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THE IMPACT OF PLANT SHAPING ON APHID BEHAVIOR

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Abstract: The paper provides a review of the studies focusing on the impact of plant trimming and pruning (especially in tree rows) and tree crown formation (in orchards and urban greenery) on the bionomy and number of aphids and some other hemipterans. The fresh, succulent shoots which appear after any trimming and pruning provide aphids with "eternal spring" conditions, *i.e.* the availability of young leaves and shoots preferred by aphids as a source of nutrition. The majority of aphid species acquiring nutrition from leaves feed on the top shoots. People shape garden greenery, forming beautiful, decorative tree crowns. Some shoots in orchards are regularly cut off; sometimes even apple trees are planted in rows. Instead of building traditional fences, hedges are planted and regularly trimmed. Trimmed plants have fresh, succulent shoots, which are an attractive source of nutrition for many aphids. Large numbers of aphids inhabit these rejuvenated plants. Cutting and trimming of plants often have an impact not only on the number of aphids, but also on their bionomy.

Key words: aphids behavior, trimmed plants, bionomy of aphids

INTRODUCTION

The following paper provides a review of studies focusing on aphid inhabitation on plants shaped by people. Names of aphid species are given after Remaudière and Remaudière (1997). The majority of those aphid species which acquire nutrition from leaves, feed on top shoots. The fresh, succulent shoots which appear after any trimming and pruning provide aphids with "eternal spring" conditions, *i.e.* the availability of young leaves and shoots preferred by aphids as a source of nutrition. However, the aphid species *Rhopalosiphoninus ribesinus* (van der Goot) inhabits the lower shoots of *Ribes* spp., since it is a hygrophilous species (Cichocka 1980). In Poland, this aphid species can be encountered in regions where the precipitation level is high and on plants growing in the shade (Cichocka 1980).

Aphids on the trimmed plants

Eriosoma lanigerum (Hausmann) very willingly and in large numbers inhabited the cuts left after apple tree grafting, and cuts resulting from tree crown formation. A large amount of this aphid species also inhabited the root offshoots of apple trees which had not been cut off. Sometimes these aphids created colonies which consisted of several hundred specimens on a thirty-centimeter long section of offshoot (Zawadzka 1962; Cichocka 1980). Another aphid species inhibiting apple trees, *Rhopalosiphum insertum* (Walker), preferred to use the ring-shaped swellings resulting from apple tree grafting, to lay numerous eggs.

Aphis pomi de Geer definitely preferred to forage on young apple orchards and tree nurseries, where young, succulent shoots were abundant. It also laid its eggs on thin, one-year-old shoots. A similar behaviour was observed in *Myzus cerasi* (Fabricius), which developed up to 13 generations on plum trees in nurseries and young orchards. It should be added, that this particular species causes serious deformation of shoots, making the formation of crowns difficult. Similar observations were made on plum trees regarding the species *Rhopalosiphon nymphae* (Linnaeus). Furthermore, the latter species was also encountered in the neighbourhood of lakes and bogs (in the Masurian District), where its secondary hosts were present in abundance. In the same regions, the species was often as numerous as *Hyalopterus pruni* (Geoffroy) (Cichocka 1980).

In dry years, the annual plant growth is small. This is when the migration of *Dysaphis plantaginea* (Passerini) onto its secondary host (*Plantago* spp.) begins in Poland – towards the end of May, after ca. four generations have developed. On the other hand, when the summer is rainy and trees have many young shoots, this aphid species may forage on the shoots even until August, developing up to nine generations. It has often been observed that if this is the case, viviparous females are more fertile (Karczewska 1965; Cichocka 1980).

Ovatus crataegarius (Walker) appeared in apple orchards in large numbers only if the trees were pruned and planted in rows. On the same apple trees on which *O. crataegarius* was observed, there also was noted *Macro-*

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siphum rosae Linnaeus, which formed colonies that were not very numerous and consisted of ten-odd specimens. Usually, it did not forage for a period exceeding one month (Cichocka 1980). In June, *Melanaphis pyraria* (Passerini) tended to inhabit young shoots of pear trees and the so-called "suckers", causing strong deformations. It should be noted, that this aphid species does not usually develop numerous colonies in spring.

While studying the fauna of trimmed rows of *Ligustrum* spp., *Cotoneaster* spp. and *Philadelphus* spp., Golan and& Gawłowska (2009) discovered the most numerous group of insects, several times larger than other groups, were the Hemiptera, including aphids. Jaśkiewicz and Kot (2007) stated that *A. pomi* inhabited and severely deformed shoot tops of *Cotoneaster divaricatus* Redh. et Wils.

On trimmed rows of *Buxus sempervirens* Linnaeus in the Botanic Garden of the Jagiellonian University in Kraków, Poland there were observed numerous specimens of *Psylla buxi* (Linnaeus), which resulted in serious damage to the plants (Wiech 1998).

