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# THE INTERSPECIFIC RELATIONSHIPS BETWEEN PLANTS, CICADELLIDS, AND DRYINIDS (HEMIPTERA: CICADELLIDAE – HYMENOPTERA: DRYINIDAE)

Valeria GIORDANO, Alberto ALMA & Alessandra ARZONE

Di.Va.P.R.A.-Entomologia e Zoologia applicate all'Ambiente "C.Vidano",
Università di Torino - Via L. da Vinci 44 - 10095 Grugliasco (TO)

**Abstract –** The relationships between 14 species of broadleaved trees, 29 species of cicadellids, 9 species of dryinids, and 1 species of a diapriid hyperparasitoid were examined in several areas of the western Piedmont (Northern Italy).

KEY WORDS: Broadleaved trees, Auchenorrhyncha, plant sucking insects, parasitoids, hyperparasitoids

**Izvleček** –MEDVRSTNI ODNOSI MED RASTLINAMI, ŠKRŽATKI DRUŽINE CICADELLIDAE IN OSICAMI DRUŽINE DRYINIDAE (HEMIPTERA: CICADELLIDAE – HYMENOPTERA: DRYINIDAE)

Na več območjih zahodnega Piemonta (severna Italija) so bili proučeni odnosi med 14 vrstami listnatega drevja, 29 vrstami škržatkov iz družine Cicadellidae, 9 vrstami osic ščipalkark (Dryinidae) in eno hiperparazitsko vrsto iz družine Diapriidae.

KLJUČNE BESEDE: listnato drevje, Auchenorrhyncha, rastline sesajoče žuželke, parazitoidi, hiperparazitoidi

## Introduction

The Hymenoptera Dryinidae are poorly known parasitoids that play an important role in the control and maintenance of the delicate balances in natural environments (Arzone *et al.,* 1988; Tavella *et al.*, 1994; Alma & Tavella, 1997). Nevertheless, until now their use in biological control has not reached the desired results due to unknown elements that did not permit a positive result (Olmi, 2000). On the other hand, so far investigations concerning the dryinid-host association are few and the hypothesis of a close interrelationship between trees and parasitoids has not yet been confirmed. Therefore, for the correct use of the control activity of these parasitoids, it seems necessary to know better their biological, ecological, and ethological peculiarities.

Keeping in mind the results of research on the relationship between cicadellids and plants (Arzone & Vidano, 1987; Vidano & Arzone, 1987a, 1987b), an attempt to increase knowledge about tree-cicadellid-dryinid associations seemed interesting, particularly in considering the necessity of using dryinids in controlling the flatid *Metcalfa pruinosa* (Say). It is now widely diffused in Italy, where it arrived from the U.S.A. without its natural enemies (Girolami & Camporese, 1994). This research has only a qualitative character, but the checked numerical data aim at least partially to light the parasitization incidence carried out by dryinids on cicadellids.

## Materials and methods

The parasitized cicadellids were sampled on the most common trees in urban, extraurban, woody, and mountainous environments of the western Piedmont, namely, *Salix* spp., *Populus nigra* L., *P tremula* L., *P alba* L., *Betula pendula* Roth, *Alnus glutinosa* Gaertner, *Carpinus betulus* L., *Corylus avellana* L., *Quercus robur* L., *Castanea sativa* Miller, and *Fagus sylvatica* L.

Captures and surveys were made weekly in the parks of Turin (230 m a.s.l.) and Cuneo (534 m a.s.l.), besides rarely inhabited environments in the neighbourhood of Boves (CN, 600 m a.s.l.), and sporadically also in mountain environments of the provinces of Cuneo (Valle Stura di Demonte, from 570 to 1,249 m a.s.l.; Valle Gesso, 730 m a.s.l.; Valle Maira, 1,010 m a.s.l.), Torino (Valle di Susa, 364 m a.s.l.; Val Chisone, 1,830 m a.s.l.), Aosta (Natural park "Monte Avic", 860 m a.s.l.), and Trento (Monte Bondone, 1,832 m a.s.l.). Extemporaneous and occasional collections were also made on different plants in other localities.

