Aphids are pests of trees and shrubs in the North-West of Russia

M N Berim
Laboratory of phytosanitary diagnostics and forecasts, All-Russian Institute of Plant Protection, 3 Podbelskogo Highway, St.-Petersburg, Pushkin 196608, Russian Federation

*Corresponding email: berim_m@mail.ru

Abstract. For nineteen years (2002-2020), the dynamics of the number and aphids’ species composition was monitored using a suction trap in the North-West of Russia. For the years of research, 17 aphids species and 1 complex of the genus Cinara species - pests of tree and shrub plantations of the region - have been identified. Of them, 13 feed on trees and 4 feed on bushes. The genus Cinara damage conifers. The species E. punctipennis prevailed in the suction trap for the entire monitoring period; its total number was 4037 individuals. Particularly high it was in 2005 and 2010. R.padi aphid species is harmful and occurs in large numbers. Outbreaks of its mass reproduction on bird cherry were noted in 1999, 2003 and 2016. Total number of trapped insects in the observation period was 1156. This species is one of the most common pests of cereals; moreover, it carries dangerous viral diseases.

1. Introduction
Aphids are one of the most numerous groups of insects. There are more than 200 species in the European part of Russia alone. We identified more than 40 species using a suction trap in the North-West of Russia. These are species that live in forest, meadow biocenoses and agrocenoses. Insects feed on phloem sap of plants, weakening them. The phytophages saliva contains toxic substances. The host plants leaves turn yellow, curl, deform. Aphids secrete sticky excrement in places where they feed, and sooty fungus develops on them. Trees, shrubs suffer significantly from these pests; in mass reproduction outbreaks loses its look. Among this group of insects, families of halogenous organisms are known which form bright, convex galls on the leaves, giving the crown an ugly look, which is negative for parks and squares. Besides, many species are carriers of a viral infection, which is transmitted through injections by aphids and other sucking insects from one plant to another, contaminating the environment [1-3]. The aim of our study was to make long-term monitoring of the population dynamics and aphids species composition - pests of trees and shrubs using suction traps in the North-West region of Russia.

2. Methods and Materials
In 2002, a fan-type suction trap with a capacity of 0.8 kW was installed on the experimental field of the All-Russian Institute for Plant Protection (Pushkin, St. Petersburg). The field is surrounded by numerous tree plantations both coniferous and deciduous and shrubs. Monitoring was made for 19 years from 2002 to 2020. The material was sampled from the trap from May to October, twice a week, and fixed in 70% ethanol. The species identification was carried out by the standard procedure using
the guide to insects of the European part of Russia [4] and an album with photographs of aphids’ permanent preparations [5].

3. Results and Discussion
For the years of research, we have identified 17 aphids’ species and 1 complex of the genus Cinara species - pests of tree and shrub plantations in the North-West region of Russia. Table 1 shows the phytophages found most often and in large quantities.

Table 1. Aphids’ species, that feed on trees and bushes in the North-West region of Russia (caught by a suction trap).

| Species of aphids | Host-plant | Number of insects by year |
|-------------------|------------|--------------------------|
|                   |            | 2002-2005 | 2006-2010 | 2011-2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| Betulaphis pelei H.R.L. | birch | 13 | - | - | - | - | - |
| Chaitophorus populeti Panz. | poplar | 2 | 8 | 8 | 2 | - | - | - |
| Complex Cinara spp. | spruce, pine, fir, larch | 229 | 213 | 91 | 1 | 5 | - | 2 | 4 |
| Eucalliupterus tiliae L. | linden birch | 2167 | 1349 | 314 | 96 | 41 | 37 | 17 | 15 |
| Euceraphis punctipennis Zett. | birch | - | 9 | 3 | - | - | - | 6 | 2 |
| Macrosiphum rosae L. | rose, wild rose | 31 | 23 | 14 | 2 | 6 | 9 | 8 | 12 |
| Metopolophium dirhodum Walk. | rose, wild rose | 2 | - | 10 | 1 | 3 | - | 1 | - |
| Mindarus abietinus Koch. | fir tree | 7 | 4 | 10 | 1 | 3 | - | 1 | - |
| Myzaphis rosarum Kalt. | wild rose | 5 | 8 | 16 | 2 | 4 | - | 12 | 11 |
| Myzocallis castanica Back. | oak | 4 | 7 | 6 | 4 | - | 3 | 3 | - |
| Pemphigus borealis Tullgr. | poplar | 8 | - | - | 24 | 26 | 63 | 58 | 49 |
| Periphyllus villosus Hart. | maple | 11 | 1 | - | 19 | 3 | - | - | 1 |
| Rhopalosipham padi L. | wild cherry | 442 | 184 | 140 | 138 | 90 | 52 | 84 | 26 |
| Tuberculatus annulatus Hart. | oak | 84 | 192 | 57 | 30 | 27 | 8 | 9 | 5 |

Birch is the main host for E. punctipennis and B. pelei. The first species is found in great numbers in the region. Especially its number in the suction trap was high in 2005 and 2010 (figure 1). The first specimens are usually recorded in mid-May. The insect has no alternative host [6]. There is a peak in numbers at the end of May - beginning of June. The second, but smaller peak is at the end of August - September. It should be noted that for the past four years, the number of captured insects of this species has noticeably decreased. The second species was recorded only in 2002, 2003 and 2005 in single specimens.
Figure 1. Aphid population dynamics of species *E. punctipennis* during 2002-2020 in the North-West region of Russia (suction trap, St. Petersburg, Pushkin).