Cichocka and Jaśkiewicz (2003) observed that on roses in parks, and green spaces in towns and cities, aphids preferred to inhabit the pruned shrubs of garden roses (*Rosa* hort.) rather than wild roses (*R. canina* Linnaeus and *R. rugosa* Thunberg). An extensively pruned specimen of *R. canina* in a private garden in Mazovia produced numerous young shoots in the spring of 2011, which became 100% inhabited by several aphid species. The shrubs of the same species growing in close proximity, which had not been pruned, were only 30% inhabited by aphids (Cichocka, unpublished data).

While conducting research in Gdańsk and in Warsaw, Tykarska (2002) discovered that arthropods (aphids, psyllids) were far more numerous on hawthorns with trimmed crowns than on the ones with naturally shaped crowns.

Brachycaudus divaricatae Shaposhnikov, which has been recorded in Lithuania and in Poland (Cichocka and Lubiarz 2003; Rakauskas and Cichocka 2005), is a new species for central Europe. In Poland, it has been encountered on a trimmed hedge of *Prunus cerasifera* Ehrhart near the John Paul II Catholic University of Lublin. *Brachycaudus divaricatae* Shaposhnikov foraged on the hedge throughout the whole vegetation period. This aphid species produced abundant populations of up to 910 specimens on the top leaves and a green shoot. However, *B. divaricatae* has not been found on *Melandrium album* (Miller) Garcke, which is mentioned in literature on the subject, as the secondary host of this species (Blackman and Eastop 1994). The young shoots of a cherry plum planted in rows turned out to also be an attractive source of nutrition for *Rhopalosiphum padi* (Linnaeus) and *Myzus cerasi* (Fabricius). *M. cerasi* foraged in April and May for the period of one month (*ca*. 560 specimens on 20 leaves). *R. padi* inhabited a cherry plum in the second half of May and foraged until the end of September (Cichocka and Lubiarz 2003). Feeding on the attractive food provided by young shoots probably induced the anholocyclic development of the aphids on the primary host.

In private gardens, climbers such as, *Hedera helix* Linnaeus are often grown. Climbers grow comparatively fast and often cover the windows. For this reason, they are frequently trimmed and new shoots appear, which are then inhabited by numerous representatives of *Aphis hederae* Kaltenbach. We observed such a case in 2011, in a private garden in Mazovia, where this aphid species settled on 96% of the fresh shoots, while in the previous years it was scarcely present.

After forty years of studying aphids, Heie (2009) stated that he still did not know the answers to many questions regarding, for instance, the aphid choice of host plants, changes of hosts, and fluctuations in the size of a population. We believe that one of many possible reasons why these phenomena take place may be human activity. An example of such activity is the decorative formation of trees and shrubs. The results are the frequent appearance of fresh, succulent shoots, which would otherwise appear only in spring. Providing "long-term spring" conditions encourages aphids to forage on the trimmed plants for a longer period than on the plants which have not been trimmed. Perhaps this is one of the reasons why anholocycles develop.

Furthermore, sweet cherry and cherry trees, as well as raspberry bushes grown in private gardens, are usually not protected chemically. Such conditions allow aphids to develop more numerous populations and often prolongs their stay on these plants. A higher number of generations and a higher number of individuals can then be observed. Apart from this, garden plants are regularly watered and do not suffer from draughts which might unfavourably affect aphids by lowering the turgidity in leaves.

Human activity is also responsible for the disappearance of some habitats (*e.g.* the communities of xerothermic grasslands), which results in the extinction of aphids associated with these habitats. According to Osiadacz (2009), at least 16 aphid species in Poland are threatened with extinction due to the operation of such a mechanism. Similar observations were made by Łagowska and Golan (2009), who studied the destruction of natural habitats of scale insects [*Porphyrophora polonica* (Linnaeus) and *Porphyrophora hameli* Brandt] which could be used as a source of natural food colouring (*e.g.* in the production of yoghurts, beverages and confectionery).

Cichocka and Lubiarz (2010) have proved that all kinds of human activity affecting the environment have an impact on the condition of habitats for arthropods, and thus, also on their species composition, number and bionomy. This is especially noticeable in agricultural landscape and landscape changed by industry.

CONCLUSIONS

Human activity in the environment results in the disappearance of some habitats, which may entail the disappearance of many aphid species. This interdependency is best illustrated by the disappearance of aphid species which are associated with xerothermic grasslands.

Cutting and trimming of plants (trees and shrubs) results in the growth of fresh young shoots. These shoots are preferred by many aphid species and inhabited by enormous colonies of these insects. Aphids are frequently more fertile on such shoots than on other parts of plants.

If cuttings and trimmings are repeated, young shoots appear throughout the whole vegetation season. Then, the aphids, *e.g. B. divaricata*, do not migrate onto secondary hosts and are subject to an anholocyclic life cycle. *P. cerasifera* is often shaped to form trimmed hedges. It is an excellent host not only for the above mentioned aphid species, but for some periods it is also inhabited by other species: *M. cerasi* and *R. padi*.

The spots where shoots have been cut and the bark is disfigured are used by bark-inhabiting aphids (*e.g. E. lanigerum*) as convenient places for egg laying and sometimes also for foraging.

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