

East Chestnut Gall Wasps *Dryocosmus kuriphilus* Yasumatsu, 1951 (Hymenoptera, Cynipidae)—New Invader in the Forests of the North Caucasus

Yu. I. Gninenko^{a, b, *} and M. E. Lyanguzov^c

^aAll-Russian Research Institute of Forestry and Mechanization of Forestry, Pushkino, Moscow oblast, 141200 Russia

^bAll-Russian Centre for Plant Quarantine, Bykovo, Moscow oblast, 140150 Russia

^cSochi National Park, Sochi, 35400 Russia

*e-mail: gninenko-yuri@mail.ru

Received October 16, 2016

Abstract—Results of the first studies of a new invasive pest of the sweet chestnut, the eastern chestnut gall wasp *Dryocosmus kuriphilus*, are presented. For the first time, this invader was discovered within the territory of Russia in 2016. Data on its distribution and some characteristics of the damage are given. Several types of galls are formed as a result of the larvae feeding. The level of occupancy of chestnut by the pest is shown.

Keywords: sweet chestnut, *Dryocosmus kuriphilus*

DOI: 10.1134/S207511171703002X

INTRODUCTION

In May 2016, *Dryocosmus kuriphilus* Yasumatsu, 1951 (Hymenoptera, Cynipidae), a new invasive organism associated with chestnut, was first identified in the North Caucasus of Russia.

Sweet chestnut *Castanea sativa* Mill. on the territory of Russia occupies about 47000 ha. It grows in Krasnodarskii krai and the Republic of Adygea; it was included in the Red Data Book of Adygeya (On the procedure..., 2011). Its condition in the Caucasian part of its range cannot be considered satisfactory, and its participation in the formation of forests in this region is constantly decreasing. Because of this fact, Rosselkhoz in 2011 decided to ban felling of the chestnut tree (On the approval..., 2011).

Chronic foci of the cryphonectrian necrosis (with *Cryphonectria parasitica* as pathogen) and the ink disease (with *Blepharospora cambivora* as pathogen), developing in chestnut groves for a long time (Issinskii, 1964, 1968; Pridnya, 2003; Shiryaev et al., 2004; Lukasova, 2013), have led to deaths of large numbers of chestnut trees, and the infection of chestnut by these diseases continues.

Appearance of a new invasive organism associated with chestnut can still more complicate the forest pathological situation and accelerate the death of trees.

MATERIALS AND METHODS

Studies were conducted in several forest districts of the Sochi National Park in May–August 2016.

We conducted special surveys of forest pathology. For this purpose, we made route paths through forest stands which involved the sweet chestnut *Castanea sativa*. During the survey, we visually determined presence of terats (galls) of *D. kuriphilus* in the chestnut crowns.

In the process of examination we cut branches with a length of 1 m from the lower part of crown and delivered them to the laboratory. There we counted the total number of galls per 1 m of branch and measured the length of the branch and the length of all small branches growing on it. Then we divided the galls according to the place of their formation: on different parts of leaves, buds, leaf petioles, etc.

To determine the density of branch occupancy by *D. kuriphilus*, we also counted the total number of leaves on the branch and then determined the number of galls per one leaf. Studies showed the level of chestnut occupancy by the pest new for this region and allowed us to determine the places of its greatest number in the place of invasion into the territory of Russia.

RESULTS AND DISCUSSION

Dryocosmus kuriphilus originates from East Asia, where it is widespread in the range of Chinese chestnut *Castanea mollissima* Blume. In North America, it was first observed in Georgia in 1974 (Payne et al., 1975). More than 30 years after the first discovery, it has spread 1400 km to the north from the place of detection and 93 km to the east (Gninenko and Melika, 2011).

In Europe, this phytophage was first discovered in northern Italy in 2002 (Brussino et al., 2002). From there,



Fig. 1. The range (black) of *Dryocosmus kuriphilus* on the Black Sea coast of the North Caucasus in 2016.

Table 1. Number of galls of *D. kuriphilus*

Collecting site	Mean branch length, cm	Mean number of healthy leaves on branch	Mean number of galls taken into account	Number of galls per 1 m of branch	Mean number of galls per leaf
Verkhnesochinskoe forest district, 43.52098 N, 39.911266 E	132.0 ± 33.8	33.2 ± 15.5	11.0 ± 2.3	8.3	0.33
Dagomysskoe forest district, 43.658772 N, 39.711094 E	175.0 ± 21.8	35.0 ± 7.5	9.0 ± 2.5	20.0	0.26
Matsestinskoe forest district, 43.558405 N, 39.818488 E	187.5 ± 25.0	43.8 ± 10.0	24.5 ± 8.7	23.0	0.56



Fig. 2. Galls forming from vegetative buds.

it dispersed to the entire territory of Italy, including the island of Sardinia (Graziosi and Santi, 2008). Then the species penetrated into Slovenia, France, Croatia (Matošević et al., 2010), and Hungary (Czoka et al., 2009).

