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Research Article

New Record of *Orosanga japonica* (Melichar, 1898) (Hemiptera: Fulgomorpha: Ricaniidae) from Azerbaijan

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Abstract | In order to identify the pests of mulberry, which is the main food source for the silkworm, in 2018-2020, monitoring of existing and newly planted mulberry orchards was carried out. *Orosanga japonica* first recorded on *Morus* sp. in the Sheki-Zagatala region located in the northwest, and then in the Khachmaz region, located in the northeast of Azerbaijan. Representatives of this family have not yet been registered in Azerbaijan. Besides of mulberry, the pest was registered in 11 more plant species. The article provides information on the distribution, phenology and plants affected by the pest. Both nymphs and adults of *O.japonica* cause serious damage to plants. When the females lay their eggs, it files the sprouts by the ovipositor and let them dry. Wintering is carried out in the egg phase. Nymphs begin to hatch from overwintered eggs in early May. The eggs of *O. japonica* were also photographed under a JCM-6000 electron microscope and given dimensions. It turned out that the surface of the egg has a peculiar microstructure (consists mainly of hexagonal and sometimes pentagonal shapes with pyramidal projections at the apex of the corners). The distribution map (scale of 1: 500000) of *O. japonica* in the study areas was prepared in a digital database using geographic spatial analysis using the ArcGIS (Geographic Information System) program.

Novelty Statement | For the first time in the north-east and north-west of Azerbaijan, i.e. on the border with Russia and Georgia, a new pest, *Orosanga japonica* (Melichar, 1898), was discovered on mulberries and other plants. *O. japonica* is a new species for the fauna of Azerbaijan.

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Introduction

Fulgoromorpha is a large group of phytophagous insects distributed around the world. At present 14,000 species belonging to 30 families, including fossils, have been identified (Bourgoin, 2017). Representatives of this superfamily have not been recorded in Azerbaijan up to now. *Orosanga japonica* (Melichar, 1898) the first recorded species of Fulgoroidea in Azerbaijan belongs to Ricaniidae family. The family includes 450 species worldwide from 46 genera (Bu *et al*., 2010; Gnezdilov, 2009; Fletcher, 2008; Shcherbakov, 2006; Williams and Fennah, 1980; Chou *et al*., 1985). Most of them are tropical species, and very few species are found in the Palaearctic. *O. japonica* belonging to this family is widespread in China, Japan, Korea, Taiwan, Russia, Ukraine, Georgia, Iran (Demir, 2018; Arslangündoğdu and Hızal, 2018; Fang, 1989; Urban and Cryan, 2007; Mozaffarian, 2018). It penetrated from Georgia to Turkey in 2006 (Demir, 2009) and spread rapidly in the Black Sea coast. In 2010, it was first recorded in Bulgaria along the Black Sea coast (Gjonov, 2011). Since the species is polyphagous and rapidly expands its population, it poses a threat to all

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plants. Both nymphs and adults of *O. japonica* feed on the sap of young shoots and cause serious damage to plants. *O. japonica* draws the juice of the cells by penetrating its stylet into the tissue of the plants, causing local necrosis of the assimilation apparatus and vessels. Contaminating the surface of plants with sweet excrements it leads to the spread of fungi, as well as a decrease in the intensity of photosynthesis. Females lay eggs on young shoots, having previously sawed them with the ovipositor. The species causes the spread of some pathogenic fungi in plants (*Cylindrocarpon* sp. , *Fusarium* sp . and *Pestalotiopsis quepinii*) (Eken *et al*., 2013). It is found on many plants in the countries where it is distributed: date-plum (*Diospyros lotus* L.), hazelnut (*Corylus avellana* L.), acacia (*Acacia* spp.), laurel (*Laurus nobilis* L.), lavender (*Lavandula* L), wild blackberry (*Rubus* sp.), chestnut (*Castanea* Mill.), kiwi (*Actinidia* Lindl.), black elderberry (*Sambucus* spp.), cherry (*Prunus laurocerasus* L.), pineapple (*Hedera* L.), tea (*Camelia sinensis* L.), common bean (*Phaseolus vulgáris* L.), corn (*Zea mays* L.), tomatoes (*Solanum lycopersicum* L.), eggplant (*Solanum melongena* L.), cabbage (*Brassica oleracea* L.), peppers (*Capsicum* L.), cucumbers (*Cucumis sativus* L.), citrus plants (*Citrus* L.), mandarins (*Citrus reticulata Blanco*), common grape vine (*Vitis vinifera* L.), apple tree (*Malus domestica* Borkh.), pear tree (*Pyrus communis* L.), peach tree (*Persica vulgaris Mill.*), cherry plum (*Prunus cerasifera* Ehrh.), fig tree (*Ficus carica* L.), alder tree (*Alnus glutinosa* (L.)), walnut (*Juglans regia* L.), wormwood (*Artemisia absinthium* L.), Japanese mashed potatoes (*Eriobotrya japonica* (Thunb.) Lindl.), Japanese rose (*Hydrangea macrophylla* (Thunb.) Ser.), nettle (*Urtica dioica* L.), hardy orange (*Poncirus trifoliata* L.), etc.

