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# First Record, Distribution, and Morphometric Characterization of the Invasive Treehopper *Stictocephala bisonia* (Hemiptera: Membracidae) in the Fergana Valley, Uzbekistan

**Alijon K. Khusanov, Saidakhon T. Tillaeva*, Zafarbek S. Turdiev and Nuriddin G. Shamsiddinov**

*Department of Biology, Andijan State University, Andijan 170100, Uzbekistan*

**Corresponding author*

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**A B S T R A C T**

Native to North America, *Stictocephala bisonia* Kopp & Yonke, 1977 is an invasive phytophagous species distributed in parts of Europe and Asia. Although recorded at some sites in Uzbekistan, its distribution and morphometric characteristics in the Fergana Valley remain insufficiently studied. This study aimed to identify occurrence sites in the Andijan Region, describe external morphological characters, and assess morphometric parameters. Field observations were conducted during 2025–2026 in Andijan city and the Andijan, Qo‘rg‘ontepa, Xo‘jaobod, and Jalaquduq districts. Nymphs were hand-collected, and adults were collected with an entomological sweep net. Specimens were identified using external diagnostic characters. Seven body parameters of 10 adults were measured using ImageJ 1.54g, and statistical calculations were performed in PAST 5.2.1. In total, 52 specimens (2 nymphs and 50 adults) were collected from seven survey sites. Nymphs were collected from *Salix* sp., and adults from *Medicago sativa* L. fields at six sites. Where adults were recorded, air temperature ranged from 29 to 34 °C and relative humidity from 25 to 40%. Body length ranged from 8.87 to 10.08 mm and pronotal length from 7.37 to 8.90 mm. The specimens matched available diagnostic descriptions of the species. These results confirm the presence of *S. bisonia* at several sites in the Andijan Region and provide new data on its distribution and morphometric characteristics in the Fergana Valley.

## Introduction

*Stictocephala bisonia* Kopp & Yonke, 1977 is a phytophagous insect belonging to the order Hemiptera, suborder Auchenorrhyncha, and family Membracidae. The native range of the species encompasses the eastern and central parts of North America, including the temperate regions of the United States and Canada. Outside its native range, it has been recorded as an alien and invasive species in many countries of Europe and Asia (Świerczewski and Stroiński, 2011; Walczak *et al.,* 2018; Cai *et al.,* 2025).

The first record of the species in Europe dates back to the

beginning of the twentieth century. After *S. bisonia* was detected in Hungary in 1912, it spread to many regions of Central, Southern, and Eastern Europe (Świerczewski and Stroiński, 2011; Walczak *et al.,* 2018). The transportation of nursery stock and other plant materials containing eggs is considered one of the important factors in the long-distance dispersal of the species (Mifsud *et al.,* 2010; Cai *et al.,* 2025). Following its introduction into Europe, the range of the species expanded eastwards, reaching the Caucasus, Central Asia, and some regions of East Asia (Walczak *et al.,* 2018; Cai *et al.,* 2025).

At present, *S. bisonia* occurs in many countries of the Northern Hemisphere, and it continues to be recorded in new areas. The widespread distribution of the species may be facilitated by its polyphagy, its use of herbaceous and woody plants, and its ability to be transported with nursery stock (Świerczewski and Stroiński, 2011; Cai *et al.,* 2025). Recent studies aimed at assessing the potential distribution of the species indicate that areas suitable for its survival may expand eastwards in the future, particularly in Eurasia (Cai *et al.,* 2025). Therefore, detecting the species in new areas, determining the boundaries of its distribution, and studying its associations with host plants are important for phytosanitary monitoring.

Members of the family Membracidae are phytophagous insects adapted to feeding on plant sap, and a strongly developed pronotum is a distinctive morphological characteristic of this group. In *S. bisonia*, the pronotum extends posteriorly from above the head, and well-developed suprahumeral processes are present on both sides. This external morphology has important diagnostic significance in distinguishing the species from other members of the Membracidae (Kopp and Yonke, 1977; Świerczewski and Stroiński, 2011). The shape of the pronotum, the structure of the suprahumeral processes, the relative proportions of the head and metopidium, and body dimensions are considered in the identification of the species (Kopp and Yonke, 1977).