The captures and surveys were carried out during 1993-1995 in two distinct periods: during the plant winter quiescence and the vegetative activity. During the winter quiescence of deciduous plants, the cicadellids were collected on conifers and brambles and reared in cages on host plants to check the probable presence of dryinid larval sacs. In spring, daily surveys were made on budding broadleaved trees to precisely detect the presence of cicadellid nymphs. Afterwards nymphs of different instars were collected and reared. When possible, the cicadellid instars in which the parasitization occurred were stated.

Two yellow sticky traps were placed on the canopy of 5 plants of *B. pendula* and *C. betulus* in Turin in the 3rd decade of March 1995, on 5 plants of *P alba* and *P nigra* in Turin, and of *P nigra* and *P tremula* at Boves in the 2nd decade of April

1994 and 1995. Similar traps were placed on all the other investigated poplars to check the emergence period of the dryinids in the open air linked to different ecological niches. The exposure date was fixed according to the appearance of the first cicadellids on broadleaved trees. Trap replacements were done weekly.

The parasitized specimens were reared, one by one, in glass tubes with a layer of wet soil mixed with sand on the bottom to permit the cocooning of dryinid larvae. Inside the tubes a leaf or a bud of the cicadellid host plant was also placed, its base dipped in a nutritive solution in order to maintain turgidity for a longer time. These tubes with the parasitoid cocoons were kept in natural climatic conditions to check the nymphosis period.

In 1995, where no emergence was obtained, we carefully examined the tubes to ascertain the mortality of cocooned or not cocooned larvae, and also larvae, pupae, and adults within the cocoon.

The dryinids were classified according to Olmi's keys (1984).

## Results

468 cicadellids were collected on conifers and brambles (Table 1). No specimen showed a dryinid larval sac.

The chromotactic traps captured 1 *Anteon jurineanum* Latreille male at the end of May on *B. pendula*, 34 males and 3 females of *A. jurineanum* at the beginning of April on *C. betulus*, 84 males and 50 females of *A. flavicorne* (Dalman) from the end of April to the end of May on *P nigra*, 32 males and 3 females of *A. flavicorne* on *P alba*, 19 males and 2 females of *A. flavicorne* on *P tremula*.

The parasitized cicadellids collected on 14 tree species are reported in Table 2, in which we indicate the dryinids emerged in the year of cocooning as well as in the following year. About half of the dryinid larvae reared in the laboratory burrowed in the soil, but several died without spinning a cocoon. Inside the cocoons we also found dead larvae, pupae and adults. A total of 44 *Aphelopus* spp. (33 in the year of the hatching) and 95 *Anteon* spp. (84 in the year of the hatching) emerged. Namely: 33 ***Aphelopus melaleucus*** (Dalman), 1 from *Edwardsiana rosae* (L.) on *Pirus malus* L., 1 from *E. candidula* Kirschbaum on *P alba*, 3 from *E. avellanae* (Edwards), 1 from *E. staminata* (Ribaut), and 1 from *Alebra coryli* Le Quesne on *C. avellana*, 1 from *E. flavescens* (F.), 3 from *Typhlocyba quercus* (F.), and 1 from *Arboridia versuta* (Melichar) on *Q. robur*, 21 from *Fagocyba cruenta* (Herrich-Schaeffer) on *F sylvatica;* 3 ***A. atratus*** (Dalman), 2 from *E. avellanae* and 1 from *E. staminata* on *C. avellana;* 5 ***A. serratus*** Richards, 2 from *Arboridia ribauti* (Ossiannilsson) on *C. betulus* and 3 from *E. avellanae* on *C. avellana*; 1 ***A. nigriceps*** Kieffer and 2 ***A. querceus*** Olmi from *A. versuta* on *Q. robur*; 23 ***Anteon arcuatum*** Kieffer, 1 from *Tremulicerus vitreus* (F.) and 22 from *Rhytidodus decimusquartus* (Schrank) on *P nigra;* 71 ***A. flavicorne*** (Dalman), 18 from *T vitreus* and 52 from *Rh. decimusquartus* on *P nigra*, and 1 from *Metidiocerus elegans* (Flor) on *Salix* sp.; 1 ***A. infectum*** (Haliday) from *Iassus scutellaris* (Fieber) on *Ulmus campestris* L.

The nymphosis mean time of the adults which emerged in the year of hatching was 28 days (from 15 to 47), that of the others was 250 days (from 176 to 336). The sex ratio ranged from 1:1 to 3:2 in favour of females, except that of *A. arcuatum* (3:20 in the favour of males).