Materials and Metods

The material was collected in 2018-2020 in accordance to the generally accepted entomological methods (Fasulati, 1971) from the territory of the Sheki-Zagatala region, located in the northwest, and the Khachmaz region, located in the northeast of Azerbaijan. A visual inspection of the plants was carried out, the nymphs and adults were collected by entomological sweep net. Stems with clutches of eggs on them were also cut with scissors and brought to the laboratory. To study the phenology of the pest during the growing season, repeated census were made in the study areas. It should be noted that the studied territories are located on the border of the republic with Georgia and Russia. The photos of nymphs and adults were taken by Canon IXUS 240 HS, and the photos of eggs were taken by JCM-6000 electron microscope. For this purpose, the eggs were removed from the female abdominal cavity under Stereomicroscope Nikon SMZ1270, and after drying on a glass slide, the eggs were gold coated and photographed in a 15 kV vacuum, and the egg sizes were obtained.

Results and Discussion

In connection with the development of silkworm breeding in Azerbaijan and in order to study the pests of mulberry plants, monitoring was conducted in the north-western and north-eastern regions of Azerbaijan in 2018-2020 and the planthopper *O. japonica* was recorded for the first time. Although it was first found on mulberry in Azerbaijan, later it was recorded on blackberry (*Rubus* sp.), peanut (*Sambucus* L.), common hazel (*Corylus avellana* L.), fig tree (*Ficus carica* L.), large-leaved linden (*Tilia platyphyllos* Scop.), trifoliate orange (*Poncirus trifoliata* (L.)), common bean (*Phaseolus vulgáris* L.), corn (*Zea mays* L.), strawberry (*Fragaria* L.), and old man's beard (*Clematis vitalba* L.).

O. japonica is a brown planthopper with two grayish-white stripes on its wings (Figure 5a). It is 8-11 mm long, the males are smaller than the females, and the color is relatively light. They are more densely populated on young shoots, lined up, and jump with a sharp movement from a slight touch. The ovaries of females are well developed and serrated. The female cuts the bark of the branches with the ovipositor and lays one egg in the resulting chamber (Figure 5d). The eggs are yellowish-white, elongated oval, with a micropile. In the laboratory, the potential egg productivity of females was calculated and averaged 40-60 eggs. The length of the eggs removed from the abdomen of the female ranged from 939 µm to 993 µm and the width from 395 µm to 420 µm (Figure 1). The surface of the egg is microsculptural (Figure 2). The microsculpture consists mainly of hexagonal and sometimes pentagonal figures, with pyramid-shaped protrusions at the top of the corners. The dimensions of the micropile were approximately 41.0 µm x 44.0 µm (Figure 3).

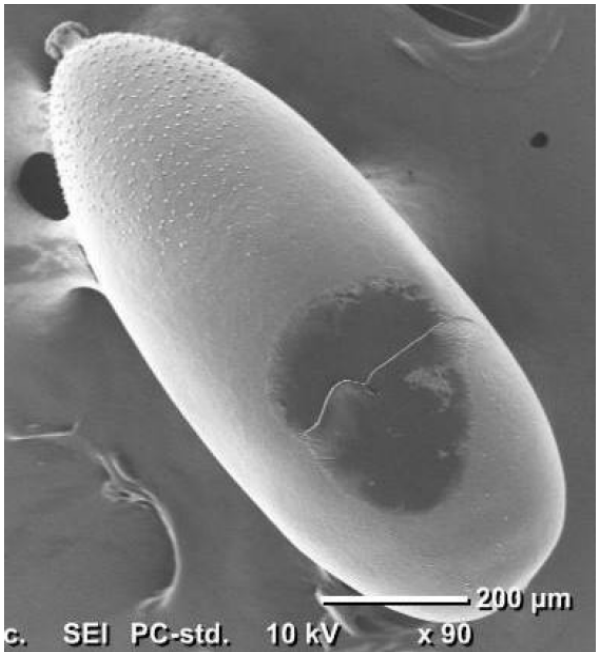

Figure 1: The egg of *O. japonica*.

