The first data on the study of Corythucha arcuata (Say, 1832) (Heteroptera: Tingidae) in Kherson region of Ukraine

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Oak lace bug (OLB) Corythucha arcuata (Say, 1832) (Heteroptera: Tingidae) is native to North America. In 2000 it got to Italy and has spread for recent 20 years in many countries in Europe. In 2017 OLB first registered in Kherson region of Ukraine. The aim of the research was to summarize the first data on oak lace bug spread in Ukraine. The studies were carried out in 2020 at 31 sample plots in the south-western part of the Kherson region (46°10’ to 47°21’N, 32°10’ to 33°05’E). The sample plots were located in forest stands, shelterbelts, and oaks in cities. The age of inspected stands is from 25 to 250 years old.

The presence of oak lace bug and the threat to oak trees was assessed by a point system: 0 – OLB is absent; 1 – single, one egg mass per whole plot; 2 – rare, below 10% of trees damaged; 3 – common, OLB presents not in all trees, foliage damage up to 50%; 4 – widespread, OLB presents in all trees, foliage damage up to 100%. The weighted average score of OLB presence was evaluated for different groups of stands and some of their characteristics.

The specimens of OLB and the traces of their vital activity were found at 19 sample plots (61.3%). At 51.6% of sample plots examined the OLB was common or widespread. The pest is widespread at 8 sample plots, including oaks in cities Kherson, Oleshki, and Hola Prystan, Doslidne forestry of the Steppe branch of Ukrainian Research Institute of Forestry & Forest Melioration named after G. M. Vysotsky (URIFFM) and Burkutske forestry of the Velikokopanske Forest & Hunting Enterprise.

Mean OLB score is higher in forests than in shelterbelts and has a trend to increase with oak age. The highest OLB infestation was assessed in the sample plots neighbouring city streets and forest roads and in the sample plots near the waterway. The proportion of SP with common and widespread OLB from all inhabited plots near city streets, forest roads, and waterways exceeds 80%.

The data obtained can be considered preliminary, since the reproduction, distribution, and settlement of the oak lace bug in the territory of the Kherson region began only 2 years ago.

Key words: oak lace bug (OLB); sample plot (SP); mean OLB score; proportion of infested sample plots; traffic ways.

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**Introduction.** Oak lace bug (OLB) *Corythucha arcuata* (Say, 1832) (Heteroptera: Tingidae) – is a dangerous pest of oak (Bernardinelli, 2006; Csóka et al., 2020; Matsiakh & Kramarets, 2020). Its larvae and adults suck sap from the leaves. Damaged trees decrease their productivity and resistance to other damaging causes. The bug develops in two or more generations per year, rapidly increasing in numbers. It spreads actively, flying over distances of several hundred meters, and passively: by wind, vehicles, and plant material (Zielinska & Lis, 2020).

OLB is native to North America, particularly the USA and Canada (Drake & Ruhoff, 1965). In 2000 it got to Italy with cargo that arrived at the seaport (Bernardinelli & Zandigiacomo, 2000). In the early years of the bug penetration into Italy, its needs for heat and moisture and their compliance with the environmental conditions of Europe were analysed. The possibility to survive in a considerable part of Europe was demonstrated for this insect as well as to feed on the foliage of different European oak species (Bernardinelli, 2006). Due to these features, the oak lace bug (OLB) has spread for recent 20 years in many countries of Europe (Csóka et al., 2020).

In Switzerland, which borders Italy, it appeared in 2002, in nearby France only in 2017, and in Austria only in 2019 (Zielinska & Lis, 2020). In Hungary, Croatia, and Serbia, the bug was found in 2013 (Csóka et al., 2020), in Romania in 2015 (Tomescu et al., 2018), in Slovakia in 2018 (Zubrik et al., 2019), and in the Czech Republic in 2019 (Nikolic et al., 2019). The last country seems to be the most northern territory of OLB penetration in Central Europe. From Romania, OLB penetrated Transnistria in 2016 (Antyhoova, Kishar’ya, Shpelejak, 2018). It could get to Ukraine from Slovakia, Hungary, and Romania but was found in Vinogradiv (Transcarpathian region) only in 2020 (Ukrbin, 2020).

