhyncha: Cicadellidae)

STEFANO DEMICHELIS and DOMENICO BOSCO

Dipartimento di Entomologia e Zoologia Applicate all'Ambiente Carlo Vidano, Università di Torino,
via P. Giuria 15, I-10126 Torino, Italy

Cicadellidae, *Alebra*, colour morphs, host-plant relationships, life histories

Abstract. Four *Alebra* species, *A. albostriella*, *A. coryli*, *A. viridis*, *A. wahlbergi* and their colour morphs, have been investigated on the following host-plants: *Corylus avellana*, *Castanea sativa*, *Quercus cerris*, *Q. robur*, *Q. petraea* and *Acer campestre*.

Host-plant relationships of *Alebra* species showed an association between *A. coryli* and *C. avellana*, *A. albostriella* and *Q. robur*, *A. wahlbergi* and *A. campestre*. On the contrary on *Q. cerris*, *Q. petraea* and *C. sativa* two different species, *A. albostriella* and *A. viridis*, are coexisting.

Alebra species showed different phenology and life histories: *A. coryli* and *A. wahlbergi* appeared univoltine, *A. viridis* bivoltine, and *A. albostriella* both uni- and bivoltine.

The oviposition sites have been documented both for overwintering eggs, laid in the branches, and for summer eggs, laid in the main leaf nervation.

Associations between nymphal and adult morphs are reported. A new morph, *A. albostriella* m. *atrata*, has been found on *Q. robur*.

INTRODUCTION

The genus *Alebra* (Auchenorrhyncha: Cicadellidae) is represented in Europe by 6 species: *A. albostriella* (Fallén), *A. neglecta* Wagner, *A. sorbi* Wagner, *A. wahlbergi* (Boheman) (Nast, 1972), *A. coryli* Le Quesne (Le Quesne, 1977), and *A. viridis* Rey (Gillham, 1991), all associated with broad-leaved trees. The leaf-hoppers of this genus are mesophyll-feeders as nymphs and adults. They have been shown harmful to chestnut in Greece (Drosopoulos et al., 1987) and to hazel in Southern Italy (Viggiani, 1971).

Normally, the specific determination of cicadellids is made by examining the male genitalia (Ribaut, 1936). However, in the European species of *Alebra*, only *A. neglecta* can be distinguished on this basis. Le Quesne & Payne (1981) and Gillham (1991) used other morphological features, both external and internal, pertaining to fore wings, abdomen and metatibiae for specific determination. Recently, since the identification was still difficult due to polymorphism of *A. albostriella* and *A. wahlbergi*, other taxonomic techniques have been employed, such as enzyme electrophoresis (Drosopoulos & Loukas, 1988) and variation in acoustic signals (Gillham, 1992).

The host-plant relationships of *Alebra* species have been documented in Britain (Claridge & Wilson, 1976, 1981) and in Italy (Vidano & Arzone, 1981, 1987a,b; Arzone & Vidano, 1987), while the specific composition of *Alebra* complex on different host plants has been reported by Gillham (1991) on oak and by Drosopoulos et al. (1987) on chestnut.

Life histories, phenology and oviposition behaviour are still poorly understood; biological data (e.g. life cycle, phenology) are reported only for *Alebra* collected on chestnut

(Drosopoulos et al., 1987). *A. albostriglia*, *A. wahlbergi* and *A. coryli* are regarded as univoltine species (Viggiani, 1971; Arzone & Vidano, 1987; Vidano & Arzone, 1987a,b; Gillham, 1991), but there are no descriptions of their life cycles. *A. viridis* appeared univoltine in Britain (Gillham, 1992) and bivoltine in Greece (Drosopoulos et al., 1987). Some preliminary data on *A. albostriglia* and *A. wahlbergi* breeding are reported by Günthart (1990).

Our research was performed in order to describe, by means of laboratory rearings and field investigations, life histories and host-plant associations of *Alebra* species and morphs on hazel, chestnut, oak and maple. Therefore, these data can represent a contribution to the biotaxonomy of *Alebra* species.

MATERIAL AND METHODS

The research was performed between 1984–1990. Field investigations were made every ten days from March to October in parks in the city of Turin (on *Quercus robur* L. and *Acer campestre* L.), in woodlands of Superga hill [on *Quercus petraea* (Mattuschka) Liebl. and *Castanea sativa* Miller] and in the hazel-wood grove of the experimental farm of the University of Turin at Chieri (on *Corylus avellana* L.). Collections on maple and hazel were made between 1984–1990, on oak between 1985–1988 and on chestnut tree in 1987 and 1988. Some observations were performed in other Piedmontese localities near Alessandria, Cuneo, Turin and Vercelli; during field surveys branches, nymphs and adults of *Alebra* were sampled.

