

**Original article (Orjinal araştırma)**

**Host diversity of *Philaenus spumarius* (L.) (Hemiptera: Cercopidae) in Bartın Region<sup>1</sup>**

*Philaenus spumarius* (L.) (Hemiptera: Cercopidae)'un Bartın yöresindeki konukçu çeşitliliği

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**Summary**

*Philaenus spumarius* which has attracted the attention of biologists and entomologists due to ecological, morphological and biological properties for many years, has also attracted attention because of the abundance of host diversity in the Bartın locality. *P. spumarius* is called as froghopper or meadow spittlebug and has polyandry and polymorphic characteristics. Meadow spittlebugs' nymphs protects themselves thanks to foam generated by themselves. When this insect has been found to generate foam on many species of plant, field and laboratory studies have been carried out with a view to revealing host types of this species in Bartın locality in 2013-2015. This study has concluded that this insect can be fed with 20 different plant species in Bartın locality.

**Keywords:** *Philaenus spumarius*, Meadow spittlebugs, Bartın, host plants, damage

**Özet**

Ekolojik, morfolojik ve biyolojik özellikleri nedeniyle biyologların ve entomologların uzun yıllardır ilgisini çeken *Philaenus spumarius*, Bartın yöresinde konukçu çeşitliliğinin fazlalığı nedeniyle de dikkati çekmiştir. Çayır köpük böceği ya da tükürük böceği olarak adlandırılan, poliandrik ve polimorfik özellik gösteren bir böcektir. Nimfleri, ürettikleri köpük ile kendilerini koruma altına almaktadırlar. Pek çok bitki türü üzerinde köpükler oluşturduğu görülünce bu türün Bartın yöresindeki konukçu türlerini ortaya koymak amacıyla 2013-2015 yıllarında arazi ve laboratuvar çalışması şeklinde araştırmalar yürütülmüştür. Bu çalışma sonucunda *P. spumarius*'un Bartın yöresinde 20 farklı bitki çeşidiyle beslenebildiği tespit edilmiştir.

**Anahtar sözcükler:** *Philaenus spumarius*, çayır köpük böceği, Bartın, konukçu bitki, zarar

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## Introduction

Foams observed on plants are generated by the insects of Cercopidae family. This foam not only prevents their fragile and soft bodies from getting dried but also protects them against the attack of predators and ultraviolet rays. *Philaenus spumarius* (L.) is 5,8-6,7 mm length, from Cercopidae family of the Suborder Auchenorrhyncha belonging to the Order Hemiptera. This species is univoltine and hemimetabola. They are also called as froghoppers or spittle bugs, or frog bugs due to their ability to jump (Chinery, 1993; Akdeniz, 2008). *P. spumarius* is the most economically important species of Cercopidae family in Turkey (Lodos & Kalkandelen, 1981).

Foamy bugs obtain nutrition from xylem through penetrating with their stylets during nymph period and absorb sap of plants. Foam is generated by epidermal glands on seventh and eighth abdominal segments from a liquid secreted superficially or discharged from anus. Air bubbles are generated through the use of caudal (fluke) extensions (Borror et. al., 1989). Adults maintain their lives as free individuals and don't generate foams. Adults have diversity on their wing patterns. Due to polymorphic features, the individuals of the same species can be perceived as different species. In studies up to now considering dorsal color/ pattern variation, 16 phenotypes have been reported to be available in *P. spumarius* taxon. This color/ pattern phenotypes emerge due to inheritance (Akdeniz, 2008). Both of nymphs and adults have piercing sucking mouthparts through which they suck plant juice (Anonymous, 2016). The main damage is done by nymphs (Tooper, 2001).

*P. spumarius* can be characterized as an insect being polyphagous and living in all the sufficiently wet habitats ranging from stream sides, pastures, abandoned areas to parks, gardens, forests and etc. In studies carried out in different zones of the world, namely, Afghanistan (Diabola, 1957), North America (Lavigne, 1959), in Europe (Whittaker, 1968), Russia (Whittaker, 1972), Japan (Harper, 1974), New Zealand (Archibald & Cox, 1979) and Turkey (Yurtsever & Lees, 1994), they are determined to get fed from herbaceous plant to woody-like plants. However, like humidity, heat also limits the spread of this insect. They are not found in Arctic, the Alpines and Arid Zone.

