COEVOLUTION AND RELATIONSHIP OF AHEES ON FODDER PLANTS (HOMOPTERA, APHIDINEA)

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Abstract. *The article examines the features of forage specialization and the co-evolution of aphids in the "parasite-host" system. Aphids of the genera Eriosoma Leach. (3 species), Tetraneura Hart. (2 species) and aphids Kaltenbachiella pallida (Halid.) Briefly use the leaves of the elm (Ulmusdensa), for the development of founders and winged migrants. Elm-gall aphids, as representatives of one guild, simultaneously use the fodder plant by subdividing ecological niches.The random distribution of aphids on the fodder plant follows Poisson's law (*$S_x^2 = 1$*), the aggregated distribution is determined by the value* $S_x^2 > \bar{x}$.

Keywords*: gall aphids, elm, coevolution, random distribution, aggregated distribution, Poisson's law.*

КОЭВОЛЮЦИЯ И ВЗАИМООТНОШЕНИИ ТЛЕЙ НА КОРМОВЫХ РАСТЕНИЙ (HOMOPTERA, APHIDINEA)

Аннотация.*В статье исследуются особенности кормовой специализации и коэволюция тлей в системе «паразит-хозяин». Тля из родов EriosomaLeach. (3 вида), TetraneuraHart. (2 вида) и тля Kaltenbachiellapallida (Halid.) Кратковременно используют листья вяза (Ulmusdensa) для развития основателей и крылатых мигрантов. Вязово-галловые тли, как представители одной гильдии, одновременно используют кормовые растения, разделяя экологические ниши. Случайное распределение тлей на кормовых растениях подчиняется закону Пуассона (*$S_x^2 = 1$*), агрегированное распределение определяется значением* $S_x^2 > \bar{x}$

Ключевые слова: *галловая тля, вяз, коэволюция, случайное распределение, агрегированное распределение, закон Пуассона.*

The habitat and feeding characteristics of amphibians are not only accidental, but also the product of historically evolutionary biotic relationships between them, the result of coevolution. Such ecological indicators, taken separately and unique to this species, play an important role in its taxonomic analysis [2, pp- 202].

Changes in the forage plant as a result of the life activity of the perennial insects, all the injuries are considered as a pathological phenomenon, the reaction of plants to the effects of insects.

The importance of gall formation of these insects is that they provide the initial stimulus for the formation of secondary meristematic tissue, not only providing nourishment to the insect, but also controlling the subsequent formation of galls, which is guaranteed to isolate them from changing environmental conditions. In general, the process of gall formation is several times faster than the growth of larvae in it.

This research was based on the materials collected from the East Fergana region in 2004-2019, the results of applied research and observations. The bulk of all materials for the study of the fauna of peregrine falcons were collected from March to the end of November, and if necessary a certain part was collected during the winter months. The collection materials of the Laboratory of Experimental Biology and Ecology of Andijan State University on aphidofauna of other regions of Central Asia were also used.

During the study, all vertical regions of East Fergana (altitude from 350-400 m. to 3500-4100 m. above sea level) - low plains, hills, foothills, mid-mountain and high mountain regions, natural and cultural landscapes were fully covered. Commonly accepted entomological, aphidological, coccidiological and cicadological methods of materials on winged insects [1, pp-82;5, pp-39;6, 250 p; 7, 312 p; 8, 450-p; 10, 256-p;11; pp. 87-88;12, 211-p;14, 21-p; 15, pp. 489-616.] collected and processed on the basis of.

Among the equal-winged insects, aphids and psillids cause damage to food plants, the specificity of the damage, i.e. the different degrees of deformation of leaves and twigs, the formation of semi-open or closed galls are unique to this group of insects. Accordingly, it can be seen that open, covert, semi-covert and mixed types of lifestyles are formed in their forage plant [3, pp. 95 - 98].

In the parasite-host system, aphids, like all parasites, specialize in the efficient use of their host, the food plant. As a result, a single leaf of the forage plant feeds on several seed species. For example, Eriosoma Leach., 3 species of seeds, Tetraneura Hart., 2 species of seeds and *Kaltenbachiella pallida* (Halid.) Species live on the slate leaves.