The adults were sampled by sweep netting (diameter of the ring 30 cm and length of the handle 50 cm) in the lower branches and edges of the canopy, between about 1 and 3 m above the ground. Samples were taken from a large number of individual trees to minimize the effect of variation between them. The nymphs were hand-collected on the same branches by glass tubes. The branches were sampled at random in the same belt where leaf-hoppers were collected and were observed in laboratory with a stereo microscope to search for eggs.

Once a year, in March, a number of young branches with overwintering eggs were put in a small tube with water and methylene blue (as fungistatic), then incubated in a climatized chamber at 22°C with a photoperiod of 16 : 8 h (light : dark) to obtain *Alebra* nymphs.

The leaf-hoppers collected in field as adults and nymphs (reared in laboratory up to adult stage), were grouped by species and morph to assess the variability of *Alebra* populations on each host-plant.

More than 200 nymphs collected in field were reared individually in glass tubes up to adult stage to correlate nymphal and adult morphs.

To investigate the life histories of *Alebra* species males and females of *A. coryli*, *A. wahlbergi* morph *pallescens*, *A. albostriglia* (*typica* and *discicollis* morphs) and *A. viridis* were isolated in plexiglass and nylon cages on potted hazel, maple, common oak and chestnut trees respectively. The nymphs were then transferred to a new plant in order to rear the different generations separately. Branches and leaves of the rearing plants were examined for oviposition sites.

Adult morphology was examined and compared with the descriptions of Ribaut (1936), Le Quesne & Payne (1981) and Gillham (1991) in order to identify the species. The features investigated were: genitalia and abdominal apodemes of males, fore wings, thorax and abdomen colour patterns, dark points at the base of the macrosetae of the posterior tibiae of males and females.

The data pertaining to the phenology of *A. coryli* and *A. wahlbergi*, very similar species (*A. coryli* has been established as new species only in 1977 on the base of the shape of the abdominal apodemes), were submitted to ANOVA and Fisher test ($P = 0.05$) to examine eventual differences in their life cycle.

RESULTS

Four species of the genus *Alebra* and their relative morphs were identified: *A. albostriglia* (*diluta*, *discicollis*, *typica* and a new, undescribed, morph), *A. viridis*, *A. coryli* and *A. wahlbergi* (*pallescens* and *typica* morphs). The new morph of *A. albostriglia* is

represented by 12 females collected as nymph and adult on *Q. robur*, and possesses vertex and scutellum uniformly black-brown; pronotum black-brown, pale at sides; fore wings, thorax and abdomen as in the *typica* morph. This new morph is given the name *atrata* (Fig. 1). *A. albostriella* m. *discicollis* and *A. wahlbergi* m. *typica* were represented only by females.

Host plant association

The host plant association of *Alebra* species and their relative adult morphs was different on the various trees. On *C. avellana* there were populations of *A. coryli*. On *Castanea sativa*, *Q. cerris* and *Q. petraea* different populations belonging to *A. albostriella* and *A. viridis* were coexisting. On *Q. robur* the *Alebra* samples were represented mainly by *A. albostriella*. On *A. campestre* there were populations of *A. wahlbergi* (Fig. 2).

In June 1986, in laboratory rearings on *Q. robur*, two specimens of *A. albostriella* morph *discicollis* have been obtained from parents of the *typica* morph isolated in the previous year. During the following years, the *typica* and *discicollis* morphs were bred together. Similar rearings of *A. wahlbergi* on *A. campestre* always provided the *pallescent* morph.

Life history and phenology

In field investigations and laboratory rearings, *A. wahlbergi* and *A. coryli* proved to be univoltine on maple and hazel respectively; *A. viridis* appeared bivoltine on chestnut; *A. albostriella* was mainly univoltine on oak, some specimens gave rise to a second generation (Table 1). *A. albostriella*, in laboratory rearing on *Q. robur*, bred twice a year only in 1986; nevertheless we found many second generation nymphs of this species in the field, on *Q. petraea* in August and September, during the whole period of investigation.