These insects can give damage to plants both through extracting sap of the plants and transferring disease factors (viruses) from one plant to other (DeLong & Severin, 1950; Wilson & Turner, 2010). Nymph can absorb sap of plant at the amount up to 280 times of their own weight through 24 hours, as a result of which, plants get damaged (Horsfield, 1978). This insect is economically very harmful particularly for *Medicago* sp., *Solidago* sp., *Trifolium* spp. and *Fragaria* spp.

Birds and frogs are nourished with these insects. Besides, many spiders as well as many predators from Diptera, Coleoptera and Hymenoptera orders also get nourished with them.

They have hemimetabolous metamorphosis. Some *P. spumarius* populations produce one generation in a year in England and Turkey (Stewart & Lees, 1996; Yurtsever, 1999). Females leave their eggs in autumn. Eggs spend winter in diaposis and hatched in spring. After undergoing to five nymph periods, they became adult in June. Adults are observed until October (Halkka, 1962). Female has polyandry characteristics.

Females can mate multiple times with different male throughout in reproductive period and a female can produce around 350- 400 eggs. As soon as the female lays their eggs, life cycle is completed (Akdeniz, 2008).

## Material and Method

The research consists of field and laboratory studies and has been carried out in two phases. In the first phase, insects of the study and plant species which are host for them have been collected and prepared. Observations have been noted. In the second phase, data obtained from field studies have been analyzed and assessed; plant and insect samples have been diagnosed in laboratory. Field studies have been carried out during vegetation period in 2013- 2015 years.

Being easily understood to host insect due to its being foamy among the samples taken within the scope of study, the plants are taken with their all vegetative parts so that they can be scientifically named correctly and eligible for being kept under herbarium conditions. These plants are put within the drying paper and pressed so that they can be dried correctly. When plants get dried completely, they are stuck on cardboards with herbarium standards and sizes and kept. Works of Davis (1965-1985), Davis et al. (1988) and Güner et al. (2000) have been used for the diagnosis of plants converted into herbarium material. In addition Yaltrık & Efe (1996), Zeydanlı et al. (1999), Ekim et al. (2000), Yücel (2002), Yücel (2005), Kaya & Başaran (2006), Güler (2007), Yücel (2008), Özhatay et al. (2010), Ekici (2012), Eminağaoğlu (2012) ve Ekici & Kaya (2014) are utilized other references. Whereas literature and internet resources are made use of in diagnosis of insect species (Yurtsever, 1999; Akdeniz, 2008; Anonymous 2013). The insects which have been just in nymph phase are removed from foamy environment and studied. On the other hand, adults jumping on the host plants are caught and killed with ethyl acetate and diagnosed.

## Results and Discussion

Researches were carried out from April to October in Bartın locality have identified that *Philaenus spumarius* get nourished with 20 different plant species, namely, 1 species each from Boraginaceae, Celastraceae, Iridaceae and Ranunculaceae families, 2 species each from Apiaceae and Salicaceae families, 3 species from Asteraceae family, 4 species from Fabaceae family and 5 species from Poaceae family. These plants and field records are provided below (Table 1).

Table 1. Host diversity of *Philaenus spumarius* in Bartın and its field records

| Host plant name                                       | Plant family | Located in plant of this insect                                                                                                               | Identified by locality                                                                                  | Identified by date                                                                             |
|-------------------------------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| <i>Agrostis capillaris</i> L.                         | Poaceae      | This insect has been identified to generate foam on above-root parts of this plant and get nourished.                                         | In agricultural fields of Bartın Orduyeri. Ağdacı Köyü. Kurtköy. Geçen Köyü.                            | 20/06/2013<br>31/05/2014<br>07/06/2015<br>01/06/2014<br>27/06/2015<br>20/06/2013               |
| <i>Ammi visnaga</i> L.                                | Apiaceae     | This insect has been identified to generate foam on suckers, petiole and places where petiole intersects with suckers.                        | In agricultural fields in Orduyeri Quarter, Bartın.                                                     |                                                                                                |
| <i>Argyrolobium biebersteinii</i> Ball.               | Fabaceae     | Intensive foam is observed on petiole in sucker of this plant.                                                                                | In campus of Bartın University. Orduyeri-Çağlayan sites.                                                | 25/05/2013<br>01/06/2014                                                                       |
| <i>Avena barbata</i> ssp. <i>barbata</i> Pott ex Link | Poaceae      | Intensive foam is observed on the place where petiole and pedicel intersects in sucker of this plant.                                         | In Karaköy campus of Bartın University. Around the river on Kanlıırmak Street. Orduyeri-Çağlayan sites. | 10/05/2013<br>30/04/2014<br>31/05/2014<br>17/05/2015<br>07/06/2015<br>20/04/2013<br>01/06/2014 |
| <i>Bromus hordeaceus</i> subsp. <i>hordeaceus</i> L.  | Poaceae      | This insect has been identified to generate intensive foam on suckers and ear stems.                                                          | In Kanatlı Quarter in Kurucaşile district of Bartın. Gecen Köyü.                                        | 13/08/2013<br>27/06/2015                                                                       |
| <i>Calendula officinalis</i> L.                       | Asteraceae   | The insect is identified to generate intensive foam on the place where pedicels intersect with the shoots on petiole in sucker of this plant. | In campus of Bartın University. River side on Kanlıırmak Street. Orduyeri-Çağlayan sites.               | 24/04/2013<br>25/04/2013<br>01/06/2014                                                         |
| <i>Caucalis platycarpus</i> L.                        | Apiaceae     | This insect has been identified to generate foam on suckers and petiole of this plant and get nourished.                                      | In campus of Bartın University. Karaköy Quarter.                                                        | 12/06/2013<br>13/07/2013                                                                       |