The species *Eriosomalaniginosum* (Hart.) is distinguished by the large, thin-walled, green hairs on the leaf surface that are round, covered with hairs. *E.faenax*Mordv. the juice forms fake galls. As a result of its action, the leaves are strongly curled and porous on the underside, the leaf surface becomes slightly reddish. As a result of feeding on the juice of *E.ulmi* (L.), the leaf is wrapped in a tube-shaped downward direction (Fig 1).

Tetraneuracoerulescens (Pass.) Forms large reddish galls on the surface of the leaf. *Tetraneuraulmi* (L.) galls are also located on the leaf surface, the main difference being that they are small in size, in the form of restored columns, the base is slightly thinner, usually 2-4, and sometimes more. *Kaltenbachiella pallida* (Halid.) galls are located on the surface of the leaf, at the base of the central vein, close to the leaf blade [4, 59 p.]. The galls are round, hard, and the walls thick.

Picture 1. Galls formed by juices that live on the birch

Based on the results of the above analysis, it can be noted that the vast majority of equal-winged insects specialize in feeding on the leaves of the plant.

Some authors have suggested that the degree of deformation of plant tissues under the influence of sap is linearly related to the concentration of β-indolyl-acetic acid in their saliva. An increase in its concentration also led to an increase in leaf deformation [9, 415 p.]. The parenchyma cells of the leaves are a rich source of carbohydrates and protein for this group of insects. For example, 15 (88.3%) species of sap belonging to 17 species living in poplars, elm and pistachio live only in the leaves of food plants. Only 2 (11.7%) species of pemphigus (*Pemhigusimmunis, P.vesicarius*) feed on phloem. Depending on the place of residence and feeding, all equal winged-proboscis insects are divided into 2 ecological groups, that is, groups of feeders differ from the parenchyma and phloem. Nevertheless, although the species diversity of this genus of insects is high, the stinging-sucking oral apparatus-stiletto has not undergone significant changes in the historical-evolutionary processes associated with their forage plant.

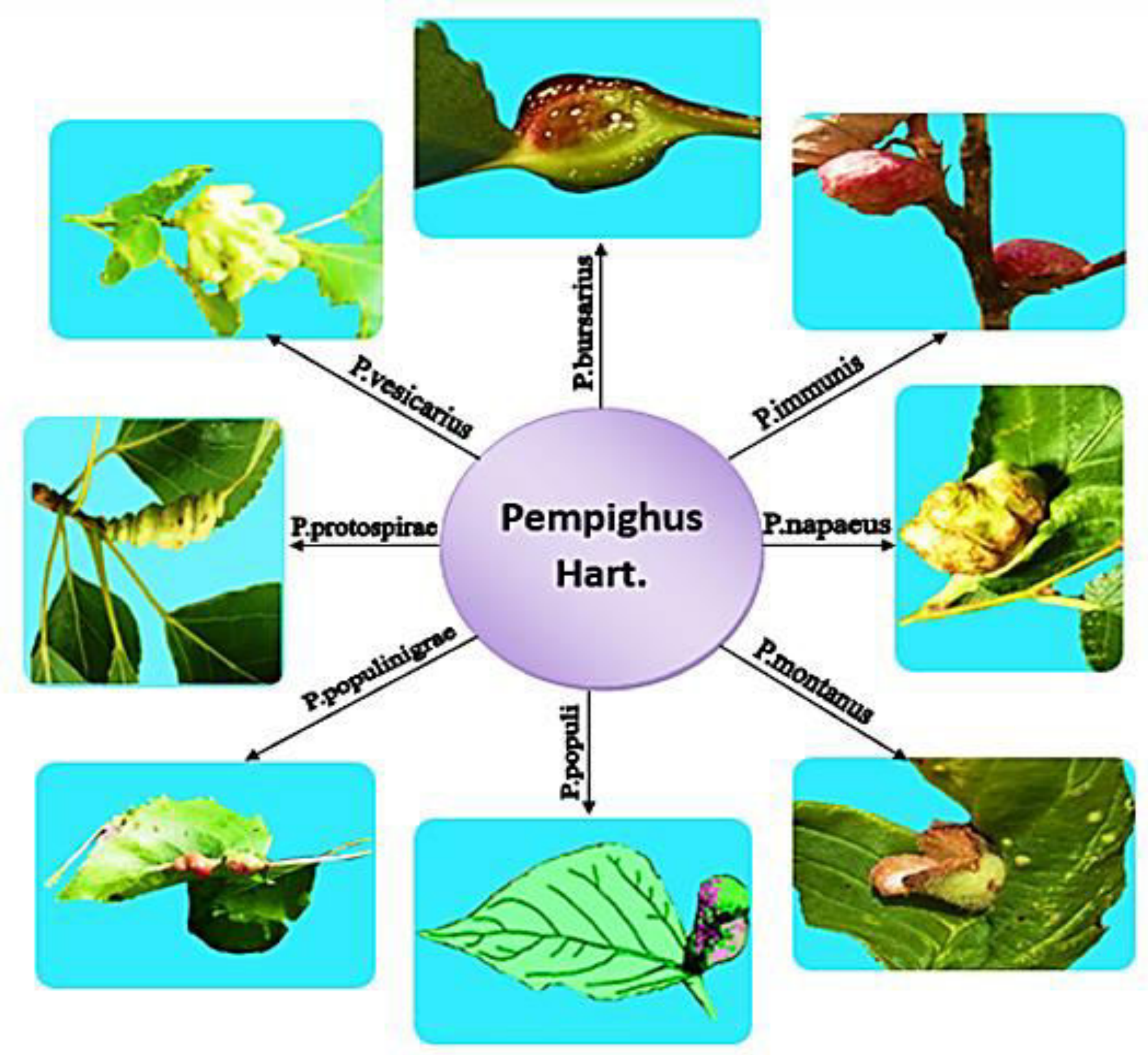
Characteristically, all species of the genus Pemphigus are associated with a single genus of plants (Populus). The center of the historical formation of pemphigus species diversity was the Hangar continent, which later expanded its range. In particular, some species of pemphigus are distributed throughout the Central Asian regions, and to this day they retain their primary morpho-ecological simplification. The specialization of pemphigus in forage plants dates back to the Upper Cretaceous.