*S. bisonia* is a polyphagous species with a broad host range. Its feeding associations with numerous wild, ornamental, and agricultural plants have been reported in the literature. The host plants of the species include alfalfa (*Medicago sativa* L.), grapevine (*Vitis vinifera* L.), apple (*Malus domestica* Borkh.), pear (*Pyrus communis* L.), plum (*Prunus domestica* L.), peach (*Prunus persica* (L.) Batsch), apricot (*Prunus armeniaca* L.), quince (*Cydonia oblonga* Mill.), poplars (*Populus* spp.), willows (*Salix* spp.), elms (*Ulmus* spp.), and other herbaceous and woody plants (Świerczewski and Stroiński, 2011; Ryaskin *et al.,* 2024). The diversity of its host plants enables the species to occur in agricultural fields, orchards, vineyards, and landscaped areas.

Woody and herbaceous plants play different roles in the life cycle of the species. Females usually lay their eggs in the bark of young shoots of trees and shrubs. Newly hatched nymphs move to herbaceous plants and feed on them; alfalfa and red clover have been recorded as suitable host plants for the nymphs. Adults are polyphagous and may occur on both herbaceous and woody plants (Świerczewski and Stroiński, 2011). The association of different developmental stages with different plants indicates that, when studying the distribution of the species, it is necessary to monitor not only adults but also the plants on which eggs and nymphs occur.

The damage caused by *S. bisonia* to plants is associated with the feeding of nymphs and adults on plant sap and with the oviposition activity of females. During oviposition, the female cuts the bark of young shoots with its ovipositor and places the eggs in the resulting slits. Such injuries may extend to the phloem and cambial tissues of the shoot, causing damage to the vascular tissues and leading to the weakening or drying of the shoots. The penetration of secondary fungal infections through injured tissues has also been reported. Damage caused by the species may be particularly important on young fruit trees and grapevine shoots (Balduf, 1928; Lauterer and Zacha, 1984; Świerczewski and Stroiński, 2011; Ryaskin *et al.,* 2024).

Records of *S. bisonia* in Central Asia indicate that the range of the species has expanded eastwards (Cai *et al.,* 2025; Ryaskin *et al.,* 2024). In Uzbekistan, the species was first detected in 2020 in alfalfa agrocenoses in the Qibray and Yuqorichirchiq districts of the Tashkent Region, and these results were published in 2023 (Jononova and Xaytmuratov, 2023). Subsequently, in 2024, one adult and one nymph were recorded in Zaamin National Nature Park in the Jizzakh Region. This finding confirmed that the species also occurs outside the Tashkent Region in Uzbekistan (Ryaskin *et al.,* 2024).

The use of herbaceous and woody plants during the life cycle of the species requires the combined monitoring of agrocenoses, fruit orchards, and landscaped areas

(Świerczewski and Stroiński, 2011). Nevertheless, the reviewed scientific publications provide no specific information on the occurrence, regional distribution, or morphometric parameters of the species in the Fergana Valley. The available studies published in Uzbekistan mainly describe records from the Tashkent and Jizzakh regions (Jononova and Xaytmuratov, 2023; Ryaskin *et al.,* 2024). Therefore, identifying the occurrence sites of the species in the Andijan Region and describing its morphological parameters are important for supplementing the available information on its distribution in Uzbekistan.

The aim of this study was to identify the occurrence sites of *Stictocephala bisonia* in the Andijan Region, describe the diagnostic external morphological characters of the collected specimens, assess their morphometric parameters, and provide data on the host plants and occurrence conditions of the species based on field observations.

## Materials and Methods

### Study area and specimen collection

The study was conducted in the Andijan Region of the Republic of Uzbekistan during 2025–2026. Field observations were carried out in Andijan city and the Andijan, Qo‘rg‘ontepa, Xo‘jaobod, and Jalaquduq districts. The geographical coordinates, elevation above sea level, collection date, developmental stage, host plant, air temperature, and relative humidity of the survey sites where specimens were collected are presented in Table 1.