In the natural range, its harm is small, but wherever it penetrated, it quickly became a dangerous pest of local chestnut (Yasumatsu, 1951; Payne, 1978; etc.).

Currently, the peculiarities of *D. kuriphilus* biology in new habitats in Russia remain unknown. It is also difficult to give a forecast of the expected harmfulness of this invader in our conditions, but, most likely, harmful activities of *D. kuriphilus* will have a significant influence on deterioration of chestnut in the Caucasus.



Fig. 3. Galls on main leaf vein.

Even before the identification of *D. kuriphilus* on the territory of Russia, we gave a forecast about its rapid penetration and big danger (Gninenko and Melika, 2011), which was later confirmed by Blumer (2016).

After identifying *D. kuriphilus*, we began the study of its biology and harmfulness in the forests of Krasnodar krai. It was found that, in the forests of the Sochi National Park, it occupied the territory of four forest districts covering an area of approximately 200 ha. However, the special survey in July 2016 conducted by specialists at VNIKR revealed that the area of spreading exceeds 200 ha. Later, specialists from the Krasnodar Center of Forest Protection found *D. kuriphilus* in the Tuapse forest district (New dangerous..., 2016).

Therefore, *D. kuriphilus* at the present time is significantly more widespread on the Black Sea coast of Krasnodar krai than it was in the spring of 2016. By the autumn of 2016, its presence was noted in chestnut stands for more than 50 km in the interfluvium of the Sochi and Shakhe rivers (Fig. 1).

We conducted surveys in July 2016 in several forest areas of the Sochi National Park, which allowed us to identify the degree of occupancy of trees by *D. kuriphilus*.

As a result, we found that on average 1 m of branches of the chestnut contains from 8 to 23 galls. The mean number of galls per one leaf on a branch ranges from 0.26 to 0.56 (Table 1).

Table 2. Sites of formation of galls

No.	Collecting site	Total number of galls taken into account	Occurrence of galls in different sites, % of those taken into account					
			buds	underdeveloped leaves	in the lower part of leaf	in the middle part of leaf	in the upper part of leaf	maces
1	Verkhnesochinskoe forest district, plot 40	269	48.4	15.2	10.4	16.7	6.3	3.0
2	Verkhnesochinskoe forest district, plot 41	95	43.2	17.9	5.2	16.8	16.8	0.0
3	Dagomysskoe forest district, plot 37	131	84.0	5.3	8.4	2.3	0.0	0.0
4	Dagomysskoe forest district, plot 39	257	53.3	26.1	4.2	8.2	7.0	1.2
5	Matsestinskoe forest district, plot 7	257	61.4	14.4	11.3	8.6	2.7	1.6