Apparently, the morpho-ecological divergence of the species, adaptation and specialization of the habitat of plants belonging to the genus Poplar in different organs went simultaneously within the seed of pemphigus. This situation can also be seen in the example of pemphigus in the south-eastern regions of Central Asia (Pic. 2).

In the southeastern regions of Central Asia, 8 species of pemphigus have been recorded, each of which has its own habitat and feeding, and develops in different parts ofthe poplar without direct interaction with each other due to the separation of ecological shelves. The gall-shaped forms of pemphigus are irreversible. For example, the gems of *Pemphigus bursarius* are formed in the leaf band, noxious these galls are green, then have red and reddish spots. Thick-walled walnut galls of the genus *P.immunis* are located on the branch. Located on the surface of the leaf, the light yellow-green galls at the base of the central vein are characteristic of *P.napaeus* sap. *P.populi* forms round galls at the base of poplar leaves. Young galls are red, then reddish-green, and when they mature, they turn greenish-pink. On the surface of the leaf, pillow-shaped pale red galls along the central vein are formed as a result of the development of *P.populinigrae* sap. The galls of *P.protospirae* juice can be easily separated, spiral green, then reddish-red galls are formed as the leaf band rotates clockwise around its own axis. A distinctive feature of the *P.vesicarius*species is the formation of large bright green capillary galls on young branches (Pic. 2).

The walls of these galls are thin, and over time their walls rupture on all sides [13, pp.517-533].

Divergence of the morpho-ecological separation of the species occurred in proportion to the habitats occupied by the pemphig sap in the main food plant. Pemphiguses form 3 types of galls according to their structure. That is, closed (*Pemphigus populi, P.populinigrae*), semi-closed (*P.protospirae*), and open (*P.bursarius*) galls [16, pp.229-247].



Picture 2. Divergence of pemphigus juices by habitat and nutrition

In the "parasite-host" system, evolutionary ancient groups of algae (e.g., Lachnidae species) live in the bodies and branches of conifers by feeding on phloem.This feature is also preserved in the way of life of the Central Asian species, which lost their primary food plants in their time (*Pterochloroidespersicae, Maculolachnussubmacula, Tuberolachnussalignus*, etc.) in secondary specialized food plants (Rosaceae, willow).