The first specimens of the species, namely two nymphs, were collected by hand from an introduced ornamental weeping willow (*Salix* sp.) on 25 May 2025 and placed in 70% ethyl alcohol. During the 2026 growing season, adults were collected using an entomological sweep net from alfalfa (*Medicago sativa* L.) agrocenoses at six survey sites.

A total of 52 specimens, including 2 nymphs and 50 adults, were collected during the study. Geographical coordinates were recorded using the GPS system of a mobile phone and verified in Google Earth Pro. Elevation above sea level was determined using Google Earth Pro. Air temperature and relative humidity at the time of specimen collection were measured on site using a thermohygrometer.

The collected specimens were placed in 70% ethyl alcohol under field conditions and transported to the laboratory on the same day. The nymphs were preserved in 70% ethyl alcohol. The adults were removed from the alcohol, mounted on entomological pins, and air-dried at room temperature. A label indicating the occurrence site, geographical coordinates, collection date, plant name, collector, and specimen number was attached to each specimen. The prepared specimens were deposited in the entomological collection of the Department of Biology, Andijan State University.

### Morphological identification

The specimens were examined under a stereomicroscope, and identification was performed based on external morphological characters. Identification of the species was based on the original taxonomic description provided by Kopp and Yonke (1977), as well as the diagnostic characters reported by Świerczewski and Stroiński (2011) and Walczak *et al.,* (2018).

The shape and posterior extension of the pronotum, the appearance of the median carina, the development of the suprahumeral processes, and the structure of the head and metopidium were considered.

### Morphometric analysis

Ten adults with all body parts intact and without deformation, whose sex was not determined, were selected for morphometric analysis. The specimens were photographed under a stereomicroscope. The obtained digital images were analysed using ImageJ 1.54g (Schneider *et al.,* 2012).

Before measurement, the images were calibrated using a 1 mm scale, and all measurements were taken in millimetres. The morphometric characters and their measurement landmarks were selected based on the description provided by Kopp and Yonke (1977). Total length (TL), pronotal length (PL), outer ocular width (OOW), suprahumeral width (SHW), head height (HH), basal width of metopidium (BWM), and diagonal metopidial breadth (DMB) were measured.

### Statistical analysis

Statistical analysis of the morphometric data was performed using PAST 5.2.1 (Hammer *et al.,* 2001). The

arithmetic mean, standard deviation, minimum value, and maximum value were calculated for each morphometric character. The results were expressed in millimetres as the mean ± standard deviation and min–max.

## Results and Discussion

### Distribution of *Stictocephala bisonia* in the Andijan Region

The study revealed the occurrence of *Stictocephala bisonia* at seven survey sites in the Andijan Region (Table 1). Specimens were collected from Andijan city and the Andijan, Qo‘rg‘ontepa, Xo‘jaobod, and Jalaquduq districts. According to the scientific literature reviewed, this finding represents the first record of *S. bisonia* in the Andijan Region and the Fergana Valley. The first specimens of the species were collected on 25 May 2025 from an introduced ornamental weeping willow (*Salix* sp.) in the Yangi Andijan area of Andijan city. Two nymphs were detected at the junction of the young shoots of the willow. During subsequent observations, adults of the species were collected in June and July 2026 from alfalfa (*Medicago sativa* L.) agrocenoses at six survey sites in the region.

A total of 52 specimens, including 2 nymphs and 50 adults, were collected during the study. *S. bisonia* was recorded at survey sites located at elevations of 530–802 m above sea level. At the time the adults were collected, air temperature ranged from 29 to 34 °C and relative humidity from 25 to 40%. These results showed that the species occurs in several areas of the Andijan Region.