All species overwintered as eggs laid in the host-plant branches. Overwintering eggs were laid deeply in the nodes of new branches of hazel, chestnut and oak and mainly in 2 and 3 year-old branches of maple. Oviposition was made by piercing the base of the leaf stalk on oak and chestnut and directly the branch of the other host-plants. The egg-laying traces were represented by obvious necrosis on oak and chestnut, clearly visible also after the leaves had fallen, while they were evident only before lignification on hazel and indistinct on maple. The summer eggs, that gave rise to the second generation on chestnut and oak, were laid in the main leaf vein (Fig. 3A–F). The oviposition sites were observed both in laboratory rearings and in field.

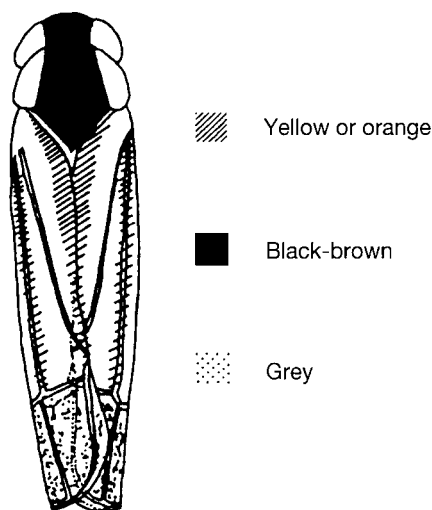


Fig. 1. *Alebra albostriella* (Faillén). Female, morph *atrata*.

TABLE 1. *Alebra* spp. life history in Piedmont (1984–1990); mean data.

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|--------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <i>A. coryli</i> | ○○○ | ○○○ | ○○○ | ○○○ | ○○○ | ○○ | | | | | | |
| | | | | | | --- | + | +++ | +++ | ++ | | |
| | | | | | | | ○○ | ○○○ | ○○○ | ○○○ | ○○○ | ○○○ |
| <i>A. wahlbergi</i> | ○○○ | ○○○ | ○○○ | ○○○ | ○○○ | ○ | | | | | | |
| morph <i>pallesceus</i> | | | | --- | --- | + | +++ | +++ | + | | | |
| | | | | | | ○○ | ○○○ | ○○○ | ○○○ | ○○○ | ○○○ | ○○○ |
| <i>A. albstriella</i> | ○○○ | ○○○ | ○○○ | ○○○ | ○○○ | ○○ | | | | | | |
| morph <i>typica</i> | | | | --- | --- | --- | +++ | +++ | +++ | | | |
| morph <i>discicollis</i> | | | | | | ○ | ○○○ | ○○○ | ○○○ | ○○○ | ○○○ | ○○○ |
| | | | | | | | --- | --- | --- | --- | --- | --- |
| | | | | | | | | +++ | +++ | | | |
| | | | | | | | | ○ | ○○○ | ○○○ | ○○○ | ○○○ |
| <i>A. viridis</i> | ○○○ | ○○○ | ○○○ | ○○○ | ○○○ | ○ | | | | | | |
| | | | | --- | --- | --- | +++ | +++ | + | | | |
| | | | | | | ○ | ○○○ | ○○ | | | | |
| | | | | | | | --- | --- | --- | --- | --- | --- |
| | | | | | | | | +++ | +++ | | | |
| | | | | | | | | ○ | ○○○ | ○○○ | ○○○ | ○○○ |

○ egg; – nymph; + adult.

TABLE 2. *Alebra coryli* (on *Corylus avellana*) and *A. wahlbergi* (on *Acer campestre*): date of occurrence of first instar nymphs, males and females in gardens of Turin reckoned as Julian day. Data are analysed with ANOVA.

| | Year | | | | | | \bar{x} | F |
|---------------------|------|------|------|------|------|------|-----------|---------|
| | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | | |
| first nymphs | | | | | | | | |
| <i>A. coryli</i> | 141 | | | 138 | 135 | 134 | 137.0 | 34.36** |
| <i>A. wahlbergi</i> | 118 | | | 110 | 107 | 95 | 107.5 | |
| first males | | | | | | | | |
| <i>A. coryli</i> | 177 | 174 | | 180 | 167 | 172 | 174.0 | 59.09** |
| <i>A. wahlbergi</i> | 149 | 148 | | 142 | 142 | 129 | 142.0 | |
| first females | | | | | | | | |
| <i>A. coryli</i> | 177 | 177 | | 180 | 172 | 172 | 175.6 | 48.38** |
| <i>A. wahlbergi</i> | 149 | 148 | | 149 | 151 | 129 | 145.2 | |

 \bar{x} – mean; F – Fisher test; ** $P < 0.01$.