|                                                                                     |               |                                                                                                                                                                                                                                                                      |                                                                                                    |                                                                                  |
|-------------------------------------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| <i>Cichorium inthybus</i> L.                                                        | Asteraceae    | This insect has been identified to generate foam on places where suckers intersect with branch on the suckers of this plant and get nourished.                                                                                                                       | On road sides in Ağdacı Quarter in Bartın. Kurtköy.                                                | 10/06/2013<br>01/06/2014                                                         |
| <i>Clematis vitalba</i> L.                                                          | Ranunculaceae | This insect has been identified to generate foam on sucker and petiole of this plant.                                                                                                                                                                                | On road sides in Ağdacı Quarter of Bartın.                                                         | 10/06/2013                                                                       |
| <i>Echium vulgare</i> L.                                                            | Boraginaceae  | The insect is identified to generate intensive foam on the leaves and petiole of this plant and get nourished within the foam.                                                                                                                                       | In campus of Bartın University. In Karaköy. Amasra- Kaleşah Quarter.                               | 13/06/2013<br>28/06/2015                                                         |
| <i>Euonymus japonicus</i> Thunb. cv. "Microphyllus"                                 | Celastraceae  | The insect is identified to generate intensive foam on the place where the branches intersect with the petiole of this plant and get nourished within the foam.                                                                                                      | In campus of Bartın University. In park area at the center of Bartın.                              | 25/05/2013                                                                       |
| <i>Galega officinalis</i> L.                                                        | Fabaceae      | This insect has been identified to generate foam on places where suckers intersect with branch on the flower suckers of this plant and get nourished.                                                                                                                | In agricultural fields of Orduyeri Quarter in Bartın. Gecen Köyü.                                  | 20/06/2013<br>27/06/2015                                                         |
| <i>Hordeum bulbosum</i> L.                                                          | Poaceae       | This insect has been identified to generate intensive foam on the suckers of this plant and get nourished.                                                                                                                                                           | In Kavaklı Quarter in Kuruçişile district of Bartın.                                               | 13/08/2013                                                                       |
| <i>Hordeum murinum</i> L. ssp. <i>leporinum</i> (Link) Arc var. <i>leporinum</i> L. | Poaceae       | Nymph is identified to generate foam on sucker, leaves, petiole, and sucker joints. The density of both the plants and foams is great.                                                                                                                               | In campus of Bartın University. Around Kanlıırmak. Orduyeri-Çağlayan sites.                        | 14/04/2013<br>01/06/2014<br>20/04/2013<br>01/06/2014                             |
| <i>Iris germanica</i> L.                                                            | Iridaceae     | The insect has been identified to generate foam on leaves of this plant and get nourished.                                                                                                                                                                           | In campus of Bartın University.                                                                    | 25/05/2013                                                                       |
| <i>Melilotus officinalis</i> (L.) Desr.                                             | Fabaceae      | Intensive foam is observed on the place where pedicels intersect with the shoots on petiole in sucker of this plant.                                                                                                                                                 | In campus of Bartın University. Ağdacı graveyard. Orduyeri-Çağlayan sites.                         | 20/04/2013<br>27/04/2013<br>01/06/2014                                           |
| <i>Populus nigra</i> L. ssp. <i>nigra</i>                                           | Salicaceae    | It has been identified to generate foam on places where petiole intersects with the sucker on sucker of plant in the form of shoots and get nourished.                                                                                                               | In campus of Bartın University. Çağlayan sites, Kanlıırmak Street.                                 | 12/06/2013<br>23/05/2014<br>01/06/2014                                           |
| <i>Psoralea bituminosa</i> L.                                                       | Fabaceae      | Intensive foam is observed on the place where sub-branches are intersected on petiole in sucker of this plant.                                                                                                                                                       | In Karaköy campus of Bartın University. Around Bartın- Amasra highroad. Kurtköy and Gecen Köyü.    | 11/05/2013<br>01/06/2014<br>10/07/2013<br>27/06/2015                             |
| <i>Salix babylonica</i> L.                                                          | Salicaceae    | This insect has been identified to generate intensive foam on places where petiole intersects with branch, on places where suckers intersect with branch and on suckers of this plant and drops like rain-drops are observed to fall while passing under this plant. | In campus of Bartın University.<br><br>In garden of dwelling house. Gecen Köyü.                    | 04/05/2013<br>12/06/2013<br>02/07/2014<br>12/06/2013<br>07/05/2014<br>27/06/2015 |
| <i>Taraxacum officinale</i> Web. ex Wigg.                                           | Asteraceae    | Intensive foam is observed on above- root parts of the plant.                                                                                                                                                                                                        | In agricultural fields in Bartın Orduyeri Quarter. Ağdacı Köyü. Kurtköy. Amasra- Kaleşkah Quarter. | 20/06/2013<br>31/05/2014<br>07/06/2015<br>01/06/2014<br>28/06/2015               |