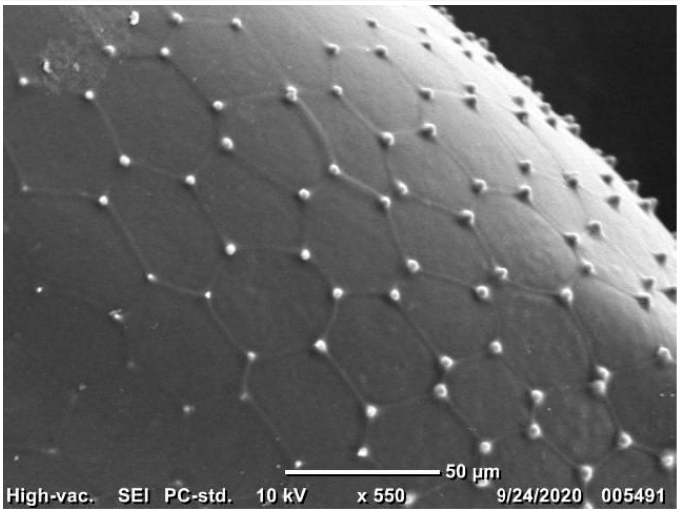

Figure 2: Microsculpture of the *O. japonica* surface.

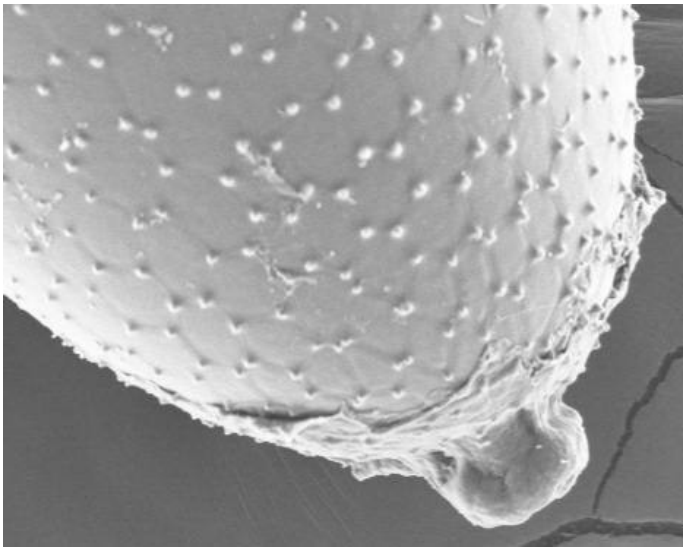

Figure 3: Micropile of *O. japonica*.

In places where eggs are laid, the bark of the tree is slightly raised and seemed to be ragged. Observations show that the imago moves along the branch in a zigzag manner laying eggs in successive groups. One female that we observed laid averagely 60 eggs in the following groups: 7 + 8 + 11 + 19 + 15. One group contained at least 5 and at most 20 eggs. It was revealed that in Azerbaijan *O. japonica* gives one generation in a year. The pest overwinter in the egg stage. Nymphs (Figure 5b, c) hatch from overwintered eggs in early May. The body color of the nymphs is yellowish with dark brown spots. Though the 1st instar nymphs are light coloured, the older instar nymphs become darker. On the back of the nymphs, which have a unique structure, there is a tail made of wax threads, which is up to 2 times longer than the body. The length of the wax threads differ depending on age stage. The wax threads are short in little instar nymphs. When the nymphs are touched, they fly with a jump, and an umbrella made of wax strings acts as a parachute facilitating the movement of the nymphs. Due to the mixing of developmental stages, nymphs of different ages are found on plants (Table 1).

Depending on climatic conditions, the nymph of the first instar can be seen from the beginning of May, and the nymph of the second instar from the third decade of May. From the second decade of June the nymphs of the third instar can be recorded, from the third decade of June and the first decade of July the older nymphs only can be recorded.