### Morphological description and morphometric parameters of *Stictocephala bisonia*

The examined adults exhibited diagnostic morphological characters typical of *Stictocephala bisonia* (Figure 1). The head was short and broad, with large, hemispherical eyes located on the lateral sides of the head. The pronotum was the largest and most characteristic part of the body and was strongly developed posteriorly from above the head. In dorsal view, the pronotum was triangular, with a distinctly expressed median carina in its central part. Well-developed suprahumeral processes were present on both sides of the pronotum; they were directed laterally and had pointed apices. The posterior part of the pronotum gradually narrowed and terminated in a sharp apex but did not reach the apical part of the forewings. Fine punctations were present on the surface of the pronotum. The forewings were transparent, with clearly visible venation, and completely covered the abdomen at rest. The legs were well developed, with the hind pair adapted for jumping.

The morphometric parameters were calculated based on measurements obtained from 10 adults and are presented in Table 2 as the mean (Mean), standard deviation (SD), and range of variation (Range).

The total body length of the adults ranged from 8.87 to 10.08 mm, with a mean of 9.48 ± 0.48 mm. Pronotal length ranged from 7.37 to 8.90 mm, with a mean of 8.26 ± 0.59 mm; outer ocular width ranged from 3.04 to 3.95 mm, with a mean of 3.50 ± 0.34 mm; and the width between the suprahumeral processes ranged from 5.23 to 6.04 mm, with a mean of 5.68 ± 0.27 mm. Head height ranged from 1.30 to 2.06 mm, with a mean of 1.77 ± 0.24 mm; basal width of the metopidium ranged from 2.55 to 3.26 mm, with a mean of 2.99 ± 0.24 mm; and diagonal breadth of the metopidium ranged from 4.28 to 5.40 mm, with a mean of 4.87 ± 0.42 mm.

### Bioecological observations under field conditions

During the field observations, the nymphal and adult stages of *Stictocephala bisonia* were recorded on different plants. On 25 May 2025, two nymphs were detected at the junction of the young shoots of an introduced ornamental weeping willow (*Salix* sp.). No trees other than the weeping willow were present at this survey site.

During observations conducted from 21 June to 7 July 2026, adults were collected using an entomological sweep net from alfalfa (*Medicago sativa* L.) agrocenoses at six sites. At the survey sites where adults were recorded, air temperature ranged from 29 to 34 °C, relative humidity from 25 to 40%, and elevation above sea level from 530 to 802 m.

In these field observations, nymphs of *S. bisonia* were recorded on *Salix* sp., whereas adults were recorded in *Medicago sativa* agrocenoses. These results provide preliminary data for more detailed future studies of the developmental stages of the species and their associations with plants in the Andijan Region.

This study documents the first record of *Stictocephala bisonia* in the Andijan Region and the Fergana Valley as a whole. The detection of the species at seven survey

sites during two consecutive growing seasons in 2025–2026 indicates that its presence in the region is not limited to an isolated, accidental finding. The collection of a total of 52 specimens, including 2 nymphs and 50 adults, shows that the material obtained from the Andijan Region has a broader geographical and quantitative basis than the previous records from Uzbekistan. However, because population density and the continuity of generations were not assessed in this study, these data are insufficient to confirm the establishment of a stable population in the region.

The record from Andijan extends the known geographical distribution of *S. bisonia* in Uzbekistan eastwards to the Fergana Valley. In the country, the species was initially detected in alfalfa agrocenoses in the Qibray and Yuqorichirchiq districts of the Tashkent Region, and subsequently, one adult and one nymph were recorded from Zaamin National Nature Park in the Jizzakh Region (Jononova and Xaytmuratov, 2023; Ryaskin *et al.,* 2024). Consideration of the findings from Tashkent, Jizzakh, and Andijan together shows that the species is present in geographically separated regions of Uzbekistan. Nevertheless, the dates and locations of these records do not make it possible to determine the direction or rate at which the species has spread across the country. Therefore, it is more appropriate to interpret the finding from Andijan not as direct evidence of active range expansion but as new biogeographical information that refines the known distributional boundary of the species in Uzbekistan.