A. coryli and *A. wahlbergi* nymphs appeared on various host-plants between the beginning of April and the end of May in significantly different periods: the former species in mid May and the latter in mid April (Tables 1–2). Egg hatching continued for 30 days on hazel and 60 days on maple. The first adults of the two species were detected in significantly different periods and emergences took place from the beginning of May (*A. wahlbergi* on maple) to the end of June (*A. coryli* on hazel); the last adults of *A. coryli* were observed in mid September, while those of *A. wahlbergi* at the beginning of August on maple (Tables 1–2). *A. albstriella* and *A. viridis* nymphs appeared on chestnut and oak at the beginning of May. The duration of the postembryonic growth varied in springtime

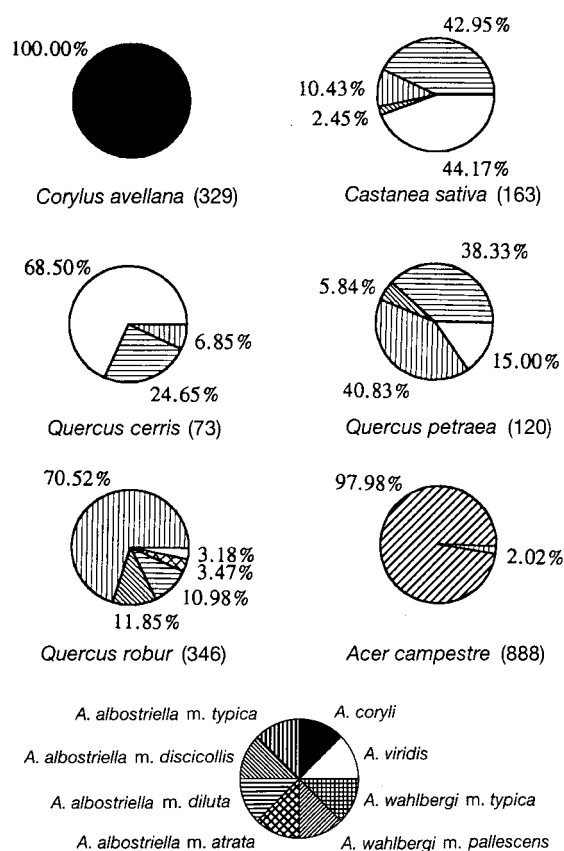


Fig. 2. *Alebra* spp., species and colour morph composition on different host-plants in Piedmont. Total number of individuals, collected as adults and nymphs, within brackets.

1991) and Greece (Drosopoulos et al., 1987). However, we never found *A. wahlbergi* m. *brunnea*, known from Greece (Drosopoulos et al., 1987).

The host-plant relationships of *Alebra* species are consistent with the specific association of *A. coryli* with *C. avellana* (Le Quesne, 1977), of *A. albobstriella* with *Q. robur* (Gillham, 1991) and of *A. wahlbergi* with *A. campestre* (Claridge & Wilson, 1981), nevertheless, only *A. coryli* is a monophagous leaf-hopper. *A. albobstriella* lives, as adult and nymph, on four species of Fagaceae, and it has also been reported on *Alnus glutinosa* (L.) Gaertner by Vidano & Arzone (1987a); this leaf-hopper can then be recognized as a polyphagous species in Italy. In Britain, *A. albobstriella* is regarded as monophagous on the oak group by Claridge & Wilson (1976, 1981) and specific on *Q. robur* by Gillham (1991). *A. wahlbergi* has been collected only on *A. campestre*, but there are many reports of other host-plants of the genera *Tilia*, *Aesculus*, *Prunus*, *Sorbus*, *Ulmus* and *Alnus* (Claridge & Wilson, 1981; Vidano & Arzone, 1981) so that this species can be considered as a

from 25 to 42 days depending on the hatching period; in the summer the minimum duration, for second generation nymphs, was 25 days. Adults of *A. albobstriella* were found from the beginning of June until the end of September on oak and chestnut; adults of *A. viridis* were found from the beginning of June until mid October on the same plants.

Alebra species were obtained from four different nymphal morphs: yellow, white, dark and striped. *A. coryli* and *A. wahlbergi* morph *pallescens* were obtained from yellow and white nymphs. *A. albobstriella* was reared from all nymphal morphs, morph *discicollis* was obtained both from dark and striped nymphs (Table 3).