The second path of OLB to Ukraine starts from Turkey, where it appeared in 2002 by seaways (Mutun, Ceyhan, & Sözen, 2009), and in 2015 also by seaway penetrated to Krasnodar region of Russia (Neimorovets et al., 2017), to Adygea (Shurov & dr., 2019) and to the 51–52° north up in Voronezh region (Blommer, 2020). At the same time, the OLB penetrated into Crimea in 2016 (Golub, Golub, Soboleva, 2020) and into the Kherson region in 2017 (Metsкова, Nazarenko, 2020). In 2020 OLB was found in Ovidiopol (Odesa region) (Ukrbin, 2020), where it could penetrate from Transnistria, Crimea, or from Kherson region.

The area of oak stands (*Quercus robur* L.) in the forest fund of Kherson Regional Forest & Hunting Administration is about 1500 ha, of which more than 90% are man-made forest plantations (Tkach, Kobets, Rumiantsev, 2019). Forests are represented by separate tracts, mainly along rivers and in other places with suitable conditions for moisture and soil richness. The distance between separate tracts sometimes reaches several kilometres. Oak is also widely represented in green stands of settlements and forest shelter belts along with fields and roads. It promotes the spread of OLB not only in Kherson region but also beyond its borders in the northern regions of Ukraine. Therefore, it is relevant to study the features of the spread of this pest in the region of the first penetration into the country.

**Objects and methods.** Object of research – invasive oak lace bug *Corythucha arcuata*. Subject of research – the spread of invasive oak lace bug in Kherson region of Ukraine. The aim of the research was to summarize the first data on oak lace bug spread in Ukraine.

The studies were carried out in 2020 at 31 sample plots in the southwestern part of the Kherson region (Fig. 1, Tab. 1). Latitude was from 46°10’ to 47°21’, longitude from 32°10’ to 33°05’. Most sample plots (SP) are located on the left bank of the Dnieper (23 SP, or 74,2%), and 8 SP are located on the right bank (25,8%).

![Fig. 1. Surveyed oak stands in the Kherson region](image_url)

*Fig. 1. Surveyed oak stands in the Kherson region (black circles – the sample plots with the presence of OLB; light circles – the sample plots with the absence of OLB)*

In the forest fund of the Kherson Regional Forest & Hunting Administration, 15 sample plots (48,4%) are located, particularly 6 SP in Rybalchanske forestry of the Zburyevsky & Hunting Enterprise (FHE), 2 SP in Buruktske forestry of the Velikokopanske FHE, 4 SP in Kherson forestry of the Oleshkovsky FHE and 3 SP in Doslidne forestry of the Steppe branch of Ukrainian Research Institute of Forestry & Forest Melioration named after G. M. Vysotsky.
In the forest belts, 11 SP (35.5%) are located. The rest sample plots are located in the Black Sea Biosphere Reserve, an arboretum of the Kherson Agrarian-Economic University, in the station of young naturalists in Hola Prystan, and in a single old tree in Oleshki. In 4 sample plots, oak is represented singularly, in 4 it is represented equally with Dnieper birch, and the rest are pure oak stands. The age of inspected stands is from 25 to 250 years old, the height from 6 to 29 meters, diameter from 18 to 80 cm. The relative density of stocking is 0.4-0.8, site index 4. Forest site conditions are very diverse – A₃, B₁, B₂, C₁, C₂, and C₄.

