

## Formation of Persistent Population of Invasive Species *Metcalfa pruinosa* (Say, 1830) (Auchenorrhyncha: Flatidae) in the South of Ukraine

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**Abstract**—The formation of a persistent population of a new invasive species, citrus flatid planthopper (*Metcalfa pruinosa* Say, 1830), is reported for the Ovidipol district, Odessa oblast, Ukraine. *M. pruinosa* originates from America. The imagoes of this insect species were observed during the surveys on fruit trees, fig trees, grape, and ornamental plants in private gardens; they were fixed with yellow sticky traps. Morphological description, features of the insect development, host plants, distribution ability, and importance are given for *M. pruinosa* as a potentially harmful insect in southern Ukraine. Taking into consideration that *M. pruinosa* continues to occupy rapidly a new territory and new host plants, it is necessary to perform phytosanitary monitoring of different crop cultures in southern Ukraine and to take action to restrict its development and to reduce its harmfulness using biological and chemical agents.

**Keywords:** *Metcalfa pruinosa*, invasion, plants, population, Ukraine

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### INTRODUCTION

The end of the 20th and beginning of the 21st century were marked by the intensification of invasion processes in many countries around the world, contributed to a large extent by global climate change, anthropogenic disturbances of natural ecosystems, and increased transportation (Dgebuadze, 2014).

The delivery of plant material from abroad to Ukraine without strict quarantine control led to the emergence of new types of diseases and pests in the regions of the country. For example, there was a report on the appearance of a new invasive mite species (*Pentamerismus taxi*) on a yew in Kyiv (Bondareva et al., 2017). The main factors contributing to the spread of this mite species are the introduction of plants from different regions and countries, climate warming, expansion and advancement of the boundaries of the ranges of mites northward (Bondareva et al., 2017).

Citrus flatid planthopper (*Metcalfa pruinosa* Say, 1830) (Homoptera: Auchenorrhyncha, Flatidae) was first discovered in Ukraine on the Black Sea coast in 2010–2015; according to various authors, it probably came through the seaports from Turkey and Bulgaria, and, possibly, from the adjacent territory of Romania. It is known that *M. pruinosa* is passively distributed by

land and sea transport, the egg clutches are transported with infected plant material; sometimes they are deliberately imported by beekeepers in order to produce honeydew (Baranets, 2016).

It is known that the birthplace of *Metcalfa pruinosa* is America, where its distribution covers more than 32 provinces and states, from Ontario and Quebec to Florida, and also west of South Texas, New Mexico, Arizona, and Mexico. It is also widespread in Cuba, Mexico, and Brazil (Mead, 2004). In Europe, the non-Arctic species of cicadas was first identified in Italy in 1979 (Duso and Pavan, 1987). After a short period of time, the range of this cicada covered most of southern Europe, and the species was registered in southeastern France (Provence) as early as 1985, where its population later reached invasive scales (Della Giustina and Navarro, 1993). In 1990, it was discovered in Slovenia (western Istria), and in 2001, in the vicinity of Ljubljana. At the beginning of the autumn of 2006, the appearance of this species was recorded in Belgrade (Mikhailovich, 2007). *M. pruinosa* was found in the Czech Republic (Lauterer and Malenovsky, 2002). The rapid spread of the citrus flatid planthopper was registered in Romania, where in two years the species advanced 250 km (Chireceanu and

Gutue, 2011). In 2009, this insect was found in the vicinity of Seoul, South Korea. This is the first report about its appearance in the eastern part of the Palaearctic (Kim et al., 2011).

At the end of July 2009, *M. pruinosa* was first discovered on sunflower stalks in the south of Russia in the urban-type settlement of Lazarevskoye, where it was probably delivered through seaports (Gnezdilov and Sugonyaev, 2009). Just two years later, it became widespread in the cities through which the maritime trade routes pass: in Sochi, Yeysk, Krasnodar, Novorossiysk, in the cities of the Western Caucasus, and other settlements. In 2013, this insect was discovered for the first time by the experts of the Forest Protection Center of the Chechen Republic, and in the middle of summer of the same year, it was registered in the gardens (Balakhnina et al., 2014; Zamotaylov et al., 2016; Abdrakhmanova and Sobina, 2017).

In 2017, we discovered for the first time a population of an unidentified insect that damaged many plants in the farmland of the Ovidiopol district of Odessa oblast in Ukraine. Therefore, the purpose of this work was to identify this insect pest, as well as its host plants on the examined territory.