In Table 3 the fate of the burrowed but not emerged dryinids is illustrated. The adults of ***A. jurineanum*** died inside the cocoons of *O. flavicollis* on *B. pendula* and of *O. carpini* on *C. betulus*, but they were classified as the same.

Sampling dates of dryinizided *T vitreus, Rh. decimusquartus, Populicerus* spp., *Oncopsis flavicollis* (L.), *O. carpini* (J. Sahlberg) and *F cruenta* are given in Fig. 1. The maximum parasitization ratio was 60 for *Rh. decimusquartus* on *P nigra*, 35 for *F cruenta* on *F sylvatica*, 28 for *T vitreus* on *P nigra*, 15 for *Populicerus* spp. on *P tremula*, 13 for *O. carpini* on *C. betulus*, 7 for *O. flavicollis* on *B. pendula*. In Table 4 the plant-cicadellid-dryinid associations are illustrated.

Six specimens of the Diapriid hyperparasitoid *Ismarus flavicornis* (Thomson) were obtained: 4 from *A. flavicorne* on *Populicerus* spp. on *P tremula,* 1 from *A. jurineanum* on *O. flavicollis* on *B. pendula*, 1 probably from *A. flavicorne* on *Rh. decimusquartus* on *P nigra*.

## Discussion

Under natural conditions, *Anteon* spp. were very abundant on Idiocerinae of *P nigra*, quite diffused on cicadellids of *P tremula, P alba,* and *Salix* spp., and less abundant on *Oncopsis* spp. dwelling on *B. pendula* and *C. betulus*. It must be remembered that the two *Anteon* species acting on *P nigra* showed a different distribution in the considered areas. In fact, only 3 *A. arcuatum* specimens emerged from the cocoons coming from the Turin area (230 m a.s.l.), the others came from cicadellids collected in the Cuneo area (534 and 600 m a.s.l.). Instead, *A. flavicorne* was found without distinction in the two areas. *Aphelopus* spp. showed a minor specificity of action and a particular adaptation to some habitats. Actually, the correspondence between parasitoids and plants seemed to be a frequent phenomenon.

Some research enlarged the knowledge of the biology of several *Aphelopus* spp. *A. melaleucus* and *A. nigriceps* are prevalently bivoltine, showing emergence peaks in May and September and passing the diapause period inside the cocoon. *A. serratus* is prevalently monovoltine and diapauses as a first instar larva inside the overwintering adults of *Zygina* spp. as well as in a larval instar inside the cocoon (Jervis, 1980). In this research and in a previous one on *Zygina rhamni* Ferrari (Alma & Tavella, 1997), we never obtained dryinids from cicadellids overwintering on conifers or brambles.

In the natural environment the parasitoids act only on a part of the potential hosts as a limiting factor. In fact, some factors provoke both a discrimination and a selection of the host and favour or prevent the parasitization. The presence of dryinids and cicadellids in the same habitat is a meeting point for the two. At first the parasitoids are attracted both by a particular environment and sugar substances available on the same plants, afterwards they stay on the vegetable parts where the plant sucking insects are concentrated. Host searching is made in a casual way and is often determined by the meeting opportunity in the sites in which such parasitoids find the best developmental conditions. According to Picard's and Rabaud's observations, many parasitoids are more sensitive to the attraction of the phytophage's host-plants than that of the phytophage itself (Flanders, 1940). In contrast, other authors argue that there is really no strict relation between host-plant and parasitoid. They had not found a direct relation between *A. atratus, A. camus, A. nigriceps*, and *A. serratus* and their habitat (Waloff & Jervis, 1987).

In our research the dryinids were shown to be attracted by their cicadellid hosts rather than by the plants. Emblematic is the aphelopine *A. melaleucus,* which attacked several typhlocybines on different host-plants. Moreover, the aphelopine *A. melaleucus* and the anteonine *A. flavicorne*, on the same host-plant *P alba,* parasitized the typhlocybine *E. candidula* and the idiocerine *P albicans,* respectively.