DISCUSSION AND CONCLUSIONS

The distribution of adult pattern morphs of *Alebra* varies in the different countries. In Italy we found *A. albobstriella* m. *diluta* and *atrata*, known to be absent from Britain (Gillham,

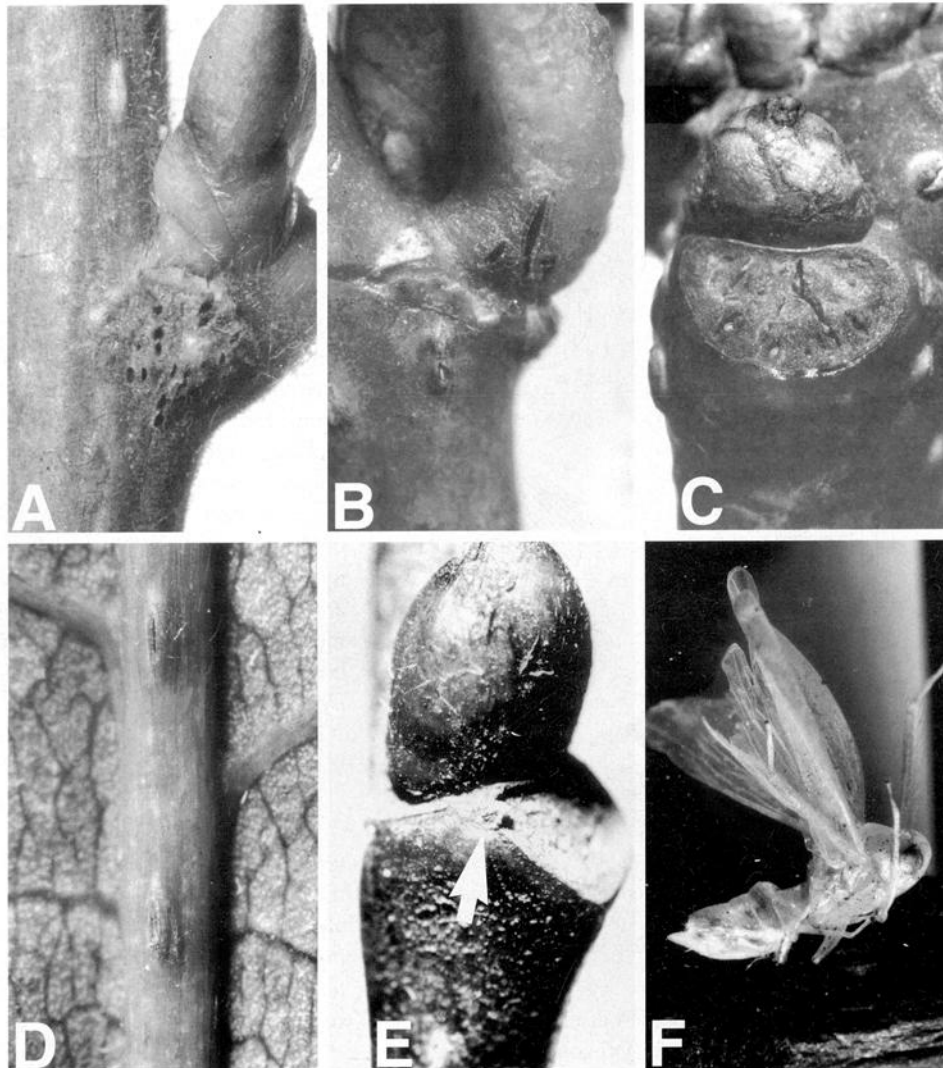


Fig. 3. Oviposition sites of *Alebra* spp. A – *A. coryli* on *Corylus avellana*; B, C, D – *A. albostriella* on *Quercus robur*: overwintering eggs before (B) and after (C) the leaf drop, summer eggs in the main leaf nervation (D); E – *A. viridis* on *Castanea sativa* (overwintering egg); F – *A. wahlbergi* on *Acer campestre* (female died during oviposition).

polyphage. *A. wahlbergi* has been reported on *C. sativa* (Claridge & Wilson, 1981; Drosopoulos et al., 1987; Vidano & Arzone, 1987b), and *Q. cerris* (Vidano & Arzone, 1987b); but for our samples, after analysing both the dark points of metatibiae and the shape of apodemes, we identified *A. albostriella* m. *diluta* on these trees.