The species *R. padi* is especially harmful and also numerous in the North-West region. The primary host of the phytophage is bird cherry; mass reproduction outbreak of the insect occurs periodically there [7-9]. The strongest outbreaks were observed in 1999, 2003 and 2016 (figure 2) [10].

![Graph showing aphid population dynamics](image1.png)

Figure 2. Aphid population dynamics of species *R. padi* during 2002-2020 in the North-West region of Russia (suction trap, St. Petersburg, Pushkin).

Damaged bush leaves turn yellow, curl longitudinally from the edges, dry out; besides, they are covered with sticky secretions of aphids. A sooty fungus develops on them, thereby the leaves turn black. The larvae of female-fundatrices hatch in mid-April and begin feeding on shoots tops, on the underside of the leaves, and on the bird-cherry flower clusters. In late May - early June, aphids migrate to grain crops. This species is one of the most damaging pests of cereals; moreover, it carries dangerous viral diseases [11, 12]. In total, for the years of observation, the suction trap captured 1156 specimens of this species. Peak migration for grain falls at the end of May - beginning of June,
remigration in August - October. A large number of the specimens recorded in the region in the yellow water traps [13-15].

The complex of the genus Cinara species feeds on conifers: spruce, pine, fir, larch. High population of phytophages in the trap was observed in 2005-2006 within 128-99 specimens, it was also noticeable in 2013 - 55 specimens. Hatching of fundatrices - female larvae from overwintering eggs occurs in late April - early May; at the end of May, winged specimens are observed flying to tree trunks near the ground, where they often live in symbiosis with ants. They damage the needles of young shoots. The vital activity of another species, M. abietinus, is recorded on the fir; 28 specimens were caught for observation period. It lives on fir trees holocyclic and monoecious, and has three generations.

One of the most common insects living in oak is aphid T. annulatus. Its number in the trap was significant in 2005 - 62 specimens, and in 2010 - 148 specimens. For the last three years, there have been isolated specimens. In much smaller numbers, two other species were observed: M. castanicola, Lachnus roboris L., whose vital activity also takes place on oaks.

P. borealis forms bright galls on the host plant leaves, thereby damaging its leaves. It inhabits on poplars Populus laurifolia, P. suaveolens, P. trichocarpa and P. moskoviensis. Saccular galls are elliptical, often fused in 2-3, even 10 together. The cavities are independent, not fused. In the middle of summer this species migrate to plant roots of Bidens spp., but in autumn they return to poplars, where females lay fertilized eggs. Part of the population does not migrate, remaining to winter on the secondary host. In the suction trap, the number of insects has noticeably increased in recent years: over 2018-2020, 170 specimens were caught. The species C. populeti, also living on poplars, was registered in a trap in a small amount.

The aphid E. tiliae damaging linden is relatively rare in the North-West region. Over monitoring period, the trap caught 20 specimens, the largest number was in 2009 and 2019. E. tiliae lives on one host, on the underside of the leaves. In spring, it multiplies in large quantities, secretes sticky excrement, and damages the leaves of the plant. The leaves turn yellow, dry up, and fall off. In summer, the number of insects decreases, and in autumn it increases again.

Over the years of observations, the aphid species Tinocallis platanii K., Tetraneura ulmi L., usually living on elm trees, and also Periphyllus villosus Hart feeding on the maple were also found in the suction trap in single specimens.

A large number of aphids are found on shrubs in the North-West region of Russia. M. rosae feeds on rosaceous crops, mainly rose flowers and rose hips. It is a dangerous pest for its host plants; large colonies on young shoots appear in summer and autumn. Fertilized eggs overwinter on rose flowers and rose hips; parthenogenetic females can overwinter there in warm winters. In monitoring, 105 specimens of this species were caught by the trap, the largest number - in 2004 and 2020. M. dirhodum also feeds on Rosaceae; for the years of observations, these species single specimens were recorded in the trap. In early summer, the phytophage migrates to grain crops, causing them noticeable harm. Besides, species M. rosarum and Chaetosiphon potentillae Walk., damaging rose hips, were also recorded in the suction trap.

4. Conclusion

Through the years of research with the help of a suction trap, we identified 17 species of aphids and 1 complex of genus Cinara species - pests of tree and shrub plantations in the North-West region of Russia. Among the dendrophilic aphids, two species were identified feeding on birch - E. punctipennis, B. pelei; phytophages damaging conifers - M. abietinus and complex of the genus Cinara species; several aphids species living on oak - T. annulatus; M. castanicola; L. roboris; on bird cherry - R.padi; on poplar - P. borealis, C. populeti; on elm tree - T. platani, T. ulmi; on maple - P. villosus; on linden - E. tiliae. Authors identified 4 aphids species living on Rosaceae - M. rosae, M. rosarum, M. dirhodum, C. potentillae.
The species *E. punctipennis* prevailed in the suction trap for monitoring period, its total number was 4037 specimens. It was especially high in 2005 and 2010. In the past four years, the number of caught aphids of this species has decreased markedly. *R. padi* species is especially harmful and occurs in large numbers. Outbreaks of its mass reproduction on bird cherry were noted in 1999, 2003 and 2016. The total number of caught insects in the observation period was 1156. This species is one of the most serious pests of cereals; moreover, it causes dangerous viral diseases. Complex of the genus *Cinara* species was also observed in the trap in large numbers, especially in 2005 and 2006: the total number of caught specimens was 412.

On shrubs, the most harmful of the captured species is *M. rosae*, as it forms large colonies in spring and summer on young shoots and buds of rose and wild rose. Because of this, the plants stop blooming and stagnate.

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