In any case the control activity exerted by dryinids on cicadellids is interesting and opens important perspectives in the applied field. The dryinid activity, if poorly evident, is particularly effective and helps to maintain the cicadellid populations under the damage threshold. During this research, both *Aphelopus* and *Anteon* species were checked on Salicaceae, Betulaceae, Corylaceae, and Fagaceae trees. In particular, Aphelopinae showed a different distribution on the trees independently from the species of typhlocybines present there. Some trees had a consistent number of such hymenopterans, while others were without, though frequented by cicadellids. Anteoninae were parasitoids of prevalently oligophagous cicadellids. There is no evidence of a consistent variability of their population distribution on different host-plants.

Phytophage communities discussed here showed a large proportion of host specialists. Their associated parasitoids, however, had a wider host range. Such a phenomenon enabled them to adapt easily to adverse conditions when the usual victims were lacking. The reduced potential of dispersal of the parasitoid populations in comparison with those of the phytophagous ones was partially compensated both by the major capacity of adaptation and the marked polyphagy.

Only one hyperparasitoid species was found in the different biocenoses. Therefore the specialization gradually decreased from the trophic level of phytophages to the parasitoids, and from the parasitoids to the hyperparasitoids.

## Summary

Research was carried out to ascertain the relationships between plants, cicadellids, and dryinids. The investigations were made in northern Italy, in urban, extraurban, woody, and mountainous environments of the western Piedmont on the most common broadleaved trees, from 230 to 1,832 m a.s.l. Parasitized cicadellids were collected on 14 tree species, particularly Idiocerinae, Macropsinae, and Typhlocybinae. The maximum percentage of parasitization was 60 for *Rhytidodus*

*decimusquartus* on *Populus nigra*, 35 for *Fagocyba cruenta* on *Fagus sylvatica*, 28 for *Tremulicerus vitreus* on *P nigra*, 15 for *Populicerus* spp. on *P tremula*, 13 for *Oncopsis carpini* on *Carpinus betulus*, 7 for *O. flavicollis* on *Betula pendula*. A total of 44 Aphelopinae and 95 *Anteoninae* emerged from the Cicadellidae. Namely: **Aphelopus melaleucus** from *Edwardsiana rosae* on *Pirus malus*, from *E. candidula* on *P alba*, from *Alebra coryli*, *E. avellanae*, and *E. staminata* on *Corylus avellana*, from *E. flavescens*, *Typhlocyba quercus*, *Arboridia versuta* on *Quercus robur*, and from *F cruenta* on *F sylvatica*, **A. atratus** from *E. avellanae* and *E. staminata* on *C. avellana*, **A serratus** from *Arboridia ribauti* on *C. betulus* and from *E. avellanae* on *C. avellana*, **A. nigriceps** and **A. querceus** from *A. versuta* on *Q. robur*, **Anteon arcuatum** from *Rh. decimusquartus* and *T vitreus* on *P nigra*, **A. flavicorne** from *Metidiocerus elegans* on *Salix* sp., from *Rh. decimusquartus* and *T vitreus* on *P nigra*, from *Populicerus* spp. on *P tremula*, and from *P albicans* on *P alba*, **A. infectum** from *Iassus scutellaris* on *Ulmus campestris*. The adults of *A. jurineanum* died inside the cocoons of *O. flavicollis* on *B. pendula* and of *O. carpini* on *C. betulus*, but they were classified as the same. Chromotactic traps captured 1 *A. jurineanum* male at the end of May on *B. pendula*, 34 males and 3 females of *A. jurineanum* at the beginning of April on *C. betulus*, 84 males and 50 females of *A. flavicorne* from the end of April to the end of May on *P nigra*, 32 males and 3 females of *A. flavicorne* on *P alba*, 19 males and 2 females of *A. flavicorne* on *P tremula*. Six specimens of the Diapriid hyperparasitoid *Ismarus flavicornis* emerged: 4 from *A. flavicorne* on *Populicerus* spp. on *P tremula*, 1 from *A. jurineanum* on *O. flavicollis* on *B. pendula*, 1 probably from *A. flavicorne* on *Rh. decimusquartus* on *P nigra*.

The Dryinids were attracted by their cicadellid hosts rather than by the plants. Emblematic is the aphelopine *A. melaleucus*, which parasitized several typhlocybines on different host-plants. The same aphelopine, *A. melaleucus*, and the anteonine *A. flavicorne*, on the same host-plant *P alba*, parasitized the typhlocybine *E. candidula*, and the idiocerine *P albicans* respectively.