Table 1

| Sample plot (SP) | Latitude N                  | Longitude E              | Type of stand. | Nearest traffic routes                        | Presence of OLB, score |
|------------------|-----------------------------|--------------------------|----------------|-----------------------------------------------|------------------------|
| 1                | 47°21'57’’ 33°12'23’’       | Shelter belt, 60 years.  | Railway 2 km   | 1                                             |
| 2                | 46°43'49’’ 32°40'19’’       | Kherson forestry of Oleshkivske FHE, 36/3, 54. | road Melitopol–Odessa, Crimea–Kherson | 0                         |
| 3                | 46°43'17’’ 32°35'28’’       | Kherson forestry of Oleshkivske FHE, 32/9, 15 years. | road Melitopol–Odessa, Crimea–Kherson | 0                         |
| 4                | 46°43'14’’ 32°35'29’’       | Kherson forestry of Oleshkivske FHE, 31/34. 37 years. | road Melitopol–Odessa, Crimea–Kherson | 0                         |
| 5                | 46°38'28’’ 32°35'7’’        | An arboretum of the Kherson Agrarian-Economic University, 64 years. | streets | 4                         |
| 6                | 46°39'42’’ 32°35'39’’       | An arboretum of the Kherson Agrarian-Economic University. 70 years. | streets | 4                         |
| 7                | 46°44'18’’ 32°10'16’’       | Shelter belt, 60 years.  | absent         | 0                         |
| 8                | 46°40'35’’ 32°45'5’’        | Kherson forestry of Oleshkivske FHE, 55 years. | Crimea–Kherson railway | 3                         |
| 9                | 46°36'21’’ 32°43'35’’       | State natural monument of local importance «Curtain of century oaks» (Oleshki). Steppe branch of URIFF. Doslidne forestry, 12/11, 210 years. | Crimea–Kherson railway | 4                         |
| 10               | 46°37'23’’ 32°43'13’’       | Arboretum, Steppe Branch of URIFFM. Doslidne forestry. 34/2. 120 years. | European road E97 | 4                         |
| 11               | 46°37'43’’ 32°44'48’’       | A single oak tree in Pershotravneva street (Oleshki). 130 years. | streets | 4                         |
| 12               | 46°35'10’’ 32°43'2’’        | Steppe branch of URIFFM. Doslidne forestry. 19/21. 71 years. | R-57 Oleshki-Skadorvsk | 0                         |
| 13               | 46°31'57’’ 32°31'32’’       | Single oak, Gola Prystan. 100 years. | streets | 4                         |
| 14               | 46°23'40’’ 32°48'32’’       | Velykokopanske FHE, Burkutske lisnyctvo, 6/3. 95 years. | forest edge | 4                         |
| 14a              | 46°23'40’’ 32°48'32’’       | Velykokopanske FHE, Burkutske lisnyctvo, 6/9. 45 years. | forest edge | 4                         |
| 15               | 46°22'40’’ 33°5'48’’        | Shelter belt. 60 years.  | Brilivka railway station, a highway to the Crimea | 2                         |
| 16               | 46°29'4’’ 32°28'59’’        | Shelter belt. 20-25 years. | route Golaya Prystan–Novaya Zburevka | 0                         |
| 17               | 46°25'52’’ 32°26'51’’       | Shelter belt. A = 65 years. | street | 0                         |
The presence of oak lace bug (OLB) and the threat to oak trees was assessed by a point system: 0 – OLB is absent; 1 – single, one egg mass per whole plot; 2 – rare, below 10% of trees damaged; 3 – common, OLB presents not in all trees, foliage damage up to 50%; 4 – widespread, OLB presents in all trees, foliage damage up to 100%.

The weighted average score of the threat to oak was evaluated for different groups of stands and some of their characteristics.

Results and discussion. The specimens of OLB and the traces of its vital activity were found in 19 sites (61.3%,) and were absent in 12 (38.7%) (see Fig. 1).

The mean OLB score in inspected stands is 1.9, the maximum (4 points) was registered at 8 SP (25.8%). Four of them are located in the cities Kherson, Oleshki, and Hola Prystan. Other SP with high spread of OLB are located in Doslidne and Burkutske forestries.

The mean OLB score is higher at the Left bank SP (2.1) than in Right bank SP (1.5), much more in forests than in shelter belts (2.5 and 0.4, respectively) (Fig. 2). The greater distribution of OLB in the forest may be associated with a more favourable microclimate, compared with forest belts. On the other hand, in forest belts, the wind promotes the spread of the bug over the territory.

Conditionally surveyed forestries were divided into «southern» (Rybalchanske and Burkutske forestries) and «northern» (Khersonske and Doslidne forestries) groups. The mean OLB score was twice higher at the sample plots from southern forestries than in northern ones (see Fig. 2).

This may be due to the fact that the bug entered the Kherson region from the Crimea, as well as the location of oak stands of the Kherson forestry on the right bank of the Dnieper, where the pest has not yet spread.

Notes: 0 – OLB is absent; 1 – single, one egg mass per whole plot; 2 – rare, below 10% of trees damaged; 3 – common, OLB presents not in all trees, foliage damage up to 50%; 4 – widespread, OLB presents in all trees, foliage damage up to 100%
For each group of sample plots, the proportion of OLB colonized plots and the proportion of plots with common and widespread OLB were evaluated (Fig. 3).