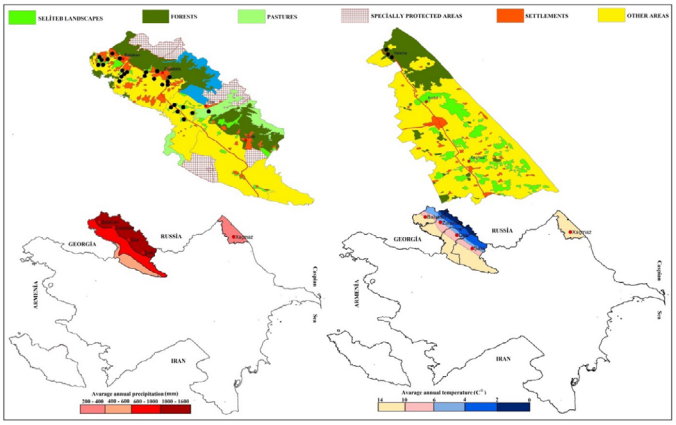

Figure 4: A map of *O. japonica* localities in Azerbaijan.

Figure 5: a) Adults of *O. japonica* b) nimpha c) nimphs on the young shoot d) the external view of the shoot with eggs on it.

Table 1: Phenology of *O. japonica* in Azerbaijan.

Months											
January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
				Nympha							
						Adult					
								Egg period wintering			
Egg period wintering											

The development of each nymphal stage requires about 15-25 days. The body of an older nymph is very large and dark. In the first decade of July, the flight of the imago is already noticed. The development of the pest from egg to adult stage requires about 2-2.5 months. From the second decade of August, the nymphs are no longer appeared. For the third decade of August, the females lay eggs under the bark of thin branches and stems. The flight of the imago also occupies about two-three months. During this time, the imago is also nourished by the juice of plants. Imago nutrition and egg laying continue until the late September. Observations show that *O. japonica* are more common in wet areas. In our opinion, *O. japonica* penetrated the territory of Balakan through neighboring Georgia , and the territory of Khachmaz-Nabrani through Russia. Despite the fact that the *O. japonica* is new for the fauna of Azerbaijan, its population density was quite high on the plants found. It is expected that the range of host plants of *O. japonica* can increase and the pest can represent a threat to the plants of Azerbaijan, as well as neighboring countries in the future.

Also, a map of the distribution of *O. japonica* was prepared in a digital database using geographic spatial analysis using the ArcGIS (Geographic Information System) program (Figure 4).

Surveys were carried out at selected sites for observation and sampling and positioned in accordance with geographic coordinates. The new species was mapped to the study area according to a special algorithm and the area of its distribution was reflected. The study was carried out in administrative districts located on geographical sites (gardens, forests, specially protected areas, cultural landscapes). Thus, the study was refined using the point method. The degree of influence of the temperature regime and the regime of precipitation in the study area on the distribution of species has been clarified. The map was developed on a scale of 1: 500000. The new species is widespread in some areas and less common in others. In the future, it is planned to zone a new species across the country using a map and research results.

It should be noted that the research areas in the Sheki-Zagatala region is located at an elevation of 500-1000 m a.s.l., the Khachmaz region at an elevation of 130-150 m above sea level. It turned out that in the research areas where *O. japonica* was found, that is, in the Sheki-Zagatala region, the average annual temperature was 10-14^{0}C, the average annual precipitation was 600-1000 mm, and in the Khachmaz region the average annual temperature was 10-14^{0}C, the average annual precipitation was 200-400 mm.

Conclusıons and Recommendations

For the first time in the north-east and north-west of Azerbaijan, i.e. on the border with Russia and Georgia, a new pest, *Orosanga japonica* (Melichar, 1898), was discovered on mulberries and other plants. *O. japonica* is a new species for the fauna of Azerbaijan. In Iran - the southern neighbor of Azerbaijan the pest was first detected in 2018. And it spread mainly in the Mazandaran province along the coast of the Caspian Sea (Mozaffarian, 2018). Closeness of Mazandaran province and similarity of the nature to southern territories of the Azerbaijan, as well as the wide distribution of *O. japonica* in these areas can create a dangerous situation for Azerbaijan in the future. Monitoring on distribution of *O. japonica* in the southern regions of the country will be carried out. Also, studies of bio-ecological characteristics of the species, trophic connections need to be continued and natural enemies in Azerbaijan will be identified.

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Conflict of interest

The authors have declared no conflict of interest.

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