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**Tab. 1:** Cicadellidae collected on conifers and brambles in the biennium 1993–1994.

| Cicadellidae | Conifers | | Brambles | |
|---|---|---|---|---|
| | m. | f. | m. | f. |
| *Stenidiocerus poecilus* | 40 | 45 | 0 | 0 |
| *Empoasca* spp. | 0 | 0 | 0 | 2 |
| *Empoasca decipiens* | 1 | 0 | 4 | 0 |
| *Empoasca vitis* | 32 | 132 | 6 | 53 |
| *Ribautiana* spp. | 0 | 0 | 0 | 8 |
| *Zyginella pulchra* | 21 | 13 | 1 | 0 |
| *Zygina* spp. | 1 | 1 | 0 | 0 |
| *Zygina angusta* | 0 | 0 | 2 | 6 |
| *Zygina flammigera* | 2 | 3 | 20 | 34 |
| *Zygina rhamni* | 2 | 5 | 3 | 3 |
| *Zygina tithide* | 6 | 9 | 2 | 1 |
| *Arboridia* spp. | 0 | 1 | 0 | 4 |
| *Arboridia versuta* | 1 | 0 | 1 | 0 |
| *Frutioidia bisignata* | 0 | 0 | 0 | 3 |

**Table 2:** Parasitoid activity of Dryinidae on Cicadellidae.

| Host plant | No. | Parasitized Cicadellids | Burrowed Dryinids | Emerged Dryinids (1) | Emerged Dryinids (2) |
|---|---|---|---|---|---|
| *Acer campestre* | 2 | *Alebra* spp. | 1 | 0 | 0 |
| *Pirus malus* | 5 | *Edwardsiana rosae* | 1 | 1 | 0 |
| *Salix* sp. | 1 | *Macropsis* sp. | 0 | 0 | 0 |
| | 2 | *Metidiocerus elegans* | 2 | 0 | 1 |
| | 1 | *Edwardsiana frustrator* | 1 | 0 | 0 |
| *Populus nigra* | 1 | *Macropsis graminea* | 0 | 0 | 0 |
| | 239 | *Rhytidodus decimusquartus* | 184 | 69 | 5 |
| | 73 | *Tremulicerus vitreus* | 55 | 15 | 4 |
| *Populus tremula* | 34 | *Populicerus* spp. | 26 | 0 | 0 |
| *Populus alba* | 8 | *Populicerus albicans* | 0 | 0 | 0 |
| | 2 | *Edwardsiana candidula* | 2 | 1 | 0 |
| *Ulmus campestris* | 1 | *Iassus scutellaris* | 1 | 0 | 1 |
| *Betula pendula* | 19 | *Oncopsis flavicollis* | 13 | 0 | 0 |
| *Alnus glutinosa* | 3 | *Oncopsis alni* | 1 | 0 | 0 |
| | 1 | *Edwardsiana frustrator* | 1 | 0 | 0 |
| *Carpinus betulus* | 43 | *Oncopsis carpini* | 25 | 0 | 0 |
| | 1 | *Typhlocyba bifasciata* | 0 | 0 | 0 |
| | 3 | *Alnetoidia alneti* | 3 | 0 | 0 |
| | 2 | *Arboridia ribauti* | 2 | 2 | 0 |
| *Corylus avellana* | 68 | *Alebra coryli* | 1 | 1 | 0 |
| | 20 | *Edwardsiana avellanae* | 15 | 4 | 4 |
| | 4 | *Edwardsiana staminata* | 3 | 2 | 0 |
| | 3 | *Alnetoidia alneti* | 2 | 0 | 0 |
| | 1 | *Arboridia parvula* | 0 | 0 | 0 |
| *Quercus robur* | 6 | *Alebra albostriella* | 6 | 0 | 0 |
| | 3 | *Fagocyba carri* | 2 | 0 | 0 |
| | 4 | *Edwardsiana flavescens* | 3 | 1 | 0 |
| | 1 | *Edwardsiana rosae* | 1 | 0 | 0 |
| | 9 | *Typhlocyba quercus* | 7 | 3 | 0 |
| | 6 | *Arboridia versuta* | 5 | 4 | 0 |
| *Castanea sativa* | 1 | *Alebra wahlbergi* | 1 | 0 | 0 |
| *Fagus sylvatica* | 83 | *Fagocyba cruenta* | 47 | 14 | 7 |
| | 3 | *Edwardsiana flavescens* | 2 | 0 | 0 |
| | 1 | *Edwardsiana staminata* | 0 | 0 | 0 |

Dryinids emerged in the year of cocooning (1) or in the following year (2).