Among all SP examined, at 51.6% the OLB was common or widespread. This parameter was influenced by the low spread of OLB in forest shelterbelts (27.3%). In forest stands both parameters were 73.3%, particularly 100% in inspected «southern» foresters and 42.9% in inspected «northern» forests. OLB was widespread in inspected oaks in cities.

No differences were found in the OLB spread in pure and mixed stands, as well as in different forest site conditions, which may be due to the small sample of inspected plots (see Tab. 1). There is the trend to increase with oak age the proportion of SP with OLB presence and the mean score of it (Fig. 4). However, the sample of inspected plots is insufficient for a clear conclusion.

As can be seen from Table 1, roads with different traffic intensities pass near many of the inspected stands. When analysing some possible relations between the OLB spread and the presence of roads near the stand, we divided the inspected SP into groups: 0 – roads are absent nearby; 1 – city streets and forest roads; 2 – roads with heavy traffic, for example, the Crimea–Kherson railway, Oleskói–Skadovsk, Golaya Pristan–Novaya Zburievka, Chulakivka–Bekhtery, etc. Group 3 includes the sample plots in Rybalchanske forestry located near the waterway towards the port of Kherson.

Single OLB infestation (score 1) was registered in the sample plots without neighbouring roads and with roads of heavy traffic (Fig. 5).

The highest OLB infestation was assessed in the sample plots neighbouring with city streets and forest roads (OLB score is 2.8 points) and in the sample plots near the waterway OLB score is 2.1 points.

Analysis of Fig. 6 shows the largest proportion of OLB populated sample plots among those that border city streets, forest roads, and waterways. The proportion of SP with common and widespread OLB (3 and 4 points) is also the highest near such roads. The proportion of SP with common and widespread OLB from all inhabited plots near city streets, forest roads, and waterways exceeds 80%.

It can be assumed that the large role of small roads in the spread of OLB is due to the fact that transport stops more often on them, the passengers enter and leave, carrying various luggage. In addition, forest products are transported along forest roads, with which the bug can spread throughout the year, including during the wintering period under the
bark. The spread of the bug in the stands next to which the waterway passes can be facilitated by the wind. However, the data obtained can be considered preliminary, since the reproduction, distribution, and settlement of the oak lace bug in the territory of the Kherson region began only 2 years ago.

**Conclusions.** In inspected forest stands, shelterbelts, and oaks in cities the specimens of the oak lace bug (OLB) and the traces of their vital activity were found in 19 sample plots (61.3%). At 51.6% of sample plots examined the OLB was common (score = 3) or widespread (score = 4). The pest is widespread at 8 sample plots, including oaks in cities Kherson, Oleshki, and Hola Prystan, Doslidne forestry of the Steppe branch of Ukrainian Research Institute of Forestry & Forest Melioration named after G.M. Vysotsky and Buruktanske forestry of the Velikokopanske FHE.

Mean OLB score is higher in forests than in shelterbelts (score 2.5 and 0.4, respectively). There is the trend to increase with oak age the proportion of SP with OLB presence and the mean score of it.

The highest OLB infestation was assessed in the sample plots neighbouring city streets and forest roads (OLB score is 2.8 points) and in the sample plots near the waterway (OLB score is 2.1 points). The proportion of sample plots with common and widespread OLB from all inhabited plots near city streets, forest roads, and waterways exceeds 80%.

The data obtained can be considered preliminary, since the reproduction, distribution, and settlement of the oak lace bug in the territory of the Kherson region began only 2 years ago.


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Дубовий клоп мереживний (ДКМ) Corythucha arcuata (Say, 1832) (Heteroptera: Tingidae) – небезпечний шкідник листя дуба, аборигенний у Північній Америці. У 2000 р. потрапив в Італію через морський порт і за останні 20 років поширился у багатьох країнах Європи. У 2017 р. вперше зареєстрований в Херсонській області України. Мета досліджень полягалася в узагальненні перших результатів вивчення щодо поширення дубового клопа мереживного в Україні.

Дослідження здійснені у 2020 р. на 31 пробній площі у південно-західній частині Херсонської обл. (46°10’ – 47°21’ Пн. ш.; 32°10’ – 33°05’ Сх. д.), за- кладених у лісових насадженнях, лісових смугах та окремих деревах і куртинам дуба у містах. Більшість пробних площ (ПП) розміщено на лівому березі р. Дніпро (23 ПП або 74,2%), вісім ПП – на лівому березі р. Дніпро (23 ПП або 74,2%), вісім ПП – на правому березі р. Дніпро (23 ПП або 74,2%), вісім ПП – на правому березі р. Дніпро (23 ПП або 74,2%). Середній бал поширення ДКМ виявився біль­шим у лісових насадженнях, ніж у лісових смугах (2,5 і 0,4 бала відповідно). Виявлено тенденцію до збільшення показників поширення ДКМ на деревах дуба із збільшенням віку.