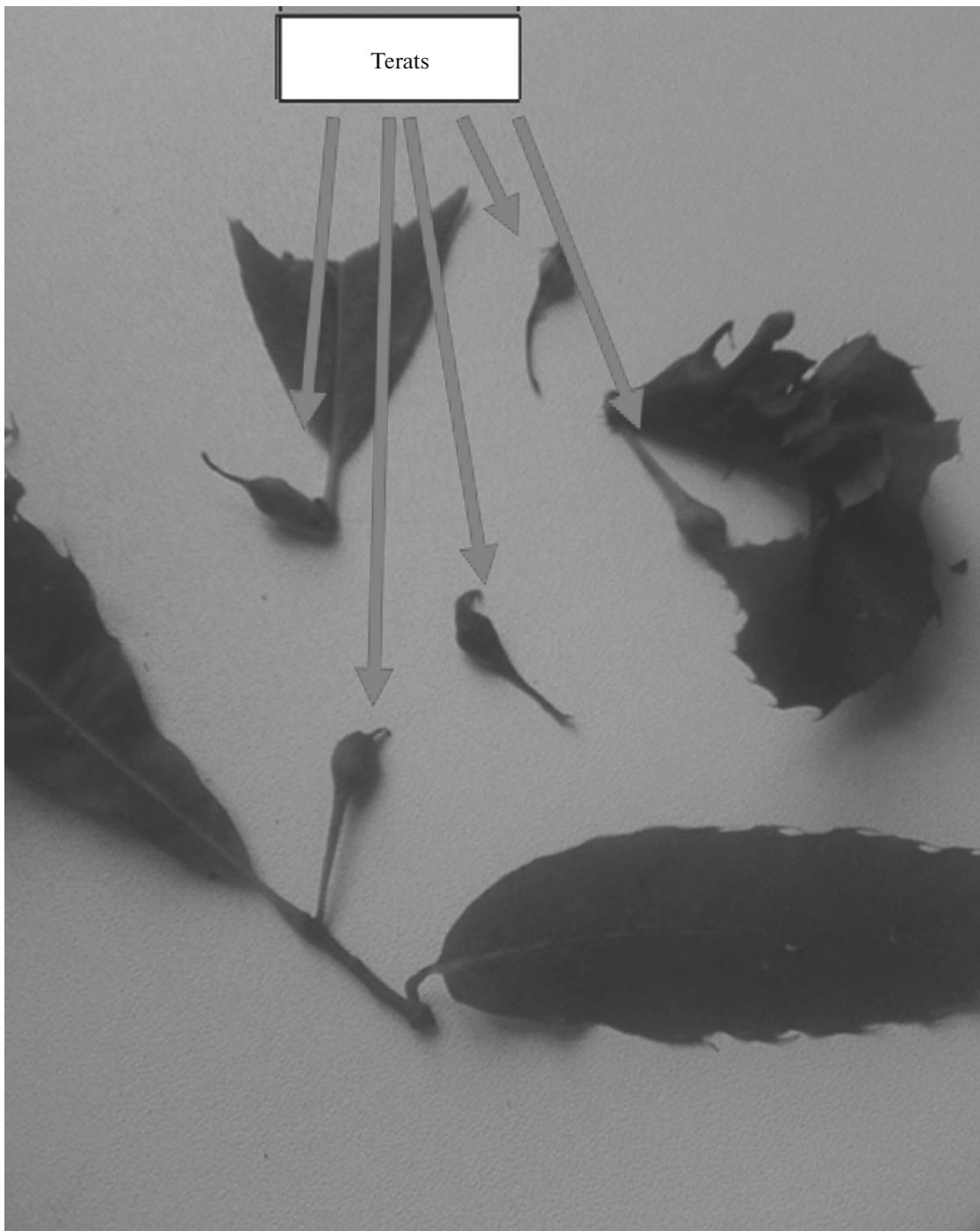


Fig. 4. Galls in the form of mace that formed instead of leaf.

Most often, galls are formed from buds that start to grow in spring under the influence of *D. kuriphilus* larvae developing in them (Fig. 2). The same concerns the main vein of the leaf blade, where they are located in different parts of the leaf (Fig. 3). A considerable fraction of leaves thus cannot open normally, and they remain underdeveloped.

In addition, in a very small number of cases, galls are formed on the top of the leaf petiole in the form of a semblance of the mace (Fig. 4).

Special calculations in all the examined stands revealed that a vast majority of galls were formed on buds (Table 2). Almost always, they developed leaves which, however, did not reach normal size.

Thus, most often, galls are formed from leaf buds beginning to bloom in the spring. As a result, small leaves are formed from such buds damaged by the pest. This reduces photosynthetic activity of the trees. All these galls die off in autumn, which reduces the number of growth points in the crowns.

The absence of drugs allowed for use to protect chestnut from this new pest makes it impossible to take timely measures to combat *D. kuriphilus*. The ignorance of biology of this invader in new habitats and the lack of data on entomophage fauna of *D. kuriphilus* also hinder protective measures.

Sweet chestnut in the North Caucasus is in poor condition owing to the development of chronic foci of cryphonectrian necrosis and ink disease in its stands, and the appearance of a new pest could worsen its condition. Therefore, it is necessary in the shortest possible time not only to start studies on *D. kuriphilus* biology but also to begin immediately development of protection methods.