**Table 3:** Dead Dryinidae found in the ground at the end of rearings.

| Host plant | Cicadellidae | Burrowed dryinids not emerged | Dead dryinids | | | |
|---|---|---|---|---|---|---|
| | | | Without cocoon | Inside cocoon | | |
| | | | | L | P | A |
| *Acer campestre* | *Alebra* sp. | 1 | 1 | 0 | 0 | 0 |
| *Salix* sp. | *Metidiocerus elegans* | 1 | 0 | 0 | 0 | 0 |
| | *Edwardsiana frustrator* | 1 | 0 | 0 | 0 | 1 |
| *Populus nigra* | *Rhytidodus decimusquartus* | 110 | 2 | 15 | 5 | 47 |
| | *Tremulicerus vitreus* | 36 | 1 | 5 | 2 | 14 |
| *Populus tremula* | *Populicerus* spp. | 26 | 1 | 8 | 0 | 5 |
| *Populus alba* | *Edwardsiana candidula* | 1 | 0 | 1 | 0 | 0 |
| *Betula pendula* | *Oncopsis flavicollis* | 13 | 1 | 5 | 0 | 3 |
| *Alnus glutinosa* | *Oncopsis alni* | 1 | 0 | 1 | 0 | 0 |
| | *Edwardsiana frustrator* | 1 | 0 | 1 | 0 | 0 |
| *Carpinus betulus* | *Oncopsis carpini* | 25 | 20 | 0 | 0 | 1 |
| | *Alnetoidia alneti* | 3 | 1 | 2 | 0 | 0 |
| *Corylus avellana* | *Alebra coryli* | 67 | 9 | 32 | 3 | 2 |
| | *Edwardsiana avellanae* | 7 | 3 | 1 | 0 | 1 |
| | *Edwardsiana staminata* | 1 | 0 | 1 | 0 | 0 |
| | *Alnetoidia alneti* | 2 | 0 | 1 | 0 | 0 |
| *Quercus robur* | *Alebra albostriella* | 6 | 0 | 5 | 0 | 0 |
| | *Fagocyba carri* | 2 | 0 | 1 | 0 | 0 |
| | *Edwardsiana flavescens* | 2 | 0 | 0 | 0 | 1 |
| | *Edwardsiana rosae* | 1 | 0 | 1 | 0 | 0 |
| | *Typhlocyba quercus* | 4 | 0 | 2 | 0 | 0 |
| | *Arboridia versuta* | 1 | 1 | 0 | 0 | 0 |
| *Castanea sativa* | *Alebra wahlbergi* | 1 | 0 | 1 | 0 | 0 |
| *Fagus sylvatica* | *Fagocyba cruenta* | 26 | 2 | 8 | 1 | 4 |
| | *Edwardsiana flavescens* | 2 | 0 | 1 | 0 | 1 |

L larva, P pupa, A adult.