Найбільше поширення ДКМ визначено на пробних площах, які межують із вулицями міст і лісовими дорогами (2,8 бала), а також розташовані недалеко від водного шляху (2,1 бала). Частка пробних площ зі звичайним (три бали) або масовим (четири бали) поширенням ДКМ серед усіх пробних площ відповідно дорівнює 3,6% і 10,6% відповідно.

Отримані дані можна вважати попередніми, оскільки розмежування, поширення та розселення ДКМ на території Херсонської обл. розпочалося лише два роки тому.

Ключові слова: дубовий клоп мереживний; пробна плоча; середній бал поширення ДКМ; частка заселених пробних площ; шляхи поширення.
Перші результати изучення *Corythucha arcuata* (Say, 1832) (Heteroptera: Tingidae) в Херсонській області України

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Дубовий клоп-кружевниця (ДКК) *Corythucha arcuata* (Say, 1832) (Heteroptera: Tingidae) – опанний вредитель листя дуба, агробіогромовий в Східній Європі. В 2000 році попав в Італію через Італійський порт і за останні 20 років розрісся по всій Європі. В 2017 році вперше зареєстрований в Херсонській області України. Це перші результати з фіксації перших випадків поширення дубового клоп-кружевниці в Україні.

Результати наведені в 2020 році на 31 пробній площадці в юго-западній частині Херсонської області (46°10′–47°21′ с.ш.; 32°10′–33°05′ в.д.), заложених у лесних насадженнях, лесополосах і на окраїнах дубового лісу. Більшість пробних площадей (ПП) заселена на левому берез у р. Дніпро (23 ПП, або 74,2%), 8 ПП – на правому берегу (25,8%). В лесному фоні Херсонського обласного лісного управління лісного і охочого господарства розташовано 15 пробних площадей (48,4%), на участках лісових насаджень Опітного лесництва ГП «Великокопанське ЛОХ», чотири ПП – в Буркутському лесництві ГП «Збурьевське ЛОХ», три ПП – в Опітному лесництві Степного філіалу УкрНИИЛХА і Буркутському лесництві ГП «Зоологічний заповідник».

Доля пробних площадей, де зареєстровано один чи декілька яйцекладок, становить 48,4% (25 ПП), 3 пр., що заселяють 80% листви. Особи ДКК та їх яйцекладки виявлені на 80% пробних площ.

В різних лісових насадженнях зазначені такі чотири ступені поширення ДКК: 0 – ДКК відсутній, 1 – ДКК зустрічається відразу на 10% площі, 2 – відразу на 50% площі, 3 – відразу на 80% площі, 4 – відразу на 100% площі. Спроби ДКК визначені на 51,6% з 31 обстежених насаджень. У лісових насадженнях, зосереджених у Черноморському Біосферному заповіднику, досягнуто наступних показників: 0 – ДКК відсутній, 1 – ДКК зустрічається відразу на 10% площі, 2 – відразу на 50% площі, 3 – відразу на 80% площі, 4 – відразу на 100% площі. У лісових насадженнях, зосереджених у Черноморському Біосферному заповіднику, досягнуто наступних показників: 0 – ДКК відсутній, 1 – ДКК зустрічається відразу на 10% площі, 2 – відразу на 50% площі, 3 – відразу на 80% площі, 4 – відразу на 100% площі. У лісових насадженнях, зосереджених у Черноморському Біосферному заповіднику, досягнуто наступних показників: 0 – ДКК відсутній, 1 – ДКК зустрічається відразу на 10% площі, 2 – відразу на 50% площі, 3 – відразу на 80% площі, 4 – відразу на 100% площі. У лісових насадженнях, зосереджених у Черноморському Біосферному заповіднику, досягнуто наступних показників: 0 – ДКК відсутній, 1 – ДКК зустрічається відразу на 10% площі, 2 – відразу на 50% площі, 3 – відразу на 80% площі, 4 – відразу на 100% площі.