Sometimes this condition also occurs in some species of the evolutionary young family aphid (Aphididae). For example, *Ferganaphisalaica*Mukh. Et Akhm. the species *Loniceranummularifolia* lives in dense colonies along the trunk and branches. Its feeding on phloem is an exception among the nearly 30 Lonicera saplings found in Central Asia. All other types of juices in this group have a parenchymal feeding method.

Another feature of the specialization and coevolution of the parasite-host system of parasitic insects is that they do not occupy all the bushes or all the leaves of the forage plant at the same time.

This condition is called "aggregation or grouping of sap in food plants" [2, 202 p.]. When this process is analyzed in the example of saplings, it becomes clear that they choose the most suitable ones for living and feeding, that is, when the number of bushes of the forage plant is dense, the sap is fed in relatively sparsely planted bushes.

For example, M.Kh.Akhmedov noted that in the basin of the Kok-Suvriver of the Alay ridge, in the area of 2 hectare, only *Hyadaphispasserinii, Semiaphislonicerina* saplings were found in the bushes on the edge of the sluice, in their lower tier. However, it is known that more than 10 species of honeysuckle juices are found in the same region. Accordingly, it is emphasized that the density of a forage plant does not always mean that species diversity and quantity density are high [2, 202 p.].

A similar condition from another group of insects was noted in the larvae of the *Pierisrapae* butterfly, where the worms were more common in areas where cabbage bushes were rare [9, 415 p.].

It should be noted that as a result of the fact that equal-winged insects do not occupy all the leaves of the food plant, the leaves that are free from them play the role of "private shelter" for insects.

For example, *Hyadaphispasserinii* was found in only 3 of the 8 leaves 10 cm long of the feeding branch, and if the pest had taken all the leaves, they would all have been deformed.

This would be contrary to the principle that in a “parasite-host” system, the parasite needs effective long-term nutrition from the host organism. A similar situation is observed in cabbage juice (*Brevicorynebrassicae*) [13,pp.517-533].

According to the results of observations in the agrocenosis of cotton (Andijan region, Altynkul district, farm "Oltinkolgulshani", may-august, 2018-2019), the density of sap (*Aphis crassivora, A.gossypii, Acyrthosiphongossypii*) during the first growing season of cotton and their random distribution across cotton fields is observed.

It is known that the random distribution of insects corresponds to Poisson's law of distribution ($y=\frac{m^x}{x!}e^{-m}$), i.e. by comparing the practical results with the value y - it is possible to determine whether the current distribution is discrete asymmetric or negative.

In particular, the analysis of the discrete asymmetric distribution of juices according to Poisson's law shows that the ratio between the quantitative density of juices (-xiPi) and the frequency of their random distribution was $\bar{x}$=1.99, the variance index (S_x^2) was 1.61. The coefficient of variation (CV) was at a high level (89.86%) in line with the random distribution requirement.

Based on the results of the calculations, the actual and theoretical frequencies in the discrete asymmetric distribution of the juices were compared, and the random distribution indicators corresponded to the theoretical indicators (280 = 280).

The random distribution of insects can also be determined on the basis of the ratio of the variance index to the arithmetic mean ($S_x^2 = \bar{x}$), i.e.this ratio is zero, flat, 1 is random, 1 is aggregation or group [9, 415 p.; 16, P.229-247.].

The result obtained for cotton stalks, i.e., the ratio $S_x^2 = 161/\bar{x} = 1.99$, is 0.80, or 1 when rounded, and a random distribution is observed in the distribution of these insects during the same period of the season.

In the middle and end of the summer season, melon (*Aphis gossypii*) and large cotton (*Acyrthosiphongossypii*) sap prefers well-developed, budding cotton stalks, resulting in the same cotton stalks suffering more severe damage than others.

During this period, the number of bushes infested with sap can be 12–21% of the total number of seedlings. The sap, which is fed in groups, forms specific local distribution centers in the cotton fields, ie, in their distribution, sparse distribution centers are formed (S_x^2>$\bar{x}$). In the bush, which is free of insects, the effect of sap is not felt.

This distribution feature of sap in food plants is of practical importance in the application of methods of combating them [2, 202 p.].

The ability of insects to aggregate or spread in clusters prevents damage to all bushes of forage plants at the expense of “private shelters” in the reserve, as well as ensures the stability of insect populations in biotic relationships. This, in turn, is undoubtedly the result of coevolution of this group of insects in the "parasite-host" system.

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