**Table.1** Collection records of *Stictocephala bisonia* in Andijan Region, eastern Uzbekistan

| N | Locality | Collection date | Coordinates | Elevation (m a.s.l.) | Specimens (n) | Life stage | Collection plant | Air temperature / RH |
|---|---|---|---|---|---|---|---|---|
| **1** | Yangi Andijan, Andijan city | 25 May 2025 | 40.79893° N, 72.44488° E | 669 | 2 | Nymph | *Salix* sp. | – |
| **2** | Qo‘rg‘ontepa District | 21 June 2026 | 40.74301° N, 72.91598° E | 742 | 10 | Adult | *Medicago sativa* | 31 °C / 37% |
| **3** | Xo‘jaobod District | 27 June 2026 | 40.59249° N, 72.63358° E | 759 | 10 | Adult | *Medicago sativa* | 29 °C / 40% |
| **4** | Xo‘jaobod District | 30 June 2026 | 40.59894° N, 72.67346° E | 802 | 8 | Adult | *Medicago sativa* | 30 °C / 31% |
| **5** | Andijan District | 3 July 2026 | 40.77721° N, 72.40778° E | 530 | 4 | Adult | *Medicago sativa* | 30 °C / 32% |
| **6** | Jalaquduq District | 7 July 2026 | 40.79904° N, 72.76384° E | 643 | 8 | Adult | *Medicago sativa* | 32 °C / 32% |
| **7** | Xo‘jaobod District | 7 July 2026 | 40.59204° N, 72.63101° E | 755 | 10 | Adult | *Medicago sativa* | 34 °C / 25% |

**Table.2** Morphometric measurements of adult *Stictocephala bisonia* (n = 10)

| Morphometric character | Mean ± SD (mm) | Range (mm) |
|---|---|---|
| **Total length (TL)** | 9.48 ± 0.48 | 8.87–10.08 |
| **Pronotal length (PL)** | 8.26 ± 0.59 | 7.37–8.90 |
| **Outer ocular width (OOW)** | 3.50 ± 0.34 | 3.04–3.95 |
| **Suprahumeral width (SHW)** | 5.68 ± 0.27 | 5.23–6.04 |
| **Head height (HH)** | 1.77 ± 0.24 | 1.30–2.06 |
| **Basal width of metopidium (BWM)** | 2.99 ± 0.24 | 2.55–3.26 |
| **Diagonal metopidial breadth (DMB)** | 4.87 ± 0.42 | 4.28–5.40 |

**Figure.1** External morphology of an adult *Stictocephala bisonia*: A – lateral view; B – frontal view; C – dorsal view.


The occurrence of developmental stages on different plants is partly consistent with the known life cycle of the species but does not prove a direct trophic association. In this study, 50 adults were collected using an entomological sweep net from alfalfa agrocenoses at six survey sites. In the first record from Uzbekistan in the Tashkent Region, the species was also detected in alfalfa agrocenoses, indicating a certain similarity between the results from the two regions (Jononova and Xaytmuratov, 2023). Alfalfa has been reported in previous studies as one of the herbaceous plants associated with *S. bisonia*, while adults are polyphagous and may occur on herbaceous and woody plants (Świerczewski and Stroiński, 2011; Walczak *et al.*, 2018). However, the exact location and feeding of adults on alfalfa leaves or stems were not observed in Andijan, and plant preference was not assessed. Therefore, this finding does not identify alfalfa as the principal host plant in the region but confirms the occurrence of adults in alfalfa agrocenoses.

The detection of two nymphs at the junction of young shoots of an introduced ornamental *Salix* sp. should be interpreted with particular caution. The eggs of *S. bisonia* are usually laid in oviposition slits in the young shoots of woody plants, whereas newly hatched nymphs develop more commonly on herbaceous plants (Balduf, 1928; Świerczewski and Stroiński, 2011). From this

perspective, the finding on *Salix* sp. is noteworthy within the life cycle of the species associated with woody plants.

However, feeding, hatching, or development of the nymphs on this plant was not observed. Therefore, it cannot be concluded that they fed on *Salix* sp. or hatched from eggs laid specifically on this plant. Rather than identifying *Salix* sp. as a confirmed plant for development, this observation indicates the need for targeted investigations of oviposition marks and nymphal movement in subsequent seasons.