Adult and particularly nymph get nourished from aboveground parts of plants; however, they particularly prefer parts such as leaves, flowers and fruits of plants (Munding, 1946; Wiegert, 1964). Halkka et al. (1976) reported that *P. spumarius* has more than 150 hosts in Finland. There is not much scientific research to done to determine the host plant species of this insect in Turkey. Lodos (1986) suggests that this species is poliphagous and *Medicago sativa*, *Trifolium* sp., *Chrysanthemum* sp., Poaceae, some Leguminosae, *Populus* sp., *Salix* sp.,

*Platanus* sp., species of *Prunus* sp., *Rosa* sp., *Ribes* sp., *Rubus* sp., *Alnus* sp. and *Betula* sp. as well as *Vitis* sp. and many vegetables can be listed among the hosts. Besides Zeybekoğlu & Turgut (2003) have reported this species is often found on the following plants: *Sanguisorba minor*, *Rubus canescens*, *Convolvulus acicularis*, *Lolium perenne*, *Onobrychis* spp., *Bromus* spp., *Geranium* spp., *Galium* spp., *Rostraria* spp., *Silene* spp., *Daucus* spp., *Melilotus* spp., *Bracypodium* spp., *Cynosurus* spp., *Cynodon* spp., *Lolium* spp., *Asteriscus* spp., *Anthemis* spp., *Psoralea* spp., *Triticum* spp., *Avena* spp., *Carpinus orientalis* and *Equisetum* spp.

According to results of studies, these insects have been identified to get nourished with totally 20 different species of plants and found particularly on places where leaves and suckers intersect with trunk of plant intensively. They are also observed on shoots and tall trees, particularly commonly in plants of pastures. They are found to make shift from herbaceous plants to tall shoots and trees. Frequent mowing of pasture plants is identified to considerably decrease intensity of these insects. Therefore, mowing can be assessed as a mechanical struggle in cases where population intensity of these insects increases. Besides being polyphagous and primarily harmful, it is known to transfer virus diseases, which requires us to be cautious against it.

Kovancı et al. (2004) researched on Hemiptera species in strawberry fields in Bursa. Reporting that *Philaenus spumarius* (L.) is the species among Cercopidae family which can cause considerable economic damages to strawberries, they mention that nymph gets nourished from leaves and petioles close to roots of strawberries, and thus their damage goes unnoticed. Nymphs of this species are observed in April-June, whereas adults are seen between June and August in strawberry fields of Bursa. However, adults of *P. spumarius* are observed until November in İnegöl. Nymph starts to be observed in April, 2013 in Bartın locality. On the other hand, adults are commonly observed between June and October. Zeybekoğlu et al. (2004) declared that the first emerging adults were observed in the late May. Specimens were found during all other months, but the least number of adults occurred in February and March.

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