## MATERIALS AND METHODS

*Metcalfa pruinosa* was the object of research. Its presence on the territory of the Ovidiopol district of Odessa oblast was analyzed in the period from the second half of May to the first half of August by conducting a route inspection of plants and using yellow sticky traps (Takitraps 25 × 10 cm TOV Biotech Systems Ukraine). On private 50-m<sup>2</sup> farm plots, we inspected all plant species (ornamental, vegetable, fruit, weeds, etc.) for the presence of the pest. Inspections were conducted every week (Balakhnina et al., 2014). The material was processed using the technique described previously (Golub et al., 2012).

## RESULTS AND DISCUSSION

Imagoes and white-colored larvae in a downy white bloom were found on the plantations of grapes, figs, fruit and vegetable crops, and ornamental plants during the observations performed on the private plots of the residential area of Sovinyon, Ovidiopol district, Odessa oblast, Ukraine. The imago has a body up to 10 mm long, and its wingspan is 17 mm. At the end of the body, the filaments are gathered together and directed backward. The eyes of the insect are orange.

According to the "Guidelines for the Identification of Pest Species of Ornamental Woody Plants on the Black Sea Coast of the Caucasus" (Karpun et al., 2015), this insect was *Metcalfa pruinosa* Say, which is a new invasive species for Odessa oblast. The accuracy of the determination of the species *Metcalfa pruinosa* was confirmed by Dr. Alexander V. Puchkov, senior

researcher of the Department of Scientific Stock Collections of the Schmalhausen Institute of Zoology of the National Academy of Sciences of Ukraine, Kyiv, Ukraine.

Citrus flatid planthopper is fairly fast and mobile, and it is able to jump and fly. Imagoes and larvae feed on leaf sap. The larvae are able to secrete a fluffy white mass, resembling sticky cotton, which serves as a repository.

*M. pruinosa* is a polyphagous species that feeds on more than 330 species of cultivated plants and weeds (Zamotailov et al., 2016; Konstantinova, 2016, 2017). The host plants are citrus fruits, Rosales, grapes, fig tree, persimmon, cucumbers, tomatoes, cabbage, onions, boxwood, linden, raspberries, potatoes, carrots, peppers, eggplants, celery, corn, etc. (Duso and Pavan, 1987; Mead, 2004; Chireceanu and Gutue, 2011).

For the first time, we registered the presence of this pest on more than 31% of the plants examined: rose, raspberry, magnolia, sweet cherry, cherry, plum, apple, peach, cherry plum, grape, fig, maple, linden, acacia, string bean, redbuds, willow, elm, nettle, cucumber, tomato, sweet pepper, boxwood, yucca, spindle tree, cherry laurel, thuja, etc.

Observations have confirmed that *M. pruinosa* is a fairly dangerous pest that feeds on plant sap, it weakens and reduces plant growth, and the fruits often flake before ripening or are not formed at all. Imagoes contribute to the spread of pathogens, especially smut fungi, from diseased plants to healthy ones. This insect is a source of viral and phytoplasmic infection of pathogens in vineyards (Konstantinova, 2016).

We believe that the cause of the appearance of the sticky plaque is the sap of plants, which begins to be produced intensely as a result of damage to the plant epithelium and active feeding by *M. pruinosa* (Fig. 1). The larvae pierce the plant with their proboscis and suck the sap, which leads to the appearance of white, yellow, and later brown spots, which can then merge into the large spots. Damaged shoots are deformed and then dry out. On grapes, the ripening and accumulation of sugar in the berries is delayed (Baranets, 2016; Konstantinova, 2016).

During our observations in Odessa oblast, we noted one generation of this insect. The insect development takes place from May to August; the appearance of imagoes is observed in late July. In the period of acceleration of the larval stage, a white fluffy plaque appears that continues until the emergence of imagoes of the pest: this is the optimal time for protective and preventive actions. The larvae of *M. pruinosa* have a rather interesting type of mimicry: they molt with a fluffy white mass, which resembles a sticky lightweight cotton wool. The mass is attached to the stalks of plants and serves as places of refuge for the larvae.

According to our observations, in the second half of August, there is a sharp decrease in the number of