The external morphological characters of the adults collected from Andijan corresponded to the diagnostic descriptions provided for *S. bisonia*. The strongly developed and posteriorly extended pronotum, median carina, pointed suprahumeral processes, and distinctive structure of the head and metopidium are the principal characters used in the taxonomic diagnosis of the species (Kopp and Yonke, 1977; Świerczewski and Stroiński, 2011). The body length of the measured adults ranged from 8.87 to 10.08 mm, with a mean of 9.48 ± 0.48 mm, corresponding to the range of 8.5–10.2 mm reported by Świerczewski and Stroiński (2011) for females and exceeding the range of 7.9–8.3 mm reported for males.

However, because the sex of the 10 adults included in the morphometric analysis was not determined, they cannot be identified as females based solely on body size. The failure to account for potential sexual dimorphism also limits the detailed interpretation of variation in the measurements of the pronotum, head, and metopidium. Nevertheless, the seven morphometric parameters obtained provide a preliminary quantitative characterisation of the material from the Fergana Valley and serve as baseline data for subsequent comparisons in which the sexes are analysed separately.

The record of the species in Andijan requires consideration of its potential phytosanitary significance associated with its polyphagy and oviposition activity. *S. bisonia* has been described as a polyphagous insect that may occur on various herbaceous, ornamental, and fruit plants (Świerczewski and Stroiński, 2011; Walczak *et al.,* 2018). The oviposition of females in the young shoots of woody plants may cause mechanical damage to the bark, phloem, and cambial tissues, while repeated and severe damage may lead to the weakening or drying of shoots in certain fruit trees (Balduf, 1928; Lauterer and Zacha, 1984; Świerczewski and Stroiński, 2011). Because the degree of plant damage was not specifically assessed in this study, no conclusion can be drawn regarding the existence of economic damage in the Andijan Region. However, the detection of the species at seven survey sites supports targeted phytosanitary monitoring based on the combined observation of developmental stages and oviposition injuries in alfalfa agrocenoses and on young fruit and ornamental trees.

The pathway by which *S. bisonia* reached the Andijan Region cannot be determined from the available data. Passive transportation with plants and nursery stock may be one of the important pathways for the long-distance dispersal of alien Auchenorrhyncha, while the development of *S. bisonia* eggs within shoot tissues provides a biological basis for the possibility of such transportation (Mifsud *et al.,* 2010; Świerczewski and Stroiński, 2011; Cai *et al.,* 2025). At the same time, the natural dispersal of adults and gradual spread from neighbouring regions remain alternative possibilities. The discovery of nymphs on *Salix* sp. does not prove that the species was introduced specifically with nursery stock. To clarify its dispersal pathways, future studies should include seasonal monitoring of oviposition marks on woody plants, standardised counts in alfalfa and surrounding vegetation, assessment of direct feeding events and the degree of plant damage, morphometric analysis of adults separated by sex, and comparison of specimens from Uzbekistan and neighbouring regions using molecular population methods.

As a result of this study, *Stictocephala bisonia* was recorded for the first time in the Andijan Region and the Fergana Valley, and new data were obtained on the distribution, diagnostic morphological characters, and morphometric parameters of the species in the region. The occurrence of nymphs on *Salix* sp. and adults in *Medicago sativa* L. agrocenoses indicates the need for further detailed studies of the associations between the different developmental stages of the species and plants. The obtained data indicate the need to monitor the regional distribution of the species and assess its potential phytosanitary risk.

## Author Contributions

Alijon K. Khusanov: Investigation, formal analysis, writing—original draft. Saidakhon T. Tillaeva: Validation, methodology, writing—reviewing. Zafarbek S. Turdiev:—Formal analysis, writing—review and editing. Nuriddin G. Shamsiddinov: Investigation, writing—reviewing.

## Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

**Ethical Approval** Not applicable.

**Consent to Participate** Not applicable.

**Consent to Publish** Not applicable.

**Conflict of Interest** The authors declare no competing interests.

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