TABLE 3. Association between nymphal and adult morphs of *Alebra* species on different host plants.

| Species | Morph | Host plant | Nymphal morph | | | | | | | | Total | |
|--------------------------------|--------------------|-------------------------|---------------|---|----|----|----|----|---|---|-------|----|
| | | | Y | | W | | D | | S | | | |
| | | | M | F | M | F | M | F | M | F | M | F |
| <i>A. coryli</i> Le Quesne | | <i>Corylus avellana</i> | 4 | 1 | 4 | 3 | 0 | 0 | 0 | 0 | 8 | 4 |
| <i>A. wahlbergi</i> (Boheman) | <i>pallescens</i> | <i>Acer campestre</i> | 17 | 9 | 15 | 16 | 0 | 0 | 0 | 0 | 32 | 25 |
| <i>A. albosriella</i> (Fallén) | <i>typica</i> | <i>Quercus robur</i> | 7 | 9 | 0 | 7 | 16 | 19 | 0 | 0 | 23 | 35 |
| | <i>typica</i> | <i>Castanea sativa</i> | 0 | 0 | 2 | 0 | 1 | 3 | 0 | 0 | 3 | 3 |
| | <i>diluta</i> | <i>Quercus robur</i> | 0 | 1 | 0 | 4 | 0 | 3 | 0 | 0 | 0 | 8 |
| | <i>diluta</i> | <i>Quercus petraea</i> | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 2 |
| | <i>diluta</i> | <i>Castanea sativa</i> | 2 | 1 | 10 | 3 | 1 | 0 | 0 | 0 | 13 | 4 |
| | <i>discicollis</i> | <i>Quercus robur</i> | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 4 | 0 | 11 |
| | <i>discicollis</i> | <i>Quercus petraea</i> | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| | <i>atrata</i> | <i>Quercus robur</i> | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 2 | 0 | 6 |
| <i>A. viridis</i> Rey | | <i>Quercus robur</i> | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| | | <i>Castanea sativa</i> | 0 | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 4 | 3 |

Y – yellow; W – white; D – dark; S – striped; M – male; F – female.

A. viridis, collected as adult and nymph on *Q. cerris*, *Q. petraea* and *C. sativa*, can be considered an oligophagous species within the Fagaceae. Gillham (1991) found a specific association of *A. viridis* with *Q. petraea* in Britain, but this cannot be confirmed in Italian woodlands. Drosopoulos et al. (1987) found three coexisting *Alebra* species on *C. sativa* in Greece. Clearly, it appears that host-plant relationships are highly variable following the geographic regions.

Voltinism is not a constant feature among and within *Alebra* species, since it is possible to recognise univoltine, bivoltine and partially uni/bivoltine species as *A. albosriella*. *A. coryli* and *A. wahlbergi* are both univoltine, but their phenology indicate that they develop in well separated periods: *A. coryli* appears and disappears one month later than *A. wahlbergi*. Thus, these two closely related species appear to be spatially and temporally well separated.

The life histories can vary in different regions: *A. viridis* appears bivoltine in Italy and in Greece (Drosopoulos et al., 1987) and univoltine in Britain (Gillham, 1991); *A. albosriella* shows a second generation only in Italy. This biological feature could suggest that *Alebra* species (at least *A. albosriella* and *A. viridis*) are non-genetically-fixed univoltine (Müller, 1979), and they may be able to produce two generations per year. It is suggested that the life cycle of *A. albosriella* is mostly influenced by its host-plant, as on *Q. robur* we rarely observed a second generation, while on *Q. petraea* and *C. sativa* we found many second generation nymphs during August and September.

It is interesting to note, that among the Typhlocybinae that feed on broad-leaved trees, only few *Alebra* species and *Alnetoidia alneti* Dahlbom (Claridge & Wilson, 1976) are known to be univoltine.

The oviposition sites of overwintering and summer eggs of *A. albosriella* and *A. viridis*, sharing the same host tree, are not species-specific. These leaf-hoppers lay overwintering eggs in the branches at the base of the buds, as observed for some species of *Oncopsis* Burmeister (Claridge & Reynolds, 1972).

Accordingly to the high variability of adult morphs, the nymphs of *A. albostriella* are polymorphic, while *A. coryli*, *A. wahlbergi* and *A. viridis* adults come from pale (white and yellow) and dark nymphs respectively. *A. albostriella* m. *discicollis* comes from striped nymphs, as reported by Gillham (1991), but also from dark ones.

A. albostriella m. *discicollis* can segregate from m. *typica* and for this reason the two morphs have always been found associated on *Q. robur*, *Q. petraea* and *C. sativa*. A detailed analysis of genetic relationships among the different Italian morphs, by means of isozyme electrophoresis and male calls, is needed.

ACKNOWLEDGEMENTS. Work supported by a grant "MURST Ricerca scientifica 60%".

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Received March 16, 1994; accepted December 29, 1994