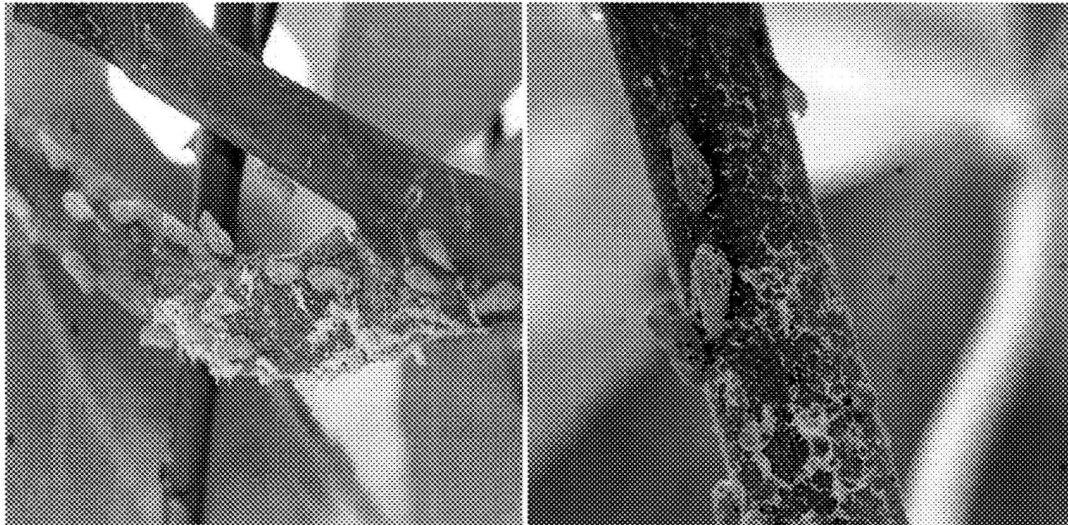


Fig. 1. Sap ooze and the appearance of the cotton-wool bloom on the fig tree, as a result of damage by the colony of *M. pruinosa*. Farm plot, Ovidiopol district, Odessa oblast, Ukraine. Photo by L.V. Popova.

imagoes, which, apparently, is due to a decrease of in air temperature at night below  $+17$  to  $+20^{\circ}\text{C}$ .

Plant protection actions against *Metcalfa pruinosa* are not fully defined. The choice of compounds depends on the plant species and times of processing and ripening of fruit (Konstantinova, 2017). It is known that the pest is widely distributed not only on agricultural lands but also in settlements, courtyards of residential buildings, and parks and on the territory of kindergartens, schools, and hospitals. Early spring spraying of perennial plantings and the destruction of coarse remains of annual plants is effective for the destruction of the overwintered eggs (Konstantinova, 2017).

Prophylactic treatments of the pest outbreaks found during the previous year with insecticides are particularly important. They are carried out from the predicted moment of hatching of the larvae (approximately the middle of the third ten days of May) with an interval of 7–8 days to prevent the dispersal of the larvae. At the end of the second ten days of June, when large-scale emergence of jumping larvae occurs, systemic insecticides are used. With an increase in the number of insects, so-called contiguous treatments are advisable with an interval of 7 days (Konstantinova, 2017).

The insecticides with a short waiting period should be used for vegetable crops. Since the insect larvae are mainly located on the underside of the leaves, spraying should be carried out in such a way that the solution gets to the places of their concentration. In private gardens, yellow glue traps are used to catch imagoes. In addition, it is necessary to disrupt and destroy the damaged parts of plants on which there are larvae in a “cotton” coating. It is important to destroy weeds, especially in the summer, when the pest begins to reproduce (Konstantinova, 2017).

In the period of emergence of imagoes, one to one and a half months before the start of fruit ripening, it is possible to use biological preparations based on avermectins: Aversectin C (50 g/L) and Avertin N (2 g/L)—preparations Actofit, Fitoverm, Agroverin, Akarin, etc. In addition, attention should be paid to introduction, acclimatization, and the use of natural enemies of *M. pruinosa*, in particular, *Neodryinus typhlocybae* (Zamotaylov, 2016; Abdrakhmanova and Sobina, 2017).

Considering the life strategy of the species (polyphagy, ability to fly), natural distribution to high latitudes in America, and relatively easy passive distribution from the Mediterranean region at the egg stage along with ornamental plants, *M. pruinosa* has the possibility of unintended introduction in the Ukraine. The species shows an excellent ability to spread over the territory of Odessa oblast. Therefore, because of the significant potential danger of this species, urgent actions should be taken to identify the insect at all stages of development and to take measures aimed at prevention, monitoring, and protection against this dangerous pest.

Thus, a persistent population of a new invasive species for the southern Ukraine, *Metcalfa pruinosa* Say, common on farm plots on various plant species, has been formed in Ovidiopol district of Odessa oblast. *M. pruinosa* was found on more than 31% of the plants examined: fig tree, grape, rose, raspberry, magnolia, sweet cherry, cherry, plum, apple, peach, cherry plum, maple, linden, acacia, bean, redbuds, willow, elm, nettle, cucumber, tomato, sweet pepper, boxwood, yucca, eucalyptus, laurel cherry, thuja, etc. These circumstances make it necessary to develop a predictive map of *M. pruinosa* distribution, as well as to plan

investigations to search for protective biological agents.

#### COMPLIANCE WITH ETHICAL STANDARDS

*Conflict of interests.* The authors declare that they have no conflict of interest.

*Statement on the welfare of animals.* All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

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