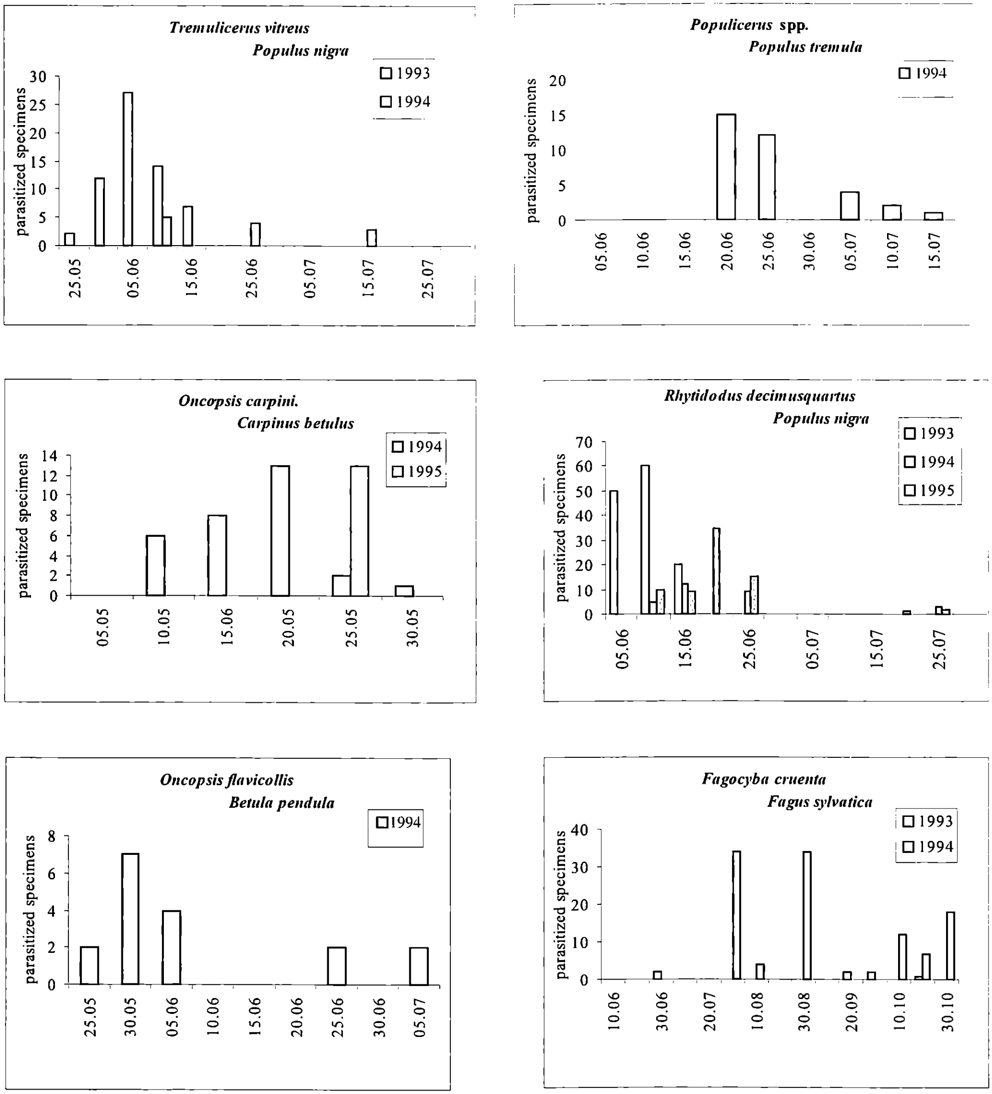


**Fig. 1:** Capture dates of parasitized specimens and parasitization rate in different plants and years.

**Table 4:** Host plant-cicadellid-dryinid associations.

| Host plant | Cicadellidae | Dryinidae |
|---|---|---|
| *Pirus malus* | *Edwardsiana rosae* | *Aphelopus melaleucus* |
| *Salix* sp. | *Metidiocerus elegans* | *Anteon flavicorne* |
| *Populus nigra* | *Rhytidodus decimusquartus* | *Anteon arcuatum* |
| | *Tremulicerus vitreus* | *Anteon flavicorne* |
| *Populus tremula* | *Populicerus* spp. | *Anteon flavicorne* |
| *Populus alba* | *Populicerus albicans* | *Anteon flavicorne* |
| | *Edwardsiana candidula* | *Aphelopus melaleucus* |
| *Ulmus campestris* | *Iassus scutellaris* | *Anteon infectum* |
| *Betula pendula* | *Oncopsis flavicollis* | *Anteon jurineanum* |
| *Carpinus betulus* | *Oncopsis carpini* | *Anteon jurineanum* |
| | *Arboridia ribauti* | *Aphelopus serratus* |
| *Corylus avellana* | *Alebra coryli* | *Aphelopus melaleucus* |
| | *Edwardsiana avellanae* | *Aphelopus atratus* |
| | *Edwardsiana staminata* | *Aphelopus serratus* |
| *Quercus robur* | *Edwardsiana flavescens* | *Aphelopus melaleucus* |
| | *Typhlocyba quercus* | *Aphelopus nigriceps* |
| | *Arboridia versuta* | *Aphelopus querceus* |
| *Fagus sylvatica* | *Fagocyba cruenta* | *Aphelopus melaleucus* |

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