REFERENCES

- Blyummer, A.G., East chestnut gall wasps *Dryocosmus kuriphilus* Yasumatsu, 1951 (Hymenoptera, Cynipidae)—a dangerous invader in the USA and Europe. Is it possible to prevent the introduction of phytophage into Russia? *Karantin Rast., Nauka i Praktika*, 2016, no. 2 (16), pp. 27–33.
- Brussino, G., Bosio, G., Baudino, M., Giordano, M., Ramero, F., and Melika, G., Nuovo cinipidae galligeno in Piemonte. Pericoloso insetto esotico per il causagno europeo, *L'Informatore Agrario*, 2002, vol. 37, pp. 59–61.
- Czoka, G., Wittmann, F., and Melika, G., A szelídgesz-tenye gubacsdarázs (*Dryocosmus kuriphilus* Yasumatsu, 1951) megjelenése Magyarországon, *Növényvédelem*, 2009, vol. 7, pp. 12–15.
- Gninenko, Yu.I. and Melika, G.G., *Kashtanovaya orekhotvorka Dryocosmus kuriphilus Yasumatsu—novyi opasnyi vreditel' kashtana posevnogo* (New Invader Chestnut Gall Wasps *Dryocosmus kuriphilus* Yasumatsu, 1951 (Hymenoptera, Cynipidae)), Moscow: All-Russia Nauchno-Issled. Inst. Lesovod. Mekhaniz. Lesn. Khoz., 2011.
- Graziosi, L. and Santi, F., Chestnut gall wasp (*Dryocosmus kuriphilus*): spreading in Italy and new records in Bologna province, *Bull. Insectol.*, 2008, no. 2, pp. 343–348.
- Issinskii, P.A., Natural reproduction of chestnut, in *Tr. Sochinskoi Nauchno-Issled. Opyt. Stn., Vseross. Nauchno-Issled. Inst. Lesovod. Mekh. Lesn. Khoz.*, 1964, no. 2, p. 5.29.
- Issinskii, P.A., The chestnut forests of the Caucasus and the basics of their economy controlling, *Tr. Sochinskoi Nauchno-Issled. Opyt. Stn., Vseross. Nauchno-Issled. Inst. Lesovod. Mekh. Lesn. Khoz.*, 1968, no. 4, p. 1.240.
- Lukmazova, E.A., Forest pathological condition of chestnut forests of Western Transcaucasia, *Cand. Sci. (Agric.) Dissertation*, St. Petersburg, 2013.
- New dangerous quarantine species of forest pest is found in Krasnodar krai, 2016. <http://krasnodar.rcfh.ru/news/5245.html>. Accessed January 27, 2017.
- Matošević, D., Atošević, D., and Hrašvec, B., First record of oriental chestnut gall wasp (*Dryocosmus kuriphilus*) in Croatia, *Šumar. List*, 2010, vol. 134, nos. 9–10, pp. 497–502.
- On the procedure for making the Red Book of the Republic of Adygea: Decree no. 204 of October 11, 2011, Archive of Documents of the Republic of Adygea. <http://adygea-gov.ru/doc/16732>. Accessed January 26, 2017.
- On the approval of the List of species of trees and shrubs, the harvesting of which is not allowed: The Order of the Federal Forestry Agency of December 12, 2011, no. 513, Moscow, *Rossiiskaya Gazeta*, 2012, Jan. 20.
- Payne, J.A., Oriental chestnut gall wasp: new nut pest in North America, *Proc. Am. Chestnut Symp.*, MacDonald, W.L., Cech, F.C., Luchok, J., and Smith, C., Eds., Morgantown: West Virginia Univ., 1978, pp. 86–88.
- Payne, J.A., Menke, A.S., and Schroeder, P.M., *Dryocosmus kuriphilus* Yasumatsu, 1951 (Hymenoptera, Cynipidae), an oriental chestnut gall wasp in North America, *U.S. Dep. Agric. Coop. Econ. Insect Rep.*, 1975, vol. 25, nos. 49–52, pp. 903–905.
- Pridnya, M.V., *Status of Populations of European and American Chestnut Connected with Cryphroecrosis and Ways of Their Recovery, Investigated in Russia, 2003*. <http://zhurnal.ape.relarn.ru/articles/2003/032.pdf>, Assessed April 29, 2017.
- Shiryayeva, N.V., Garshina, T.D., and Pin'kovskii, M.D., *Fitosanitarnoe Sostoyanie kashtanovykh lesov Severnogo Kavkaza, meropriyatiya po ikh ozdorovleniyu i vosstanovleniyu* (Phytosanitary Condition of the Chestnut Forests of the North Caucasus and Measures for their Rehabilitation and Reconstruction), Sochi: Nauchno-Issled. Inst. Gorn. Lesovod. Ekol., 2004.
- Yasumatsu, K., A new *Dryocosmus kuriphilus* injurious to chestnut trees in Japan (Hymenoptera, Cynipidae), *Mushi*, 1951, vol. 22, no. 15, pp. 89–92.

Translated by S. Kuzmin